

# Determinants of Unfavourable Viral Load Suppression among Pregnant and Breastfeeding Women on Antiretroviral Therapy in Lesotho: A Case-control Study



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## Abstract:

**Introduction:** Lesotho is making strides toward 95-95-95 targets for the population living with HIV and improved antenatal care coverage. However, challenges persist in new HIV infections, including vertical HIV infection. There is a paucity of evidence on the determinants of Viral Load (VL) suppression among pregnant and breastfeeding women living with HIV in Lesotho. The objective of the study was to determine VL suppression among pregnant and breastfeeding women living with HIV on ART in the Maseru district of Lesotho.

**Methods:** A case-control study employing 420 pregnant and breastfeeding women living with HIV was performed; 140 cases with VL > 1000 copies/ml and 280 in the control group with VL ≤ 1000 copies/ml were included. Bivariate and multivariate analyses were carried out to identify determinants of VL unsuppression via Adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CIs).

**Results:** A total of 420 (140 cases and 280 controls), 263 (86.4%) were breastfeeding, and 57 (13.7%) were pregnant. The mean age was 29.21 ± 5.33 years (SD), two-thirds (66%) of women's partners' HIV status was positive, and 21% of partners' HIV status was unknown. Two-thirds (64.3%) of women received ART from urban facilities. More than one-fifth (21.2%) of the women did not adhere to ART. The majority (60%) knew their HIV status during pregnancy. The partner's unknown HIV status, knowledge of HIV before pregnancy, transfer from other facilities, and adherence status were identified as independent predictors of VL suppression (AOR: 95% CI; *p*-value < 0.05). An unknown HIV status was 3 times more likely to indicate an unsuppressed VL: AOR = 3.08 (95% CI: 1.15-8.21, *p*-value < 0.05), and an HIV status before pregnancy was 4.6 times more likely to indicate an unsuppressed VL: AOR = 4.62 (95% CI: 2.50-8.48, *p*-value < 0.001). Transferring from facilities was 12.4 times more likely to have unsuppressed VL; AOR = 12.45 (95% CI: 5.04-30.75). Women who did not adhere to ART were 24.7 times more likely, AOR = 24.7 (95% CI: 12.3-60.9).

**Discussion:** Despite national progress toward the 95-95-95 targets, gaps remain that increase the risk of mother-to-child transmission. Poor ART adherence, unknown partner HIV status, transfers between facilities, and knowing HIV status before pregnancy were major predictors of VL unsuppression. Addressing these factors is essential for sustaining maternal health gains and accelerating the elimination of vertical HIV transmission in Lesotho.

**Conclusion:** This study identified modifiable determinants of VL suppression among pregnant and breastfeeding women with HIV. The study highlights the need for improved partner involvement in the HIV care continuum, encouraging their status to be known by their partners, posttest counseling strategies, and continuing psychosocial support for young and single women, ensuring that women know their HIV status and VL suppression before conception and ART adherence.

**Keywords:** Viral load suppression, Pregnant women, Breastfeeding women, ART, PMTCT, Lesotho, Vertical transmission.

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## 1. INTRODUCTION

Globally, more than 39.9 million people are living with HIV (PLHIV), and more than half of all PLHIV are in eastern and southern Africa [1]. Although approximately 39% fewer people acquired HIV in 2023 than in 2010, more than 1.3 million people acquired HIV in 2023, which is three times greater than the target of 370,000 or fewer new infections in 2025 [1]. More than 630,000 people around the world lost their lives to AIDS in 2023 [1]. The burden of HIV/AIDS varies significantly worldwide; however, the highest burden is concentrated in Sub-Saharan Africa (SSA), which accounts for two-thirds of global infections [2, 3]. Lesotho has the highest age-standardized HIV/AIDS incidence rate [3, 4] and mortality rate worldwide [4].

More than 30.7 million PLHIV were receiving treatment in 2023. However, 9.3 million people are left without treatment, and almost half a million (4.7 million) are in SSA [3, 5]. Thus, in 2023, 86% of PLHIV were aware of their status, 89% were on ART, and 93% had a suppressed Viral Load (VL), indicating good progress in meeting the 95-95-95 target set for 2025 [1, 5]. However, a significant number of PLHIV struggle with taking prescribed antiretroviral medicines, frequently drop out of care, and do not achieve viral suppression [1].

Globally, approximately 84% of pregnant women with HIV in 2023 were receiving ART, up from 49% in 2010. Despite these impressive achievements, approximately 190,000 people still did not receive ART in 2023. More than half (58%) were in western and central Africa, and 23% were in eastern and southern Africa, including Lesotho [1]. Vertical HIV infection has decreased due to fewer new HIV infections in women and broader access to ART for pregnant and breastfeeding women living with HIV. However, approximately 120,000 children acquired HIV in 2023, over 80% of whom were in SSA countries [5].

Women living with HIV who become pregnant or who acquire the virus during pregnancy are at risk of both maternal and perinatal morbidity and mortality, especially if the virus is poorly controlled [6]. Vertical HIV infection persists and is the greatest burden of incidence in Sub-Saharan Africa [7], accounting for almost 14% of all new HIV infections worldwide [8].

Lesotho is making strides toward 95-95-95 targets [9], reaching 93-85-86 among the total population living with HIV in 2023 [10]. According to Global AIDS Monitoring

and UNAIDS 2024 estimates, the proportion of pregnant women living with HIV in Lesotho receiving effective ARVs for PMTCT was estimated to be 93% (84-95) [11]. However, challenges persist in new HIV infections, including vertical HIV infection [9]. Even though there is an increase in PMTCT uptake in Lesotho, adherence to care is critical since a correlation is established between maternal ART adherence and the risk of vertical transmission [12, 13]. The Sustainable Development Goals aim to eliminate vertical HIV transmission, with a global set target of < 5% risk of transmission in the first 5 years [14]. Lesotho still has an 8% risk of vertical HIV transmission [15], whereas 8% of child infections are due to the mother being on ART during pregnancy or breastfeeding but are not virologically suppressed, and 14% of child infections are due to the mother acquiring HIV during pregnancy or breastfeeding [15].

Studies have identified factors associated with virological suppression in pregnant and breastfeeding women, including adherence [16], WHO clinical stage [17], support system [18], ART regimen [19], and attitudes or service delivery within health facilities [20]. These factors are critical for use by program managers as a prognostic tool in identifying pregnant and breastfeeding women at high risk of treatment failure. However, there is a paucity of evidence on the determinants of VL suppression, which have not been well documented in Lesotho. Therefore, a case-control study was conducted to identify determinants of VL unsuppression among pregnant and breastfeeding women living with HIV on ART in the Maseru district of Lesotho.

## 2. METHODS

### 2.1. Study Design and Setting

A case-control study design was employed among pregnant and breastfeeding women living with HIV on Antiretroviral Therapy (ART) in the Maseru district, Lesotho. Maseru District is the most urban, densely populated, and second-highest prevalence of HIV among districts, with a prevalence of 20.1% [6], in Lesotho. The district has three subdistricts, and there are several categories of facilities: those funded by either the Government (GOV) or the Christian Health Association of Lesotho (CHAL), the Millennium Challenge Corporation (MCC), private surgeries, nurse clinics, and private-government facilities.

## 2.2. Study Population

Selected HIV-positive pregnant and breastfeeding women on ART were included in the study. Among the 2,758 HIV-positive women aged 17- 49 years during the study period, the majority (2,266, 82.2%) were breastfeeding, and 492 (17.8%) were pregnant women on ART. The data revealed that 2,618 (94.9%) women living with HIV were virally suppressed, including 2145 (94.7%) breastfeeding and 473 (96.1%) pregnant women.

Study period: Data were collected from 1 July to 15 August 2023 from 20 HIV clinics providing ART services.

## 2.3. Viral Load Measurement

### 2.3.1. Operational Definition

Women who were not virally suppressed were classified as cases. We defined VL suppression as (<1000 copies/ml) [21], which is in line with the Lesotho national ART guidelines. For this study, we used routine viral load testing for pregnant and breastfeeding women living with HIV, which was done on a routine basis through the national clinic-laboratory network. Blood samples were collected by trained nurses and clinicians at antenatal and postnatal care facilities and transported to district laboratories. Viral load analyses were performed by trained laboratory technologists using WHO-aligned plasma-based HIV RNA testing methods. Lesotho followed the WHO 2016 Option B+-aligned ART guidelines, which required lifelong triple-drug ART for all pregnant and breastfeeding women, regardless of CD4 count. The PMTCT protocol (based on WHO recommendations) used TDF + 3TC + EFV as the standard first-line ART regimen for pregnant women.

### 2.3.2. Adherence

Optimal adherence is defined as taking  $\geq 95\%$  of prescribed ART doses during the reference period (30 days), sufficient to achieve and maintain viral suppression and to reduce the risk of Mother-to-Child Transmission (MTCT).

### 2.3.3. Transfer from other Facilities

A pregnant or breastfeeding woman already on ART who formally transfers care from another health facility to the reporting facility, with documented evidence showing previous ART regimen and ART start date at the sending facility; no treatment interruption  $\geq 30$  consecutive days during the transfer process; and date first attended and date first dispensed ART at the receiving facility recorded as the transfer-in date.

### 2.3.4. Knowledge of HIV Status

Refers to a pregnant or breastfeeding woman's awareness of her HIV-positive status before conception or at any point during pregnancy, confirmed through documented HIV testing and receipt of results. A woman is considered to know her HIV status if she received an HIV test result indicating HIV-positive status prior to the current pregnancy, or was diagnosed as HIV-positive during the current pregnancy through antenatal HIV

testing, and was informed of her HIV test result by a healthcare provider.

## 2.4. Inclusion Criteria

### 2.4.1. Cases

Pregnant and breastfeeding women who received ART for more than six months and whose VL ( $\geq 1000$  copies/ml) was defined as not virally suppressed were classified as cases [21].

### 2.4.2. Control

Pregnant and breastfeeding women who received ART for more than six months and whose VL (< 1000 copies/ml) was defined as virally suppressed were classified as controls [21].

### 2.4.3. Exclusion Criteria

Pregnant and breastfeeding women who were not receiving antiretroviral therapy (ART), had been on ART for less than six months, lacked viral load data or did not use the 1000 copies/mL threshold, or had incomplete or duplicate data were excluded.

### 2.4.4. Data Collection

#### 2.4.4.1. Sampling Procedure and Technique

Data were sourced from the Lesotho PMTCT facility-based aggregated database. We included all the virally unsuppressed pregnant and breastfeeding women in the district as cases and recruited two controls for each case. Two controls for each case were randomly selected from the facility where the case occurred. Using this selection process, a total of 140 cases and 280 controls were included in this study.

#### 2.4.4.2. Data Processing and Analysis

Data from the records reviewed were entered into an Excel spreadsheet for cleaning before being exported to SPSS for analysis. Missing data were verified through other data sources, such as patient files and the laboratory results system. Data cleaning was performed to check for accuracy, consistency, and mean values. Univariate analysis uses frequency techniques to describe data according to study characteristics. Data are expressed in terms of frequency, percentage, and mean. Bivariate logistic regression analysis was used to examine crude associations between the independent and dependent variables. A variable with  $p$ -value < 0.2 was subjected to multivariable logistic regression to measure the strength of associations and was expressed in terms of Adjusted Odds Ratios (AORs) with 95% confidence intervals, adjusting for confounders. Significance was declared at a  $p$ -value  $\leq 0.05$ . The multicollinearity was checked using the Variance Inflation Factor (VIF) < 10. Model fitness was checked *via* the Hosmer-Lemeshow test. Thus, the  $p$ -value for the Hosmer-Lemeshow chi-square test was < 0.61, greater than 0.05, and the classification table was 84.8%, indicating model fitness.

### 3. RESULTS

#### 3.1. Sociodemographic Characteristics

A total of 2758 pregnant and breastfeeding women living with HIV, 2266 breastfeeding, and 492 pregnant women received ART in the Maseru district of Lesotho during the study period. With respect to viral load suppression, the ART records revealed that 2145 (94.7%) breastfeeding and 473 (96.1%) pregnant women experienced viral load suppression (< 1000).

In this study, among a total of 420 women living with HIV on ART, the majority (263, 86.4%) were breastfeeding mothers, and 57 (13.7%) were pregnant women who participated. The mean age was  $29.21 \pm 5.33$  years (SD), ranging from 17 to 49 years. Approximately half (48.3%) of the participants were in the age range of 25- 29 years. The

majority, 364 (86.7%), were married. Two-thirds (66%) of women's partners were positive for HIV. The HIV status of more than one-fifth (21%) of the partners was unknown.

Approximately two-thirds (64.3%) of those receiving ART services received services from urban facilities. The government owned two-thirds (66%) of the facilities providing ART services, and approximately a quarter (27%) were owned by CHA.

More than one-fifth (21.2%) of the women did not adhere to ART. Approximately 5.5% of women have ever defaulted on ART. Approximately two-thirds of the patients, 271 (64.5%), were on the TDF/3TC/DTG ART regimen. The majority (60%) knew their HIV status during pregnancy. Among breastfeeding babies (26, 6%), the DNA results of a child were positive (Table 1).

**Table 1. Characteristics of pregnant and breastfeeding women living with HIV on ART in the Maseru district, Lesotho.**

Characteristics		No	Percent
Marital status	Married	364	86.7
	Single	50	11.9
	Separated	3	0.7
	Widowed	3	0.7
Age category	<25	50	11.9
	25-29	203	48.3
	30-34	103	24.5
	35-39	48	11.4
	>40	16	3.8
Mothers' status	Pregnant	57	13.7
	Breastfeeding	263	86.4
Partners HIV status	Positive	278	66.2
	Negative	53	12.6
	Unknown	89	21.2
Terrain of the facility	Rural	114	27.1
	Per urban	36	8.6
	Urban	270	64.3
Type of facility	CHAL	114	27.1
	GOV	279	66.4
	PRIV	3	0.7
	PRI-GOV	24	5.7
Adherence category	Adherent	331	78.8
	Non adherent	89	21.2
Has ever defaulted on treatment	No	397	94.5
	Yes	23	5.5
Dosage of drug category	once	413	98.3
	Twice	7	1.7
Type of regimen category	AZT/3TC EFV	7	1.7
	TDF/3TC/DTG	271	64.5
	TDF/3TC/EFV	142	33.8
Knowledge of HIV before or during pregnancy	Before pregnancy	168	40
	During pregnancy	252	60
DNA results of a child (n=363)	Negative	337	80.2
	Positive	26	6.2

(Table 1) contd....

Characteristics	No	Percent
Duration of ART in years	6 months - 1 year	33.6
	2-3 years	30.5
	4- 5 years	26.0
	>5 years	10
Transfer in from other facilities	No	91.4
	Yes	8.6

### 3.2. Distribution of Sociodemographic Variables vs. VL Suppression

The majority of cases (84, 60%) and controls (222, 79%) were in the 25- 34-year-old age group. With respect to mothers' status, ( 40 (29%) were single, with viral load unsuppressed 16, 6% had viral load suppressed.

Partners' HIV status unknown (64, 46%) were viral load unsuppressed, versus (25,9%) were suppressed. Knowledge of HIV status before pregnancy (97,69%) was unsuppressed, versus (71, 25%) had viral load suppressed (Table 2).

### 3.3. Predictors of VL Suppression among Pregnant and Breastfeeding Mothers Living with HIV

Bivariate logistic regression analysis was performed to assess the associations between the dependent and independent variables.

Age, marital status, partner's HIV status, knowledge of HIV before pregnancy, transfer from other facilities, and adherence status were associated with VL suppression, and candidate variables for multiple logistic regression had a *p*-value < 0.2 in the bivariate analysis. However, a multiple logistic regression analysis revealed no difference between cases and controls concerning age and marital status. Binary logistic regression demonstrated that women aged 17-21 years were significantly associated with VL suppression. Those aged 17-24 years were 3.5 times more likely to have an unsuppressed viral load than those aged 35+ years were (COR: 3.46, 95% CI: 1.59-7.52). Additionally, marital status, with respect to singles, was associated with a 6.6-fold greater odds of unsuppressed VL than married status was (COR = 6.6, 95% CI: 3.53-12.3).

In the final model, partners' HIV status, knowledge of

HIV before pregnancy, transfer from other facilities, and adherence status were strong predictors significantly associated with VL suppression among pregnant and breastfeeding women on ART in the Maseru district, Lesotho.

The partner's unknown HIV status, knowledge of HIV before pregnancy or during pregnancy, transfer from other facilities, and adherence status were identified as independent predictors of VL suppression (AOR: 95% CI; *p*-value < 0.05).

The partner's HIV status was significantly associated with unsuppressed VL. The participants' HIV status was unknown, and they were 3 times more likely to have an unsuppressed VL, AOR = 3.08 (95% CI: 1.15-8.21, *p*-value < 0.05).

Women who were aware of their HIV status before pregnancy were significantly associated with VL suppression. Women who knew their HIV status before pregnancy were 4.6 times more likely to have unsuppressed VL than those who knew their HIV status during pregnancy (AOR = 4.62; 95% CI: 2.50-8.48; *p*-value < 0.001).

Transferring from facilities was significantly associated with unsuppressed VL among pregnant and breastfeeding women. Women who transferred from other facilities were 12.4 times more likely to have unsuppressed VL; AOR = 12.45 (95% CI: 5.04-30.75).

ART adherence was significantly associated with VL suppression. Women who did not adhere to ART were 24.7 times more likely to have unsuppressed VL; AOR = 24.7 (95% CI: 12.3-60.9) (Table 3). Hosmer-Lemeshow = 4.58 (*p*-value = 0.61), and 84.8% of the variables were used to check model fitness, indicating that the model was fit to predict a significant association.

**Table 2. Distribution of sociodemographic variables vs. VL suppression among pregnant and breastfeeding women on ART at health facilities in Masero District, Lesotho.**

Characteristics	Response	Viral Load Suppression		COR (95%: CI)	<i>p</i> -value
		Cases (unsuppressed)	Control (suppressed)		
Age	17-24	33 (23%)	17 (6%)	3.46 [1,59-7,52]	0.002
	25- 34	84 (60%)	222 (79%)	0.65 (0.38-1.19)	0.07
	35+	23 (17%)	41 (15%)	1	-
Marital status	Married	100 (71%)	264 (94%)	1	-
	Single	40 (29%)	16 (6%)	6.6(3.53 -12.3)	0.000

(Table 2) contd....

Characteristics	Response	Viral Load Suppression		COR (95%: CI)	p-value
		Cases (unsuppressed)	Control (suppressed)		
Matters status	Pregnant	18 (13%)	39 (14%)	1.09 (0.6-1.99)	0.76
	BF	122 (87%)	241(86%)	1	-
Partners HIV status	Positive	62 (44%)	216 (77%)	1	-
	Negative	14(10%)	39 (14%)	1.25 (0.63-2.45)	0.51
	Unknown	64 (46%)	25 (9%)	8.91(5.18-15.33)	0.000
Knowledge of HIV status	Before pregnancy	97 (69%)	71 (25%)	6.64 (4.23-10.4)	0.000
	During pregnancy	43 (31%)	209 (75%)	1	-

**Table 3. Predictors of unsuppressed VL among pregnant and breastfeeding women receiving ART services in Maseru district, Lesotho.**

Characteristics	Response	Viral Load Suppression		COR (95%: CI)	p-value	AOR (95%: CI)	
		Cases (unsuppressed)	Control (suppressed)				
Age	17-24	33 (24%)	17 (6%)	3.46 [1,59-7,52]	0.002	2.55(0.79-8,23)	0.11
	25- 34	84 (60%)	222 (79%)	0.65 (0.38-1.19)	0.07	1.11(0.45-2.67)	0.8
	35+	23 (16%)	41 (15%)	1	-	-	-
Marital status	Married	100 (71%)	264 (94%)	1	-	-	-
	Single	40 (29%)	16 (6%)	6.6(3.53 -12.3)	0.000	1.77(0.57 -5.5)	0.3
Partners HIV status	Positive	62 (44%)	216 (77%)	1	-	-	-
	Negative	14(10%)	39 (14%)	1.25 (0.63-2.45)	0.51	0.86 (0.31- 2.35)	0.77
	Unknown	64 (46%)	25 (9%)	8.91(5.18-15.33)	0.000	3.08(1.15 - 8.21)	0.024
Knowledge of HIV status	Before pregnancy	97 (69%)	71 (25%)	6.64 (4.23-10.4)	0.000	4.62(2.50-8.48)	0.000
	During pregnancy	43 (31%)	209 (75%)	1	-	-	-
Mothers' status of pregnancy or BF	pregnant	18 (13%)	39 (14%)	1	-	-	-
	BF	122 (87%)	241 (86%)	1.09(0.6-1.99)	0.76	-	-
Transfer in from other facilities	No	110 (79%)	274 (98%)	1	-	-	-
	Yes	30 (21%)	6 (2%)	12.45 (5.04-30.75)	0.000	-	-
Terrain of the facility	Rural	38 (27%)	76 (27%)	1	-	-	-
	Peri-urban	12 (9%)	24 (9%)	1(0.45 - 2.21)	0.45	-	-
	Urban	90(64%)	180 (64%)	1(0.62-1.59)	1	-	-
Ownership of the facility	CHAL	38 (27%)	76 (27%)	1	-	-	-
	GOV	93 (66%)	186(66%)	1(0.63 -1.58)	1	-	-
	PRI-GOV	9(6%)	18 (6%)	1(0.41 -2.43)	-	-	-
Adherence	Adherent	61(44%)	270 96)	1	-	-	-
	Nonadherent	79(56%)	10 (4%)	34.96(17.21-71.41)	0.000	24,7(12.3-60.9)	0.00
Duration on ART	<=2 years	57(41%)	122(44%)	0.88(0.58-1.34)	0.57	-	-
	>2 years	83(59%)	158 (56%)	-	1	-	-

### 3.4. DNA PCR Results of the Child with a Viral Load >1000 Copies/mL

This study revealed that the higher the VL is, the greater the risk of HIV transmission. For example, 66.7% of breastfeeding women with a viral load > 30,000 copies/mL had infants whose results were positive, whereas those with a viral load between 1000 and 30,000 copies/mL had 2.4% of infants with positive results.

## 4. DISCUSSION

The main objective of this study was to determine

predictors of VL unsuppression among pregnant and breastfeeding women living with HIV at ART health facilities in the Maseru district, Lesotho. A facility-based case-control study was employed to answer the research question. The findings of this study revealed that age, marital status, partners' HIV status (unknown HIV status), knowledge of HIV before pregnancy, transfer from other facilities, and nonadherence to ART were significantly associated with VL suppression among pregnant and breastfeeding women on ART in the Maseru district, Lesotho. The partner's unknown HIV status, knowledge of HIV before pregnancy, transfer from other facilities, and

non-ART adherence were identified as independent predictors of VL suppression in the final multiple logistic regression model (AOR: 95% CI;  $p$ -value < 0.05). These findings are discussed below.

Binary logistic regression demonstrated that young age (17- 24 years) was significantly associated with VL unsuppression. Those aged 17- 24 years were 3.5 times more likely to have an unsuppressed VL than those aged 35+ years. This finding is consistent with studies from South Africa [22, 23], Ethiopia [24], and Kenya [25]. This might be because younger age has been associated with the abrupt cessation of ARVs [20]. This calls for prioritization of this age group on adherence counseling through peer-to-peer support and psychosocial support, which could help ensure consistent and high adherence to ART and thus could contribute to VL suppression [26].

In addition, those who were not married had 6.6 times greater odds of unsuppressed VL than those who were married. This finding is consistent with a study from South Africa [22, 27, 28]. Therefore, it is critical that we prioritize single women in PMTCT adherence implementation strategies.

In this study, women whose partner's HIV status was unknown were more likely to have an unsuppressed VL, which is consistent with other study findings [27-31]. A woman not knowing their male partner's HIV status is a concern because it may increase the risk of contamination during pregnancy and breastfeeding. This implies the need for discussions on partner dynamics in pregnant and breastfeeding women, which can enhance HIV care, improve maternal outcomes, and aid in the Prevention of Mother-to-Child Transmission of HIV (PMTCT). Involving partners in the HIV care continuum *via* a couple-based counseling approach might be appropriate. Male involvement has been shown to be associated with maternal or infant Antiretroviral Therapy (ART) adherence [32].

This study revealed that HIV status before pregnancy was significantly associated with VL, similar to other findings. A study from South Africa reported that HIV positivity during pregnancy and initiation of ART were subsequently associated with a reduced risk of VL  $\geq$  50 copies/mL at delivery [33]. This might be because even women who are HIV positive prior to pregnancy are aware of their HIV status prior to pregnancy, but may have lived with HIV for a long duration, allowing the virus to multiply and not initiate Antiretroviral Therapy (ART) immediately, and not achieve viral suppression before conception. It is also very important to note that longer duration of HIV infection and longer ART treatment history among pregnant and breastfeeding women living with HIV should not be interpreted as an independent harmful factor affecting viral suppression [34]. Instead, these characteristics usually reflect the chronic and lifelong nature of HIV care under Option B+, where women remain on ART continuously through multiple pregnancies and breastfeeding periods. Women who have lived longer with HIV and been on treatment for an extended period are more likely to have experienced multiple transitions in

care, treatment interruptions, or changes in ART regimens due to national guideline updates. These programmatic and structural factors, not the duration of HIV infection itself, are what may influence viral suppression outcomes. Therefore, duration of HIV infection or duration on ART should not be viewed as inherently detrimental but rather as a marker of long-term engagement in care [34]. To reduce mother-to-child transmission of HIV, the promotion of HIV prevention and control strategies among women in their preconception period is needed.

Adherence to treatment plays a crucial role in achieving undetectable viral loads. In this study, ART adherence was strongly associated with VL suppression. Women who did not adhere to ART were 24.7 times more likely to have unsuppressed VL. This finding is consistent with similar studies conducted in Ethiopia [24], Ghana [35], and Uganda [36]. The focus should be on adherence to treatment. Adherence counseling during ART initiation and throughout treatment should be emphasized through communication about the prevention benefits of viral load suppression to all people living with HIV [21].

Transferring from facilities was significantly associated with unsuppressed VL among pregnant and breastfeeding women in this study. Women who transferred from other facilities were 12.4 times more likely to have unsuppressed VL; AOR = 12.45 (95% CI: 5.04-30.75). These findings are similar to those of a study conducted in South Africa [37]. This finding indicates that transitions between care settings may represent a vulnerable period during which treatment adherence and viral suppression could be compromised.

Finally, our study revealed that children born to mothers with higher viral loads were significantly more likely to be HIV positive. This finding is consistent with decades of research and underscores the importance of the PMTCT program [8, 27, 38]. Therefore, recognition and prioritization of all the above-discussed viral load suppression determinants are critical to ensure that mothers are virally suppressed and that HIV is not transmitted to their children. This calls for urgent management of high viral loads, which should be prioritized with proper social support and close monitoring [23]. This is crucial for advancing the elimination of HIV in alignment with the Sustainable Development Goals (SDGs) [39].

## 5. LIMITATIONS OF THE STUDY

Although a case-control study design was used, we used PMCT data, which have limitations such as bias, incomplete data, missing information, poor record quality, lack of detail in data, lack of active follow-up, and difficulty in establishing cause-and-effect relationships. A study was conducted in one district with a high HIV burden, but it might not represent the whole country. It is also important to note that the study included only women already engaged in PMTCT services; therefore, women who were lost to follow-up or who remained outside the formal care system—arguably those at highest risk—were not captured. As a result, the findings may not be

generalizable to all pregnant and breastfeeding women living with HIV in Lesotho. Additionally, it should be noted as a limitation that our study did not include an assessment of pregnancy outcomes, including mother-to-child HIV transmission.

## CONCLUSION

To achieve the UNAIDS 95-95-95 strategy and eliminate mother-to-child transmission, those identified determinants of VL suppression among pregnant and breastfeeding women living with HIV require attention in the design of appropriate strategies. Suboptimal viral load suppression is concerning and poses a threat to eliminating mother-to-child transmission in Lesotho, where the mother-to-child risk of transmission was still > 5% at the time of this study. Given that low-level viraemia increases the risk of vertical HIV transmission, we recommend strengthening the implementation of updated guidelines. These should include improved ART adherence, ensuring VL suppression, knowledge of HIV status before pregnancy through optimized monitoring schedules for maternal Viral Load (mVL), enhanced psychosocial support for younger and single women, and encouraging partners' participation in HIV care continuity. Additionally, district-level complementary interventions should be explored to ensure that viral loads remain.

## AUTHORS' CONTRIBUTIONS

The authors confirm their contributions to the paper as follows: A.S.B., P.M., and J.N.: Conception and study design; P.M. and J.N.: Data collection; A.B., P.M., and J.N.: Data analysis and interpretation; A.B., P.M., and J.N.: Manuscript drafting; A.B., P.M., and J.N.: Manuscript revision. All authors approved the final version of the manuscript.

## LIST OF ABBREVIATIONS

VL	=	Viral Load
AORs	=	Adjusted Odds Ratios
CI	=	Confidence Intervals
SSA	=	Sub-Saharan Africa
ART	=	Antiretroviral Therapy
MCC	=	Millennium Challenge Corporation
CHAL	=	Christian Health Association of Lesotho

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical) with reference R14/49 and from the Lesotho Ministry of Health National Health Research Committee, Lesotho with reference number REF: ID30-2020.

## HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and

national), and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

Informed consent was obtained from all of the participants in the study.

## STANDARDS OF REPORTING

STROBE guidelines were followed.

## AVAILABILITY OF DATA AND MATERIALS

Data and supplementary information files generated for this study are available and provided to the corresponding author [A.B] upon reasonable request.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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## REFERENCES

- [1] The urgency of now: AIDS at a crossroads. 2024. Available from: [https://www.unaids.org/sites/default/files/media\\_asset/2024-unaids-s-global-aids-update\\_en.pdf](https://www.unaids.org/sites/default/files/media_asset/2024-unaids-s-global-aids-update_en.pdf)
- [2] In danger: UNAIDS global AIDS update 2022. 2022. Available from: <https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update>
- [3] Lu Y, Li H, Dong R, *et al.* Global and regional disease burden of HIV/AIDS from 1990 to 2021 and projections to 2030. *BMC Public Health* 2025; 25(1): 1928. <http://dx.doi.org/10.1186/s12889-025-23121-4> PMID: 40413521
- [4] Carter A, Zhang M, Tram KH, Walters MK, Jahagirdar D, Brewer ED. Global, regional, and national burden of HIV/AIDS, 1990-2021, and forecasts to 2050, for 204 countries and territories: The global burden of disease study 2021. *Lancet HIV* 2024; 11(12): e807-22. [http://dx.doi.org/10.1016/S2352-3018\(24\)00212-1](http://dx.doi.org/10.1016/S2352-3018(24)00212-1) PMID: 39608393
- [5] Political declaration on HIV and AIDS: Ending inequalities and getting on track to end AIDS by 2030. 2021. Available from: [https://www.unaids.org/sites/default/files/media\\_asset/2021\\_political-declaration-on-hiv-and-aids\\_en.pdf](https://www.unaids.org/sites/default/files/media_asset/2021_political-declaration-on-hiv-and-aids_en.pdf)
- [6] Chilaka VN, Konje JC. HIV in pregnancy - An update. *Eur J Obstet Gynecol Reprod Biol* 2021; 256: 484-91. <http://dx.doi.org/10.1016/j.ejogrb.2020.11.034> PMID: 33246666
- [7] Myer L, Phillips TK, McIntyre JA, *et al.* HIV viraemia and mother-to-child transmission risk after antiretroviral therapy initiation in pregnancy in Cape Town, South Africa. *HIV Med* 2017; 18(2): 80-8. <http://dx.doi.org/10.1111/hiv.12397> PMID: 27353189
- [8] Ebuy H, Bekele A, Redae G. HIV testing, test results and factors influencing among infants born to HIV positive mothers in public hospitals of Mekelle City, North Ethiopia: A cross-sectional study. *BMC Infect Dis* 2020; 20(1): 67. <http://dx.doi.org/10.1186/s12879-020-4790-9> PMID: 31964397

- [9] Lesotho annual state of the AIDS response report 2024. 2024. Available from: <https://nac.org.ls/wp-content/uploads/2025/05/2024-Lesotho-State-of-the-AIDS-Response-October-24.pdf>
- [10] Pathways to success in the HIV response: UNAIDS global AIDS update 2023. 2023. Available from: [https://thepath.unaids.org/wp-content/themes/unaids2023/assets/files/2023\\_report\\_chapter\\_1.pdf](https://thepath.unaids.org/wp-content/themes/unaids2023/assets/files/2023_report_chapter_1.pdf)
- [11] HIV - Elimination of mother-to-child transmission. 2025. Available from: <https://data.unicef.org/topic/hivaids/emtct/>
- [12] Nachega JB, Marconi VC, van Zyl GU, *et al.* HIV treatment adherence, drug resistance, virologic failure: Evolving concepts. *Infect Disord Drug Targets* 2011; 11(2): 167-74. <http://dx.doi.org/10.2174/187152611795589663> PMID: 21406048
- [13] McDougall L, Moteetee MM, Mohai F, *et al.* Lesotho's minimum PMTCT package: lessons learned for combating vertical HIV transmission using co-packaged medicines. *J Int AIDS Soc* 2012; 15(2): 17326. <http://dx.doi.org/10.7448/IAS.15.2.17326> PMID: 23273267
- [14] How AIDS changed everything: MDG 6—15 years, 15 lessons of hope. 2015. Available from: [https://www.unaids.org/en/resources/documents/2015/MDG6\\_15years-15lessonsfromtheAIDSresponse](https://www.unaids.org/en/resources/documents/2015/MDG6_15years-15lessonsfromtheAIDSresponse)
- [15] The state of HIV prevention in lesotho. 2023. Available from: <https://hivpreventioncoalition.unaids.org/en/resources/state-hiv-prevention-lesotho-poster>
- [16] Chander G, Lau B, Moore RD. Hazardous alcohol use: A risk factor for non-adherence and lack of suppression in HIV infection. *J Acquir Immune Defic Syndr* 2006; 43(4): 411-7. <http://dx.doi.org/10.1097/01.qai.0000243121.44659.a4> PMID: 17099312
- [17] Huang DTM, Bannister W, Phong PT, Kirk O, Peters L. Factors associated with HIV-1 virological failure in an outpatient clinic for HIV-infected people in Haiphong, Vietnam. *Int J STD AIDS* 2011; 22(11): 659-64. <http://dx.doi.org/10.1258/ijsa.2011.010515> PMID: 22096052
- [18] Chi BH, Bolton-Moore C, Holmes CB. Prevention of mother-to-child HIV transmission within the continuum of maternal, newborn, and child health services. *Curr Opin HIV AIDS* 2013; 8(5): 498-503. <http://dx.doi.org/10.1097/COH.0b013e3283637f7a> PMID: 23872611
- [19] Paterson DL, Swindells S, Mohr J, *et al.* Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Ann Intern Med* 2000; 133(1): 21-30. <http://dx.doi.org/10.7326/0003-4819-133-1-200007040-00004> PMID: 10877736
- [20] Psaros C, Rimmert JE, Bangsberg DR, Safren SA, Smit JA. Adherence to HIV care after pregnancy among women in sub-Saharan Africa: Falling off the cliff of the treatment cascade. *Curr HIV/AIDS Rep* 2015; 12(1): 1-5. <http://dx.doi.org/10.1007/s11904-014-0252-6> PMID: 25620530
- [21] The role of HIV viral suppression in improving individual health and reducing transmission: Policy brief. 2023. Available from: <https://www.who.int/publications/i/item/9789240055179>
- [22] Ntombela NP, Kharsany ABM, Soogun A, *et al.* Viral suppression among pregnant adolescents and women living with HIV in rural KwaZulu-Natal, South Africa: A cross sectional study to assess progress towards UNAIDS indicators and implications for HIV epidemic control. *Reprod Health* 2022; 19(1): 116. <http://dx.doi.org/10.1186/s12978-022-01419-5> PMID: 35550580
- [23] Ngandu NK, Lombard CJ, Mbira TE, *et al.* HIV viral load non-suppression and associated factors among pregnant and postpartum women in rural northeastern South Africa: A cross-sectional survey. *BMJ Open* 2022; 12(3): e058347. <http://dx.doi.org/10.1136/bmjopen-2021-058347> PMID: 35273061
- [24] Hailu G, Keraleme A, Zealiyas K, *et al.* Human immunodeficiency virus (HIV) viral load suppression status and associated factors among pregnant women receiving highly active antiretroviral therapy (HAART) in Ethiopia. *Virology* 2025; 22(1): 49. <http://dx.doi.org/10.1186/s12985-025-02659-0> PMID: 40001227
- [25] Chan M, Muriuki EM, Emery S, *et al.* Correlates of HIV detection among breastfeeding postpartum Kenyan women eligible under option B+. *PLoS One* 2019; 14(5): e0216252. <http://dx.doi.org/10.1371/journal.pone.0216252> PMID: 31150396
- [26] Okonji EF, Mukumbang FC, Orth Z, Vickerman-Delpont SA, Van Wyk B. Psychosocial support interventions for improved adherence and retention in ART care for young people living with HIV (10–24 years): A scoping review. *BMC Public Health* 2020; 20(1): 1841. <http://dx.doi.org/10.1186/s12889-020-09717-y> PMID: 33261566
- [27] Yotebieng M, Mpody C, Ravelomanana NL, Tabala M, Malongo F, Kawende B. HIV viral suppression among pregnant and breastfeeding women in routine care in Kinshasa province: Baseline evaluation of CQI-PMTCT participants. *J Int AIDS Soc* 2019; 22(9): e25376. <http://dx.doi.org/10.1002/jia2.25376> PMID: 31496051
- [28] Gultie T, Genet M, Sebsibie G. Disclosure of HIV-positive status to sexual partner and associated factors among ART users in Mekelle hospital. *HIV AIDS* 2015; 7: 209-14. <http://dx.doi.org/10.2147/HIV.S84341> PMID: 26185470
- [29] Sithole Z, Mbizvo E, Chonzi P, *et al.* Virological failure among adolescents on ART, Harare city, 2017- A case-control study. *BMC Infect Dis* 2018; 18(1): 469. <http://dx.doi.org/10.1186/s12879-018-3372-6> PMID: 30227831
- [30] Abadia-Barrero CE, LaRusso MD. The disclosure model versus a developmental illness experience model for children and adolescents living with HIV/AIDS in São Paulo, Brazil. *AIDS Patient Care STDS* 2006; 20(1): 36-43. <http://dx.doi.org/10.1089/apc.2006.20.36> PMID: 16426154
- [31] Schrubbe LA, Stöckl H, Hatcher AM, Marston M, Kuchukhidze S, Calvert C. Prevalence and risk factors of unsuppressed viral load among pregnant and breastfeeding women in sub-Saharan Africa: Analysis from population-based surveys. *AIDS* 2023; 37(4): 659-69. <http://dx.doi.org/10.1097/QAD.0000000000003459> PMID: 36511117
- [32] Jones DL, Rodriguez VJ, Soni Parrish M, *et al.* Maternal and infant antiretroviral therapy adherence among women living with HIV in rural South Africa: A cluster randomised trial of the role of male partner participation on adherence and PMTCT uptake. *SAHARA J* 2021; 18(1): 17-25. <http://dx.doi.org/10.1080/17290376.2020.1863854> PMID: 33641621
- [33] Brittain K, Mellins CA, Remien RH, Phillips TK, Zerbe A, Abrams EJ. Impact of HIV status disclosure on viral load in pregnant and postpartum women on ART. *J Acquir Immune Defic Syndr* 2019; 81(4): 379-86. <http://dx.doi.org/10.1097/QAI.0000000000002036> PMID: 30939530
- [34] Brown JA, Motaboli L, Leretholi M, *et al.* Cohort profile: The viral load cohort North-East Lesotho (VICONEL) from 2016 to 2023 - cohort description, test volumes, predictors of viraemia and the road ahead. *BMJ Open* 2025; 15(2): e085404. <http://dx.doi.org/10.1136/bmjopen-2024-085404> PMID: 39915024
- [35] Owusu LB, Ababio C, Boahene S, *et al.* The predictors of unsuppressed viremia among PLHIV: A cross-sectional study in Ghana. *BMC Public Health* 2023; 23(1): 1113. <http://dx.doi.org/10.1186/s12889-023-16032-9> PMID: 37296400
- [36] Wakoko P, Gavamukulya Y, Wandabwa JN. Viral load suppression and associated factors among HIV patients on ART in Eastern Uganda: A retrospective cohort study. *Infect Dis Res Treat* 2020; 13: 1178633720970632. PMID: 33223836
- [37] Zondi S, Cele L, Mathibe M, Mogale M. Virological non-suppression and associated factors among adult patients receiving antiretroviral therapy at selected health facilities in uMgungundlovu district of KwaZulu Natal, South Africa: A cross-sectional study. *Pan Afr Med J* 2024; 47(96): 96. PMID: 38799193
- [38] Landes M, van Lettow M, Nkhoma E, Tippet Barr B, Truwah Z,

Shouten E. Low detectable postpartum viral load is associated with HIV transmission in Malawi's prevention of mother-to-child transmission programme. *J Int AIDS Soc* 2019; 22(6): e25290.

<http://dx.doi.org/10.1002/jia2.25290> PMID: 31180186

[39] Bekker LG, Alleyne G, Baral S, *et al.* Advancing global health and

strengthening the HIV response in the era of the sustainable development goals: The international AIDS society—lancet commission. *Lancet* 2018; 392(10144): 312-58.

[http://dx.doi.org/10.1016/S0140-6736\(18\)31070-5](http://dx.doi.org/10.1016/S0140-6736(18)31070-5)

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