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ANEMIA AND NUTRITIONAL STATUS OF HIV- EXPOSED INFANTS AND HIV-INFECTED MOTHERS IN BUSIA COUNTY, WESTERN KENYA

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ABSTRACT

Background: **World Health Organization recommends 6 months of exclusive breastfeeding (EBF) for HIV-exposed infants with maternal antiretroviral drugs (ARVs) to prevent mother-to-child transmission (PMTCT) of HIV. Inadequate food and breastfeeding cause malnutrition. Assessment of their nutritional status is essential.**
Objective: **To determine the association of EBF with, maternal and infant hemoglobin and nutritional status.**
Design: **Cross-sectional survey**
Setting: **PMTCT of HIV clinics in Busia County, western Kenya**
Subjects: **HIV-infected mothers and HIV-exposed infants**
Method: **Data on socio-demography, food security and maternal ARVs treatment was collected from 371 mothers using a questionnaire. Mother-infant dyads' anthropometric and hemogram measurements were obtained. Infant weight for height zee scores (WHZ) and maternal body mass index were computed.**
Results: **Three hundred and forty-nine (94%) mothers practiced EBF; 162 (44%) were food insecure; 284 (77%) infants had normal WHZ; 298 (81%), 28 (8%) and 43(12%) mothers were normal, undernourished and overweight respectively; 261 (75%) of infants and 100 (29%) of mothers were anemic. There was no significant difference in the nutritional status of anemic and normal infants (p value 0·423). Difference in hemoglobin of mothers and infants on tenofovir disoproxil fumarate (TDF) based and zidovudine-based regimens significantly differed (p values 0.003 and 0.001 respectively).**
Conclusion & Recommendation: **Anemia among HIV-exposed EBF infants is a public health problem in Busia. Normal nutritional status does not imply normal**

hematological status. Hemogram monitoring is essential for maternal and infant nutritional status assessment in this context.

INTRODUCTION

Breast milk is best during the first 6 months of life due to nutritional, anti-infective and psychological benefits. However, breastfeeding accounts for 10-25% of mother-to-child transmission (MTCT) of HIV. Antiretroviral treatment given to the mother and exclusively breastfed (EBF) infant can reduce mother-to-child transmission (MTCT) of HIV to less than 5% (1).

Mixed feeding during the first six months carries a greater risk of transmission because other liquids and foods given to the infant alongside breast milk can damage the already delicate and permeable gut wall thus allowing the virus to be transmitted more easily by penetration. Mixed feeding also poses the same risks of contamination and diarrhea as artificial feeding further diminishing the chances of survival (2). Approximately 1.3 million child deaths per year worldwide could be prevented if universal coverage of EBF were increased to 90% among infants aged less than 6 months (3). Therefore, World Health Organization (WHO) recommends EBF and antiretroviral drugs (ARVs) for HIV-infected mothers and their infants to prevent MTCT of HIV.

Despite these benefits, the prevalence of EBF is 39% globally and 36% in resource limited settings (4). According to Kenya Demographic and Health Survey of 2014, 61% of mothers practised EBF for 5-6 months (5). Over the last two decades, more emphasis has been laid on MTCT of HIV than malnutrition due to macro or micronutrient deficiencies which affect overall child survival thus negating the benefits of EBF. Sufficient food intake is essential for lactation and effective EBF in order to avoid infant malnutrition. Fat loss and micronutrient deficiencies occur more during lactation among HIV-infected compared to uninfected women (6). EBF without iron supplementation might compromise hematologic status (7). There are no studies reported on nutritional outcome of EBF infants and their HIV-infected mothers in Busia County of western Kenya. Determination of the food security and nutritional status of EBF mothers and infants might guide health policy makers in designing appropriate intervention strategies.

METHODOLOGY

Setting: The study was conducted at Prevention of Mother-to-child Transmission (PMTCT) of HIV clinics in 3 hospitals and 7 health centers under United States Urgency for International Development and Academic Model Providing Access to Health Care (USAID-AMPATH Plus) Project in Busia County of western Kenya. These were Busia County Referral Hospital, Port Victoria and Teso Sub-county Hospitals. The health centers were Angurai, Malaba, Matayos, Bumala A, Bumala B, Khunyangu, and Mukhobola. ARVs, vitamins, hematinic and 9 kg rations of corn soy blend (CSB) are given to pregnant and EBF mothers monthly. No nutritional supplementation is given to the infants. Hematological status of the mothers and infants is determined before initiation of antiretroviral drugs (ARVs) and thereafter if required.

Materials and Method: Approval and consent to conduct the study was sought from Moi University and Moi Teaching and Referral Hospital Institutional Research and Ethics Committee, Director of USAID-AMPATH

Plus Project, Medical Officer of Health in Busia County, HIV-infected mothers and health care workers. Between February 2013 and August 2015, a cross-sectional survey was conducted to determine the association between household food security and maternal and infant nutritional status in relation to EBF during the first six months. Three hundred and seventy-one 15-45-year-old mothers attending PMTCT clinics with 6 months old infants were purposively sampled for the questionnaire. Non-Kenyan citizens and infants with anomalies were excluded.

Food security was determined using Household Food Insecurity Access Scale (HFAIS), monthly income in Kenya Shillings (KSh) and United States of America Dollars (USD) spend on food per day. Mothers who spend less than 1.9 USD /day were classified as food insecure. Maternal nutritional status was determined using body mass index (BMI) computed as weight in kilograms divided by the square of height in meters and classified as follows:

Under-nourished	< 18·5
Normal	18·5 - < 24.9
Pre-obese	25-29.9
Obese Class I	30-34.9
Obese Class II	35-39.9
Obesity Class II	=/>40

Weight, length and mid arm circumference (MUAC) of infants were measured and growth z-scores generated using 2006 WHO standards for children up to five years (10) to determine infant nutritional status. Infant nutritional status based on WHZ was classified as follows;

Normal	= / > -2
Wasted	< -2 - -3
Severe wasting	< -3

Infant nutritional status based on mid arm circumference in centimeters (cm) was classified as follows:

<11·5	severe acute malnutrition
11·5- <12·5	moderate acute malnutrition
12·5-<13·5	mild acute malnutrition
=/>13·5	normal

One milliliter of infant and maternal blood was collected in an EDTA tube for determination of complete blood count using a Coulter ACT 5 DIFF Al (Autoloader) - Beckman Coulter Inc.

Data was cleaned, coded and entered in IBM SPSS version 20 for storage and analysis. Chi-square and Fisher's Exact tests were used to determine of association of EBF with maternal and infant nutritional status and hemoglobin. A 5% level of statistical significance was used.

RESULTS

Sociodemographic Data: The median maternal age was 30 (IQR: 25-33). Two hundred and forty-three (66%) of the mothers were in the 25-35 years age bracket. Seventy-eight (21%) were less than 25 years while 49 (13%) were more than 35 years. Most mothers (76%) had achieved primary level of education. Two hundred and fifty-five (69%) of the mothers were unemployed. Three hundred and ten (84%) of the mothers were married while 32 (9%) were single, 19(5%) were separated, 5(1%) were divorced while 5(15) were widowed. Two hundred (54%) of the infants were male (table 1).

Table 1
Maternal and infant Socio-demographic Characteristics

Characteristic	Detail	Number	Percent
Ethnic group	Luhya	240	64.7
	Luo	98	26.4
	Teso	23	6.2
	Others*	10	2.7
Maternal age (years)	<25	78	21.1
	25 – 35	242	65.6
	>35	49	13.3
Residence	Rural	304	81.9
	Urban	67	18.1
Marital status	Married	310	83.6
	Single	32	8.6
	Separated	19	5.1
	Divorced	5	1.3
	Widowed	5	1.3
Education	None	10	2.7
	Primary	280	75.5
	Secondary	81	22
Occupation	Unemployed	255	68.7
	Self-employed	62	16.7
	Informal employment	26	7
	Peasant farmer	12	3.2
	Casual laborer	8	2.2
	Formal employment	8	2.2
Religion	Protestant	229	61.7
	Catholic	111	29.9
	Other**	31	8.4
Infant sex	Male	200	53.9
	Female	171	46.1
	Total	371	100

Other Kikuyu 5, Kisii 1, Meru 1, Taita 1 Maasai 1, Other** Muslim 11, African origin denominations 10*

Food security: Three hundred and six (82%) of the mothers had a regular monthly income. Sixty-five mothers did not have regular monthly income. The median income was 3000 Kenya shillings (IQR: 1,200 – 5,500). Based on USD spent on food per day, 162 (44%) were food insecure (table 2). Two mothers could not quantify USD spend on food per day. Based on USD spent on food per day, there was no significant difference in EBF among food insecure and secure mothers (Fisher's Exact Test p value 0·329). Based on HFIAS, most mothers had household food access anxiety and uncertainty, insufficient food quality and insufficient food intake. There was no significant difference in food security between mothers who EBF or not as shown in table 2 (Fisher's Exact Test p value 0·32, 0·305, 0·414 and 0.329 respectively).

Table 2

Relationship between Exclusive Breastfeeding and food insecurity based on Household Food Access Insecurity Scale & US Dollars spent on Food per Day

Parameter	**Food security**	**Exclusive breastfeeding**		**Total (%)**	**Fisher's Exact Test P value**
		Yes (%)	No (%)		
Household food access anxiety & uncertainty	Yes No	248 (93.6) 101 (95.3)	17(6.4) 5 (4.7)	265(71.4) 106 (28.6	0.362
	Total	349 (94)	22(6)	371(100)	
Insufficient food quality	Yes No	276(93.6) 73 (96)	19 (6.4) 3 (4)	295(79.5) 76(20.5)	0.305
	Total	349 (94)	22(6)	371(100)	
Insufficiency food intake	Yes No	221 (93.6) 128 (94.8)	15 (6.4) 7 (5.2)	236 (63.5) 135 (36.4)	0.414
	Total	349 (94)	22(6)	371(100)	
USD spent on food /day	< 1.9 = / > 1.9	155 (44.7) 192 (55.3)	7(31.8) 15(68.2)	162 (43.7) 207(56.1)	0.329
	Total	347	22	369	

Infant Nutritional Status at 6 months of age: The median infant weight was 7.5 kg (IQR: 7.0-8.2, length 66cm (IQR: 63-68) and MUAC 14cm (IQR: 13-15). Using MUAC, 68% of the infants were well nourished while 3% had severe acute malnutrition. Using weight for height zee (WHZ) score, 284 (77%) and 87 (23%) were well nourished and wasted respectively (table 3). All infants with severe acute malnutrition were exclusively breastfed. Using WHZ and mid arm circumference zee score, there was no significant difference in the nutritional status of infants who were EBF or not (Fisher's exact test p value 0·586 and 0.59 respectively).

Table 3

Relationship between Exclusive Breastfeeding with Maternal and Infant Nutritional Status

Anthropometric indicator	Classification	Exclusive breastfeeding		Total (%)	Fisher's Exact Test P value
		Yes (%)	No (%)		
Infant MUAC	=/>13.5 <13.5	237(94) 112(94.1)	15 (6) 7(5.9)	252(67.9) 119(32.1)	0.592
	Total	349	22	371 (100)	
WHZ	= / > -2 <-2	267 (94) 82(94.3)	17 (6) 5(5.7)	284(76.5) 87(23.4)	0.586
	Total	349	22	371 (100)	
BMI	Underweight <18.5 Well-nourished 18.5 – 24.9 Overweight =/>25	25(89.3) 281(94.3) 41(95.3)	3(10.7) 17(5.7) 2(4.7)	28 (7.6) 298(80.8) 43(11.6)	0.523
	Total	347	22	369(100)	

MUAC - mid upper arm circumference, WHZ – weight for height zee score, BMI – body mass index

Two hundred and ninety-eight (80%), 28 (8%), 43(12%) of the mothers were well-nourished, underweight, overweight (pre-obese and obese) respectively (table 3). All obese mothers exclusively breastfed for 6 months. One pre-obese and 3 underweight mothers did not EBF for 6 months. Nutritional status of mothers who EBF compared to those who did not was not significantly different (Chi-square p value 0·523). Cross-tabulation of WHZ with maternal BMI indicated that malnourished infants born to overweight mothers were less than those born to underweight and normal weight mothers (table 4). Nutritional status of infants born to underweight, normal, and overweight mothers was significantly different (Chi-square p value 0·003).

Table 4

Relationship between Maternal and Infant nutritional status

Maternal Nutritional status (BMI)	WHZ		Total (%)	Chi-square P value
	Well nourished WHZ >-2	Wasted WHZ <-2		
Underweight < 18·5	15 (53·6)	13(46·4)	28(7·6)	0.003
Normal 18.5 – 24·9	230 (77·2)	68(22·8)	298(80·7)	
Overweight 25 – 29.9	38 (88·4)	5(11·6)	43(11·7)	
Total	**283 (76·7)**	**86(23·3)**	**369(100)**	

Results for complete blood count were available for 348 mothers and 346 infants. The median infant hemoglobin and MCV were 10.1 g/dl (IQR: 9.2-10.9) 69.7fl (IQR: 65.1-74.2) respectively while median maternal hemoglobin and MCV were 12g/dl (IQR: 10.7-13.3 and 92.2fl (IQR: 82.6-102) respectively. Two hundred and fifty-nine (75%) of the infants were anemic; of these 18 (5%), 241 (70%) and 87 (25%) had moderate anemia, mild anemia and no anemia respectively. Two hundred and forty-six (76%) of anemic infants were EBF compared to 13 (65%) not EBF (table 5). All infants with moderate anemia were EBF. However, there was no significant difference between hemoglobin of EBF and no EBF infants (Fisher's Exact Test P value table 0·213).

Table 5

Relationship between Exclusive breastfeeding and Infant Anemia

Exclusive breastfeeding	Infant hemoglobin classification		Total (%)	Fisher's Exact Test P value
	Anemia Hemoglobin < 11g/dl	**No anemia Hemoglobin = / >11 g/dl**		
Yes	246(75·5)	80(24·5)	326(94·2)	0.213
No	13(65)	7(35)	20 (5·8)	
Total	**259(74·9)**	**87(25·1)**	**346(100)**	

One hundred and seventy-six (51%) of the infants had low MCV (table 6). Infants with low MCV were likely to be anemic. There was a significant difference in the hemoglobin of infants with low and normal MCV (Chi-square p value 0·000). There was no

significant difference in hemoglobin and MCV of EBF and no EBF infants (p value 0.195, 0.559 respectively). One hundred (29%) of the mothers were anemic; of these 13 (25%) had MCV less than 76 Fl; 103 (72%) had normal MCV while 132 (87%) had high MCV. There was a significant difference in the MCV of anemic and normal mothers (Chi-square p value 0·000)

Table 6

Relationship between Infant & Maternal Mean Corpuscular (MCV) Volume with Anemia

Maternal and infant MCV (Fl)	**Infant hemoglobin classification**		**Total (%)**	**Chi-square P value**
	Number anemic (%)	**Number not anemic (%)**		
Infant < 70	148 (84)	28 (16)	176 (50·9)	0.000
=/> 70-86	113 (66·5)	57 (33·5)	170 (49·1)	
Total	**261**	**85**	**346**	
Maternal <76	40 (75·5)	13 (24·5)	53 (15·2)	0.000
76-96	41(28·5)	103(71·5)	144 (41·5)	
>96	19 (12·6)	132 (87·4)	151 (43·4)	
Total	**100**	**248**	**348**	

Data on hemoglobin and WHZ score was complete for 346 infants. Two hundred and sixty-three (76%) of the infants were well-nourished while 82 (24%) were undernourished. Anemic infants were 260 (75%) while 85 (25%) were normal. There was no significant difference in the nutritional status of anemic and normal infants (Chi-square p value 0·423, table 7).

Table 7

Relationship between Hemoglobin classification and Infant nutritional status

Infant weight for height zee score (WHZ)	**Hemoglobin level (g/dl)**		**Total (%)**	**Chi-square P value**
	<11	**= />11**		
=/> - 2	195(73·9)	69(26·1)	264 (76·3)	0.271
< -2	64(78)	18 (22)	82 (23·7)	
Total	**259 (74·9)**	**82 (25·1)**	**346(100)**	

Maternal Antiretroviral Treatment: ARVs data was available for 330 mothers; hemoglobin data was available for 330 and 329 mothers and infants respectively (table 8). One hundred and eighty (51%) and 173 (49%) of the mothers were on tenofovir disoproxil fumarate (TDF) based and zidovudine (AZT) based regimens respectively. More anemic mothers and infants were exposed to TDF based regimens compared to those on AZT regimens. There was a significant difference in maternal and infant hemoglobin based on maternal ARV treatment regimen (Fisher's exact Test P value 0.003, 0.001 respectively shown in table 8)

Table 8

Relationship between Maternal Antiretroviral Treatment Regimen with Maternal & Infant Hemoglobin

Maternal ARVs	**Maternal hemoglobin (g/dl)**		**Total**	**P Value**	**Infant hemoglobin (g/dl)**		**Total**	**Fisher's Exact Test P Value**
	<11 (%)	**=/>11 (%)**			**<11 (%)**	**=/>11 (%)**		
Zidovudine based	34 (21·1)	127 (78·9)	161 (48·8)	0.003	111 (69·4)	49 (30·6)	160 (48·6)	0.001
Tenofovir disoproxil fumarate based	63 (37·3)	106 (62·7)	169 (51·2)		140 (82·8)	29 (17·1)	169 (51·4)	
Total	**97 (29·4)**	**233 (70·6)**	**330 (100)**		**251 (76.3)**	**78 (23·7)**	**329 (100)**	

DISCUSSION

Food security is essential for lactation and effective EBF. Therefore, food insecure mothers believe that their breast milk is insufficient for the infant. Obese mothers EBF due to belief in the community that fat mothers produce more breast milk than the contrary. Fat mothers are believed to have access to enough food required for production of enough breast milk to satisfy the infant. However, this data demonstrates that the difference between the mothers who EBF and the ones who did not based on USD spend on food per day was not significant. This could be due to the fact that money spend on food per day is subject to a number of factors including consumption of food grown in the home and the cost of food. In this case one might be living on more than 1.9USD because they do not grow their own food, or the cost of food is high. USAID-AMPATH Plus project supplied all malnourished mothers with 9kg monthly rations of corn soy blend (CSB) flour for porridge to supplement their high nutritional requirements during exclusive breastfeeding. This cushioned food insecure mothers from the effects of household food access anxiety and uncertainty, insufficient food quality and insufficient food intake. All mothers were supplemented with multivitamins and hematinic (blood building elements). This offset the nutritional requirement of the mothers from food insecure households making their capacity to lactate and EBF at par with the food secure ones. This enabled 94% of the mothers to sustain exclusive breastfeeding for 6 months.

Similarity in nutritional status of infants who were exclusively breastfed (EBF) or not suggests that in the context of maternal HIV infection, EBF does not invariably lead to better nutritional status. This data demonstrates that infants of overweight mothers had better WHZ due to the belief that fat mothers with large chests produce enough breast milk to satisfy the infants. All mothers who were obese practiced EBF. Similarly, in Bangladesh, milk production declined before

the major harvest and was limited by nutritional status (9).

Anemia is defined as hemoglobin less than 11g/dl among 6-59 months old children. Seventy five percent of the infants were anemic (mild and moderate anemia) while 25% had normal hemoglobin. This is far much more than the global prevalence of anemia of 43% among young children aged 6-59 months old in the general population (10). This suggests that anemia is a public health problem among EBF HIV-exposed infants in Busia County than the general population. This data, therefore, suggests that EBF during the first 6 months of life in the context of maternal HIV infection is not ideal for maternal and infant nutritional status than alternative feeding. Using 10g/dl as a cut off, the prevalence of anemia among children aged 1-3 years born to mothers of unknown HIV status in the neighboring Bungoma County was 92% (11). This implies that the prevalence of anemia among HIV exposed infants is bound to increase with age.

HIV-exposed, uninfected (HIV-EU) infants have been found to be at increased risk of mortality, morbidity and slower early growth than HIV-unexposed counterparts (12). This might increase infant mortality in this context thus negating efforts that have been made to reduce under five mortality. An MTCT trial in Zimbabwe which included HIV-uninfected women found that mortality within the first 2 years was significantly higher among HIV-exposed-uninfected (HIV-EU) children than among HIV-unexposed children. Risk factors for death among HIV-EU children were lower birth weight, male sex, maternal death, low maternal CD4 count, severe maternal anemia, single or widowed mother and low household income (13).

In Kisumu, Kenya, 75% of the cases of anemia among children aged 0-24 months occurred during the first 6 months. The proportion of children with anemia increased over a time in HIV-1 infected children peaking at 24 months while cases of severe anemia peaked during 6-12-month period, coincident with cessation of breastfeeding and rise in malaria infections. The proportion with malaria was 5% during the 1st 6 months (14). Similarly, data in this study demonstrated that infants who suffered from malaria were 5%. Therefore, it is unlikely that the high prevalence of anemia among infants in this study was due to malaria. In Lilongwe, Malawi, data from a randomized controlled trial between 2004-2009 of infants up-to 9 months from the Breastfeeding, Antiretrovirals and Nutrition Study demonstrated that cotrimoxazole prophylaxis offered protection against malaria (65% reduction) among HIV-exposed, uninfected infants from 6-16 weeks. However, it offered no protection against anemia, low weight for age or the collapsed outcome of severe illness or death (15).

In developing-country settings where the newborn iron stores might be suboptimal, evidence suggests that EBF without iron supplementation through six months might compromise hematologic status of the infant (7). Fifty one percent of the infants in this study had low mean corpuscular volume (MCV). The significant difference in the hemoglobin level of infants with low and normal MCV suggests that EBF for 6 months might predispose the infants to development of anemia due to the reducing capacity of breast milk to meet all the nutritional requirements as the infant grows older. The nutrients include iron deficiency which results into microcytic hypochromic anemia diagnosed by reduced MCV from the complete blood count. During this study no iron supplementation was given to the

infants. Therefore, during the first 6 months of life, the hematological profile of EBF infants born to HIV-infected mothers warrant further research to determine the point at which iron supplementation should be instituted.

Another factor that could contribute to infant anemia is maternal iron or folate deficiency; 29% were anemic; of these, 76% had low MCV, 29% had normal MCV while 13% had high MCV; 29% of the mothers with high MCV were anemic. There was a significant difference in the MCV of mothers with and without anemia. Considering the fact that mothers in my study were on folate and iron supplementation during pregnancy and breastfeeding, this data suggests possible interference with folate metabolism rather than deficiency due to prolonged use of cotrimoxazole – a combination of sulphamethoxazole and trimethoprim. Sulfamethoxazole and trimethoprim inhibit tetrahydrofolate synthetase and dihydrofolate reductase respectively required for purine biosynthesis. Inhibition of dihydrofolate reductase diverts folate from the donor pool required for DNA biosynthesis thus producing a state of folate deficiency in the face of normal tissue folate concentration. This causes defective DNA biosynthesis thus resulting into megaloblastic anemia.

There was no significant difference in the nutritional status of the anemic and normal infants. This suggests that normal anthropometric measurements do not invariably imply normal hematological status. An infant might have normal WHZ score but still have other micronutrient deficiencies such as iron which present as anemia. This can only be identified by complete physical examination of the infants and confirmed by complete blood count. This will necessitate further laboratory evaluation and treatment as deemed necessary to save the anemic infants. Unfortunately, it was observed that none of the clinical officers examined the infants for anemia except when they presented with symptoms.

There was no significant difference in hemoglobin and MCV levels of EBF and no EBF infants further suggesting that the possible cause of anemia among the infants equally affected all of them. Perinatal exposure to ART appears to be responsible for some of the abnormalities in lymphocyte, neutrophil and red cell populations of HIV-EU children (16). Data in this study demonstrates a significant difference in infant hemoglobin based on maternal ARV treatment regimen. The high prevalence of anemia among these infants could be explained by excretion of zidovudine in the breast milk. Zidovudine causes bone marrow suppression thus causing anemia.

The results of this study are similar to the study in Botswana where there was increased risk of severe infant anemia after exposure to maternal HAART (17). In Tanzania, AZT exposure during pregnancy and after birth resulted in significant reduction of hemoglobin, total white blood, cell, granulocytes, platelet count and red cell distribution width (18). Contrary to these results, anemia among breastfed infants of mothers on AZT has been postulated to be unlikely due to maternal AZT in breast milk due to negligible levels of AZT in breast milk (19). These contradictory results suggest further research on hematological profile of mothers and their infants exposed to AZT regimens for PMTCT of HIV during the first 6 months. The effect of tenofovir disoproxil fumarate on hematological profile of breastfeeding mothers and infants has not been reported in the literature. In this study anemia among mothers on TDF could be due to selection bias because those with anemia

are likely to be switched to TDF. Hence this requires further research.

A study was conducted by the Kisumu Breastfeeding Study between 2003 and 2009 in Kisumu, Kenya to investigate whether a maternal triple-antiretroviral regimen designed to maximally suppress viral load in late pregnancy and the first 6 months of lactation was safe, tolerated and effective PMTCT. MTCT of HIV rate at birth, 6 weeks, 6, 12 and 24 months was 2.5, 4.2, 5, 5.7 and 7 % respectively (20). The study did not focus on other effects of ARVs such as anemia in both the infants and the mothers. In this study 342 (99.7%) of the infants tested for HIV were HIV negative while 1 (0.3%) was positive at 6 weeks which is better than the Kisumu Breastfeeding Study. However, the high prevalence of anemia among these infants remains a public health concern of high magnitude.

CONCLUSION

Despite the good nutritional status based on WHZ scores, 75% of the infants were anemic yet there was no significant difference in the nutritional status of the anemic and normal infants. The high prevalence of anemia among EBF infants suggests that EBF in the context of maternal HIV-infection is not ideal for optimal infant nutritional status during the first 6 months. Maternal ARV treatment and iron deficiency might have predisposed the infants to development of anemia. This negates efforts and prospects of achieving reduced infant morbidity and mortality by 2030. There is need to include a hemogram in routine nutritional assessment of HIV exposed infants during the first 6 months to facilitate identification of those with anemia.

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