Prevalence of HIV infection among female sex workers in the Eastern Mediterranean Region countries: a systematic review

Leili Abedi¹, Narges Khanjani², Hamid Sharifi³

¹Department of Statistics and Epidemiology, Faculty of Health, Kerman University of Medical Sciences, Kerman, Iran
²Neurology Research Center, Kerman University of Medical Sciences, Kerman, Iran
³HIV/STI Surveillance Research Center, and WHO Collaborating Center for HIV, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

Abstract

Introduction: Female sex workers (FSWs) are one of the groups most affected by human immunodeficiency virus (HIV) infection. In Eastern Mediterranean (EM) countries, HIV prevalence among FSWs is often extremely high. However, no review has been conducted on FSWs in EM countries. The purpose of this systematic review was to estimate the prevalence of HIV infection among FSWs in EM countries.

Material and methods: Articles published on the prevalence of HIV infection among FSWs in EM countries were searched until September 10, 2020. Appropriate keywords were used in Web of Science, Scopus, PubMed, EMBASE, Ovid, and IMEMER databases. References of each paper and conference abstracts were additionally searched. Papers were selected according to inclusion and exclusion criteria.

Results: In total, 21 studies were selected, which were performed in 8 EM countries. The reported prevalence of HIV infection ranged from 0 to 16% among FSWs. The average time women worked as FSWs ranged from 2 to 6 years, and in some papers, FSWs never or rarely used condoms during sexual contact. However, the consistency of using condoms among FSWs was reported as high as 65% in Pakistan, 64% in Lebanon, and 62% in Iran. The prevalence of drug use was high among FSWs, and it ranged from 5% in Pakistan and Sudan, to 91% in Iran and 96.2% in Egypt. Heterogeneity among the studies and sub-groups was very high, and meta-analysis was not done due to high heterogeneity.

Conclusions: The reported prevalence of HIV infection varied differently among female sex workers’ populations in the Eastern Mediterranean Region. More studies are needed from different EM countries.

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Key words: Eastern Mediterranean Region, FSWs (female sex workers), HIV infection, prevalence, review.

Introduction

Human immunodeficiency virus (HIV) is still an important public health issue, even though three decades has passed since its emergence. Currently, nearly 36.7 million people live with HIV infection around the world. In 2016, approximately 2.1 million new cases of HIV infections were identified [1]. According to the World Health Organization (WHO), only 19.5 million patients (52%) out of 36.7 million HIV-infected individuals are treated with antiretroviral drugs [2]. One way of HIV infection transmission is sexual contact, and female sex workers (FSWs) are among the at-risk groups [3].
FSWs are usually marginalized and deprived of many things in their living environments, and are perceived as criminals. Therefore, they are more vulnerable to HIV infection [3]. According to the WHO, FSWs are 13.5% more likely to be infected with HIV than other women in the age of fertility. In Asia, this probability reaches nearly 30% [4].

In low- to medium-income countries, the prevalence of HIV infection is estimated to be 12% among FSWs [5]. In the Eastern Mediterranean (EM) countries in 2016, approximately 230,000 people lived with HIV infection, with 21,000 new cases of HIV infection identified, and the prevalence rate was 0.1% among adults [2]. A study indicated that the probable world prevalence of HIV infection ranged from 0.3% in the Middle East and North Africa to 29.3% in sub-Saharan Africa [6]. In 2012, the prevalence of HIV infection was reported 5% in the Middle East and North Africa, in which the infection was mainly transmitted by FSWs [7, 8]. In Morocco, a review study showed that the prevalence of infection was 2% among FSWs, and FSWs played a major role in the transmission of HIV infection in comparison with intravenous drug addicts and homosexual men [9]. According to previous studies, FSWs are exposed to many risk factors, such as having various sex partners, and not using or rarely using condoms [10]. In Libya, the prevalence of HIV infection among FSWs was 15.7%, and it was mainly due to their high number of sex partners and not using condoms [11].

Studies have reported that the frequency of using condoms is higher among customers who pay for sex than those who do not pay for it. Moreover, the prevalence of HIV infection is higher among FSWs who were intravenous drug addicts compared with those FSWs who used non-intravenous drug [12, 13]. Such individuals are usually infected by a common syringe or unprotected sex [14].

Many review studies have been conducted on the prevalence of AIDS in different parts of the world [15-17]. However, no review has been performed on FSWs in the EM countries. The aim of this systematic review was to investigate the prevalence of HIV infection among female sex workers in the EM countries.

**Material and methods**

**Search strategy**

In this review, articles published on the prevalence of HIV infection among FSWs in the Eastern Mediterranean (EM) countries until September 10, 2020, were searched. The information was retrieved from both electronic databases and WHO reports [8]. Appropriate keywords were searched in the Web of Science, Scopus, PubMed, EMBASE, Ovid, Google Scholar, and IMEMER (Index Medicos for Eastern Mediterranean Region) databases.

First, the words "Prevalence", "Incidence", and "Frequency" were searched by using an 'OR' operator. In the second step, "Human Immunodeficiency Virus", "Immunodeficiency", "Virus", "Human", "Human Immunodeficiency Viruses", "AIDS Virus", "AIDS Viruses", "Acquired Immune Deficien-

**Eligibility criteria**

The retrieved papers were evaluated, and duplicate papers were deleted by checking the names of authors, publication year, place of study, and sample size. Then, the titles and abstracts of papers were screened according to the inclusion and exclusion criteria to remove irrelevant papers. Later, the entire texts of remaining papers were evaluated. Table 1 demonstrates the flowchart of papers’ selection.

The inclusion criteria for the papers included in this review were studies conducted in EM countries, which reported the prevalence of HIV infection among the population, including FSWs who had sex in return for money, drugs, or goods, and their HIV infection had been diagnosed by laboratory tests. Papers that had reported HIV infections based on self-reports, and review papers were deleted. The texts of the papers were evaluated according to STROBE checklist [18]. The items of STROBE checklist were ranked zero (poor), one (medium), or two (good). The poor-quality papers included articles with a total score of 30 or lower. The medium-quality group consisted of the papers with a score between 31 and 35, and the good-quality group included the papers with a score of 36 or higher.

**Classification and analysis of published articles**

Key information was extracted from the included papers. A test of heterogeneity was performed before meta-analysis. In order to test heterogeneity, \( \chi^2 \) test and \( F \) test were used along with Galbraith chart. In the \( \chi^2 \) test, a small \( p \)-value indicated a significant difference in the results of included studies. The \( F \) test was introduced by Higgins, and it shows what percentage of differences in study results are due to heterogeneity among the results rather than sampling. Generally, values higher than 50% showed significant heterogeneity among the studies. We assessed the potential for publication bias by using Egger’s bias test for regression asymmetry [19]. The Galbraith chart graphically indicates if the results are homogenous by plotting each study’s log transferred effect size divided by its SE (Z score) on y-axis and the inverse of SE on x-axis [20]. After observing substantial heterogeneity across the studies, meta-regression was performed to identify potential sources of heterogeneity for years of data collection, and sample size. Sub-group analysis was performed according to years of data collection categories (2010 and before, after 2010), laboratory methods (DBS [dried...
### Table 1. Key characteristics of female sex workers (FSWs) in the Eastern Mediterranean Region by 2020

| Location, author/s, year | Years of data collection | HIV testing method | Demographics | Setting and characteristics of sex workers | Proportion with any drug use | Setting and characteristics of HIV and AIDS | Research quality (score) |
|--------------------------|--------------------------|--------------------|--------------|--------------------------------------------|-----------------------------|-------------------------------------------|-------------------------|
| Iran | Mirzazadeh et al., 2014 [14] | 2010 | Dried blood spot (DBS) specimen | Mean age: 31.6 years | • Using illicit drugs (66.6%) and injecting drugs (37.6%) | • Mean number of sexual contacts with both commercial and non-commercial partners in the last 7 days was 3.8. | Average 32 |
| Iran, Kerman | Navadeh et al., 2012 [24] | 2010 | Serum specimens | Age group: < 20 years – 4.5%, 20-29 years – 60.2%, ≥ 30 years – 35.3% | • Having more than 18 years of working as FSW | • Mean age at first sex: 24.9 years | Average 34 |

**Note:** The table provides a summary of key characteristics of female sex workers (FSWs) in the Eastern Mediterranean Region countries. The data includes years of data collection, HIV testing methods, demographics, setting and characteristics of sex workers, proportion with any drug use, and research quality scores. The table is a systematic review of HIV infection among female sex workers in the Eastern Mediterranean Region countries.
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|----------------------------------|--------------------------|----------------------------------|----------------------------------|----------------|---------------------|-------------------|--------------|-----------------------------|---------------------------------------------|------------------------|
| Iran, Sajadi et al., 2013 [13]   | 2010                     | 3.7% (30/817); 95% CI: 2.3-4.9    | Study design: national survey    | Selected FSWs were selling sex for money, drugs, or goods in the last 12 months; a history of doing sex work for at least 6 months | • Age ≥ 18 years  
  • Selling sex for money, drugs, or goods in the last 12 months  
  • A history of practicing sex work for at least 6 months | Dried blood spot (DBS) specimen | Mean age (SD): 31.8 (9.1) years | • Almost 20.5% of FSWs had intravenous drug injection  
  • Almost 26.6% of participants were active injecting drug users  
  • The percentage of FSWs who reported high-risk injection (i.e., shared syringes or equipment) at their last injection was 11.6% | • Almost 22.1% of FSWs had never used condoms  
  • Nearly 37.6% of FSWs had more than 26 years at first commercial sex | Good 37 |
| Iran, Shiraz, Kazerooni et al., 2013 [23] | 2010-2011                | 4.7% (13/278); 95% CI: 2.2-7.2 | Study design: national survey    | FSWs were selected through 14 seeds with maximum eight waves | FSWs who were 17 years or older performed sexual intercourse for money, drugs or other goods for at least six months during their life-time or at least once within the last 12 months | Serum specimens | Age group: < 20 years – 7.3%, 20-29 years – 30.8%, ≥ 30 years – 61.9%  
  Age at first intercourse: ≤ 15 years – 40.7%, > 15 years – 59.3%  
  Age at first commercial sex: ≤ 15 years – 5.7%, > 15 years – 94.3% | • Drug abuse and injecting drugs was 69.6% and 16.4%, respectively  
  • Almost 4.3% of IV drug users, used unsterile needles  
  • 44% of FSWs used drug and alcohol together; 13.7% of them only used alcohol  
  • More than half of FSWs used condom with clients during last sex  
  • Condoms were used occasionally by 30.1% of FSWs  
  • FSWs reported having vaginal sex (91%), anal sex (7%), and oral sex (16.2%) in previous month  
  • FSWs reported abnormal genital discharge (72.2%) and genital ulcers (18.5%) during the previous year | Good 36 |
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|--------------------------------|--------------------------|------------------------------------|----------------------------------|----------------|---------------------|-------------------|--------------|-----------------------------|-------------------------------------------|---------------------|
| Iran, Tehran Moayedi-Nia et al., 2016 [34] | 2012-2013 | 5% (8/161) 95% CI not mentioned | Study design: cross-sectional Sampling strategy: respondent-driven sampling (RDS) | Not reported | Sex trading during the 12 months prior to this study, and selling sex for at least 6 months in participants’ life-time | Dried blood spot (DBS) specimen | Mean age (SD): 37.43 (8.9) years Mean age (SD) of first sex: 16.3 (3.6) years Mean age (SD) of first commercial sex: 27.5 (9.5) years | • About 90.7% of FSWs used drugs at least once in their life-time • Of these, 55.9% were active drug users at the time of participation • Methamphetamine was the most prevalent drug used • Among active drug users, 25.5% reported injecting drugs intravenously at least once in their life-time | • Among FSWs who traded sex within seven days prior to the interview, the average number of clients was 4.9 (SD ± 7.7); • 65.2% of FSWs reported using a condom with their prior client, while only 49% reported using condoms with their significant other clients, respectively; • Approximately three-fifth of FSWs had contracted at least one sexually transmitted infections (STIs) symptom over the one year prior to the study; • 32.9% of FSWs reported being tested for HIV in 12 months prior to this study and knew the results of the test; • HIV-infected FSWs were significantly more likely to test positive for HS type 1/ type 2 (75% vs. 35.9%) than HIV-negative FSWs; HIV-positive participants were significantly younger than HIV-negative participants (31.25 ± 8.2 vs. 37.75 ± 8.8); • History of having at least one of STIs symptoms in 12 months prior to the study has been found significantly more frequent among HIV-positive participants (100% vs. 59.6%) | Bad 22 |
### Table 1. Cont.

| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|---------------------------------|--------------------------|-----------------------------------|----------------------------------|----------------|---------------------|-------------------|--------------|-------------------------------|---------------------------------------------|------------------------|
| Iran, Sari Taghizadeh et al., 2015 [27] | 2014 | 4% (6/154) 95% CI: 0.84-6.95 | Study design: cross-sectional Sampling strategy: census | Female SWs participated in the DIC | Eligibility criteria: not reported | Serum specimens tested with rapid test | Median age: 33 years (range, 19-54) | Almost 59% of participants were drug users The percent addicted to Iranian crack or heroin, opium and methamphetamine, only methamphetamine, and methamphetamine with alcohol among FSWs were 16%, 16%, 25%, and 13%, respectively 1.1% of FSWs were intravenous drug users | Almost 61%, 44% of FSWs had candidiasis, cervicitis, respectively 62% of them regularly used condoms Number of sexual acts per day was from 1 to 3 Forty eight percent of FSWs consumed psychiatric drugs | Average 32 |
Table 1. Cont.

| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|--------------------------------|--------------------------|-------------------------------------|--------------------------------------|----------------|---------------------|------------------|--------------|---------------------------|-----------------------------------------------|----------------------|
| Iran [35]                      | 2015                     | 2.1% 95% CI: 0.9-4.6                 | Study design: cross-sectional        | Sampling strategy: not reported     | Women who came to the non-governmental organizations and sexually transmitted disease clinic | Iranian women aged ≥ 18 years who resided or worked in the city Women who self-reported having vaginal, anal, or oral sex with more than 1 male client in exchange for money, goods, drugs, or a favor during the previous year | Serum specimens tested with rapid test | Mean age (SD): 35.6 (9.3) years Education: illiterate – 10.1%, university degree – 6.3% Median age at first sex: 17 years Median age at first commercial sex: 25 years | Not reported Only 32.9% of women reported consistent condom use. Nearly 49% of FSWs had at least 1 STI. The prevalence of laboratory-based STI: syphilis – 0.4%, gonorrhea – 1.3%, Chlamydia – 6%, trichomoniasis – 11.9%, HPV – 41.9% | Bad | 30 |
### Table 1. Cont.

| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|----------------------------------|--------------------------|-----------------------------------|-----------------------------------|----------------|---------------------|-------------------|--------------|-----------------------------|----------------------------------------|------------------------|
| **Iran**                         |                          |                                   |                                   |                |                     |                   |              |                             |                                        | Average 31               |
| Iran, Tehran Karami et al., 2017 [28] | 2016                     | 4.6% (17/214) 95% CI: not reported | Study design: cross-sectional Sampling strategy: convenient sampling | All FSWs registered through trained researchers and peer health educators | Eligibility criteria: not reported | HIV testing method: Not reported | Demographics: Age group: < 15 years – 0.8%, 15-24 years – 22.5%, 25-39 years – 45.5%, ≥ 40 years – 31.1% | Setting and characteristics of sex workers: More than 89% of participants engaged in sex prior to age 20 About 43.9% of participants did not use condom in the last sexual contact 8.67% of them never used condom during sexual intercourse About 23.58% of them had sex with IDUs |                                        |
| **Pakistan**                     |                          |                                   |                                   |                |                     |                   |              |                             |                                        | Average 27               |
| Pakistan, Karachi Baqi et al., no date [36] | 1993-1994               | 1.23% (1/81) 95% CI: 1.17 to 3.63 | Medical clinic in Karachi was established All FSWs registered in this clinic were enrolled | Females who worked as CSWs any time within the past 10 years and were registered at a medical clinic established from 1993-1994 | Females who worked as a CSW (commercial sex worker) any time within the past 10 years who were registered at a medical clinic from 1993-1994 | Serum specimens: Mean age: 30 years (range, 10-50) Illiteracy rate: 78% Mean age at first sex: 14 years | Not reported | Proportion with any drug use: 9% of FSWs rarely used condoms 27% of them had a medical history of STI 30% of FSWs had pelvic inflammatory disease | Setting and characteristics of sex workers: |                                        |
| Location, author/s, year [Ref.]          | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|----------------------------------------|--------------------------|------------------------------------|-----------------------------------|---------------|---------------------|-------------------|--------------|-----------------------------|---------------------------------------------|------------------------|
| Pakistan, Karachi and Lahore Bokhar et al., 2007 [37] | 2004                     | 0.24% (2/827) 95% CI: –0.09 to 0.57 | Study design: cross-sectional Sampling strategy: cluster sampling | Women who were engaged in selling sex at least once in the past three months | Serum specimens | Mean age, median (range): Karachi: 35 (15-66), Lahore: 35 (15-70) | Almost 1.4% of FSWs had injected drugs during the last 12 months | More than half of FSWs had had a one-time client during the last week | Almost 81.7% of FSWs had regular clients during the last week Nearly more than a quarter of FSWs used condom during vaginal sex with the last one-time client Condom use among FSWs with last regular client during vaginal sex was 37% | Bad 28 |
| Pakistan, Karachi, Hyderabad, and Sukkur Altaf et al., 2012 [39] | 2005-2006                | 0.26% (3/1,158) 95% CI: –0.03 to 0.55 | Study design: cross-sectional Sampling strategy: snowball sampling | Females that were between 15-45 years old and were willing to participate | Dried blood spot (DBS) specimen | Mean (SD) age: 27.3 (6.7) years | In the past six months, 15% of FSWs, used injection for taking illicit drugs | Almost 27.9% of FSWs used condoms at last sexual act | Average 35 |
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pakistan, Lahore \*Khan et al., 2011 [22] | 2007 | 0.7% (5/730) | Study design: cross-sectional Sampling strategy: respondent-driven sampling (RDS) | FSWs in three areas (referred to as “A”, “B”, and “C”) of Lahore. In “Area A”, FSWs were “home-based”. In areas “B” and “C”, FSWs were “kothi-khana”-based | Not reported | Serum specimens | Median age: 30 years (range, 13-50) | Three participants (0.4%) reported injecting drugs, and one among these reported sharing needles or syringes in a group | The prevalence of T. pallidum, N. gonorrhoeae, C. trachomatis, and T. vaginalis were 4.5%, 7.5%, 7.7%, and 5.1%, respectively. FSWs had been selling sex for a median period of seven years, and had a median of three clients per day. Sixty-five percent of the participants reported that they “Always use condom.” Ninety-one percent of the participants cited poverty and financial reasons for reason to start selling sex. Almost all participants (99%) said that they continued to sell sex for economic survival | Good 38 |
| Pakistan, Punjab, Sind, Khyber, Pakhtunkhwa, Baluchi- stan \*Emmanuel et al., 2013 [41] | 2011-2012 | 0.8 (35/4,298) 95% CI: 0.5-1 | Study design: 4 rounds of SGS conducted in 20 cities Sampling strategy: systematic random sampling | Brothel-based FSWs, street-based FSWs, kothi-khana FSWs, and home-based FSWs | Eligibility criteria: not reported | Dried blood spot (DBS) specimens | Mean age (SD): 26.9 (6.4) Duration of sex work (SD) (years): 5.3 (6.6) years Mean age (SD) at first sex: 21.9 (5.6) years | In the past 6 months, 4.9% of FSWs used injecting drugs | Condom use was lower when the sexual partner was a non-paying regular partner | Average 34 |
## Table 1. Cont.

| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|---------------------------------|--------------------------|-----------------------------------|-----------------------------------|---------------|----------------------|--------------------|--------------|-----------------------------|---------------------------------------------|--------------------------|
| **Pakistan**                    |                          |                                   |                                   |               |                      |                    |              |                             |                              |                          |
| Pakistan, Faisalabad            | 2015-2016                | 9.6% (37/387) 95% CI: 6-12        | Study design: cross-sectional Sampling strategy: respondent-driven sampling (RDS) | FSWs of brothels, hair/beauty salons, hotels, and private homes were enrolled | FSWs involved in commercial sex for money or goods during the past 2 months FSWs were ≥16 years old | Serum specimens | Median (range): 22.5 (17-35) years | Not reported | About 32.7% of FSWs had syphilis infection HIV as co-infection was in 20% of FSWs | Bad 30 |
| [Waheed et al., 2017 [38] | | | | | | |
| **Sudan**                       |                          |                                   |                                   |               |                      |                    |              |                             |                              |                          |
| Sudan, Khartoum Abdelrahim, 2010 | 2008                     | 0.9% (3/321) 95% CI: 0.12 to 1.98 | Study design: cross-sectional Sampling strategy: respondent-driven sampling (RDS) | FSWs were recruited through seeds | Paid for sex during the last 3 months Age: 18-49 years Living in Khartoum State at least for 1 year | Dried blood spot (DBS) specimen | Mean age, SD: 18-22 years = 32.2, 23-27 years = 35.7, 28-32 years = 15.1, 33-37 years = 8.7, ≥38 years = 8.3 years Age at first sex: ≤14 – 21.6%, 15-18 years – 45%, ≥19 years – 33.4% | Not reported | More than half of FSWs had their first selling sex in 19-25 years; Forty-four percent of FSWs were in sex work for 2-4 years; In the last 30 days, 36% of participants always used condoms with clients; The three most common reasons for not using a condom at last commercial sex were: Did not think of it (34.3%); Partner refused (21.8%); Using of other contraceptive methods (18.8%) | Average |
| [34] | | | | | | |
| Sudan, 14 states, (names of states not reported) | 2011-2012 | 1.53% (63/4,049) 95% CI: 1.1-1.9 | Study design: national survey Sampling strategy: respondent-driven sampling (RDS) | FSWs were selected through 8 to 14 seeds in RDS sites | 15-49 years old, lived or worked in the area, sold sex or exchanged sex for goods in the last 3 months | Serum specimens | Median age per site: 21-28 years Started selling sex at less than 18 years of age (range): 3.3-50.1% | Almost 5% of FSWs had injected drugs | Condom used at last sex with a client varied from 4.7% to 55.1% | Good |
| [Elhadi et al., 2013 [38] | | | | | | | | | | |
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Libya, Tripoli, Valadez et al., 2013 [11] | 2010 | 15.7% (11/ 69) 95% CI: (0.73-25%) | Study design: Cross-sectional Sampling: Peer-driven chain-referral method of RDS | Females were over 15 years and earned all or part of their income through the exchange of money for vaginal or anal sex Participants had to be born females; They had earned all or part of their income through the exchange of money for vaginal or anal sex with more than one client in the last six months Participants had to be ≥ 15 years old; They had to have a valid referral coupon; | Serum specimens | Age group: 15-29 years, 53.6% 30-50 years, 42.03% > 50 years, 0.04% Country of origin: Libya (12.4%); Abroad (87.6%) | None of the FSWs had ever injected drugs or consumed alcohol | Almost 8.2% of FSWs had sex during the past year; 42.8% of FSWs had 10–50 sex partners during the past six months and 30.5% of them had 50 or more; 63.4% of FSWs reported consistent condom use during sex with one-time clients, and 56.8% during sex with regular clients; 27.8% of FSWs experienced STI symptoms in the past year; | Good 37 |
| Lebanon, Beirut, Mahfoud et al., 2010 [32] | 2007-2008 | 0% (0/ 135) | Study design: Cross-sectional Sampling: Respondent-driven sampling (RDS) | Women who had sold sex, within the past 12 months Residents of Lebanon, ≥ 16 years old; Engaged in an HIV risk behavior within the past 12 months | Serum specimens tested with rapid test | Age group: 16–24: 42%; ≥ 25 years: 58% Age at first sexual intercourse (years): 11–15 years, 36% (45/ 134); 16–17 years, 27% (35/134); ≥ 18 years, 37% (54/ 134) | None of FSWs had ever injected drugs | In the last month, 97% of FSWs had sold sex; Majority (96%) of them had five or more clients in the last month; 48% of FSWs had used condoms with their non-commercial partner; Almost 92% and 98% of FSWs stated that they used a condom in the last time for regular male clients and no regular male client, respectively; Sixty-four percent of the respondents stated they always use condoms with their non-commercial partner | Average 34 |
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|---------------------------------|--------------------------|-----------------------------------|-----------------------------------|----------------|--------------------|-------------------|--------------|--------------------------|-----------------------------------------------|----------------------|
| Egypt                           | 2009-2010                | 0% (0/ 431)                       | Study design: Cross-sectional     | FSWs at bars and night clubs; FSWs at brothels; FSWs at coffee houses; FSWs at hotels | Participants needed to be residents of Lebanon; At least 16 years old, women who had sold sex, within the past 12 months; | Serum specimens | Mean age: 29.38 years (median, 27 years) Mean age (SD) at first sex: 22.28 years (median, 6.66) years Duration of sex work (years): Range, 1–35; Mean (SD), 6.32 (6.42); Median, 4.0 | Abuse of hashish was (96.2%) by FSWs; Injecting drug abuse was 5.6% among FSWs in the last year | 15.5% of FSWs had genital ulcers; 22.4% of FSWs had used condoms with the last client; In the past month, 32.8% of participants had used condoms; The main reasons for not using male condom were: Not thinking about it (40.6%) Client refused (20.5%) Do not like it (19.3%) Using another contraceptive method (13.5%) | Average 33 |
| Afghanistan                     | 2006-2008                | 0.19% (1/ 520) 95%CI: (-0.18-0.56%) | Study design: Cross-sectional     | Only individuals previously identified as SWs through outreach or other prior programs were considered for participation | Reporting sex work within the past six months; Able to provide informed consent; Aged 18 years or greater | Serum specimens | Median age: 29 years Mean age (SD) at first sex: 23.3 years (5.1) | Using illicit drugs, alcohol, and injected drugs among FSWs was 6.9%, 4.7% and 0.4%, respectively More than half of FSWs had ever used a condom; In the last 6 months, 38.2% of participants used condoms with clients; 29.8% of FSWs reported genital sores, warts, or itching; 75% of them worked as a sex worker at least for 5 years | Average 33 |
| Location, author/s, year [Ref.] | Years of data collection | HIV prevalence, n/N tested, 95% CI | Study design and sampling strategy | Sampling frame | Eligibility criteria | HIV testing method | Demographics | Proportion with any drug use | Setting and characteristics of sex workers | Research quality (score) |
|--------------------------------|--------------------------|-----------------------------------|-----------------------------------|----------------|---------------------|-------------------|--------------|-----------------------------|-----------------------------------------------|------------------------|
| Somalia, Hargeisa, Somaliland, Kritimaa et al., 2010 [25] | 2008 | 5.2% (13/237) 95% CI: (2.5-8.5%) | Study design: Cross-sectional Sampling: Respondent-driven sampling (RDS) | Women who had sold sex, within the past 3 months | Respondents had to be 14 years or older; Having exchanged sexual intercourse (vaginal and/or anal) for money, a gift, or a favor in the past 3 months; FSWs were currently living and trading sex in Hargeisa, and were able to give informed consent | Serum specimens | Age group: 15-19 years, 6.9%; 20-24 years, 18%; 25-29 years, 33.5%; 30-34 years, 7.7%; 35-39 years, 23.7%; > 40 years, 8.9% Education: Never attended school, 86.6%; Attended some primary, 0.7%; Completed primary, 12.7% | No injecting drug use was reported | The prevalence of syphilis was 3.1%; Co-infection with HIV and syphilis occurred in one woman (0.4%); Over two-thirds (67.4%) of FSWs reported 2–4 transactional sex clients in the past 7 days; Less than one-quarter (24.0%) of FSWs reported using a condom at last transactional sex; Only 4.3% of them reported consistent condom use with clients over the past 1 month; 24% did use a condom at last sexual intercourse with a client; Self-report STI symptoms (genital discharge, genital ulcer, or sore) in the past 12 months among FSWs was 7.8%; Almost one-third (29.5%) of FSWs reported the reason for not using a condom with a client was due to not knowing where to obtain condoms; At last sex with a non-transactional partner, 1.8% of FSWs reported using a condom, a considerably lower proportion than with clients | 31 |

* - second-generation surveillance; ** - those who solicit clients in public places through cruising sites or pick-up points; *** - those who live in small premises/houses rented by a network operator and entertain clients; **** - sex workers who live at home with their families and are involved in covert sexual activities through contacts with network operators; ** - seeds had strong social networks with the population of FSWs in the city, and had good collaboration with the interview site staff.
blood samples] and serum groups), and sample size categories (387 and lower, over 387). Stata version 11 (Stata Corp., College Station, TX, USA) was used to analyze the data.

Results

In this study, 156 papers were retrieved by searching the databases, conference abstracts, reference lists, and reports published by the WHO. Eventually, 21 papers were selected for the review (Figure 1). Table 1 shows the information extracted from these 21 papers, in which 17,205 FSWs were investigated.

The results of quality assessment revealed that 5 (23.8%) studies were of good-quality [11, 13, 21-23], 11 (52.4%) were of medium-quality [5, 24-33], and 5 (23.8%) were of poor-quality [34-38].

The study designs of 16 papers were cross-sectional [11, 22, 24, 25, 27, 28, 31-40], and the rest of them were national surveys for AIDS [13, 21, 23, 26, 41]. Out of 21 Eastern Mediterranean countries, only 8 countries had conducted studies on the prevalence of HIV infection among FSWs. The majority of these studies were conducted in Iran [13, 23, 24, 26-28, 34, 35] and Pakistan [22, 29, 30, 36-38].

Moreover, 13 papers were exclusively about FSWs [13, 21, 23-25, 27-29, 31, 33-35, 40], and the rest of them classified FSWs as a sub-group of the population under study [11, 32, 36-38, 41]. Nearly 16 papers had been published in the last 10 years [11, 13, 21-24, 26-28, 30, 33-35, 38-40].

In 11 studies included in this systematic review, the average age of FSWs was 30 and lower [11, 21, 22, 24, 25, 31, 33, 38-41]. FSWs had different education levels, and more than a quarter of FSWs had elementary or junior high school education in 11 papers [11, 13, 21, 23, 24, 26, 27, 31, 33, 35, 37]. Moreover, in other studies, more than half of FSWs were illiterate [22, 25, 30]. The rest of the papers had not reported education levels [28, 34, 36, 38, 39].

The onset age of sexual contact had not been reported in 12 studies [5, 13, 21, 23, 24, 26, 30-36]. Studies reported that the mean age of FSWs at first sex was after 15 years [13, 23, 31, 36], before 18 years [21, 34, 35], at 18 years [24], 22 ± 5.6 years [30], 23 ± 5.1 years [33, 40], or 25 years [26]. The average time, in which women worked as FSWs ranged from 2 to 6 years in five studies [21, 26, 27, 32, 36, 40]. Some other papers reported the frequency of genital infectious diseases [11, 22, 24, 25, 34-36, 38], candidiasis and cervicitis [27], genital ulcers [23, 33, 40], and pelvic inflammation [36] among FSWs. In several papers, FSWs never or rarely used condoms during sexual contact [24, 28, 36]. However, the consistency of using condoms among FSWs were as high as 65% in Pakistan, 64% in Lebanon, and 62% In Iran [22, 27, 32]. Condom use among regular and non-regular clients was reported to be respectively, 92% and 98% in Lebanon [32], and 63.4% among non-regular clients in Libya [11] and 57.1% in Iran [13]. A study from Sudan reported that 36% of FSWs used condoms for all clients [31], and in one study from Kerman, Iran, not using condoms was reported to be 17% and 22% with paying and non-paying partners, respectively [24]. Studies in Egypt and Sudan have mentioned that the main reasons for not using male condoms were not knowing where to obtain condoms [25], client refusal, not liking it, using another contraceptive method, not

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**Figure 1.** Flow diagram of the search strategy for systematic review on the prevalence of HIV among female sex workers (FSWs) in the Eastern Mediterranean Region by 2020
Table 2. Egger’s test for detection of publication bias for studies included in HIV infection among FSWs in the Eastern Mediterranean Region by 2020

| Model       | Coefficient (95% CI) | Std. error | t    | P > | P-value |
|-------------|----------------------|------------|------|-----|---------|
| Slope       | –0.00015             | 0.002      | –0.07| 0.945| (–0.00472, 0.004) |
| Bias        | 3.38                 | 0.73       | 4.61 | < 0.001 | (1.84, 4.92) |

Table 3. Meta-regression of some covariates on the prevalence of HIV infection among FSWs in the Eastern Mediterranean Region by 2020

| Model       | Coefficient (95% CI) | τ²     | Adj. R² | P     | p-value |
|-------------|----------------------|--------|---------|-------|---------|
| No covariates | 0.025 (0.0043–0.038) | 0.00059 | –       | 89.99% | 0.001 |
| Univariate   |                      |        |        |       |         |
| Sample size  | –5.89e-06 (~0.0000173, 5.49e-06) | 0.0006 | –2.66% | 89.97% | 0.292 |
| Years of data collection | 0.0028 (~0.00015, 0.0055) | 0.0004 | 27.06% | 87.43% | 0.04 |
| All covariates |                    | 0.000389 | 35.01% | 87.75% |         |
| Sample size  | –7.65e-06 (~0.0000172, 1.86e-06) | 0.0239032 | (~0.0033577, –0.051164) | 0.11 |
| Years of data collection | 0.0239032 | (~0.0033577, –0.051164) | | | |

Table 4. Characteristics of sub-group analysis of the included studies on HIV infection among FSWs in the Eastern Mediterranean Region by 2020

| Sub-group | Number of studies | P     | p-value |
|-----------|-------------------|-------|---------|
| Years of data collection | | | |
| ≤ 2010    | 13                | 86.24% | < 0.001 |
| > 2010    | 8                 | 90.70% | < 0.001 |
| Laboratory method | | | |
| DBS       | 6                 | 92.17% | < 0.001 |
| Serum     | 14                | 89.23% | < 0.001 |
| Sample size | | | |
| ≤ 387     | 11                | 85.82% | < 0.001 |
| > 387     | 10                | 91.54% | < 0.001 |

thinking about it, and partner’s refusal [31, 33]. The most common reported reason for starting to work as FSWs was poverty and financial problems [22].

The prevalence of drug use was high in the included papers and it ranged from 5% in Pakistan [30] and Sudan [21], to 91% in Iran [34] and 96.2% in Egypt [33]. The drugs abused included Iranian crack or heroin (in 16%), opium with methamphetamine (in 16%), methamphetamine (in 25%), methamphetamine with alcohol (in 13%) in Iran [27], and only alcohol in 4.7% [40], to 14% in Afghanistan and Iran, respectively [23]. In these studies, intravenous drug abuse ranged from 0.4% in Pakistan [22] and Afghanistan [40], to 38% in Iran [26]. One study in Iran reported that 11.6% of intravenous drug-addicted FSWs used non-sterilized syringes [13]. However, no statistics were reported on the use of drugs and alcohol in three other studies [11, 25, 32].

In all the studies, laboratory methods were used to identify HIV infections, and six studies used DBS [13, 26, 29, 31, 34, 41]. The rest of the papers used direct blood sampling methods to diagnose HIV infection.

The prevalence of HIV infection ranged from 0% to 16% in the 21 papers reviewed. The prevalence of HIV infection was zero in three papers published from Iran [24], Lebanon [32], and Egypt [33]. The results of Egger’s test for the funnel plot were statistically significant (p < 0.001), which means that publication bias was likely to occur (Table 2).

Heterogeneity of the reported prevalence was very high among the studies (I² = 89.9%, Q = 199.77, df = 11, p < 0.001), and therefore a meta-analysis was not applicable to perform [42]. Moreover, the studies were plotted on Galbraith chart (Figure 2). Some study results were out of the 95% CI, and this showed high heterogeneity. It was neither reasonable nor logical to remove specific studies to make the remaining results homogeneous for a meta-analysis.

The result of meta-regression demonstrated that no significant relation was observed between the sample size and the prevalence of HIV, but there was a significant relation between the year of research and the prevalence of HIV (Table 3). Authors used “visual binning” in SPSS v. 22, and divided the studies into sub-groups according to the years of data collection. The studies were divided into two groups (2010 and before, and after 2010), and in each category, heterogeneity was assessed. Heterogeneity in the 2010 and before group was I² = 86.2%, Q = 87.23, df = 12, p < 0.001, and in the after 2010 group, it was I² = 90.7%, Q = 75.30, df = 7,
Findings of our study showed that the prevalence rate of HIV infection among FSWs in the EM countries is different. Review studies in Europe (from 2005-2011) showed that there was a wide variation in HIV infection among FSWs at city level, and HIV infection prevalence among FSWs was highest in Eastern Europe in 2006, 2007, and 2009, with high HIV infection prevalence countries, such as Russia and Ukraine [12]. Also in the US (during 1984-2007), the prevalence of HIV infection among FSWs ranged from a minimum of 0.3% (1996-1998) to as high as 32.1% (1992-1994), and the pooled prevalence was 17.3% [42]. A review from Latin America and the Caribbean (from 1986 to 2010) showed that the median of HIV infection prevalence was 2.6% (IQR: 0.6-4.2) among FSWs [15].

HIV infection surveys among FSWs in the eleven Eastern Mediterranean (EM) countries demonstrated that the prevalence rate was below 4% in all countries, with the exception of Somalia (5.2%, 2007), Iran, and Djibouti [43]. The HIV infection prevalence among FSWs in Iran revealed an HIV infection prevalence of 4.5% in 2011 [13], whereas it was 2.6% in 2007; in Morocco, it was 2.7% in 2010, and 19.7% in 2007 and 15.4% in 2009 in Djibouti [44]. However, data on HIV infection prevalence among FSWs is unavailable from several low- or high-income countries, including Bahrain, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, South Sudan, Syria, and United Arab Emirates (UAE), and the existing evidence do not portray the real picture of HIV infection in this region [43, 44]. On the other hand, HIV infection surveillance for evaluating HIV infection trends were performed in only four countries, included Djibouti, Iran, Morocco, and Pakistan. These countries have developed functioning HIV infection surveillance programs with national-level coverage. However, in the other 10 countries, HIV infection surveillance has been insufficient [43]. A review from the Middle East and North Africa showed a very low prevalence of HIV infection among FSWs in Afghanistan, Egypt, Jordan, Lebanon, Pakistan, Tunisia, and Yemen [45]. Despite the overall relatively low prevalence of HIV infection among FSWs, commercial heterosexual sex networks appear to be a cause of HIV infections in some countries, probably because of the larger size of these networks compared with other high-risk groups, such as homosexual men [45]. For example, in Morocco, commercial heterosexual sex networks contributed to about half of the HIV infection incidences, despite a rather low prevalence (2%) of HIV infection among FSWs [21].

Studies have demonstrated the significance of sex work in the ongoing transmission of HIV infection and other sexually transmitted infections (STIs). In the EM countries, genital infectious diseases, candidiasis, cervicitis, genital ulcers, warts, or itching and pelvic inflammation were reported among FSWs. The prevalence of drug use was high, and heroin, opium, methamphetamine, and alcohol were the drugs with the highest use among FSWs.

In the Eastern Mediterranean (EM) countries, only three countries, including South Sudan, Djibouti, and Somalia, have generalized epidemics; the remaining countries have an estimated HIV infection prevalence of below 1% in the general population, with either low-level epidemics or HIV infection epidemics concentrated in at-risk of HIV infection populations, and with limited spread to the general population [43].

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Our review showed that the usage of condoms during sexual contact among FSWs was rare, and condom use among regular and non-regular clients was different. Several studies in African countries [47–49], China [50,51], various Asian countries [52,53], Latin America [54,55], and Europe [56] have shown that FSWs use condoms less frequently with their steady sex partners than with other clients [57].

The studies included in this review demonstrated that the prevalence of drug use among FSWs was high. A review showed that in Iran, over 70% of FSWs had ever used drugs, and around 15% had ever injected drugs. Moreover, older age, longer duration (> 5 years) of involvement in sex work, and a history of alcohol drinking were associated with a lifetime history of drug injection among FSWs [58]. In Iran, about 15% of FSWs reported injecting drugs, and these were over three times more likely to be infected with HIV compared with FSWs who never injected drugs [13].

It is possible that most HIV infections among FSWs in Iran are due to drug injection rather than sexual transmission [45]. Drug injection was the main cause of HIV infection among female sex workers in Europe, and the prevalence of HIV infection was higher among FSWs intravenous drug abusers. The prevalence of syphilis was highest among samples taken from FSWs in Eastern Europe [42].

Putting FSWs under surveillance is critical because their behaviors are usually considered illicit, and they are frequently stigmatized, deprived from health services, and exposed to sexual diseases and violence [12]. Between 1989 and 2007, less than 1 percent of HIV infection tests performed in the region were for these key populations [59]. In the EM countries, condoms are unpopular and rarely used. Reasons for such low use are the fact that some men do not believe they are at risk of STIs or HIV infection, they do not like the feeling of condoms, and FSWs are worried about their clients reactions to their suggestion of using a condom. Some believe condoms may be hazardous to use, some are embarrassed about buying and using condoms, or lacking the skills to use them [60].

Some of the essential ways of controlling HIV infection and AIDS include raising awareness in the society through training, consulting, and changing behaviors [61]. According to the WHO, the only effective way for controlling AIDS is training, especially among vulnerable groups [62]. Therefore, comprehensive knowledge about HIV infection and AIDS as well as using condoms should be seriously and actively provided to FSWs [63]. Studies have also shown that health training plans designed according to health belief models, can be effective in preventing AIDS [62, 64]. One of the other educational methods for behavior change is theory of planned behavior (TPB), which considers intention as the main determinant of behavior. Studies have suggested that TPB can be used in education programs for HIV prevention [65], and it is necessary to provide free education and condoms to FSWs [62, 64].

In Tunisia, some forms of commercial sex are legal, and condoms are made available within regulated establishments. Around half of female sex workers in Morocco and Tunisia reported using a condom with their most recent client. However, in general, condom use is still largely tabooed in the region [59]. Four countries, including Pakistan, Egypt, Lebanon, and Tunisia, have provided HIV infection prevalence estimates for FSWs [66]. Different harm reduction programs, such as consistent condom use during high-risk sex and providing clean syringes, have been implemented in many EM countries, such as Egypt, Morocco, Tunisia, Bahrain, Iran, Lebanon, and Oman [66]. In Egypt, harm reduction interventions targeting PWID (people who inject drugs) and FSWs were established in 2008, and included education about safe sex and safe injection, HIV infection counseling, testing using rapid test kits, medical services for the management of sexually transmitted infections, and distribution of behavior-change booklets and brochures, needles, and condoms free of charge [67].

MENA region has had the lowest rate of antiretroviral treatment (ART) globally (11%) [68]. In the UNAIDS 2017 and global AIDS update reports in 2019 [69], none of these countries reported using ART for FSWs. Although some countries, such as Bahrain, Djibouti, Iran, Egypt, and Tunisia, have used ART for patients based on the latest WHO guidelines, which are CD4+ counts under 500 cells/mm³, but Iraq, Qatar, and Yemen did not report ART use [70].

There was a high-rate of heterogeneity among the papers included in this study. The difference in studies might be due to the difference in sampling, demographic characteristics of the participants, place of study, type of risky behaviors, and application of different laboratory kits for HIV diagnosis. Previous reviews have also reported high heterogeneity [6, 42]. In this review, the included papers, except for one paper from Pakistan [36], were conducted between 2004 to 2016. During this time period, different methods might have been used to investigate the prevalence. However, meta-regression showed no relation between the prevalence and the year of research.

Most of the studies included in this review were conducted in Iran (8 papers) [13, 23, 24, 26-28, 34, 35], Pakistan (6 papers) [22, 29, 36-38, 41], and Sudan (2 papers) [21, 31]. There was only one study conducted on the prevalence of HIV infection among FSWs in Afghanistan, Egypt, Lebanon, Libya, and Somalia. In the other 13 countries of the EM, such as Bahrain, Djibouti, Iraq, Jordan, Kuwait, Morocco, Palestine, Oman, Saudi Arabia, Syria, Tunisia, UAE, and Qatar, no studies were conducted. However, it is necessary to survey female sex workers in these countries in regard to HIV infection, risky behaviors, problems in performing diagnostic tests, antiretroviral therapy coverage, and HIV prevention programs.

The present review had several limitations. First, the included studies were different in regard to sample size, study implementation dates, and sampling strategies. The prevalence rates reported from Pakistan, Afghanistan, and Lebanon were from before 2008, but the prevalence rates reported for Iran and Libya were after 2010. Moreover, the high heterogeneity of these studies excluded undertaking a pooled analysis. Also, it was not possible to evaluate geographical diversity due to small number of studies and lack of information from countries, such as Bahrain, Iraq, Jordan, Kuwait, Qatar, Saudi Arabia, Oman, Syria, Tunisia, UAE, Yemen, Morocco, and Djibouti. National studies were only conducted in a few coun-
tries of that region [13, 21, 26, 30, 35, 38], and other studies were limited to only some cities [11, 22-25, 27-29, 31-34, 36-38, 40]. Another limitation was that different HIV infection diagnosing tests had been used in the included studies, which makes the results even more incomparable. The specimens collected in the studies were different (plasma, serum, whole blood, DBS, and oral fluid), and this depended on the logistics, populations, sites, HIV infection testing strategies, and algorithms. In this review, the majority of tests were performed based on serum and DBS samples.

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Conflict of interest

The authors declare no conflict of interest with respect to the research, authorship, and/or publication of this article.

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### Appendix A. Search strategy details in each database by 2020

| Name of database | Search strategy                                                                                                                                                                                                 | Yielded number of articles | Number of duplicate articles | Number of screened articles | Number of articles assessed for eligibility criteria |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|-----------------------------|----------------------------------------------------|
| PubMed           | (((Prevalence [Title/Abstract] OR frequency [Title/Abstract] OR Incidence [Title/Abstract]) AND (“Human Immunodeficiency Virus” [Title/Abstract] OR “Immunodeficiency Virus Human” [Title/Abstract] OR “Human Immunodeficiency Viruses” [Title/Abstract] OR “AIDS Virus” [Title/Abstract] OR “AIDS Viruses” [Title/Abstract] OR “Acquired Immune Deficiency Syndrome Virus” [Title/Abstract] OR “Acquired Immunodeficiency Syndrome Virus” [Title/Abstract])) AND (“female sex worker” [Title/Abstract]) AND (EMRO [Title/Abstract] OR “Eastern Mediterranean Regional” [Title/Abstract] OR Afghanistan [Title/Abstract] OR Bahrain [Title/Abstract] OR Djibouti [Title/Abstract] OR Egypt [Title/Abstract] OR Iran [Title/Abstract] OR Iraq OR Jordan [Title/Abstract] OR Kuwait [Title/Abstract] OR Lebanon [Title/Abstract] OR Libya [Title/Abstract] OR Morocco [Title/Abstract] OR “occupied Palestinian territory” [Title/Abstract] OR Oman [Title/Abstract] OR Pakistan [Title/Abstract] OR Qatar [Title/Abstract] OR “Saudi Arabia” [Title/Abstract] OR Somalia [Title/Abstract] OR Sudan [Title/Abstract] OR “ Syrian Arab Republic” [Title/Abstract] OR Tunisia [Title/Abstract] OR “United Arab Emirates” [Title/Abstract] OR Yemen [Title/Abstract]) | 9                                           | 1                                           | 0                                           | 0                                                   |
| Web of Science   | TITLE: (prevalence OR frequency OR incidence) AND TITLE: (“Human Immunodeficiency Virus” OR “Immunodeficiency Virus Human” OR “Human Immunodeficiency Viruses” OR “AIDS Virus” OR “AIDS Viruses” OR “Acquired Immune Deficiency Syndrome Virus” OR “Acquired Immunodeficiency Syndrome Virus”) AND TITLE: (female sex worker) AND TITLE: (EMRO or “Eastern Mediterranean Region” or Afghanistan or Bahrain or Djibouti or Egypt or Iran or Iraq or Jordan or Kuwait or Lebanon or Libya or Morocco or “Occupied Palestinian Territory” or Oman or Pakistan or Qatar or “Saudi Arabia” or Somalia or Sudan or “Syrian Arab Republic” or Tunisia or “United Arab Emirates” or Yemen) | 6                                           | 0                                           | 1                                           | 1                                                   |
| Scopus           | (TITLE-ABS-KEY (prevalence OR frequency OR incidence) ) AND TITLE-ABS-KEY (“Human Immunodeficiency Virus” OR “Immunodeficiency Virus Human” OR “Human Immunodeficiency Viruses” OR “AIDS Virus” OR “AIDS Viruses” OR “Acquired Immune Deficiency Syndrome Virus” OR “Acquired Immunodeficiency Syndrome Virus”) AND TITLE-ABS-KEY (female AND sex AND worker) AND TITLE-ABS-KEY (emro OR “Eastern Mediterranean Regional” OR afghanistan OR bahrain OR djibouti OR egypt OR iran OR iraq OR jordan OR kuwait OR lebanon OR libya OR morocco OR “occupied palestinian territory” OR oman OR pakistan OR qatar OR “saudi arabia” OR somalia OR sudan) | 72                                          | 1                                           | 23                                          | 19                                                  |
### Appendix A. Cont.

| Name of database               | Search strategy                                                                                                                                                                                                 | Yielded number of articles | Number of duplicate articles | Number of screened articles | Number of articles assessed for eligibility criteria |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------|-----------------------------|------------------------------------------------------|
| Embase                        | (prevalence:ti,ab,kw OR frequency:ti,ab,kw OR incidence:ti,ab,kw) AND ('human immunodeficiency virus':ti,ab,kw OR 'immunodeficiency virus human':ti,ab,kw OR 'human immunodeficiency viruses':ti,ab,kw OR 'aids virus':ti,ab,kw OR 'aids viruses':ti,ab,kw OR 'acquired immune deficiency syndrome virus':ti,ab,kw OR 'acquired immuno deficiency syndrome virus':ti,ab,kw) AND 'female sex worker':ti,ab,kw AND (emro:ti,ab,kw OR 'eastern mediterranean regional':ti,ab,kw OR afghanistan:ti,ab,kw OR bahrain:ti,ab,kw OR djibouti:ti,ab,kw OR egypt:ti,ab,kw OR iran:ti,ab,kw OR iraq:ti,ab,kw OR jordan:ti,ab,kw OR kuwait:ti,ab,kw OR lebanon:ti,ab,kw OR libya:ti,ab,kw OR morocco:ti,ab,kw OR 'occupied palestinian territory':ti,ab,kw OR oman:ti,ab,kw OR pakistan:ti,ab,kw OR qatar:ti,ab,kw OR 'saudi arabia':ti,ab,kw OR somalia:ti,ab,kw OR sudan:ti,ab,kw OR 'syrian arab republic':ti,ab,kw OR tunisia:ti,ab,kw OR 'united arab emirates':ti,ab,kw OR yemen:ti,ab,kw)                                                                 | 2                          | 1                            | 0                           | 0                                                    |
| Google Scholar                | (Prevalence OR Frequency OR Incidence) AND (“Human Immunodeficiency Virus” or “Immunodeficiency Virus Human” or “Human Immunodeficiency Viruses” or “AIDS Virus” or “AIDS Viruses” or “Acquired Immune Deficiency Syndrome Virus” or “Acquired Immuno Deficiency Syndrome Virus”) AND “female sex worker” AND (EMRO or “Eastern Mediterranean Regional” or Afghanistan or Bahrain or Djibouti or Egypt or Iran or Iraq or Jordan or Kuwait or Lebanon or Libya or Morocco or “occupied Palestinian territory” or Oman or Pakistan or Qatar or “Saudi Arabia” or Somalia or Sudan or “Syrian Arab Republic” or Tunisia or “United Arab Emirates” or Yemen)                                                                 | 7                          | 0                            | 0                           | 0                                                    |
| Ovid                          | (Prevalence OR Frequency OR Incidence) AND (“Human Immunodeficiency Virus” or “Immunodeficiency Virus Human” or “Human Immunodeficiency Viruses” or “AIDS Virus” or “AIDS Viruses” or “Acquired Immune Deficiency Syndrome Virus” or “Acquired Immuno Deficiency Syndrome Virus”) AND “female sex worker” AND (EMRO or “Eastern Mediterranean Regional” or Afghanistan or Bahrain or Djibouti or Egypt or Iran or Iraq or Jordan or Kuwait or Lebanon or Libya or Morocco or “occupied Palestinian territory” or Oman or Pakistan or Qatar or “Saudi Arabia” or Somalia or Sudan or “Syrian Arab Republic” or Tunisia or “United Arab Emirates” or Yemen)                                                                 | 2                          | 0                            | 1                           | 1                                                    |
| Index Medicus for the Eastern Mediterranean Region (IMEMsR) | Female sex worker AND prevalence of HIV                                                                                                                                                                                                 | 58                         | 1                            | 0                           | 0                                                    |