



HIV prevalence and associated factors among female sex workers in Iran: a bio-behavioral survey in 2020

Neda Izadi⁹ · Mohammad-Mehdi Gouya² · Samaneh Akbarpour³ · Bushra Zareie⁴ · Yousef Moradi^{5,6} · Parvin Afsar Kazerooni⁷ · Marzieh Mahboobi² · Parisa Mohseni¹ · Ghabad Moradi^{5,6,8}

Accepted: 21 August 2022

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

Despite the overall decline in human immunodeficiency virus (HIV) prevalence, it remains unacceptably high in key populations. This study aimed to estimate prevalence of HIV infection and high-risk behaviors among female sex workers (FSWs). This study was a cross-sectional survey of FSWs conducted between December 2019 and August 2020 in eight geographically diverse cities in Iran. After providing informed consent, participants completed a bio-behavioral questionnaire and after completion of the interview, rapid diagnostic tests (RDT) and dried blood spots (DBS) were collected to determine HIV and syphilis status as per national guidelines, if the women consented. All analyzes were based on RDS adjustment. Weighting was done according to Giles' SS estimator. Among the 1515 FSWs, the overall prevalence of HIV and syphilis were 1.6% (95% CI: 0.8–2.3) and zero, respectively. The highest HIV prevalence was observed in Shiraz (5.1%) and Khorramabad city (1.6%). In addition, HIV-positive FSWs had a higher mean age at first sexual contact than HIV-negative FSWs (21.4 ± 5.6 vs. 17.2 ± 4.2 years). Injection drug use and a history of arrest or incarceration were associated with an increased odds of HIV infection (OR = 6.25; 95% CI: 1.90–20.55 and OR = 4.57; 95% CI: 1.64–12.72, respectively). Based on the results, strategies to improve early HIV diagnosis, harm reduction, and use of testing and treatment strategies are needed to reduce and control HIV infections.

Keywords HIV Prevalence · Female Sex Workers · Respondent-Driven Sampling · Surveillance · Iran

Introduction

Human immunodeficiency virus (HIV/AIDS) is one of the greatest challenges to health systems worldwide, affecting societies with a variety of health, social, and economic problems [1]. At the end of 2020, approximately 37.7 million

people worldwide were living with HIV, of whom 36 million were over 15 years of age and 53% were women and girls [2]. Despite the overall decline in HIV prevalence, it remains unacceptably high in key populations, including female sex workers (FSWs) and their clients, injecting drug users (IDUs), men who have sex with men (MSM),

✉ Ghabad Moradi
moradi_gh@yahoo.com

¹ Department of Epidemiology, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran

² Iranian Center for Communicable Diseases Control, Ministry of Health and Medical Education, Tehran, Iran

³ Occupational Sleep Research Center, Baharloo Hospital, Tehran University of Medical Sciences, Tehran, Iran

⁴ Department of Epidemiology, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran

⁵ Social Determinants of Health Research Center, Research

Institute for Health Development, Kurdistan University of Medical Science, Sanandaj, Iran

⁶ Department of Biostatistics and Epidemiology, Faculty of Medicine, Kurdistan University of Medical Science, Sanandaj, Iran

⁷ National HIV/AIDS/STI Office, Ministry of Health and Medical Education, Tehran, Iran

⁸ Social Determinants of Health Research Center, Research Institute for Health Development, Kurdistan University of Medical Sciences, P.O.Box 66177-13446, Sanandaj, Iran

⁹ Research Center for Social Determinants of Health, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran

transgender people (TG), and prisoners [3]. In 2020, key populations accounted for more than two-thirds (65%) of new HIV infections [2].

FSWs who offer sex in exchange for money, food, space, services, or drugs are among the high-risk groups. They are highly vulnerable to HIV infection because they engage in risky behaviors such as multiple sexual partners, high prevalence of other sexually transmitted infections (STIs), high use of injectable or non-injectable drug use, inconsistent condom use, or non-use during sexual contact, etc. [4, 5]. In a 2019 meta-analysis, 37 eligible original articles published between 2010 and 2017 reported HIV prevalence at 2.17% in 46,657 FSWs. The prevalence also varied widely from 0% in the Middle East and East Asia to 38% in East Africa [1].

In recent years, the prevalence of HIV/AIDS transmission in Iran has changed and sexual transmission has increased [6]. In a study by Mirzazadeh et al., HIV prevalence was 4% in 2010 and 2.1% in 2015 among FSWs in Iran [7]. It is estimated that there were 228,700 FSWs in Iran and HIV and sexually transmitted infection screening, treatment, and harm reduction measures should be strengthened [7, 8].

In Iran, the HIV/AIDS surveillance system conducted two integrated bio-behavioral surveillance (IBBS) surveys among FSWs in 2010 and 2015 [9], but neither of these surveys used the respondent-driven sampling (RDS) method. However, several studies that examined the prevalence of HIV infections and STIs among FSWs using the RDS method could not be generalized to other cities [10, 11]. Since the RDS method has been shown to be successful among hard-to-reach populations, including FSWs [12], and biological and behavioral surveillance of FSWs is an integral part of any surveillance system, furthermore, this study aimed to update previous findings and estimate the prevalence of HIV and syphilis infections and high risk behaviors among FSWs using the respondent-driven sampling method.

Methods

Study design, setting, and population

This study was a cross-sectional survey of FSWs conducted between December 2019 and August 2020 in eight geographically diverse cities in Iran, including Bandar-Abbas, Kermanshah, Khorramabad, Mashhad, Sari, Shiraz, Tehran, and Tabriz.

According to the following formula based on the 2015 study [7], a minimum of 150 and a maximum of 250 samples were selected for each city.

$$n = \frac{\text{DEFF} \times N \times P \times (1 - P)}{\frac{D^2}{(Z_{1-\alpha/2})^2} \times (N - 1) + P \times (1 - P)}$$

DEFF (design effect)=4; N=the population size predicted in the 2015 study; P=the prevalence of HIV among vulnerable women in each city was based on the 2015 study; D=0.05; Z (value for type I error)=1.96; n=the estimated sample size for each city.

The inclusion criteria were: (1) being born female; (2) being at least 16 years old; (3) having had sexual contact (vaginal/anal) with more than one male client for money in the past year; (4) living or working in the target city for at least 12 months before the interview; (5) having a valid RDS coupon (excluding seeds) and consent to participate in this study.

Seed selection

The respondent-driven sampling method requires a limited number of individuals to serve as seeds to start the process [3]. These individuals, who are the initiators of the reference chain, are not randomly selected from the target population [13, 14]. In this study, a formative assessment phase was first conducted based on in-depth interviews and focus group discussions with key members of the target population. Seeds were then selected from different networks and based on several criteria: Age, geographic region, and risk characteristics related to the subgroup. Finally, 45 seeds were selected, with a minimum of 4 and a maximum of 9 seeds for each city. One of the seeds was non-generative and did not recruit anyone to the study, so she was excluded from the study (44 seeds).

Recruitment and data collection

Recruitment began with 4–9 seeds representing different groups of FSWs in each city. After providing informed consent, participants completed a bio-behavioral questionnaire. Efforts were made to avoid sensitive questions at the beginning of the interview as much as possible. The questionnaire was based on previous IBBS surveys of FSWs in Iran and also on a World Health Organization studies (WHO) [9, 15, 16] to allow comparability of results from different surveys and included the following sections.

Demographic characteristics (nationality, marital status, family, and work); history of sexual relations; history of sexual relations with clients; condom use and access to condoms; sexually transmitted infections (STI); characteristics related to alcohol and drug abuse; social network size (the

number of women known by the initial participant to be at highest risk of HIV and to have lived in the target city in the past 12 months); and stigma, discrimination, and history of incarceration.

Data were collected face-to-face at RDS centers and the most important criteria for the study interviewers were: having strong public relations, having work experience with women in the target group, being interested in working with this group of women and not being judgmental. After completion of the interview on the behavioral questions, rapid diagnostic tests (RDT) and dried blood spots (DBS) were collected to determine HIV and syphilis status (lifetime contact) as per national guidelines, if the women consented. HIV and syphilis testing consisted of two steps: a rapid test (SD BIOLINE HIV/Syphilis Duo Rapid Test, Standard Diagnostics, Gyeonggi-do, South Korea) and, if the first rapid test was reactive, confirmation by a second test, i.e., enzyme-linked immunosorbent assay (ELISA). Moreover, in this study, the HIV test was performed in all women, but the syphilis test was performed only in 1275 women. The questionnaire was anonymously linked to the blood sample by a unique code.

Coupon and incentive management

After completing the questionnaire and a post-test counseling session, participants received three coupons to recruit peers. These coupons were valid for up to two months. The coupon number indicated the individuals enrolled in the study by a particular participant and mapped the chain of reference to the researchers. Recruitment waves were repeated until the desired sample size was achieved (13 waves). At the end of each interview and test, each individual received a primary incentive (Rls. 200,000 for participation in the study and Rls. 200,000 for completing the tests (~US\$1.5)) and a secondary incentive for each successful recruitment referral (Rls. 300,000 (~US\$1) for up to three peers).

Data entry and analysis

All data were continuously entered into Excel at each RDS center during the study. RDS-Analyst (RDS-A, version 0.10) and R (version 4.1.2) were used for analyzes. All analyzes were based on RDS adjustment, which requires adjustment for social network size and homophily within networks. To correct for outliers, network sizes were limited to the interval (3, 150), i.e., values smaller than three were replaced by three, and values larger than 150 were replaced by 150 [17]. Weighting was done according to Giles' SS estimator and the initial population estimate was considered

to be 90,000. The adjusted mean \pm standard deviation (SD) or number (adjusted percentage) for the target population was calculated based on the RDS-II method and Bootstraps 1000. The P-value for the qualitative and quantitative variables was calculated based on Pearson's chi-squared and t-test, respectively. To identify factors associated with HIV infection, all variables with a P-value less than 0.2 in the univariable model were included in the multivariable analysis. Based on Avery et al., (2019) study, univariable and multivariable logistic regression was performed using unweighted analysis [18]. Recruitment trees were used to visualize recruitment.

Ethical considerations

All procedures performed in the study conformed to the ethical standards of the Kurdistan University of Medical Sciences Committee (approval ID=IR.MUK.REC.1398.132). The study was anonymous and all women were informed about the study and asked for written informed consent to participate.

Results

One thousand five hundred and fifteen (1515) FSWs recruited by RDS in eight Iranian cities participated in the survey. Due to the COVID-19 pandemic, some cities collected less than the sample size. In the eight cities, the 44 seeds recruited 1471 women in 13 waves (Fig. 1).

The mean age of the participants was 35.8 ± 9.2 years. 13.6% of the women were under 30 years of age and only 1.7% of the study participants were not Iranian. Regarding education, 8.2% were illiterate, 24% had diploma and about 9.8% had academic education. Most of the respondents (46.4%) were divorced at the time of the study, followed by married women (25.1%) (Table 1).

The mean age at first sexual contact was 17.3 ± 4.2 years and the age at first prostitution was less than 18 years for 10.3% of the women. The main client-seeking pattern was through the pimp; about 18% find their clients through phone/internet and about 6% through hot spots. About 87% of participants reported having sex with more than one client in the past month. About 43% of the women had anal sex with their clients and 16 % of the participants had group sex. About 70.6% of the women used condoms during their last sexual contact. About 37% had an intentional abortion. 29.9% also reported having been raped at least once. 80.1% of the participants reported that their main source of income was sex. 21.4% had a history of arrest and incarceration, with the most common reason being drug use or

Table 1 Socio-demographic characteristics by HIV test result among female sex workers in Iran in 2019–2020

Variable	Total N = 1515	HIV Negative N = 1491	HIV Positive N = 24	Pearson's Chi-squared test*	P-value
	n (%) weighted)	n (%) weighted)	n (%) weighted)		
Age (yr) (Mean ± SD) (n = 1515)	35.8 (9.2)	35.7 (9.2)	39.2 (5.9)	-2.852 [†]	0.009
Age groups					
≤ 30 years	479 (31.6)	475 (99.5)	4 (0.5)	10.437	0.020
31–40 years	610 (40.1)	598 (98.3)	12 (1.7)		
41–50 years	350 (23.2)	342 (96.8)	8 (3.2)		
≥ 51 years	76 (5.2)	76 (100)	0 (0.0)		
Nationality (n = 1514)					
Iranian	1496 (93.3)	1472 (98.4)	24 (1.6)	2.4833e-29	1.00
Other	18 (1.7)	18 (100)	0 (0.0)		
Education level (n = 1514)					
Illiterate	110 (8.2)	106 (95.5)	4 (4.4)	14.956	0.011
Elementary	310 (22)	306 (98.9)	4 (1.1)		
Middle school	386 (25.3)	360 (97.3)	8 (2.7)		
High school	175 (10.6)	174 (99.5)	1 (0.5)		
Diploma	390 (24)	386 (99.6)	4 (0.4)		
Academic	161 (9.8)	158 (98.6)	3 (1.4)		
Marital status (n = 1506)					
Single	146 (10.2)	144 (99.2)	2 (0.8)	9.394	0.094
Married	324 (25.1)	320 (98.5)	4 (1.5)		
Divorced	700 (46.4)	692 (98.9)	8 (1.1)		
Concubine	174 (8.1)	169 (95.6)	5 (4.4)		
Widow	117 (8)	114 (97.8)	3 (2.2)		
Living with partner	45 (2.2)	43 (95.6)	2 (4.4)		
Age at first marriage (yr) (mean ± SD) (n = 1289)	17.7 (4.5)	17.8 (4.5)	17.5 (6.4)	0.226 [†]	0.840
Education level of the sexual partner (n = 1509)					
Illiterate	100 (5.8)	97 (96.6)	3 (3.4)	8.636	0.071
Less than a high school	283 (18)	276 (97)	7 (2.9)		
Diploma	423 (22.5)	420 (98.9)	3 (1.1)		
Academic	230 (13.8)	228 (99.9)	2 (0.1)		
Don't know	473 (39.9)	464 (98.5)	9 (1.5)		
The number of people under guardianship (n = 1324)					
Just myself	275 (23.7)	271 (98.5)	4 (1.5)	6.762	0.034
One	478 (34.4)	467 (97.2)	11 (2.8)		
≥ 2 people	571 (41.9)	566 (99.3)	5 (0.7)		

*: Pearson's Chi-squared test with Yates' continuity correction

†: from t-test

transportation. In addition, 52.6% of the participants had experienced alcohol consumption, 29.3% were using any drug use at the time of the study and only 2% had injected drugs (Table 2).

HIV-positive prevalence among FSWs

Among the 1515 and 1471 FSWs who provided a sample, the overall prevalence of HIV-positive and syphilis was 1.6% (95% CI: 0.8–2.3) and zero, respectively. The highest

HIV prevalence was observed in Shiraz (5.1%) and Khorramabad city (1.6%) (Table 3).

The mean age of HIV-positive FSWs was higher than that of HIV-negative FSWs (39.2 ± 5.9 vs. 35.7 ± 9.2 years) ($t = -2.852$; $P = 0.009$). The prevalence of HIV infection was higher in the age group 41–50 (3.2%) than the other age groups.

The highest prevalence of HIV infection was found among illiterate (4.4%) and then among those with intermediate education (2.7%). Regarding marital status, the prevalence was lower among single participants (0.8%). The prevalence was 2.8% among FSWs who had a person under guardianship (Table 1). In addition, HIV-positive

Table 2 Behavioral characteristics, history of sex working, condom use, abortion, violent sex, alcohol and drug use by HIV test result among female sex workers in Iran in 2019–2020

Variable	Total N = 1515 n (%) weighted	HIV Negative N = 1491 n (%) weighted	HIV Positive N = 24 n (%) weighted	Pearson's Chi- squared test*	P-value
Age at first sexual contact (yr) (mean ± SD) (n = 1430)	17.3 (4.2)	17.2 (4.2)	21.4 (5.6)	-4.807†	<0.001
Age of initiation into sex working < 18 years (n = 1430)					
Yes	155 (10.3)	155 (100)	0 (0.0)	1.104	0.293
No	1275 (89.6)	1254 (98.5)	21 (1.5)		
Ever worked in a hot spot (n = 1499)					
Yes	695 (32.5)	684 (98.2)	11 (1.8)	0.082	0.773
No	804 (67.4)	791 (98.5)	13 (1.5)		
Client-seeking pattern (n = 1502)					
Hot spot	144 (5.8)	143 (99.1)	1 (0.9)	3.141	0.370
Pimp	339 (21.5)	331 (98.7)	8 (1.3)		
Phone/Internet	266 (18.1)	265 (99.3)	1 (0.7)		
Others (party, shopping center, streets, friends, hotel, etc.)	753 (54.7)	739 (97.9)	14 (2.1)		
Number of clients (past month) (n = 1448)					
1	80 (7.1)	80 (100)	0 (0.0)	7.692	0.053
2–5	487 (38.2)	474 (97.8)	13 (2.2)		
≥ 6	771 (48.7)	768 (99.5)	3 (0.5)		
Don't know	110 (5.9)	107 (98.8)	3 (1.2)		
Ever had anal sex (n = 1475)					
Yes	796 (43.3)	786 (98.9)	10 (1.1)	1.524	0.217
No	679 (56.7)	665 (98)	14 (2)		
Ever had group sex (n = 1486)					
Yes	406 (16)	404 (99.4)	2 (0.6)	1.133	0.287
No	1080 (84)	1058 (98.2)	22 (1.8)		
Type of sexual contact (n = 1456)					
Vaginal	1391 (95.59)	1373 (98.8)	18 (1.2)	0.013	0.908
Anal/Oral	65 (4.41)	64 (99.8)	1 (0.2)		
Condom use at last sexual contact (n = 1507)					
Yes	1045 (70.6)	1027 (98.2)	18 (1.8)	0.609	0.435
No	462 (29.4)	456 (98.9)	6 (1.1)		
Ever had intentional abortion (n = 1390)					
Yes	598 (37.3)	592 (99.3)	6 (0.7)	2.855	0.091
No	792 (62.7)	777 (98)	15 (2)		
Ever had violent sex (n = 1508)					
Yes	600 (29.9)	587 (98.3)	13 (1.7)	7.085e-28	1.00
No	908 (70.1)	897 (98.4)	11 (1.6)		
Type of FSW (n = 1417)					
Direct sex worker	1181 (80.1)	1163 (98.2)	18 (1.8)	0.545	0.460
Indirect sex worker	236 (19.9)	232 (99.1)	4 (0.9)		
Ever had a history of arrest or incarceration (n = 1438)					
Yes	425 (21.4)	409 (94.7)	16 (5.3)	30.184	<0.001
No	1013 (78.6)	1006 (99.4)	7 (0.6)		
Ever used alcohol (n = 1464)					
Yes	900 (52.6)	889 (98.9)	11 (1.1)	1.784	0.182
No	564 (47.4)	553 (97.9)	11 (2.1)		
Ever used drug (n = 1480)					
Yes	509 (29.3)	493 (95.9)	16 (4.1)	20.54	<0.001
No	971 (70.7)	963 (99.4)	8 (0.6)		
Ever used injection drug (n = 1480)					
Yes	45 (2)	40 (85.1)	5 (14.9)	24.385	<0.001
No	1435 (98)	1416 (98.6)	19 (1.4)		

*: Pearson's Chi-squared test with Yates' continuity correction

†: from t-test

Table 3 Number of participants, seeds, and HIV prevalence among female sex workers in Iran in 2019–2020

City	Participants		Seeds		Prevalence n (% weighted)	95% CI
	n	%	n	%		
Bandar-Abbas	100	6.6	4	9.1	1 (0.7)	0-1.4
Kermanshah	200	13.2	4	9.1	2 (0.3)	0-0.9
Khorramabad	250	16.5	6	13.6	5 (1.6)	0.2-3
Mashhad	149	9.9	6	13.6	0	-
Sari	153	10.1	5	11.4	0	-
Shiraz	227	15	6	13.6	12 (5.1)	2.1–8.2
Tehran	156	10.3	9	20.4	2 (0.1)	0-0.3
Tabriz	280	18.5	4	9.1	2 (0.7)	0-1.5
Total	1515	100	44	100	24 (1.6)	0.8–2.3

FSWs had a higher mean age at first sexual contact than HIV-negative FSWs (21.4 ± 5.6 vs. 17.2 ± 4.2 years) ($t=4.807$; $P < 0.001$). HIV prevalence among women with experience working in hot spots (1.8%), client-seeking pattern through pimps (1.3%), women with 2–5 clients in the last month (2.2%), those who had no anal (2%) and group sex (1.8%), women with experience of violent sex (1.7%), arrest or incarceration (5.3%) ($\chi^2=30.184$; $P < 0.001$), drug use (4.1%) ($\chi^2=20.54$; $P < 0.001$), injection drug use (14.9%) ($\chi^2=24.385$; $P < 0.001$), and direct sex workers (1.8%) were more common. The prevalence of HIV infection among women who had an intentional abortion and used alcohol was 0.7% and 1.1%, respectively (Table 2).

In a univariable model, a significant association was found between HIV infection and drug use, injection drug use, and arrest or incarceration ($P < 0.05$). In the multivariable model, injection drug use and a history of arrest or incarceration were associated with an increased odds of HIV infection (OR=6.26; 95% CI: 1.90–20.55 and OR=4.57; 95% CI: 1.64–12.72, respectively) and intentional abortion was also associated with a decreased odds of HIV infection (OR=0.31; 95% CI: 0.10–0.91) (Table 4).

Red circles represent women with negative HIV test, blue circles represent women with positive HIV test.

Discussion

The results of two nationwide IBBS surveys conducted in 2010 and 2015 showed an overall HIV prevalence of 4% and 2.1%, respectively, among Iranian FSWs [19]. The declining trend in HIV prevalence is promising, possibly due to the existence of more than 60 centers for vulnerable women across the country that provide a range of harm reduction services, including HIV testing and counseling, sexual health education, free condom and needle distribution, and community empowerment activities to prevent HIV [20]. This decline may also be due to the fact that FSWs now have different risk behaviors and know more than those who sold sex at the last IBBS. Another reason

for the decline in HIV prevalence could be the nature of the sampling method. The earlier studies were conducted in facilities (facility-based sampling). That is, individuals who received services at women's centers were studied, and this group of women tends to have higher-risk sexual behaviors, so the prevalence of STI and HIV is likely to be higher among these individuals. However, this study used the RDS sampling method, and indeed we found access to individuals who did not attend women's centers and were likely to be at lower risk for HIV.

A systematic review and meta-analysis from 2010 to 2017 found that the global prevalence of HIV/AIDS among FSWs was 2.2% (95% CI: 1.4–3.1) [21]. In addition, a recent systematic review and meta-analysis in Iran estimated the pooled prevalence of HIV among FSWs to be 2.2% (95% CI: 0.8–3.6), which is almost consistent with our findings [20]. Baral et al. [4] examined the incidence of HIV/AIDS among FSWs in low-income countries using a meta-analysis. Their results showed that the prevalence of HIV-positive among FSWs in 50 low-income countries was 11.8%, which was higher than the prevalence found in the present study. In the study by Ahmadi et al., 57.8% (95% CI: 20–88) of participants reported being tested for HIV, and HIV prevalence among FSWs who were tested for HIV was 10.3% (95% CI: 7.5–13) [22]. In the Netherlands, an overall HIV prevalence of 3.8% was reported, but this was significantly higher among women with a history of injecting drug use (13.6%) than among women without drug use (1.5%) [23]. In a study by Hensen et al. among 1637 FSWs recruited in Zimbabwe in 2017 using RDS, HIV prevalence among FSWs was 28.1% [24]. In addition, a 2011 global study estimated that 15% (95% CI: 11.5–18.6) of HIV infections among women were due to female sex work as an occupational risk factor [25].

The mean age of participants in this study was 35.8 ± 9.2 years and most HIV-positive individuals were in the age group of 31–40 years. The mean age at first sexual contact was 17.3 ± 4.2 years. FSWs who had started sex work at age 18 or later had significantly higher HIV prevalence than those who had started at a younger age. The average age

Table 4 Factors associated with HIV infection among female sex workers in Iran using logistic regression (n = 1328)

Variables	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age (yr) (mean ± SD)	1.02 (0.98, 1.07)	0.306	-	
Education level *	1.17 (0.89, 1.54)	0.251	-	
The number of people under guardianship				
One and Just myself respectively	1.34 (0.76, 2.34)	0.311	-	
≥2 people	Ref.		-	
Age at first sexual contact (yr)	0.99 (0.94, 1.05)	0.839	-	
Ever used the drug†				
No	Ref.	0.002	-	
Yes	3.91 (1.66, 9.19)		-	
Ever used an injection drug†				
No	Ref.	<0.001	Ref.	0.002
Yes	9.32 (3.31, 26.20)		6.26 (1.90, 20.55)	
Ever had a history of arrest or incarceration				
No	Ref.	<0.001	Ref.	0.004
Yes	5.62 (2.30, 13.77)		4.57 (1.64, 12.72)	
Marital status				
Widow	Ref.		-	
Single	0.53 (0.09, 3.21)	0.488	-	
Married	0.47 (0.10, 2.15)	0.335	-	
Divorced	0.44 (0.11, 1.68)	0.229	-	
Concubine	1.12 (0.26, 4.80)	0.874	-	
Living with partner	1.77 (0.29, 10.94)	0.540	-	
Education level of the sexual partner				
Academic	Ref.		Ref.	
Diploma	0.81 (0.14, 4.91)	0.823	1.38 (0.08, 23.41)	0.821
Less than a high school	2.89 (0.59, 14.05)	0.188	2.86 (0.33, 24.89)	0.339
Illiterate	3.53 (0.58, 21.43)	0.171	1.26 (0.12, 12.54)	0.839
Don't know	2.21 (0.47, 10.32)	0.198	3.24 (0.39, 26.56)	0.273
Number of clients (past month)				
1	Ref.		-	
2–5	0.99 (0.27, 3.49)	0.973	-	
≥6	0.14 (0.028, 0.70)	0.017	-	
Don't know	1 (Omitted)	-	-	
Ever had intentional abortion				
No	Ref.	0.185	Ref.	0.033
Yes	0.52 (0.20, 1.36)		0.31 (0.10, 0.91)	
Ever used alcohol				
No	Ref.	0.269	-	
Yes	0.62 (0.27, 1.44)		-	

OR = Odds Ratio; CI = Confidence Interval

*Education level was coded from highest level (basic) to lowest level

†Because there is collinearity between drugs used and injection drugs, only one variable was selected for the adjusted model based on the maximum of crud OR.

of participants in most studies was 30 to 35 years and these results were consistent with the other studies [26, 27]. Possible reasons for the higher HIV prevalence among women whose first sexual contact occurred at an older age are that

age increases the likelihood of changes in relationship status (such as divorce, separation, or death of a partner). For this reason, FSWs are more likely to gain new partners [28]. As FSWs age, the prevalence of alcohol use, drug use, and



Fig. 1 Recruitment trees (female sex workers network and HIV test)

injection drug use is also likely to increase, increasing the likelihood of risky sexual behavior [29]. HIV infections were significantly more common among older FSWs than younger ones. Similar findings were observed in several other studies [30, 31].

About 87% of participants reported having sex with more than one client in the past month, and all HIV-positive women had sex with more than one client. In a 2010 and 2015 survey in Iran, 46.6% and 63.4%, respectively, had sex with more than one client in the past month [7]. A study in Afghanistan found that about 60% of FSWs had more than 12 clients in a month [27]. In another study, 56% of women reported selling sex to more than four men (clients) in the past month [24].

About 70.6% of women used condoms during their last sexual contact, and HIV prevalence was significantly higher among those who used condoms. It is possible that HIV-positive FSWs who were aware of their HIV status had better access to condom programs, more counseling, and training on condom use to prevent HIV transmission to their sexual partner. In a more recent 2010 study using RDS to recruit 177 FSWs in Kerman, condom use at last sexual contact with a client was reported to be 83.1% [32]. A meta-analysis in low- and middle-income countries, 44 of 87 countries with available data, found that over 80% of sex workers used condoms with their last client [4].

In our study, 80.1% of the participants reported that their main source of income was sex. In the study of Hensen et al. the majority of FSWs (88.1%) reported that selling sex was the main way to support themselves [24]. Study in northern Sudan showed, only 28.5% of FSWs had jobs other than sex work and the majority (86.2%) reported financial need as the reason for entering sex work [33].

In the present study, 21.4% of FSWs had a history of arrest and incarceration and HIV prevalence was higher

among women with a history of arrest or incarceration, and furthermore, a history of arrest or incarceration was associated with an increased odds of HIV infection (OR=4.57; 95% CI: 1.64–12.72). Beattie et al. found that FSWs arrested in the past year were strongly associated with HIV infection (OR = 1.9; 95% CI: 1.2–3.1) [34].

Multivariable analysis showed that HIV infection was associated with injection drug use and incarceration among FSWs. In the 2010 survey, high HIV prevalence was found among FSWs with a history of injection drug use (11.2%) [35]. In the 2015 survey, participants were less likely to report lifetime non-injecting drug use (27% decrease) and more likely to report injection drug use (i.e., 58% decrease) [7]. In our study, 29.3% of FSWs had ever used drugs and only 2% had injected drugs. Part of the decrease in HIV prevalence among FSWs may be attributed to a lower proportion of FSWs who inject (and use) drugs. Injecting drug use was associated with increased odds of HIV infection (OR = 6.25; 95% CI: 1.90–20.55).

In a nationwide study of FSWs in Iran, more than 70% of FSWs had ever used drugs and about 15% had ever injected drugs [29]. A recent systematic review estimated the pooled prevalence of recent non-injecting and injecting drug use at 56.9% and 5.6%, respectively [36]. In studies of drug use by FSWs in Iran, estimates of drug use range from over 60% [37] to 70% [10], whereas estimates of injecting drug use range from 1.1% [38] to 18% [32]. The results are consistent with those of other studies. For example, the prevalence of drug use among FSWs in China ranged from 2.6 to 7.4%, whereas lifetime use was 25% in India and 34% in Myanmar [39].

The limitation of our study is that it is a cross-sectional study; therefore, it is difficult to establish a temporal relationship between HIV positivity and its correlates. The behavioral data in this study were self-reported; therefore, there is a possibility of underreporting or over reporting. Also, in this study, written informed consent was used, which may cause information bias. The strength of our study is that we used RDS to recruit FSWs, which allowed us to successfully build a broad network and reach FSWs. Network-based application programs and referral coupons were used as incentives to reach all FSWs.

Conclusion

Our results show that HIV prevalence is more common among FSWs with 2–5 clients in the past month and among women who have experienced violent sex, arrest or incarceration, drug use, and injection drug use. The most important factors associated with increased odds of HIV infection in multivariable analysis included injection drug

use and a history of arrest or incarceration. Thus, it is particularly important to monitor prevalence and risk among FSWs who use injecting drugs and have a history of arrest or incarceration.

In addition, HIV prevalence among FSWs in Iran has declined compared to previous years. This decline is due to the nationwide expansion of opioid substitution (OST) and harm reduction services. Strategies to improve early HIV diagnosis, timely detection of HIV transmission clusters, and use of testing and treatment strategies are needed to reduce HIV transmission in the most at risk and general populations.

Acknowledgements We would like to thank all the managers, experts, and staff of the selected Universities of Medical Sciences and AIDS Office of Centre for Communicable Disease Control (CCDC), Iranian Ministry of Health, as well as to all the individuals who helped us in carrying out this research project.

Authors' contributions **N. I:** Contribution to study concept and design, acquisition, analysis and interpretation of data, drafting of manuscript. **M-M. G:** Contribution to study concept and design, acquisition. **S. A:** Contribution to study concept and design, acquisition, analysis and interpretation of data. **B. Z:** Contribution analysis and interpretation of data. **Y. M:** Contribution to study concept and design, acquisition. **P. A-K:** Contribution to study concept and design, acquisition. **M. M:** Contribution to study design, acquisition. **P. M:** Contribution to drafting of manuscript. **Gh. M:** Contribution to study concept and design, acquisition, analysis and interpretation of data, drafting of manuscript.

Funding This study was supported by WHO grant number IR.MUK.REC.1398.132. The funding agency played no role in the planning, conduct, reporting, or decision to submit the paper for publication.

Data Availability The datasets used and/or analysed during the current study are available from the corresponding author and Ministry of Health and Medical Education on reasonable request.

Code Availability Not applicable.

Declarations

Conflict of interest The authors declare that they have no competing interests.

Ethical approval All procedures performed in the study conformed to the ethical standards of the Kurdistan University of Medical Sciences Committee (approval ID=IR.MUK.REC.1398.132). The study was anonymous and all women were informed about the study and asked for written informed consent to participate.

Consent to participate All study participants provided written informed consent.

Consent for publication Not applicable.

References

- Eilami O, Nazari A, Dousti M, Sayehmiri F, Ghasemi M. Investigation of HIV/AIDS prevalence and associated risk factors among female sex workers from 2010 to 2017: a meta-analysis study. *HIV AIDS (Auckl)*. 2019;11:105–17.
- UNAIDS. Global. HIV & AIDS statistics — Fact sheet. Available online: <https://www.unaids.org/en/resources/fact-sheet> (accessed on 20 April 2021).
- Mizinduko MM, Moen K, Likindikoki S, Mwijage A, Leyna GH, Makyao N, et al. HIV prevalence and associated risk factors among female sex workers in Dar es Salaam, Tanzania: tracking the epidemic. *Int J STD AIDS*. 2020;31(10):950–7.
- Baral S, Beyrer C, Muessig K, Poteat T, Wirtz AL, Decker MR, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet Infect Dis*. 2012;12(7):538–49.
- Ahmadi S, Khezri M, Roshanfekar P, Karimi SE, Vameghi M, Ali D, et al. HIV testing and its associated factors among street-based female sex workers in Iran: results of a national rapid assessment and response survey. *Subst Abuse Treat Prev Policy*. 2021;16(1):43.
- Lotfi R, Tehrani FR, Yaghmaei F, Hajizadeh E. Barriers to condom use among women at risk of HIV/AIDS: a qualitative study from Iran. *BMC Womens Health*. 2012;12(1):13.
- Mirzazadeh A, Shokoohi M, Karamouzian M, Ashki H, Khajehkazemi R, Salari A, et al. 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. *Sex Transm Infect*. 2020;96(1):68–75.
- Sharifi H, Karamouzian M, Baneshi MR, Shokoohi M, Haghdoost A, McFarland W, et al. Population size estimation of female sex workers in Iran: Synthesis of methods and results. *PLoS ONE*. 2017;12(8):e0182755.
- Sajadi L, Mirzazadeh A, Navadeh S, Osooli M, Khajehkazemi R, Gouya MM, et al. HIV prevalence and related risk behaviours among female sex workers in Iran: results of the national biobehavioural survey, 2010. *Sex Transm Infect*. 2013;89(Suppl 3):iii37–40. Suppl 3(.
- Kazerooni PA, Motazedian N, Motamedifar M, Sayadi M, Sabet M, Lari MA, et al. The prevalence of human immunodeficiency virus and sexually transmitted infections among female sex workers in Shiraz, South of Iran: by respondent-driven sampling. *Int J STD AIDS*. 2014;25(2):155–61.
- Moayedi-Nia S, Bayat Jozani Z, Esmaeeli D, Javid G, Entekhabi F, Bayanolhagh S, Saatian M, et al. HIV, HCV, HBV, HSV, and syphilis prevalence among female sex workers in Tehran, Iran, by using respondent-driven sampling. *AIDS Care*. 2016;28(4):487–90.
- Malekinejad M, Johnston LG, Kendall C, Kerr LR, Rifkin MR, Rutherford GW. Using respondent-driven sampling methodology for HIV biological and behavioral surveillance in international settings: a systematic review. *AIDS Behav*. 2008;12(4 Suppl):105–30.
- Heckathorn DD. Respondent-Driven Sampling II. Deriving Valid Population Estimates from Chain-Referral Samples of Hidden Populations. *Soc Probl*. 2002;49(1):11–34.
- Wirtz AL, Mehta SH, Latkin C, Zelaya CE, Galai N, Peryshkina A, et al. Comparison of Respondent Driven Sampling Estimators to Determine HIV Prevalence and Population Characteristics among Men Who Have Sex with Men in Moscow, Russia. *PLoS ONE*. 2016;11(6):e0155519.
- Integrated HIV. Bio-behavioral Surveillance Toolbox. Available online: <https://globalhealthsciences.ucsf.edu/resources/>

- [integrated-hiv-bio-behavioral-surveillance-toolbox](#) (accessed on 20 Mar 2018).
16. Shokoohi M, Noori A, Karamouzian M, Sharifi H, Khajehkazemi R, Fahimfar N, et al. Remaining Gap in HIV Testing Uptake Among Female Sex Workers in Iran. *AIDS Behav.* 2017;21(8):2401–11.
 17. Damacena GN, Szwarcwald CL, Souza Júnior PRB, Ferreira Júnior ODC, Almeida WDS, Pascom ARP, et al. Application of the Respondent-Driven Sampling methodology in a biological and behavioral surveillance survey among female sex workers, Brazil, 2016. *Rev Bras Epidemiol.* 2019;22(Suppl 1(Suppl 1):e190002.
 18. Avery L, Rotondi N, McKnight C, Firestone M, Smylie J, Rotondi M. Unweighted regression models perform better than weighted regression techniques for respondent-driven sampling data: results from a simulation study. *BMC Med Res Methodol.* 2019;19(1):202.
 19. Mirzazadeh A, Shokoohi M, Khajehkazemi R, Hosseini Hooshyar S, Karamouzian M, Nadji S et al, editors. HIV and sexually transmitted infections among female sex workers in Iran: findings from the 2010 and 2015 national surveillance surveys. AIDS Conference; 2016.
 20. Karamouzian M, Nasirian M, Hoseini SG, Mirzazadeh A. HIV and other sexually transmitted infections among female sex workers in Iran: a systematic review and meta-analysis. *Arch Sex Behav.* 2020;49(6):1923–37.
 21. Eilami O, Nazari A, Dousti M, Sayehmiri F, Ghasemi M. Investigation of HIV/AIDS prevalence and associated risk factors among female sex workers from 2010 to 2017: a meta-analysis study. *Hiv/aids (Auckland, NZ)* 2019;11:105.
 22. Ahmadi S, Khezri M, Roshanfekar P, Karimi SE, Vameghi M, Ali D, et al. HIV testing and its associated factors among street-based female sex workers in Iran: results of a national rapid assessment and response survey. *Subst Abuse Treat Prev Policy.* 2021;16(1):1–7.
 23. Platt L, Jolley E, Rhodes T, Hope V, Latypov A, Reynolds L, et al. Factors mediating HIV risk among female sex workers in Europe: a systematic review and ecological analysis. *BMJ open.* 2013;3(7):e002836.
 24. Hensen B, Chabata ST, Floyd S, Chiyaka T, Mushati P, Busza J, et al. HIV risk among young women who sell sex by whether they identify as sex workers: analysis of respondent-driven sampling surveys, Zimbabwe, 2017. *J Int AIDS Soc.* 2019;22(12):e25410.
 25. Prüss-Ustün A, Wolf J, Driscoll T, Degenhardt L, Neira M, Calleja JMG. HIV due to female sex work: regional and global estimates. *PLoS ONE.* 2013;8(5):e63476.
 26. Mirzazadeh A, Nedjat S, Navadeh S, Haghdoost A, Mansournia M-A, McFarland W, et al. HIV and related risk behaviors among female sex workers in Iran: bias-adjusted estimates from the 2010 National Bio-Behavioral Survey. *AIDS Behav.* 2014;18(1):19–24.
 27. Todd CS, Nasir A, Stanekzai MR, Bautista CT, Botros BA, Scott PT, et al. HIV, hepatitis B, and hepatitis C prevalence and associated risk behaviors among female sex workers in three Afghan cities. *AIDS.* 2010;24(0 2):69.
 28. Sherman CA, Harvey SM, Noell J. “Are they still having sex?” STI’s and unintended pregnancy among mid-life women. *J Women Aging.* 2005;17(3):41–55.
 29. Karamouzian M, Mirzazadeh A, Rawat A, Shokoohi M, Haghdoost AA, Sedaghat A, et al. Injection drug use among female sex workers in Iran: Findings from a nationwide bio-behavioural survey. *Int J Drug Policy.* 2017;44:86–91.
 30. Mizinduko M, Moen K, Likindikoki S, Mwijage A, Leyna GH, Makyao N, et al. HIV prevalence and associated risk factors among female sex workers in Dar es Salaam, Tanzania: tracking the epidemic. *Int J STD AIDS.* 2020;31(10):950–7.
 31. Szwarcwald CL, Damacena GN, de Souza-Júnior PRB, Guimarães MDC, de Almeida WdS, de Souza Ferreira AP, et al. Factors associated with HIV infection among female sex workers in Brazil. *Medicine* 2018;97(1 Suppl).
 32. Navadeh S, Mirzazadeh A, Mousavi L, Haghdoost A, Fahimfar N, Sedaghat A. HIV, HSV2 and Syphilis Prevalence in Female Sex Workers in Kerman, South-East Iran; Using Respondent-Driven Sampling. *Iran J public health.* 2012;41(12):60–5.
 33. Abdelrahim MS. HIV prevalence and risk behaviors of female sex workers in Khartoum, north Sudan. *Aids.* 2010;24:55–60.
 34. Beattie TS, Bhattacharjee P, Isac S, Mohan H, Simic-Lawson M, Ramesh B, et al. Declines in violence and police arrest among female sex workers in Karnataka state, south India, following a comprehensive HIV prevention programme. *J Int AIDS Soc.* 2015;18(1):20079.
 35. Sajadi L, Mirzazadeh A, Navadeh S, Osooli M, Khajehkazemi R, Gouya MM, et al. HIV prevalence and related risk behaviours among female sex workers in Iran: results of the national biobehavioural survey, 2010. *Sex Transm Infect.* 2013;89(Suppl 3):iii37–40.
 36. Tavakoli F, Khezri M, Tam M, Bazrafshan A, Sharifi H, Shokoohi M. Injection and non-injection drug use among female sex workers in Iran: a systematic review and meta-analysis. *Drug and Alcohol Dependence* 2021:108655.
 37. Kassaian N, Ataei B, Yaran M, Babak A, Shoaee P. Hepatitis B and C among women with illegal social behavior in Isfahan, Iran: Seroprevalence and associated factors. *Hepat monthly.* 2011;11(5):368–71.
 38. Taghizadeh H, Taghizadeh F, Fathi M, Reihani P, Shirdel N, Rezaee SM. Drug Use and High-Risk Sexual Behaviors of Women at a Drop-In Center in Mazandaran Province, Iran, 2014. *Iran J psychiatry Behav Sci.* 2015;9(2):e1047-e.
 39. Shokoohi M, Karamouzian M, Bauer GR, Sharifi H, Hooshyar SH, Mirzazadeh A. Drug use patterns and associated factors among female sex workers in Iran. *Addict Behav.* 2019;90:40–7.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10461-022-03827-x>.