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Integrated bio-behavioural HIV surveillance surveys among female sex workers in Sudan, 2011–2012

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Arabic Abstract translation

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ABSTRACT

Objectives To assess HIV and syphilis prevalence, HIV-related behaviours and testing for HIV in female sex workers (FSW) in Sudan.

Design Bio-behavioural surveys using respondent-driven sampling were carried out among FSW in the capital cities of 14 states in Sudan in 2011–2012. HIV and syphilis testing was done by rapid tests.

Results 4220 FSW aged 15–49 years were recruited. The median age of recruited women varied from 21 to 28 years per site. The highest HIV prevalence was measured at two sites in the eastern zone (5.0% and 7.7%), while in the other zones it ranged from 0% to 1.5%. Syphilis prevalence ranged from 1.5% in the northern zone to 8.9% in the eastern zone. Ever having been tested for HIV was reported by 4.4%–23.9% of FSW across all sites. Condom use at last sex with a client varied from 4.7% to 55.1%, while consistent condom use with clients in the month preceding the surveys was reported by 0.7%–24.5% of FSW. The highest reporting of ever injecting drugs was measured at a site in the western zone (5.0%).

Conclusions The surveys' findings indicate that the highest burden of HIV in FSW is in the eastern states of the country. Condom use and HIV testing data demonstrate the need for HIV interventions that should focus on HIV testing and risk reduction strategies that include stronger condom promotion programmes in FSW and their clients.

INTRODUCTION

Years of conflict and limited epidemiological data in Sudan make a robust assessment of the nature and dynamics of the HIV epidemic difficult. As of November 2012, there had been no UNAIDS estimates of the burden of HIV in Sudan due to the separation of South Sudan and its establishment as an independent state in 2011. The Sudanese Government estimates that HIV prevalence in Sudan is 0.53%, which implies that approximately 99 000 people are living with HIV in the country.¹

A survey carried out in 2007 in 9164 pregnant women attending antenatal care services in all 15 Sudanese states found an HIV prevalence of 0.2%.² In that survey, HIV prevalence in pregnant women aged 15–24 years was 0.3%. Four bio-behavioural surveys were carried out in the year 2008 among female sex workers (FSW), men who have sex with men (MSM) and truck drivers in Khartoum and Gezira states using respondent-driven sampling (RDS) in FSW and MSM and time–location

sampling in truck drivers.² HIV prevalence in FSW in Khartoum was 0.9% (N=321) and 0.1% in Gezira (N=267). In MSM in Khartoum, HIV prevalence was 2.3% (N=450); among truck drivers, prevalence was 0.3% (N=570).

To develop better evidence on the extent and the patterns of the HIV epidemic in Sudan, the Sudanese National AIDS Programme in 2010 started the implementation of integrated bio-behavioural surveillance surveys (IBBSS) using RDS in all 15 Sudanese states among two key populations at higher risk of HIV infection: FSW and MSM. The University of Gezira, Faculty of Medicine, Primary Health Care and Health Education Center was assigned to lead the implementation of IBBSS.

The IBBSS described in this article were conducted in FSW at 14 sites in 14 of the 15 states because the survey could not be conducted in one site in the western zone due to the ongoing conflict and the resulting security concerns. We report on the main findings from the surveys per site and in zones (figure 1), and these include the prevalence of HIV, syphilis and hepatitis C virus (HCV), HIV-related risk behaviours and key demographic characteristics of FSW surveyed.

METHODS

RDS is a chain referral method which has been extensively used to survey and recruit hard-to-reach populations.³ It relies on social networking of the target group and begins with non-randomly selected seeds who recruit other members of the target population using coupons. The bias introduced by non-random selection of initial respondents is minimised as the recruitment progresses from wave to wave, and usually after 4–6 waves, the sample composition becomes independent from the initial choice of seeds. Other details of the RDS method are described elsewhere.^{4–7}

To assess the feasibility of the RDS methodology, formative research was carried out to collect information about FSWs' network sizes, willingness to participate in IBBSS, the level of incentives and a desirable type of study site. Formative research was carried out for 8–12 weeks, and interviews were done with 30 FSW and 5–10 key informants per survey site. It was confirmed that FSW have reasonably large peer networks (the median personal network size ranged from 6 to 12 FSW). The majority of interviewed FSW expressed willingness to participate in the study.



Figure 1 Map of the six zones of Sudan.

Eight to 14 seeds of different ages, ethnicities and neighbourhood residences were identified per survey site during the formative research.

The desired sample size per site was 300. The sample size calculation was based on detecting an HIV prevalence of 0.9%, with an α error of 5% and the width of the CI of 0.1%. A design effect of 2.0 was used, and the expected response rate was 85%.

Procedure and participants

RDS sites in the targeted states were located in the centres of major urban areas. A woman was eligible to participate in the study if she was 15–49 years old, lived or worked in the area, and sold sex or exchanged sex for goods in the last 3 months. All eligible individuals were informed about the nature and requirements of the study (type of data collected, procedures, incentives, etc.) and were asked for informed consent. After giving verbal consent, the participant was interviewed and then received HIV pre-test counselling.

After taking blood, a participant received her primary incentive and three coupons for peer recruitment. As rapid tests were used, test results were communicated during post-test counselling at the first visit. Participants who were found seropositive for HIV were referred for further clinical assessment at a local HIV treatment centre. Those who tested positive for syphilis were referred to a local clinic for sexually transmitted infections (STI). Information was collected on the number of

women who refused to accept coupons and reasons for refusal once participants came back to the survey site to collect secondary incentives. Participants received a primary incentive of \$US10 (this amount is slightly less than the price of an act of sexual intercourse with one client) for the participation in the survey and \$US10 as a secondary incentive for each person they recruited.

Questionnaire and measures

The questionnaire used was developed by the Family Health International (2000) and translated into Arabic after being slightly revised by the national IBBSS research team.⁸ In addition to socio-demographic data, the questionnaire included items on sex work and sexual behaviours, drug use, attitudes toward people living with HIV, STI-related symptoms, HIV knowledge, HIV testing and self-assessment of risk of HIV. The questionnaire was completed via face-to-face interviews.

Data were also collected on participants' social network sizes, assessed by a sequence of the following questions: (1) How many FSW do you know by name/nickname and they know you by name/nickname? (2) How many of these did you meet in the last month? (3) How many of those live in the same city where you live? (4) How many of them are below 15 years of age? (5) How many of them do you think would accept to participate in this study?

Laboratory methods

HIV serostatus was assessed by SD Bio-Line rapid test (SD Bioline HIV Ag/Ab Combo Rapid test, Pantech, South Africa), and reactive samples were confirmed with two rapid tests—Uni-Gold (Uni-Gold Recombigen HIV, Trinity Biotech, Ireland) and Colloidal Gold (Kehua Bio-Engineering, China). Syphilis testing was done using SD Bio-Line Syphilis rapid test (SD Bio-Line Syphilis, Pantech, South Africa). Detection of antibodies to HCV was also done by a rapid test (HCV device, HCVCOO20/HCVCOO40, Biorex Diagnostics, UK). HCV testing was done only in 10 sites. All testing was anonymous and participants were able to obtain all test results on the same day after their participation in the study was completed.

Statistical analysis

RDS Analysis Tool (RDSAT) V.6.0.1 was used to calculate weighted population proportions with 95% CIs.⁹

Ethical considerations

All study procedures were approved by the National Research Ethical Review Committee of the Federal Ministry of Health. Informed verbal consent for both behavioural and biological data collection was obtained from each participant. To protect participants' anonymity, no personally identifying information was collected at any point. Interviews were conducted privately in separate rooms to ensure confidentiality. All team members received training on ethical conduct.

RESULTS

Recruitment

A total of 4220 FSW was recruited in 14 sites (one site was selected in each of 14 states), ranging from 292 to 315 FSW per site. The number of seeds varied from 7 to 12 and the number of waves from 7 to 10, and 404 to 915 coupons were distributed per study site. The reported median social network sizes ranged from 4 to 10. The number of women who were not eligible to participate varied from 18 to 40 per survey site. The most frequent reason for non-eligibility was not being a sex worker.

Socio-demographic characteristics

Women younger than 24 years of age comprised a substantial proportion of the women recruited, particularly in the western zone (table 1). The median age per site varied from 21 to 28 years old. Marital status varied greatly across the sites, and the highest proportion of FSW who were unmarried was in Sites 1, 4 and 7 (74.3%, 83.3% and 79.1%, respectively). Recruited FSW were predominantly born in Sudan, with the exception of two sites in the eastern and the northern zones, where 9.4% and 9.2% of women, respectively, were non-Sudanese originating from Ethiopia, Eritrea and Nigeria. The proportion of FSW without any education ranged markedly across the sites, from 4.5% to 58.2%. At only two sites (Sites 8 and 12), slightly more than a third of FSW had a comprehensive knowledge of HIV, while it was below 10% at five sites.

Sexual and injecting drug use behaviours

At 10 sites, at least one fifth of FSW had started selling sex at less than 18 years of age, with a particularly high proportion reporting such early initiation of sex work at Site 10 in the western zone (50.1%) and Site 7 in the southern zone (47.8%). There were wide variations in condom use at last sex with clients (4.7–55.1%) and in consistent condom use with clients

in the past month (0.7–24.5%). Only a minority of women reported ever injecting drugs; the highest proportion was at two sites in the western zone (2.6% and 5.0%). The median number of transactional sex clients over the past week ranged from two to five per site.

Infection prevalence and testing for HIV

HIV prevalence was below or equal to 1% at 10 sites (table 2). The highest HIV prevalence was 5.0% and 7.7% and was found at two sites in the eastern zone. Syphilis prevalence ranged from 1.5% in the northern zone to 8.9% in the eastern zone. The highest level of HCV was measured in the western zone (2.6% and 5.1% at two sites).

Testing for HIV was low. It was highest in one site in the eastern zone and another site in the south-east, where slightly more than a quarter of FSW were ever tested for HIV. At six sites, less than 10% of FSW had ever been tested for HIV. Similarly, testing for HIV in the past year was low and was most frequently reported by FSW at one site in the eastern zone (19.1%). Over 85% of those who tested for HIV in the past year had received their test results, with the exception of FSW at Site 6 in the southern zone (38.5%) and Site 4 in the south-eastern zone (51.8%).

Seeking care for STI symptoms at healthcare facilities in the past year was the lowest at Sites 8 and 5 (21.1% and 24.0%, respectively). At other sites, it ranged from 39.5% to 79.2%, while it was 100% at Site 12 in the northern zone.

DISCUSSION

Our findings indicate a concentrated HIV epidemic in FSW in the eastern zone of Sudan. Site 1 in the eastern zone had also the highest syphilis prevalence. Higher HIV prevalence in this zone could be due to the proximity of the countries where the HIV epidemic is of greater magnitude, mainly Eritrea and Ethiopia, and frequent population movement across the borders. The existence of sex work and the vulnerability of FSW and their clients to HIV and STIs in eastern parts of Sudan have been documented in other reports.¹⁰ At Site 2 in the eastern zone, a sizeable proportion of FSW sampled were of non-Sudanese nationality. At Site 14, none of the recruited FSW tested positive for HIV, while in the RDS survey in 2008 that recruited 321 FSW at the same city, HIV prevalence was 0.9%.¹¹

The number of transactional sex partners per week ranged from two to five, which is similar to the study carried out in 2009 in Somalia, where the median number of partners was three.¹² A synthesis of studies on sex work and HIV in the Middle East and North Africa region suggests that FSW in the region have one client per day or less, though the number of clients per day in some settings is higher.¹³ Given the low use of condoms at last sex and consistently in the past month across all survey sites, the exposure to HIV in FSW in Sudan could be substantial. Comparable bio-behavioural data that used the same RDS methodology in Sudan are available only for Khartoum and suggest a decline in condom use at last sex with clients, from 45.0% in 2008 to 30.3%, as found in our study.⁹ In a recent study in FSW in Greater Cairo in the neighbouring country of Egypt, 22.4% of FSW reported condom use at last sex with clients, similar to a study in Somalia where it was reported by 24.0% of women.¹⁴ The overall condom use in FSW throughout the Middle East and North Africa region is similarly low.¹³ In our study, somewhat more than a quarter of FSW reported using condoms consistently in the past month only in three states (at Sites 6, 9 and 12). Such low reported

Table 1 Socio-demographic and behavioural data, and data on HIV-related knowledge in 14 sites in Sudan

Zone	Eastern		South-eastern			Southern			Western			Northern		
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14
Sample size (without seeds)	293	288	282	296	303	279	288	296	299	284	303	305	291	287
FSW <24 years of age (%)	29.7 (15–39)	30.7 (20–42)	39.9 (30–51)	44.5 (39–52)	29.6 (18–40)	34.5 (22–44)	54.7 (43–66)	45.8 (33–58)	55.9 (44–64)	60.5 (51–72)	32.1 (25–40)	20.6 (19–24)	39.7 (29–50)	35.1 (26–48)
Marital status (%)														
Married	4.3 (2–8)	2.3 (1–8)	9.1 (8–12)	5.1 (2–8)	11.3 (9–15)	30.7 (27–35)	6 (4–8)	20.2 (18–25)	35.2 (27–41)	15.1 (12–18)	15.5 (10–22)	36.3 (28–41)	47.5 (35–62)	21.1 (15–29)
Cohabiting	20.5 (13–28)	35.8 (28–41)	15.7 (10–20)	10.4 (8–13)	58.7 (46–71)	55.9 (47–61)	12.1 (9–15)	73.8 (61–88)	63.9 (51–78)	24.8 (18–31)	84.1 (70–95)	11.6 (8–17)	9.1 (7–13)	57.5 (43–72)
Single or divorced	74.3 (62–86)	58.8 (48–61)	64.1 (55–72)	83.3 (70–95)	34.4 (27–42)	11.5 (8–15)	79.1 (60–90)	6.3 (4–10)	2.5 (0–4)	58.9 (41–72)	2.1 (1–4)	53.5 (42–65)	43.1 (37–53)	22.1 (17–29)
Country of origin (%)														
Sudan	99.5 (98–100)	89.1 (86–92)	99.7 (99–100)	98.4 (97–100)	100	100	99.1 (99–100)	100	100	100	100	99.1 (98–100)	98.8 (98–100)	99.1 (99–100)
Other	0.3 (0–1)	9.2 (8–11)	0.3 (0–1)	3.3 (2–5)	0	0	0.6 (0–1)	0	0	0	0	0.5 (0–1)	1.4 (1–2)	9.4 (7–12)
Level of education (%)														
None	58.2 (44–69)	42.1 (33–51)	52.1 (44–64)	45.5 (34–52)	26.7 (19–34)	41.5 (36–48)	29.3 (21–37)	15.1 (12–18)	14.3 (11–20)	29.1 (23–37)	10.3 (9–12)	15.3 (12–18)	4.5 (2–6)	31.1 (26–39)
Primary/intermediate	31.9 (27–40)	45.7 (34–57)	44.9 (36–53)	45.1 (38–51)	60.1 (50–71)	46.1 (38–53)	54.6 (43–62)	41.1 (33–52)	43.6 (34–52)	40.4 (34–48)	41.9 (34–50)	41.3 (31–53)	46.3 (37–55)	30.3 (22–38)
Secondary	7.7 (6–10)	9.1 (8–12)	4.5 (2–7)	8.1 (7–11)	13.4 (9–18)	11.1 (9–16)	12.3 (9–19)	23.5 (18–31)	39.5 (30–53)	26.5 (20–37)	39.7 (32–49)	27.3 (20–38)	33.3 (25–43)	23.7 (18–31)
Post-secondary	0.3 (0–1)	0.6 (0–2)	0	0.9 (0–2)	1.1 (0–3)	0.5 (0–2)	2 (1–4)	22.4 (19–29)	6.7 (5–8)	4.5 (2–6)	12.1 (10–14)	15.8 (12–19)	15.1 (11–19)	15.9 (12–19)
Comprehensive knowledge of HIV* (%)	17.9 (12–24)	23.0 (17–28)	8.1 (5–12)	13.1 (8–18)	9.5 (6–13)	3.4 (1–7)	18.2 (13–24)	39.0 (33–49)	10.1 (7–14)	18.2 (13–24)	7.7 (4–12)	39.6 (33–46)	11.2 (8–15)	8.7 (6–13)
Started selling sex at younger than 18 years old (%)	21.6 (18–24)	20.5 (19–23)	27.1 (19–32)	27.2 (25–30)	16.3 (15–18)	39.2 (31–48)	47.8 (46–51)	3.3 (3–4)	41.2 (40–43)	50.1 (48–53)	28.8 (26–31)	17.3 (11–24)	28.6 (26–30)	18.8 (17–20)
Used condom with client at last sexual intercourse (%)	18.7 (12–26)	55.1 (48–61)	16.2 (12–22)	8.2 (5–13)	8.4 (5–12)	4.7 (3–9)	12.5 (8–18)	15.8 (11–22)	21.6 (16–27)	14.6 (10–20)	23 (17–31)	41 (34–48)	28.8 (23–37)	30.3 (24–37)
Used condoms consistently with clients during last month (%)	13.7 (7–20)	0.7 (0–1)	12.4 (7–19)	5 (3–8)	3.1 (1–6)	23.9 (19–28)	5 (2–9)	8.9 (5–14)	24.5 (20–30)	7.6 (4–11)	11.4 (6–18)	24.1 (18–30)	18.6 (13–25)	18.5 (13–24)
Ever injected drugs (%)	0	0.9 (0–2)	0.5 (0–2)	0.4 (0–1)	1 (0–2)	0.9 (0–2)	1.6 (0–3)	0.1 (0–0)	2.6 (1–4)	1.6 (1–3)	5.0 (3–8)	1.5 (0–2)	0.6 (0–2)	2.3 (1–4)
Self-reported as being at high risk of HIV (%)	15.5 (10–21)	32 (27–40)	5.9 (3–9)	8.6 (6–12)	21.4 (16–27)	14.5 (11–18)	14.3 (9–20)	13.8 (10–20)	6.6 (4–10)	15.8 (11–22)	7.4 (4–12)	9.6 (7–13)	10.9 (7–15)	20.7 (16–26)

*Comprehensive knowledge means knowing that consistent use of a condom during sexual intercourse and having just one uninfected faithful partner can reduce the chance of getting HIV and knowing that a healthy-looking person can be infected with HIV, and rejecting the two most common local misconceptions about HIV transmission or prevention (mosquito bites and sharing food).
FSW, female sex worker.

Table 2 Prevalence of HIV, syphilis and hepatitis C virus, and patterns of HIV testing and seeking STI services

Zone	Eastern			South-eastern			Southern			Western			Northern		
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	
Sample size (without seeds)	293	288	282	296	303	279	288	296	299	284	303	305	291	287	
HIV prevalence	7.7 (4–12)	5.0 (2–8)	0.6 (0–1)	0.7 (0–1)	0.7 (0–2)	1.5 (0–3)	1.3 (0–3)	1.0 (0–3)	0.2 (0–1)	1.0 (0–3)	0.7 (0–3)	0.3 (0–1)	0.7 (0–2)	0	
Syphilis prevalence	8.9 (4–14)	4.3 (2–7)	3.4 (1–6)	5.4 (3–9)	5.3 (2–8)	3.4 (1–6)	4.2 (2–7)	4.1 (2–7)	1.8 (1–4)	1.8 (0–4)	5.2 (2–10)	1.5 (0–3)	1.9 (0–4)	1.7 (0–4)	
HCV prevalence	N/A	N/A	N/A	0	0.2 (0–0.3)	N/A	0	0	5.1 (3–8)	0.5 (0–1)	2.6 (1–5)	1.5 (0–3)	0	0.5 (0–1)	
Ever tested for HIV (%)	23.9 (17–30)	22.0 (17–27)	10.4 (8–16)	5.4 (3–10)	14.4 (9–19)	4.4 (2–7)	5.2 (2–9)	8 (5–13)	8.6 (5–13)	12.2 (9–18)	9.4 (6–15)	17.6 (13–22)	14.6 (11–21)	17.9 (13–24)	
Tested for HIV in the past year (%)	19.1 (17–24)	12.1 (9–15)	8.5 (7–9)	3.1 (2–5)	12.4 (10–16)	0.9 (0–2)	2.5 (2–4)	4.5 (3–6)	5.2 (3–9)	6.2 (4–9)	8.1 (7–18)	9.6 (8–14)	11.1 (9–14)	12.7 (9–16)	
Received HIV test result among those that tested for HIV in the last year (%)*	96.4 (89–100)	93.9 (88–99)	93.5 (88–98)	51.8 (41–62)	91.6 (83–99)	38.5 (30–47)	93.8 (88–100)	93.5 (81–99)	99.3 (98–100)	93.3 (81–98)	100	96 (91–99)	89.8 (74–98)	86 (76–97)	
Sought STI care at health care facilities when had STI symptoms in the past year (%)	72.4 (59–86)	79.2 (71–86)	39.5 (22–58)	41.6 (35–47)	24 (19–29)	39.5 (28–52)	51.2 (40–63)	21.1 (11–35)	48.9 (37–59)	70.5 (57–82)	55.8 (45–67)	100	72.2 (53–85)	70.2 (60–82)	

*Of note is that the denominators for the indicator 'received HIV test result among those that tested for HIV in the last year' are low since the proportion of FSW who tested for HIV in the past year is low. FSW, female sex worker; HCV, hepatitis C virus; STI, sexually transmitted infections.

condom use implies a need for urgent introduction of condom promotion programmes for FSW and their clients.

We also found that injecting drugs was infrequently reported, with the exception of one site in the western zone (5.0%). Starting selling sex before the age of 18 was most commonly reported in the western zone.

Additionally, in spite of substantial exposure to HIV, the majority of women do not consider themselves at risk of HIV. Ever testing for HIV was low and the highest rates were found in the eastern zone (22.0% and 23.9% at two sites). This may be explained by insufficient information and the consequent low awareness of HIV. Currently, there are 143 voluntary counselling and testing sites in Sudan, which are located mainly in urban areas. Overall, in 2012, 86 299 individuals were tested for HIV; 3% of these were found to be HIV-positive. Most of those who tested for HIV did so at voluntary counselling and testing sites (n=44 709) and antenatal care (n=37 055) sites, while the remainder tested elsewhere.¹⁵ Overall, the findings of the surveys underscore the need to provide better access to various HIV prevention services to FSW and their clients, including information, voluntary counselling and testing, STI care, and prevention commodities. Recently, as international funding has become more available for key populations programmes, there is at least one non-government organisation per state providing services to FSW. Most of these non-government organisations are focussing on raising FSWs' awareness of HIV, providing information and supporting alternate income-generating activities, with the ultimate goal of discontinuation of sex work. Such programmes should continue, as they aim to empower FSW to generate alternate sources of income and should be accompanied with other structural policies that confront stigma, discrimination and violence against FSW. Effective HIV and STI prevention measures, including raising knowledge about HIV prevention, promotion of correct and consistent condom use, STI screening and condom distribution need to be scaled up in a non-stigmatising manner to both FSW and their clients. Increasing availability and access to HIV testing and treatment of those who test HIV-positive should be seen as key interventions that need to be scaled up to prevent further HIV transmission in this vulnerable group. Interventions with FSW should include multiple components and be implemented with strong community involvement and backed by supportive policies.

Further research should explore characteristics that are important for HIV transmission and which were found in our studies, such as reasons behind the highest HIV prevalence in FSW being found in the eastern zone and the higher frequency into early initiation of sex work and injecting drug use in the western zone. Additionally, it is important to understand the context within which sex work occurs in Sudan, and sex workers' broader health and social needs, as that would enable researchers to design a comprehensive package of interventions.¹⁶

Limitations

The key limitations are due to difficulties in sampling populations at higher risk, particularly in settings characterised by stigma towards HIV. One of our challenges was establishing whether women who came to participate in the survey were truly sex workers. The financial incentives that were given for participation may have motivated some women of poorer socio-economic status to claim falsely to be FSW, thereby affecting the generalisability of our findings. Much effort was undertaken to overcome this challenge, including training interviewers in soliciting information with which to establish eligibility and setting

up the incentive levels according to the information obtained during the formative research. Additionally, the interpretations are limited by the sample sizes which might have been low for estimating with accuracy the level of HIV prevalence. Other sources of bias might have affected our results such as social desirability bias in relation to reporting sexual and drug-using behaviours and non-response bias due to refusals to participate in the surveys. Interpretation of syphilis and HCV prevalence data was limited by the types of the tests used, since both tests measured the presence of antibodies and did not allow us to determine whether the infections were active or resolved.

CONCLUSION

The highest HIV prevalence in FSW in Sudan was measured in the eastern zone (5.0%–7.7%), while in all other zones, it ranged between 0% and 1.5%. Given the low knowledge of HIV, low condom use and insufficient HIV testing, FSW should be provided with more intensive and comprehensive HIV prevention services in order to curtail further HIV transmission. It is also important to continue the implementation of such community-based bio-behavioural surveys as they enable us to assess changes in the patterns of HIV epidemics and the reach and effectiveness of HIV interventions.

Key messages

- ▶ The highest HIV prevalence among FSW in Sudan was measured in the eastern zone (5.0–7.7%), while in all other zones it ranged between 0% and 1.5%.
- ▶ Comprehensive knowledge about HIV and coverage of services for FSW are very low in Sudan.
- ▶ There is a need for rapid scale-up of effective HIV prevention interventions for FSW and their clients, within an enabling environment and through strong engagement of community and non-governmental organisations.

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REFERENCES

- 1 Federal Ministry of Health of Sudan. Country progress report 2012. March 2012 [http://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_SD_Narrative_Report\[1\].pdf](http://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_SD_Narrative_Report[1].pdf) (accessed 15 Nov 2012).
- 2 Sudan National AIDS Control Programme. UNGASS Report 2008–2009, North Sudan. Federal Ministry of Health, 2010.
- 3 Heckathorn D. Respondent driven sampling: a new approach to the study of hidden populations. *Soc Probl* 1997;44:174–99.
- 4 Heckathorn D, Semaan S, Broadhead RS, *et al*. Extensions of respondent-driven sampling: a new approach to the study of injection drug users aged 18–25. *AIDS Behav* 2002;6:55–67.
- 5 Heckathorn D. Respondent driven sampling II: deriving valid population estimates from chain referral samples of hidden populations. *Soc Probl* 2002;49:11–34.
- 6 Magnani R, Sabin K, Saidel T, *et al*. Review of sampling hard-to-reach and hidden populations for HIV surveillance. *AIDS* 2005;19:S67–72.
- 7 Johnston LG, Malekinejad M, Kendall C, *et al*. Implementation challenges to using respondent-driven sampling methodology for HIV biological and behavioral surveillance: field experiences in international settings. *AIDS Behav* 2008;12:131–41.
- 8 Behavioural Surveillance Surveys. *Guidelines for repeated behavioural Surveys in populations at risk of HIV*. Arlington: Family Health International, 2000.
- 9 Volz E, Wejnert C, Degani I, Heckathorn D. Respondent-driven sampling analysis tool v.6.0.1. Ithaca, NY 2007: Cornell University.
- 10 Lake S, Wood G. *Combating HIV/AIDS in eastern Sudan: the case of preventive action*. London, UK: Ockenden International, 2005.
- 11 Abdelrahim MS. HIV prevalence and risk behaviors of female sex workers in Khartoum, north Sudan. *AIDS* 2010;24(Suppl 2):S55–60.
- 12 Kriitmaa K, Testa A, Osman M, *et al*. HIV prevalence and characteristics of sex work among female sex workers in Hargeisa, Somaliland, Somalia. *AIDS* 2010;24(Suppl 2):S61–7.
- 13 Abu-Raddad L, Akala FA, Semini I, *et al*. *Characterizing the HIV/AIDS epidemic in the Middle East and North Africa: time for strategic action*. Middle East and North Africa HIV/AIDS Epidemiology Synthesis Project. World Bank/UNAIDS/WHO Publication. Washington, DC: The World Bank Press, 2010.
- 14 Kabbash IA, Abdul-Rahman I, Shehata YA, *et al*. HIV infection and related risk behaviours among female sex workers in greater Cairo, Egypt. *East Mediterr Health J* 2012;18:920–7.
- 15 Federal Ministry of Health. *Responding to the AIDS treatment crisis in Sudan; test, treat, retain cascade analysis*. Khartoum, Sudan, Federal Ministry of Health, 2013.
- 16 World Health Organisation (WHO). *Prevention and treatment of HIV and other sexually transmitted infections in sex workers in low- and middle-income countries. Recommendations for a public health approach*. Geneva: WHO, 2012.