High burden of HIV infection and risk behaviors among female sex workers in three main urban areas of Mozambique

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Abstract

This is the first integrated biological and behavioral survey among female sex workers (FSW) in Mozambique. Using respondent-driven sampling, 400, 411 and 429 FSW were enrolled respectively in Maputo, Beira and Nampula in 2011-2012. Estimates were produced using RDSAT 7.1. HIV prevalence was 31.2%, 23.6%, and 17.8% in each location respectively. Among HIV-positive FSW, 48.1%, 79.8% and 89.6% in each city, were unaware of their serostatus. Condom use at last sex with a client was 85.8%, 73.4% and 62.8% among FSW, respectively. HIV was associated with current age, age of first sex for money, low educational level, and having had a genital ulcer in the last six months. Results suggest the urgent need to increase behavioral and structural interventions in this key population.

Abstract

Este es el primer estudio biológico y conductual integrado entre las mujeres trabajadoras de sexo (MTS) en Mozambique. En el 2011-2012 usando el muestreo dirigido por los participantes (RDS), se enroló 400, 411 y 429 MTS en el estudio en Maputo, Beira y Nampula, respectivamente. Se utilizó RDSAT 7.1 para producir las estimaciones. La prevalencia del VIH fue del 31,2%, 23,6% y 17,8%, respectivamente, en cada lugar. La prevalencia aumenta significativamente con la edad. Entre las MTS seropositivas, el 48,1%, 81,9% y 89,6% en cada lugar, no tenían conocimiento de su estado serológico. El uso del condón en la última relación sexual con un cliente fue 85,8%, 73,4% y 62,8% en cada ciudad. VIH se asocia con la edad, la edad que hizo sexo por dinero primera vez, el bajo nivel escolar, y haber tenido una ulcera genital los últimos seis meses. Los

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resultados sugieren la necesidad urgente de aumentar las intervenciones conductuales y estructurales en esta población clave.

Introduction

Mozambique is situated in the sub-region of Africa experiencing the most severe HIV epidemic in the world (1). According to the most recent population-based national HIV/ AIDS indicator survey, in 2009, HIV prevalence was estimated at 11.5% (95% Confidence Interval - CI: 10.3-12.6%) among the Mozambican population aged 15-49 years old. Key features of the national epidemic are that women are more affected than men (13.1% vs. 9.2%, respectively), and urban areas have higher prevalence than rural areas (15.9% vs. 9.2%, respectively). Additionally, regions of the south (17.8%) and center (12.5%) have higher prevalence than the north (5.6%) (2).

While Mozambique's HIV epidemic affects large segments of the general population, some groups may be particularly vulnerable and harder to reach with programs due to engagement in stigmatized and illegal behavior. High number of commercial sexual partners, inconsistent condom use, multiple HIV-infected partners, and other high-risk sexual practices expose FSW, and in turn their sex partners, to greater risk of HIV acquisition and onward transmission (3,4). To date, there is a paucity of systematic data on FSW in Mozambique; prior research was based on small convenience samples, which may have missed the full diversity of FSW. A rapid assessment among FSW in Maputo, Beira and Nampula, in which 74% of participants refused testing, found HIV prevalence of 48% (5). Program data from a night clinic catering to FSW in Tete province Mozambique (central region) determined HIV prevalence among FSW to be 49.7% in (6).

Qualitative research has characterized sex work in most countries of sub-Saharan Africa as principally occurring without intermediaries, where women contract with men for sex in bars, hotels, and on the street (7). Sex work also appears more "occasional" than has been described elsewhere in the world with fewer days per week in sex work, fewer clients, and fewer brothels or venues devoted to on-site sex (4). Indirect sex work (i.e., where women may have other employment in bars or hotels) or transactional sex (i.e., where instead of receiving cash for sex, women may receive goods or have other needs met) is common (8– 10).

We present the results of the first-ever integrated biological and behavioral surveillance (IBBS) survey among FSW in Mozambique. The main objective of this IBBS survey was to provide more rigorous, representative estimates of HIV prevalence among FSW in Mozambique's three largest cities: Maputo, Beira and Nampula, representing the three regions of Mozambique. The study further sought to characterize the demographic make-up of the FSW populations, and the risk and preventive behaviors associated with HIV infection.

Methods

Study population, sampling and recruitment

In preparation for the survey, we conducted formative research using ethnographic mapping and key informant interviews to explore i) the interconnectivity of FSW social networks; ii) FSW willingness to recruit their peers, iii) challenges in finding diverse segments of this hidden population, and iv) preferences expressed by FSW for various operational aspects associated with the survey. Based on the results, respondent driven sampling (RDS) was chosen as the sampling and recruitment method; RDS has been described elsewhere in detail (11,12). Recruitment chains were initiated by "seed" FSW purposely selected as women who were eligible for the study, well-connected to other FSW, and diverse with respect to age, education, language, neighborhood, and use of services.

Recruitment took place in Mozambique's three largest urban areas: Maputo (the capital) in the south, Beira in the center and Nampula in the north (Figure 1). Data was collected from September 2011 to March 2012. FSW were eligible to participate if they were: biologically female, at least 15 years old, had received money in exchange for sex from someone other than a steady partner in the six months preceding the survey, resided or socialized in the survey area, provided written informed consent, and had a valid recruitment coupon.

Seven seeds were selected in Maputo, six in Beira, and five in Nampula. After completing study procedures, participants were given a health and beauty kit and transport reimbursement as the primary incentive. Additionally, they were given a brief training on how to recruit eligible FSW peers and three coded coupons to be given to peers in order to verify and analyze the recruiter-recruit linkages. Mobile phone credit was given for each successful recruit (i.e., the secondary incentive) and participants were also provided reimbursement for transportation to the project site.

Sex worker status was determined by questions assessing their familiarity with terminology used by the population, their relationship to the person who gave them the coupon, and amounts charged for sex. Duplicate enrollment was limited by use of a unique code and staff recognition. The recruitment process continued until the target sample size was met and equilibrium achieved (i.e., the point where no major change in the sample composition was noted) on key demographic characteristics (e.g., age, education, student status, marital status, neighborhood), risk behavior (e.g., number of clients and location where most recent client was found), service use (e.g., prior HIV testing), and knowledge of HIV serostatus.

Measures

Social and demographic information and sexual risk behaviors were collected using a standard questionnaire programmed on a netbook (HP, Windows 7) using Questionnaire Development System (QDS) software version 2.6.1 (Nova Research, Bethesda, MD) and was administered to the FSW by an interviewer in a private room at the study site. The instrument was based on previous questionnaires of FSW (13), field tested during the formative assessment phase, and included sections on demographic characteristics, sex work history, condom use (obtained for client and non-client partners), reproductive health, and health program use. The Alcohol Screening Tool Audit C (AUDIT-C) was used to measure

hazardous alcohol use (14). Personal network size used for statistical adjustment was arrived at by a series of questions asking how many other FSW they know by name who are over the age of 15 and have been in contact with in the last month.

Laboratory methods

Blood was collected by finger stick (in Maputo by venous blood draw) for on-site rapid testing and dried blood spot (DBS) samples sent to the serology laboratory of the National Institute of Health for testing. HIV testing for surveillance consisted of a sequential algorithm of three immunoassays (EIA) detecting anti-HIV antibodies: Vironostika HIV Uni-Form II Plus O EIA (Biomérieux, Marcy l'Etoile, France) for screening, Murex HIV-1.2.O EIA (DiaSorin, Dartford, UK) for confirmation and quality testing of 5% of negative samples, and Genscreen HIV-1.2 Version 2 (Bio-Rad, France) for retesting samples with discordant results. Samples with two reactive results were classified as HIV-positive, all others were classified as HIV-negative. Surveillance test results were not returned to participants as samples were unlinked and anonymous.

All participants were offered onsite rapid HIV testing with disclosure counseling and referral to public clinics staffed with personnel trained to work with key populations such as FSW.

Analysis

Analysis was conducted separately for each city. We present population estimates and 95% confidence intervals (CI) adjusted for RDS design using the RDS Analysis Tools (RDSAT) version 7.1.38 (RDS, Inc., Ithaca, NY). In RDSAT the number of re-samples for bootstrap was set to 15,000 and the algorithm type as "enhanced data-smoothing". For analysis of associations with HIV infection, RDSAT-generated weights on the outcome variable (HIV positivity) were exported into R software version 2.15 (R Development Core Team, 2011) and used in logistic regression using the svyglm command for complex weighted surveys (15,16). For each city separately, bivariate analysis was done and variables whose association with HIV-positivity was significant at the $p<0.05$ level are reported. Variables significant at the $p<0.1$ level were included in initial multivariate regression models for each city. Variables were removed based on analysis of deviance, until Rao-Scott likelihood ratio tests indicated a significant ($p<0.05$) change in model fit. Model diagnostics performed included leverage, influence, scale-location and Q-Q plots. Overall model fit was evaluated using a Hosmer-Lemeshow goodness-of-fit test. In the final models number of clients in last month was log-transformed in order to obtain a reasonable fit.

Ethical considerations

The protocol for this survey was submitted, reviewed and approved by the National Bioethics Committee for Health (CNBS) in Mozambique, the Committee on Human Research (CHR) at the University of California, San Francisco (UCSF) and the Centers for Diseases Control and Prevention (CDC) of the United States of America. Written informed consent was obtained from all participants. Ethical approval was given to interview sex workers between the ages of 15-17 as tacitly emancipated minors.

The decision to include 15-17 year olds in the survey was carefully assessed (17) by the study team, as they represent an especially vulnerable segment of the target population. Based on evidence from other studies in Mozambique (18,19), the exclusion of this age group from surveillance would result in failure to collect valuable data, useful for policy and programmatic purposes, potentially causing more harm to this subgroup. In order to ensure the needs of participants were adequately addressed, the survey team received sensitivity training on legal and psychosocial needs of FSW and participants were referred to protective and legal services when needed.

Results

Figure 1 illustrates the peer-referral recruitment chains of FSW in the three cities of Mozambique. Enrollment took 26 weeks in Maputo, 18 weeks in Beira, and 17 weeks in Nampula. From seven seeds in Maputo, three produced recruitment chains containing more than five participants. The longest chain included 14 waves and 313 participants, 78.2% of the total sample for Maputo. From six seeds in Beira, five produced recruitment chains with the longest consisting of 19 waves and 209 participants (50.9% of the sample). All five seeds in Nampula produced recruitment chains; the longest was 19 waves with 191 participants (44.5% of the sample). Equilibrium was achieved in all three cities for key variables including age group, educational level, place of last client pick-up, and contact with peer educator. A total of 2,160, 1,455 and 1,446 coupons were distributed in Maputo, Beira, and Nampula, respectively. Of these, the numbers returning to the study sites were 432 (20.0%) in Maputo, 485 (33.3%) Beira, and 482 (33.3%) Nampula. All women presenting to the study site with a coupon were screened for eligibility; 32 were not eligible in Maputo, 74 were not eligible in Beira, and 53 were not eligible in Nampula. The primary reason for ineligibility was not having sold sex for money in the six months preceding the survey, followed by being under 15 years of age. Two women in Maputo, one in Beira and nine in Nampula declined to provide written informed consent. Three women (one in Beira and two in Nampula) completed the survey but the data were accidentally not saved.

The majority of FSW in the three cities were under the age of 25 years (Table 1), with about two in 10 being under 18. A majority had some secondary education, with many reporting currently being in school (36.5% in Maputo, 58.8% in Beira, 59.0% in Nampula). A considerable proportion of FSW were single, never married: 63.8% in Maputo, 76.5% in Beira and 65.4% in Nampula. Few reported having earned any income from work other than sex work (23.7% in Maputo, 30.4% in Beira, 16.8% in Nampula).

Sexual debut occurred under the age of 15 years for 30.4% of FSW in Maputo, 25.5% in Beira, 37.3% in Nampula; and, 43.4% in Maputo, 59.4% in Beira and 63.9% in Nampula had sex for money before 18 years old. A condom was used at last sex with the most recent client among 85.8% of FSW in Maputo, 73.4% in Beira, 62.8% in Nampula; while approximately half of FSW used a condom with their most recent non-client partner.

At least three in 10 FSW had symptoms of an STI in the six months preceding the survey, and about one in 10 had a genital ulcer in that period. About three in 10 FSW with a past pregnancy had at least one induced abortion during her lifetime. Using the AUDIT-C

indicator, nearly half of FSW were classified as having problematic alcohol use. About two in 10 FSW had contact with a peer educator in the six months preceding the survey, and 73.7% in Maputo, 63.0% in Beira, 59.1% in Nampula had ever tested for HIV. The estimated weighted HIV prevalence was 31.2% (95% CI 24.5-37.5) in Maputo, 23.6% (95% CI 18.6-29.1) in Beira, and 17.8% (95% CI 13.3-22.7) in Nampula (Figure 1).

Forty-eight percent (95% CI 31.2-66.5) of HIV-infected FSW in Maputo, 79.8% (95% CI 68.1-89.3) in Beira, and 89.6% (95% CI 57.6-100.0) in Nampula were unaware of their serostatus (Table 2). Among HIV-positive FSW, 39.4% in Maputo, 15.3% in Beira and 11.9% in Nampula sought health care services in the last 6 months preceding the survey and 23.5% in Maputo, 8.6% in Beira and 3.6% in Nampula were currently on ART treatment.

There was a strong association between HIV and age in Maputo, Beira, and Nampula (Table 3). Having secondary education or higher was negatively associated with HIV, and being out of school was positively associated with HIV. Being previously married (separated, divorced, widowed) was also positively associated with HIV, as was co-habiting or currently being married. There was a protective effect of having earned income other than sex work in Beira [Odds Ratio (OR): 0.6, 95% Confidence Interval (CI) 0.4-0.9] and Nampula (OR: 0.5, 95%CI 0.3-0.8). History of genital ulcer symptoms in past six months was associated with HIV in Beira (OR: 2.4, 95%CI 1.3-4.4) and in Nampula (OR: 2.4, 95%CI 1.1-4.7). Problematic alcohol use was associated with HIV infection only in Nampula (OR: 4.6, 95%CI 2.7-8.0). Higher earning for sex [326 MZN (~10 USD)] was protective against HIV among FSW in Maputo (OR: 0.4, 95%CI 0.2-0.8). The number of first-time or regular clients in last month was associated with HIV infection among FSW only in Beira. Having a single non-client sex partner was protective in Maputo (OR: 0.5, 95%CI 0.3-0.8). Use of contraceptive was protective in Maputo, but the opposite was so in Beira. Prior HIV testing was also associated with HIV infection in all three cities.

In multivariate regression (Table 4), the association between age and HIV infection was confirmed in all three cities. The association between limited education and HIV infection persisted in Maputo and Beira, but not in Nampula. The association between genital ulcer in the previous six months and HIV infection continued in Beira. Even after adjusting for age, the association between age of first sex for money and HIV infection continued in Beira and Nampula. The significant association between number of client sex partners in last month and HIV infection continued in Beira.

Discussion

HIV prevalence was high with nearly one in three FSW in Maputo, one in four in Beira, and one in six in Nampula having HIV. This is the first study in Mozambique to provide representative estimates of HIV prevalence among FSW in the three largest cities in the three geographic regions of Mozambique, and findings confirm that FSW are a key population in the HIV epidemic. We found that large proportions of HIV-positive FSW were unaware of their serostatus; with most HIV-infected FSW in Beira and Nampula and nearly half in Maputo having received a previous HIV-negative test.

The main risk factors in multivariate analysis associated with HIV infection among FSW across all three cities included age older than 19 years, low level of education, and older age when first sold sex. In addition, having had genital ulcer and greater numbers of client sex partners in Beira were also risk factors associated with HIV infection among FSW. Age and education have also been found to be associated with HIV in other contexts in sub-Saharan Africa, such as among FSW in Kigali, Rwanda (20) and in Kisumu, Kenya (21).

We found a protective effect on HIV infection of higher price charged for sex in Maputo and on having an occupation other than sex work in Beira and Nampula in bivariate analyses but these associations did not persist in multivariate regression. The economic context and intensity of sex work may affect individual vulnerability and impact health outcomes (22). Women who are economically dependent on sex work for their daily survival may be more vulnerable to HIV than women who practice sex work as a means to supplement other income.

Our findings point to the urgent need to scale-up HIV prevention and care among FSW. Early diagnosis and initiation of treatment can contribute to reduced HIV transmission and to individual health benefits (23); yet, we found that few HIV-positive FSW were currently on treatment. We also found that a high proportion of FSW were unaware of their HIV infection, despite modestly high numbers ever having had an HIV test. These results indicate that FSW may not repeat testing despite continuing risk behaviors and suggest the need to promote routine HIV testing in order to catch HIV infection early and as an opportunity to reinforce prevention behavior. There are many prevention benefits that increased HIV testing can provide (24), including access to "prevention with positives" interventions which can improve safe sex behaviors (25), and allowing access to ART which reduces risk of death and HIV transmission (24,26). In the specific case of FSW, viral load suppression through ART can not only lead to better health outcomes for FSW but also reduce onward transmission of HIV (27) to clients and other partners of FSW even in the absence of other behavior change.

Our data reveal that FSW in Mozambique have not yet achieved the high levels of condom use found elsewhere in Africa, such as in Benin where surveys found consistent condom use with clients increased from 49% to 95% in the main city of Cotonou as well as a 96% improvement in five other cities from 2002 to 2005 as a result of behavioral interventions (28). The finding that many FSW in Mozambique are not being reached by the few existing interventions in country (e.g. about eight out of every 10 FSW had not had contact with a peer educator in the last six months), reveals an opportunity to increase prevention efforts in this area. A surprising and tragic finding of our surveys was the high proportion of minors under 18 years engaged in sex work in Mozambique, particularly in Nampula in the north, as explored in greater detail elsewhere (29). While infections among FSW under the age of 18 were relatively rare, HIV prevalence dramatically and significantly rises with each subsequent year of age. Other findings in our study point to the need to increase prevention efforts among FSW with lower levels of education, that are divorced/separated or widowed and who have been in sex work for three or more years. Additionally, the high levels of self-reported STI symptoms point to the need to increase screening and treatment of STI among FSW.

We recognize limitations of our study. Although difficult to verify outside of the formative data, there may be segments of the population that our surveys missed. One poignant example is the low number of foreign sex workers, such as those from neighboring countries like Zimbabwe, known from formative research to be working in Beira, whose absence in our data limit our understanding of this group. Other missing groups may be those who are not socially connected to other FSW in Mozambique or who are more distrustful of health programs and research. Future rounds of IBBS should consider recruiting and training community outreach workers that are members of these groups to build trust and encourage participation. Findings may also be skewed as a result of social desirability response bias, such as under-reporting of known HIV-positive serostatus, over-reporting of condom use, and under-reporting of client numbers. Future rounds of surveys should also consider including measures of disease progression and treatment impact, such as CD4 count and viral load. As our survey was primarily designed as a disease surveillance activity, it was not powered for examination of specific associations through multivariate analysis, and it is possible that a larger sample size may have led to detection of more significant associations. Finally, we wish to emphasize that our survey is not likely to have included women engaged solely in non-monetary transactional sex as the eligibility criterion was recent cash for sex rather than sex in exchange for other material needs.

Despite limitations, we note that in each of these cities RDS was able to reach diverse segments of the FSW population and achieve the projected sample size while conforming to the theoretical underpinnings and logistical procedures of the methodology (12). RDS holds promise as a standardized method for bio-behavioral surveys to track HIV prevalence and drivers of infection over time in FSW and potentially for other hard to reach populations in Mozambique. While the HIV epidemic remains widespread in the country, there is increasing recognition that many groups are more severely affected than others and require specifically-crafted interventions based on rigorous data. We believe these initial RDS surveys among FSW are a first step in obtaining such data.

Acknowledgements

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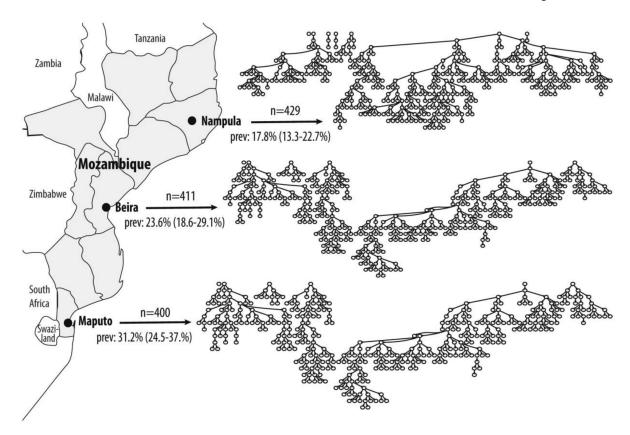
Figure 1.
Recruitment chains and HIV prevalence among FSW in Maputo, Beira, and Nampula, Mozambique, 2011-2012.

Table 1

Socio-demographic characteristics and preventive sexual risk behaviors among FSW in Maputo, Beira, and Nampula, Mozambique, 2011-2012.

Category	Maputo (n=400)		Beira (n=411)		Nampula (n=429)	
	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)
Age group (years)						
15-17	39 (9.8)	19.6 (12.5-26.7)	70 (17.0)	23.3 (16.4-29.3)	110 (25.6)	32.1 (25.2-40.5)
18-19	79 (19.8)	26.2 (21.4-33.9)	102 (24.8)	27.6 (21.9-33.9)	88 (20.5)	20.2 (15.3-25.9)
20-24	120 (30.0)	29.9 (25.9-38.5)	145 (35.3)	33.1 (27.1-39.9)	135 (31.5)	29.0 (22.1-35.8)
25-29	71 (17.8)	12.2 (6.0-13.7)	55 (13.4)	10.4 (7.1-14.4)	64 (14.9)	11.9 (7.7-15.8)
30	91 (22.8)	12.1 (6.8-17.1)	39 (9.5)	5.6 (3.1-8.6)	32 (7.5)	6.9 (3.4-10.4)
Missing	0 -		0 -		0 -	
Education level						
Never studied	19 (4.8)	4.5 (1.9-6.8)	22 (5.4)	5.6 (3.3-8.5)	12 (2.8)	3.0 (1.2-5.1)
Some primary education	158 (39.6)	35.3 (28.1-42.8)	146 (35.6)	33.5 (27.2-39.9)	101 (23.6)	27.9 (21.3-33.5)
Some secondary education	217 (54.4)	59.0 (51.5-66.8)	241 (58.8)	60.9 (54.0-67.4)	312 (72.9)	68.8 (62.8-75.8)
More than secondary education	5 (1.3)	1.2 (0.1-3.2)	1 (0.2)	0 (0.0-0.1)	3 (0.7)	0.3 (0.0-0.9)
Missing	1 -		1 -		1 -	
Currently studying	118 (29.6)	36.5 (28.8-43.2)	206 (50.2)	58.8 (51.4-66.8)	270 (63.1)	59.0 (51.0-66.6)
Missing	1 -		1 -		1 -	
Marital status						
Single	227 (56.9)	63.8 (57.7-71.4)	293 (71.5)	76.5 (71.3-81.4)	278 (65.0)	65.4 (58.2-71.4)
Married	31 (7.8)	4.6 (2.5-8.0)	19 (4.6)	4.4 (2.4-6.6)	37 (8.6)	10.6 (6.6-14.8)
Divorced/separated/widowed	141 (35.3)	31.6 (24.0-36.9)	98 (23.9)	19.1 (14.6-24.1)	113 (26.4)	24.0 (19.1-30.4)
Missing	1 -		1 -		1 -	
Resides in province of survey	397 (99.5)	99.7 (99.1-100)	408 (99.5)	99.3 (98.0-100)	425 (99.3)	99.1 (97.7-100)
Other income other than sex work	103 (25.8)	23.7 (18.1-29.3)	129 (31.5)	30.4 (25.0-36.4)	62 (14.5)	16.8 (11.9-21.8)
Missing	1 -		1 -		1 -	
Age at first vaginal sex (years)						
15	97 (24.9)	30.4 (23.5-38.1)	114 (28.2)	25.5 (20.8-30.2)	177 (41.5)	37.3 (30.9-43.7)
15-17	224 (57.4)	54.5 (46.9-61.7)	228 (56.4)	58.6 (52.7-64.8)	200 (46.8)	51.8 (45.0-58.5)
18	69 (17.7)	15.1 (10.7-20.0)	62 (15.3)	15.8 (11.6-20.5)	50 (11.7)	10.9 (7.4-15.1)

Category	Maputo (n=400)		Beira (n=411)		Nampula (n=429)	
	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)
Missing	10	-	7	-	2	-
Age at first sex for money (years)						
<15	25 (6.3)	8.5 (4.2-13.2)	34 (8.4)	7.9 (4.8-10.5)	67 (15.7)	15.5 (11.7-20.2)
15-17	117 (29.4)	34.9 (28.8-42.5)	198 (49.0)	51.5 (44.4-57.2)	206 (48.2)	48.4 (41.7-55.2)
18-20	132 (33.2)	31.0 (26.2-38.9)	122 (30.2)	29.3 (24.4-36.5)	110 (25.8)	24.8 (18.6-31.1)
21	124 (31.2)	25.6 (17.5-30.3)	50 (12.4)	11.3 (7.9-15.2)	44 (10.3)	11.4 (7.3-15.5)
Missing	2	-	7	-	2	-
Less than three years since first sex for money	174 (43.7)	48.8 (42.0-56.6)	185 (45.8)	48.5 (42.3-55.5)	200 (46.8)	54.3 (47.1-62.3)
Missing	2	-	7	-	2	-
Number of client sex partners last month						
None	5 (1.3)	0.7 (0.1-1.7)	5 (1.2)	2.1 (0.5-4.1)	5 (1.2)	2.0 (0.3-4.3)
1-2	68 (17.2)	27.9 (21.8-34.9)	176 (43.0)	47.0 (42.1-53.0)	87 (20.5)	26.5 (20.3-32.9)
3-4	116 (29.3)	29.7 (24.6-35.7)	122 (29.8)	29.6 (24.3-33.9)	141 (33.2)	33.9 (27.9-40.4)
5-6	68 (17.2)	16.7 (11.6-20.4)	56 (13.7)	10.8 (7.8-14.2)	82 (19.3)	15.8 (11.9-20.1)
7	139 (35.1)	24.9 (20.0-30.6)	50 (12.2)	10.5 (7.0-14.4)	110 (25.9)	21.8 (16.3-27.3)
Missing	4	-	2	-	4	-
Number of first-time client partners last month						
None	111 (28.2)	30.9 (25.0-37.2)	53 (13.0)	12.5 (9.1-17.2)	175 (41.4)	42.2 (36.2-48.5)
1	103 (26.1)	30.4 (24.3-36.7)	141 (34.6)	36.9 (30.9-43.3)	85 (20.1)	23.5 (17.7-28.8)
2	53 (13.5)	14.8 (10.3-19.6)	119 (29.2)	28.9 (23.5-33.8)	47 (11.1)	8.6 (6.0-12.0)
3	30 (7.6)	7.1 (4.4-11.1)	52 (12.7)	13.0 (9.3-17.0)	41 (9.7)	10.6 (7.0-14.6)
4	97 (24.6)	16.8 (12.3-20.8)	43 (10.5)	8.7 (5.6-11.6)	75 (17.7)	15.1 (10.9-19.9)
Missing	6	-	3	-	6	-
Number of non-client sex partners last month						
No partners	268 (68.5)	65.4 (59.3-72.0)	216 (52.8)	51.9 (45.8-58.2)	251 (59.8)	60.0 (53.9-66.6)
1	103 (26.3)	27.8 (22.0-34.5)	120 (29.3)	30.6 (24.9-36.3)	116 (27.6)	26.5 (21.3-32.1)
1	20 (5.1)	6.8 (2.4-10.7)	73 (17.8)	17.5 (12.7-22.6)	53 (12.6)	13.5 (8.9-17.8)
No fixed/Missing	9	-	2	-	9	-
Condom use last sex with client						
Condom used	353 (88.7)	85.8 (81.0-90.1)	300 (73.3)	73.4 (67.7-79.1)	266 (62.1)	62.8 (56.6-69.4)

Category	Maputo (n=400)		Beira (n=411)		Nampula (n=429)	
	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)
Missing	2 -		2 -		1 -	
Condom use last sex with non-client						
Condom used	64 (55.2)	50.6 (33.0-66.2)	100 (55.9)	52.3 (40.3-65.7)	72 (46.5)	56.7 (44.3-72.7)
No non-client partner/Missing	284 -		232 -		274 -	
Had STI symptom or diagnosis last 6 months	106 (26.6)	31.1 (25.3-37.6)	171 (41.8)	43.0 (37.2-48.6)	119 (27.8)	30.6 (24.2-37.3)
Missing	1 -		2 -		1 -	
Had a genital ulcer last 6 months						
Yes	27 (6.8)	7.4 (4.1-11.8)	51 (12.5)	13.0 (9.6-16.9)	41 (9.6)	9.0 (5.7-12.8)
Missing	1 -		2 -		1 -	
Using modern contraception	210 (52.5)	54.5 (47.8-60.8)	155 (37.7)	37.7 (32.5-43.2)	241 (56.2)	51.1 (44.8-57.7)
Missing	0 -		0 -		0 -	
Abortion history						
Ever had spontaneous abortion	29 (9.6)	10.3 (5.3-13.9)	40 (14.9)	14.5 (10.1-20.7)	33 (11.5)	9.7 (5.5-17.9)
Ever had intentional abortion	105 (34.9)	38.3 (31.2-48.3)	79 (29.5)	28.9 (22.2-37.4)	108 (37.6)	36.3 (27.2-46.4)
Never had abortion	167 (55.5)	51.4 (42.4-60.0)	149 (55.6)	56.6 (47.2-63.6)	146 (50.9)	54.0 (42.8-62.0)
Never pregnant/Missing	99 -		143 -		142 -	
Ever had anal sex	85 (21.3)	22.8 (17.7-29.1)	63 (15.4)	13.8 (9.9-18.2)	122 (28.5)	26.1 (20.5-31.7)
Missing	1 -		1 -		1 -	
Problematic alcohol use score (AUDIT-C)	180 (46.3)	44.5 (38.0-51.9)	204 (49.9)	50.0 (44.0-56.0)	185 (43.2)	41.3 (34.1-48.1)
Missing	11 -		2 -		1 -	
Minimum charged for sex last month (MZN); 1USD=30MZN						
1-175	96 (24.9)	24.8 (19.3-31.6)	103 (25.6)	31.1 (23.2-38.8)	128 (30.5)	29.8 (23.6-36.8)
176-325	165 (42.7)	46.0 (39.2-52.3)	99 (24.6)	22.4 (17.3-28.0)	166 (39.6)	39.0 (32.3-45.9)
326	125 (32.4)	29.2 (22.5-35.8)	201 (49.9)	46.5 (38.6-55.1)	125 (29.8)	31.2 (24.4-38.1)
Missing	14 -		8 -		10 -	
Contact with peer educator last 6 months	77 (19.3)	16.8 (12.0-21.6)	75 (18.3)	17.8 (13.8-21.9)	113 (26.4)	23.5 (18.4-29.0)
Missing	2 -		2 -		1 -	
Ever had an HIV test	305 (76.4)	73.7 (66.3-79.7)	279 (68.0)	63.0 (56.4-69.2)	259 (60.5)	59.1 (51.8-65.6)
Missing	1 -		1 -		1 -	
Reactive for HIV antibodies	144 (36.2)	31.2 (24.5-37.5)	117 (28.5)	23.6 (18.6-29.1)	80 (18.6)	17.8 (13.3-22.7)

	Maputo (n=400)		Beira (n=411)		Nampula (n=429)	
Category	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)	Crude n (%)	RDS % (95% CI)
Missing	2	-	1	-	0	-

Table 2

HIV serostatus knowledge and health service access among FSW in Maputo, Beira, and Nampula, Mozambique, 2011-2012.

Category	Maputo			Beira			Nampula		
	Crude n=143	(%)	RDS % (95% CI)	Crude n=116	(%)	RDS % (95% CI)	Crude n=80	(%)	RDS % (95% CI)
Unknown status among HIV+ FSW									
Unaware they were positive	96	(67.1)	48.1 (31.2-66.5)	95	(81.9)	79.8 (68.1-89.3)	72	(90.0)	89.6 (57.6-100)
Knew they were positive	47	(32.9)	51.9 (34.4-69.0)	21	(18.1)	20.2 (10.6-31.8)	8	(10.0)	10.4 (0.0-40.6)
Sought care last 6 months									
Yes	42	(29.4)	39.4 (26.0-49.1)	20	(17.2)	15.3 (9.0-23.6)	6	(7.5)	11.9 (4.9-27.5)
No	5	(3.5)	3.4 (0.1-8.3)	1	(0.9)	0.3 (0.0-0.9)	2	(2.5)	2.4 (0.0-5.0)
Not diagnosed before	96	(67.1)	57.2 (47.4-71.1)	95	(81.9)	84.4 (76.2-90.6)	72	(90.0)	85.7 (71.3-94.0)
Currently or ever on HIV antiretroviral therapy (ART)									
Currently taking	23	(16.1)	23.5 (11.8-32.9)	14	(12.1)	8.6 (3.7-14.6)	3	(3.8)	3.6 (0.8-9.3)
Ever, but not currently	2	(1.4)	0.9 (0.0-2.1)	1	(0.9)	1.4 (0.0-4.9)	0	(0)	-
Never on ART	22	(15.4)	18.2 (9.1-28.0)	6	(5.2)	5.7 (1.6-11.2)	5	(6.2)	10.6 (0.9-20.8)
Not diagnosed before	96	(67.1)	57.4 (47.8-71.6)	95	(81.9)	84.3 (76.7-91.0)	72	(90.0)	85.9 (74.7-96.1)

Table 3

Bivariate associations between HIV infection, socio-demographic characteristics and sexual risk behavior among FSW in Maputo, Beira, and Nampula, Mozambique, 2011-2012.

Category	Maputo				Beira				Nampula			
	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)
Age group (years)												
15-17	0.0	<0.001	(0.0-18.0)	<0.001 (104.8,4)	5.1	0.5	(0.1-1.5)	<0.001 (66.1,4)	0.5	0.1	(0.0-1.2)	<0.001 (104.7,4)
18-19	14.1	ref			6.8	ref			3.5	ref		
20-24	25.1	2.3	(1.1-5.1)		31.9	4.3	(2.1-9.7)		20.3	6.7	(2.2-28.7)	
25-29	63.7	9.6	(4.3-22.7)		42.9	9.3	(4.0-22.9)		45.3	20.9	(6.7-92.6)	
30	56.7	8.7	(4.1-20.1)		54.1	10.8	(4.1-29.7)		54.4	32.2	(9.5-150.4)	
Education level												
None or primary	50.8	ref		<0.001 (58.4,1)	35.7	ref		<0.001 (17.6,1)	25.6	ref		0.042 (4.1,1)
Secondary or more	14.5	0.2	(0.1-0.3)		16.7	0.4	(0.2-0.6)		15.7	0.6	(0.3-1.0)	
Currently studying												
Yes	15.2	ref		<0.001 (20.8,1)	12.6	ref		<0.001 (25.1,1)	11.0	ref		<0.001 (21.1,1)
No	37.5	3.2	(1.9-5.6)		35.0	3.3	(2.1-5.5)		28.6	3.3	(2.0-5.5)	
Marital status												
Single	19.1	ref		<0.001 (33.3,2)	17.9	ref		<0.001 (31.3,2)	6.8	ref		<0.001 (59.3,2)
Married	42.4	3.5	(1.4-8.5)		33.0	2.2	(0.7-6.3)		38.6	8.7	(4.1-18.5)	
Separated, Divorced, or Widowed	46.6	3.6	(2.3-5.8)		46.5	4.4	(2.6-7.5)		34.8	7.5	(4.1-14.0)	
Other income besides sex work												
Yes	33.0	ref		0.35 (0.9,1)	31.7	ref		0.029 (4.8,1)	28.4	ref		0.012 (6.3,1)
No	30.8	0.8	(0.5-1.3)		19.7	0.6	(0.4-0.9)		15.6	0.5	(0.3-0.8)	
Age at first vaginal sex (years)												
<15	20.0	ref		0.082 (5,2)	24.2	ref		0.019 (7.9,2)	14.1	ref		0.23 (2.9,2)

Category	Maputo HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	Beira HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	Nampula HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)
15-17	28.2	1.4	(0.8-2.4)		21.7	0.9	(0.5-1.5)		19.4	1.4	(0.8-2.5)	
18	38.9	2.2	(1.1-4.3)		38.7	2.1	(1.0-4.2)		23.3	1.9	(0.8-4.1)	
Age at first sex for money				<0.001 (49.3,3)				<0.001 (50.2,3)				<0.001 (49.3)
<15	6.2	ref			28.6	ref			3.1	ref		
15-17	19.6	3.4	(1.0-21.0)		12.3	0.4	(0.2-1.0)		9.8	3.3	(0.9-19.8)	
18-20	24.9	4.7	(1.3-28.3)		27.1	1.1	(0.5-2.7)		24.8	9.6	(2.8-57.5)	
21	57.7	17.0	(4.9-102.8)		66.8	4.9	(1.9-13.7)		47.4	26.6	(7.4-164.0)	
Years since first sex for money				<0.001 (48.2,1)				<0.001 (21.5,1)				<0.001 (53.1,1)
0-2	14.8	ref			12.5	ref			4.7	ref		
3	45.8	5.0	(3.1-8.3)		32.6	3.1	(1.9-5.2)		29.8	8.9	(4.6-19.1)	
Had genital ulcer in last 6 months												
Yes	29.2	1.0	(0.4-2.3)		40.3	2.4	(1.3-4.4)		30.2	2.4	(1.1-4.7)	
No	31.2	ref		0.93 (0.007,1)	21.5	ref		0.006 (7.5,1)	16.6	ref		0.025 (5,1)
Had STI symptom or test in last 6 months												
Yes	25.7	0.8	(0.5-1.2)		25.7	1.3	(0.8-2.1)		19.4	1.2	(0.7-2.1)	
No	32.7	ref		0.3 (1.1,1)	21.7	ref		0.21 (1.5,1)	17.5	ref		0.42 (0.6,1)
Problematic alcohol use score (AUDIT-C)												
Alcohol problem	30.1	0.9	(0.6-1.4)		22.1	0.9	(0.6-1.5)		30.3	4.6	(2.7-8.0)	
No alcohol problem	31.3	ref		0.78 (0.08,1)	24.0	ref		0.8 (0.07,1)	8.5	ref		<0.001 (33.5,1)
Lowest price for sex in last month (MZN)												
1-175	36.7	ref		0.013 (8.7,2)	21.0	ref		0.4 (1.8,2)	17.0	ref		0.72 (0.7,2)
176-325	31.3	0.8	(0.5-1.4)		26.7	1.6	(0.8-3.1)		21.0	1.2	(0.7-2.3)	
326	19.6	0.4	(0.2-0.8)		23.1	1.4	(0.8-2.5)		17.0	1.0	(0.5-1.9)	

Category	Maputo				Beira				Nampula			
	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)
Number of first-time client partners last month												
None	26.4	ref		0.31 (4.8,4)	31.5	ref		0.037 (10.2,4)	17.1	ref		0.21 (5.9,4)
1	27.5	1.2	(0.7-2.1)		14.0	0.5	(0.2-1.0)		10.6	0.6	(0.3-1.3)	
2	43.1	1.8	(0.9-3.6)		23.9	0.8	(0.4-1.7)		18.4	1.1	(0.4-2.6)	
3	28.4	0.9	(0.3-2.4)		36.9	1.3	(0.5-3.0)		22.2	1.5	(0.6-3.3)	
4	30.0	1.7	(0.9-3.1)		30.5	1.1	(0.4-2.7)		22.8	1.6	(0.8-3.2)	
Number of client sex partners in last month												
0-4	27.2	ref		0.36 (2.0,2)	20.5	ref		0.029 (7.1,2)	17.7	ref		0.31 (2.3,2)
5-9	29.5	1.3	(0.8-2.1)		32.8	1.9	(1.0-3.3)		16.5	0.9	(0.5-1.7)	
10	34.1	1.5	(0.8-2.6)		43.5	2.7	(1.0-7.0)		23.5	1.6	(0.8-3.1)	
Number of non-client sex partners last month												
No partners	36.6	ref		0.017 (8.2,2)	25.4	ref		0.33 (2.2,2)	22.2	ref		0.051 (5.9,2)
1	16.6	0.5	(0.3-0.8)		24.7	0.9	(0.6-1.6)		13.7	0.6	(0.3-1.1)	
1	16.9	0.6	(0.2-1.4)		17.3	0.6	(0.3-1.2)		10.6	0.4	(0.2-1.0)	
Age at first sex for money												
<15	6.2	ref		< 0.001 (49.3,3)	28.6	ref		< 0.001 (50.2,3)	3.1	ref		< 0.001 (49,3)
15-17	19.6	3.4	(1.0-21.0)		12.3	0.4	(0.2-1.0)		9.8	3.3	(0.9-19.8)	
18-20	24.9	4.7	(1.3-28.3)		27.1	1.1	(0.5-2.7)		24.8	9.6	(2.8-57.5)	
21	57.7	17.0	(4.9-102.8)		66.8	4.9	(1.9-13.7)		47.4	26.6	(7.4-164.0)	
Use of contraceptive to prevent pregnancy												
Yes	26.6	ref		0.016 (5.8,1)	34.4	ref		0.001 (10.8,1)	16.3	ref		0.56 (0.3,1)
No	36.4	1.7	(1.1-2.6)		17.2	0.5	(0.3-0.7)		19.0	1.2	(0.7-1.9)	
Ever had an HIV test												

Category	Maputo				Beira				Nampula			
	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)	HIV+ (%) RDS Adjusted	Odds Ratio	(95% CI)	p-value (test statistic, df)
Yes	35.5	ref		< 0.001 (13.1,1)	29.4	ref		< 0.001 (12.2,1)	20.4	ref		0.044 (4.1,1)
No	15.2	0.4	(0.2–0.6)		13.8	0.4	(0.2–0.7)		12.8	0.6	(0.3–1.0)	

Table 4

Multivariable regression results of associations between HIV infection and socio-demographic characteristics and sexual risk behavior among FSW in Maputo, Beira, and Nampula, Mozambique, 2011–2012.

	Odds of HIV Infection		
	Maputo	Beira	Nampula
Age 20-24 years	3.89 *** (3.04,4.74)	4.40 *** (3.57,5.24)	13.18 *** (12.04,14.32)
Age 25-29 years	14.19 *** (13.27,15.11)	8.15 *** (7.18,9.11)	38.33 *** (37.08,39.58)
Age 30+ years	9.95 *** (9.05,10.84)	6.59 *** (5.37,7.81)	51.77 *** (50.30,53.24)
Never studied or some primary education only	3.72 *** (3.15,4.28)	2.19 *** (1.32,3.07)	
Genital ulcer in previous 6 months		2.19 *** (1.32,3.07)	
First sex for money aged 15-17 years		0.54 (<0.01, 1.61)	3.65 *** (1.97,5.32)
First sex for money aged 18-20 years		0.73 (<0.01,1.87)	3.43 *** (1.73,5.13)
First sex for money aged 21+ years		2.44 *** (1.16,3.71)	3.94 *** (2.22,5.66)
Number of client sex partners last month (log-transformed)		1.80 *** (1.30,2.30)	
Constant	0.05 (<0.01,0.83)	0.05 (<0.01,1.30)	0.01 (<0.01,1.72)
Observations	397	401	427
Log Likelihood	−176.52	−166.2	−139.74
Akaike Inf. Crit.	363.05	350.4	293.47

Note:

*p<0.1

**p<0.05

***
   p<0.01