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Prevalence and predictors of HIV infection among female sex workers in Kaiyuan City, Yunnan Province, China

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Summary
Background: Sexual transmission is the fastest growing route of HIV transmission in China. We undertook this study to describe the risk factors for HIV infection in female sex workers (FSWs), and to determine the commercial sex venues where FSWs are most at risk of being infected with or infecting others with HIV.
Methods: This was a cross-sectional study of 737 FSWs in Kaiyuan City, Yunnan Province in southern China, which took place from March to May 2006.
Results: The overall HIV prevalence was 10.3%, but prevalence varied with sex venue with 25.8% of FSWs working on the streets being HIV-positive and none of the FSWs working in nightclubs. Adjusted odds ratios (OR) of HIV infection were 9.1 (95% confidence interval (CI) 4.67—17.55) for injection drug use, 3.3 (95% CI 1.46—7.37) for non-injection illegal drug use, 2.7 (95% CI 1.25—5.93) for duration of sex work $\geq$5 years, 2.2 (95% CI 1.05—4.70) for infection with herpes simplex virus type 2, and 2.0 (95% CI 1.12—3.47) for working at a higher risk entertainment venue. Although condom use was not a significant risk factor in the overall model, FSWs in lower risk venues who reported consistent use with clients had a 70% reduction in HIV infections (OR 0.30, 95% CI 0.12—0.90).
Conclusions: Illegal drug use, particularly with injection drugs, is the single greatest risk factor for HIV infection among FSWs in Kaiyuan City, China. FSWs working on the street or in temporary sub-lets, beauty salons, or saunas are at particularly high risk for transmitting and being infected with HIV. HIV prevention efforts among FSWs should target illegal drug users and these other subgroups.

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Introduction

The China Ministry of Health currently estimates that around 650 000 people are infected with HIV in China. Although injection drug users (IDUs) account for about 44% of total infections in China, sexual transmission of HIV has increased in recent years and was linked to 50% of new infections in 2005.[1,2] National sentinel surveillance data and other reports suggest that, overall, about 1% of female sex workers (FSWs) in China were HIV-positive in 2004.[3–6]

HIV infection rates are highest among FSWs in Yunnan Province in southern China, near the borders with Vietnam, Thailand, and Myanmar.[7] Although the HIV epidemic there has been driven predominantly by injection drug use, sexual transmission has played an increasingly greater role.[8] The National HIV Risk Population Survey in 2003 showed that the average prevalence of HIV among FSWs in Yunnan was 3.7%.[9] The major goal of this study was to inform future HIV prevention efforts in this high-risk area of China by assessing the current prevalence of HIV in FSWs, determining the role of injection drug use in the epidemic, and describing other risk factors for HIV infection. The study was conducted in Kaiyuan City, Yunnan, a city with a population of 292 000 and large numbers of drug users and sex workers.

Methods

This study was conducted by the Chinese Center for Disease Control and Prevention (China CDC) in Beijing in conjunction with provincial and local CDC staff in Yunnan. With the approval of both the national and local Yunnan institutional review boards, we conducted a cross-sectional study of all women identified as FSWs in Kaiyuan City, Yunnan Province from March to May 2006. The FSWs were recruited by outreach workers of Kaiyuan City who went to all sex work venues and explained the purpose of the study and the procedures and risks/benefits of participation to FSWs and to their bosses. All women working as sex workers were invited to participate in this research. Women included in the study were those aged $\geq$16 years, self-reported to have sold sex for money within the previous 3 months, and who agreed to testing and counseling for HIV, other sexually transmitted infections (STIs), and the use of illegal drugs. After providing informed consent, participants were asked standardized questions about their demographics, basic medical history, and potential HIV risk factors.

Blood was collected and tested for HIV-1 antibodies (ELISA, Vironostika HIV Uni-Form plus O, bioMerieux, Holland), herpes simplex virus type 2 antibody (HSV-2; HerpeSelect-2 ELISA IgG, Focus, USA), and syphilis (rapid plasma reagin (RPR) test, Xinjiang Xindi Co., China). Positive HIV-1 ELISAs were confirmed by Western blot (Diagnostics HIV Blot 2.2, Genelabs, USA) and positive RPR tests for syphilis were confirmed by the *Treponema pallidum* particle assay (TPPA) test (Serodia TP-PA Fujirebio, Fuji, Japan). Endocervical swabs were collected and tested for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* by PCR (AMPLICOR, Roche, USA). 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, Inc., USA). Participants were classified as using non-injection illegal drugs if they self-reported as such or did not self-report but tested urine-positive; injection drug use status was based only on self-report. All participants were scheduled for a follow-up visit 4–6 weeks later to discuss test results and for counseling.

Statistical tests were performed using SAS^{TM} 9.1 software (SAS Institute Inc., Cary, NC, USA). We compared HIV prevalences and factors associated with HIV infections among FSWs working in different sex work venues, in order to classify venues as being higher risk or lower risk in terms of HIV risks. Fisher's exact tests, *t*-tests, and Chi-square tests were used to compare subjects infected or not infected with HIV, as well as to compare subjects whom we classified as working in higher or lower risk venues. Univariate associations between risk factors and HIV seropositivity were evaluated using simple logistic regression analysis. In addition, adjusted odds ratios (ORs) were calculated for all FSWs and separately for FSWs working at lower and higher risk venues, building logistic models first by adjusting for the factors found to be significant in univariate analysis ($p < 0.02$), and then limiting final multivariate models to risk factors or confounders that were statistically significant in the overall and venue-specific analyses. The collinearity diagnostics were evaluated for the variables included in the final model by calculating the following indices: tolerance, variance inflation factor, condition number, and variance proportion. We multiplied the number of clients with whom HIV-positive FSWs had unprotected sex (condom was not used or broke or fell off during intercourse), by the probability of female-to-male transmission of HIV-1 per sexual contact (0.031), to arrive at an estimate of the number of clients infected.[10]

Results

Of the 756 FSWs screened for the study, 15 were excluded because they had not sold sex for money in the previous 3 months, and four others were excluded because blood specimens could not be obtained. Of the 737 FSWs included in the study, 393 (53.3%) returned for test results and post-test counseling.

Table 1 shows the behavioral characteristics of FSWs working in the various sex work venues. Based on these characteristics we classified streetwalkers, temporary sub-lets, and beauty salons as the higher risk venues in terms of HIV risks and the other four venues as lower risk venues. About half (48.6%) of FSWs worked in karaoke clubs, and about a quarter (26.7%) worked in beauty salons. HIV prevalences were substantially higher in the higher risk venues, with the exception of hotels, for which numbers were small. The mean earnings per client were lower in what we classified as higher risk venues, and the mean number of clients per week tended to be higher in these higher risk venues. The percentages of FSWs reporting injection drug use were substantially higher in the higher risk venues, particularly in streetwalkers. Although we classified saunas as a lower risk venue based on injection drug use, mean cost per client, and HIV prevalence of FSWs working here, they shared several characteristics more in common with higher risk venues, including the mean number of clients per FSW in the previous week.

Table 2 shows the demographic and behavioral characteristics of HIV-positive and –negative FSWs, and a comparison of those working in higher and lower risk venues. Not surprisingly, because HIV prevalence was a key factor in the classification of

Table 1 Comparison of major factors associated with HIV risks for female sex workers (FSWs) according to their usual venue for sex work: classification of venues as higher and lower risk

Behavioral characteristics	Entertainment venue						
	Higher risk venues			Lower risk venues			
	Streetwalkers (n = 31)	Temporary sub-lets (n = 51)	Beauty salons (n = 197)	Saunas (n = 37)	Karaoke clubs (n = 358)	Hotels (n = 6)	Night clubs (n = 57)
Drug use (ever)							
Non-drug user	17 (54.8)	37 (72.6)	148 (75.1)	32 (86.5)	321 (89.7)	6 (100)	56 (98.2)
Illegal drug user (non-injection)	2 (6.5)	7 (13.7)	18 (9.1)	5 (13.5)	19 (5.3)	0	0
Injection drug user	12 (38.7)	7 (13.7)	31 (15.7)	0	18 (5.0)	0	1 (1.8)
Duration of commercial sex work (years)							
<1	3 (9.7)	18 (35.3)	64 (32.5)	17 (46.0)	123 (34.4)	3 (50.0)	21 (36.8)
1—2	9 (29.0)	15 (29.4)	74 (37.6)	10 (27.0)	149 (41.6)	2 (33.3)	24 (42.1)
3—4	7 (22.6)	6 (11.8)	28 (14.2)	3 (8.1)	48 (13.4)	0	5 (8.8)
≥5	12 (38.7)	12 (23.5)	31 (15.7)	7 (18.9)	38 (10.6)	1 (16.7)	7 (12.3)
Number of clients in previous week							
Mean	5.55	8.7	6.59	6.95	2.80	4.83	3.12
Median	4	4	5	5	2	3.5	2
Always used condom with every client in previous week							
Yes	10 (32.3)	38 (74.5)	164 (83.2)	33 (89.2)	316 (88.3)	6 (100)	49 (86.0)
No	21 (67.7)	13 (25.5)	33 (16.8)	4 (10.8)	42 (11.7)	0	8 (14.0)
Always used condom with regular partner in previous week							
Yes	2 (18.2)	3 (14.3)	15 (15.6)	2 (10.0)	34 (16.5)	0	5 (19.2)
No	9 (81.8)	18 (85.7)	81 (84.4)	18 (90.0)	172 (83.5)	3 (100)	21 (80.8)
HSV-2 antibody positive							
Yes	29 (93.5)	30 (58.8)	149 (75.6)	31 (83.8)	226 (63.1)	3 (50.0)	34 (59.6)
No	2 (6.5)	21 (41.2)	48 (24.4)	6 (16.2)	132 (36.9)	3 (50.0)	23 (40.4)
Earnings per client (in Yuan)							
Mean	46.1	97.1	94.1	131.6	174.4	128.3	168.6
Median	30	100	100	100	125	100	100
Infected with HIV							
Yes	8 (25.8)	11 (21.6)	31 (15.7)	4 (10.8)	21 (5.9)	1 (16.7)	0 (0)
No	23 (74.2)	40 (78.4)	166 (84.3)	33 (89.2)	337 (94.1)	5 (83.3)	57 (100)

venues as higher or lower risk, FSWs working in higher, as opposed to lower, risk venues were at a significantly greater risk of HIV infection (17.9% vs. 5.7%; $p < 0.0001$). FSWs were primarily of Han ethnicity with permanent residences in Yunnan. We found significantly higher HIV infection rates among FSWs living in their family home rather than in an apartment (27.1% vs. 7.7%), reporting tooth extractions or fillings (15.4% vs. 9.3%), tattoos (13.6% vs. 8.0%), seeing seven or more clients a week compared to fewer (17.6% vs. 8.6%), engaging in paid sex for 5 years or more compared to less than 1 year (29.6% vs. 5.6%), and always using vs. sometimes or never using condoms with every client in the previous week (9.1% vs. 16.5%). The median duration of sex work was 46 months for HIV-positive subjects and 18.5 months for those who were HIV-negative ($p < 0.0001$). FSWs working in higher risk venues were significantly more likely to be from Yunnan Province, to have worked as an FSW for a longer time, and to have reported not using condoms with all clients in the previous week.

HIV infection rates were particularly high among injection drug users (49.3% positive) and non-injection drug users (19.6% positive). Of the 114 FSWs who tested urine opiate-positive for drug use, 82 (71.9%) of them self-reported drug use. Correspondingly, of the 88 FSWs who reported any illegal drug use, 82 (93.2%) tested urine opiate-positive. Among all FSWs, the median duration of sex work was 19.4 months (interquartile range (IQR) 8.1—40.5 months) and the median number of paid clients in the preceding week was three (IQR 1—5).

Fifty-two percent of women reported a 'regular partner', defined as a male with whom they had regular sexual relations without compensation, such as a boyfriend or spouse. Of the subjects who said they had a regular sex partner, 84% said they did not use condoms routinely with him, and there was no association between using condoms with regular sex partners and being HIV-infected. Among the 38 HIV-positive FSWs with regular sex partners, only seven (18.4%) said they always used condoms with them in the previous week. In contrast, 56 (73.7%) of the 76 HIV-positive FSWs said they used condoms with all paid sex partners in the previous week. The overall HIV prevalence was significantly lower in those

Table 2 Comparison of demographic and behavioral characteristics of 737 HIV-positive and HIV-negative female sex workers (FSWs), and comparison of sex workers working in higher or lower risk venues[c]

Demographic and behavioral characteristics	HIV test status		Sex work venue		
	HIV positive ($N = 76$) F (row %)	p-Value	Higher risk ($N = 279$) F (column %)	Lower risk ($N = 458$) F (column %)	p-Value
Age (years)					
16–20[b]	14 (6.2)		88 (31.5)	137 (29.9)	
21–25	22 (8.6)	0.3862	81 (29.0)	174 (38.0)	0.1037
26–52	40 (15.6)	0.0013	110 (39.5)	147 (32.1)	0.4580
Nationality					
Han[b]	48 (9.8)		186 (66.7)	306 (66.8)	
Other	28 (11.4)	0.5207	93 (33.3)	152 (33.2)	1.0000
Registered permanent residence					
Outside Yunnan[b]	4 (2.8)		40 (14.3)	105 (22.9)	
Other cities in Yunnan	21 (7.1)	0.0790	114 (40.9)	181 (39.5)	0.0255
Kaiyuan City	51 (17.2)	<0.0001	125 (44.8)	172 (37.6)	0.0033
Education level					
<9 years[b]	40 (10.3)		164 (58.8)	223 (48.7)	
≥9 years	36 (10.3)	1.0000	115 (41.2)	235 (51.3)	0.0079
Marital status					
Single or cohabiting[b]	57 (11.0)		200 (71.7)	316 (69.0)	
Married, separated, divorced, or widowed	19 (8.6)	0.3564	79 (28.3)	142 (31.0)	0.4567
Residence type					
Apartment[b]	38 (7.7)		167 (59.9)	324 (70.7)	
Family home	16 (27.1)	<0.0001	23 (8.2)	36 (7.9)	0.4703
Brothel or other working location	22 (11.8)	0.1291	89 (31.9)	98 (21.4)	0.0014
Entertainment venue					
Lower risk[b]	26 (5.7)		–	–	–
Higher risk	50 (17.9)	<0.0001	–	–	–
Tooth extracted or filled					
No[b]	57 (9.3)		234 (83.9)	380 (83.0)	
Yes	19 (15.4)	0.0503	45 (16.1)	78 (17.0)	0.8387
Tattoo					
No[b]	35 (8.0)		160 (57.3)	276 (60.3)	
Yes	41 (13.6)	0.0188	119 (42.7)	182 (39.7)	0.4408
Blood transfusion					
No[b]	72 (10.1)		272 (97.5)	442 (96.5)	
Yes	4 (17.4)	0.2839	7 (2.5)	16 (3.5)	0.5190
Drug use (ever)[a]					
Non-drug user[b]	32 (5.2)		202 (72.4)	415 (90.6)	
Non-injection illegal drug user	10 (19.6)[c]	<0.0001	27 (9.7)	24 (5.2)	0.0053
Injection drug user	34 (49.3)[c]	<0.0001	50 (17.9)	19 (4.2)	<0.0001
Duration of commercial sex work (years)					
<1 year[b]	14 (5.6)		85 (30.5)	163 (35.6)	
1–2 years	21 (7.4)	0.4849	98 (35.1)	186 (40.6)	1.0000
3–4 years	9 (9.3)	0.2349	41 (14.7)	56 (12.2)	0.1732
≥5 years	32 (29.6)	<0.0001	55 (19.7)	53 (11.6)	0.0045
Number of clients previous week					
<7[b]	51 (8.6)		184 (65.9)	411 (89.7)	
≥7	25 (17.6)	0.0031	95 (34.1)	47 (10.3)	<0.0001
Always used condom with every client in previous week					
Yes[b]	56 (9.1)		212 (76.0)	404 (88.2)	

Table 2 (*Continued*)

Demographic and behavioral characteristics	HIV test status		Sex work venue		
	HIV positive (*N* = 76) *F* (row %)	*p*-Value	Higher risk (*N* = 279) *F* (column %)	Lower risk (*N* = 458) *F* (column %)	*p*-Value
No	20 (16.5)	0.0209	67 (24.0)	54 (11.8)	<0.0001
Always used condom with regular partner in previous week					
Yes[b]	7 (11.5)		20 (15.6)	41 (16.1)	
No	31 (9.6)	0.6424	108 (84.4)	214 (83.9)	1.0000
Vaginal douching					
No[b]	6 (5.1)		47 (16.8)	70 (15.3)	
Yes	70 (11.3)	0.0464	232 (83.2)	388 (84.7)	0.6039
Syphilis infection					
No[b]	70 (10.3)		252 (90.3)	430 (93.9)	
Yes	6 (10.9)	0.8187	27 (9.7)	28 (6.1)	0.0833
Chlamydia trachomatis infection					
No[b]	62 (11.4)		196 (70.3)	350 (76.4)	
Yes	14 (7.3)	0.1292	83 (29.7)	108 (23.6)	0.0690
Neisseria gonorrhoeae infection					
No[b]	74 (10.9)		251 (90.0)	425 (92.8)	
Yes	2 (3.3)	0.0752	28 (10.0)	33 (7.2)	0.2144
Trichomonas vaginalis infection					
No[b]	61 (9.3)		248 (88.9)	411 (89.7)	
Yes	15 (19.2)	0.0101	31 (11.1)	47 (10.3)	0.7129
HSV-2 antibody positive					
No[b]	10 (4.3)		71 (25.4)	164 (35.8)	
Yes	66 (13.1)	<0.0001	208 (74.6)	294 (64.2)	0.0034

[a] Use of non-injection illegal drugs was based on both self-report and/or positive urine opiate testing; use of injection drugs was based only on self-report.
[b] Referent category.
[c] Fisher's exact or *t*-tests were used to compare HIV-positive and −negative subjects and to compare FSWs working in higher and lower HIV risk venues.

reporting consistent condom use with clients (9.1% vs. 16.5% for those not always using condoms with clients).

The median number of paid sex partners in the previous week before participating in the study was four for HIV-positive FSWs (and five and three for HIV-infected FSWs working in higher and lower risk venues, respectively). It was estimated that 2.79 clients would be infected in a week by sexual transmission; 2.17 and 0.62 clients in higher and lower risk venues, respectively.

The prevalence of STIs other than HIV was also very high in this study (Table 2). About two-thirds of FSWs were positive for HSV-2 and about one-third for *C. trachomatis* (respectively, 74.6% and 29.7% of those working in higher risk venues and 64.2% and 23.6% of those working in lower risk venues). *T. vaginalis* and HSV-2 infections were significantly more common among women infected with HIV.

Table 3 shows adjusted ORs and 95% CIs of HIV infection for potential risk factors or confounders that remained statistically significant after we included in the multivariate logistic models all variables that were significant in the univariate analysis; ORs are shown for all FSWs together and according to their venue of sex work. Overall, IDUs had a 9.1-fold greater risk of HIV infection than FSWs who did not use drugs; risks were higher for FSWs working in higher, as opposed to lower, risk venues (OR 10.2 vs. 6.9). Non-injection drug users were at 3.3-fold greater risk than FSWs not using drugs, but this association was significant only for FSWs working in higher risk venues and not for those working in lower risk venues. These results for non-injection drug users remained statistically significant when FSWs who did not self-report drug use but tested urine-positive were excluded from the analysis. Compared to working in commercial sex for less than 1 year, working for 5 or more years was associated with 2.7-fold greater risk of HIV infection.

Vaginal douching was a strong risk factor among women working in higher risk venues (OR 3.8, 95% CI 1.06−13.68), but this was not a significant risk factor among FSWs working in lower risk venues. FSWs reported douching with soapy water (27% HIV-positive), spermicide (23% infected), toothpaste (20% infected), water (20% infected), medical disinfectant (19% infected), and salt water (18% infected); there were no significant differences between HIV infection status and the douche product used. The potential risk factors and confounders that were statistically significant in the univariate analysis but not in the multivariate analysis are listed in a footnote to Table 3.

The most important risk factors for FSWs working in higher risk venues were injection drug use (OR 10.2), duration of sex

Table 3 Odds ratios (OR) and 95% confidence intervals (CI) of HIV infection among all female sex workers (FSWs) and according to location of sex work in higher or lower risk venues[a]

Potential risk factors	All FSWs ($N = 737$) OR (95% CI)[b]	FSWs at higher risk venues ($N = 279$) OR (95% CI)[b]	FSWs at lower risk venues ($N = 458$) OR (95% CI)[b]
Injection drug user (vs. non-drug user)	9.1 (4.67–17.55)	10.2 (4.35–23.73)	6.9 (2.06–23.18)
Non-injection illegal drug user (vs. non-drug user)	3.3 (1.46–7.37)	4.9 (1.74–13.72)	
Duration of commercial sex work ≥5 years (compared to duration <1 year)	2.7 (1.25–5.93)	5.2 (1.68–15.87)	
Duration of commercial sex work 1–5 years (compared to duration <1 year)	1.1 (0.52–2.11)	1.4 (0.51–4.02)	
HSV-2 antibody positive (vs. negative)	2.2 (1.05–4.70)		
Higher risk (vs. lower risk) venue for sex work	2.0 (1.12–3.47)	-	-
Vaginal douching (yes vs. no)		3.8 (1.06–13.68)	
100% condom use with client in previous week (vs. not)			0.3 (0.12–0.90)
History of blood transfusion (yes vs. no)			4.7 (1.17–19.15)
Trichomonas vaginalis infection (yes vs. no)			4.4 (1.57–12.13)

[a] The following potential risk factors or confounders were statistically significant in the univariate analyses but not in multivariate models: age, permanent residence in Kaiyuan, residence type (i.e., family home, apartment, etc.), 100% condom use with regular sex partner in previous week, number of clients in previous week, and tattoo.

[b] Odds ratios and 95% confidence intervals adjusted for the potential risk factors that were statistically significant in the three different logistic models.

work for ≥5 years (OR 5.2), non-injection drug use (OR 4.9), and vaginal douching (OR 3.8). Consistent use of condoms with clients or regular sex partners was not significantly associated with HIV risk in this group. In comparison, the major risk factors for FSWs working in lower risk venues were injection drug use (OR 6.9), history of blood transfusion (OR 4.7), and trichomoniasis (OR 4.4). FSWs working in lower risk venues who said they used condoms with all clients in the previous week showed a 70% reduction in HIV risk that was statistically significant (OR 0.3, 95% CI 0.12–0.90). For the variables that remained in the multivariate model, the collinearity diagnostic was run, and the key indicators showed no collinearity between these variables. The condition number was 4.16 (less than 10), tolerance exceeded 0.8, and the variance inflation factor was less than 1.2.

Discussion

Our results suggest that HIV infections in FSWs in Yunnan are primarily driven by illegal drug use and the sharing of drug injection equipment. Our results also suggest that the risk of transmission of HIV from FSWs to their clients and regular sex partners is high, because condoms are infrequently used. In addition, our results suggest that there are important differences both in HIV prevalence and in the risk factors for HIV infection according to the venue where sex work occurs.

Overall 10.3% of the 737 FSWs included in this study were infected with HIV, with infections significantly more frequent among FSWs working in higher risk venues (beauty salons, temporary sub-lets, and on the street; 17.9% HIV-positive) as opposed to the venues we defined as lower risk (karaoke clubs, night clubs, saunas, and hotels; 5.7% HIV-positive). Based on a female-to-male HIV transmission risk of 0.031 from a Thai study,[10] and taking into account condom use among clients, client frequency, and HIV prevalence, we estimate that 2.79 clients per week would be infected with HIV by FSWs in this study, with about 2.17 or 78% of the infections being passed by FSWs working in higher risk venues. Thus, to better prevent HIV infections in clients and the entry of HIV into the general population in China, prevention efforts among FSWs should particularly focus on FSWs working on the street, in temporary sub-lets, or in beauty salons. Saunas should also be considered for prevention efforts since they share some of the high-risk characteristics of the other venues we classified as higher risk.

Adjusting for significant covariates, HIV risk factors were also found to differ by venue. While injection drug use was a significant risk factor in both higher and lower risk venues (OR 10.2 and 6.9, respectively), non-injection drug use (OR 4.9) was also a significant risk factor for HIV infection among FSWs working in higher risk venues. Although a much higher percentage of FSWs working in higher risk venues used injection drugs than those working in lower risk venues (17.9% vs. 4.2%), our results suggest that public health measures addressing illegal drug use, in particular needle exchange and drug treatment programs, are needed for FSWs in Yunnan, regardless of the venue in which they work.

We found that using condoms with all of the previous week's clients was only a significant protective factor among FSWs working in lower risk venues (OR 0.3), and not among FSWs working in higher risk venues. Consistent condom use with clients was significantly more common among FSWs working in the lower risk venues (88.2% vs. 76.0%; $p < 0.0001$). We also found that among HIV-positive FSWs, only 18.4% consistently used condoms with their regular sex partners and 73.7% with their clients. Condoms have been consistently shown to protect against HIV infection,[11,12] so FSWs need to be counseled to use condoms to protect both their paying and non-paying sex partners and themselves, especially if their sex partners are known to use injection drugs.

Vaginal douching was practiced by 84.1% of the FSWs in our study, a finding consistent with results from another study of FSWs in China, which found that 65% of them douched.[13] This same study identified an association between vaginal douching

and decreased use of condoms and increased self-reported history of STI. Our finding that among FSWs working in higher risk venues, those who douched were at 3.8-fold greater risk of HIV infection after adjusting for other key risk factors, suggests that douching is being substituted for condoms by FSWs working in higher risk venues, particularly since the prevalence of HIV was similar regardless of the douching agent used. Although the association between douching and HIV infection is controversial,[14–16] douching should never be substituted for condom use.

Our results are consistent with other studies of FSWs in China. Although general estimates of HIV infection in FSWs have been much lower, about 1–2%,[4–6,17,18] studies show that FSWs who also use drugs are at a much higher risk for acquiring HIV than FSWs who do not.[19,20] Studies of Chinese FSWs show that up to 25% use drugs as well,[21] and HIV prevalence rates will differ according to what proportion also use drugs. One study identified a 10% HIV prevalence among FSWs in Kunming, the capital of Yunnan Province, with all the HIV-infected also being drug users and a significant association between drug use and HIV infection ($p < 0.01$).[22] Another study quantified drug use as a significant risk factor for HIV infection (OR 8.0, 95% CI 2.1–30.3) but found that Trichomonas infection was an even larger risk factor (OR 11.2, 95% CI 2.9–42.7).[18] In our study, drug use is the single largest risk factor for HIV acquisition among FSWs, much larger than any risk factor traditionally associated with sex work, such as condom use rates, numbers of partners, and STIs.

Like other studies of Chinese FSWs,[6,18,19,21] we found high rates of STIs in this group and significant associations between HIV and other STIs. Adjusting for the key covariates, we found that FSWs with HSV-2 were at a 2.2-fold, statistically significant, greater risk of HIV infections than FSWs who were negative for HSV-2, an association that was consistent, but not statistically significant, in the venue-specific analysis (OR of HIV for HSV-2, 1.7 and 2.4 for FSWs working in the higher and lower risk venues, respectively). We also found that FSWs working in lower risk venues were at a statistically significant 4.4-fold greater risk of HIV if they were infected with *T. vaginalis*. These results are consistent with those of van den Hoek et al. who reported an adjusted OR of 11.2 (95% CI 2.9–42.7) of HIV for trichomoniasis in China.[18] The role of STIs in HIV transmission has been well reviewed[23] with many studies specifically associating both HSV-2 and Trichomonas infection with HIV acquisition.[24–26] Suppressive therapy of HSV-2 has been shown to reduce genital and plasma HIV-RNA levels in dually infected women,[27] and studies are underway to determine if treatment of HSV-2 will reduce HIV transmission.[28] Screening and treatment of STIs may be an effective public health intervention to reduce HIV transmission.

The HIV-positive participants who returned for their testing results were referred to the Kaiyuan People's Hospital for further evaluation. The hospital provided antiretroviral therapy through the support of the Clinton Foundation to those individuals who met the national treatment guidelines. Although sex work is prohibited in China, the government has developed interventions to reduce HIV infections, including condom distribution programs, HIV/AIDS education programs, and provision of free HIV treatment for HIV-infected FSWs. Additionally there are a number of programs supported by foreign countries to provide free treatment for HIV-infected FSWs, which also reduces their risk of infecting others. However, because many FSWs in China do not know their infection status, they cannot be treated for HIV or advised to alter their risk behaviors. Thus, HIV screening programs for FSWs are needed.

Our study has several limitations. Because some of the data collected were based on self-report, some risk factors, such as use of condoms and injection drug use, may have been misclassified. To minimize this effect, we asked questions about recent events, such as condom use in the previous week, and we conducted objective tests of risk factors as much as possible, such as urine testing for opiates and laboratory tests for STIs. Second, because this was a cross-sectional study, temporality could not be determined. Whether the HIV-infected, drug-using FSWs were infected primarily through their drug use or sex work is not known and requires further study. Finally, although our results are consistent with other studies from China, as described above, few studies examining the association of drug use and sex work in China have been published, and further studies are needed in more areas of China.

In summary, we found that the prevalence of HIV is high in FSWs in Yunnan, particularly among those who also use illegal drugs, work in higher risk entertainment establishments, have been in commercial sex for $\geq$5 years, or are HSV-2 antibody positive. We also found that many HIV-infected FSWs do not consistently use condoms with either clients or their regular sex partners, putting both sides at risk of infection. Infected clients may serve as the bridging population from HIV-positive FSWs to their low-risk wives. Reports of HIV prevalence >1% in antenatal clinics from certain high-risk areas in Yunnan[7] provide evidence that this bridging is already occurring. Although traditional HIV prevention methods among FSWs such as condom promotion should continue to be emphasized, other interventions should be considered that target the highest risk FSWs and particularly those working on the street, in temporary sub-lets, in beauty salons, or in saunas. Significant attention should focus on the overlap group of drug-using FSWs, and needle exchange and methadone or other drug reduction treatments should be promoted to this cohort. Education regarding vaginal douching and STI symptoms and treatment should be provided.

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