

# Willingness to use pre-exposure prophylaxis for HIV prevention among female sex workers: a cross-sectional study in China

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**Background:** Pre-exposure prophylaxis (PrEP) is a strategy developed to prevent individuals who are human immunodeficiency virus (HIV)-negative from developing HIV infection. In China, while conducting a clinical trial to investigate the effectiveness and safety of PrEP, we performed this survey to assess the willingness of female sex workers to use PrEP, and identify predictors of this willingness.

**Methods:** From July 2009 to April 2010, a cross-sectional study was carried out in four provinces of China. We recruited 1611 female sex workers who completed a self-administered survey to assess their awareness of and intention to use PrEP. The survey also canvassed demographic, behavioral, and psychosocial variables. Bivariate and multivariable logistic regression models were fitted to identify predictors of intent to use PrEP.

**Results:** In total, 69% of the women (95% confidence interval [CI] 66.7–71.3) reported intent to use PrEP, and 12% (95% CI 10.5–13.7) had used drugs in the past to prevent a sexually transmitted infection. Further, 16.5% (95% CI 14.7–18.4) had previously heard of PrEP, and 1.4% (95% CI 0.9–2.1) had used PrEP previously to prevent HIV infection. Multivariate analysis indicated the following significant predictors of intent to use PrEP: Han ethnicity (adjusted odds ratio [AOR] 1.446;  $P = 0.011$ ), urban residence (AOR 1.302;  $P = 0.027$ ), knowledge about transmission of HIV/acquired immune deficiency virus syndrome (AIDS, AOR 1.817;  $P = 0.0007$ ), a history of sexually transmitted infection (AOR 1.830;  $P < 0.0001$ ), a history of using medication to prevent a sexually transmitted disease (AOR 2.547;  $P < 0.0001$ ), and willingness to access knowledge about HIV/AIDS (AOR 2.153;  $P < 0.0001$ ).

**Conclusion:** The majority of female sex workers reported intent to use PrEP if it is safe and effective. Given that most of the participants had never heard of PrEP before, we strongly recommend that educational materials be developed with detailed introduction of PrEP. The risks and benefits of PrEP use should be fully explained to potential users when promoting PrEP in the future.

**Keywords:** human immunodeficiency virus, infection, pre-exposure prophylaxis, PrEP, willingness, female sex workers

## Introduction

In the past 30 years, acquired immune deficiency syndrome (AIDS) has been quickly spreading to almost every corner of the world. A well known threat to humans, AIDS has created many challenges and placed a heavy burden on our global public health system. At the end of 2010, about 34 million people were living with human immunodeficiency virus (HIV) worldwide. This number is 17% higher than that in 2001 and includes 2.7 million new HIV infections in 2010.<sup>1</sup> Although the HIV prevalence rate is low in Asia, the continent still has the second largest HIV population.

By the end of 2011, it was reported that 0.78 million people were living with HIV/AIDS in China,<sup>2</sup> with 46.5% infected by heterosexual transmission and 17.4% by homosexual contact. In 2011, the national prevalence of HIV was 0.058%, with 48,000 new infections. Even though the prevalence remains low in China nationwide, challenges in HIV/AIDS prevention and control remain critical in certain regions and populations. For example, five provinces account for 60% of the total population with HIV/AIDS in China.<sup>2</sup>

Although the prevalence of HIV among female sex workers is relatively low nationwide, and was only 0.3% in 2011, it exceeded 1% in the same year at sentinel surveillance sites for female sex workers located in five provinces of China.<sup>3</sup> In 2009, it was estimated that there were 2.68 million female sex workers and 26.5 million clients of female sex workers in China.<sup>4</sup> In the urban areas of Guiyang and Xingyi, the estimated number of female sex workers accounted for 3.4% and 3.6% of the local urban female population, respectively.<sup>5</sup> There is a significant risk of sexually transmitted diseases spreading from female sex workers to their long-term partners or even spreading to the general population through their clients.<sup>6,7</sup>

HIV control still looks grim in China. In order to prevent transmission and spread of HIV, various strategies and methods have been considered. It was expected that a safe and effective HIV vaccine would be developed, but this has proved to be extremely challenging due to technical and implemental difficulties. Although there do exist some solutions for HIV infection prevention and control (eg, sexual health education, proper condom use, disposable needles, treatment of infection, and circumcision), their effectiveness has been limited. Therefore, it is important and urgent that we develop more effective and affordable prevention strategies in China to contain the spread of HIV/AIDS from female sex workers and their sexual clients.

Pre-exposure prophylaxis (PrEP), which is a potentially effective strategy for biomedical prevention, has been the focus of recent studies.<sup>8-13</sup> Through oral administration of antiretroviral drugs or use of microbicides with antiretroviral activity, PrEP is a strategy to prevent HIV-negative individuals from becoming infected with HIV. Until February 2011, there were more than ten clinical studies of PrEP ongoing throughout the world, and distributed across 12 countries including Africa, Asia, Latin America, and the US.<sup>14</sup> A study in nearly 900 African women showed for the first time that the tested anti-HIV vaginal gel was associated with a 39% lower risk of HIV infection than placebo.<sup>15</sup> More promising, the recent

iPrEx trial results suggested that in gay men, transgender women, and other men who have sex with men (MSM), daily TDF-FTC (tenofovir disoproxil fumarate plus emtricitabine, also known as Truvada<sup>®</sup>) reduces the risk of HIV by 44%.<sup>14,16</sup> The Partners PrEP study showed that TDF and TDF-FTC taken daily both reduce the risk of HIV transmission among both men and women by 62% and 73%, respectively.<sup>14</sup> The TDF2 study also indicated that daily oral TDF-FTC was associated with a 62.6% lower risk of HIV infection in both male and female participants.<sup>14</sup> On the other hand, two trials, ie, FEM-PrEP (use of PrEP for HIV prevention among heterosexual women) and VOICE (Vaginal and Oral Interventions to Control the Epidemic), were terminated due to lack of effectiveness.<sup>14</sup> Nonetheless, once the efficacy of PrEP is proven to be without safety issues by further studies, it would have a high impact on HIV prevention. The PrEP strategy not only complements other existing prevention methods, but also has some unique advantages. For example, it does not require compliance from sexual partners.

The success of the PrEP strategy depends heavily on the user's willingness to use it, and also involves a level of user awareness, acceptance, and compliance. Under the premise that PrEP has not yet been proven to be safe and effective, little research on the willingness to use it has been conducted. A study of 42 subjects indicated that, among the various features of PrEP (including price, efficiency, side effects, and duration of treatment), the most important ones included price, efficacy, and safety, but did not include duration of treatment. Note that PrEP would require routine treatment for at least 10 years.<sup>17</sup> A survey of 227 MSM in Boston, MA, suggested that about 74.4% participants expressed willingness to use PrEP, but the willingness level varied greatly between demographic groups. For instance, 48.6% of those with a college degree were willing to use PrEP, compared with 90.9% of those with high school or lower education.<sup>8</sup> Currently, we are planning to conduct a large-scale clinical trial of PrEP in China, mainly targeting high-risk populations, such as female sex workers and MSM. This survey was conducted mainly to assess the willingness of female sex workers in western China to use PrEP and to identify significant predictors of willingness. As a feasibility study for the clinical trial, the survey will also provide evidence and information for future promotion of PrEP among female sex workers in China.

## Materials and methods

### Design and participant recruitment

Our research team conducted a cross-sectional study between July 2009 and April 2010 in four provinces of China,

ie, Chongqing, Guangxi, Xinjiang, and Sichuan. The four sites in this study were specifically chosen because of their markedly higher incidences of HIV infection, wide diversity of infected groups, and the higher prevalence of drug abuse and the sex trade in western regions of China.<sup>2,3</sup> The target population for this study was female sex workers, who have a high risk of contracting HIV/AIDS. Considering that female sex workers frequently change business locations and sexual services are illegal in China, it is very difficult to estimate the number of female sex workers and their geographic distribution. This study adopted a nonprobability sampling method when recruiting participants, especially for “seed” subjects, ie, those who were recruited earlier and were willing to provide references. We advertised through local media (eg, newspapers and leaflets) and the local branches of the Centers for Disease Control and Prevention. At the same time, the seed participants helped to recruit other female sex workers by peer referral, enabling more participants to be added to the study in the form of a “rolling snowball”.

During the study, all participants were asked to complete a self-administered quantitative questionnaire under the guidance of interviewers. Most participants completed the questionnaire in 30–40 minutes and each received 50 RMB (Chinese dollars) as an incentive. Before conducting the survey, the study protocol and institutional review board application were reviewed and approved by the local ethics review committee of Chongqing Medical University. All participants signed an “informed consent” form describing how privacy was ensured before they contributed any data to the study.

## Measures

### Demographic information

Socioeconomic characteristics of participants including age, marital status, race, residence, education, and income were collected.

### Knowledge, behavior, and awareness of HIV/AIDS

Thirteen questions concerning knowledge about infection and prevention of HIV/AIDS were used to assess the level of awareness about HIV/AIDS, eg, “Does AIDS spread through mosquito bites?”, “Does AIDS spread through coughing, sneezing?”, and “Would anyone who dines with HIV carriers or patients get HIV infected?” HIV/AIDS-related risk behaviors were enquired about, eg, any history or previous diagnosis of a sexually transmitted infection, whether an HIV consultation had ever been sought, previous testing for HIV, medication to prevent sexually transmitted infection, awareness of

post-exposure prophylaxis, awareness of vaginal microbicides, condom use, and history of substance and/or alcohol abuse. The questionnaire also included a question on the willingness of participants to access knowledge about HIV/AIDS.

### PrEP use and intention

At the beginning of the survey, each participant was given a brief introduction to PrEP as a form of preventive medication taken before having sex to prevent HIV infection. The participants were then asked about their history of PrEP use and their willingness to use PrEP in the future, “Assuming that PrEP is safe and effective in preventing HIV, how likely would you use it?”. The level of willingness of PrEP use was recorded on a five-point scale of: 1, definitely; 2, probably; 3, not sure; 4, probably not; and 5, definitely not. For data analysis, the willingness scale was further dichotomized into “willing” (definitely or probably) and “unwilling” (probably not, definitely not, or not sure). Some further hypothetical questions were asked to assess the participants’ intentions to use PrEP: “Suppose that PrEP is safe and effective in preventing HIV, how likely would you use it if it were available for free?”, “How likely would you use it if it were available for free and used by very few people?”, and “How likely would you use it if it were available for free and used by a fair large number of people?”

## Data analysis

We used EpiData 3.0 for Windows (EpiData Association, Odense, Denmark) as the software package for double-entry and management of the survey data. Statistical analyses were done using SAS 9.1 for Windows (SAS Institute Inc, Cary, NC), whereby statistical significance was determined at the level of  $\alpha = 0.05$ . Univariate descriptive statistics included mean and variance for quantitative variables and frequency and percentage for qualitative variables. The prevalence of PrEP use and intention to use were calculated with 95% confidence intervals (CI). Univariate logistic regression was first applied to select variables that were individually significantly associated with the outcome variable (ie, willingness to use PrEP). Multivariate logistic regression was then fitted to determine the joint influence of predictors on the outcome variable. Odds ratios (ORs) and their 95% CI were reported to evaluate the influence of predictor variables. It was assumed that PrEP use is hypothetically safe and effective throughout the study.

## Results

### Demographics

The study recruited 1611 female sex workers who completed the self-administered questionnaire. Participant

demographics stratified by willingness to use PrEP are shown in Table 1 (willing versus unwilling). The average age of the participants was 26.8 (median 25, range 16–53) years. About 60% of the female sex workers were self-identified as rural residents. Regarding participant education, 52.3% had completed junior high school education, 32.5% had completed senior high school education, and only 15.2% had college or higher level of education experience. The majority of participants were self-reported as unmarried (63.4%), while 27.3% reported being married, 9.3% reported being divorced or widowed, and 32.4% of participants reported having children. Most of the participants (47.5%) reported receiving a monthly income of 1000–3000 RMB, 28.6% had a monthly income of 3000–5000 RMB, 12.7% had a monthly income of 5000+ RMB, and 11.2% had a monthly income of <1000 RMB.

## Willingness to use PrEP

Our study showed that, assuming PrEP to be safe and effective, 55% of the 1161 female sex workers said they would “definitely” use it, and 14% said they would “probably” use it. In contrast, only 10.1% and 11% participants, respectively,

indicated that they would “definitely not” or “probably not” use PrEP. According to the earlier definition of “willingness to use PrEP”, 69% of participants expressed positive responses (95% CI 66.7–71.3, see Table 2).

When it was assumed that “PrEP drugs will be provided for free”, willingness to use PrEP increased to 72.6% (95% CI 70.3–74.7). When it was assumed that the PrEP would be freely provided and “a few people” had already been using it, the willingness rose to 77% (95% CI 74.9–79.1). When “a few people” was changed to “a lot more people”, the willingness was further increased to 80.6% (95% CI 78.6–82.5).

## HIV/AIDS-related knowledge, behavior, and attitudes

Participants’ attitudes toward AIDS and PrEP use are shown in Table 3, ie, 93.8% of participants considered AIDS to be a serious or very serious disease, 76.7% worried about the threat of HIV/AIDS to themselves or their families, and only less than 16% indicated little or no worry about AIDS at all. Almost all (95%) participants expected to be able to access knowledge on HIV/AIDS prevention.

**Table 1** Demographic characteristics of female sex workers and willingness to use PrEP

Characteristic	Total n (%)	Willingness to use PrEP	Unwillingness to use PrEP	OR (95% CI)	P value
Age (years)					
Mean (range)	26.8 (16–53)	27.0 (17–52)	26.5 (16–53)		
Median (Q1–Q3)	25.0 (22–31)	25.0 (22–31)	25.0 (22–30)		
Race					0.011
Han	1327 (82.4)	934 (70.4)	393 (29.6)	1.415 (1.083–1.850)	
Others	284 (17.6)	178 (62.7)	106 (37.3)	1.000	
Registered residency					0.009
Rural residency	972 (60.6)	649 (66.8)	323 (33.2)	1.000	
Urban residency	632 (39.4)	461 (72.9)	171 (27.1)	1.342 (1.076–1.673)	
Education					0.649
Elementary school	244 (15.2)	164 (67.2)	80 (32.8)	1.000	
Junior high school	840 (52.3)	588 (70.0)	252 (30.0)	1.138 (0.839–1.545)	
Senior high school and beyond	521 (32.5)	356 (68.3)	165 (31.7)	1.052 (0.761–1.456)	
Marital status					0.107
Unmarried	1020 (63.4)	696 (68.2)	324 (31.8)	1.000	
Married	440 (27.3)	300 (68.2)	140 (31.8)	0.998 (0.786–1.268)	
Others (divorced or widowed)	150 (9.3)	115 (76.7)	35 (23.3)	1.529 (1.024–2.283)	
Have children					0.140
Yes	518 (32.4)	370 (71.4)	148 (28.6)	1.189 (0.945–1.495)	
No	1080 (67.6)	732 (67.8)	348 (32.2)	1.000	
Income per month					0.006
≤1000 RMB	181 (11.2)	117 (64.6)	64 (35.4)	0.474 (0.300–0.748)	0.001
1001–3000 RMB	764 (47.5)	520 (68.1)	244 (31.9)	0.553 (0.381–0.801)	0.002
3001–5000 RMB	460 (28.6)	311 (67.6)	149 (32.4)	0.541 (0.366–0.800)	0.002
>5000 RMB	204 (12.7)	162 (79.4)	42 (20.6)	1.000	

**Note:** RMB, Chinese dollars.

**Abbreviations:** CI, confidence interval; OR, odds ratio; PrEP, pre-exposure prophylaxis.

**Table 2** Willingness to use PrEP in four hypothetical situations

Willingness to use PrEP	Safe and effective	Safe, effective, and free	Safe, effective, free, and a few are using	Safe, effective, free, and some are using
Willing	1112 (69.0)	1169 (72.6)	1241 (77.0)	1298 (80.6)
95% CI	66.7–71.3	70.3–74.7	74.9–79.1	78.6–82.5
Definitely	886 (55.0)	981 (60.9)	1068 (66.3)	1110 (68.9)
Probably	226 (14.0)	188 (11.7)	173 (10.7)	188 (11.7)
Unwilling	499 (31.0)	442 (27.4)	370 (23.0)	313 (19.4)
Not sure	159 (9.9)	119 (7.4)	97 (6.0)	47 (2.9)
Probably not	177 (11.0)	169 (10.5)	144 (8.9)	153 (9.5)
Definitely not	163 (10.1)	154 (9.6)	129 (8.0)	113 (7.0)

**Abbreviations:** CI, confidence interval; PrEP, pre-exposure prophylaxis.

The results (Table 4) showed that only 14% managed to answer all 13 questions on knowledge of HIV/AIDS correctly; 20.1% incorrectly answered one question, 21.2% incorrectly answered two questions; and 44.7% had three or more questions with wrong answers. More than half of the participants (52.5%) said that they had recently received a free consultation on AIDS, and 61% reported having had HIV tests, of which 78% were offered free of charge.

The survey on AIDS-related behavior (Table 4) showed that 35.1% of female sex workers had observed symptoms of venereal disease, but less than 10% of them reported having been diagnosed with a sexually transmitted disease. About half (51.1%) of participants indicated that they had never consumed alcohol, and only 5.7% reported use of illicit drugs within the last 6 months. Among drug users, 63% reported using “K powder” (ketamine); other drugs included ecstasy (30.4%), methamphetamine hydrochloride (30.4%), heroin (8.7%), cannabis (5.4%), and Magu (4.3%); and nobody reported use of opium, pethidine, or morphine. About half of the drug users (47%) reported using drugs before having sex.

## Awareness and application of HIV/AIDS prevention strategies

Our study shows that 194 (12%) female sex workers reported previous use of medication for a sexually transmitted infection and 22 (1.4%) had previously taken medication preventive against HIV (see Table 4). Meanwhile, 16.5% of participants reported having heard of PrEP from various sources, ie, doctors (27%), researchers (26%), online media (16%), television (15%), friends (14%), and newspapers (9%). With regard to post-exposure prophylaxis, nearly 20% participants reported having heard of it from the following sources: doctors (28%), researchers (24%), friends (16%), television (12%), online media (10%), and newspapers (8%). Nearly 30% of the female sex workers interviewed had heard of “vaginal/rectal microbicides” from the following sources: doctors (34%), television (23%), friends (20%), the survey staff (17%), online media (7%), and newspapers (7%). Regarding condom use, more than 80% of the participants said they “always used” condoms when having sex with clients, while only 2% said they “never used” condoms.

**Table 3** Measures of attitudes toward AIDS and willingness to use PrEP

Characteristic	Total n (%)	Willingness to use PrEP	Unwillingness to use PrEP	OR (95% CI)	P value
Is AIDS serious					0.408
Yes	1492 (93.8)	1034 (69.3)	458 (30.7)	1.199 (0.780–1.844)	
No	98 (6.2)	64 (65.3)	34 (34.7)	1.000	
Worried about family members infected with HIV					0.091
Yes	1219 (76.7)	855 (70.1)	364 (29.9)	1.237 (0.967–1.583)	
No	371 (23.3)	243 (65.5)	128 (34.5)	1.000	
Wish to access knowledge of HIV/AIDS					<0.0001
Yes	1531 (95.0)	1073 (70.1)	458 (29.9)	2.462 (1.567–3.869)	
No	80 (5.0)	39 (48.8)	41 (51.3)	1.000	
Attitude toward HIV/AIDS patients					0.009
Discriminatory	308 (19.4)	196 (63.6)	112 (36.4)	1.000	
Hard to say	467 (29.4)	313 (67.0)	154 (33.0)	1.161 (0.859–1.571)	0.331
Non-discriminatory	813 (51.2)	589 (72.4)	224 (27.6)	1.503 (1.137–1.985)	0.004

**Abbreviations:** AIDS, acquired immune deficiency syndrome; CI, confidence interval; HIV, human immunodeficiency virus; OR, odds ratio; PrEP, pre-exposure prophylaxis.

**Table 4** AIDS-related knowledge, behavior, and willingness to use PrEP

Characteristic	Total n (%)	Willingness to use PrEP	Unwillingness to use PrEP	OR (95% CI)	P value
STI history					<0.0001
Yes	565 (35.1)	436 (77.2)	129 (22.8)	1.850 (1.464–2.337)	
No	1046 (64.9)	676 (64.6)	370 (35.4)	1.000	
Previous STI diagnosis					0.006
Yes	156 (9.7)	123 (78.8)	33 (21.2)	1.758 (1.179–2.622)	
No	1454 (90.3)	988 (68.0)	466 (32.0)	1.000	
Alcohol					0.028
Yes	786 (48.9)	563 (71.6)	223 (28.4)	1.269 (1.027–1.569)	
No	822 (51.1)	547 (66.5)	275 (33.5)	1.000	
Ever used illicit substances					0.408
Yes	92 (5.7)	60 (65.2)	32 (34.8)	0.830 (0.533–1.292)	
No	1516 (94.3)	1051 (69.3)	465 (30.7)	1.000	
Has HIV/AIDS transmission knowledge <sup>a</sup>					0.002
Yes	226 (14.0)	176 (77.9)	50 (22.1)	1.689 (1.210–2.357)	
No	1385 (86.0)	936 (67.6)	449 (32.4)	1.000	
Ever received free consultation for HIV/AIDS					0.003
Yes	845 (52.5)	611 (72.3)	234 (27.7)	1.379 (1.115–1.704)	
No	764 (47.5)	500 (65.4)	264 (34.6)	1.000	
Ever tested for HIV					0.084
Yes	981 (61.0)	693 (70.6)	288 (29.4)	1.209 (0.975–1.499)	
No	628 (39.0)	418 (66.6)	210 (33.4)	1.000	
Condom use					0.110
Every time	1,294 (80.5)	905 (69.9)	389 (30.1)	1.237 (0.953–1.606)	
Other	314 (19.5)	205 (65.3)	109 (34.7)	1.000	
Ever used STI preventive medication					<0.0001
Yes	194 (12.0)	160 (82.5)	34 (17.5)	2.299 (1.562–3.383)	
No	1,417 (88.0)	952 (67.2)	465 (32.8)	1.000	
Ever used HIV preventive medication					0.931
Yes	22 (1.4)	15 (68.2)	7 (31.8)	0.961 (0.389–2.371)	
No	1,589 (98.6)	1097 (69.0)	492 (31.0)	1.000	
Aware of vaginal microbicides					0.104
Yes	475 (29.5)	314 (66.1)	161 (33.9)	0.827 (0.658–1.040)	
No	1,135 (70.5)	797 (70.2)	338 (29.8)	1.000	
Awareness of PEP					0.654
Yes	317 (19.7)	222 (70.0)	95 (30.0)	1.063 (0.814–1.389)	
No	1292 (80.3)	888 (68.7)	404 (31.0)	1.000	
Awareness of PrEP					0.089
Yes	265 (16.5)	171 (64.5)	94 (35.5)	0.786 (0.596–1.038)	
No	1342 (83.5)	937 (69.8)	405 (30.2)	1.000	

**Notes:** <sup>a</sup>13 items in total; yes = all of 13 answers were corrected; no = others.

**Abbreviations:** AIDS, acquired immune deficiency syndrome; CI, confidence interval; HIV, human immunodeficiency virus; OR, odds ratio; PEP, Post-exposure prophylaxis; PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection.

## Participants' concerns about PrEP

Participants were concerned about the safety (81.6%), efficacy (81.0%), cost (51.2%), convenience (19.2%), and accessibility (16.6%) of PrEP drugs. Regarding costs, 20.6% of the study participants expressed reluctance to purchase PrEP drugs with their own money; among those who were willing to purchase them, 18.2% were inclined to pay less than 100 RMB per month, 17.9% wanted to pay 100–200 RMB; and 17.3% wanted to pay 200–400 RMB. Even when they

were told that PrEP drugs need to be taken daily, 46% of the participants said they “definitely” would take them, 21% said they would “probably” do so, and nearly 20% said they would “probably not” or “definitely not” persist with treatment. When comparing two hypothetical PrEP drugs, 74% of the participants preferred to use drugs that were more expensive but with longer medication intervals, while only 14% chose to use the cheaper option but with a much higher use frequency.

## Univariate predictors of willingness to use PrEP

Fitted univariate logistic regression models (ie, those with only single predictors) are listed in Table 1. We found that race, residence, and income level were significantly associated with the outcome variable, ie, willingness to use PrEP. Compared with female sex workers of other races, Han female sex workers seemed to be more likely to use PrEP (OR 1.415,  $P = 0.011$ ), and female sex workers registered as urban residents were more willing than those registered as rural residents to use PrEP (OR 1.342,  $P = 0.009$ ). Those with a monthly income of 5000+ RMB were more willing to use PrEP than those at lower income levels. Other features, such as age, level of educational attainment, and marital status, were not detected as being significant predictors when evaluated independently.

Among the variables measuring attitudes toward HIV/AIDS, Table 3 shows the subsets that were significantly associated with or predictive of the outcome variable: participants who wanted to access knowledge about HIV/AIDS were more willing to use PrEP (OR 2.462,  $P < 0.0001$ ) than those who were not interested in acquiring knowledge about HIV/AIDS, and participants who had a nondiscriminatory attitude towards AIDS patients were more willing to use PrEP (OR 1.503,  $P = 0.004$ ) than those who had a discriminatory attitude.

Table 4 shows significant predictors of willingness to use PrEP among the list of AIDS-related behavioral and preventive measures: having a history of sexually transmitted infection (OR 1.850,  $P < 0.0001$ ); having a previous diagnosis of sexually transmitted disease (OR 1.758,  $P = 0.006$ ); a history of alcohol abuse (OR 1.269,  $P = 0.028$ ); having HIV/AIDS transmission knowledge (OR 1.689,  $P = 0.002$ ); recipient of free HIV/AIDS consultation in the last year (OR 1.379,  $P = 0.003$ ); and having a history of STI prevention (OR 2.299,  $P < 0.0001$ ). We found that willingness to use PrEP was not statistically significantly related to types of substance use (K powder, ice, ecstasy), frequency of condom use, tests for HIV in the past, or a history of medical prevention of HIV/AIDS.

## Multivariate predictors of willingness to use PrEP

All the significant factors identified above using bivariate models (three demographic, three attitude, and six knowledge and behavior variables) were included into a multivariable

logistic regression analysis to predict future use of PrEP (ie, willing to use PrEP). In the model-fitting procedure, the strategy of stepwise variable selection was applied to include or exclude variables based on testing of whether their regression coefficients were significantly above zero. In the final logistic regression model chosen, the following six significant predictors (Table 5) were selected: Han ethnicity (adjusted odds ratio [AOR] 1.446,  $P = 0.011$ ), urban residence (AOR 1.302,  $P = 0.027$ ), having knowledge about HIV/AIDS transmission (AOR 1.817,  $P = 0.0007$ ), having a history of sexually transmitted disease (AOR 1.830,  $P < 0.0001$ ), having a history of use of preventative medication for sexually transmitted disease (AOR 2.547,  $P < 0.0001$ ), and intent to access knowledge about HIV/AIDS (AOR 2.153,  $P < 0.0001$ ).

## Discussion

This survey was part of a feasibility study preparing for a large-scale clinical trial of PrEP in China for the first time. The study indicates that a relatively high (69%) proportion of surveyed female sex workers would be willing to use PrEP for HIV prevention when it was assumed that PrEP would be safe and effective. If the drugs were further assumed to be offered free and widely used, the willingness to use PrEP

**Table 5** Fitted multivariable logistic regression model for predicting willingness to use PrEP

Characteristic	AOR	95% CI	P value
Race			0.011
Han	1.446	1.087–1.924	
Others	1.000		
Registered residency			0.027
Urban residency	1.302	1.030–1.645	
Rural residency	1.000		
Has HIV/AIDS transmission knowledge			0.0007
Yes	1.817	1.285–2.568	
No	1.000		
STI history			<0.0001
Yes	1.830	1.431–2.340	
No	1.000		
Ever used STI preventative medication			<0.0001
Yes	2.547	1.671–3.882	
No	1.000		
Wish to access knowledge of HIV/AIDS			<0.0001
Yes	2.153	1.685–2.752	
No	1.000		

**Abbreviations:** AIDS, acquired immune deficiency syndrome; CI, confidence interval; HIV, human immunodeficiency virus; AOR, adjusted odds ratio; PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection.

increased to 80%. Such support levels for PrEP among the female sex workers surveyed provides strong evidence of acceptance of a PrEP clinical trial and related intervention programs in China among female sex workers in the future. By demonstrating the benefits and feasibility of PrEP for HIV prevention in hesitant users and initiating promotion by users with a strong positive attitude, more people would use PrEP.

Although we have not seen any published assessment of willingness to use PrEP among female sex workers, there have been three studies in MSM groups, with reported acceptance rates of 67%,<sup>18</sup> 68.9%,<sup>19</sup> and 74.4%.<sup>8</sup> These estimates are fairly consistent with our findings in the present research. Compared with condom use, an advantage of PrEP is that users do not need the consent of their sexual partners to use it.<sup>20</sup> Considering that in China, for tradition and cultural reasons, women often play a passive role or have a weak position in sexual activity, PrEP would be a particularly appropriate and effective option for HIV prevention.<sup>21</sup> Therefore, it is likely that female sex workers would have a greater likelihood of embracing PrEP than other groups, such as MSM.

Female sex workers who had previously noticed symptoms of sexually transmitted infection and had previously used drugs to prevent venereal disease were found to be more willing to accept PrEP for HIV/AIDS prevention. Symptoms of sexually transmitted disease were noticed by 35.1% of the female sex workers, but less than 10% of them actually went for diagnosis or received treatment. Fearing the pain and burden resulting from a sexually transmitted disease, such as discrimination and privacy concerns, 12% of female sex workers chose to use over-the-counter medicines to prevent sexually transmitted disease. These people would be more willing to use PrEP in preventing HIV infection than others without experience of prevention of sexually transmitted disease (OR 1.858). Our study also shows that economic and cultural factors play an important role in the willingness of female sex workers to use PrEP. Female sex workers with a high income or living in an urban area were more willing to use PrEP, and those with a better understanding of HIV/AIDS or a strong desire to receive related education would be more likely to use PrEP. A comprehensive understanding of the infection, dissemination, and hazards of HIV/AIDS among female sex workers would make the prevention and control of HIV/AIDS more effective, especially among female sex workers, but due to the nature of this study we do not have supportive data for this.

Although female sex workers had a strong willingness to use PrEP, their knowledge about PrEP was rather limited. Only 16.5% had heard of PrEP before participation, and only 1.4% had used PrEP before, which is consistent with results reported for MSM groups, eg, 16% and 0.8%, respectively, in California,<sup>18</sup> 23.7% and 1.7% in New York City,<sup>19</sup> 25% and 5% in four other US cities,<sup>22</sup> and 18.9% and 0.3% in another seven US cities.<sup>23</sup> Along with our survey staff, other important sources of information on PrEP included health professionals, the Internet, television, newspapers, and communication with friends. As a new prevention strategy, public understanding and awareness of PrEP are key to developing successful promotion and intervention programs.

The safety and efficacy of PrEP drugs are the two aspects of most concern to female sex workers. Although previous clinical studies have shown that PrEP is effective in preventing and reducing HIV infection,<sup>14–16,24</sup> and a number of mathematical models have demonstrated that the PrEP strategy could significantly reduce HIV infection rates among high-risk groups,<sup>25–27</sup> PrEP is still under development.<sup>20,21</sup> The price of PrEP drugs, their prescription, and related marketing channels are also the focus of attention. More than half of the female sex workers interviewed said that they did not want to spend more than 400 RMB per month on PrEP, and most of them preferred to take the drug at relatively long intervals if possible. Even though few people liked to take medicine on a daily basis, they “definitely” would persist with the treatment if required to do so. However, the drug formulation used needs to be convenient for the patient’s lifestyle. It would be ideal if the timing of a medication dose was not critical, such that occasionally missing a dose would not have a negative impact. Therefore, the pharmacokinetics and toxicological characteristics of PrEP drugs are key to the success of the strategy.<sup>28</sup>

Even if clinical trials did confirm the safety and efficacy of PrEP, many issues still need to be resolved.<sup>8,19–21,29–33</sup> For example, the effectiveness and compliance demonstrated in the trial may carry over to the general population, but they may decrease in natural contexts due to reasons such as behavioral disinhibition, risk compensation, and cultural or social barriers. The PrEP intervention within the above cultural and social contexts should be designed carefully in order to maximize the effectiveness and compliance, considering the controversial findings from various studies on how Truvada prevents HIV transmission in HIV-negative men and women who take it every day.<sup>14</sup> It is important that we tackle HIV infection among female sex workers and other



high-risk groups in the future, especially with regard to how people negotiate condom use in relationships, how well they maintain compliance with medication, and how we look at sexuality and sexual behavior. As stated by Kim et al,<sup>21</sup> “there is no single prevention scheme that can effectively prevent HIV transmission worldwide”. Hence it is emphasized that PrEP should not completely replace other preventive means, such as comprehensive health education and condom use.

There are several limitations to this research. First, because of the underground nature of the population studied, we used a variety of methods to recruit subjects. This could have led to selection bias and limited the generalizability of our research findings. Second, this study has a cross-sectional design, and asks participants to recall events that happened in the past. This would be associated with problems such as recall bias and accuracy. Third, because the questionnaire was self-administered under the supervision of field investigators, the results may be biased due to a desire on the part of the participants to provide socially acceptable answers. In other words, when facing the survey staff, the participants tend to answer questions in a way that would satisfy the people around them. Finally, we should be cautious about the concept of “willingness to use” PrEP because anticipated willingness does not always translate well into actual behavior.

## Conclusion

This study shows that the majority of female sex workers would be willing to use PrEP for the purpose of HIV/AIDS prevention so long as it is proven to be effective and safe. Because the majority of female sex workers are rarely aware of information or knowledge of PrEP, materials for public education are greatly needed and should be carefully designed to target high-risk groups. Users should be educated on the risks and benefits of taking PrEP when developing programs for promotion of PrEP strategies for HIV prevention in the future. For the first time in China, we have a study providing evidence of acceptance of PrEP among female sex workers and identifying factors that can potentially be utilized to enhance the quality of this strategy in the future. It offers a clear guideline for creating a protocol for our future clinical trial of PrEP, and for creating tailored prevention and control of HIV infections among high-risk populations in China.

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## Disclosure

The authors report no conflicts of interest in this work.

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