

Determinants of Mother to Child Transmission of HIV Among Infants Born from HIV Positive Women in North Wollo Zone, North East Ethiopia: 2018, Case Control Study

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Abstract

Background: HIV infection has a pandemic aspect and is extremely severe, making it one of the most important current public health problems. Without treatment, the likelihood of HIV passing from mother-to-child is 15% to 45%.

Objectives: To identify determinant factors of HIV infection among HIV exposed infant in selected health facilities of North wollo zone, Amhara, North east Ethiopia, 2018.

Methods: Unmatched case-control study was conducted using record review of DNA PCR HIV virology test and confirmatory test results determined during follow up in selected health facilities of North wollo zone, Amhara, North east Ethiopia. The data collection period was from March 03, 2018 – April 25, 2018. A case was defined as a child who tested HIV positive by DNA PCR or rapid antibody test born to a mother who had been on PMTCT program. A control was an HIV negative child born to a mother who had been on PMTCT program. Total of 415 charts of HIV-exposed infant – mother pairs (83 cases and 332 controls) from each of the health facilities were included using stratified random sampling method and proportional allocation. Descriptive statistics, bi-variate and multivariable logistic regression analysis were performed to identify determinants. P value <0.05 and the corresponding 95% confidence interval (CI) was considered for statistical significance.

Result: Assisted vaginal delivery [AOR: 6.87, 95% CI(2.5-15.8)], mothers who knew their HIV status after delivery [AOR: 10.6, 95% CI(3.31-24.17)], mothers who knew their HIV status during pregnancy [AOR: 4.42, 95% CI (1.37-14.25)], history of breast infection during lactation [AOR: 4.10, 95% CI(1.40-11.98)], poor adherence of the mother to ART drug [AOR: 7.46, 95% CI(2.01-27.3)], fair adherence of the mother to ART drug [AOR: 7.15, 95% CI(2.26-22.3)] were factors increased mother to child HIV transmission. Whereas ARV prophylaxis intake for the infant [AOR: 0.07, 95% CI (0.03– 0.21)] and using PMTCT service [AOR: 0.04, 95% CI (0.014-0.13)] were protective.

Conclusion & Recommendations: Both fair and poor adherences to ART drug, assisted vaginal delivery, history of any form of breast infection during lactation, a mother who knew her sero status during pregnancy and after delivery are all increase the chance of HIV MTCT while infant ARV intake and utilizing PMTCT service decreased the chance. For policy makers to enhance all reproductive age female know their HIV status before they become pregnant and prepare standard protocol for birth option and delivery of HIV positive pregnant women. For health facilities follow effectively the level of adherence to ART drugs for mothers who are pregnant or intend to be pregnant and lactating mothers.

Keywords: Infant; HIV; MTCT; Risk factors

Introduction

Background

HIV infection has a pandemic aspect and is extremely severe, making it one of the most important current health problems globally. In adults it is mainly transmitted via sexual inter course, on the other hand most children acquired it from their mother [1]. Mother-to-child transmission of HIV accounts for the major means of HIV infection in children under the age of 15 years [2]. Without treatment, the likelihood of HIV-1 transmission from an infected mother to her baby is estimated to be 15% - 45% in the developing countries where more than half of the transmission occurring late in pregnancy or during labor and delivery [3].

In Ethiopia it is stated the rate is as high as 15.7%. In (PMTCT) Prevention of HIV Mother-To-Child Transmission service providing sites, of the total pregnant women diagnosed with HIV, (67%) received antiretroviral prophylaxis [4]. The national HIV prevalence in 2014 among pregnant women attending ANC clinics was 2.2% (urban 3.9%, rural 1.4 %) [5].

The risk of a mother living with HIV passing the virus to her child can be reduced to 5% or less if she has access to effective antiretroviral therapy during pregnancy, delivery and breastfeeding [6]. Today, developed countries have reduced the rate of transmission to babies to less than 1% by a combination of interventions, most importantly by antiretroviral therapy. However; in most African countries the rate remains above 10% [7,8].

Mother to child transmission of HIV is a multi-factorial process transmitted during pregnancy trans placentally in the uterus, during the process of labor and delivery in the prenatal period and during breast feeding in the postnatal period [9]. Infants born from women who develop acute HIV infection while breastfeeding are at greater risk of becoming infected than those whose mothers have chronic HIV infection [10] because acute HIV infection is accompanied by a rapid increase in viral load and a corresponding decrease in CD4 cell count [11]. When women have lower CD4+ cell counts lesser breast milk protection or other sensitive risks occur [12].

Study done in Amhara region indicated that around 12% of HIV exposed infants became infected born from HIV+mothers [9]. Even though the rate of Mother to child transmission was very high as it is indicated there must be many researches that reveal factors that contribute for the transmission of MTCT. Therefore, this study will determine factors of mother to child HIV transmission among infants born from HIV positive women in selected health facilities of north wollo zone, north east Ethiopia to push up the interventional activity in PMTCT services.

The study was conducted in 19 ART site health facilities of North Wollo zone. North wollo zone is located in North east Ethiopia, Amhara region. The capital is woldia town that is located 520 kilometers north of Ethiopia's capital-Addis Ababa. According to the 2007 Ethiopian population and Housing census, north wollo zone has estimated population of 1,769,761 [13]; there are totally 65 health facilities found but only 19 health facilities offer ART services which implements option B+ PMTCT since 2014 all of them send Dried Blood Sample (DBS) of HIV exposed infants to Dessie Regional Laboratory for Deoxyribonucleic acid (DNA) polymerase chain reaction (PCR) HIV test and receive the result within a month to confirm HIV infection.

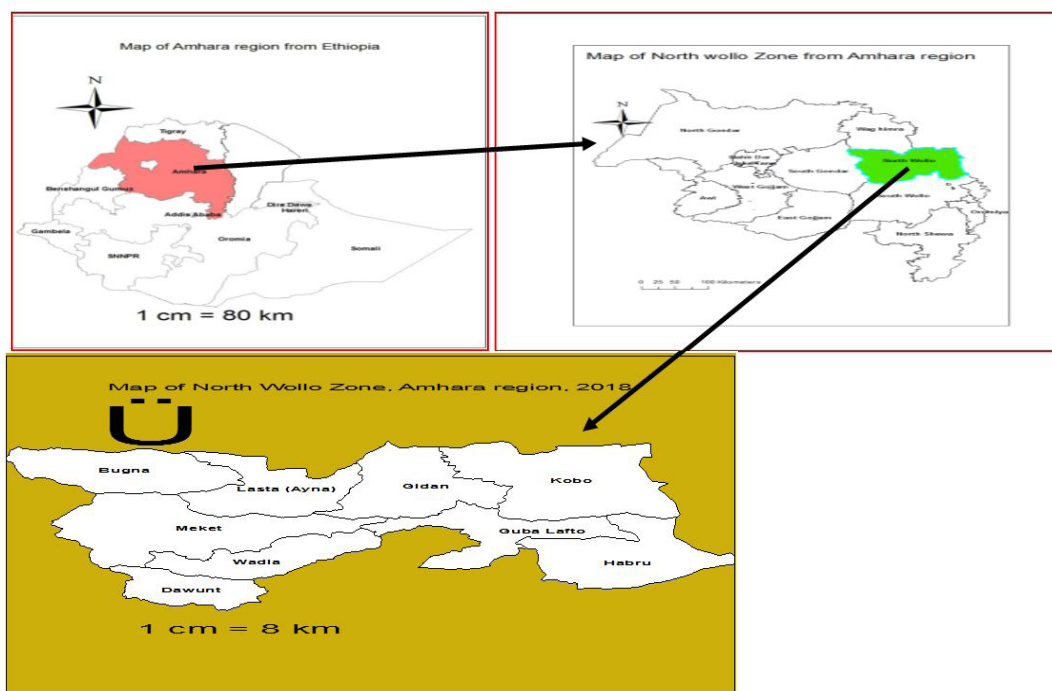


Figure 1: Map of the study area north wollo zone, Amhara region, Ethiopia

Statement of the problem

Globally, in 2016, there were 36.7 million people living with HIV. From which 17.8 million are women (15+ years). In that year, there were roughly 1.8 million new HIV infections. On the other side new HIV infections among children were 160,000. Globally over Four hundred children become infected with HIV every day [11] but just only 49% had access to the life-saving medicines it means that half the children in need of treatment do not have access.

East and Southern Africa is the region that is hardest hit by HIV. It is home to 6.2% of the world's population but has 19.4 million people living with HIV, over 50% of the total number of people living with HIV in the world and also 14.2million (80% of the

world) Estimated number of women (15+ yrs.) living with HIV and above all 90% of Estimated number of pregnant women living with HIV were found in sub Saharan Africa including Ethiopia plus to this there were 790,000 new HIV infections, 43% of the global total and there was 120,000 new children HIV infection in 2016 that is 84% of the world's total [14].

While new cases have been reported in all regions of the world, approximately two-thirds are in sub-Saharan Africa, with 43% of new total cases and 84 % of new children cases [15]. 77 000 new HIV infected children only in eastern and southern Africa reported in 2016 [14].

The estimated number of people living with HIV in Ethiopia is 740,251, including 143,201 Children. The estimate indicated that 11,479 new adult HIV infection and 2,105 children less than 14 years are also newly infected in 2016 [16] more than 90% of them acquired from their mother [17]. The urban HIV prevalence for pregnant women aged 15-49 in Ethiopia is 3.9% while Amhara region has among the highest Urban HIV prevalence that was 6.1% [12].

Despite the significant progress of 70% decline in new HIV infections among children in the world between 2000 and 2015 the number of children becoming newly infected with HIV remains unacceptably high. About 23% of pregnant women living with HIV did not have access to ARVs [11].

The risk of a mother living with HIV passing the virus to her child can be reduced to 5% or less if she has access to effective antiretroviral therapy during pregnancy, delivery and breastfeeding [8]. In 2011, globally a 90% Plan was launched to reduce the number of new HIV infections of mother-to-child transmission until 2015 [8]. The WHO identified 22 priority countries, with the top 10 including Ethiopia accounting for 75% of the global PMTCT service need. It was estimated that the effective scaling up of interventions in these countries would prevent over 250,000 new infections annually [8].

In 2015, six priority countries (Botswana, Mozambique, Namibia, South Africa, Swazi land, Uganda) met the Global Plan target of reducing mother-to-child transmission by 90% [8]. In mid-2015, Cuba became the first country to eliminate the mother-to-child transmission of HIV [18]. In 2016, Belarus and Armenia achieved the same achievement also in the Asia and pacific region Thailand eliminates HIV MTCT [19]. As PMTCT is not 100% effective, elimination is defined as a reduction of transmission to such low levels (below 5%) that it no longer constitutes a public health problem. Even though the above promising achievement found in some countries of the world generally elimination target of MTCT is set as off target by world health organization.

After 2015 elimination became off target UNAIDS with PEPFAR among others launched a new target called "super fast-track targets" to end AIDS among children, adolescents and young women by 2020. Targets relating to PMTCT include reducing the number of new HIV infections among children to fewer than 40,000 by 2018 and fewer than 20,000 by 2020. There is also a commitment to ensure that 95% of pregnant women living with HIV are receiving lifelong HIV treatment by 2018 [20].

Ethiopia is among countries agreed the goal set by UNAIDS in 2011, the Joint United Nations Program on HIV/AIDS; a global call for the elimination of MTCT by the passed 2015 [21]. Due to the deployment of tremendous strategies over the past couple of years on the issue, HIV incidence in children was declined by 60% in Ethiopia. However, the rate of MTCT is unacceptably high in recent studies showing that the rate is up to 15.2% that is far from the target of reaching <5% [20,22].

Researches are done regarding determining factors of mother to child HIV transmission in some parts of Ethiopia but their data sources were largely referral hospitals on this regard our study sufficiently includes primary health care units (PHCU) district hospitals and health centers besides no similar research was done in north eastern part of Ethiopia specifically in wollo, Amhara region.

Significance of the study

From the study primarily HIV exposed infants will benefit and the infant's mother also benefited in one way or another. By having information on determinants of HIV PMTCT those who works in prevention of HIV and PMTCT programs use the result from the study to prioritize interventions particularly in resource limited setting as in Ethiopia. The result of this study would help the health policy makers and responsible bodies such as Woreda, zonal and regional health bureaus and for the country at large to plan necessary public health measures and interventions for the prevention of mother to child HIV transmission so that it will help them for the journey to eliminate MTCT that is not achieved as it is targeted till 2015. This study, also will contribute to the intensively continuing study in the field to identify factors independently associated with HIV MTCT and will have an input for interventional planning. In addition, this study will be encouraging data for other researchers to investigate better study such as qualitative supplemented prospective study for the future.

Literature review

Magnitude of the problem

Vertical transmission of HIV is a multi-factorial process. Studies conducted among infants born to HIV positive mothers in different part of the world showed that HIV MTCT rate varies from country to country. A research in French indicated, MTCT rate was 1.5% [23], while 11.8% newborns were HIV-1-positive in Brazil [24].

In a study of Tanzania, the cumulative HIV infection was 8.6% at 6 months and 13.6% at 18 months after delivery [25]. Whereas a study conducted in Kenya Results from a Nationally Representative Study showed the rate of mother to child HIV transmission is about 15% [26]. On the other hand, a retrospective follow-up study in eastern Ethiopia showed, the rate of HIV transmission is 15.7%; most of them 91.7% were confirmed by DNA-PCR. The transmission was higher in females than in males (17.6% versus 13.8%) [21].

Another study in oromia region showed from a total of 854 infants, 15.0% were HIV positive [27]. While Study in southern Ethiopia showed that Cumulative and overall incidence rate of HIV positivity among infants were 4.16% and 4.47/1000 PM (95% CI: 4.02-4.92) respectively [28]. And also, cross sectional study in Amhara region indicated the proportion of HIV infection of infants was 12.4% [9].

Factors affecting MTCT of HIV

Socio-demographic and economic factors: A study conducted in Ukraine showed factors like marital status, maternal education, mode of delivery and birth order were significantly associated with infant abandonment in addition infants whose mothers had been diagnosed with HIV earlier (in the first and second trimesters) were also less likely to be abandoned so that less likely of getting HIV [29].

A Retrospective Follow-Up Study in Southwest Ethiopia indicated that maternal age greater than 27.4 years were associated with HIV positive outcome of infants [30] on the other hand a facility based retrospective study in Amhara region Showed Infants whose DBS tested after 6 months of age were more likely to have positive HIV results than their counterparts (AOR = 9.24, 95% CI = (3.5, 24.2)). This study also indicated, infants born to mothers with no education were also more likely to be DNA/PCR positive than infants born from educated mothers (AOR = 8.4, 95% CI = 2.9, 14.8) [31].

Maternal factors related to MTCT: Research in Malawi shows that, there was a significant association in maternal viral load concentration with MTCT But there was no statistically significant association between MTCT and maternal CD4 count [32]. Elective cesarean section prevent vertical transmission of HIV, 50% reduction of risk in women not on HAART or those with a high plasma viral load [33].

A study in three hospitals of oromia disclosed Mothers who knew their HIV status during pregnancy and after delivery were found significantly more likely to transmit HIV to their babies compared with those who knew before getting pregnant (AOR = 4.71) and (AOR= 4.46), respectively.

Maternal ARV and obstetric factors associated with HIV MTCT, mothers who didn't use Zidovudine (AZT) prophylaxis during pregnancy for PMTCT were found about 15 times significantly more likely to transmit HIV to their babies than those mothers who took AZT for four or more weeks before birth (AOR = 15.63). Likewise, Mothers with CD4 cell count < 200 and 201-500 cells/ μ l during lactation were found significantly more likely to transmit (AOR [95% CI] = 7.65 [3.20-18.31] and 4.07 [1.90-8.71]), respectively. Mother who had cracked nipple/mastitis while lactating and who were practicing mixed feeding were also found significantly more likely to transmit (AOR [95% CI] = 13.05 [1.23-138.21] and 3.55 [1.62-7.78]) respectively [26].

Another study in southwest Ethiopia also indicated Those mothers who didn't have ANC follow up were five times more likely to have HIV sero positivity infant than those mothers who had ANC visits AOR = 5.28 [34].

A follow up study in Dire Dawa City, Eastern Ethiopia being rural resident (AOR: 3.29; 95% CI: 1.40, 7.22), delivery at home (AOR: 3.35; 95% CI: 1.58, 8.38), infant not receiving ARV prophylaxis at birth (AOR: 5.83; 95% CI: 2.84, 11.94), mixed feeding practice (AOR: 42.21; 95% CI: 8.31, 214.38), and mother-child pairs not on PMTCT were found to be the most important significant determinants of mother-to-child HIV transmission [21] but a cross sectional study in Amhara region showed, residence (rural or urban) has no association with HIV infection among HIV exposed infant. While Antenatal care attendance, delivering in health institution, mode of delivery, having no problems during delivery and provision of both infant and maternal prophylaxis had a significant association with HIV infection among HIV exposed infants [9]. Follow Up study at Two Hospitals of Southern Ethiopia, 2014 indicated ARV prophylaxis (AOR: 0.19(95% CI, 0.04- 0.89)), Maternal HAART (AOR: 0.16(95% CI, .041, 0.59) and SdNVP + AZT+ 3TC (AOR: 0.113(95% CI: 0.02, 0.61)) intervention were independent predictors of HIV positivity among exposed infants [27].

Study in southwest Ethiopia reveals Mothers who were in WHO clinical stage III were six times and WHO clinical stage IV were ten times more likely to have HIV positive infant than those mothers who are WHO clinical stage I [33].

Infant factors related to MTCT: A study from Zambia Transmission rates at six weeks when ARVs were received by both mother and baby, mother only, baby only, and none were 5.8%, 10.5%, 15.8% and 21.8% respectively, the use of ARV drugs reduces vertical transmission of HIV. In this study rate MTCT was highest with home delivery followed by when delivered by C-section at health facility and lowest when children were delivered vaginally at health facility [35]. Another study conducted in southeastern Nigeria reported that prophylactic ARV in mothers and babies gave a remarkable reduction in MTCT rate and of infants who were exclusive breastfeeding 18.5% were HIV infected, of babies' exclusive formula fed (EFF) 4.8% were HIV infected, infants with mixed-fed 68.0% of them were found infected [36].

Study in three hospitals of oromia Ethiopia Regarding types of ARV prophylaxis given to infants after birth showed, infants those provided no ARV prophylaxis and provided and single dose NVP only were about 7 times and 5 times significantly more likely to contract HIV from their mothers than to those infants provided with sdNVP + AZT for 7 or 28 days (AOR [95%CI] = 7.57 [2.84-20.22] and 5.35 [2.08-13.79]), respectively. Looking at infant feeding option, infants on mixed feeding (MF) were 3.55 times [95% CI for AOR = 1.62-7.78] more likely to contract HIV from their mothers than infants on exclusive breast feeding (EBF) but Infants' oral lesion didn't retain its statistical significance in the final multivariate analysis in this study [26].

Another study conducted in Southwest Ethiopia showed Those Infants who are on mixed feeding were six times, Infant on complementary feeding ten times and Infant weaned off were ten times more likely to have HIV positive infant compared with Infant on exclusively breastfeeding [33]. Retrospective cohort study design study in east and west gojam zone indicated that Infants who were enrolled for treatment and care later than 6 weeks, ARV prophylaxis, immunization status and the initiation of option B+ PMTCT program were associated with HIV positivity on bi-variable analysis [10].

Conceptual Framework

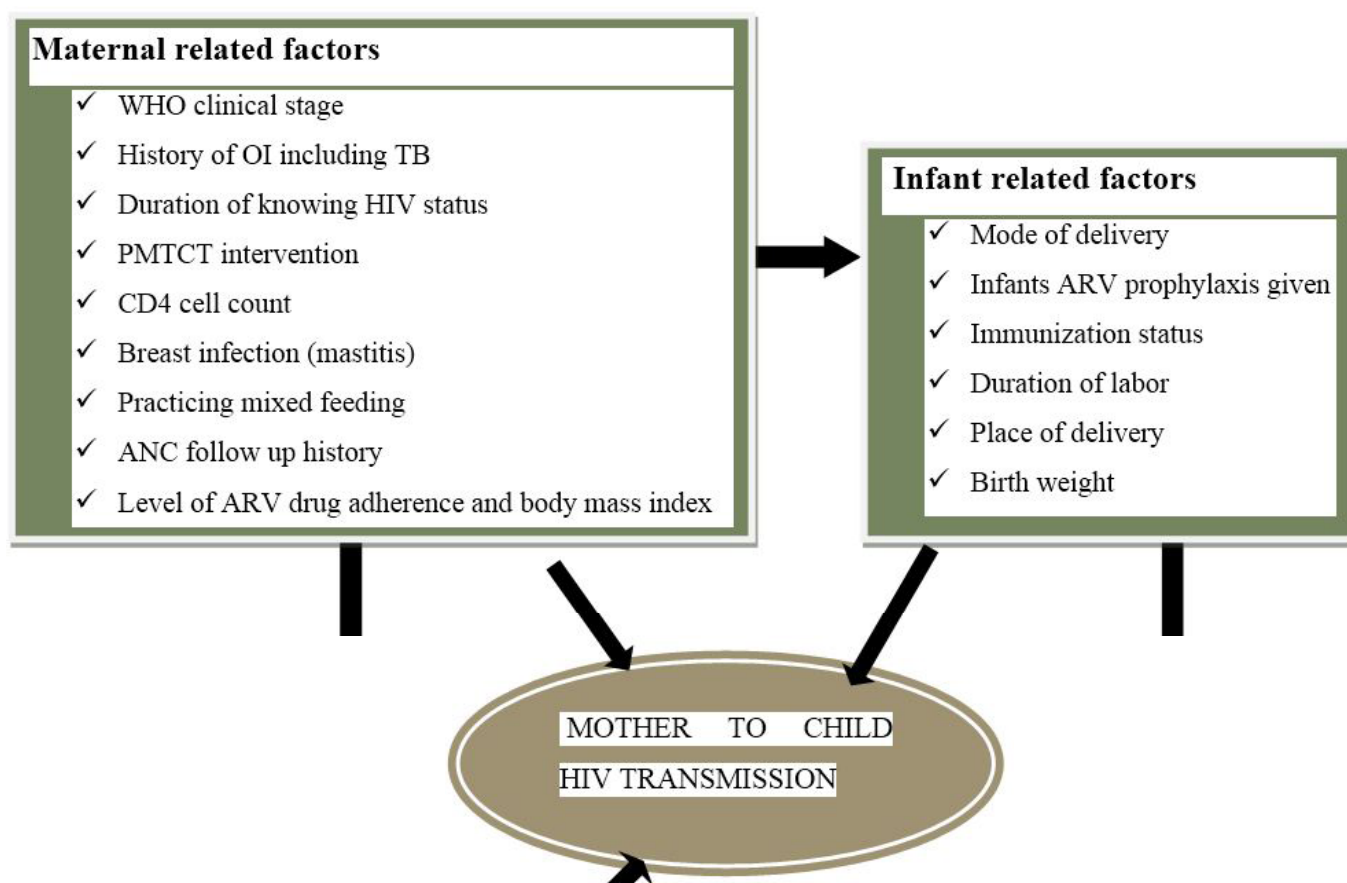


Figure 2: Conceptual frame work of the study

Objective

► To identify determinant factors of HIV infection among HIV exposed infant in selected health facilities of north wollo zone, Amhara, North east Ethiopia, data collection from march 03 – April 25, 2018

Methods and Materials

Study design and period

An unmatched case-control study was conducted based on results of DNA PCR HIV virology test and confirmatory test determined during March 2015 (2007) to March 2018 (2010) for infants who had follow up in selected health facilities. Data collection period was from 03 March 2018 to 25 April 2018.

Source population

Source population for cases

All infants born to HIV positive mothers who had positive test result

Source population for controls

All infants born to HIV positive mothers who had negative test result

Study population

Infants born to HIV positive mothers and who have had DNA PCR HIV test result from 6 - 52 weeks of their age and has confirmatory test result at 18 month age in selected health facilities.

Cases (HIV-infected infants)

Infants born to HIV positive mothers and found with at least one positive HIV DNA PCR test result 6 - 52 weeks of age or has positive confirmatory test result at 18 months of age.

Controls (not HIV- infected infants)

Infants born to HIV positive mothers and found negative for HIV DNA PCR test at >52 weeks of age and found confirmatory test results negative at 18 months of age

Inclusion criteria

Inclusion criteria for cases: An infant whose maternal & infant's record available from 2015 to 2018 in North wollo zone health facilities and tested positive for the virus.

Inclusion criteria for controls: An infant whose maternal & infant's record available from 2015 to 2018 in North wollo zone health facilities and tested negative for the virus.

Exclusion criteria

An infant's & maternal record incomplete and those infants who had negative DNA/PCR test result and had not determined or unknown confirmatory test result.

Dependent variable

HIV status of the Infant that obtained by DNA PCR testing the sample taken via DBS (dry blood sample) technique in North wollo zone Health facilities.

Independent variable

Socio demographic characteristics of both the infant and mother	Maternal related factors	Infant related factors
	History of OI including TB	infants ARV prophylaxis intake
Sex of the infant	Duration of knowing HIV status	immunization status
Educational status of mother	PMTCT service	Duration of labor
Residence	CD4 cell count	Place of delivery
Occupational status	Breast infection(mastitis)	Birth weight
Marital status of the mother	Practicing mixed feeding	Mode of delivery
Age of the mother	ANC follow up history	Age of infant during DBS
	WHO clinical stage	
	Body mass index	
	Drug adherence of mother	
	Viral load of the mother	

Table 1: List of independent variables

Definition of terms

HIV exposed infant: - an infant born from HIV infected mother < 18 months age

Spontaneous Vaginal delivery: - mode of delivery of the infant born without any external intervention only by a natural process via a birth canal.

Cesarean section delivery: - mode of delivery by surgical operation.

Assisted vaginal delivery: - mode of delivery of the infant by using external intervention (forceps or vacuum delivery) including episiotomy.

Duration of knowing HIV status of mother: - period of knowing HIV status of a women by testing her blood before or during pregnancy and after delivery

Confirmatory test result: - infants HIV test result after cessation of breast feeding at least for 4 weeks usually WHO recommends at 18 months of age

HIV positive infant: - an infant found positive on either DNA-PCR or by rapid anti body test

HIV negative infant: - those infants found negative result by either test

HIV mother to child transmission: - when the infant acquired HIV from his/her mother during pregnancy, delivery and breast-feeding time.

Good adherence: -missing < or equal to 2 daily doses of the total 30 daily doses or 3 daily doses of the total 60 daily doses: - (daily dose can be either single dose or above single dose)

Fair adherence: -missing 3-5 daily doses of the total 30 daily doses or 3 -9 daily doses of the total 60 daily doses

Poor adherence: -missing >or equal to 6 daily doses of the total 30 daily doses or 9 daily doses of the total 60 daily doses

Dry blood sampling: - a technique of taking blood sample from the infant for HIV testing by DNA-PCR machine

Sample size determination

The sample size is calculated by two population proportion formula for unmatched case-control study design using Epi-Info version7 statistical software by considering 4.72% proportion of home delivery among controls as an exposure variable and odds ratio of 3.56 from study conducted among health centers and hospitals in Amhara Region, Ethiopia⁹, 95% confidence interval, 80% power of the study, 1:4 case to control ratio. The final total sample size considered will be 415 study participants (83 cases and 332 controls).

Sampling method

Stratified random sampling method was used to identify study subjects from each of the three health facilities strata using proportional allocation to their study population size as it is elaborated under figure 2.

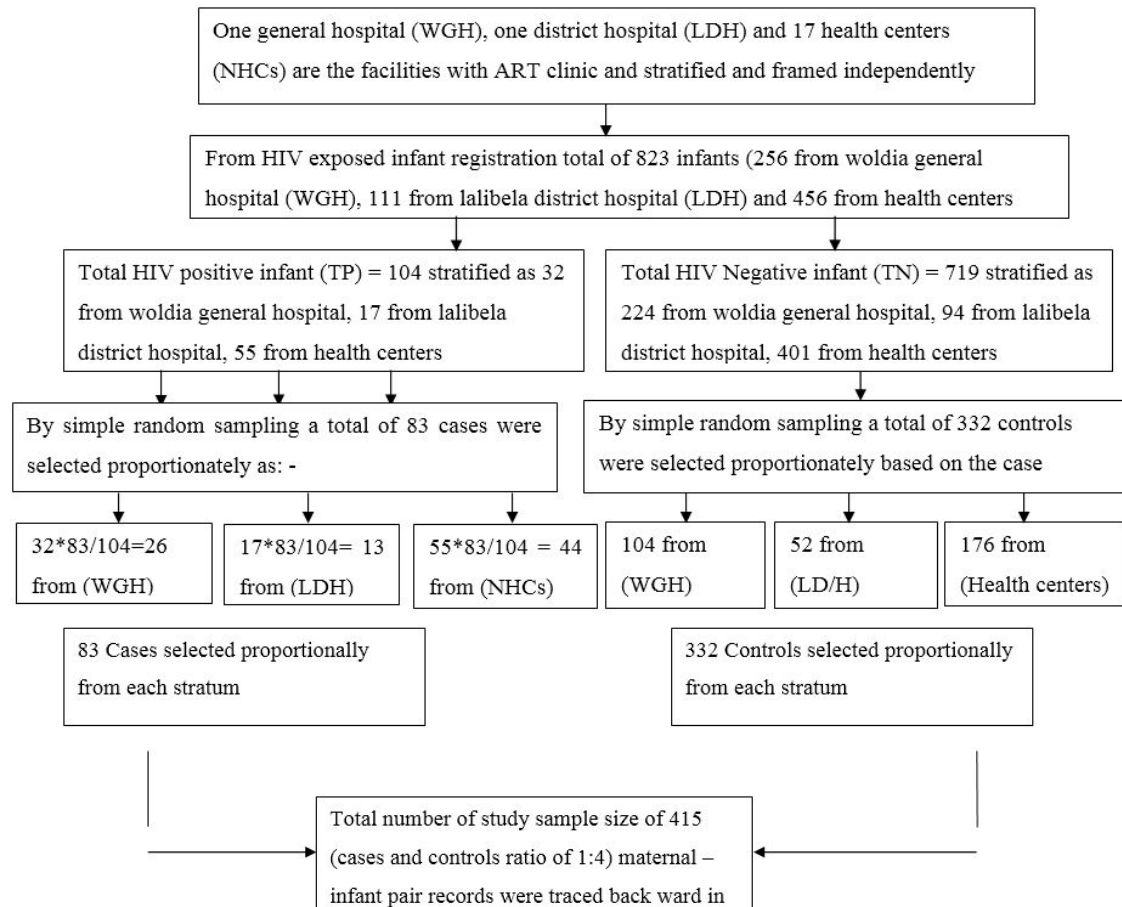


Figure 3: Diagrammatic representation of sampling process and design of the study

Data Collection instrument and procedure

A format checklist that contains study variables of interest was prepared based on contents of health facility HIV/AIDS care records in touch of or directly addressing PMTCT and records of Anti-Retroviral Therapy (ART) follow up card to an infant and its mother. A nurse working in ART clinic and data-clerks from each health facilities were recruited and trained for 1 day on the format to be completed. Thereafter, sampled record of the infants and mothers was reviewed and completed the format.

Data analysis

After collection of the necessary data it was entered in to Epi info version 7 then exported to SPSS version 22.0 with 95 % confidence interval, hosmer lemeshow goodness of fit and neglkerke R square seen and Descriptive statistics was done also bi variable analysis was conducted and those factors which had p value below 0.2 were taken into multivariable logistic regression analysis.

Ethical Considerations

The study protocol was evaluated and approved by the Research Ethics Review Committee (RERC) of College of Health Sciences, Bahir Dar University. After the approval of the research Amhara public health institute (APHI) and North Wollo zone health department gave permission letter to conduct the research.

Results

For the study 83 cases from those positives and 332 controls from the rest totally 415 infants were selected and then cases and controls were compared by independent variables selected for the study.

Socio demographic characteristics of the mothers and infants

From infants included in the study 33.3% (138) were delivered at home and 188 (45.3%) were female. Majority of the infants 182 (43.8 %) were DNA/PCR tested in the age range of 9 weeks to 24 weeks (6 months) followed by 151(36.4%) were tested within the recommended age range of 6 to 8weeks. Majority (57.8%) of the cases and 85.8% of controls of the study participant had determined DNA test result by the age of 6 months (24 weeks) of their life.

Infant's Mother in between 15 to 30 years old age group were 198 (47.7%). Infant mother urban residence contained 206 (49.6%) and majority had house wife 166 (40.0%) occupational status. Concerning marital status married contains 121 (29.1%), divorced 166 (40%). Among infant's mother majority 237 (57.1%) of them unable to read and Wright.

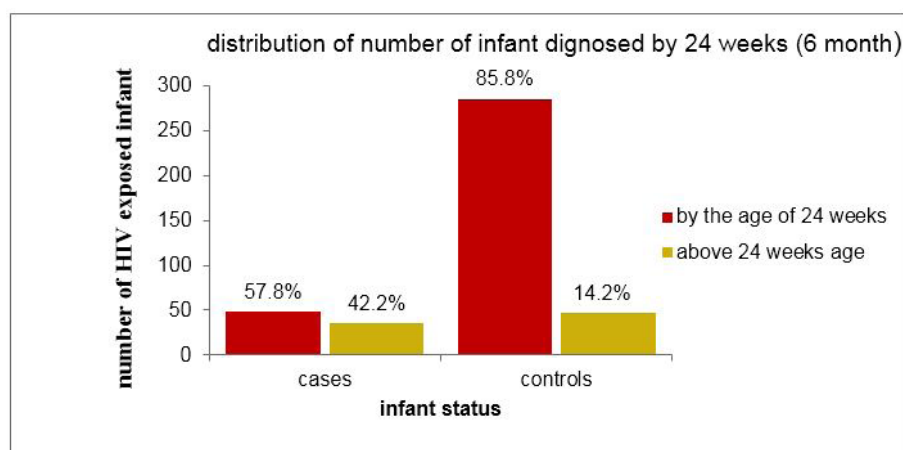


Figure 4: Number of infant HIV tested from 6 weeks to 24 weeks and infant tested above 24 weeks of age north wollo zone, Amhara, Ethiopia

Characteristics	HIV positive (83 cases) frequency (%)	HIV negative (332 controls) frequency (%)	Total (N=415) Frequency (%)
Sex of infant:			
Female	39 (46.9)	149 (44.9)	188 (45.3)
Male	44 (53.1)	183 (55.1)	227 (54.7)
Place of delivery:			
Health institution	56 (67.5)	221 (66.6)	277 (66.7)
home	27 (32.5)	111 (33.4)	138 (33.3)
Age of infant during DBs:			
6- 8 weeks	20 (24.1)	131 (39.5)	151 (36.4)
9 weeks- 6 months	28 (33.7)	154 (46.3)	182 (43.8)
7- 18 month	35 (42.2)	47 (14.2)	82 (19.8)

Characteristics	HIV positive (83 cases) frequency (%)	HIV negative (332 controls) frequency (%)	Total (N=415) Frequency (%)
Mother's age group:			
15- 30 years	38 (45.7)	160 (48.2)	198 (47.7)
31- 49 years	45 (54.3)	172 (51.8)	217 (52.3)
Residence:			
Urban	33 (39.7)	173 (52.1)	206 (49.6)
Rural	50 (60.3)	159 (47.9)	209 (50.4)
Occupation of the mother:			
Gov employed	17 (20.5)	56 (16.9)	73 (17.6)
Farmer	23 (27.7)	137 (41.2)	160 (38.5)
House wife	48 (57.8)	118 (35.5)	166 (40.0)
Trader	5 (6.0)	21 (6.4)	26 (3.9)
Marital status of the mother:			
Married	13 (15.6)	108 (32.5)	121 (29.1)
Divorced	33 (39.7)	133 (40.1)	166 (40.0)
Widowed	14 (16.8)	32 (9.6)	46 (11.1)
Single	23 (27.9)	59 (17.8)	82 (19.8)
Educational status of the mother:			
Read and Wright	30 (36.1)	148 (44.6)	178 (42.9)
Not read and Wright	53 (63.9)	184 (55.4)	237 (57.1)

Table 2: Socio-demographic characteristics of HIV-exposed infants and their mothers in North Wollo zone 2018 (N=415, 83 cases, and 332 controls)

Infant and maternal related factors associated with HIV MTCT

Hosmer and Lemeshow Test was fulfilling the desired value which was 0.87 it was above 0.05 and neglkerke R square was also seen which is 0.79 means 79%.

The Odds of mother to child transmission of HIV were 4.4 folds higher in infants from women who knew their HIV status during pregnancy AOR: 4.4, 95% CI [1.34-14.2] and 10.6 folds higher in infants from who knew after delivery AOR: 10.6, 95% CI [3.31-24.1] as compared to infants from women who knew before pregnancy.

Utilization PMTCT intervention decreases the risk of HIV MTCT by 96% AOR: 0.04, 95%CI [0.014 – 0.13]. Mothers with History of breast infection had 4.4 times higher risk of transmitting HIV virus to their infant AOR 4.35 [1.02-18.5].

Those Infants who took ARV prophylaxis were 93% less likely infected by vertical transmission of the virus AOR: 0.07, 95%CI [0.03 – 0.21].

Infants delivered with assisted vaginal delivery had 4.72 times higher risk of acquiring the virus from MTCT AOR: 4.72, 95% CI [1.11-20.4] as compared to infant delivered by spontaneous vaginal delivery.

Concerning ART drug adherence those infants born from mothers who had poor and fair adherence of drug were 5.65 times AOR: 5.69, 95% CI [1.87-17.3] and 5.85 times AOR: 5.85, 95% CI [2.09-16.3] at higher risk of acquiring the virus from their mother.

The Odds of HIV mother to child transmission were 4.9 folds higher in infants who born from women with no antenatal care follow up AOR: 4.94, 95% CI [1.87-13.04]. The risk of HIV MTCT was 3.2 folds higher in women with lower CD4 cell count (< 350) AOR: 3.17, 95% CI [1.19-8.46].

Place of delivery whether it was in health institution or home delivery not showed significant difference concerning HIV/MTCT. Besides place of delivery after adjusting possible confounders, HIV mother to child transmission was not associated with factors as birth weight of the infant, residence of the mother, infant's age during DBS, body mass index of the mother, immunization status, practicing mixed feeding and marital status in multivariable analysis. Testing is not taken as one of the determinant socio demographic variable because the study is around those mothers who tested and know their status and became pregnant.

Variables	cases	controls	COR [95% CI]	AOR [95% CI]	p-value
duration of knowing HIV status of mother among those positive mothers					
Before pregnancy	20	227	1.00	1.00	
During pregnancy	22	61	4.09[2.09-7.98]	4.42[1.37-14.25]	0.042*
After delivery	41	44	10.57[5.66-19.74]	10.6[3.31-24.17]	0.001***

Variables	cases	controls	COR [95% CI]	AOR [95% CI]	p- value
PMTCT intervention					
No	11	250	1.00	1.00	
Yes	72	82	0.05[0.03-0.10]	0.04[0.014-0.13]	0.001***
History of breast infection during lactation					
No	35	276	1.00	1.00	
Yes	48	56	6.75[4.01-11.39]	4.10[1.40-11.98]	0.047*
Mode of delivery					
Spontaneous vaginal	35	147	1.00	1.00	
C/S	5	65	3.09[1.16-8.25]	2.87[0.53-15.35]	0.096
Assisted vaginal	43	120	4.65[1.75-12.33]	6.87[2.5-15.8]	0.014*
ARV prophylaxis for the infant					
No	29	299	1.00	1.00	
Yes	54	33	0.06[0.03-0.11]	0.07[0.03- 0.21]	<0.001***
ART drug adherences of the mother					
Good	17	193	1.00	1.00	
Fair	28	81	3.92[2.03-7.56]	7.15[2.26-22.3]	0.001***
Poor	38	58	7.43[3.91-14.14]	7.46[2.01-27.3]	0.002**
History of ANC follow up					
Yes	23	255	1.00	1.00	
No	60	77	4.54[2.71-7.60]	4.94[1.87-13.04]	0.001***
CD4 cell count of the mother					
>350	31	208	1.00	1.00	
<350	52	124	2.81[1.71-4.62]	3.17[1.19-8.46]	0.021*

* p value < 0.05; ** p – value < 0.01; *** P – value < 0.001

C/S: Cesarean Section; ART: Anti-Retroviral therapy; ANC: Anti Natal Care

Table 3: Factors of the infants and their mothers that have significant association with HIV MTCT in multi variable analysis of HIV- exposed infants in North Wollo zone 2018

Discussion

In this study various factors that can affect the transmission of HIV from mother to child during pregnancy delivery and in the first 18 months of the infant were analyzed.

The odds of mother to child transmission of HIV were 4.4 folds higher in infants from women who knew their HIV status during pregnancy AOR: 4.4, 95% CI [1.34-14.2] and 10.6 folds higher in infants from women who knew after delivery AOR: 10.6, 95% CI [3.31-24.1] as compared to infants from women who knew before pregnancy. Consistent with finding from a Case-Control Study Nested in the French Perinatal Cohort [22] and case control study done in three hospitals of oromia regional state in Ethiopia [26]. This might be due to mothers who know their HIV status at later time was less likely to take ARV drugs [44] and a research in Malawi revealed that starting ART with an Option B+ indication was Risk factors for inadequate adherence Study in south Africa disclosed that MTCT rates were lower in women who became pregnant on HAART than those initiating HAART during pregnancy [37,38].

Utilization of PMTCT intervention decreases the risk of HIV MTCT by 95% AOR: 0.04, 95%CI [0.014 – 0.13]. This was supported by a retrospective institutional cohort study in Dire dawa eastern Ethiopia and cohort study in Myanmar [21,39].

Those mothers who had history of breast infection had 4.4 folds higher risk of transmitting HIV virus to their infant AOR 4.10 [1.40-11.98]. This is consistent with the finding from follow up study of maternity hospital in Nairobi Kenya [40]. This might be due to breast infection increase the transmission of the virus during breast feeding.

ARV prophylaxis gave to the infant had significantly decrease mother to child HIV transmission. Those Infants who took ARV prophylaxis were 93% less likely infected by the virus AOR: 0.07, 95%CI [0.03 – 0.21]. This result of our study agrees with Meta-analysis systematic review study here in Ethiopia [41].

Assisted vaginal delivery significantly increased mother to child HIV transmission. Infants delivered with assisted vaginal delivery had 4.72 folds higher risk of acquiring the virus from MTCT AOR: 4.72, 95% CI [1.11-20.4] as compared to infant delivered by spontaneous vaginal delivery. This is supported by a research from cohort study in 10 European countries from 1983 to 2004 [42] and also a study done in India showed elective cesarean section has protective effect against HIV MTCT [43]. This is due

to assisted vaginal delivery is an invasive procedure that increase contact between maternal and infant blood. Despite the above, this finding is contradicted with a study done in china Guangdong province showed there was no association between mode of delivery and HIV MTCT [44]. The inconsistency between studies in different countries may be due to the difference in quality of health care services and health care provider.

ART drug adherence of the mother has significant association with HIV MTCT in this finding of our research having had fair adherence and poor adherence to ART drug has almost equally likely increasing the risk of infant HIV infection with AOR: 7.15, 95% CI [2.26-22.3], AOR: 7.46, 95% CI [2.01-27.3] respectively. This is parallel with result from matched case control study in rural Kenya with AOR: 8.1, 95%CI: 3.7–17.8 [45]. This is because inadequate adherences of HAART drug leads to insufficient control of viral replication and drug resistance this in turn increases maternal viral load then facilitates HIV MTCT.

The odds of HIV mother to child transmission were 4.9 folds higher in infants who born from women with no (ANC) antenatal care follow up AOR: 4.94, 95% CI [1.87-13.04]. This is because as women who had no ANC follow up usually delivered at home and no any PMTCT intervention including ARV prophylaxis then the risk is higher. The result is consistent with cohort study in southwest Ethiopia [33].

The risk of HIV MTCT was 3.2 folds higher in women with lower CD4 cell count (< 350) AOR: 3.17, 95% CI [1.19-8.46]. It is consistent with unmatched case control study in Zimbabwe at Chitungwiza Hospital [46]. This might be due to high viral load concentration as CD4 cell count is an indication of viral load concentration.

Infant's age during DNA PCR test was not significantly associated with mother to child HIV transmission. This finding is consistent with the finding from case control study in three hospitals of oromia region in Ethiopia [26].

Limitations of the Study

- As a case control study doesn't show causation so all factors found in this study cannot determine the cause of infant HIV infection instead only shows association.
- As the study is based on retrospective record review immunological factors like viral load can't be used because viral load measurement as a routine follow up monitoring is begun recently instead, we used only CD4 cell count which indirectly show viral load concentration

Conclusion

Maternal related determinant factors that significantly associated with HIV MTCT were duration of knowing her HIV status, level of adherences to ART drug, history of any form of breast infection during lactation, level of her CD4 count and antenatal care follow up (ANC) visit besides utilizing PMTCT service. Whereas infant related determinant factors were mode of delivery and infant ARV prophylaxis intake was also a determinant factor significantly associated with HIV MTCT but no socio demographic factors found to be determinant factors in this study.

Recommendation

For country policy makers: -

- To enhance all reproductive age female knowing their HIV status before they become pregnant, the current health extension programs package needs to include HIV counseling and testing services at the health post level to put this into practice health extension workers should get training on basic HIV counseling and testing services.
- Standard protocol for birth option and delivery of HIV positive pregnant women need to be prepared to decrease risky birth option like assisted vaginal delivery because it has paramount importance in reducing HIV infection of new born infants.

For Hospitals and Health centers: -

- Health facilities with PMTCT services need to have individual and stringent mechanism to follow effectively the level of adherence to ART drugs for mothers who are pregnant or intend to be pregnant as fair adherence is almost equally significantly increase the chance as that of poor adherence concerning HIV MTCT. Plus, ARV prophylaxis to the infant must be given any circumstance including those who delivered outside health institutions.

For HIV positive lactating mothers: -

- Lactating mothers who has any form of breast infection must use another method of breast feeding their infant either by expressing method or if it is feasible abandon breast milk. To facilitate these government health institutions and non-governmental organization that works on maternal and child health should support the necessary infant feeding option for those mothers who had breast infection as the option may not be affordable by those poor family of developing nation.

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