

Prevalence and Risk Factors of HIV, HBV, and HCV Among Women Who Inject Drugs in Five Mozambican Cities: A Cross-Sectional Biological and Behavioral Survey, 2023–2024

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Research Article

Keywords: HIV, hepatitis, injecting drug use, harm reduction, women's health, Mozambique

Posted Date: February 25th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-8679000/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Women who inject drugs (WWID) are disproportionately affected by HIV and viral hepatitis, yet data on prevalence and risk factors in Mozambique remain scarce. This study aimed to estimate the prevalence of Human Immunodeficiency Virus (HIV), Hepatitis B surface antigen (HBsAg), and Hepatitis C (HCV) among WWID and to identify associated sociodemographic and behavioral risk factors.

Methods

A cross-sectional biological and behavioral survey was conducted among 524 WWID in five Mozambican cities (Maputo, Beira, Tete, Quelimane, Nampula) between July 2023 and March 2024, using respondent-driven sampling (RDS). Participants completed structured questionnaires and underwent rapid testing for HIV, HBV, and HCV. RDS-weighted prevalence estimates were calculated for all outcomes. Modified Poisson regression with robust standard errors was used to identify factors associated with HIV infection.

Results

The weighted prevalence was 28.5% (95% CI: 23.3–33.9) for HIV, 4.3% (95% CI: 2.2–6.4) for HBsAg positivity, and 17.9% (95% CI: 13.9–22.0) for HCV. HIV prevalence increased markedly with age and duration of injection and was highest in Maputo City. In adjusted analyses, compared to those aged 16–17, older age (≥ 35 years; aRR = 13.8; 95% CI: 4.7–40.8), longer injecting duration (≥ 7 years), and residence in Maputo were independently associated with HIV infection, while secondary or higher education and absence of recent STI symptoms were protective. Among WWID living with HIV, 85.0% were aware of their status, 86.6% of those aware were on antiretroviral therapy, and 75.7% of those on treatment were virally suppressed.

Conclusion

WWID in Mozambique face a high burden of HIV and HCV, with significant geographic disparities. Losses along with the HIV care continuum, particularly gaps in retention and viral suppression, highlight critical issues in sustained treatment and adherence access rather than initial diagnosis. Urgent interventions integrating harm reduction, gender-sensitive HIV/HCV services, and targeted prevention in high-burden areas are needed.

Background

People Who Inject Drugs (PWID) remain one of the populations most affected by HIV and viral hepatitis worldwide. Without access to harm reduction programs such as needle and syringe distribution or opioid substitution therapy, PWID are at elevated risk of acquiring Human Immunodeficiency Virus (HIV), Hepatitis B (HBV), and Hepatitis C (HCV) (1, 2). Yet, in many low- and middle-income countries, reliable data on the size and characteristics of this population remains scarce, limiting their visibility in national surveillance systems and hindering evidence-based policy and service delivery planning.

Globally there were an estimated 14 million PWID in 2023 (3), including approximately 2.8 million women (4). The global median HIV prevalence among PWID is 5%, nearly seven times higher than among adults aged 15–49 years in the general population across 47 reporting countries (1). In addition, PWID experience high burdens of HBV and HCV, with global prevalence estimates of 6% and 60%, respectively (5). Yet, Women Who Inject Drugs (WWID) are consistently reported to have higher HIV prevalence than men, reflecting compounded biological, social, and structural risks (5). These include exposure to gender-based violence, reliance on transactional sex, reduced negotiating power in relationships, and less access to prevention and treatment services (6, 7). The intersection of these risks situates WWID at the confluence of the HIV, HBV, HCV, and gender inequality epidemics.

In sub-Saharan Africa, the geography of HIV is changing. While heterosexual transmission remains dominant, emerging evidence points to injection drug use as a growing but under-recognized contributor to new infections (8, 9). Regional estimates suggest HIV prevalence of 24%, HBV prevalence of 5%, and HCV prevalence of 38% among PWID (5). However, these figures mask profound gender disparities: meta-analytic data indicate that WWID are nearly three times more likely to live with HIV than men who inject drugs, with a relative risk of 2.8 (95% CI: 1.8–4.4) (10). Despite this, few African countries systematically collect or publish gender-disaggregated data on PWID, effectively erasing women from policy visibility and resource allocation.

Mozambique reflects this broader blind spot in global harm reduction (11). The country faces a concentrated HIV epidemic among key populations (12), yet surveillance systems remain largely blind to the realities of WWID. The *National Strategic Plan for the Response to HIV and AIDS 2021–2025* recognizes the need for gender-responsive prevention but acknowledges the absence of data and tailored services for WWID (13). The

underrepresentation of WWID in research is widely acknowledged. For instance, the 2013–2014 BBS among PWID in Mozambique included only 5% women, which may reflect either sampling limitations or their actual proportional size within the hidden PWID population. That survey reported HIV/HBV and HIV/HCV co-infection prevalences of 14.9% and 38.7% in Maputo, respectively (14). While this imbalance does not automatically confirm underrepresentation, it does align with the broader pattern of systemic exclusion of WWID from health research and programming, a pattern shaped by stigma, gender inequality, and intersecting forms of criminalization.

Against this backdrop, Mozambique provides a critical lens through which to examine how gender, stigma, and structural inequities shape vulnerability among WWID in sub-Saharan Africa. This study aims to generate context-specific evidence on the socio-demographic characteristics, sexual behaviors, and experiences of stigma and discrimination among WWID in Mozambique providing critical insights to inform gender-responsive harm reduction and HIV prevention strategies.

Methods

Setting, participants, and procedures

We conducted a cross-sectional study as part of the second round of the BBS among PWID in five urban areas of Mozambique, between July 2023 and March 2024. The selected sites included Maputo City in the southern region; Beira, Tete, and Quelimane in the central region; and Nampula in the northern region.

Maputo City and Nampula/Nacala had also been included in the first round of BBS, allowing for comparative analyses of HIV prevalence and risk behaviors over time. Site selection was guided by national stakeholders to ensure representation of geographic, cultural, and programmatic diversity. The chosen areas were characterized by: (1) a known or suspected concentration of PWID; (2) an adult population size sufficient to meet sampling requirements; and (3) the presence of PWID-friendly HIV and sexually transmitted infection (STI) services for referrals. Socially connected contiguous neighborhoods were also included in the sampling frame to capture overlapping injection networks (15).

The new sites for this round, namely Beira, Quelimane, and Tete were selected through a systematic process that considered HIV prevalence in the general population, the presence of PWID community-based prevention programs, and the availability of PWID-friendly services at health facilities.

Eligible participants met the following criteria: (1) were aged ≥ 16 years old; (2) reporting injecting non-prescription drugs in the past 12 months before the survey; (3) presented a valid referral coupon; and (4) had resided in, worked in, or regularly socialized in the study area during the 12 months prior to the survey.

We used respondent-driven sampling (RDS) to recruit participants, a method widely applied to reach hard-to-access populations, to generate population-based estimates of HIV prevalence and related behavioral indicators (16–18). The recruitment process of participants for this round of the survey was identical to the first round (15). All participants provided written informed consent prior to participation. Confidentiality was ensured through the use of unique participant codes and secure data storage systems.

In total, 2,624 PWID were recruited across the five cities: 520 in Maputo (119 women), 517 in Beira (54 women), 524 in Tete (120 women), 531 in Quelimane (117 women), and 532 in Nampula (114 women). The present analysis focuses exclusively on the 524 women who inject drugs (WWID) included in the second-round BBS.

Measures

A structured quantitative questionnaire, adapted from the first round of the BBS among PWID in Mozambique, was used to collect data. The tool captured information across several domains, including socio-demographic characteristics, sexual behavior, substance use, biological and clinical history, symptoms of STIs, and HIV-related knowledge, attitudes, practices, stigma, discrimination, and perceptions.

Biological samples were collected to determine the prevalence of HIV, active hepatitis B infection (HBsAg positivity), HCV, and HIV viral load. Before sample collection, all eligible participants received pre-test counseling on the importance of testing and the implications of positive results. Approximately 6 mL of venous blood was drawn using adult EDTA Vacutainer® tubes for rapid testing and dried blood spot (DBS) preparation.

HIV testing followed the Mozambique's sequential algorithm: an initial screening with *Alere Determine® HIV-1/2* (Abbott Laboratories, UK), followed by a confirmatory test with *Uni-Gold™ HIV* (Trinity Biotech, Ireland). Indeterminate results were recorded if the confirmatory test was non-reactive. HBV testing was performed using *Alere Determine® HBsAg* rapid diagnostic test, which detects the presence of hepatitis B surface antigen (HBsAg) in blood samples. A reactive HBsAg result was considered indicative of current HBV infection, in line with WHO guidelines and standard epidemiological practices (19). It is important to note that HBsAg positivity reflects active infection but does not differentiate between acute and chronic stages. This marker was used to estimate the prevalence of ongoing HBV infection and to assess co-infections with HIV and/or HCV. HCV testing used the *SD Bioline HCV* rapid test, where all reactive results were also considered positive.

All participants received post-test counseling with tailored messages according to their test results and risk profiles. Those testing positive for HIV, HBsAg, or HCV were referred to appropriate care services. Referral forms included both HBsAg and anti-HCV results to facilitate clinical linkage

and confirmatory evaluation at designated health facilities

Alcohol consumption was assessed using the Alcohol Use Disorders Identification Test – Consumption (AUDIT-C), a validated three-item screening tool derived from the full WHO AUDIT questionnaire. The AUDIT-C evaluates frequency of drinking, quantity per occasion, and frequency of heavy episodic drinking during the past 12 months (20). Scores range from 0 to 12, with higher values indicating greater risk of hazardous drinking. Following standard cut-offs used in previous studies, a score ≥ 3 for women was classified as “hazardous alcohol use”.

Of the 524 participants in the study, 11 participants did not consent to rapid HIV testing, four participants did not consent to HCV testing, and five participants did not consent to HBV testing.

For the cascade of care and treatment among WWID living with HIV, the study applied the The Joint United Nations Program on HIV/AIDS (UNAIDS) 95–95–95 framework (21): **First 95:** WWID living with HIV who had prior knowledge of their HIV-positive status at the time of the survey; **Second 95:** WWID living with HIV who were already on antiretroviral therapy (ART) during the survey; **Third 95:** WWID living with HIV with viral suppression, as determined by their viral load results during the survey.

Statistical analysis

Both bivariate and multivariable statistical analyses were conducted to assess associations between explanatory variables and outcomes of interest (HIV, HCV, and HBsAg seropositivity). Bivariate analyses were used to present the prevalence of each outcome across explanatory variable categories and to explore potential associations. The computed prevalence was derived using a meta-analytic approach, where we computed RDS-weighted estimates within each study site using the Gile’s Successive Sampling estimator and then derived one single pooled estimate using a fixed-effect meta-analysis approach. This approach was chosen to account for the clustered RDS design across multiple sites while generating an overall population estimate. Associations between explanatory and outcome variables were assessed using Pearson’s Chi-square test, and the Fisher’s exact test was applied whenever expected cell counts were fewer than five.

Given the relatively high prevalence of HIV (>10%) in our sample, multivariate analysis was conducted for HIV using multivariable Poisson regression with robust standard errors, also known as modified Poisson regression, to identify independent predictors and estimate relative risks (22–24). This method is preferred over logistic regression for common outcomes to avoid overestimation of odds ratios. Variables included in the multivariable model were those that demonstrated statistical significance at the 0.20 significance level in the bivariate modified Poisson regression, allowing for the inclusion of potentially relevant covariates. Although the data were collected using RDS, the modified Poisson regression analysis was conducted without weighting. This methodological decision is supported by simulation studies indicating that unweighted regression often yields more stable and precise estimates in RDS analyses when the predictors of interest are not strongly correlated with network size or recruitment homophily (25–27). We acknowledge this as both a methodological choice and a limitation for comparability with other studies. The model was assessed for multicollinearity using variance inflation factor (VIF), and variables with VIF >5 were excluded.

The final model was assessed for Goodness-of-fit using the Pearson Chi-square statistic. Statistical significance was set at a 0.05 level (28). All analyses were conducted using R statistical software version 4.2.2 (29), and the full R code is publicly available in our GitHub repository: <https://github.com/RachidMuleia/HIV-prevalence-among-WWID.git>.

Results

Characteristics of Study Participants

The characteristics of the participants are described in Table 1. A total of 524 WWID were included in the analysis, with a median age of 22 years (interquartile range: 18–27). The majority (43.7%) were between 18 and 24 years old, while only 11.1% were aged 35 years or older.

Participants were almost equally distributed across the five study sites, with approximately one-fifth recruited from Maputo City (22.7%), Tete (22.9%), Quelimane (22.3%), and Nampula (21.8%), and a smaller proportion from Beira (10.3%).

In terms of education, 69.0% of the women had completed at least secondary education, while 31.0% had only primary education. The majority were single (74.6%), followed by married (13.5%) and separated or widowed (11.8%). A large proportion of participants (80.3%) reported unstable housing conditions, reflecting high social and economic vulnerability.

Regarding sexual behavior, 68.6% initiated sexual activity at age 15 or older, whereas 31.4% reported sexual debut before age 15. Nearly all participants (97.4%) reported receiving money or goods in exchange for sex, and 27.3% reported having engaged in anal sex with male partners. Most identified as heterosexual (93.5%), while 6.5% identified as bisexual or homosexual.

About 51.5% of participants met the criteria for hazardous alcohol use according to the AUDIT-C scale. Concerning injection practices, 67% reported sharing syringes at some point, while 71.2% used a new or sterilized syringe in the month preceding the survey. The majority (83%) reported injecting drugs within the last month, with 55.6% injecting 1–3 times per day.

The main injectable drug was heroin (95%), followed by cocaine (4.4%). Almost half (54%) had been injecting drugs for 1–3 years, and 15.7% for seven years or more, indicating varying levels of exposure to long-term risk behaviors.

Access to prevention and harm reduction services remained limited: only 18.9% reported receiving harm reduction services in the previous year, and just 10% had heard of naloxone. Similarly, 55.3% reported access to health services or peer educators in the past 12 months.

Regarding reproductive and sexual health, 70.6% had already been pregnant, and 55.9% reported signs or symptoms of sexually transmitted infections (STIs) in the past year. Experiences of sexual violence were reported by 16.5% of participants in the previous six months, while 67.8% experienced discrimination in the past year.

Prevalence of HIV and association with sociodemographic, behavioural characteristics and injecting drug use

The analysis of sociodemographic, behavioral, and drug use-related variables identified multiple factors significantly associated with HIV prevalence among the study participants ($p < 0.05$) (table 1). A progressive increase in HIV prevalence was observed with age, reaching the highest level in the group aged 35 years or older (72.9%; $p < 0.001$). The geographic distribution revealed marked differences: prevalence was highest in Maputo (51.8%) and lowest in Quelimane (13.3%; $p < 0.001$).

Educational attainment was inversely associated with HIV prevalence. WWID with only primary education had significantly higher prevalence (36.5%) compared to those with secondary or higher education (19.6%; $p < 0.001$). Marital status was also associated with HIV, with higher prevalence among married and separated/widowed women compared to single women ($p < 0.001$).

Structural vulnerabilities were strongly associated with HIV. Women without stable housing had higher prevalence than those with housing (42.3% vs. 23.8%; $p < 0.001$).

Among variables related to injecting practices, HIV prevalence was slightly lower among women who reported using a new or sterilized syringe in the past month (26.0%) compared to those who did not (29.4%), with a statistically significant difference observed ($p = 0.029$).

Age at first injection was also an associated factor: initiation before age 18 was associated with lower prevalence (9.2%) compared to initiation at 25 years or older (58.8%; $p < 0.001$).

Both duration of injecting drug use ($p < 0.001$) and injection frequency ($p = 0.001$) showed a dose–response relationship with HIV prevalence, increasing with longer duration and higher frequency of injection.

Access to health services or a peer educator was positively associated with prevalence (32.2% vs. 12.6%; $p < 0.001$). Additionally, those with a history of pregnancy had higher prevalence (29.7%) compared to those who never became pregnant (14.8%; $p = 0.002$).

No statistically significant associations were observed between HIV prevalence and the following variables: condom use, sexual orientation, anal sex practice, alcohol abuse, syringe sharing, easy access to needles, access to naloxone, participation in harm reduction treatments, presence of STI symptoms, history of sexual violence, and reports of discrimination.

In the adjusted model (table 1), HIV infection among WWID remained significantly associated with older age, city of residence, educational level, duration of drug injection, and occurrence of STI symptoms. Compared with adolescents aged 16–17 years, the adjusted relative risk of HIV infection increased progressively with age: 18–24 years ($aRR = 5.8$; 95% CI: 2.1–15.7; $p = 0.001$), 24–34 years ($aRR = 9.1$; 95% CI: 3.2–26.4; $p < 0.001$), and ≥ 35 years ($aRR = 13.8$; 95% CI: 4.7–40.8; $p < 0.001$). Geographical variation persisted after adjustment, with women in Quelimane ($aRR = 0.5$; 95% CI: 0.3–0.9; $p = 0.016$) and Nampula ($aRR = 0.4$; 95% CI: 0.3–0.7; $p = 0.001$) exhibiting significantly lower HIV risk infection compared to Maputo City. Educational attainment remained significant, as women with only primary education had 1.4 times higher risk of HIV infection than those with secondary or higher education ($aRR = 1.4$; $p = 0.010$).

Absence of STI symptoms in the past 12 months was associated with a lower risk of HIV infection ($aRR = 0.8$; $p = 0.050$). All other variables were not significantly associated with HIV prevalence in the adjusted model.

HBsAg Positivity

The proportion of participants with reactive HBsAg tests varied significantly by geographic location ($p = 0.001$). Tete (10.0%) and Beira (9.3%) had the highest proportions, while no reactive cases were detected in Maputo City. Other cities showed lower reactivity, including Quelimane (2.6%) and Nampula (3.6%).

Age at first sexual intercourse was significantly associated with HBsAg positivity: women who initiated sexual activity before age 15 had a prevalence of 8.8% compared to 2.9% among those who initiated at age 15 or older ($p = 0.008$).

A significant association was observed with age at first injection ($p = 0.050$), with positivity rates of 7.2% among women who initiated injection before age 18, compared to 4.6% among those initiating at age 25 or older.

HCV Positivity

Significant geographic variation in HCV prevalence was observed across study sites ($p<0.001$). The highest prevalence was observed in Beira (48.1%) and Nampula (29.5%), while markedly lower rates were recorded in Maputo City (9.5%), Quelimane (4.3%), and Tete (13.3%).

Injecting practices were significantly associated with prevalence. Women who initiated injection before age 18 had a higher prevalence (13.5%; $p = 0.012$) than those who initiated between ages 18–24 (8.8%).

Women reporting heroin as their primary injectable drug had a prevalence of 7.6%, while no HCV cases were identified among those injecting cocaine, or other, although the number of women injecting these last two are very reduced ($N = 23$ and $N = 3$, respectively).

Table 1. Prevalence of HIV, HBsAg and HCV among WWID in Mozambique, 2023, stratified by sociodemographic variables, behavioural characteristics and injecting drug use, with results from the association analyses (Chi-square χ^2 or Fisher exact test $\ddagger$). For HIV, simple and multivariable Poisson regression with robust standard errors are also reported (crude relative risk, cRR, and relative risk, aRR, respectively, and corresponding p-values). Significant values at 0.05 significance level are indicated in bold.

Characteristics	N (%)	HIV						HBsAg		HCV	
		N positives (%)	χ ² or Fisher P-value	cRR (95%CI)	cRR P-value	aRR (95%CI)	aRR P-Value	N positives (%)	χ ² or Fisher P-value	N positives (%)	χ ² or Fisher P-value
Age group (years) The median age was 22 years (IQR: 18–27)											
16-17	119 (22.7)	4 (6.1)	<0.001	Ref		Ref		10 (8.4)	0.117	20 (22.5)	0.887
18-24	229 (43.7)	53 (21.0)		7 (2.6-19.0)	<0.001	5.8 (2.1-15.7)	0.001	7 (3.1)		43 (2.0)	
25-34	118 (22.5)	47 (44.0)		12.4 (4.6-33.2)	<0.001	9.1 (3.2-26.4)	<0.001	6 (5.2)		18 (11.9)	
35+	58 (11.1)	36 (72.9)		18.8 (7.0-50.2)	<0.001	13.8 (4.7-40.8)	<0.001	1 (1.7)		10 (12.5)	
City											
Maputo City	119 (22.7)	59 (51.8)	<0.001	Ref		Ref		0 (0)	0.001	11 (9.5)	<0.001
Beira	54 (10.3)	15 (27.8)		0.4 (0.2-0.7)	0.004	0.6 (0.4-1.0)	0.056	5 (9.3)		26 (48.1)	
Tete	120 (22.9)	29 (24.2)		0.3 (0.2-0.5)	<0.001	0.7 (0.5-1.1)	0.168	12 (10.0)		16 (13.3)	
Quelimane	117 (22.3)	15 (13.3)		0.1 (0.1-0.3)	<0.001	0.5 (0.3-0.9)	0.016	3 (2.6)		5 (4.3)	
Nampula	114 (21.8)	22 (19.6)		0.2 (0.1-0.4)	<0.001	0.4 (0.3-0.7)	0.001	4 (3.6)		33 (29.5)	
Educational level											
Primary	162 (31.0)	63 (36.5)	<0.001	1.8 (1.4-2.4)		1.4 (1.1-1.9)	0.010	10 (6.2)	0.353	27 (2.5)	0.845
Secondary/higher education	361 (69.0)	77 (19.6)		Ref	<0.001	Ref		14 (3.9)		64 (4.3)	
Marital status											
Single	391 (74.6)	83 (20.4)	<0.001	Ref		Ref		18 (4.6)	1.000	71 (3.0)	0.571
Married	71 (13.5)	32 (32.1)		2.1 (1.5-2.9)	<0.001	1 (0.8-1.4)	0.861	3 (4.3)		9 (15.5)	
Separated/widowed	62 (11.8)	25 (31.6)		1.9 (1.3-2.6)	0.001	1 (0.7-1.4)	0.856	3 (4.8)		11 (5.1)	
Housing											
No stable housing	421 (80.3)	41 (42.3)	<0.001	0.4 (0.3-0.7)	<0.001	1 (0.7-1.4)	0.878	4 (4)	1.000	19 (19.2)	0.737
Stable housing	103 (19.7)	99 (23.8)		Ref		Ref		20 (4.8)		72 (17.1)	
Age at first sexual intercourse											
<15	160 (31.4)	37 (27.6)	0.186	Ref		Ref		14 (8.8)	0.008	34 (1.4)	0.140

≥15	349 (68.6)	102 (24.7)		1.3 (0.9- 1.7)	0.161	1 (0.7- 1.3)	0.929	10 (2.9)		54 (6.6)	
Received money or goods in exchange for sex‡											
Yes	486 (97.4)	129 (27)	0.197	Ref				23 (4.8)	1.000	80 (16.6)	0.130
No	13 (2.6)	1 (8.3)		0.2 (0- 1.9)	0.181	---	---	0 (0)		4 (33.3)	
Sexual orientation											
Heterosexual	490 (22.2)	133 (27.8)	0.479	Ref				24 (4.9)	0.392	87 (6.4)	---
Bisexual/Homosexual	34 (14.3)	7 (20.6)		0.7 (0.4- 1.5)	0.386	---	---	0 (0)		NA	
Have you ever had anal sex with a man											
Yes	143 (27.3)	36 (25.6)	0.648	Ref				5 (3.5)	0.603	27 (9.8)	0.688
No	380 (72.7)	104 (18.8)		1.1 (0.8- 1.5)	0.574	---	---	19 (5.1)		64 (2.6)	
Hazardous alcohol use (AUDIT-C)											
Abusive	270 (51.5)	76 (29.0)	0.493	Ref				10 (3.7)	0.412	49 (9.3)	0.758
Not abusive	254 (48.5)	64 (17.8)		0.9 (0.7- 1.2)	0.434	---	---	14 (5.6)		42 (0.7)	
Ever shared syringes for injecting drugs											
Yes	350 (25.3)	90 (25.9)	0.303	Ref				17 (4.9)	0.883	69 (7.6)	0.081
No	172 (22.8)	50 (30.7)		1.2 (0.9- 1.6)	0.251	---	---	7 (4.1)		22 (1.1)	
Used new/sterilized syringe last month before the survey											
Yes	369 (71.2)	109 (26.0)	0.029	Ref				18 (4.9)	0.660	72 (9.7)	0.090
No	55 (10.6)	15 (29.4)		0.9 (0.6- 1.5)	0.79	---	---	1 (1.9)		4 (3.8)	
Age of first drug injection											
<18	208 (39.8)	32 (9.2)	<0.001	Ref		Ref		15 (7.2)	0.050	28 (13.2)	0.012
18-24	226 (43.3)	68 (26.2)		1.9 (1.3- 2.8)	0.001	0.9 (0.5- 1.8)	0.788	5 (2.2)		52 (8.8)	
25+	88 (16.9)	40 (58.8)		3 (2- 4.4)	<0.001	0.7 (0.3- 2.2)	0.575	4 (4.6)		11 (3.1)	
Primary injectable drug **											
Heroin	496 (95.0)	133 (26.2)	0.300	Ref				22 (4.5)	0.370	91 (7.6)	---
Cocaine	23 (4.4)	5 (11.5)		0.8 (0.4- 1.8)	0.646	---	---	2 (9.1)		NA	
Other	3 (0.6)	NA		2.4 (1.1- 5.5)	0.031	---	---	0 (0)		NA	

Years injecting drugs											
<1 year	65 (12.6)	8 (11.3)	<0.001	Ref		Ref		3 (4.6)	0.954	11 (13.7)	0.984
1-3 years	278 (54)	58 (21.9)		1.7 (0.9-3.4)	0.122	1.7 (0.8-3.5)	0.173	14 (5.1)		50 (6.5)	
4-6 years	91 (17.7)	30 (30.5)		2.8 (1.4-5.7)	0.004	1.6 (0.8-3.5)	0.193	3 (3.3)		15 (5.0)	
7+	81 (15.7)	43 (63.1)		4.5 (2.3-8.8)	<0.001	2 (0.9-4.3)	0.085	4 (5)		15 (5.0)	
Injection frequency											
Not injections	94 (18)	15 (16.3)	0.001	Ref		Ref		5 (5.4)	0.334	15 (16.1)	0.662
4 times a month	42 (8)	6 (14.6)		0.9 (0.4-2.1)	0.808	0.7 (0.2-2.4)	0.529	1 (2.4)		5 (12.2)	
2-7 times a week	61 (11.7)	11 (18.3)		1.1 (0.6-2.3)	0.745	0.7 (0.2-1.9)	0.433	6 (9.8)		9 (14.8)	
1-3 times a day	291 (55.6)	94 (33.1)		2 (1.2-3.3)	0.005	1.4 (0.6-3.2)	0.388	11 (3.8)		57 (19.7)	
≥5 times a day	35 (6.7)	14 (40)		2.5 (1.3-4.5)	0.004	2.1 (0.7-6.8)	0.203	1 (2.9)		5 (14.7)	
Access to new syringe/needle											
Very easy/Easy	258 (60.1)	70 (19.1)	0.327	Ref				13 (5.1)	0.604	53 (9.4)	0.075
Difficult/Very difficult	171 (39.9)	55 (32.3)		1.2 (0.9-1.6)	0.274	---	---	6 (3.5)		23 (5.9)	
Ever heard of naloxone?											
Yes	52 (10.0)	13 (14.1)	0.959	Ref				2 (3.8)	1	9 (16.8)	1
No	467 (90.0)	126 (26.7)		1.1 (0.6-1.7)	0.828	---	---	22 (4.7)		80 (6.5)	
Received harm reduction services, past 12 months? ¥											
Yes	99 (18.9)	26 (12.0)	1	Ref				4 (4.1)	1	13 (5.9)	0.299
No	424 (81.1)	114 (27.4)		1 (0.7-1.5)	0.905	---	---	20 (4.7)		78 (5.6)	
Access to health services/peer educator, past 12 months											
Yes	290 (55.3)	95 (32.2)	<0.001	Ref		Ref		10 (3.5)	0.257	49 (9.5)	0.913
No	234 (44.7)	45 (12.6)		0.6 (0.4-0.8)	<0.001	1 (0.7-1.4)	0.949	14 (6)		42 (2.5)	
Have you ever been pregnant											
Yes	367 (70.6)	113 (29.7)	0.002	Ref		Ref		15 (4.1)	0.73	62 (7.6)	0.801
No	153 (29.4)	27 (14.8)		0.6 (0.4-0.8)	0.003	1.1 (0.7-1.6)	0.693	8 (5.3)		28 (2.6)	

Symptoms or signs of STI, past 12 months											
Yes	289 (55.9)	86 (30.6)	0.056	Ref		Ref		15 (5.2)	0.672	58 (8.5)	0.112
No	228 (44.1)	50 (13.6)		0.7 (0.5-1)	0.047	0.8 (0.6-1)	0.050	9 (4)		32 (2.5)	
Experience sexual violence, past 6 months											
Yes	86 (16.5)	26 (30.1)	0.525	Ref				5 (5.8)	0.574	13 (17.6)	0.612
No	435 (83.5)	113 (22.6)		0.9 (0.6-1.2)	0.434	---	---	19 (4.4)		78 (6.6)	
Experience of discrimination, past 12 months											
Yes	353 (67.8)	86 (23.7)	0.101	Ref		Ref		18 (5.1)	0.566	65 (6.4)	0.475
No	168 (32.2)	54 (29.9)		1.3 (1-1.7)	0.078	1.1 (0.9-1.5)	0.315	6 (3.6)		26 (3.6)	

‡Exact Fisher test

* Abscess treatment, overdose treatment, opioid substitution therapy with methadone, detoxification programme, rehabilitation

Overall prevalence of HIV, HBsAg, HCV, and co-infections

Among the WWID, the weighted RDS results were used to estimate the prevalence of disease among the population, based on the sample of study participants. The estimate of HIV prevalence was 28.5% (140/513; 95% CI: 23.3–33.9). Hepatitis B surface antigen (HBsAg) positivity, indicating current HBV infection, was detected in 4.3% (24/520; 95% CI: 2.2–6.4), while hepatitis C virus (HCV) infection was identified in 17.9% (91/519; 95% CI: 13.9–22.0) of participants.

Population-level estimates of co-infection showed that concurrent HIV and HBsAg positivity (HIV/HBV co-infection) was 0.9% (95% CI: 0.1–1.7; 5/520 participants), and HIV/HCV co-infection was 4.7% (95% CI: 2.4–7.0; 23/512 participants). Triple infection with HIV, HBV, and HCV was rare, with a population estimate of 0.2% (95% CI: 0.0–0.4; 1/512 participants).

Table 2. Weighted prevalence of HIV, HBsAg positivity, HCV, and co-infections among women who inject drugs in Mozambique, 2023–2024

	n/N	Crude Prevalence (%)	% (95% CI): Weighted
HIV	140/513	27.3	28.5 (23.3–33.9)
HBsAg positive (current HBV infection)	24/520	4.6	4.3 (2.2–6.4)
HCV	91/519	17.5	17.9 (13.9–22.0)
HIV + HBsAg	5/520	1.0	0.9 (0.1–1.7)
HIV + HCV	23/512	4.5	4.7 (2.4–7.0)
HIV + HBsAg + HCV	1/512	0.2	0.2 (0.0–0.4)

HIV Care and Treatment Outcomes Compared to UNAIDS 95–95–95 Targets

Among WWID living with HIV in the study sample, 85.0% were aware of their HIV-positive status (first 95). Among those who were aware of their status, 86.6% reported current use of antiretroviral therapy (ART) (second 95). Among those on ART, 75.7% had viral load suppression (third 95). When considered cumulatively, these steps correspond to an estimated ~56% of all WWID living with HIV being virally suppressed overall, compared with the UNAIDS benchmark of approximately 86%.

Discussion

This study revealed a high prevalence of HIV (28.5%), HCV (17.9%), and, to a lesser extent, HBsAg (4.3%) among WWID in the studied areas in Mozambique (524), with significant geographic and sociodemographic variations. These findings underscore the disproportionate vulnerability of this population and highlight the urgent need for gender-responsive, integrated interventions aligned with global public health goals. The observed patterns mirror global evidence identifying people who inject drugs (PWID) as a high-risk group for HIV and viral hepatitis infection(4).

The HIV prevalence of 28.5% among WWID in Mozambique is almost double that of women in the general adult population (15%) and five times higher than the global median among PWID (5%) (30, 31). Maputo showed the highest rate (51.8%), which may reflect its longer-established injecting networks, higher urban mobility, and overlap between sex work and injection drug use dynamics also documented in Johannesburg and Nairobi (32, 33). In contrast, Quelimane and Nampula had significantly lower prevalences (13.3% and 19.6%, respectively), suggesting differences in drug use patterns, less mature drug markets, access to harm reduction services, or transmission dynamics.

HIV prevalence among participants was strongly correlated with age, educational attainment, and housing stability. The increasing prevalence with age reflects cumulative exposure and vulnerability over time, combining longer injecting trajectories, repeated sexual exposures, and interrupted access to care. This pattern mirrors findings across sub-Saharan Africa, where HIV prevalence among PWID rises sharply with duration of injection (34). Lower education and unstable housing emerged as key structural determinants: women with limited education and no fixed residence had substantially higher HIV prevalence. These results align with evidence showing that educational disadvantage and homelessness amplify vulnerability through reduced health literacy, economic precarity (35), amplify exposure within high-risk injection and sexual networks and limited access to prevention and treatment services (36).

No significant associations were found with traditional behavioral indicators such as syringe sharing, likely reflecting social desirability bias, underreporting, or recent exposure to harm-reduction interventions whose coverage remains insufficient to produce population-level effects. The association between STI symptoms and HIV infection likely reflects health-seeking behavior among symptomatic women, suggesting that those who access STI care are also more likely to be tested for HIV. This underscores the potential of integrated sexual and reproductive health (SRH) services as a gateway to HIV prevention and treatment (37).

The prevalence of HCV (17.9%) was lower than the African average among PWID (38%) (5), but remains concerning, especially in Beira (48.1%) and Nampula (29.5%), where intensive heroin injection networks have been previously reported (14). This geographic clustering suggests that HCV transmission in Mozambique may be at an earlier stage of diffusion compared with West and Central Africa, where endemic HCV infection among PWID often exceeds 40% (38, 39). The concentration of cases in specific urban corridors likely reflects limited harm-reduction coverage, reuse of injecting equipment, and overlapping sex- and drug-related risk networks.

The findings of HBsAg positivity varied by location (Tete and Beira with higher proportions, and absence in Maputo), highlighting regional differences in HBV circulation. This is consistent with the heterogeneity observed in other studies that identify subnational disparities in HBV among high-risk populations (14, 40, 41). The association between early sexual debut and HBV infection aligns with the known efficiency of sexual transmission of hepatitis B in high-risk populations.

Despite the encouraging finding that 85% of HIV-positive WWID were aware of their status, only half were receiving ART and less than one in three achieved viral suppression. This steep attrition along the HIV care continuum exposes systemic barriers such as stigma, criminalization of drug use, gender-based violence, and fragmentation of services (36, 42). These barriers restrict consistent engagement with care and undermine viral suppression efforts. Addressing these gaps requires integrating ART delivery with harm-reduction programs, HCV/HBV testing and treatment, and psychosocial support services tailored to women's experiences of trauma, pregnancy, and caregiving responsibilities. Achieving the UNAIDS 95–95–95 targets among WWID will depend on shifting from purely biomedical interventions toward gender-sensitive, community-based, and trauma-informed models of care. Viral suppression, in this context, should be seen as a measure of health-system equity and resilience, not merely a clinical outcome.

Limitations

This study has several limitations that need to be acknowledged. First, its cross-sectional design precludes causal inference; observed associations between sociodemographic factors, behavioral indicators, and HIV, HBsAg, or HCV status should be interpreted as correlational rather than causal. Second, recruitment used RDS, which is appropriate for hidden and criminalized populations but may still under-represent subgroups of WWID who are less socially networked, more mobile, or more isolated by violence and stigma. As such, even the high prevalence estimates reported here may be conservative. Third, behavioral indicators (e.g., condom use, syringe sharing, number of partners) were based on self-report and therefore subject to recall bias and social desirability bias, particularly in a context of criminalization of drug use and sex work. Fourth, hepatitis B infection was defined using HBsAg rapid testing, which identifies current infection but does not distinguish acute from chronic infection, and HCV status was based on a rapid antibody test without confirmatory RNA testing; these constraints may lead to misclassification of infection stage and transmissibility. Finally, although we present weighted prevalence estimates to account for the RDS design, the multivariable analysis was conducted unweighted, consistent with evidence that unweighted regression often performs better in terms of bias and stability in RDS studies; however, this choice may limit direct comparability with other RDS-weighted analyses. Despite these limitations, this study provides rare, policy-relevant evidence on WWID in Mozambique, a population largely invisible in routine surveillance.

Conclusions

This study demonstrates a high burden of HIV, HCV, and HBsAg positivity among WWID in Mozambique, with clear geographic and sociodemographic disparities. The findings reveal how prolonged drug use, low educational attainment, housing instability, and limited access to

healthcare converge to create multi-layered and cumulative vulnerability among WWID. These structural and social determinants of health compound biological risks, perpetuating gender and economic inequities that sustain the epidemics of HIV, HBV, and HCV. Addressing these overlapping challenges requires integrated, gender-responsive, and trauma-informed strategies. Priority actions should include expanding harm reduction interventions, and integrating diagnosis and treatment for HIV, HBV, and HCV within a unified continuum of care. Additionally, reducing stigma, criminalization, and gender-based violence remains fundamental to ensuring service uptake and retention in care. Without immediate, targeted, and sustained investment, these intertwined epidemics will continue to fuel health inequities and undermine Mozambique's progress toward epidemic control. Conversely, implementing an inclusive, multisectoral public health response that prioritizes WWID will not only improve individual and population-level outcomes but also represent a tangible step toward achieving the Sustainable Development Goal of ending AIDS and viral hepatitis as public health threats by 2030.

Abbreviations

ART- Antiretroviral Therapy

AUDIT-C - Alcohol consumption was assessed using the Alcohol Use Disorders Identification Test – Consumption

HBsAg- Hepatitis B Surface Antigen

HBV- Hepatitis B

HCV- Hepatitis C

HIV- Human Immunodeficiency Virus

PWID- People Who Inject Drugs

RDS- Respondent-Driven Sampling

STI- Sexually Transmitted Infections

UNAIDS - The Joint United Nations Program on HIV/AIDS

WWID- Women Who Inject Drugs

Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Ethics Review Board of the Institutional Ethics Committee of the National Institute of Health (CIE-INS) under reference 097/CIBS-INS/2022, and by the National Bioethics Committee for Health in Mozambique (CNBS) under references 877/CNBS/22 and 690/CNBS/2023. The study was conducted in accordance with the Declaration of Helsinki and relevant national regulations. All participants provided written informed consent prior to participation. Participants aged 16–17 years were considered emancipated minors according to Mozambican regulations, and the CNBS exceptionally authorized the waiver of parental or guardian consent. These minors provided their consent using the same process applied to participants aged 18 years or older, with all necessary explanations to ensure understanding. No identifying information was collected, and measures were taken to protect participants' privacy and safety

Consent for publication

Not applicable. No individual-level identifiable data are presented in this manuscript.

Availability of data and materials

All study datasets are accessible in the Mozambique National Institute of Health (INS) data repository for researchers who meet the criteria for access to confidential data. The data comes from the second round of the study on BBS among PWIDs, and the authors can be contacted at: [https://ins.gov.mz/institucional/unidade-organicas/direccoes/direccao-de-inqueritos-e-observacao-de-saude/data-bases/Availability of data and materials](https://ins.gov.mz/institucional/unidade-organicas/direccoes/direccao-de-inqueritos-e-observacao-de-saude/data-bases/Availability%20of%20data%20and%20materials). The analysis code used in this study is publicly available at: <https://github.com/RachidMuleia/HIV-prevalence-among-WWID.git>.

Clinical trial number

Not applicable.

Competing interests

The authors declare no competing interests.

Funding

This manuscript used data from research supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund). The funder had no role in the study design, data collection, data analysis, data interpretation, or writing of the manuscript.

Authors' contributions

ARB elaborated the manuscript, coordinated all survey activities from study design, implementation and dissemination, and supervised data collection in the field. RM supervised data collection and performed quantitative analyses. SN, SGS, IC and CSB reviewed and approved all drafts and the final manuscript. All authors reviewed and approved all drafts and the final manuscript.

Acknowledgements

The authors extend their gratitude to all individuals who contributed to the planning, execution, analysis, and dissemination of the results, including investigators, study teams, Technical Working Groups, Non-Governmental Organizations, members of civil society, and the National HIV/STD program.

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Figures

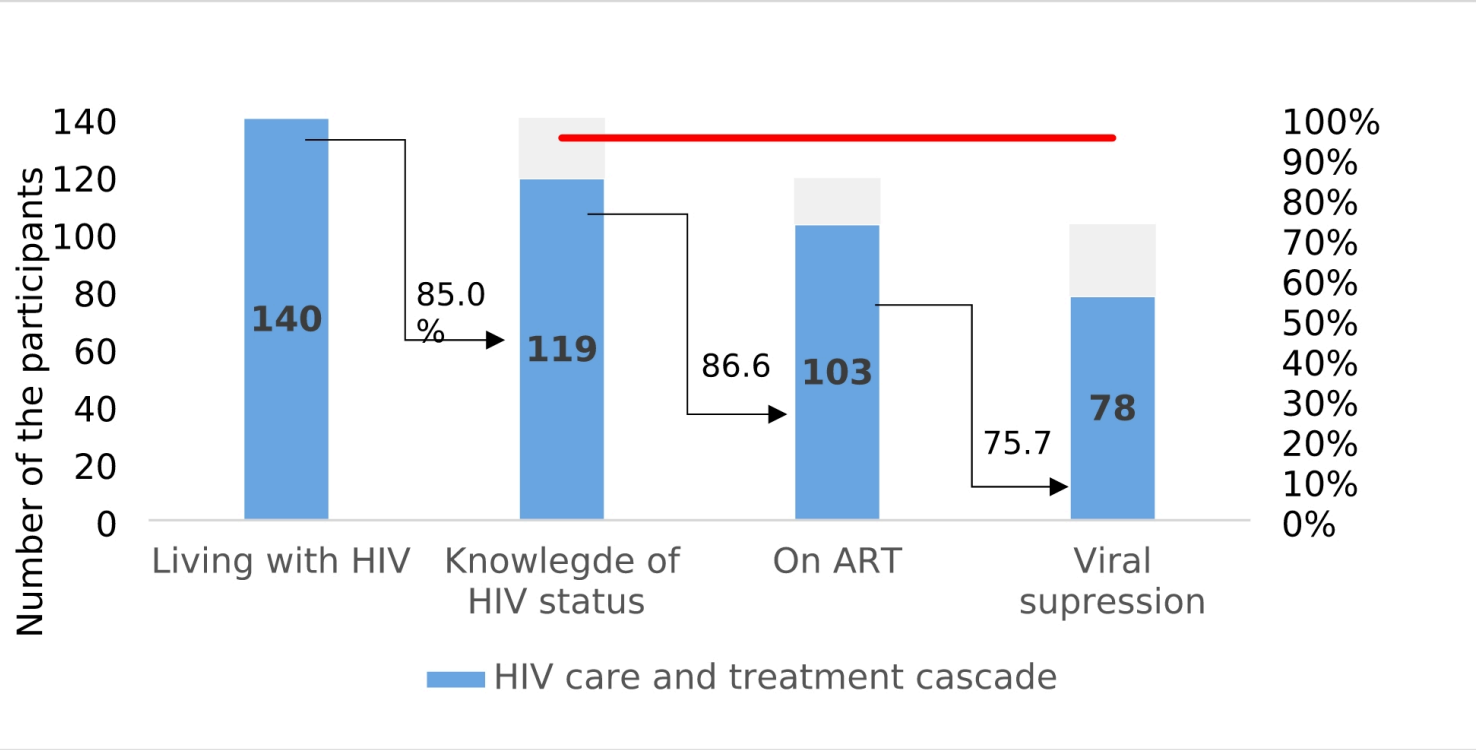


Figure 1

Progress towards the UNAIDS 95–95–95 Targets AMONG WWID in Mozambique, 2023–2024