Sexually Transmitted Diseases, June 2008, Vol. 35, No. 6, p.558–565
DOI: 10.1097/OLQ.0b013e318165926b

HIV and STIs in Clients and Female Sex Workers in Mining Regions of Gejiu City, China

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Objective: **To investigate HIV/sexually transmitted infections (STIs) among female sex workers (FSWs) and clients in a mining region of China.**

Goal: **To estimate HIV/STI prevalence and to identify HIV risk factors among FSWs and miner clients.**

Study Design: **A cross-sectional study of 96 FSWs and 339 miner clients.**

Results: **In FSWs, prevalence of HIV was 8.3%, herpes simplex virus-2 70.8%, syphilis 12.5%, *Neisseria gonorrhoeae* 36.8%, *Chlamydia trachomatis* 46.3%, *Trichomonas vaginalis* 22.1%, and 90.6% were infected with any STI. Illegal drug use was associated with HIV [adjusted odds ratio (OR) = 45.1, 95% confidence interval, 6.4–317.9] in FSWs, and 45.8% reported no condom use with the last client. In miner clients, HIV prevalence was 1.8%, herpes simplex virus-2 14.9%, syphilis 2.4%, *N. gonorrhoeae* 2.1%, *C. trachomatis* 6.5%, and 23.2% were infected with any STI. Never using condoms with FSWs and regular partners were reported in 61.2% and 84.1%, respectively. Independent risk factors for HIV in miner clients were illegal drug use (OR 190.2), symptoms of urethral discharge or frequent urination (OR 32.9), early sexual debut (OR 7.1), and visiting 4 or more FSWs in the last 12 months (OR 11.5).**

Conclusions: **HIV/STI prevalence is high among FSWs and moderate among clients in mining regions of Gejiu City. Drug use is the most important factor placing FSWs and miner clients at risk for HIV in Gejiu City; risky sexual characteristics such as early sexual debut, frequent visits to FSWs, and STI symptoms are also important factors for miner clients. FSWs and miner clients may constitute bridging groups for HIV to low-risk populations.**

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THE HIV/AIDS EPIDEMIC IN CHINA is currently concentrated in certain geographic regions and populations such as sex workers.[1–3] The latest estimate at the end of 2005 found 650,000 people living with HIV/AIDS (PLWHA) in Mainland China,[4,5] with the percentage of sexually infected PLWHA increasing from 5.5% in 1997 to 10.9% in 2002,[6] and to 43.6% by the end of 2005.[4] Soon after China's economic reform in the 1980s, female sex workers (FSWs) were reintroduced into Mainland China, and by the end of 2005, there were an estimated 2.8 to 4.5 million FSWs in China.[5] High-risk behaviors, the high prevalence of sexually transmitted infections (STIs) among FSWs, and the epidemiologic synergy between STIs and HIV[7–10] place FSWs at risk for HIV infection. According to national surveillance data, HIV prevalence among FSWs increased from 0.02% in 1995 to 1.0% in 2004, with the prevalence reaching 6.7% to 10.3% in some regions of Yunnan Province.[11,12] High HIV prevalence and inconsistent use of condom[11] among FSWs may put male clients, and subsequently, their regular partners at great risk for HIV.

Previous studies in Africa, Asia, and South America have reported a high prevalence of HIV/STIs and risk behaviors among clients of FSWs.[13–16] For instance, in Thailand, 26% of clients were positive for 1 or more STI,[17] and in Senegal 4.4% of clients were HIV-1 or HIV-2 positive by saliva testing and higher numbers of sexual partners were associated with infection.[18,19] In Yunnan, HIV prevalence has reached relatively high levels among male clients of FSWs (0.3%–1.8%),[20] but little is known about their risk characteristics for HIV acquisition and transmission. Several reports showed that frequent population migration is one important factor that may contribute to the HIV/AIDS epidemic in China,[2,3,6,21] and migrants who are clients of sex workers may be an important subpopulation. There are about 100 to 150 million migrant workers in China, mostly young, poor, and unmarried males from the countryside.[22] Changes in sexual mores and distance from spouses while migrating may predispose them to take part in unsafe sex,[6] putting them at greater risk for HIV/STIs. Two studies in China found that 10%–11.9% of male migrants had patronized sex workers,[23,24] and studies in Shanxi and Shandong provinces found that 66.7%–70.9% of PLWHAs were migrants.[25,26] Two recent studies in Eastern China, however, found no HIV and low STI prevalence in migrants, underscoring that migration alone may not be a risk factor for HIV/STIs.[27,28]

There are signals that HIV/AIDS in China is rapidly spreading to the general population by sexual transmission, and sex worker clients may be a bridge from high- to low-risk populations. In some areas of Yunnan Province and Xinjiang Autonomous Region, HIV prevalence has reached 1.3% and 1.2% in antenatal

The authors thank the staff at Gejiu City CDC, Yunnan Provincial CDC, and National Center for STD Control Center in Nanjing for their cooperation in laboratory testing and their enthusiastic help and support throughout the implementation of the project. They thank all the FSWs and miners who participated in the study. They also thank Ray Chen and Gerald Sharp for review of this manuscript.

Supported by the National Institute of Allergy and Infectious Diseases (NIAID) of NIH (U19 AI51915) under China Integrated Programs for Research on AIDS (CIPRA).

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Received for publication September 6, 2007, and accepted December 16, 2007.

pregnant women.[6] In Yunnan, almost 1% of couples attending premarital examination were HIV seropositive,[29] and nationwide, mother-to-infant HIV transmission accounted for 1.6% of all PLWHA by the end of 2005.[4] Male clients have played an important bridging role in HIV transmission to the general population in Thailand and sub-Saharan Africa,[30,31] mainly through regular female sexual partners, and they may also be important in China's HIV epidemic. Although studies in China have focused on FSWs and their HIV/STI risk factors[12,32–34], few studies have examined high-risk sexual behaviors among male clients, which may potentiate the HIV transmission to the general population. Our study presents HIV/STI prevalence and HIV risk characteristics in both FSWs and clients in 2 towns and mining regions of Gejiu City, Yunnan Province, China.

Materials and Methods

Research Site and Participants

The study was conducted in Kafang and Laochang townships and 5 surrounding mines in Gejiu City, Yunnan Province. Gejiu City is located in southeastern China and because of its proximity with the Mynamar border has become part of the drug trafficking route into China. HIV rates are relatively high in Gejiu (0.8% and 1.1% among antenatal pregnant women in 2005 and 2006, respectively),[20] with injection drug use (IDU) being the main route of HIV transmission. Of 825 reported PLWHA in March 2004, 81.1% were associated with IDU. Gejiu City is known as the "Tin Capital" because of its abundance in tin and other minerals, attracting migrant workers. The total population is about 453,300 but has an additional 67,900 floating migrant population.

A cross-sectional study of FSWs and miner workers was conducted between March 2006 and April 2006 in Kafang Town, Laochang Town, and 5 surrounding mines about 20 km outside of Gejiu City. FSWs from entertainment venues (e.g., KTV, nightclubs, and hair salons) were actively recruited by outreach workers who had established connections with the FSW community. Miner workers were recruited by Centers for Disease Control and Prevention (CDC) staff who established relationships with mining area leaders of the 5 nearby mines. All efforts were made to include all potential FSWs and miners in these areas.

FSWs were included in the study if they (a) lived in either of the 2 towns, (b) were 16 years of age or older, and (c) reported providing commercial sex in the past 3 months. The 5 mines have an estimated 2000 miners, and all potential clients from these mines were screened and included if they (a) were aged 16 years or older and (b) worked in 1 of the 5 mines. All enrolled miners were asked to report whether they patronized FSWs at least once, and if so, were defined as miner clients. And miners who reported that they had not had commercial sex were classified as nonminer clients.

Data Collection

The questionnaire was reviewed and approved by National Institutes of Health staff and research consultants to the China Integrated Programs for Research on AIDS project. The study protocol was approved by the Institutional Review Boards of China CDC, Yunnan Provincial CDC, and the Division of AIDS Prevention Science Review Committee at the United States National Institutes of Health. A questionnaire was administered anonymously to each subject by face-to-face interview. Although most participants were able to speak Mandarin, all interviewers were fluent in both Mandarin and local dialects. Data on demographics, reproductive health, illegal drug use history, and high-risk behavior during commercial sex were obtained. Both miners and FSWs provided blood and urine samples. Vaginal secretion swab and cervical secretion swab were also collected from the FSWs by trained physicians.

Laboratory Testing

Serum specimens were screened for HIV antibodies by enzyme-linked immunosorbent assay (ELISA; Organon Teknika, Boxtel, Co., Ltd., the Netherlands), and positive tests were confirmed by HIV-1/2 Western blot assay (HIV Blot 2.2 WB; Genelabs Diagnostics, Singapore). Each plasma specimen was also tested for antibodies to herpes simplex virus (HSV)-2 by ELISA (Herpe Select-2 ELISA IgG; Focus Technologies, Cypress, CA) and *Treponema pallidum* by rapid plasma reagin (RPR; RPR Diagnosis kit; Xinjiang Xindi, China). Plasma specimen positive for RPR were confirmed by *T. pallidum* particle assay (Serodia; Fujirebio, Inc., Fuji, Japan). Subjects with plasma positive for both *T. pallidum* particle assay and RPR were considered infected with syphilis.

All urine specimens were screened for opiates by morphine-gold-conjugate test strip (Acon MOP; Acon Biotech, Hangzhou, China) method. In addition, urine specimens of the miner clients were also tested for nucleic acid of *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) by polymerase chain reaction (Amplicor; Roche Diagnostics).

Wet mounts were made from vaginal swabs at the study site by trained professional staff. Samples were classified as positive if motile organisms were seen.

Cervical swab specimens were tested for nucleic acid of NG and CT by polymerase chain reaction (Amplicor). A specimen was considered negative for NG if the optical density (OD) was <0.2 or positive if the OD was ≥ 0.8. For CT testing, OD <0.2 was considered negative, and OD ≥ 0.8 was considered positive. If $0.2 \leq \text{OD} < 2.5$ for NG or $0.2 \leq \text{OD} < 0.8$ for CT, the specimens were retested in duplicate tubes. For the NG test, if at least 2 of the 3 tubes had OD ≥ 2.0, the specimen was considered positive and negative if otherwise. For the CT test, if at least 2 of the 3 tubes had OD ≥ 0.2 the specimen was considered positive and negative if otherwise.

Data Management and Statistical Analysis

Data from questionnaire and laboratory tests were entered into and managed by a DataFax system (Clinical DataFax Systems, Hamilton, ON, Canada), and transferred to a SAS database (SAS Institute Inc., Cary, NC) for analysis. HIV seroprevalence rates were calculated for FSWs and miner clients. Comparison between rates and proportions were performed by univariate logistic regression. Variables significant ($P \leq 0.1$) in univariate analysis were included in multivariate logistic regression analysis. Variables not significant ($P > 0.1$) in multivariate analysis were eliminated from the model in a stepwise manner. All probability values were reported as 2-sided. SAS 9.1 (SAS Institute Inc.) was used for data analysis.

Results

Participant Recruitment

Of the 98 FSWs approached for this study, 96 enrolled and completed the questionnaire and provided both venous blood and urine specimens. Ninety-five FSWs also provided both vaginal and cervical secretions swab specimens. A total of 1804 miners were identified and screened from the 2 townships, and 1798 of them were enrolled. Reasons for not enrolling included age less

than 16 (n = 1), refusal to participate (n = 3), and withdrawal from the study after the informed consent (n = 2). Of all the enrolled miners, 1796 completed the questionnaires (2 dropouts during the interviews), 1760 provided blood specimens, and 1773 provided urine specimens. Of the 1796 miners who completed the survey, 339 (18.9%) reported at least 1 paid sexual act with FSWs, and 336 of the 339 (99.1%) provided both blood and urine specimens.

Sociodemographic Characteristics

Sociodemographic characteristics of miner client and FSW participants are reported in Table 1. Almost half of the FSWs (43 of 96, 44.8%) were less than 20 years old. Of FSWs, 45.8% were of Han ethnicity, the predominant ethnic group in China, and most others were of either Hani (28.1%) or Yi (21.9%) ethnicity. Most FSWs completed less than 9 years of schooling (84.3%), were single (68.8%), and were not originally from Gejiu City (90.6%). On average, FSWs had worked at their current locations for 4.4 months, with most (81.3%) working there for less than 6 months.

Of all miner clients, 74.4% (252 of 339) were less than 30 years old. About half (52.2%) of the miner clients were of Hani ethnicity, 36.0% were of Han ethnicity, and 10.0% of Yi ethnicity. Most (67.5%) miner clients had completed less than 9 years of school. Of the miner clients, 53.1% were married, and 67.0% had regular sexual partners. Most were originally from outside Gejiu City (86.1%). Most were farmers (59.6%) previously, 12.1% were students, and 11.2% were miners (Table 1).

Sexual Behavior, STI Symptoms, and Illegal Drug Use

Sexual debut for FSWs was on average 17.5 years, with the youngest being 11 years. Average charge per sexual service from client was 81.1 Yuan (~10 USD). They received 4 clients on average per week, with the most being 13 clients. Regarding condom use, 45.8% (44 of 96) did not use a condom during sex with their last client, mainly because of unwillingness of the clients (68.2%, 30 of 44) but also of the FSWs themselves (20.5%, 9 of 44). Of FSWs, 62.5% (60 of 96) and 66.7% (64 of 96) reported that miners were their last and second to last services, respectively. One-fourth of FSWs (26.4%, 25 of 96) had regular sexual partners, of which only 16% (4 of 25) reported consistent use of condoms with regular partners, and 68.0% (17 of 25) reported never using with regular partners.

Of FSWs, 63.5% (61 of 96) reported at least 1 STI symptom in the past 12 months, with abnormal vaginal secretions in 41.7% (40 of 96), pain or burning on urination in 27.1% (26 of 96), dyspareunia in 15.6% (15 of 96), and genital ulcer in 5.2% (5 of 96). Use of illegal drugs at least once in the last 3 months was reported in 10.4% (10 of 96), of which 70.0% (7 of 10) reported using injection drugs. Urine was positive for opiates in 11.5% (11 of 96); one FSW was urine opiate positive but did not self-report drug use.

Sexual debut for miner clients was on average 22.2 years, with the youngest 13 years old. Of miner clients, 43.4% (147 of 339) reported that the last FSWs they patronized were from the 2 studied towns. Condom use with FSWs was low among miner clients, with only 13.3% (45 of 339) reporting consistent use of condoms, and 61.2% (244 of 399) reported they have never used condom with FSWs. In their last encounter with FSWs, only 20.4% of the miner clients used a condom. In addition, 66.1% (222 of 339) of the miner clients had at least 2 sexual partners in the past 12 months, with the most being 70 partners in the past 12 months. Condom use with regular partners was even lower. Of all miner clients, 67.0% (227 of 339) reported regular sexual partners of which 84.1% (191 of 227) were married, but only 2.6% (6 of 227) reported consistent use of condoms with their regular partners, and 84.1% (191 of 227) reported never using with regular partners.

Of miner clients, 19.5% (66 of 336) reported STI symptoms in the last 5 years, of whom 56.1% (37 of 66) had abnormal urethral secretion or frequent urination. Illegal drug use was reported in 2.4% (8 of 336), and of these, IDU was reported in a quarter (2 of 8). Urine was positive for opiates in 1.8% (6 of 336) of miner clients.

TABLE 1. Sociodemographic Characteristics and HIV/STI Prevalence of Female Sex Workers (FSWs) and Miner Clients

	Female Sex Workers (N = 96)		Miners Clients (N = 339)	
Characteristics	n	%	n	%
Age (yr)				
16–19	43	44.8	43	12.7
20–29	49	51.0	209	61.7
30–39	4	4.2	66	19.5
≥40	0	0.0	21	6.2
Ethnic				
Han	44	45.8	122	36.0
Hani	27	28.1	177	52.2
Yi	21	21.9	34	10.0
Others	4	4.2	6	1.8
Schooling (yr)				
0–5	56	58.3	136	40.1
6–8	25	26.0	93	27.4
≥9	15	15.6	110	32.4
Marital status				
Single	66	68.8	137	40.4
Cohabited	6	6.3	10	2.9
Married	7	7.3	180	53.1
Separated	1	1.0	0	0.0
Divorced	15	15.6	11	3.2
Widowed	1	1.0	1	0.3
Native place				
Gejiu City	9	9.4	47	13.9
Other cities in Yunnan	73	76.0	280	82.6
Outside Yunnan	14	14.6	12	3.5
Previous job				
Farmer	NA	NA	202	59.6
Student	NA	NA	41	12.1
Miner	NA	NA	38	11.2
Urban worker	NA	NA	22	6.5
Others	NA	NA	36	10.6
Laboratory testing*				
HIV	8	8.3	6	1.8
Syphilis	12	12.5	8	2.4
HSV-2	68	70.8	50	14.9
NG	35	36.8	7	2.1
CT	44	46.3	23	6.5
Trichomonas vaginalis	21	22.1	NA	NA
STIs in total†	87	90.6	78	23.2
Urine morphine positive	11	11.5	6	1.8

*Ninety-five FSWs provided vaginal swab specimens and cervical swab specimens, and were tested for NG, CT, and trichomonas infection, and 336 miner clients provided venous blood and urine samples, and were tested for HIV, syphilis, HSV-2, NG, CT, and urine morphine.

†FSW had at least 1 STI (syphilis, HSV-2, NG, CT, or trichomonas infection), or miner clients had at least 1 STI (syphilis, HSV-2, NG, and CT).

NA indicates not applicable.

Knowledge and Attitudes of HIV/STIs

Although most FSWs reported that they had heard of HIV/AIDS (82.3%) and STIs (70.8%), 34.4% believed they had no risk for acquiring HIV. Only 13.9% of the FSWs completely knew the correct routes of HIV transmission.

Of miner clients, 81.4% reported that they had heard of HIV/AIDS, but only 4.4% of the completely correctly knew the routes of HIV transmission, and 56.9% thought they were not at risk for acquiring HIV. Of clients, 23.6% did not know that HIV can be transmitted by sexual intercourse, 24.2% had never heard of condoms, and only 47.8% knew that condoms can be used to prevent STIs.

HIV and STI Prevalence

Among FSWs, HIV prevalence was 8.3% [8 of 96, 95% confidence interval (CI) 2.8%–13.8%], and 90.6% of FSWs were infected with at least 1 of the 5 tested STIs. HSV-2 was the most frequent (70.8%) followed by CT (46.3%), NG (36.8%), trichomonas infection (22.1%), and syphilis (12.5%) (Table 1).

Among miner clients, HIV prevalence was 1.8% (6 of 336, 95% CI 0.7%–3.8%), and 23.2% of them were infected with at least 1 of the tested STIs. HSV-2 was also the most frequent (14.9%), followed by CT (6.5%), syphilis (2.4%), and NG (2.1%) (Table 1).

Because of the implementation of the equivocal zone-retesting, the algorithm for NG/CT testing may increase in its specificity from 98.8% to 99.9% without loosing its sensitivity,[35] so the false-positive rate for NG/CT testing may be very low in the survey. Although wet mount microscopy is a relatively cost-effective method, the test is able to detect only approximately 90% of all cases of trichomonas infection,[36] which may lead to underestimation of the true prevalence rate of trichomonas infection in the survey.

Risk Factors for HIV Seropositivity

Among both FSWs and miner clients, illegal drug use was the major risk factor for HIV infection (Table 2). Risk factors for HIV among FSWs by univariate analysis included history of illegal drug use [odds ratio (OR) 49.8, 95% CI 7.9–312.7], history of IDU (OR 71.7, 95% CI 9.7–531.4), and age more than 25 years (OR 7.0, 95% CI 1.5–32.0). Other factors were not significantly associated with HIV infection ($P > 0.05$; Table 2). Multivariate logistic regression analysis showed that history of illegal drug use (OR 45.1, 95% CI 6.4–317.9) was the independent risk factor for HIV infection, and age more than 25 years (compared with ≤25 years) was marginally associated with HIV (OR 5.9, 95% CI 0.8–41.2, $P = 0.0751$; Table 2).

Our univariate analysis showed that miner clients who reported illegal drug use were at significantly increased risk of HIV infections (OR 35.7, 95% CI 6.3–201.6); other significant risk factors were younger age at sexual debut (OR 11.3, 95% CI 1.9–66.9), age less than 14 at first commercial sex (OR 21.8, 95% CI, 1.9–247.5), symptom of abnormal urethral discharge or frequent urination in the last 5 years (OR 18.0, 95% CI 3.2–102.0), HSV-2 positivity (OR 6.0, 95% CI 1.2–30.7), STI infection (OR 6.9, 95% CI 1.2–38.5), current STI infection for NG or CT (OR 5.5, 95% CI 1.1–27.9), previously acquired STI infection for HSV-2 or syphilis (OR 6.9, 95% CI 1.2–38.5), and HIV/AIDS knowledge score ≥9 (OR 9.9, 95% CI 1.1–95.5). However, other variables including migration characteristics of birth place and residence time in Gejiu did not have significantly associated with HIV ($P > 0.05$). Multivariate logistic regression analysis showed that a history of illegal drug use (OR 190.2, 95% CI 9.1–3988.9) and symptoms of urethral discharge or frequent urination in the past 5 years (OR 32.9, 95% CI 2.6–409.0) were independent risk factors for HIV in miner clients, and the more number of visits with FSWs (OR 12.7, 95% CI 0.9–173.3, $P = 0.0560$) and sexual debut at age less than 14 years (OR 8.2, 95% CI 0.9–76.8, $P = 0.0649$) were marginally associated with HIV infection (Table 2).

Because only 2 miner clients reported using injection drugs, we could not include this risk factor in logistic models, but both miners were HIV-positive. Although illegal drug use was most strongly associated with HIV seropositivity in both miner clients and FSWs, sample sizes of drug users in both populations were not large enough to conduct further analyses of this subset.

The Comparisons of HIV/STIs Infection Among Miners by Whether Buying Sex From FSWs

Among nonminer clients who reported having never had sex (N = 1424) with FSWs, the HIV prevalence was 0.5% (7 of 1424, 95% CI 0.2%–1.0%), and 13.1% of nonminer clients were infected with at least 1 of the 4 tested STIs. HSV-2 was also the most frequent (8.4%) followed by CT (4.4%), syphilis (1.6%), and NG (0.5%).

Chi-square test showed that, compared with nonminer clients, miner clients had statistically significant higher prevalences of HIV, HSV-2, NG, and STIs ($P < 0.05$). The prevalence of both syphilis and CT was higher among the miner clients than nonminer clients, but these differences were not statistically significant ($P > 0.05$; Table 3).

Discussion

To our knowledge, this survey was the first to estimate HIV and STI prevalence among Chinese miner clients who were mostly migrants, and to describe their risk characteristics for HIV. Understanding this population and FSWs they patronized is important to China's HIV epidemic because miner clients and FSWs may serve as bridge populations for HIV/STIs to low-risk populations, through unprotected sex with their regular partners or spouses.

Miners in Lachang and Kafong townships reported patronizing FSWs about twice more (18%) compared with a national survey of Chinese men in a similar age range[37] (9%), a smaller sample of miners in these same towns[24] (9%), and male migrants in Beijing and Nanjing[23] (10%). Rates of patronization among miners in our study may be higher because of our larger sample size, later date of study, and location. China's rapidly changing economy has prompted migration of rural males to seek jobs outside their hometowns, and distance from regular partners accompanied by changing sexual mores may set the stage for migrant mine workers to use FSW services.

Comparison of our miner clients' and FSWs' HIV prevalence with other populations is difficult because of the unique setting in a mining area and high-IDU region, and differences in sampling and laboratory techniques. Nonetheless, HIV prevalence in our rural-to-mine clients (1.8%) was still higher than that in a recent sample of sexually experience miners in the same 2 townships of Gejiu City (0.5%),[24] higher than that in rural-to-metropolis (Shanghai) migrants (0.0%) in 2002,[28] and about 30 times more than that in the general population of China (average 0.05% at the end of 2005).[4] Even higher HIV prevalences among FSW clients, however, have been reported worldwide[14,18]; for example, HIV prevalence was 8.4% in a high HIV-burdened area of Africa.[38] STI prevalence among our miner clients was over 100 times and 3 times greater than gonorrhea and chlaymdia rates (0.02% and 2.1%) in a population-based study of 20- to 64-year-old Chinese male adults,[37] and about 2-fold higher than

TABLE 2. Univariate and Multivariate Analysis of HIV Infection Risk Factors in FSWs and Miner Clients

	FSWs (N = 96)					Miner Clients (N = 336)				
Variables	Total	Positive	OR (95% CI)	Adjusted OR (95% CI)	*P*	Total	Positive	OR (95% CI)	Adjusted OR (95% CI)	*P*
Ethnicity										
Han	44	5				215	2			
Non-Han	52	3	0.5 (0.1–2.1)	—	—	121	4	3.6 (0.7–20.2)	—	—
Age (yr)										
≤25	74	3				128	1			
>25	22	5	7.0 (1.5–32.0)*	5.9 (0.8–41.2)	0.0751	208	5	0.3 (0.0–2.8)	—	—
Schooling (yr)										
>7	68	5				129	4			
≤6	28	3	1.5 (0.3–6.8)	—	—	207	2	0.3 (0.1–1.7)	—	—
Marital status										
Married	24	2				191	2			
Unmarried	72	6	1.0 (0.2–5.3)	—	—	145	4	2.7 (0.5–14.8)	—	—
Native place										
Non-Gejiu	97	8				308	4			
Gejiu	9	0	ND	ND	—	28	2	5.8 (1.0–33.4)	—	—
Residence time in Gejiu (yr)										
<1	22	2				106	1			
≥1	74	6	0.9 (0.2–4.7)	—	—	230	5	2.3 (0.3–20.2)	—	—
Age at sex debut (yr)										
>14	93	8				320	4			
≤14	3	0	ND	ND	—	16	2	11.3 (1.9–66.9)*	8.2 (0.9–76.8)	0.0649
Age at first commercial sex (yr)										
>14	1	0				332	5			
≤14	95	8	ND	ND	—	4	1	21.8 (1.9–247.5)*	—	—
Average monthly income (Yuan)										
≤800	NA	NA			—	163	3			
>800	NA	NA	NA	NA		173	3	0.9 (0.2–4.7)	—	—
No. FSWs visited in past 12 mo										
<4	NA	NA				278	3			
≥4	NA	NA	NA	NA	—	58	3	5.0 (1.0–25.4)†	12.7 (0.9–173.3)	0.0560
Abnormal urethral discharge secretion or frequent urination in past 5 yr										
No	NA	NA				299	2			
Yes	NA	NA	NA	NA	—	37	4	18.0 (3.2–102.0)*	32.9 (2.6–409.0)	0.0066
Illegal drug use‡										
No	85	2				324	3			
Yes	11	6	49.8 (7.9–312.7)*	45.1 (6.4–317.9)	0.0001	12	3	35.7 (6.3–201.6)*	190.2 (9.1–3,988.9)	0.0007
Injection drug use										
No	89	3				334	4			
Yes	7	5	71.7 (9.7–531.4)*	—	—	2	2	ND	ND	—
No. clients in recent week										
≤2	87	6				NA	NA			
>2	9	2	3.9 (0.7–22.8)	—	—	NA	NA	NA	NA	—
HSV-2										
Negative	28	0				286	3			
Positive	68	8	ND	ND	—	50	3	6.0 (1.2–30.7)*	—	—
STIs§										
Negative	9	0				258	2			
Positive	87	8	ND	ND	—	78	4	6.9 (1.2–38.5)*	—	—
STIs‖ (HSV-2, syphilis)										
Negative	28	0								
Positive	68	8	ND	ND		282	3			
STIs¶ (NG, CT, TV)				—	—	54	3	5.5 (1.1–27.9)*	—	—
Negative	33	4				308	5			
Positive	63	4	0.5 (0.1–2.1)	—	—	28	1	2.2 (0.3–19.9)	—	—
Condom use in commercial sex#										
Never	25	1				242	2			
Some times	71	7	2.6 (0.3–22.4)	—	—	94	4	5.3 (1.0–29.6)†	—	—
AIDS knowledge score										
Poor AIDS/HIV knowledge (0–8)	79	7				220	1			
Good AIDS/HIV knowledge (≥9)	17	1	0.6 (0.1–5.6)	—	—	116	5	9.9 (1.1–95.5)*	—	—

*$P < 0.05$; †$0.1 < P < 0.05$.
‡Admitted to illegal drug use at least once or morphine urine test positive, or both.
§Include NG, CT, syphilis, and HSV-2.
‖Include HSV-2 and syphilis.
¶Include NG, CT, and TV.
#Condom use is reported for last week.
NA indicates not applicable; ND, not defined because of insufficient sample sizes; TV, *Trichomonas vaginalis.*

TABLE 3. The Comparison of Prevalence of HIV/STIs Between Miner Clients and Nonminer Clients

	Nonminer Clients (N = 1424)		Miner Clients (N = 336)			
HIV/STIs	Positive (%)	Negative	Positive (%)	Negative	χ^2	*P*
HIV	7 (0.5)	1417	6 (1.8)	330	6.210	0.013
Syphilis	23 (1.6)	1401	8 (2.4)	328	0.921	0.337
HSV-2	119 (8.4)	1305	50 (14.9)	286	13.331	<0.001
NG*	7 (0.5)	1414	7 (2.1)	329	8.699	0.003
CT*	63 (4.4)	1358	23 (6.8)	313	3.395	0.065
STIs†	187 (13.1)	1237	78 (23.2)	258	21.607	<0.001

*Three nonminer clients did not provide urine samples, and not be tested for NG and CT.
†STIs include NG, CT, syphilis, and HSV-2.

STI rates among rural-to-Shanghai migrants (CT 3.5%, NG 0.5%, syphilis 1.0%).[28] The HIV prevalence among FSWs in our study (8.3%) was also high. It was 8 times the national average prevalence of HIV (1%) in FSWs in 2004,[11] exceeded that of recent studies of FSWs in Sichaun (0.6%)[33] and Henan (0.6%),[39] but was closer to a study in Gejiu City, Honghe Prefecture (6.7%).[20]

The high rate of drug use in Honghe Prefecture likely influenced the high HIV prevalence in our study and in studies from the same region. According to Honghe Prefecture CDC data, there are 11,686 illegal drug users in Honghe Prefecture, of which 89.1% are IDUs, and HIV prevalence among IDUs was 58.9% to 60.4% in 2003 to 2004.[20,40] Self-reported illegal drug use in the last 3 months among our FSWs was much higher (10.4%) compared with the national averages (1.4%),[11] but similar to rates of FSWs in other heavy drug-trafficking regions (Sichuan, 10%; Yunnan, 10%).[33,39,41] Illegal drug use was indeed identified as the only HIV risk factor among FSWs (OR 45.1) and the most important risk factor among HIV-positive miner clients (OR 190.2) in our study. Of the FSWs and miner clients who reported IDU, 5 of 7 and 2 of 2 were HIV-positive. National sentinel site data support that FSWs who are drug users are a high-risk population for HIV, as HIV rates among FSW drug users were higher compared with nondrug users.[21] Even FSW nondrug users who worked in high-drug use areas had a higher HIV prevalence than the FSW national average.[21] Higher rates of IDU have also been reported in male clients of sex workers[42] and migrant workers.[43] In a recent study of male migrant workers in Beijing, Nanjing, and Shanghai, clients had significantly more illegal drug use compared with nonclients in both community and STI clinic samples.[43] Our study's sample sizes of FSW and client drug users was too small to conduct further analysis, and future studies should address HIV risk behaviors in FSWs and clients who are drug users, critical subpopulations at risk for HIV acquisition and spread.

In addition to drug use, risky sexual characteristics, including early sexual debut, multiple encounters with FSWs, and a history of urethritis symptoms, also likely contributed to the HIV prevalence among miner clients in our study. This is consistent with other studies of male clients in China and Hong Kong that found that high numbers of sexual partners were associated with HIV/STIs.[13,44] Symptoms of urethritis were also associated with HIV among our miner clients, and are commonly caused by chlamydia infection and gonorrhea, which have been implicated with increased HIV acquisition and transmission.[9] Of the 16 miner clients who reported sexual debut before 14 years of age, 2 were HIV-positive. Early age of sexual debut has been associated with HIV in Thailand and Africa,[44,45] and linked with subsequent risky sexual behaviors, HIV/STI infection, adolescent pregnancy, and substance use in China.[46] More liberal attitudes about sex among China's youth may facilitate earlier sexual debut, and the setting of limited sexual education and traditional Chinese values limiting open discussion of sex may increase risks for unsafe sex and STIs/HIV.[47]

Poor knowledge and low perceived risk of HIV/STIs among both miner clients and FSWs may also mediate risky sexual behaviors. In turn, high-risk behaviors such as condom disuse may fuel sexual transmission of HIV/STIs from FSWs to clients, and subsequently to the general population through spouses or other regular sexual partners of clients. The leading cause for not using condoms among clients in Lima, Peru was their belief that they were not at risk for HIV/STIs.[16] In our study, over half of miner clients and more than one third of FSWs believed that they were not at risk for HIV/STIs, and less than half of FSWs reported using condoms with last clients. Over 60% of clients reported never using condoms with FSWs and even more (84%) reported never using condoms with regular partners. This is consistent with other studies showing steadiness of relationship is related to condom use among clients and partners,[15,18] potentially putting low-risk partners at greater risk for HIV/STI transmission. Additionally, most miner clients were migrants from rural to mining areas with little access to STI treatment, furthering their transmission risk of HIV and STIs to their regular partners. Although less FSWs than clients reported regular partners, only 16% of FSWs reported consistent condom use with their regular partner. Their boyfriends and spouses may also be a high-risk group for further HIV/STI spread.

Our study also found that over half of miners were married, and more than 20% of these married miners lived with spouses at the mining sites. Given the low condom use rate with both FSWs and regular partners, married miners may further STI/HIV transmission to the general population through their wives. This pattern of married clients furthering HIV transmission through wives and other partners has been identified in several other cultural contexts such as Africa, where it is acceptable for men but not women to have multiple partners, including sex workers.[15] Although further analysis of marriage status was not independently associated with HIV or STIs in this study, married miners have the potential to bridge HIV/STIs to their wives.

There were several limitations in this study. (a) It is unclear whether the FSWs in our study are representative of sex workers that our miner clients patronized, as only 40% of miner clients reported patronizing FSWs in Kafang and Laochang in the last commercial sex visits, and about 65% of FSWs reported miners were clients in last 2 sex visits. Therefore, we cannot deduce whether HIV or STI infections in miner clients were transmitted to or from FSWs in these 2 towns. (b) Every effort was made to recruit a group of a sample of subjects that reflected the characteristics of the study population, and a high percentage of eligible subjects took part in the study. However, as in any survey study problems of access to all potential subjects may introduce sampling bias and affect the representativeness of the sample population. Our study group is probably representative of tin miners in this area, but it may not be representative of miners in other areas or of other clients of FSWs, so results should not be generalized to other client types. (c) The numbers of FSW and miner client numbers included in this study were relatively small, which led to relatively wide CIs of OR estimates and lower statistical power. Thus, although our statistically significant risk factors are likely to

be valid, our failure to find other significant risk factors may reflect the small size of the study rather than reality. (d) Only miners who reported having purchased sex from FSWs were considered miner clients and included in this study. As some subjects may not want to disclose their commercial sex behavior, the survey results may underestimate the actual prevalence of HIV and other STIs among miner clients. The fact that this study found a high prevalence of STIs, particularly of HSV-2, among nonminer clients suggests that the number of miners who visit sex workers was in fact higher than that reported in this survey. Even with possibility of the bias of underreporting, this study found alarmingly high STI prevalence rates among its subjects, further underscoring the urgent need to curb HIV/STIs among FSWs and their clients in mining districts around Gejiu City.

Our study highlights the importance of drug use in both FSWs and miner client's risk for HIV, in a high-IDU region. Given that China's HIV epidemic was previously led by IDU but now sexual transmission cases are rapidly increasing, it is possible that drug users who also engage in unsafe sex with both high-risk populations (sex workers) and low-risk populations (regular partners or spouses) may be fueling the current epidemic, especially in the high-IDU area of Yunnan. Mining communities, who are predominantly migrant workers, may have higher rates and mixing of drug use and commercial sex, and thus may be key targets for HIV prevention. Effective interventions such as 100% condom use programs,[48] clean syringe exchanges, and STI treatment[49] should therefore be enforced and up-scaled for miners and FSWs in these mining districts. Future studies should further examine HIV risk in sex workers and clients who are also drug users to determine which subgroup is at greatest risk for HIV acquisition and transmission to lower-risk populations.

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