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Temporal trends in HIV prevention service access and use among female sex workers (FSW) in Mozambique: a comparative analysis 2011–2019

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Abstract

Background Female sex workers (FSWs) remain disproportionately affected by HIV due to a combination of structural, social, and behavioral factors, including stigma, limited access to health services, gender-based violence, and legal barriers. In Mozambique, where sex work is informal and highly marginalized, monitoring trends in service uptake is essential to guide responsive and equitable HIV interventions. This study analyzes changes in access to and use of HIV prevention services among FSWs between 2011 and 2019.

Methods We conducted a secondary analysis of cross-sectional bio-behavioral survey (BBS) data collected among FSWs in 2011 and 2019 in three Mozambican urban centers. Standardized questionnaires were used to collect behavioral and biological data, including indicators of HIV prevention service access. Participants were recruited using Respondent-Driven Sampling (RDS). Logistic regression was applied to assess time trends and identify factors associated with service uptake.

Results A total of 1,240 FSWs participants were recruited in 2011 and 1,530 in 2019. Between 2011 and 2019, there was a significant increase in HIV prevalence (from 11.9 to 24.5%). The proportion of participants accessing HIV prevention services more than doubled (from 21.4 to 52.3%), alongside marked improvements in HIV testing uptake (68.0–83.1%) and consistent condom use with clients (74.1–86.3%). Multivariate analysis showed that age ≥ 25 , moderate HIV risk perception, and experiences of sexual violence were positively associated with access to prevention services in 2019. In contrast, alcohol use and physical assault were negatively associated with service use. Determinants of access shifted over time; for example, while secondary education was positively associated with service access in 2011, it was negatively associated in 2019.

Conclusion There has been substantial progress in access to and use of HIV prevention services among FSWs in Mozambique over the past decade. Nonetheless, the rising HIV prevalence and persistent disparities related to age, education, economic vulnerability, and exposure to violence signal the need for more comprehensive, context-

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specific, and equity-focused strategies. Reinforcing peer-led outreach, integrating gender-based violence response, and addressing risk misperception are critical to strengthening Mozambique's HIV prevention continuum for this key population.

Keywords Health services accessibility, HIV, Female sex workers, Mozambique, Prevention, Key populations

Background

In the context of the global HIV epidemic, female sex workers (FSWs) remain one of the most affected and underserved populations. While key populations as a whole face increased vulnerability, FSWs in particular experience a convergence of risks, including limited access to health services, legal marginalization, and high exposure to gender-based violence. In 2022, FSWs were estimated to have a risk of HIV acquisition nearly nine times higher than that of the general adult population [1, 2].

In Sub-Saharan Africa alone, there are an estimated 2.5 million FSWs aged 15–49, many of whom face persistent barriers to care. A recent systematic review and meta-analysis estimated the pooled HIV prevalence among FSWs in the region at 36.0% (95% CI: 31.0–41.0%), with stark disparities between subregions: 59.0% in Southern Africa and 29.0% in Eastern Africa [2]. These findings reflect the ongoing burden of HIV in this population, as well as the persistent inequities in access to prevention and care services.

Although global attention to the HIV prevention needs of FSWs has increased in recent years, major gaps remain in the availability, coverage, and quality of services, particularly in low- and middle-income countries. These gaps are largely driven by systemic challenges such as stigma and discrimination within healthcare systems, the criminalization of sex work, inadequate provider training, and insufficient integration of key populations into national health strategies [3, 4].

In Mozambique, the HIV epidemic remains a major public health challenge. The country is among those with the highest number of new HIV infections and people living with HIV (PLHIV) globally. The 2021 Mozambique Population-based HIV Impact Assessment (INSIDA 2021) estimated a national HIV prevalence of 12.5% among individuals aged 15–49, with higher rates among women (15.4%) compared to men (9.5%) [5]. FSWs and their sexual partners are estimated to account for 5.2% of new HIV infections in Mozambique, according to national HIV modeling estimates [6].

In response, Mozambique has implemented a range of national strategies and donor-supported initiatives aimed at increasing access to HIV prevention services for key populations, including FSWs. These include community-based outreach, peer-led interventions, and differentiated service delivery approaches. However, there remains a limited body of longitudinal evidence evaluating the

impact of these efforts, particularly whether they have effectively expanded coverage or improved equity in service access for FSWs over time. Moreover, these efforts continue to unfold within a health system marked by deep structural inequalities. Factors such as poverty, mobility, criminalization, and social exclusion continue to undermine the ability of FSWs to access consistent, high-quality prevention services [4, 7].

Against this backdrop, this study examines trends in access to and utilization of HIV prevention services among FSWs in Mozambique between 2011 and 2019. Using data from two rounds of nationally implemented bio-behavioral surveillance surveys (BBS), we assess changes in key prevention indicators such as HIV testing, consistent condom use, and health-seeking behavior, and explore associated demographic and structural factors. The findings aim to inform evidence-based programming and support the design of more responsive and equitable HIV interventions targeting FSWs. By addressing the specific needs of this population, Mozambique can strengthen the inclusivity of its national HIV response and accelerate progress toward epidemic control, leaving no one behind.

Methods

Study design

This study used data from two cross-sectional BBS conducted among FSW conducted in Mozambique. The first round was carried out in 2011 and the second in 2019. In 2011, data collection was conducted in three major urban areas: Maputo, Beira, and Nampula, while the subsequent 2019 was expanded to include two additional urban areas, Tete and Quelimane.

Both surveys employed Respondent-Driven Sampling (RDS), a peer-referral recruitment method specifically designed to reach hidden and stigmatized populations. Participants completed a structured, interviewer-administered questionnaire that captured data on sociodemographic characteristics, sexual behaviors, access to HIV prevention and care services, and healthcare-seeking practices. Additionally, dried blood spot (DBS) samples were collected for laboratory-based HIV testing.

The BBS methodology, including sampling procedures, data collection protocols, and laboratory methods, has been extensively described in prior publications [4, 7–9].

For the purpose of this analysis, only data from Maputo, Beira, and Nampula were included to ensure comparability between the two survey rounds.

Sampling and recruitment

Both survey rounds applied RDS to recruit participants through peer networks [10]. Recruitment began with the selection of initial participants (“seeds”), identified as well-connected FSWs in each city. Each seed received five referral coupons to distribute to peers within their social networks. All subsequent eligible participants received three coupons, enabling successive waves of recruitment.

Eligibility criteria were consistent across both rounds. Participants had to be biologically female, aged 15 years or older, report having received money or goods in exchange for sex with someone other than a regular partner in the previous six months, and have lived, worked, or socialized in the study city for at least six months. All eligible participants completed the survey and provided a DBS sample for HIV testing.

In 2011, recruitment took place in Maputo, Beira, and Nampula. A total of 2,160 coupons were distributed in Maputo, 1,455 in Beira, and 1,446 in Nampula. Coupon return rates were 20% in Maputo and 33% in Beira and Nampula. After eligibility screening, 32 individuals in Maputo, 74 in Beira, and 53 in Nampula were excluded due to not meeting criteria or declining participation. Final sample sizes were 400 in Maputo, 411 in Beira, and 429 in Nampula, totaling 1,240 participants.

In 2019, the survey was extended to five cities, but this analysis focuses only on the three original cities. That year, 1,454 coupons were distributed in Maputo, 1,425 in Beira, and 1,313 in Nampula. The overall return rate was 37.4%. After screening, 492 participants were enrolled in Maputo, 520 in Beira, and 518 in Nampula, totaling 1,530 participants, as detailed in Table 1.

Coupon tracking and management were conducted using the RDS Coupon Manager software and manual logbooks to ensure traceability of recruitment and referral chains.

Study measures

The present study analyzed two primary outcomes: access to health services and utilization of health services. Access to health services was assessed using the following survey questions: whether the participant had contact with a peer educator or HIV/AIDS activist in the six months preceding the survey, and whether the participant received free condoms, lubricants, and pamphlets during the same period. A female sex worker (FSW) who

answered “yes” to either question was considered to have access to health services.

Utilization of health services was evaluated based on the following criteria: whether participants sought medical attention from a doctor, nurse, or other health professional for health issues in the past six months, consistent condom use, and whether they had been tested for HIV/AIDS. A “yes” response to any of these items indicated that the FSW was utilizing health services, while a “yes” response to all items indicated non-utilization of health services.

Regarding the explanatory variables, they were selected based on studies by Armstrong and Harriet and their availability in the dataset for both periods [11, 12].

These variables encompass socio-demographic, behavioural, and sexual history factors. The socio-demographic factors included age, marital status, religion, language, education level, and monthly income. The behavioural factors included alcohol consumption, illicit drug use, and condom use during the last sexual encounter with a client. Sexual history factors included whether the participant had a diagnosis or symptoms of STIs in the six months preceding the survey and the age at which the participant first had sex for money. Additionally, we considered the participant’s perception of their risk of contracting HIV, whether they had been tested for HIV in the last 12 months, and whether they had experienced physical or sexual violence in the six months preceding the survey.

Data analysis

Analysis was conducted using R version 4.2.1. The RDS package for R was used generate proportion estimates with 95% confidence intervals adjusted for recruitment patterns associated with RDS [13]. We conducted descriptive analysis to describe the study variable and compute the coverage of access to health service and utilization of health services by study variables. To compare the coverages between the two surveys, we used the Z-test statistics for equality of proportion. Subsequently, logistic regression was applied with the goal of evaluating the variation in odds of access to and use of HIV prevention services among FSW between 2011 and 2019.

Furthermore, additional logistic regression analysis was conducted to study the relationship between selected FSW characteristics and access to and use of HIV prevention services during this period, examining how this relationship varies across different time periods. To this end, interaction effects between the characteristics of FSW and the “year” variable, which identifies the periods, were included in the logistic regression model. During the logistic regression estimation process, RDS sampling weights were also included to generate weighted estimates. The weights were defined so that they were

Table 1 Geographic distribution of study participants in 2011 and 2019 in Mozambique

Year	Urban Center			Total FSW recruited
	Maputo	Beira	Nampula	
2011	400	411	429	1,240
2019	492	520	518	1,530

inversely proportional to the size of the network. Furthermore, a stepwise variable selection method was employed to eliminate less significant variables and interactions in the multivariate logistic regression.

Ethical considerations

Both survey protocols received ethical approval from the Institutional Bioethics Committee for Health of the Faculty of Medicine and Central Hospital of Maputo (CIBS FM&HCM), and the National Bioethics Committee for Health (CNBS). The current secondary analysis was reviewed and approved by the same Institutional Bioethics Committee under protocol number CIBS FM&HCM/086/2021, version 1.4 of April 2022. Approval was also granted by the Data Management Unit of the National Institute of Health.

The authors declare that they have strictly followed all procedures by the ethical principles established in the relevant Declaration of Helsinki and have followed internationally recognized standards for research involving human subjects.

Results

FSW sociodemographic and behavioral characteristics, HIV prevalence, and history of sexual violence (2011–2019)

Table 2 presents the sociodemographic characteristics, sexual behavior, HIV positivity rates, and reported experiences of sexual violence among FSWs in Mozambique in 2011 and 2019. A total of 1,240 FSWs were recruited in 2011 and 1,530 in 2019.

In 2011, 39.8% (95% CI: 35.3–44.3) of participants were aged 15–19 years, compared to 29.5% (95% CI: 27.4–35.5) in 2019. The proportion of FSWs participants who relied exclusively on sex work as their main source of income decreased from 75.5% (95% CI: 72.7–78.3) in 2011 to 70.8% (95% CI: 69.2–74.1) in 2019. Monthly earnings of $\geq 1,000$ meticaïs (~USD 16) increased from 24.1% (95% CI: 20.5–27.0) to 28.1% (95% CI: 24.6–29.6).

The proportion of participants who reported initiating transactional sex before the age of 18 declined from 67.3% (95% CI: 63.9–70.8) in 2011 to 42.4% (95% CI: 39.3–46.1) in 2019. Alcohol consumption increased from 53.1% (95% CI: 50.9–55.4) in 2011 to 54.8% (95% CI: 50.4–56.3) in 2019. Similarly, the proportion of FSW participants reporting drug use increased from 1.6% (95% CI: 1.3–2.0) in 2011 to 15.6% (95% CI: 12.3–16.7) in 2019.

Consistent condom use with clients declined from 25.8% (95% CI: 23.1–28.6) in 2011 to 18.8% (95% CI: 16.8–21.1) in 2019. The proportion of FSWs participants who reported a diagnosis or symptoms of STIs decreased slightly, from 59.5% (95% CI: 57.2–61.7) to 57.5% (95% CI: 47.8–67.2), and HIV positivity increasing from 11.9% (95% CI: 8.6–15.4) in 2011 to 24.5% (95% CI: 20.7–26.3) in 2019.

Access and use of HIV prevention services among FSW (2011–2019)

The proportion of FSW participants reporting access of HIV prevention services increases from 21.4% (95% CI: 15.6–27.2) in 2011 to 52.3% (95% CI: 46.7–57.9) in 2019. This corresponds to a 5.6-fold increase in the odds of access in 2019 compared to 2011. Free access to condoms, lubricants, and informational materials also improved, increasing from 51.9% (95% CI: 43.7–61.1) to 56.5% (95% CI: 50.9–61.9) during the same period. The odds of access to these materials were 3.4 times higher in 2019 than in 2011 (Fig. 1).

Significant improvements were also observed in the use of prevention services. The proportion of FSWs who sought care from a health professional due to health-related concerns increased from 39.5% (95% CI: 35.3–43.6) in 2011 to 61.2% (95% CI: 55.8–66.7) in 2019, reflecting 1.8 times higher odds of seeking care. Consistent condom use with clients increase from 74.1% (95% CI: 69.5–78.7) to 86.3% (95% CI: 82.7–89.9), and HIV testing uptake increased from 68.0% (95% CI: 63.9–72.2) to 83.1% (95% CI: 76.2–90.3) between the two survey rounds. The odds of consistent condom use and HIV testing were 1.5 and 1.7 times higher, respectively, in 2019 compared to 2011 (Fig. 2).

Temporal variation and determinants of access to HIV prevention services

Multivariate logistic regression results are presented in Table 3. Several variables were significantly associated with access to HIV prevention services, and their effects varied between 2011 and 2019, as evidenced by interaction terms with survey year.

In 2011, FSWs participants aged ≥ 25 years were more likely to access prevention services compared to those aged 15–19 years (OR: 2.0). This association became stronger in 2019 (OR: 2.4). In 2011, having secondary or higher education was positively associated with service access (OR: 2.0) compared to having no formal education or only primary education. However, in 2019, this relationship reversed, with higher education being negatively associated with access (OR: 0.4), indicating a 60% lower likelihood of accessing services. FSWs participants identifying as Christian (OR: 0.5) or Muslim (OR: 0.6) were less likely to access services compared to those with no religious affiliation or other beliefs. By 2019, this trend had reversed, with Christians (OR: 5.0) and Muslims (OR: 3.4) participants significantly more likely to report access to services. FSWs participants engaged in additional income-generating activities beyond sex work were more likely to access services in 2011 (OR: 2.0) than those who relied exclusively on sex work. In contrast, in 2019, the same group had substantially lower odds of access (OR: 0.3). FSWs participants who perceived their HIV

Table 2 Sociodemographic characteristics and risk factors among FSWs in Mozambique between 2011 and 2019¹

Variable	2011 BBS		2019 BBS		P-value
	n	% (IC:95%)	n	% (IC:95%)	
Age group					
15–19	488	39.8 (35.3–44.3)	452	29.5 (27.4–35.5)	0.01
20–24	400	33.5 (30.2–36.9)	438	28.6 (25.9–31.0)	0.04
25–29	190	14.4 (12.1–16.8)	249	16.3 (13.8–18.3)	0.21
≥ 30	162	12.2 (9.6–14.9)	391	25.6 (20.8–27.4)	< 0.0001
Marital Status					
Single	798	65.8 (62.6–69.1)	938	61.3 (58.5–64.9)	0.84
Married/Common-law Marriage	87	6.3 (3.6–9.1)	138	9.0 (5.7–11.6)	0.74
Widowed/divorced/separated	352	27.8 (25.3–30.4)	453	29.6 (27.3–31.9)	0.62
Language spoken at home					
Portuguese	580	46.2 (43.5–48.9)	748	48.9 (48.9–54.6)	0.91
Second main language*	550	45.2 (42.5–48.0)	693	45.3 (40.1–45.7)	1.0
Other	107	8.6 (7.4–9.8)	89	5.8 (4.1–6.6)	0.72
Religion					
Christian	838	68.3 (65.7–70.8)	959	62.7 (59.8–65.6)	0.18
Muslim	161	12.5 (10.4–14.6)	243	15.9 (14.5–20.3)	0.25
Other/None	238	19.2 (17.5–21.0)	328	21.4 (17.7–22.3)	0.63
Level of education					
Primary/no schooling	458	36.4 (4.0–38.8)	376	25.9 (23.1–28.3)	0.07
Secondary/Higher	779	63.6 (61.2–66.1)	1073	74.1 (71.7–76.9)	0.07
Didn't do any other work besides sex work	943	75.5 (72.7–78.3)	1084	70.8 (69.2–74.1)	0.01
Monthly income in metical (Mt)					
≤ 325	322	26.1 (22.6–29.6)	392	26.9 (24.6–29.7)	0.07
326–530	294	23.7 (21.2–27.0)	276	18.9 (16.8–21.5)	0.10
531–999	305	26.1 (23.0–29.1)	380	26.1 (24.2–29.1)	0.02
≥ 1000	294	24.1 (20.5–27.0)	409	28.1 (24.6–29.6)	0.02
Had 1st transactional sexual relationship when < 18 years old	826	67.3 (63.9–70.8)	645	42.4 (39.3–46.1)	< 0.0001
Alcohol consumption	670	53.1 (50.9–55.4)	838	54.8 (50.4–56.3)	0.001
Drug use	24	1.6 (1.3–2.0)	238	15.6 (12.3–16.7)	< 0.0001
Perceived risk of contracting HIV*					
Low risk	234	23.0 (19.9–26.1)	255	26.7 (24.2–30.3)	0.5
Moderate risk	268	26.1 (23.2–29.0)	216	22.6 (17.3–22.7)	0.999
High risk	325	29.2 (26.5–31.9)	320	33.5 (31.1–36.9)	0.09
Frequent condom uses with client	316	25.8 (23.1–28.6)	288	18.8 (16.8–21.1)	0.003
Diagnosis or symptoms of STI	750	59.5 (57.2–61.7)	878	57.5 (47.8–67.2)	< 0.0001
Has been rape or sexually assaulted	138	11.4 (10.0–12.8)	227	16.7 (12.5–17.2)	0.999
Tested HIV positive	91	11.9 (8.6–15.4)	359	24.5 (20.7–26.3)	< 0.0001

* Applies only to FSWs who have never tested positive for HIV

¹The percentages herein are weighted and were computed using the Gile's sequential sampling (SS) estimator. The P-value assesses the differences between the percentages in two rounds of BBS and was computed using the Z- test statistic for equality of proportions

risk as low (OR: 1.4) or moderate (OR: 3.1) were more likely to access services than those perceiving no risk. In 2019, perceived low risk was associated with decreased access (OR: 0.5), while moderate risk remained strongly associated with increased access (OR: 6.1). reporting sexual violence was negatively associated with service access (OR: 0.5). By 2019, this association had reversed, with affected FSWs participants being three times more likely to report access (OR: 3.0).

Table 4 presents factors associated with the use of HIV prevention services in 2019. FSWs aged 20–24 had higher

odds of using services than those aged 15–19 (aOR: 2.2), with even greater likelihood among those aged ≥ 25 (aOR: 10.0). Being married or in a cohabiting relationship was strongly associated with service use (aOR: 5.0), as was speaking a foreign language (aOR: 8.0). Higher education (aOR: 1.5) and having an additional source of income (aOR: 2.0) were also positively associated with service use. In contrast, earning between 531 and 999 meticals (~ USD 8–16) was associated with lower odds of service use (aOR: 0.6) compared to those earning less than 325 meticals (~ USD 5). Alcohol consumption (aOR: 0.5) and

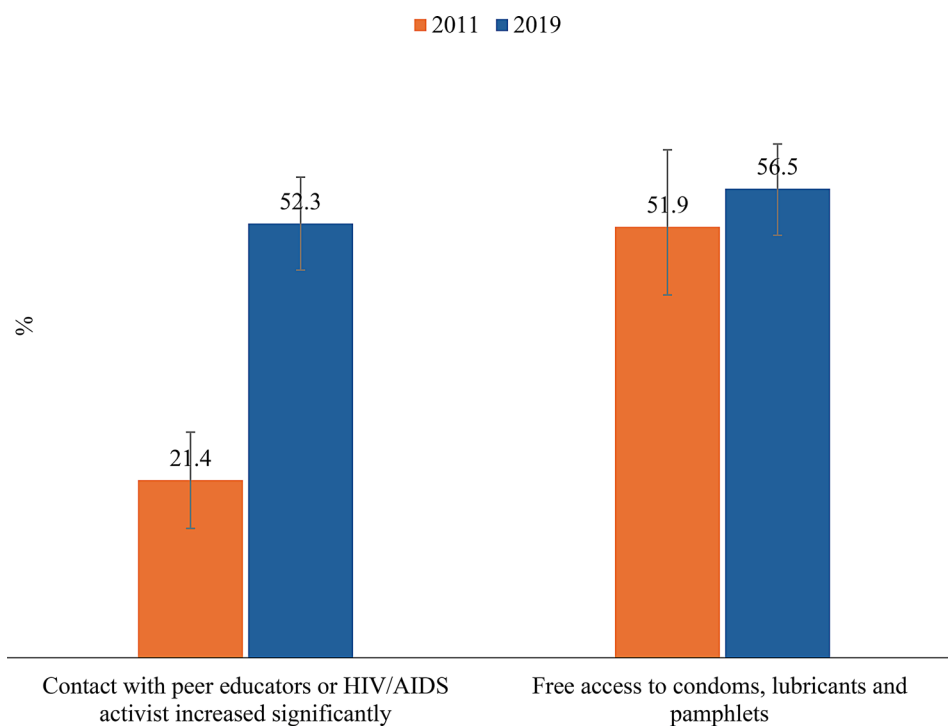


Fig. 1 Proportion of FSWs with access to health services for HIV/AIDS prevention in Mozambique, 2011 and 2019. The percentages are weighted and were computed using the Gile's sequential sampling (SS)

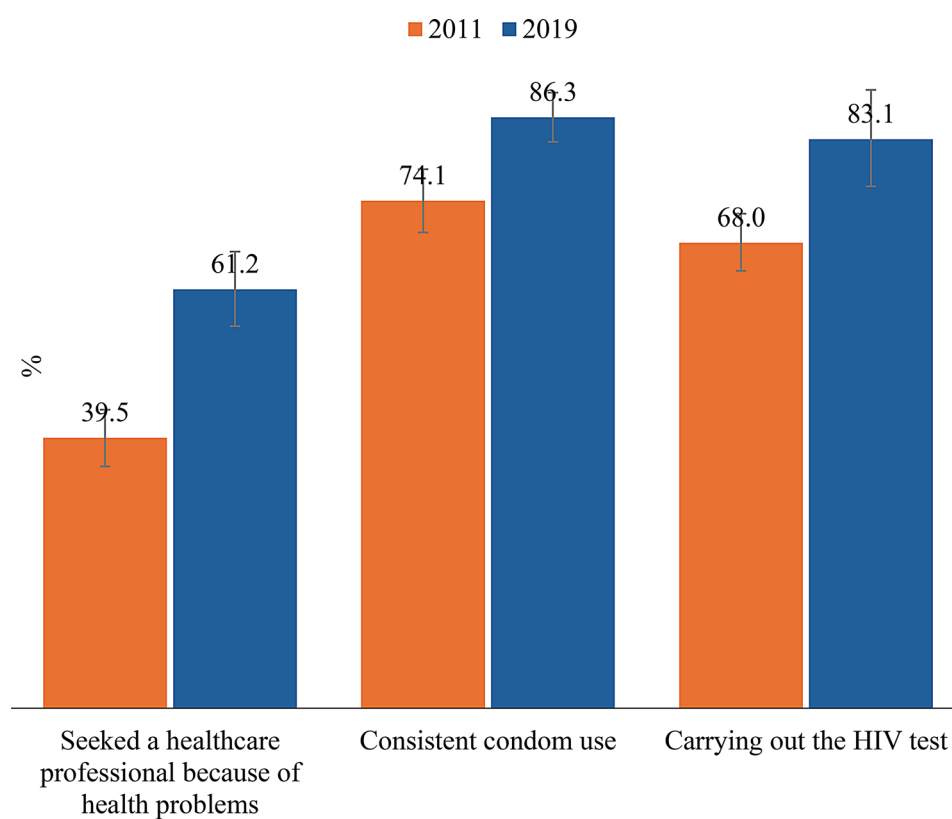


Fig. 2 Proportion of FSWs who used health services for HIV/AIDS prevention among FSWs in Mozambique, 2011 and 2019. The percentages are weighted and were computed using the Gile's sequential sampling (SS)

Table 3 Logistic regression analyses for access to health services for HIV/AIDS prevention among FSWs, 2011 and 2019

Variable	Access			
	2011 OR (IC 95%)	P-value	2019 OR (IC 95%)	P-value
Age group (Ref. = 15–19 years old)				
20–24	1.4 (1.2–1.7)	<0.0001	1.2 (0.8–1.7)	0.49
≥ 25	1.9 (1.5–2.6)	<0.0001	2.4 (1.2–4.7)	0.02
Education (Ref. = Sem/Primary)				
Secondary/Higher	1.9 (1.6–2.2)	<0.0001	0.4 (0.3–0.7)	0.001
Religion (Ref. = None/Other)				
Christian	0.4 (0.3–0.5)	<0.0001	5.0 (3.3–7.7)	<0.0001
Muslim	0.4 (0.3–0.4)	<0.0001	3.4 (1.9–6.2)	<0.0001
Did other work other than sex work (Ref. = No)				
Yes	1.9 (1.6–2.2)	<0.0001	0.3 (0.2–0.5)	<0.0001
Alcohol consumption (Ref. = No)				
Yes	0.9 (0.8–1.1)	0.3	5.7 (3.8–8.4)	<0.0001
Perception of one's own risk of contracting HIV infection (Ref. = No risk)				
Low	1.4 (1.2–1.7)	0.0006	0.8 (0.4–1.3)	0.3
Moderate	3.1 (2.5–3.8)	<0.0001	0.5 (0.3–0.8)	0.008
High	1.0 (0.8–1.1)	0.9	6.1 (1.5–24.2)	0.01
She was raped or sexually assaulted (Ref. = No)				
Yes	0.5 (0.4–0.6)	<0.0001	3.0 (1.9–4.6)	<0.0001
She was physically attacked for being FSWs (Ref. = No)				
Yes	2.1 (1.6–2.6)	<0.0001	0.2 (0.1–0.3)	<0.0001

experiences of physical assault (aOR: 0.3) were both associated with significantly reduced likelihood of using HIV prevention services.

Discussion

This study provides one of the few longitudinal analyses of HIV prevention service access and use among FSWs in Mozambique, highlighting both encouraging progress and persistent inequities. Between 2011 and 2019, significant improvements were observed in multiple indicators, including HIV testing, consistent condom use, and health-seeking behavior suggesting enhanced integration of FSWs into the national HIV response. These findings coincide with the scale-up of targeted interventions and national strategies to enhance service delivery for key populations, increased availability of community-based services, partners support and broader national policy commitments to reduce HIV incidence and improve health equity [8, 14].

However, despite these gains, the analysis reveals persistence and, in some cases, growing disparities in access to services. Sociodemographic and structural factors, including age, education, economic dependency, religion, perceived risk, and exposure to violence, continue to shape who accesses and benefits from HIV prevention interventions. The nuanced interplay of these determinants highlights the need for differentiated,

Table 4 Logistic regression analyses for the use of health services in HIV/AIDS prevention among FSWs from 2011 and 2019

Variable	Use of services	
	OR (IC 95%)	p-value
Age group (Ref. = 15–19 years old)		
20–24	2.2 (1.6–2.9)	<0.0001
≥ 25	10.0 (5.5–18.3)	<0.0001
Marital Status (Ref. = Single)		
Married/Marital Union	5.0 (1.7–15.1)	0.004
Widowed/divorced/separated	1.3 (0.8–1.9)	0.3
Language spoken at home (Ref. = Second main language)		
Portuguese	0.9 (0.7–1.1)	0.3
Other	8.3 (2.3–30.0)	0.001
Religion (Ref. = None/Other)		
Christian	0.4 (0.2–0.6)	<0.0001
Muslim	0.4 (0.2–0.7)	0.002
Education (Ref. = Sem/Primary)		
Secondary/Higher	1.5 (1.1–2.0)	0.01
Did other work other than sex work (Ref. = No)		
Yes	2.3 (1.5–3.4)	<0.0001
Monthly income in Mt (Ref. ≤325)		
326–530	1.2 (0.9–1.8)	0.42
531–999	0.6 (0.4–0.9)	0.005
≥ 1000	0.8 (0.6–1.2)	0.2
Alcohol consumption (Ref. = No)		
Yes	0.5 (0.2–0.8)	<0.0001
She was physically attacked for being FSWs (Ref. = No)		
Yes	0.3 (0.2–0.4)	<0.0001

context-specific programming tailored to the evolving realities of FSWs in Mozambique.

Age emerged as a consistent predictor of both access and use of services. Older FSWs participants (≥ 25 years) were more likely to access and use services in both years, with stronger associations observed in 2019. This finding aligns with previous research suggesting that older FSWs may have greater experience navigating health systems, more stable social networks, and heightened awareness of HIV-related risks [15, 16].

By contrast, education demonstrated a reversal in its association with access to HIV prevention services over time. In 2011, FSWs with secondary or higher education were more likely to access services, potentially reflecting greater health literacy and empowerment. However, in 2019, this association became negative, with more educated FSWs reporting significantly lower access. This shift may reflect evolving dynamics in the sex work environment, where FSWs with higher education may increasingly operate in more discreet or private settings such as online platforms, closed venues, or transactional relationships not openly labeled as sex work making them less visible to outreach programs. Similar patterns have been reported in other sub-Saharan countries, where more educated FSWs tended to be more mobile,

exercised greater client selectivity, and had weaker connections to peer-led support networks, all of which can reduce engagement with HIV prevention services [17, 18].

The relationship between economic activity and access also changed over time. In 2011, FSWs engaged in additional income-generating activities were more likely to access services. In 2019, however, this group showed significantly lower odds of access, suggesting that economically dependent FSWs are now better reached by targeted services, while those with alternative income may disengage due to perceived lower vulnerability or lack of targeted outreach. Notably, Mozambique experienced substantial macroeconomic challenges during this period, including inflation, currency devaluation, and rising unemployment [19]. These dynamics likely influenced income sources, economic precarity, and access to health services for vulnerable groups.

At the same time, the decline in exclusive reliance on sex work and the modest increase in reported income may suggest some degree of economic diversification, which is often linked to reduced vulnerability and improved negotiation capacity within sexual encounters [4, 20]. Additionally, the decrease in early initiation into transactional sex (<18 years) is a positive sign, as early involvement in sex work is associated with increased exposure to violence, HIV, and limited agency [4].

The role of perceived HIV risk was also dynamic. In 2011, FSWs participants who perceived themselves at low or moderate risk were more likely to access HIV prevention services than those reporting no perceived risk. By 2019, however, FSWs participants who perceived themselves at low risk were significantly less likely to access services, while those perceiving moderate risk remained more engaged. This shift may reflect a growing disconnect between self-perceived risk and actual vulnerability, shaped by multiple contextual factors. Despite substantial investments to expand HIV prevention services in the country, risk communication strategies may not have sufficiently adapted to reflect the evolving and heterogeneous realities of FSWs, particularly those who do not self-identify as such or who perceive themselves as “low risk” due to fewer clients, condom use with regular partners, or engagement in less visible forms of transactional sex (e.g., through private arrangements) [7, 15, 21]. These findings highlight the importance of addressing risk misperception and ensuring that individuals with undetected or underestimated vulnerability continue to be reached by prevention messaging and services.

Experiences of violence, both sexual and physical had complex associations with service access. In 2011, sexual violence was a barrier, likely reflecting trauma, fear, or mistrust of health services. By 2019, this association had reversed, suggesting that survivors may now be better

identified and supported by service providers. Nonetheless, physical violence remained a barrier to service use in 2019. This shift may reflect improvements in the identification of survivors, greater integration of gender-based violence (GBV) response into HIV services, and enhanced community-level awareness and support mechanism within communities and health facilities. However, despite this progress, physical violence remained a barrier to service use in 2019, underscoring the persistent role of structural and interpersonal violence in limiting access to health care. In Mozambique, evidence suggests that FSWs frequently experience physical violence from clients, police officers, and even intimate partners, often without access to legal recourse or trauma-informed care [7, 22].

The sharp increase in HIV prevalence among FSWs in Mozambique, from 11.9% in 2011 to 24.5% in 2019 is deeply concerning, and reflects a complex interplay of behavioral and structural determinants. This rise may be associated with declining consistent condom use, increasing alcohol and drug consumption, and the cumulative burden of poverty, gender-based violence, and limited access to prevention services. These findings are consistent with regional evidence showing that FSWs bear a disproportionate burden of HIV, driven by stigma, criminalization, and exclusion from formal health systems [23]. Despite these challenges, the fivefold increase in access to HIV prevention services between 2011 and 2019 represents a significant public health achievement. This improvement likely reflects targeted investments in peer-led outreach, differentiated service delivery, and community empowerment strategies designed for key populations [8, 14]. As emphasized by WHO and UNAIDS, ensuring equitable access to HIV prevention, particularly among the most marginalized, is central to achieving epidemic control and universal health coverage [1, 24].

Conclusion

Between 2011 and 2019, access to and use of HIV prevention services among female sex workers in Mozambique improved significantly, reflecting progress in national efforts to expand service coverage for key populations. However, the concurrent rise in HIV prevalence highlights persistent gaps in prevention effectiveness and structural vulnerability. The findings point to important disparities shaped by age, education, economic activity, risk perception, and experiences of violence, underscoring the need for more differentiated and context-responsive strategies.

To accelerate progress toward HIV epidemic control, interventions must go beyond service availability and address the complex social and structural barriers that continue to limit access and utilization among the

most marginalized. Integrating violence prevention and response, strengthening community-led outreach, and tailoring communication strategies to challenge risk misperception are critical. Sustained investment in rights-based, peer-centered approaches will be essential to ensure that no segment of the FSW population is left behind in Mozambique's HIV response.

Abbreviations

BBS	Bio-Behavioral Surveillance
CIBS FM&HCM	Institutional Bioethics Commission for Health of the Faculty of Medicine and Maputo Central Hospital
CNBS	National Bioethics Committee for Health (Comité Nacional de Bioética para a Saúde)
DBS	Dried Blood Spot
FSW	Female Sex Workers
HIV	Human Immunodeficiency Virus
INS	Instituto Nacional de Saúde (National Institute of Health)
OR	Odds Ratio
PLHIV	People Living with HIV
RDS	Respondent-Driven Sampling
STI	Sexually Transmitted Infection
USD	United States Dollar

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Author contributions

SN conducted the data analysis and drafted the manuscript. ARB and RM contributed to the data analysis and reviewed the manuscript. DCL, JS, and ER provided oversight of the analysis and contributed to manuscript review. CSB supervised the analysis, provided critical revision, and contributed to the final review of the manuscript. All authors read and approved the final version of the manuscript.

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Data availability

The raw data from the dataset in this manuscript are not publicly available to preserve the privacy of individuals under the Institutional Data Protection Regulation but may be made available upon institutional request at <https://ins.gov.mz/>.

Declarations

Ethical approval and consent to participate

All eligible participants in both BBS rounds (2011 and 2019) provided written informed consent prior to participation. The consent process was designed to allow participants to provide separate consent for different components of the survey, including the option to decline HIV testing while still completing the behavioral questionnaire. The two BBS surveys received ethical approval from the National Bioethics Committee for Health (CNBS) in Mozambique and the INS Institutional Bioethics Committee for Health (CIBS-INS). Written

informed consent was obtained from all participants prior to enrolment in the surveys. Additionally, the secondary analysis protocol underlying this manuscript was reviewed and approved by the Institutional Bioethics Committee for Health of the Faculty of Medicine and Maputo Central Hospital (CIBS FM&HCM/086/2021, Version 1.4, April 2022). The INS granted formal authorization for the use of the BBS-FSW database.

Consent to publish

Not applicable.

Competing interests

The authors declare no competing interests.

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