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Born to HIV-Positive Women  
in Amhara National Regional  
State, Ethiopia

HATASO

# Mother-to-Child HIV Transmission among Infants Born to HIV-Positive Women in Amhara National Regional State, Ethiopia

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## Abstract

Mother-to-child transmission (MTCT) is the major source of HIV infection among children under the age of 15 years. There were limited studies on the MTCT rate in Amhara Region, Ethiopia. Therefore, this study aimed to measure mother-to-child transmission and to identify factors associated with MTCT. An institutional-based retrospective cohort study was conducted among HIV-exposed infants (HEIs). The HEIs who booked in mother-baby pair cohort register between January 2014 and December 2016 were abstracted and included in the study. A structured pretested questionnaire was used for data abstraction. The collected data were coded and double entered into EPI Info version 3.5.4 and exported to STATA version 14 for analysis. A penalized logistic regression model was used. *p*-value <0.05 was taken as the significance level. A total of 796 HEIs participated in the study in which 96.9% received nevirapine prophylaxis, 97.5% were exclusively breastfed for 6 months, and 95.2% received HIV test at 6 weeks. About 36.5% of mothers of HEIs received ART (Antiretroviral Treatment) for less than 4 weeks during delivery. Of the mothers of HEIs, 7.6% were in WHO clinical stage I and 64.1% had >350 CD4 count at the first antenatal care visit. Overall, MTCT of HIV was 1.5%, and 59.2% of HEIs were discharged from the PMTCT care at the age of 12-18 months. The vertical transmission of HIV was significantly associated with the duration of ART (AOR 0.16; 95% CI: 0.02, 0.96). The MTCT was 84.0% less likely in mothers who did receive Antiretrovirals (ARVs) >12 months compared with mothers who did receive ARVs <4 weeks during delivery. The study indicated that vertical transmission of HIV was significantly associated with the duration of ART. Even if a considerable low MTCT rate was observed, early identification and treatment among HIV-positive pregnant women should be strengthened.

**Keywords:** Mother to child transmission rate; Vertical transmission; MTCT rate; HIV.

## 1. INTRODUCTION

Mother-to-child transmission (MTCT) is the major source of HIV infection among children under the age of 15 years. Globally, over 90% of HIV infections in children are acquired through MTCT [1]. The risk of MTCT without intervention ranges from 20% to 45% [2]. However, the risk of MTCT can be reduced to less than 5% with specific interventions [2]. Study indicates that without appropriate intervention for HIV-infected babies, about 50% of those infants born with HIV will die before their second birthdays [3]. The sustainable development goals (SDGs) place a heightened emphasis on the prevention of mother-to-child transmission (PMTCT) in the context of better health for mothers and their children [4]. Globally, from 2000 to 2014, PMTCT programs prevented an estimated 1.4 million children from acquiring HIV infection and 1.2 million of them were from the African Region [5].

Ethiopia is among the 21 prioritized countries with the highest number of pregnant women living with HIV in 2014 [6]. According to the 2015 UNAIDS progress report, the proportion of pregnant women living with HIV who were receiving antiretroviral treatment had increased from 64% in 2013 to 73% in 2014 in Ethiopia, and the incidence of new HIV infections in children had reduced by 65% since 2009. The report also showed that there were gaps in maintaining women on antiretroviral treatment throughout the breastfeeding period, as the 6-week MTCT rate of 6% increases to 18% after breastfeeding ends. In addition, only 25% of HEIs received early infant diagnosis, and 22% of children with HIV received antiretroviral therapy in 2014 [7]. This shows a big gap in all prongs of PMTCT care cascades.

The transmission of HIV from HIV-positive mother to her child during pregnancy, labor, and breastfeeding is called MTCT [4]. The MTCT of HIV can be reduced with effective interventions during the period of pregnancy, labor, delivery, and breastfeeding. These interventions primarily focus on lifelong ART for the mothers and a short course of antiretroviral drugs for the baby [4]. At 6-8 weeks old, all infants who are born to HIV-positive mothers should be given an early infant diagnosis (EID) and antibody test at 18 months and/or when breastfeeding ends to provide the final infant diagnosis [4, 8-10].

## 2 Original Research Article

Implementation of the elimination of mother-to-child HIV transmission strategic plan through option B+ recommendations (test and treat) has started in Ethiopia since 2013 [11, 12]. According to the 2015 Amhara Regional Health Bureau annual report, about 63% of pregnant women living with HIV received antiretroviral drugs and 43.5% of HEIs received nevirapine prophylaxis to prevent MTCT in Amhara Region, Ethiopia [13].

Prevention of communicable disease including HIV/AIDS is the government's top priority. Moreover, the availability of PMTCT and ART services will lead to the reduction of HIV infection to reproductive health women and create opportunities to prevent pediatric HIV and improve child survival. Although Ethiopia has been using the Option B+ strategy since 2013, PMTCT of HIV still remains to be a challenge for the country due to high MTCT. Moreover, limited evidence is available on the MTCT rate in Amhara National Regional State (ANRS). Therefore, this study aimed to assess the MTCT of HIV and factors associated with MTCT of HIV among HEIs.

### 2. METHOD(S)

#### 2.1. Study Design and Setting

A retrospective cohort study design was employed to assess MTCT among HEIs who were booked in the PMTCT register between January 2014 and December 2016 using facility-based document review. The study was conducted in three referral hospitals and three health centers in ANRS. The ANRS is located in the northwestern part of Ethiopia. The estimated HIV-positive women in need of PMTCT services in the region in 2017 were 8,720 [14]. The region has five referral hospitals, 54 district hospitals, 832 health centers, and 3,345 health posts [13].

#### 2.2. Source and Study Population

The source population of the study was all HEIs who have been followed at the PMTCT unit and registered at the mother–baby pair cohort (MBPC) register in all ANRS health facilities. The study population was all HEIs who have been followed up for 24 months at PMTCT units and documented at MBPC registers in the selected health facilities of ANRS. All HEIs who have been followed up at PMTCT units in the past 24 months were included in the study, all HEIs who have not been followed up at PMTCT units and with no dried blood sample (DBS) and antibody test result were excluded from the study.

#### 2.3. Sample Size Determination and Sampling Procedures

The sample size for measuring MTCT and factors associated with MTCT was determined using a double population proportion formula and calculated using software EPI-info version 7.2.1.0 statcalc. The sample size was calculated by using the following assumptions: 95% confidence level, 80% power, and 1:3 ratios of PMTCT service users (exposed) and nonusers (nonexposed). Furthermore, 18% of MTCT among HEIs in users [7] and 28% proportion of unexposed with the disease (nonuser) were taken. Thus, the final sample size for the study was 796 HEIs.

A multistage sampling technique with simple random sampling at each stage was employed. By using a simple random sampling technique, three referral hospitals that represent the ANRS were selected. Then, three catchment health centers of the selected hospital were included in the study by using a simple random sampling technique. The PMTCT registers were the sampling frame and HEIs who have had follow-up at PMTCT units in the past 24 months and who had HIV antibody and DNA/PCR test results were the study subjects. Data were taken from selected health facilities PMTCT unit registration by using a systematic random sampling technique. The number of HEIs that represented each health facility was allocated using proportion to the population size of HEIs of each health facility.

#### 2.4. Data Collection Tool and Procedures

A structured questionnaire was used to collect data. The structured questionnaire was prepared in the English version. The questionnaire was adapted from different published journals, WHO, MOH PMTCT manuals, and mother–baby pair cohort registers [15-17]. The reliability of the tools was measured using Cronbach's alpha value, and the scales with a value of above 0.7 were accepted as reliable. Data were abstracted from PMTCT registers (mother–baby pair cohort follow-up registers) using a structured questionnaire. The HEIs who were booked between 2014 and 2016 in PMTCT registers were abstracted and included in the study. Data about HEIs were collected from the PMTCT registration books related to DNA/PCR test results, time of HIV testing, intake of Nevirapine (NVP) prophylaxis by infants, and infant feeding practice. Data related to maternal ART intake and duration of treatment and place of delivery were also collected.

A 2-day training was given for the data collectors about the objectives and procedures of the data collection by the investigator. In addition, supervisors checked all completed questionnaires, and forms were checked by supervisors for their completeness and consistency at field level. The questionnaires were pretested on 50 HEIs from other nonselected health facilities before the actual data collection started and relevant corrections were included.

#### 2.5. Data Processing and Analysis

The data were coded and double entered into EPI Info version 3.5.4 and exported to STATA version 14 for analysis. Descriptive statistics such as frequency, proportion, and mean were used to describe the data. Penalized logistic regression analysis was

conducted to assess the association between MTCT of HIV with explanatory variables: sociodemographic factors, maternal-related factors, and infant related. Penalized regression methods can provide better predictions than standard regression methods because the standard regression model could produce overfitted risk models that make inaccurate predictions in datasets with a low number of events relative to the number of predictors [18-21]. Those potential variables associated with the MTCT of HIV were included in the initial multivariable penalized logistic regression model using forward fitting. Variables persisted to be associated with the outcome variable at  $p \leq 0.2$  were included in the final model. The  $p \leq 0.05$  and Odds ratio (OR) with its 95% CI were considered to check the significance and strength of association between MTCT of HIV and explanatory variables.

## 2.6. Ethical Considerations

The ethical clearance for this study was obtained from Ethics and Research Committee of the Institute of Public Health, the University of Gondar with reference number O/V/P/RCS/05/817/2017 on November 13, 2017. Support letters from the Amhara National Regional State Health Bureau were secured. Information obtained from PMTCT registers was confidential and anonymous. Records in the PMTCT room were observed for completeness, confidentiality, and outcome of HIV-exposed infants (HEIs). As these documents are anonymous, getting verbal consent from the facility is sufficient to access them.

## 3. RESULTS

### 3.1. Sociodemographic Characteristics of the Study Participants

A total of 796 HEIs were included in the study. The study showed that 97% of HEIs were born at health facilities, 96.9% of HEIs received nevirapine prophylaxis, and 97.5% of HEIs were breastfed exclusively for 6 months (Table 1).

### 3.2. Sociodemographic and HIV Status of HEIs' Mothers

The study revealed that 69% of mothers of HEIs were in the age group of 25-34 years, 67.6% were in WHO clinical stage I, 64.1% had CD4 count of  $>350$  at the first visit, 36.5% received ART for less than 4 weeks during delivery, 56.0% were on ART, and only 1% were either lost to follow-up or stopped the treatment (Table 2).

### 3.3. Outcome of HIV-Exposed Infants

The study showed that 95.2% of HEIs received HIV test at 6 weeks by DNA/PCR, and the overall MTCT of HIV was 1.5%. The study also indicated that 59.2% of HEIs were discharged from PMTCT care at the age of 12-18 months, and from infants with known outcomes, 97.9% were discharged negative, and 1.5% were on ART (Table 3).

### 3.4. Factors Associated with Mother-to-Child HIV Transmission

In this study, a short duration of maternal ARV use is found to be one of the risk factors for MTCT. Vertical transmission of HIV was 84% (AOR 0.16, 95% CI = 0.02-0.96) less likely in mothers who were on ART for a duration of more than 12 months compared to mothers who were on ART for a duration of less than weeks (Table 4).

**Table 1: Sociodemographic characteristics of the study participants, ANRS, Ethiopia, 2018 (n=796).**

Variables	Frequency (n=796)	Percentage (%)
<b>Infant received NVP</b>		
Yes	771	96.9
No	25	3.1
<b>Infant feeding practice in the first 6 months</b>		
Exclusive breastfeeding (EBF)	776	97.5
Exclusive replacement feeding (ERF)	20	2.5
<b>Age in weeks CPT started for the infant</b>		
6 weeks	761	95.6
7-8 weeks	21	2.6
8-12 weeks	14	1.8
<b>Place of delivery</b>		
Health facility	772	97.0
Home	24	3.0

**Table 2: HIV status of mothers of HIV-exposed infants, ANRS, Ethiopia, 2018 (n=796).**

Variables	Frequency (n=796)	Percentage (%)
<b>Maternal age (years)</b>		
18-24	174	21.8
25-34	549	69.0
35-49	73	9.2
<b>Maternal HIV status at entry to PMTCT</b>		
Known HIV positive on ART	446	56.0
Newly diagnosed at ANC	252	31.7
Newly diagnosed at delivery	47	5.9
Newly diagnosed at PNC	29	3.6
Known HIV positive not on ART	22	2.8
<b>Partner testing</b>		
Positive	373	46.8
Negative	202	25.4
Not done	221	27.8
<b>Initial CD4 test result (CD4 at ANC)</b>		
<200	80	10.1
200-350	154	19.3
>350	510	64.1
Not done	52	6.5
<b>WHO clinical stage for mother</b>		
WHO stage I	538	67.6
WHO stage II	225	28.2
WHO stage III	27	3.4
Not found	6	0.8
<b>Maternal CPT started</b>		
No	579	72.7
Yes	217	27.3
<b>Duration of maternal ART intake at delivery (months) (N=786)</b>		
<4 months	287	36.5
4-12 months	144	18.3
>12 months	355	45.2
<b>Current maternal treatment status</b>		
Mothers transferred out to ART (TO)	786	98.7
Mothers lost from follow-up	5	0.6
Stopped the treatment	3	0.4
Mothers dead	2	0.3

**Table 3: Outcome of HIV-exposed infants, ANRS, Ethiopia, 2018 (n=796).**

Variables	Frequency	Percentage (%)
<b>Age in weeks for DNA/PCR test</b>		
6 weeks	758	95.2
7-8 weeks	23	2.9
8-12 weeks	15	1.9
<b>Result of DNA/PCR test</b>		
Negative	785	98.6
Positive	7	0.9
Not known	4	0.5

Table 3: Continued

Variables	Frequency	Percentage (%)
<b>Rapid HIV antibody test result at/within 18 months</b>		
Negative	781	99.0
Positive	5	0.6
Unknown	3	0.4
<b>MTCT (HIV result from both DBS and antibody test)</b>		
Negative	784	98.5
Positive	12	1.5
<b>Infant outcome</b>		
Discharge negative	779	97.9
On ART	12	1.5
Dead	3	0.3
Lost	2	0.3
<b>Age at discharge</b>		
<1 year	47	5.9
12-18 months	471	59.2
18-24 months	278	34.9

Table 4: Factors associated with MTCT among HEIs, ANRS, Ethiopia, 2018 (n=796).

Explanatory variable	MTCT		Crude OR (95% CI)	AOR (95% CI)	p-Value
	Positive	Negative			
<b>Maternal age (years)</b>					
18-24	4	170	1		
25-34	6	543	0.45 (0.13, 1.52)	0.53 (0.15, 1.83)	0.321
35-49	2	71	1.37 (0.27, 6.37)	1.45 (0.26, 7.02)	0.704
<b>Maternal HIV status at entry to PMTCT</b>					
Newly diagnosed at ANC	5	247	1		
Newly diagnosed at delivery & PNC	2	74	1.51 (0.33, 6.88)	1.10 (0.21, 5.75)	0.906
Known HIV positive on ART	5	441	0.56 (0.17, 1.84)	2.0 (0.47, 8.43)	0.343
Known HIV positive not on ART	0	22	0.99 (0.05, 18.67)	1.33 (0.06, 25.96)	0.850
<b>Place of delivery</b>					
Home	1	23	1		
Health Facility	11	761	0.23 (0.04, 1.36)	0.69 (0.08, 5.57)	0.730
<b>WHO clinical stage for mother (n=790)</b>					
WHO stage I	10	528	1		
WHO stages II and III	2	250	0.50 (0.12, 2.01)	0.76 (0.17, 3.39)	0.723
<b>Duration of maternal ART intake at delivery (months) (n=786)</b>					
<4 months	8	279	1		
4-12 months	2	142	0.57 (0.13, 2.39)	0.55 (0.12, 2.54)	0.450
>12 months	2	353	0.23 (0.05, 0.96)	0.16 (0.02, 0.96)	0.046
<b>Infant received NVP</b>					
Yes	11	760	1		

Table 4: Continued

Explanatory variable	MTCT		Crude OR (95% CI)	AOR (95% CI)	p-Value
	Positive	Negative			
No	1	24	4.04 (0.70, 23/26)	2.89(0.35, 33.96)	0.324
<b>Infant feeding practice in the first 6 months</b>					
Exclusive breastfeed- ing (EBF)	11	765	1		
Exclusive replacement feeding (ERF)	1	19	5.12 (0.98, 29.75)	5.12(0.81, 32.09)	0.081

#### 4. DISCUSSION

For the PMTCT program to effectively prevent vertical transmission of HIV, women with HIV and HEIs must successfully follow the PMTCT cascade cares [4, 8-10]. The study indicated that the overall MTCT rate of HIV among HEIs was 1.5%, which is lower than the national estimated MTCT rate of 18% in 2014 [7], and a similar study finding in Ethiopia, which is 9.6% [22]. The finding is also lower than the findings reported from similar studies that indicate the rate of MTCT is 4.6% and 8.2% in Brazil [23, 24], 11% in Malawi [25], 9.6% in Tanzania [26], and 4.5% in Cameroon [27]. Another study in Nigeria also showed a transmission rate of HEIs among those who had mixed feeding was 25.6% and exclusively breastfed was 11.8% [28]. The difference in findings could be due to the time difference, as most of the studies were conducted earlier than this study and the improvements of the PMTCT program from time to time that leads to effective prevention of MTCT [7].

Early diagnosis of HIV in infants provides a critical opportunity to strengthen the follow-up of HEIs and initiate early treatment for those who are HIV infected. If untreated, HIV infection in children is associated with very high mortality rates. About 50% of those infants born with HIV will die before their second birthdays [3]. WHO recommends all infants who are born to HIV-positive mothers should be given an EID and antibody test at 18 months and/or when breastfeeding ends. The Ethiopia National PMTCT guidelines put the time for DNA PCR test to be conducted at 6-8 weeks old for all HEIs [15, 17, 29]. However, we observed in our study that the majority of the infants came for the EID at 6 weeks. Slightly higher proportion of HEIs undergone for HIV diagnoses based on the recommended time in this study compared with other studies in Brazil (12%) of mothers brought their children for HIV-1 determination before they reached 2 months old, 47.7% between 2 and 4 months, 10% between 5 and 6 months, 7.4% between 7 and 8 months, and 22.9% over 8 months old [23]. Similar studies from Kenya and Mozambique also show low uptake and high dropout rates of HEIs for HIV diagnoses and care [30, 31].

In our study, a higher proportion of HEIs were breastfed exclusively and received NVP prophylaxis. This finding is slightly higher than the studies in Zambia (92.5%) and 83.6% of HEIs whose records were reviewed had ever been breastfed and received chemoprophylaxis [26]. The discrepancy in findings could be due to the promising indicator for the success of PMTCT [5].

The findings of this study on the outcome of HEIs indicate that a higher proportion of HEIs were discharged negative. The finding of this study on lost to follow-up and dead is lower compared with other similar studies in Ethiopia, which show that 40.1% discharged and 39.4% lost [22]. In Tanzania, from 93.0% of infants with known outcomes at 6 months, 43.5% were alive, 49.4% were lost to follow-up, 6.5% had transferred, and 0.6% had died [26]. The difference in findings could be due to the improvements in the PMTCT program from time to time, which leads to effective prevention of MTCT [7].

In this study, a short duration of maternal ARV use is found to be one of the risk factors for mother-to-child HIV transmission. Vertical transmission of HIV was less likely in mothers who were on ARVs for a duration of more than 12 months compared to mothers who were on ARVs for a duration of less than 4 weeks. This finding is in line with a study reported from Nigeria in which vertical transmission of HIV is eight times more likely in mother-baby pairs who did not receive ARVs [28].

This study has some limitations. As the data were secondary, the information gathered was not complete for some infants and mother's data. In addition, all maternal potential factors for vertical transmission were not explored by the study.

#### 5. CONCLUSION

The reduction of MTCT of HIV is possible with effective PMTCT interventions, including improved access to ARVs for HIV-positive mothers and early infant diagnosis and appropriate infant feeding practices for HEIs. The study indicated that vertical transmission of HIV was significantly associated with the duration of ART. Even if a considerable low MTCT rate was observed in the Amhara Region, early identification and treatment among HIV-positive pregnant women should be strengthened. Further research is needed to identify the determinants of the MTCT of HIV.

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### Authors' Contributions

ZZ, YM, KY, and GA designed the research study, performed the research and critically reviewed the paper. ZZ analyzed the data and wrote the draft paper. All authors approved the final manuscript and agreed to be accountable for all aspects of the work.

### Conflict of Interest

The authors report no conflict of interest in this work.

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