

# Declining trends in HIV and other sexually transmitted infections among female sex workers in Iran could be attributable to reduced drug injection: a cross-sectional study

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## ABSTRACT

**Objective** The HIV trend among female sex workers (FSWs) is understudied. We assessed the prevalence and trend of HIV and five other STIs among FSWs in Iran.

**Methods** We recruited FSWs (1337 in 2015, 1005 in 2010) from 21 sites in 13 cities in two cross-sectional biobehavioural surveys. Eligible FSWs were women aged  $\geq 18$  years who reported selling sex to more than one male client in the past 12 months. Consenting FSWs were interviewed using a behavioural questionnaire and tested for HIV and five other STIs. We considered study sites as clusters in the analysis and two-sided Fisher's exact test to compare the HIV prevalence between the two survey rounds.

**Results** HIV prevalence was 2.1% in 2015 (vs 4.0% in 2010,  $p=0.007$ ). Lifetime drug injection was reported by 6.1% of participants in 2015 (vs 14.6% in 2010,  $p=0.003$ ). In 2015, among FSWs with history of lifetime drug injection, HIV prevalence was 8.6% (vs 9.8% in 2010,  $p=0.425$ ). The prevalence of other STIs in 2015 was 0.4% (95% CI 0.2 to 1.0) for syphilis, 1.3% (95% CI 0.8 to 2.1) for gonorrhoea, 6.0% (95% CI 4.8 to 7.4) for chlamydia, 11.9% (95% CI 8.5 to 16.5) for trichomoniasis and 41.8% (95% CI 39.2 to 44.5) for human papillomavirus.

**Conclusions** HIV prevalence among FSWs in Iran decreased, but remains considerably high. The decrease in HIV prevalence compared with 2010 might be explained by a decrease in drug injection. Other STIs are also high in this population. Harm reduction programmes need to be continued and scaled up among this underserved population in Iran.

## INTRODUCTION

Female sex workers (FSWs) are disproportionately affected by HIV worldwide. International studies have indicated that women involved in sex work have a greater likelihood for acquisition and transmission of HIV infection as well as other STIs. For example, a systematic review in 2012, representing 99 878 FSWs from 102 studies in 50 countries, reported a global HIV prevalence of 11.8% in this population.<sup>1</sup> Another review in 2015 suggested HIV prevalence among FSWs to vary widely from 0.3%

in the Middle East and North Africa (MENA) to 29.3% in Sub-Saharan Africa.<sup>2</sup> Such high HIV infection rates among FSWs could be attributed mainly to high-risk sexual practices such as condomless sex,<sup>3</sup> high number of paying and non-paying sexual partners, and unsafe drug injection.<sup>4-6</sup>

Despite the growing body of HIV research in the MENA region in the past few years, our understanding of the dynamics of HIV infection among MENA's key populations remains limited.<sup>7</sup> In MENA, Iran has the largest number of people living with HIV (ie, 66 000), 38% of whom have been diagnosed and referred to HIV care services.<sup>8</sup> In Iran, HIV transmission continues to be primarily driven by injection drug use. Concentrated HIV epidemics continue to exist among people who inject drugs (PWID), with an estimated HIV prevalence of 15.2% in 2010 and 13.8% in 2013.<sup>9</sup> However, recent analyses suggest that sexual transmission of HIV is increasing, particularly among women and FSWs. That being said, FSWs in Iran are considered the second most at-risk population for HIV infection.<sup>9</sup>

We estimated the number of FSWs living in Iran to be as high as 228 700 and called for scaling up targeted programmes for HIV/STIs screening, treatment and harm reduction.<sup>10</sup> Given the concerns around the shift in HIV modes of transmission from injection drug use to unsafe sexual practices, Iran has implemented harm reduction programmes provided through health centres for vulnerable women, including FSWs, homeless or street-involved women, women who use or inject drugs, and women with a history of incarceration.<sup>11</sup> These centres, which have been expanded to major cities across the country (ie, 69 centres are available to provide care to these women), also provide a platform for understanding the dynamics of FSWs in Iran.<sup>9</sup>

In this paper, we aimed to report the prevalence of HIV and five other STIs among FSWs. We also compared the prevalence and correlates of HIV seropositivity in the 2015 survey with the previous round conducted in 2010. Our findings have important implications for informing HIV prevention programmes in Iran.



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## METHODS

### Setting and data collection

The study population included a total of 1337 (in 2015) and 1005 (in 2010) FSWs who were recruited from 21 harm reduction facilities across 13 major cities in Iran. Details of the study protocols were previously described.<sup>12 13</sup> In brief, participants were recruited and included in the study if they met the following eligibility criteria: (1) were  $\geq 18$  years old, (2) were assigned female sex at birth, (3) self-reported selling sex (ie, vaginal, oral or anal) for money, goods or favours with more than one male client in the past 12 months, (4) held an Iranian citizenship, (5) lived in the city where the study was conducted, and (6) consented for participation in the study.

After attending a training workshop in Tehran, local team members ran and oversaw the survey data collection across their respective recruitment sites. The selection of the health facilities was informed by the feedback of local health authorities and experts at the HIV/STIs office of the Ministry of Health. The study sites were chosen based on feasibility, staff and locations that were accessible to the target population (ie, FSWs). We recruited all participants in 2010 and majority of participants in 2015 from facilities using convenience sampling method. A small number (~11.4%) of participants in 2015 were recruited through a peer-led outreach team from street-based venues. Behavioural data were collected in an individual face-to-face interview with a trained interviewer using a validated questionnaire that took about an hour to complete. The questionnaire was in Farsi and included several sections collecting data on FSWs' demographic information as well as drug use/injection and sexual practices.

### HIV/STIs testing

In 2010, consenting FSWs provided dried blood samples for HIV testing. HIV seropositivity was assessed using two tests. First, an ELISA was done using a bioMérieux Vironostika Uni-Form II Ag/Ab kit, and if positive it was followed by a Bio-Rad Genscreen Plus HIV Ag-Ab kit. FSWs were not tested for other STIs in 2010. Of the 1005 recruited FSWs, data for 100 FSWs had low-quality as reported by the city supervisors, 32 FSWs were not eligible, 1 FSW did not provide consent for interview, 55 FSWs did not provide consent for blood test, 72 FSWs had inadequate dried blood samples; and so, we analysed the HIV prevalence using data from 745 FSWs participants in the survey 2010. In 2015, however, consenting FSWs provided a blood sample for an HIV and syphilis combined rapid diagnostic test (SD BIOLINE HIV/Syphilis Duo Rapid Test, Standard Diagnostics, Gyeonggi-do, South Korea). HIV and syphilis rapid tests were completed using a finger prick sample. FSWs with non-reactive (ie, negative) HIV rapid test results were provided with post-test counselling and informed of their test results on the same day/visit. FSWs with reactive or inconclusive HIV test results on their first rapid test were retested by a second rapid test, and blood samples with discordant results were tested again at a central lab in Tehran.

In 2015, FSWs were also tested for gonorrhoea, chlamydia, trichomoniasis and human papillomavirus (HPV) using PCR on self-administered vaginal swabs. STIs test results (as well as laboratory HIV confirmatory results) were returned to participants in 3 weeks through a local HIV counselling facility. Receiving test results was strongly encouraged, but not mandatory for study participation. STIs were treated free of charge, and those tested positive for HIV were referred to antiretroviral therapy (ART) services. A monetary incentive of ~US\$2 and

~US\$1 were provided for the interview and HIV/STIs testing, respectively.

### Covariates

We examined the prevalence and correlates of HIV seropositivity in the 2010 and 2015 surveys. Covariates of interest included a range of sociodemographic and behavioural variables, including age group (<25 or  $\geq 25$  years), educational level (illiterate, primary school or below, or middle school or above) and current marital status (married, single/divorced/widowed or temporarily married). Sex work-related variables included receiving free male condoms in the last year (yes or no), frequency of male condom use with all sex partners in the past month (never, occasionally or always), age at first sex debut (younger than 15, 15–19, 20+), number of paying clients in the past month (0 or 1–5, or 6+) and number of non-paying partners in the past month (0 or 1+). Other covariates included history of lifetime non-injection drug use (yes or no) and lifetime injection drug use (yes or no).

### Statistical analysis

We used the Survey Package in Stata V.13.1 to conduct the analyses. Facilities were considered as the primary sampling unit to account for the clustering of the sampling strategy. We reported the descriptive characteristics of participants in the 2010 and 2015 surveys using mean and percentages and tested the differences by  $\chi^2$  or two-sided Fisher's exact tests as appropriate. The overall and city-level prevalence of HIV (for 2010 and 2015) and other STIs (only for 2015) were also reported. To assess the factors associated with HIV prevalence in each round of the surveys, we constructed bivariable and multivariable logistic regression models to examine the correlates of HIV seropositivity. Covariates with a *p* value <0.2 in the bivariable regression were entered into the multivariable regression model. Crude and adjusted ORs (AOR) along with their 95% CIs were reported.

## RESULTS

Participants in the two surveys were comparable with regard to education, receiving free male condoms, frequency of male condom used in the last month, age at sex work debut, number of clients in the last month and lifetime non-injection drug use (table 1). However, participants in the 2015 survey were on average older than those in the 2010 survey (mean age 35.4 vs 31.6, *p*=0.01). They were also more likely to be divorced or widowed (45.3% vs 33.9%, *p*=0.001) or in temporary marital relationships (15.4% vs 10.4%, *p*=0.001), have only one non-paying partner (40.5% vs 20.1%, *p*=0.016), and less likely to have ever injected drugs (6.1% vs 14.6%, *p*=0.003).

The overall HIV prevalence was 4.0% in the 2010 survey and 2.1% in the 2015 survey (*p*=0.007) (figure 1, table 2). In the 2010 survey, HIV prevalence was significantly higher among FSWs who reported a lifetime history of drug injection (9.8% vs 2.9%, *p*=0.001). In the 2015 survey, the HIV prevalence was significantly higher among FSWs who were illiterate (5.3% vs 1.5% in those with middle school or higher education, *p*=0.029), reported having one to five clients in the past month (3.1% vs 0.5% in FSWs with 6+ clients, *p*=0.001), reported a lifetime history of non-injection drug use (2.8% vs 0.9% in FSWs without non-injection drug use history, *p*=0.003) and a lifetime history of injection drug use (8.6% vs 1.6% in those without a history of injection drug use, *p*=0.001). In 2015, the HIV prevalence was 1.9% in those FSWs recruited from facilities and was 2.6% in those recruited from street-based venues (*p*=0.695).

**Table 1** Demographic characteristics and behaviours of participants in the two rounds of the biobehavioural survey of FSWs in Iran

| Variables  | 2010 survey (n=745)† | 2015 survey (n=1337) | P value* |
|--|----------------------|----------------------|----------|
| Age group  |                      |                      | 0.002    |
| <25  | 24.3 (17.0 to 33.5)‡ | 10.3 (7 to 14.8)     |          |
| ≥25  | 75.7 (66.5 to 83.0)  | 89.7 (85.2 to 93)    |          |
| Mean age   | 31.6 (29.7 to 33.6)  | 35.4 (33.9 to 36.8)  | 0.001    |
| Highest educational level  |                      |                      | 0.372    |
| Illiterate   | 14.7 (8.8 to 23.4)   | 10.0 (7.6 to 13.1)   |          |
| Primary or below   | 30.1 (21.8 to 39.8)  | 27.9 (22.2 to 34.4)  |          |
| Middle or high school  | 51.0 (40.5 to 61.5)  | 55.7 (50.3 to 61)    |          |
| College and above  | 4.2 (1.9 to 9.7)     | 6.4 (4.2 to 9.6)     |          |
| Current marital status   |                      |                      | <0.001   |
| Single   | 19.8 (12.6 to 29.7)  | 6.3 (4.2 to 9.4)     |          |
| Married  | 35.9 (25.6 to 47.8)  | 33.0 (25.8 to 41.1)  |          |
| Divorced/widowed   | 33.9 (27.6 to 41.0)  | 45.3 (38.4 to 52.4)  |          |
| Temporarily married (Sigheh)   | 10.4 (6.8 to 15.4)   | 15.4 (12.4 to 19.1)  |          |
| Received free male condom in the last year                           |                      |                      | 0.110    |
| Yes  | 63.6 (50.8 to 74.7)  | 74.4 (64.8 to 82.1)  |          |
| No   | 36.4 (25.3 to 49.2)  | 25.6 (17.9 to 35.2)  |          |
| Frequency of male condom use with all sex partners in the last month |                      |                      | 0.595    |
| Never  | 29.5 (20.6 to 40.4)  | 23.7 (15.4, 34.7)    |          |
| Occasionally   | 44.4 (36.6 to 52.4)  | 50.0 (42.7 to 57.4)  |          |
| Always   | 26.1 (18.0 to 36.2)  | 26.3 (20.4 to 33.1)  |          |
| Age at first sex work debut  |                      |                      | 0.195    |
| <15  | 3.0 (1.6 to 5.4)     | 2.2 (1.4 to 3.7)     |          |
| 15–19  | 23.0 (16.5 to 31.2)  | 16.7 (11.5 to 23.7)  |          |
| 20–24  | 28.6 (24.0 to 33.5)  | 26.9 (22.6 to 31.8)  |          |
| 25+  | 45.4 (35.21 to 56.1) | 54.1 (46.2 to 61.8)  |          |
| Number of clients in the last month                                  |                      |                      | 0.158    |
| 0  | 29.1 (20.2 to 40.1)  | 22.5 (13.9 to 34.3)  |          |
| 1  | 24.3 (19.1 to 30.3)  | 14.2 (9.4 to 20.8)   |          |
| 2–5  | 18.0 (12.7 to 42.8)  | 33.4 (24.9 to 43.0)  |          |
| 6+   | 28.6 (19.1 to 40.6)  | 30.0 (17.2 to 46.9)  |          |
| Number of non-paying sex partner in the last month                   |                      |                      | 0.016    |
| 0  | 51.5 (40.2 to 62.7)  | 47.6 (39 to 56.4)    |          |
| 1  | 20.1 (16.3 to 24.6)  | 40.5 (33.1 to 48.3)  |          |
| 2–5  | 25.5 (17.0 to 36.3)  | 11.2 (5.7 to 20.7)   |          |
| 6+   | 2.9 (1.2 to 6.6)     | 0.8 (0.1 to 5.9)     |          |
| Lifetime non-injection drug use                                      |                      |                      | 0.112    |
| Yes  | 71.6 (59.5 to 81.3)  | 59.8 (47.1 to 71.4)  |          |
| No   | 28.4 (18.7 to 40.5)  | 40.2 (28.6 to 52.9)  |          |
| Lifetime injection drug use  |                      |                      | 0.003    |
| Yes  | 14.6 (10.1 to 20.6)  | 6.1 (4.4 to 8.4)     |          |
| No   | 85.4 (79.4 to 89.9)  | 93.9 (91.6 to 95.6)  |          |

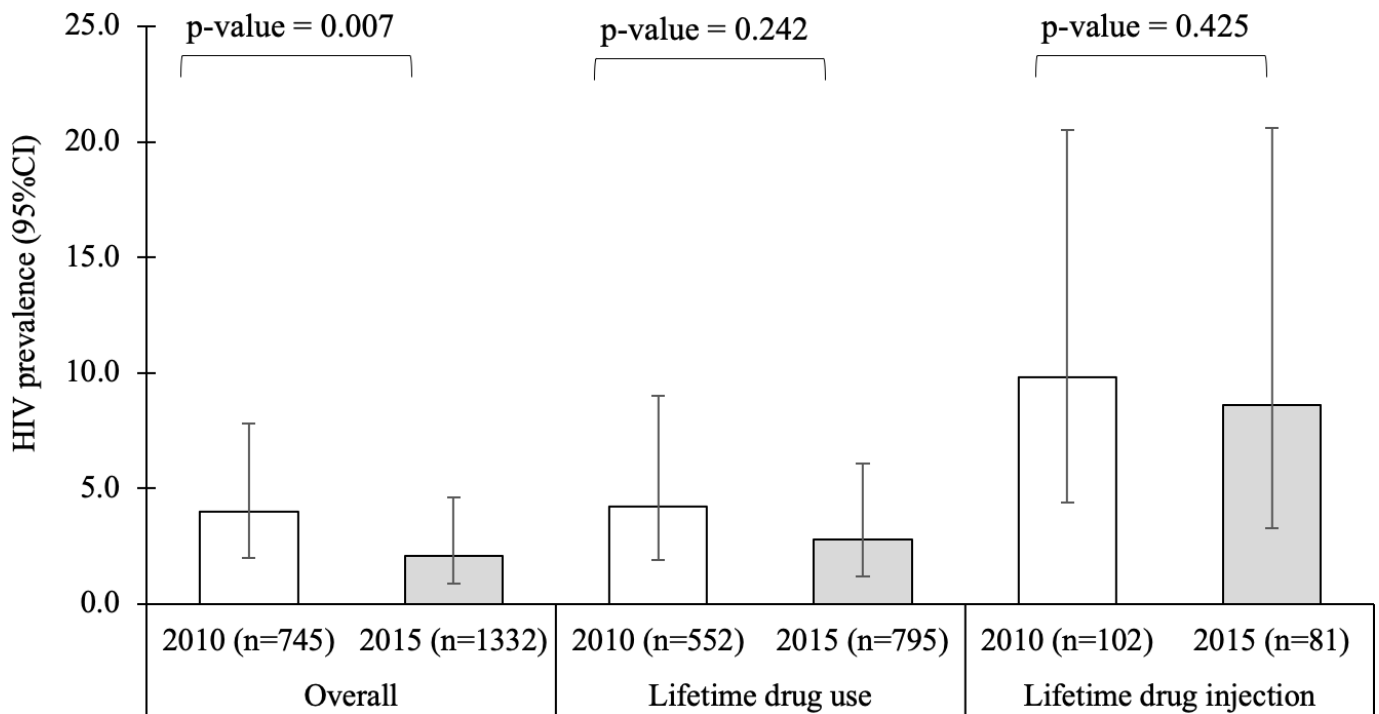
\*P values are for tests to compare the distribution of variables between the two rounds.

†Out of 1005 FSWs who participated in the survey, 745 had confirmed HIV test results.

‡Estimates are expressed as % (95% CIs), unless otherwise specified.  
FSWs, female sex workers.

Multivariable analysis of the 2010 survey data showed that the HIV status was more likely to be positive among FSWs aged 25 years or older (AOR=10.94) as well as those who reported a lifetime history of injection drug use (AOR=2.99) (table 3). In the 2015 survey, HIV seropositivity was also more likely to be reported among those who reported a lifetime history of injection drug use (AOR=5.32) and non-injection drug use (AOR=2.33). In addition, in the 2015 survey, those who reported receiving free condoms in the previous year were more likely to be HIV-positive (AOR=6.23).

HIV prevalence varied by geographical location (online supplementary table S1). We were not able to estimate the HIV prevalence in four cities in 2010 due to small sample size. In the 2015 survey, the highest HIV prevalence was observed for Khorramabad (9.4%), Shiraz (6.2%) and Kermanshah (3.8%). In six cities, we found no HIV infection among the FSWs participants, and in the rest of the cities HIV prevalence ranged from 0.6% to 1.8%. However, in the 2010 survey, FSWs in Khorramabad (10.1%), Shiraz (8.2%) and Sari (4.2%) had the highest HIV prevalence. While the HIV prevalence decreased in Sari (by



**Figure 1** HIV prevalence overall and in subgroups of female sex workers who reported lifetime history of drug use or injection in 2010 and 2015 in Iran.

2.8%), Shiraz (by 2%) and Khorramabad (by 0.7%), it almost tripled in Tehran (the capital city) since 2010 (0.6% vs 1.8%).

The prevalence of STIs other than HIV in 2015 was 0.4% for syphilis, 1.3% for gonorrhoea, 6.0% for chlamydia, 11.9% for trichomoniasis and 41.8% for HPV. STIs prevalence also varied by geographical location (online supplementary table S1). The highest prevalence of syphilis was observed among FSWs in Khorramabad (4.7%), where HIV was also the highest (9.4%). In Zahedan, both syphilis (2%) and gonorrhoea (8%) were very high among FSWs in comparison with those in other cities. The prevalence of chlamydia ranged from 0% (in Arak) to 13.6% (in Shiraz), and four cities had a prevalence higher than 5%. The prevalence of trichomoniasis peaked at 28% in Zahedan, and five cities had a prevalence higher than 10%. HPV was the most frequent STIs, ranging from 25.9% to 54.0%, with a prevalence of 40% or higher in seven cities.

## DISCUSSION

Our results suggest that the prevalence of HIV among FSWs in Iran has decreased in 2015 compared with 2010, which could be attributed to a decrease in drug injection behaviours. However, it is still considerably higher than the prevalence among the general female population and certain key populations at risk for HIV (eg, prisoners).<sup>9</sup> The HIV prevalence was significantly higher among FSWs subgroups who reported drug use and injection (ie, up to 9.8%) in the past and among those who lived in cities in the western part of the country and in places where other STIs were prevalent, such as Khorramabad.

The HIV prevalence in the 2015 survey was in range with those reported in recent small-scale, city-level studies among FSWs, such as in Kerman (0.1%–2.6%),<sup>14</sup> Shiraz (2.5%–7.8%),<sup>15</sup> Sari (1.8%–9.1%)<sup>16</sup> and Tehran (CI 2.1% to 9.5%)<sup>17</sup>; however, comparisons between these studies need to be done keeping an eye on the differences in sample size and sampling approaches.

In the 2010 survey, a high prevalence of HIV was observed among FSWs with a history of drug injection (ie, 11.2%).<sup>12</sup> High prevalence of HIV was also reported among female PWID (ie, 9.9%) in Iran.<sup>18</sup> Studies on FSWs who inject drugs<sup>19–20</sup> reported client violence, intimate partner injection drug use, being injected by others and obtaining syringes from personal connections to increase the risk for HIV infection. FSWs who inject drugs are a highly vulnerable and marginalised subpopulation of FSWs, and may have many barriers to access and use of harm reduction services to mitigate the risk for both unsafe sex and unsafe injections. FSWs who have stopped the use of injection drugs are shown to have risk profiles closely similar to FSWs with no history of drug injection.<sup>20</sup> Such harm reduction interventions targeting FSWs who inject drugs are a critical need in Iran and need to be prioritised.

We found HIV prevalence to be heterogeneous across cities. We could not assess sources of heterogeneity due to the small sample size per city, but the likely reasons are differences in risk profiles, background STIs and HIV rates, and surveillance and service activities targeted at FSWs. We found high HIV prevalence among FSWs in cities located in the western part of Iran, where HIV prevalence is higher among PWID and where more PWID engage in unsafe injection and sexual behaviours. In Tehran, the capital of Iran and home to more than 35 000 FSWs,<sup>10</sup> the HIV prevalence almost tripled over 5 years, which could be attributed to changes in drug use and injection patterns.<sup>21</sup> The link between FSW and PWID populations overall and in each city needs to be carefully investigated in future quantitative and qualitative studies.

The decrease in the overall HIV prevalence in 2015 compared with the 2010 nationwide survey could also be due to the differences in FSWs population recruited in the two rounds. Although we had the same eligibility criteria and recruited participants from the same facilities in 2010 and 2015, participants in the 2015 survey were less likely to report lifetime non-injection drug use (ie, dropped by 27%) and particularly injection drug

**Table 2** HIV prevalence overall and in subgroups of participants recruited in the two rounds of the biobehavioural survey of FSWs in Iran

| Variables  | 2010 survey |                         |         | 2015 survey |                         |         | P value* |
|--|-------------|-------------------------|---------|-------------|-------------------------|---------|----------|
|  | n (%)       | HIV prevalence (95% CI) | P value | n (%)       | HIV prevalence (95% CI) | P value |          |
| Overall  |             | 4.0 (2.0 to 7.8)†       | –       | 1332        | 2.1 (0.9 to 4.6)‡       | –       | 0.007    |
| Age group  |             |                         | 0.086   |             |                         | 0.320   | 0.091    |
| <25  | 182         | 0                       |         | 136         | 0.7 (0.1 to 5.3)        |         |          |
| ≥25  | 560         | 5.4 (2.7 to 10.2)       |         | 1194        | 2.2 (0.9 to 5.0)        |         |          |
| Highest educational level  |             |                         | 0.227   |             |                         | 0.029   | 0.385    |
| Illiterate   | 116         | 7.8 (3.2 to 17.7)       |         | 133         | 5.3 (2.1 to 12.3)       |         |          |
| Primary or below   | 223         | 3.1 (1.1 to 8.9)        |         | 373         | 2.1 (0.9 to 5.2)        |         |          |
| Middle school and above  | 409         | 3.4 (1.4 to 8.0)        |         | 826         | 1.5 (0.5 to 4.2)        |         |          |
| Current marital status   |             |                         | 0.292   |             |                         | 0.543   | 0.835    |
| Married  | 290         | 3.8 (1.4 to 10.1)       |         | 440         | 1.4 (0.6 to 3.3)        |         |          |
| Single/divorced/widowed  | 380         | 3.4 (1.6 to 7.3)        |         | 684         | 2.2 (1.0 to 4.8)        |         |          |
| Temporarily married (Sigheh)   | 75          | 8.0 (3.1 to 19.2)       |         | 205         | 2.9 (0.5 to 16.2)       |         |          |
| Received free male condom in the last year                           |             |                         | 0.086   |             |                         | 0.067   | 0.522    |
| Yes  | 280         | 5.3 (2.5 to 10.7)       |         | 988         | 2.5 (1.0 to 6.1)        |         |          |
| No   | 456         | 2.1 (0.8 to 5.8)        |         | 341         | 0.6 (0.2 to 2.1)        |         |          |
| Frequency of male condom use with all sex partners in the past month |             |                         | 0.447   |             |                         | 0.097   | 0.706    |
| Never  | 183         | 1.6 (0.4 to 6.0)        |         | 314         | 1.6 (0.8 to 3.1)        |         |          |
| Occasionally   | 263         | 4.2 (1.4 to 12.0)       |         | 663         | 1.7 (0.6 to 4.5)        |         |          |
| Always   | 140         | 2.9 (0.8 to 9.6)        |         | 347         | 3.2 (1.3 to 7.8)        |         |          |
| Age at first sex debut   |             |                         | 0.573   |             |                         | 0.632   | 0.129    |
| <15  | 22          | 0                       |         | 27          | 3.7 (0.5 to 23.9)       |         |          |
| 15–19  | 154         | 2.6 (0.7 to 9.7)        |         | 217         | 2.8 (0.7 to 10.8)       |         |          |
| 20+  | 504         | 4.6 (2.2 to 9.3)        |         | 1047        | 1.8 (0.8 to 4.0)        |         |          |
| Number of clients in the past month                                  |             |                         | 0.242   |             |                         | <0.001  | 0.865    |
| 0  | 409         | 4.9 (2.3 to 10.0)       |         | 294         | 2.0 (0.9 to 4.6)        |         |          |
| 1–5  | 111         | 2.7 (0.9 to 8.1)        |         | 435         | 3.1 (1.2 to 7.4)        |         |          |
| 6+   | 188         | 2.1 (0.5 to 8.3)        |         | 390         | 0.5 (0.2 to 1.5)        |         |          |
| Number of non-paying sex partner in the past month                   |             |                         | 0.197   |             |                         | 0.952   | 0.279    |
| 0  | 504         | 4.7 (2.4 to 9.4)        |         | 626         | 2.1 (0.9 to 4.8)        |         |          |
| +1   | 208         | 2.4 (0.7 to 7.8)        |         | 694         | 2.0 (0.7 to 5.6)        |         |          |
| Lifetime non-injection drug use                                      |             |                         | 0.479   |             |                         | 0.003   | 0.242    |
| Yes  | 552         | 4.2 (1.9 to 9.0)        |         | 795         | 2.8 (1.2 to 6.1)        |         |          |
| No   | 195         | 3.1 (1.5 to 6.3)        |         | 536         | 0.9 (0.3 to 2.7)        |         |          |
| Lifetime injection drug use  |             |                         | 0.001   |             |                         | <0.001  | 0.425    |
| Yes  | 102         | 9.8 (4.4 to 20.5)       |         | 81          | 8.6 (3.3 to 20.6)       |         |          |
| No   | 645         | 2.9 (1.4 to 5.9)        |         | 1249        | 1.6 (0.7 to 3.8)        |         |          |
| Type of recruitment  |             |                         |         |             |                         |         |          |
| Facility-based   | –           | –                       |         | 1185        | 1.9 (0.8 to 4.5)        | 0.695   | –        |
| From street-based venues   | –           | –                       |         | 152         | 2.6 (0.5 to 13.5)       |         |          |

\*P values are for test of homogeneity of the two rounds in 2010 and 2015; non-significant p value (>0.05) means there is no heterogeneity between the two rounds.

†There were 30 positive cases when the total prevalence was computed. But 12 of the positive FSWs did not experience sexual contact during the last month and 3, 3, 1, 1 and 1 of the positive FSWs did not have information for age at first sex work, number of clients in the last month, number of non-paying sex partner in the last month, lifetime drug use and lifetime drug injection, respectively.

‡There were 28 positive cases when the total prevalence was computed. But one of the positive FSWs did not have information for other factors, so the subanalysis was done for 27 positive cases. However, for the total prevalence we used 28 cases to estimate the overall estimate. FSWs, female sex workers.

use (ie, dropped by 58%). In our analysis and in many other studies,<sup>14 15 22 23</sup> drug use has been reported to be associated with higher risks for HIV infection in Iran, so part of the decrease in HIV prevalence in 2015 among FSWs could be attributed to a

smaller proportion of FSWs engaged in drug injection (and use) behaviours. The overall prevalence of drug injection has been declining in Iran in recent years,<sup>9</sup> but drug use has remained almost stable or slightly declining.<sup>24</sup> It is likely that with the same

**Table 3** Factors correlated with HIV prevalence in the two rounds of the biobehavioural survey of female sex workers in Iran

| Variables  | 2010 survey            |                       | 2015 survey          |                     |
|--|------------------------|-----------------------|----------------------|---------------------|
|  | Crude analysis         | Adjusted analysis     | Crude analysis       | Adjusted analysis   |
| <b>Age group</b>   |                        |                       |                      |                     |
| <25  | 1                      | 1                     | 1                    |                     |
| ≥25  | 14.63 (2.59 to +Inf)*‡ | 10.94 (1.91 to +Inf)‡ | 3.0 (0.28 to 32.1)   | –                   |
| <b>Highest educational level</b>   |                        |                       |                      |                     |
| Illiterate   | 1                      | –                     | 1                    | 1                   |
| Primary or below   | 0.38 (0.11 to 1.39)    | –                     | 0.39 (0.14 to 1.05)  | 0.27 (0.10 to 0.76) |
| Middle school and above  | 0.42 (0.10 to 1.70)    | –                     | 0.26 (0.09 to 0.76)* | 0.22 (0.08 to 0.61) |
| <b>Current marital status</b>  |                        |                       |                      |                     |
| Married  | 1                      | –                     | 1                    |                     |
| Single/divorced/widowed  | 0.90 (0.32 to 2.56)    | –                     | 1.6 (0.72 to 3.65)   | –                   |
| Temporarily married (Sigheh)   | 2.21 (0.72 to 6.78)    | –                     | 2.2 (0.33 to 14.23)  | –                   |
| <b>Received free male condom in the last year</b>                            |                        |                       |                      |                     |
| No   | 1                      | 1                     | 1                    | 1                   |
| Yes  | 2.54 (0.84 to 7.70)†   | 2.37 (0.90 to 7.32)‡  | 4.40 (0.76 to 25.2)† | 6.23 (1.11 to 34.9) |
| <b>Frequency of male condom use with all sex partners in the last months</b> |                        |                       |                      |                     |
| Always   | 1                      | –                     | 1                    | 1                   |
| Occasionally   | 1.48 (0.26 to 8.30)    | –                     | 1.04 (0.38 to 2.83)  | 0.60 (0.27 to 1.34) |
| Never  | 0.57 (0.08 to 4.03)    | –                     | 2.02 (0.88 to 4.64)† | 1.17 (0.63 to 2.14) |
| <b>Age at first sex debut</b>  |                        |                       |                      |                     |
| <15  | 1                      | –                     | 1                    |                     |
| 15–19  | 0.77 (0.13 to 5.41)‡   | –                     | 0.74 (0.05 to 11.2)  | –                   |
| +20  | 1.38 (0.41 to 7.36)‡   | –                     | 0.48 (0.04 to 5.31)  | –                   |
| <b>Number of clients in the last month</b>                                   |                        |                       |                      |                     |
| 0  | 1                      | 1                     | 1                    |                     |
| 1–5  | 0.54 (0.17 to 1.71)    | 0.54 (0.10 to 1.90)‡  | 1.52 (0.70 to 3.34)  | –                   |
| +6   | 0.42 (0.12 to 1.54)    | 0.36 (0.09 to 1.12)‡  | 0.25 (0.09 to 0.67)  | –                   |
| <b>Number of non-paying sex partner in the last month</b>                    |                        |                       |                      |                     |
| 0  | 1                      | –                     | 1                    |                     |
| +1   | 0.49 (0.16 to 1.51)    | –                     | 0.97 (0.35 to 2.67)  | –                   |
| <b>Lifetime non-injection drug use</b>                                       |                        |                       |                      |                     |
| No   | 1                      | –                     | 1                    | 1                   |
| Yes  | 1.37 (0.55 to 3.39)    | –                     | 3.02 (1.48 to 6.16)* | 2.33 (1.13 to 4.81) |
| <b>Lifetime injection drug use</b>   |                        |                       |                      |                     |
| No   | 1                      | 1                     | 1                    | 1                   |
| Yes  | 3.58 (1.65 to 7.78)*   | 2.99 (1.18 to 7.21)‡  | 5.81 (2.39 to 14.1)* | 5.32 (2.31 to 12.3) |
| <b>Type of recruitment</b>   |                        |                       |                      |                     |
| Facility-based   | –                      | –                     | 1                    |                     |
| From street-based venues   | –                      | –                     | 1.42 (0.21 to 9.41)  | –                   |

\*These variables had a p value less than 0.05 and entered into the multivariable model.

†These variables had a p value less than 0.20 and entered into the multivariable model.

‡Exact logistic regression was used for data in 2010.

pattern, drug injection has also decreased among FSWs and has led to less exposure to HIV infection. Moreover, most of the centres for vulnerable women (from where we recruited FSWs for our study) only provide counselling and testing services for HIV, and not treatment. FSWs who were diagnosed with HIV were referred to other centres that offer ART services. Over time, this might reduce HIV prevalence among FSWs who are clients of centres for vulnerable women. This selective dropout may decrease HIV prevalence over time.

HIV prevalence was significantly higher among those who received free condoms in the previous year. It is likely that HIV-positive FSWs who were aware of their HIV status, had more access to condom programmes, were receiving more counselling and education, and were more motivated to receive and use

condoms to prevent HIV transmission to their partners. Thus, the observed association between HIV prevalence and receiving condom is most likely a reverse causality.

We found STIs prevalence among FSWs to be high, as reported in previous surveys in Iran.<sup>22–25</sup> Compared with STI prevalence among the general female population in Iran,<sup>26–27</sup> FSWs have a higher STIs prevalence due to unsafe sex with multiple partners. We found almost no improvement in safe sex practices among FSWs from the 2010 to the 2015 surveys.<sup>3,9</sup> Several individual and structural barriers to consistent use of condoms among FSWs in Iran have been reported.<sup>3,28</sup> Innovative interventions that address these barriers and reach underserved FSWs are needed.

Our study has four limitations. First, the study participants were recruited from facilities, and generalising the findings to

all FSWs should be done with caution; surveillance surveys in Iran should be improved by using sampling designs such as respondent-driven sampling or time locations which may be closely similar to random sampling. Second, we did not track individuals over time and so changes between the two surveys' findings could be due to differential selection of FSWs subgroups. Third, we assumed that HIV-positive and HIV-negative FSWs leave the FSWs population or migrate out of the study sites at similar rates, which may not be true. Lastly, we measured behaviours by inperson interviews, which may have led to under-reporting bias of stigmatised sexual and injection behaviours.

## CONCLUSION

We found that HIV prevalence among FSWs in Iran was still considerable. The decrease in HIV prevalence compared with 2010 might be explained by a decrease in drug injection. Other STIs were also high in the FSWs population. Harm reduction programmes need to be continued and scaled up among this underserved FSWs population in Iran.

### Key messages

- ▶ HIV prevalence among female sex workers in Iran has decreased but remains alarming.
- ▶ Decrease in HIV prevalence is most likely attributable to reduction in drug injection.
- ▶ Other STIs other than HIV are prevalent among female sex workers.

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**Data availability statement** The Ministry of Health and Medical Education owns the data. Sex work is highly stigmatised and currently illegal in Iran. To protect the study population, all individual level data on their size and risk behaviours are being considered sensitive data. It is required that all researchers who wanted to work on this data submit their data request access to info@hivhub.ir (the HIV/STI Surveillance Research Center).

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