

Determinants of Mother to Child Transmission of HIV in Public Hospitals of West Shewa Zone, Oromiya Region: Mixed Method Study.

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Abstract**Background**

Mother-to-child transmission of HIV (MTCT) occurs when a mother infected with the human immunodeficiency virus (HIV) passes the virus to her child. Without intervention, the transmission rate of HIV ranges from 15% to 45%. With effective interventions, this rate can be reduced to below 5%. Ethiopia aimed to reduce transmission to lower than 5% by 2020, but their final MTCT rate was 15% in 2016. The aim of this study was to identify the determinants of HIV transmission from mother to child in the West Shoa Zone of the Oromiya region.

Methods: This study employs mixed methods, including an unmatched case-control study among children who tested HIV positive and negative at the end of Prevention of Mother-to-Child Transmission (PMTCT) follow-up and one-on-one interview. Additionally, one-on-one interviews with mothers of positive infants were conducted. Variables of interest were collected using structured and semi-structured questionnaires and data abstraction forms from mothers of exposed infants, medical records of mothers, and children.

Results: The majority of cases (70.8%) were not included in the Option B+ program. Home delivery increases the chance of HIV transmission by six times, AOR=6.0; CI (1.5–29.2). None-inclusion in the Option B+ program increases the chance of transmission by 18 times, AOR=18.0; CI (5.0–68.1). Partner non-involvement in HIV care increases the chance of transmission by 7.3 times, AOR=7.3; CI (1.1–37.4). The mother-to-mother support program decreases the chance of transmission by 86.5%, AOR=0.13; CI (0.11–0.39). Poor antenatal care (ANC) awareness and practices among rural residents, and unstable marriage in urban residents, contribute to unaware MTCT of HIV.

Conclusion: ART clinics should focus on and strengthen the mother-to-mother support program, create space for partner involvement in HIV care, and provide training for Health Extension Workers (HEWs). Health education and awareness creation should be implemented by HEWs to improve ANC practices, reduce home delivery, and increase voluntary counseling and testing among residents.

Key words: Pmtct, West Shewa, Hiv Transmission**1. Background**

HIV mother-to-child transmission (MTCT) refers to the transmission of HIV virus from an HIV positive mother to their child during pregnancy, labor and delivery or breastfeeding(1). In the absence of treatment, 15-30% of babies born to HIV positive mothers can become infected with HIV-1 during pregnancy and birth, with a further 5-20% becoming infected through breastfeeding to 18-24 months [1]. Over 90% of HIV infections in children, under 15 years are acquired from the mother [2]. With more than 50% of postnatal transmission through breastfeeding occurring during the first 6 months of life [3]. Transmission rates vary from 15% to 45% in the absence of any intervention and can be reduced to less than 5% with effective interventions during pregnancy, labor, delivery, and breastfeeding [4-7].

In Ethiopia, the estimated prevalence of HIV among adults was 1.0% in rural areas and 2.8% in urban areas in 2017 according to Eco-HIV [8]. In the capital, Addis Ababa, it was estimated at 5.0% in the same year [8]. The Oromiya region, which includes Addis Ababa, had an estimated 1,851,334 people living with HIV in 2019, of whom 16,820 were in the pediatric age group (under 15), with 236 newly infected cases reported up to May 2019 [8].

Preventing MTCT entails primary prevention of HIV, prevention of unintended pregnancies, effective access to HIV testing and counseling, initiation of lifelong antiretroviral therapy (ART) with support for adherence, retention, and viral suppression for mothers living with HIV, safe delivery practices, optimal infant-feeding practices and access to postnatal antiretroviral

prophylaxis for all infants, which contribute to the prevention of mother-to-child transmission (PMTCT), thereby reducing maternal and child mortality [9]. Suppression of HIV in pregnant women is the most important and achievable action to reduce MTCT. However, failure to initiate ART early in pregnant HIV-positive mothers, poor adherence to ART, lack of ANC and early diagnosis, and poor implementation of national policies like option B+ among care providers hinder PMTCT [10].

Although option B+ (test and treat) was implemented in Ethiopia in 2011, by 2014 only an estimated 50% of infants born to women living with HIV received a virological test within two months of birth (EID) [12]. At a national level, 58% of HIV-positive pregnant mothers in Ethiopia receive ART [12]. The estimated number of mothers in urban areas needing prevention of mother-to-child transmission (PMTCT) is 16,959 in 2017 [13]. EPHI estimates suggest that the number of mothers needing PMTCT in Addis Ababa was 1,466 in the same year [14]. According to the EDHS 2016, HIV testing and counseling for ANC clients was 19% countrywide, reaching 56% in urban areas and 14% in rural areas. The 2016 EDHS also indicates that 62% of women received ANC from a skilled provider at least once during their last birth [15].

In May 2016, the World Health Assembly endorsed the new WHO global health strategy on HIV, which calls for member states and WHO to work towards the goal of zero new HIV infections in infants by 2020 [9]. Ethiopia has implemented a

four-pronged approach to reduce and control transmission of HIV from mother to child. These include primary prevention of HIV infection, prevention of unintended pregnancies in HIV-positive women, prevention of HIV transmission from mother to her infants, and care and support for HIV positive mothers and exposed infants [11]. The target for MTCT in Ethiopia was set at less than 5% by 2020 [9]. But the MTCT rate was still 15% in 2016 [7].

While studies have been conducted in different parts of the country, a similar study has not been conducted in West Shoa. This study, therefore, intends to identify particular determinants of HIV transmission from mother to child among patients of West Shoa zone. The study aims to identify determinants of mother to child HIV transmission in West Shewa Zone and contribute to the identification of factors independently associated with PMTCT and provide inputs for interventional planning for future epidemic control.

2. Methodology

The methodology employed in this study involved selecting a particular study setting - the West Shewa Zone located in the central parts of Ethiopia, covering 14,788.78 square kilometers and comprising 18 woredas, with a population of 2.5 million and six functional hospitals. From the six hospitals, three were selected for the study, based on their provision of ART services for more than four years (as shown in Figure 1).

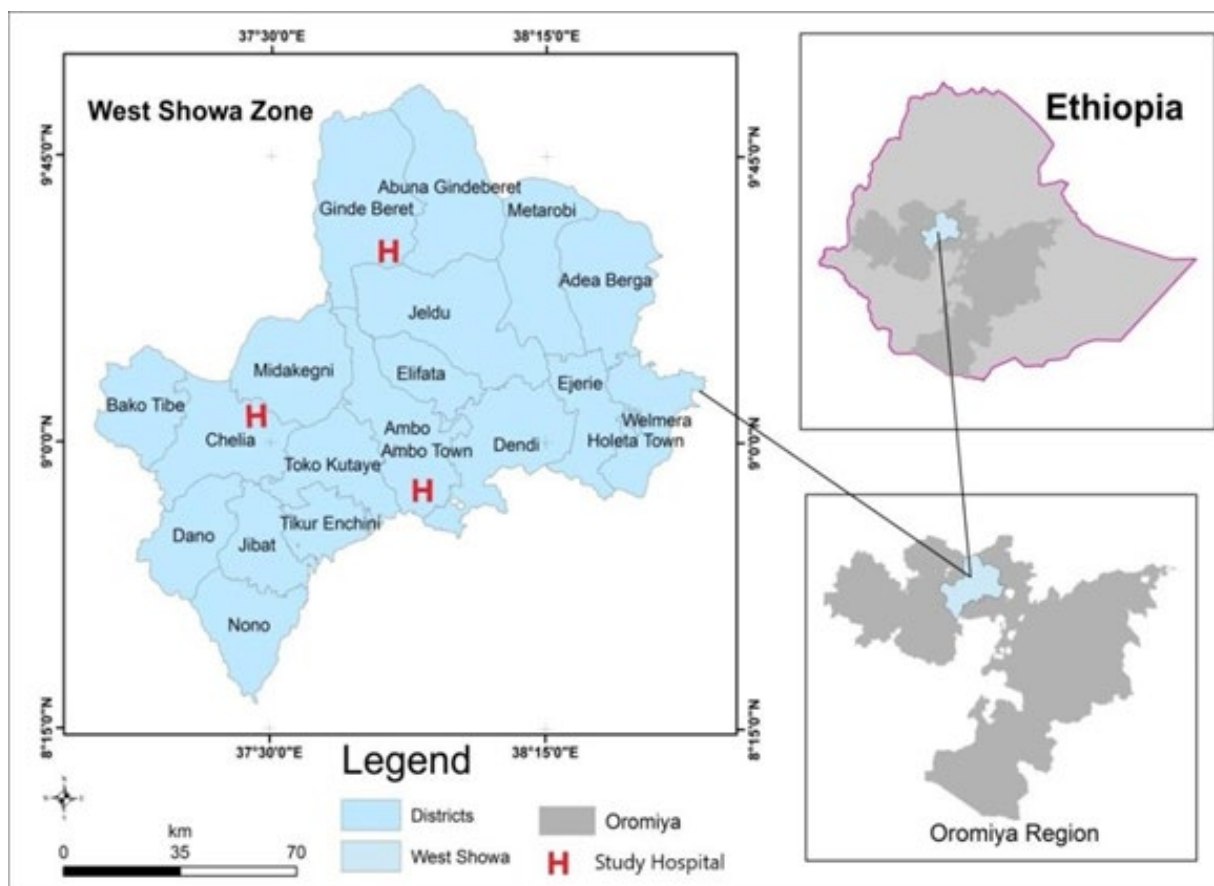


Figure 1: Shows Geographical location of West Shewa Zone in Ethiopia.

The study design involved a mixed-methods approach, utilizing both one-on-one interview for mothers of positive infants, as well as an unmatched case-control study. Specifically, the study focused on infants who were exposed to HIV, whose sero status had been determined and confirmed as positive, but were subsequently declared negative within the last two years (between June 2017 to June 2019).

Data was collected using structured questionnaires administered to mothers of exposed infants, as well as extracted from medical records of study participants through a data abstraction form. To minimize information bias, closed-ended questionnaires were designed for the mothers, while trained data clerks were employed to collect information from medical records and to cross-reference this information with the logbooks and databases.

The study was carried out over a period of three months, from June to August 2019, and focused specifically on PCR tests conducted within the specified two-year period from June 2017 to July 2019.

The study population comprises infants born to HIV positive mothers whose serostatus was determined at Ambo, Gedo, and Gindabarat Hospitals and classified as either positive or negative. Cases refer to infants born to HIV positive mothers and diagnosed with HIV themselves. Controls refer to infants born to HIV positive mothers but classified as negative according to national guidelines. The inclusion criterion for the study was a singleton birth with both maternal and infant records available in the hospital. Exclusion criteria included infants whose medical records were not available or poorly documented and orphaned or denied infants with no maternal records. The sample size for the study was determined using the methods of comparison between two population proportions with unequal sample sizes and the "difference between population proportions" with an unmatched case-control study. The study used an 80% power, 95% level of confidence interval, 5% margin of error, and a ratio of cases to controls of 1:3. The percentage of non-exposure to ANC follow-up among the infected group was determined to be 67.5% from other similar studies and 34.4% among non-

infected individuals. Based on these parameters, a sample size of 24 cases and 72 controls was calculated which was consistent with the result calculated by Epi Info version 7.2.

$$n_1 = \frac{r+1}{r} \frac{\bar{p}(1-\bar{p})(Z_{\alpha/2} + Z_{\beta})^2}{(p_1 - p_2)^2}$$

Where n_1 = number of cases

And $n_2 = rn_1$

n_2 = number of controls

$Z_{\alpha/2}$ = Standard normal deviate for two-tailed test based on alpha level is 1.96

Z_{β} = Standard normal deviate for one-tailed test based on beta level is 0.84

r = Ratio of controls to cases is 3

p_1 = proportion of cases with exposure is 0.67 and $q_1 = 1-p_1$

p_2 = proportion of controls with exposure is 0.34 and $q_2 = 1-p_2$

$$\bar{p} = (p_1 + rp_2)/(1+r) = 0.42$$

$$\bar{q} = 1 - \bar{p} = 0.58$$

$$\text{Thus, } n_1 = \frac{1.33(0.42)(0.58)(1.96+0.84)^2}{(0.34-0.67)^2} = 24,$$

$$n_2 = 3n_1 = 72$$

∴ Total sample = 96.

The sampling methodology employed in this study involved the purposive selection of three hospitals, namely Ambo Hospital, Gedo Hospital, and Gindabarat Hospitals. The selection of these hospitals was based on the fact that they were the only ones that had been providing ART services for a period of more than four years in the zone. The cases were then assigned proportionately based on the total number of infants and children who were living with HIV at each of the hospitals. To identify study controls, a random sampling method was employed, with the controls being selected proportionate to their study cases from each of the hospitals. Figure 2 provides a visual representation of the study's sampling procedure. (figure 2)

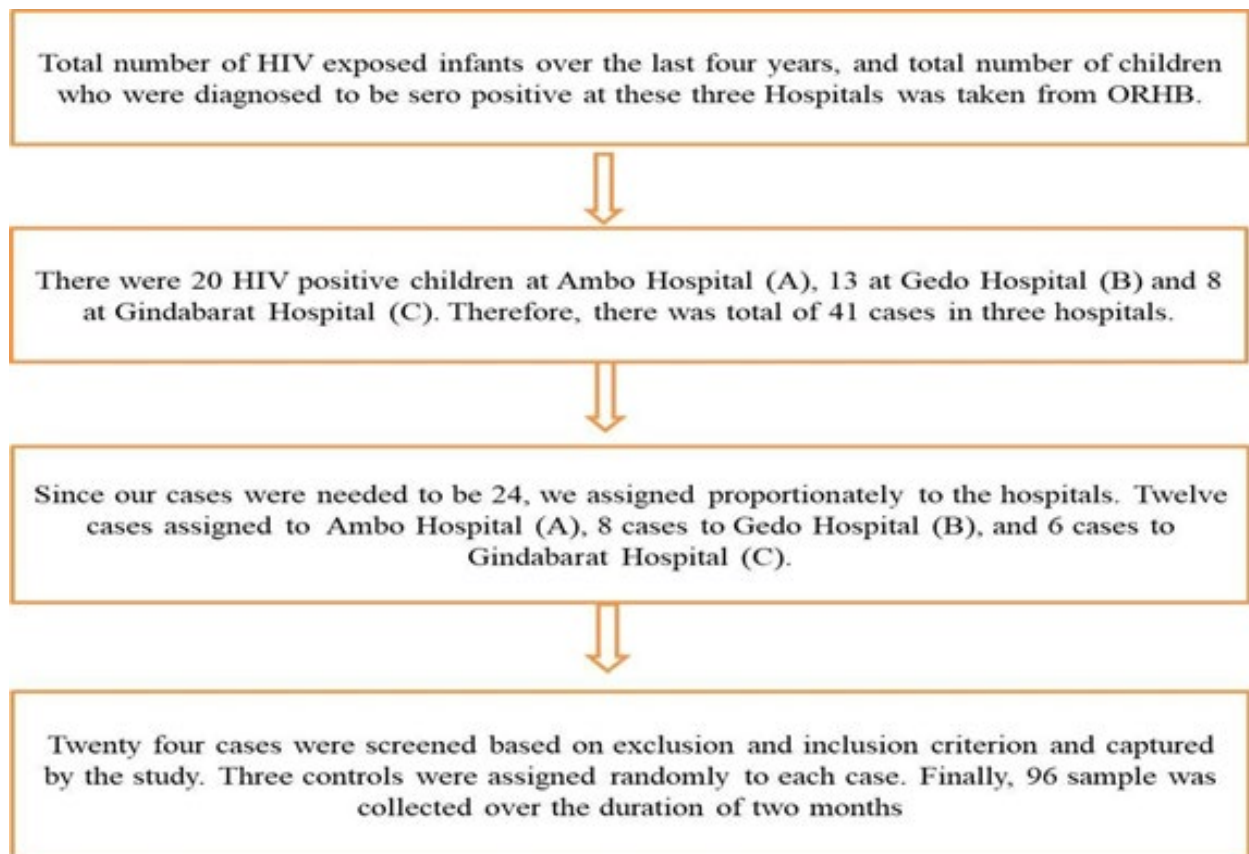


Figure 2: Approach used to Select Cases and Controls from Three Hospitals.

The study focuses on the relationship between independent variables such as age, sex, residence, socioeconomic status, clinical history, obstetric history, and the dependent variable of being HIV positive. The operational definitions of poor adherence, fair adherence, and good adherence were established as those who missed more than 10%, 5-10%, as and less than 5% respectively of their ART doses. In order to collect data, information about the HIV status of hospitals was gathered from the Oromiya Regional Health Bureau. Additionally, a questionnaire was prepared to collect data from mothers of study participants, and the data abstraction format was used to collect information from health facility HIV/AIDS care records related to PMTCT and anti-retroviral therapy. Data analysis and interpretation were conducted using SPSS version 23. The collected data was first entered into Microsoft Excel and then checked for redundancy, incompleteness, and ambiguities which were removed before analysis. Bivariate logistic regression was conducted to determine at $p \leq .025$ the variables which would be included to final logistic regression model. Thematic analysis was employed to analyse the qualitative interview. The ethical considerations of the study were met by seeking review and approval from the college's ethical review board and obtaining written permission to conduct the study. Written consent was obtained from participants and an official letter from the research office was sent to the Oromiya Regional Health Bureau to gain access to necessary data and relevant health facilities.

3.Result

3.1 General Description of the Study

The study included a total of 96 participants from three hospitals in Ambo, Gindabarat and Gedo. Of these, 24 were cases and 72 were controls. The majority of participants' mothers (53.13%) were housewives and 89.5% were married. The majority of married participants were orthodox (29.1%) living in urban areas, followed by 25% married protestants from rural areas. (Table 1) Over the last four years, Gedo hospital had 13 HIV-positive children under the age of five and 135 exposed infants, resulting in a transmission rate of 9.6% per 100 exposed infants. Gindabarat hospital had 94 exposed infants, of which 8 were HIV positive, resulting in a transmission rate of 8.5%. Ambo hospital had 192 exposed infants, of which 20 (10.4%) were confirmed to be positive. Overall, there were 421 exposed infants delivered, of which 41 acquired HIV from their mothers, resulting in a transmission rate of 9.7% out of 100 exposed infants in West Shewa hospitals. (Table 1) Of the participants, 2 (2.01%) were stage I, 42 (43.75%) were stage II, 19 (19.79%) were stage III and the rest were 34 (35.41%) were stage IV. Among the controls, 25 (34.7%) were classified as WHO stage one and were dwelling in urban areas. In contrast, 75% of those who transmitted HIV to their children and were dwelling in rural areas said they did not start antiretroviral therapy (ART) during pregnancy. However, 58.3% of urban dwellers responded that they started ART and had good adherence. Among cases, the majority (54.2%) of mothers had at least one antenatal care visit, but 70.8% of them did not take ART during follow-up. All

deliveries for cases were vaginal, and 70.8% were delivered at home. The majority of control partners were involved in HIV care (86.1%), but only 33.3% of partners of cases were involved in HIV care. Slightly over half of cases (50.5%) did not receive

ART during pregnancy, and 37.5% of them did not start ART during breastfeeding. Among controls, however, all started ART during pregnancy, and 97.2% of them appropriately adhered to medication.

		Negative		Positive		Total	
		N	%	N	%	N	%
Marital status of mother	Married	69	95.8%	17	70.8	86	89.6
	Divorced	2	2.8%	6	25.0	8	8.3
	Widowed	1	1.4%	1	4.2	2	2
Religion of the mother	Orthodox	31	43.1%	9	37.5	40	41.6
	Protestant	37	51.4%	15	62.5	52	54
	Muslim	3	4.2%	0	0.0	3	3
	Other	1	1.4%	0	0.0	1	1
Occupation of mother	Housewife	41	56.9%	10	41.7	51	53
	Employee	7	9.7%	2	8.3	9	9.3
	Farmer	12	16.7%	9	37.5	21	21.8
	Daily laborer	9	12.5%	2	8.3	11	11.4
	Other	3	4.2%	1	4.2	4	4.6
Place of Residence	Urban	48	66.7%	12	50.0	30	31
	Rural	24	33.3%	12	50.0	36	37.5
Level of maternal education	No school	12	16.7%	11	45.8	23	24
	Grade 1-6	28	38.9%	11	45.8	39	40.6
	Grade 7-8	11	15.3%	2	8.3	13	13.5
	Grade 9-12	14	19.4%	0	0.0	14	14.5
	College	7	9.7%	0	0.0	7	7.2
Pregnancy planned?	No	33	45.8%	10	41.7	43	44.7
	Yes	39	54.2%	14	58.3	53	55
Partner involved to HIV care	Yes	62	86.1%	8	33.3	70	73
	No	10	13.9%	16	66.7	26	27
M2M support program	No	3	4.2%	15	62.5	18	18.7
	Yes	69	95.8%	9	37.5	78	81
Place of delivery	Institution	66	91.7%	7	29.2	73	76
	Home	6	8.3%	17	70.8	23	24
Mode of delivery	Caesarian C	2	2.8%	0	0.0	2	2
	Vaginal	70	97.2%	24	100.0	94	98
ART before pregnancy	Yes	72	100.0%	13	54.2	85	88.5
	No	0	0.0%	11	45.8	11	11.4
Option B+	No	8	11.1%	17	70.8	25	26
	Yes	64	88.9%	7	29.2	71	74

Table 1: Variables Related To Socioeconomic and Prevention Intervention Summary of Mother-Infant Pair of the Study.

Questioners collected from mothers of children were summarized based on sero-status of the child. ANC= Antenatal care, M2M= mother to mother, ART before pregnancy = whether started ART before conception.

3.2 Factors Associated to HIV MTCT

Based on multivariate analysis, the presence of mother to mother support has a protective effect, while the absence of partner involvement in HIV care, non-inclusion in Option B+, and home delivery have a significant association with the transmission of

HIV from mother to child. Mothers who are included in the mother to mother support program have a lower chance of transmitting HIV to their children. In contrast, mothers who were not included in the mother to mother support program have a higher chance of transmitting HIV to their children, with an adjusted odds ratio (AOR) of 0.135 and a confidence interval (CI) of 0.111 – 0.396, $p < 0.05$.

Mothers whose partners were not involved in HIV care have a greater probability of transmitting HIV to their children. The absence of partner involvement in HIV care could increase the

chance of transmitting HIV to a baby by 7.3 times compared to those whose partners were involved, with an AOR of 7.331 and a CI of 1.142 – 37.459, $p < 0.05$. Mothers who were not included in the Option B+ protocol have 18 times a higher chance of transmitting HIV to their baby, with an AOR of 18.0 and a CI of

5.0 – 68.1, $p < 0.05$. Home delivery also increased the chance of transmitting HIV from mother to child by 6 times compared to those who delivered in an institution, with an AOR of 6.047 and a CI of 1.549 – 29.230, $p < 0.05$. (Table 2).

		Final outcome		COR.	AOR	95% C.I.for EXP(B)	
		Positive	Negative			Lower	Upper
M2M support	Present	9	69	.26	.135	.111	.396
	Absent	15	3	1	1		
Option B+	No	17	8	24.00	18.000	5.000	68.100
	Yes	7	64	1	1		
Place of Delivery	Home	17	6	26.21	6.049	1.549	29.230.
	Institution	7	66	1	1		
ARV prophylaxis	No	18	2	105.00	92.00	0.966	121.161
	provided	6	70	1	1		
HIV Partner Care	No	16	10	12.50	7.332	1.142	37.459
	Yes	8	62	1	1		

M2M= mother to mother, ARV=antiretroviral, HIV= Human Immunodeficiency Virus.

Table 2: Factors associated to HIV transmission from mother to child by regressions analysis. (Source: taken from main document of the project. It was produced by SPSS from raw data of participants by PI).

3.3 Factors Inhibited Application of Option B+ Among Seropositive Mothers.

Based on the one-on-one interview conducted, it was identified that the majority of cases (17 out of 24) or 70.8%, were not included in option b+. Of these 17 cases, 13 or 76.5% of them did not go for an ANC visit even once. Consequently, they did not receive any advice on HIV or institutional delivery during pregnancy. The main reason cited by the mothers of these cases for not enrolling in the option b+ program during pregnancy was a lack of knowledge about ANC and HIV testing during pregnancy. Additionally, there was a policy application gap. Four out of the 17 mothers (23.5%) visited the ANC clinic during pregnancy but were not diagnosed as seropositive and thus not included in the program. Furthermore, eight out of the 17 (47.0%) responded that there was poor communication with Health Extension Workers (HEW) during their pregnancy period. These mothers believed that they would have had a better understanding of ANC and HIV testing had the HEWs advised them initially.

4. Discussion

At the three hospitals included in this study, a total of 421 infants were exposed to HIV during delivery, and 41 (9.7%) of them acquired the virus from their mothers. This represents a transmission rate of 9.7 out of 100 exposed infants in West Shewa Hospitals, which is slightly lower than the transmission rate documented for Ethiopia as a whole in 2016. In that year, the final mother-to-child transmission rate, including the breastfeeding period, was recorded to be 15% in Ethiopia, which was much higher than rates reported in other countries [7]. Nevertheless, the country has set a target to reduce the transmission rate to less than 5% by 2020 [9].

Over the past two decades, improved interventions in developed countries have reduced mother-to-child transmission rates to less than 2% [4]. In low- and middle-income countries, vertical transmission of HIV has declined to less than 5% in the best-case scenarios after the introduction of prevention of mother-to-child transmission (PMTCT) strategies [4,5]. In wealthy countries, transmission rates are below 2%. Applicable measures to reduce transmission in resource-poor countries include safer delivery practices, infant feeding counseling and support, and the use of antiretroviral (ARV) treatment or PMTCT prophylaxis [5]. In this study, the majority of mother-to-child transmission of HIV occurred among those who remained at home, delivered at home, and did not know their aerostats during pregnancy. This indicates that activities to mobilize pregnant mothers to follow antenatal care (ANC) and institutional delivery were low. According to this study, the presence of mother-to-mother support has a protective effect, while the absence of partner involvement in HIV care, none inclusion in Option B+, home delivery, maternal WHO clinical stage two and above, and an undetermined viral load have a significant association with transmission of HIV from mother to child. Similar to this study, home delivery was found to be a significant determinant of mother-to-child transmission of HIV in a study done in Dirre Dawa, Ethiopia [19]. It is also similar to a study done in the northwestern part of Ethiopia, which indicated that rural residence, home delivery, and absence of maternal PMTCT interventions were significantly and independently associated with mother-to-child transmission of HIV [16].

An additional study done in Gojjam, Amhara region identified factors associated with transmission of HIV from mother to child to be infants whose mother could not get PMTCT intervention [17]. Another study done in Addis Ababa, Ethiopia shows that

lack of participation in mother-to-mother support programs, low partner involvement, poor adherence to antiretroviral therapy, and home delivery were significantly associated with mother-to-child transmission of HIV [18]. In this study, the majority of mothers, 70.8%, were not included in Option B+, and 76.5% did not go to ANC even once [6]. According to the WHO, the accelerated roll-out of ARV therapy for pregnant women was an important factor in the success of the global plan towards the elimination of new HIV infections among children. However, the main reason for not including mothers in Option B+ in this study was a lack of knowledge about ANC and related policy application gap. Four mothers out of 17 (23.5%) visited ANC clinics but were not diagnosed appropriately and included in the program [10].

Previous studies have identified that variables such as rural residence, unawareness of mother about ANC before pregnancy, maternal education, presence of a mother-to-mother support program, partner involvement in HIV care, home delivery, positive syphilis test result, absence of ARV prophylaxis, poor adherence to antiretroviral therapy during pregnancy, mixed breastfeeding, and undetermined viral load have a significant relationship with mother-to-child transmission of HIV. The determinants of mother-to-child transmission of HIV identified in a study done in Dirre Dawa, Ethiopia were rural residence, home delivery, and infant not receiving ARV prophylaxis [19]. A study done in the Oromiya region (Assela, Adama, and Bishoftu) found that infants who were given ARV prophylaxis for 28 days after birth were significantly less likely to contract HIV [3]. Another study done in the northwestern part of Ethiopia also indicated that rural residence, home delivery, and absence of maternal PMTCT interventions were significantly associated with mother-to-child transmission of HIV. Infants whose mother could not get PMTCT intervention were more likely to acquire HIV, as indicated by a study done in Gojjam, Amhara region [17]. Another study done in Addis Ababa, Ethiopia also showed that lack of participation in mother-to-mother support programs, low partner involvement, poor adherence to antiretroviral therapy, positive syphilis tests, home delivery, and mixed feeding of the child during the first six months of life were significantly associated with mother-to-child transmission of HIV [18, 20].

4.1 Limitations

Since the study Hospitals were purposively selected based on duration of ART service, it might limit generalization for new Hospitals which started providing ART service in recent years.

4.2 Conclusion and Recommendation

Several maternal, obstetric, and child-related factors that play a critical role in determining mother-to-child transmission (MTCT) of HIV during pregnancy, delivery, and the post-natal period have been identified. While the mother-to-mother support program has a protective effect, several factors, including the absence of partner involvement in HIV care, none inclusion to Option B+, home delivery, higher maternal WHO clinical stage, and undetermined viral load, have been found to be significantly associated with the transmission of HIV from mother to child. The lack of antenatal care (ANC) follow-up in rural areas has been

identified as the primary reason for none inclusion in Option B+. As a result, there is a high probability of home delivery and low ANC follow-up among rural residents. Future research aimed at understanding the factors related to poor antiretroviral therapy adherence and home delivery problems is highly recommended. Health care workers, such as health extension workers (HEWs), who are assigned to rural health facilities, may play a crucial role in raising community awareness and identifying pregnant mothers for prenatal care. There is a need to improve awareness of ANC among rural resident mothers, and health care workers should follow national protocols while providing prenatal care. ART providers should try to involve the partners of mothers in HIV care.

Abbreviations

Abbreviations: ANC Ante Natal Care
ART Anti Retroviral Treatment
ARV Antiretroviral
EPHI Ethiopian Public Health Institute
INH Isoniazid
MTCT Mother-to-child transmission
PCR Polymerase Chain Reaction
PMTCT prevention of mother-to-child transmission (of HIV)
SPHMMC Saint Paul's Hospital Millennium Medical College
STI sexually transmitted infection
UNAIDS United Nations Program on HIV/AIDS
UNICEF United Nations Children's Fund VL Viral load

Declarations: We hereby declare that, this research on determinants of mother to child transmission of HIV in public hospitals of West Shewa zone, Oromiya region is our original work and has not been submitted to peer review journals elsewhere, and all source materials used for this research have been duly acknowledged.

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Authors' contributions: Fufa Hunduma: conceived the research idea, wrote proposal, supervised and conducted the data collection, data processing, analysis and data interpretation, wrote first draft, wrote final paper paper and manuscript write-up.

Ethical clearance was obtained from the Institutional Review Board of Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. Permission was also obtained from Oromia Regional Health Bureau Ethical Review Committee, Ambo Hospital, Gedo Hospital and Gindeberet Hospital administrative bodies prior to patient interview and document review. Consent of participants was taken before participating to this study. Consent for publication: NA 7.

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