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Risk Factors Associated with HIV Infection Among Infants Below 24 Months Born to HIV Positive Mothers

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Abstract: In order to eliminate infant HIV infection from mother to child, evidence based implementation strategies are needed to address the risk factors that are associated with this infection using limited resources and applicable to all stakeholders especially the parents of the infants. This study assessed the infant, maternal and paternal risk factors associated with HIV infection among infants below 24 months born to HIV positive mothers in care. An unmatched nested case control study was conducted at the HIV/ART clinic, Mildmay Uganda in 2012. 370 HIV positive mothers with their biological infants below 24 months who had had a DNA-PCR test done in the last 6 months were enrolled in the study (cases: DNA-PCR positive infants, controls: DNA-PCR negative infants). Data was collected using a structured questionnaire. Descriptive, bivariate and multivariate analyses were done. The risk factors that showed a significant relationship with HIV infection of infants below 24 months born to HIV positive mothers were: Infant factors: Infant and young child feeding option used in the first 8 weeks of life ($p < 0.001$) ART status ($p<0.001$), Immunization status ($p=0.031$) and duration of receiving Nevirapine syrup of the infant ($p=0.002$) significantly increased the risk of infection. Maternal factors: High baseline viral load during pregnancy ($p=0.046$), Body Mass Index > 30kg/m2 ($p=0.008$), receipt of ART during pregnancy ($p<0.001$), receipt of nutrition counseling ($p=0.002$) and non-disclosure of HIV status to spouse of the mother during pregnancy ($p<0.001$). Paternal factors: Acceptance to test for HIV ($p<0.001$), non-disclosure of HIV status to spouse ($p<0.001$) and receipt of ART ($p<0.001$). Multivariate analysis showed a significant relationship with HIV infection of infants who were mixed fed the infant (OR: 4.971, 95%CI: 1.71 - 14.48, $p=0.003$), receipt of ART (NVP) of the infant (OR: 0.0062, 95%CI:0.002 - 0.019, $p<0.001$), mother not disclosing of HIV status to spouse (OR:2.736, 95%CI:1.074 - 6.971, $p=0.035$) and Father not disclosing of HIV status to spouse (OR:4.38, 95%CI:1.764 - 11.235, $p=0.002$). The results show that mixed feeding of infants and parental non-disclosure of HIV status are key drivers that significantly increase the risk of infant infection while infant prophylactic Niverapine reduces the risk of infection. It is recommended that exclusively breastfeed of infants born to HIV positive women, HIV testing and spousal disclosure of HIV status be promoted among PLHIV.

Keywords: Non-Disclosure, HIV DNA-PCR Test, HIV Infection, Exclusive Breastfeeding, Mixed Feeding, Risk Factors

1. Introduction

At the end of 2010, an estimated 34 million people were reported to be living with HIV globally, out of which 3.4 million are children less than 15 years of age. 2.7 million People (1.9million in sub Saharan Africa) were new HIV infections out of which an average of 390,000 were new infections among children less than 15 years [1]. However, in 2016, the estimated number of PLHIV has increased to 36.7 million globally of which 2.1 million are children below 15 years. Out of the 1.8million new HIV infections registered globally, 160,000 are children. [13]. Unfortunately sub Saharan Africa accounts for 90% new infections and, vertical transmission of HIV still accounts for over 95% of infant infection with an estimated 1.8million people died from

AIDS-related causes worldwide, 250,000 of which are children less than 15 years of age [1]. in 2016, 19.4 million people are living with HIV out of which 77,000 are children below 15 years [2]. In Uganda, the prevalence of HIV infection in the central region and Kampala is 8.5% (0.7% among children), 10% in urban areas compared to rural prevalence of 6% 57% of people living with HIV are women while 13% are children below 15 years at the time of the study. [3] However, the prevalence of HIV has declined in 2017 to 7.5% and 5.8% in urban and rural areas respectively. The prevalence among the target group (below 15 years) is now at 0.5% [4]. At Mildmay Uganda, approximately 27,000 people are enrolled into care out of which 19% are children 15 years and below [5]. The Mother to child infection rate was at 4.2% in 2016 [6]. This disease burden has consequently increased the morbidity and mortality of these vulnerable children while also increasing the cost of care.

A number of risk factors have been associated with vertical transmission such as maternal indicators of disease progression (high viral load, low CD4 count, and viral characteristics) paternal involvement during after pregnancy as well as Infant young child feeding options. [7] These trends have also been linked to the low utilization of medication in resource limited settings, low uptake of HIV and PMTCT services, use of inappropriate infant and young child feeding options, high illiteracy levels, low family planning uptake, poverty and low male partner involvement - the men's shared responsibility, their active participation in responsible parenthood, sexual and reproductive behavior including family planning; prenatal, maternal child health; prevention of unwanted and high-risk pregnancies; shared control and contribution to family income, children's education, health and nutrition; recognition and promotion of the equal value of children of both sexes. [8-13].

Prevention of mother to child infection entails acceptance of HIV testing, disclosure of HIV result, having consistent safe sex, ARV treatment for both mother and child, safe infant and young child feeding practices and other supportive decision making and support. [14] Despite the documented evidence on the risk factors associated with HIV infection, limited data exists on the infant, paternal and maternal factors that influence HIV infection among infants born to HIV positive mothers in resource limited settings. The identification of the actual risk factors to infant infection will inform policy makers and help design more effective interventions to eliminate infant infection and hence reducing HIV-related morbidity and, mortality and cost of medical care hence the need for this study to examine the infant, maternal and paternal risk factors that are significantly associated with infant HIV infection.

2. Materials and Methods

2.1. Study Design

The study was an unmatched nested case control study with the number of controls twice the number of cases. At Mildmay, all pregnant women are enrolled for PMTCT, provided with highly active antiretroviral therapy (HAART) and followed up through delivery and their infants followed until 24 months when the last HIV confirmatory test is done, both the mother and child are prospectively followed and vital records taken at particular intervals. It is from these cohort participants that this study was conducted on mothers who fulfilled the inclusion criteria. Retrospective data on socio-demographic data, infant, maternal and paternal factors was recorded from the mother; verification of some information was by review of secondary data in existence.

2.2. Study Area

The study was carried out at Mildmay Uganda in Wakiso district, Uganda between June and October 2012. The centre provides comprehensive HIV care and treatment using a holistic family-centered approach to approximately 24,000 people out of which 4560 (19%) are children (0-18 years).

2.3. Study Population and Selection Criteria

All HIV positive mothers with infants below 24 months who are receiving care and support at Mildmay Uganda. Inclusion criteria: HIV positive mothers with biological infant (0-24 months), mother who had been in care at Mildmay at least 3 months before conception, infant had at least one DNA-PCR test done and results given to the mother and mother formally consented to participate in the study.

2.4. Sample Size and Sampling Procedure

A total of 370 infants were included in the study [15]
Formula

$$n = \frac{\mathrm{r}+1}{\mathrm{r}} \frac{(p)(1-p)(Z_{\beta}+Z_{\alpha/2})^2}{(P_1-P_2)^2}$$

n = sample size, (r + 1)/r= ratio of controls to cases, r=1, p = a measure of variability (similar to standard deviation), Zβ = Desired statistical power (typically 0.84 for 80% power), $Z_{\alpha/2}$ = Desired level of statistical significance (Two-sided significance level = 1.96), OR = Assumed odds ratio of 2.0 or greater is desired, p1 –p2 = effect size (the difference is proportion), P2 = the proportion exposed in the control group = 20%, P1 = the proportion of cases exposed is calculated below, average proportion exposed = (0.33 +0.20)/2 = 0.265. The calculated sample size was 362.

Controls: DNA-PCR Negative infants below 24 months born to HIV positive mothers in care at Mildmay

Cases: DNA-PCR Positive infants below 24 months born to HIV positive mothers in care at Mildmay

Eligible participants were selected purposively and data collection done during the peadiatric clinic days using a structured questionnaire. The infants whose DNA-PCR test result was confirmed negative (by mother's word of mouth, HCT records, records in the infant's file and laboratory records) were enrolled as controls while infants who had their DNA-PCR result confirmed positive were recruited as

cases. A total of 370 mothers with their biological infants participated, 116 were cases while 254 were controls; they were unmatched and control participants were twice the number of cases.

2.5. Study Variables

Dependent variables: Infant DNA-PCR test outcome that has been categorized as DNA-PCR negative and DNAPCR positive.

Independent variables: Infant factors: age, sex, birth weight, Breastfeeding history, IYCF option used and period of receiving NVP syrup of the infant; Maternal factors: age, residence, education level, employment status, marital status, family income, religion, duration of the relationship, acceptance to test for HIV, disclosure of HIV status to spouse, ANC visits made to the health facility, baseline CD4 count, Viral load and receipt of ART and nutrition counselling of the mother during pregnancy. Paternal factors: age, residence, education level, employment status, religion, acceptance to test for HIV, disclosure of HIV status to spouse and receipt of ART

2.6. Data Sources and Collection

Primary data was collected from the respondent mothers using a detailed structured questionnaire. information collected included; age of the infant, mother and father, Breastfeeding history, IYCF option used and period of receiving NVP syrup of the infant; residence, education level, employment status, marital status, family income, religion, duration of the relationship, acceptance to test for HIV and disclosure of HIV status of the parents. Secondary data was reviewed and retrieved from patient files, HCT registers, Laboratory records, infant growth monitoring cards, mothers' ANC card, nutrition counseling register and PMTCT register. information retrieved included; birth weight, DNA-PCR test and results of the infants, baseline CD4 count and viral load, receipt of ART and nutrition counseling of the mother during pregnancy.

2.7. Data Management and Analysis

Data collection was done by trained interviewers and questionnaire was pre-tested and a preview meeting of the pre-test results was done to handle corrections and clarifications before preparing the final questionnaire. The completely filled questionnaires were then coded with numbers 1,2,3…k, variable entry sheet was created and data entered into the variable fields accordingly using SPSS version 20.0 data sheet, upon completion, data was cleaned and then exported to STATA 11.0 software for analysis. All continuous variables such as age, family income were converted into a categorical ordinal scale; other absolute variables were also grouped such as marital status, religion, education status, family planning methods used. All available responses from the interviews were included in the analysis and no sensitivity analyses were done. Logistical regressions were done to determine the statistical significant relationship between the dependent and independent variables in question as well as determining the level of association. During analysis, the association of each exposure variable (independent variable) and the outcome (dependent variable) was determined in cross tabulations. All variables whose p-values were less than 0.2 were considered to be included in the multivariate model; adjusted odds ratios and their respective confidence intervals were obtained and included in the presentation. All statistical tests and their respective confidence intervals were based on a two-tailed test and were performed at the 5% error rate.

2.8. Ethical Considerations

Ethical approval for this study was given by the International Health Sciences University Review Board and Mildmay Uganda Review Board. Written informed consent of all respondents (mothers) was obtained and all information was protected and kept confidential. No videos and photographs of the respondent and their infants were taken and the standard operating procedures at each service delivery points were adhered to. There was no risk to the human subjects participating in the study.

3. Results

3.1. Socio-Demographic Characteristics of Infants and Parents

3.1.1. Infants Characteristics

Table 1. *Infants socio-demographic characteristics (N=370).*

Variables	N	Percentage
Age(months)		
0-6	177	47.84
>6	193	52.16
Sex		
Male	156	42.70
Female	212	57.30
Birth weight (kg)		
<2.5	91	24.59
≥2.5	279	75.41
Weight for height (%)		
<70	4	1.08
70-79	30	8.11
80-84	113	30.54
≥85	223	60.27
Age at first DNA-PCR test (months)		
0-2	312	84.32
>2	58	15.68
IYCF used in the infant's first 8 weeks		
Exclusive breastfeeding	194	52.43
Replacement feeding	118	31.89
Mixed feeding	56	15.14
Pre-heated expressed breast milk	2	0.54
Duration of receiving ART (weeks)		
Never	39	10.54
<6	63	17.03
6	225	60.81
>6	43	11.62
Immunization status		
Incomplete	307	82.97
complete	63	17.03
Infant on ART		
Yes	91	24.59
No	278	75.41

Table 1 shows that 57.3% (212/370) of the infants were female, 52% were aged above 6 months, 75% weighed 2.5kg and above at birth, 60% of the infants had a weight for height percentage above 85, 84% had had their first DNA-PCR test done and results given to the mother between the age of 0 to 2 months. A large proportion of infants 52.4% (194) had been exclusively breastfed, while 225 (61%) had received Nevirapine syrup for 6 completed weeks. 83% of the infants had not completed immunization by the time of the study and 278 (75.4%) were not taking Niverapine at the time of the study.

3.1.2. Mothers Characteristics

Table 2. *Socio demographic characteristics of the mothers.*

Variables	N	Percentage
Age (years)		
15-24	93	25.14
≥25	277	74.86
Body Mass Index (kg/m^2)		
<18.5	54	14.59
18.5-25	231	62.43
>25	85	22.97
Baseline CD4 count during pregnancy (cells/mm^3)		
0-350	149	40.27
>350	221	59.73
Baseline Viral load during pregnancy (copies)		
Detectable(>5000)	49	13.24
Undetectable(<5000)	321	86.76
Marital status		
Married	250	67.57
Not married (Divorced, widowed, separated)	120	32.43
Education level		
None	23	6.22
Primary	144	38.92
Secondary	172	46.49
Tertiary	31	8.38
Duration of the relationship with spouse (years)		
1-3	169	45.68
≥4	201	54.33
Religion		
Christian	296	80.0
Moslem	71	19.19
Others	3	0.81
Employment status		
Yes	169	45.80
No	200	54.20
Family planning method in use		
None	121	32.70
Hormonal (Norplant, pills, inject-plan)	139	37.57
Non hormonal (condom, IUD)	110	29.73
Monthly family income (shs)		
<100,000	276	74.59
>100,000	94	25.41
Receiving ART during pregnancy		
Yes	299	80.81
No	71	19.19
Test for HIV during pregnancy		
Yes	238	64.32
No (before)	132	35.68
Receive nutrition counseling during pregnancy		
Yes	245	66.22
No	125	33.78
Disclosure of HIV status to spouse		
Yes	293	79.19
No	77	20.81

Table 2 shows that 75% (277/370) of the mothers who participated were aged 25 years and above, 62% had a body mass index within normal range of 18.5 -25 kg/m^2, 221 (59.7%) had a baseline CD4 count above 350 cells / mm^3 during pregnancy and 321 (87%) had an undetectable viral load copies during pregnancy. Majority (67.6%) of the mothers who participated were married, 172 (47%) had attained secondary level of education, 201 (54%) reported

to have had a sexual relationship with the father of the infant for more than four years, 296 (80%) mothers were Christians, 200 (54%) of the mothers were unemployed, 75% mothers revealed to have a monthly family income less than shs 100,000. The proportion of mothers who had tested for HIV during pregnancy was 64% (238) while the rest had tested before pregnancy; however, only 79% (293) reported to have disclosed their HIV status to their spouses. 139 (38%) of the mothers reported to have used a hormonal method of family planning method before pregnancy, 299 (81%) mothers had received ART during pregnancy and 66%(245) reported to have received nutrition counseling during pregnancy

3.1.3. Fathers Characteristics

Table 3 shows that out of the 370 mothers who participated, 334 (96%) reported their husbands to be aged 25 years and above, 342 (98%) were employed and 79 (23%) had attained primary level of education. Majority 244 (70%) of the fathers were reportedly Christians. The proportion of fathers reported to have tested for HIV when their wives were pregnant was 60% (209), 59% (205) fathers had reportedly disclosed their HIV status to their spouse, however, 139 (40%) and 138 (40%) of the mothers did not know the HIV status and ART status of their husbands respectively.

Table 3. *Socio-demographic characteristics of fathers.*

Variables	N	Percentage
Age (years)		
15-24	14	4.02
≥25	334	95.98
Employment status		
Yes	342	98.27
No	6	1.72
Residence		
Kampala	118	33.91
Wakiso	133	38.22
Others	97	27.87
Test for HIV		
Yes	209	60.06
No	139	39.94
Education level		
None	17	4.89
Primary	79	22.70
Secondary	205	58.91
Tertiary	42	12.07
Unknown	5	1.44
Disclosure of HIV status to spouse		
Yes	205	58.91
No	142	40.80
HIV status		
Negative	73	20.98
Positive	136	39.08
Unknown	139	39.94
Receiving ART		
Yes	102	29.31
No	108	31.03
Unknown	138	39.66
Religion		
Christian	244	70.11
Moslem	104	29.89

3.2. Bivariate Analyses

3.2.1. Infant Factors Influencing HIV Infection Among Infants Below 24 Months Born to HIV Positive Mothers

Table 4 reveals that there is a significant association between the age (P=0.01), gender (P=0.09), age at first DNA –PCR test (P<0.001), Infant and young child feeding option used in the first 8 weeks of life (p <0.001) ART status (p<0.001), Immunization status (p=0.031), duration of receiving Nevirapine syrup of the infant (p=0.002) and HIV infection among infants below 24 months born to HIV positive mothers. However, there is no statistically significant association between the birth weight (P=0.096), weight for height percentage (P=0.506) of the infant and HIV infection among infants below 24 months born to HIV positive mothers

Table 4. *Infant risk factors.*

Variables	N (%)	Controls (%)	Cases (%)	X^2	P- value
Age(months)					
0-6	177(47.84)	133(52.36)	44(37.93)	6.646	0.01
>6	193(52.16)	121(47.64)	72(62.07)		
Sex					
Male	158(42.70)	97(38.19)	61(52.59)	6.7462	0.009
Female	212(57.30)	157(61.81)	55(47.41)		
Birth weight (kg)					
<2.5	91(24.59)	68(26.77)	23(19.24)	4.6938	0.096
≥2.5	279(75.41)	186(73.23)	93(80.17)		
Weight for height (%)					
<70	4 (1.08)	3(1.18)	1(0.86)	2.3358	0.506
70-79	30 (8.11)	17(6.69)	13(11.21)		
80-84	113(30.54)	80(31.50)	33(23.45)		
≥85	223(60.27)	154(60.63)	69(59.48)		
Age at first DNA-PCR test (months)					
0-2	312(84.32)	238(93.70)	74(63.79)	53.8861	<0.001
>2	58(15.68)	16(6.30)	42(36.21)		
IYCF used in the infant's first 8 weeks					
Exclusive breastfeeding	194(52.43)	161(63.39)	33(28.45)	69.6562	<0.001
Replacement feeding	118(31.89)	77(30.31)	41(35.34)		
Mixed feeding	56(15.14)	14(5.51)	42(36.21)		
Pre-heated expressed breast milk	2(0.54)	2(0.79)	0(0)		
Duration of receiving Nevirapine (weeks)					
Never	39(10.54)	17(6.69)	22(18.97)	15.1167	0.002
<6	63(17.03)	40(15.75)	23(19.83)		
6	225(60.81)	165(64.96)	60(51.72)		
Immunization status					
Incomplete	307(82.97)	218(85.83)	89(76.72)	4.6703	0.031
Complete	63(17.03)	36(14.17)	27(23.28)		
Infant on ART					
Yes	91(24.59)	5(1.97)	86(74.14)	223.6964	<0.001
No	278(75.41)	249(98.03)	30(25.86)		

3.2.2. Maternal Factors Influencing HIV Infection Among Infants Below 24 Months Born to HIV Positive Mothers

Table 5 reveals that there is a significant association between HIV infant infection and key maternal factors which include baseline viral load during pregnancy (p=0.046), receipt of ART during pregnancy (p<0.001), receipt of nutrition counseling (p=0.002), disclosure of HIV status to spouse of the mother during pregnancy (p<0.001). However, there is no statistically significant association between HIV infant infection and the maternal age (p=0.211), baseline CD4 count during pregnancy (p=0.333), marital status (p=0.152), education status (p=0.972), duration of the relationship with the spouse (p=0.280), religion (p=0.225), employment status (p=0.599), family planning method (p=0.245), monthly family income (p=0.123), acceptance to test for HIV (p=0.193).

Table 5. *Maternal risk factors.*

Variables	N (%)	Controls (%)	Cases (%)	X2	P- value
Age (years)					
15-24	93(25.14)	59(23.23)	34(29.31)	1.5654	0.211
≥25	277(74.86)	195(76.77	82(70.69)		
<18.5	54(14.59)	28(11.02)	26(22.41)	9.6131	0.008
18.5-25	231(62.43)	161(63.39)	70(60.34)		
>25	85(22.97)	65(25.59)	20(17.24)		
Baseline CD4 count during pregnancy (cells/mm3)					
0-350	149(40.27)	102(40.16)	47(40.52)	2.1964	0.333
>350	221(59.73)	152(59.84)	69(59.48)		
Baseline Viral load during pregnancy (copies)					
Detectable(>5000)	49(13.24)	39(15.35)	10(8.62)	6.1473	0.046
Undetectable(<5000)	321(86.76)	215(84.65)	106(91.38)		
Marital status					
Married	250(67.57)	167(65.75)	83(71.55)	5.2839	0.152
Not married (Divorced, widowed, separated)	120(32.43)	87(34.25)	33(28.45)		
Education level					
None	23(6.22)	16(6.30)	7(6.03)	0.2318	0.972
Primary	144(38.92)	97(38.19)	47(40.52)		

Variables	N (%)	Controls (%)	Cases (%)	X2	P- value
Secondary	172(46.49)	120(47.24)	52(44.83)		
Tertiary	31(8.38)	21(8.27)	10(8.62)		
Duration of the relationship with spouse (years)					
1-3	169(45.68)	113(44.49)	56(48.28)	2.5447	0.280
≥4	201(54.33)	141(55.51)	60(51.72)		
Religion					
Christian	296(80.0)	198(77.95)	98(84.48)	2.9818	0.225
Moslem	71(19.19)	53(20.87)	18(15.52)		
Others	3(0.81)	3(1.18)	0(0.0)		
Employment status					
Yes	169(45.80)	114(44.88)	55(47.83)	0.2764	0.599
No	200(54.20)	140(55.12)	60(52.17)		
Family planning method in use					
None	121(32.70)	82(32.28)	39(33.62)	7.9062	0.245
Hormonal (Norplant, pills, inject - plan)	139(37.57))	99(38.97)	40(34.48)		
Non hormonal (condom, IUD)	110(29.73)	73(28.74)	37(31.9)		
Family income					
<100,000	276(74.59)	184(72.44)	92(79.31)	4.1895	0.123
>100,000	94(25.41)	70(27.56)	25(20.69)		
Mother receiving ART during pregnancy					
Yes	299(80.81)	224(88.19)	75(64.66)	28.4412	<0.001
No	71(19.19)	30(11.81)	41(35.34)		
Mother test for HIV during pregnancy					
Yes	238(64.32)	156(61.42)	82(70.69)	3.2941	0.193
No (before)	132(35.68)	98(38.58)	34(29.31)		
Receive nutrition counseling during pregnancy					
Yes	245(66.22)	181(71.26)	64(55.17)	9.2128	0.002
No	125(33.78)	74(28.74)	52(44.83)		
Disclosure of HIV status to spouse					
Yes	293(79.19)	216(85.04)	77(66.83)	16.8252	<0.001
No	77(20.81)	38(14.96)	39(33.62)		

3.2.3. Paternal Factors Influencing HIV Infection Among Infants Below 24 Months Born to HIV Positive Mothers

Table 6 shows that there was a significant association between HIV infection of infants and key paternal variables which include; acceptance to test for HIV (p<0.001), HIV status (p<0.001), disclosure of HIV status to spouse (p<0.001), receipt of ART (p<0.001). However, there is no statistically significant association between HIV infection of infants and the paternal age (p=0.428), employment status (p=0.632), residence (p=0.358), education level (p=0.078), religion (p=0.182).

Table 6. *Paternal risk factors.*

Variables	N (%)	Controls (%)	Cases (%)	X^2	P- value
Age (years)					
15-24	14(4.02)	11(4.58)	3(2.78)	0.6289	0.428
≥25	334(95.98)	229(95.42)	105(97.22)		
Employment status					
Yes	342(98.27)	236(98.33)	106(98.15)	0.9180	0.632
No	6(1.72)	4(1.67)	2(1.85)		
Residence					
Kampala	118(33.91)	86(35.83)	32(29.63)	2.0551	0.358
Wakiso	133(38.22)	86(35.83)	47(43.52)		
Others	97(27.87)	68(28.33)	29(26.85)		
Test for HIV					
Yes	209(60.06)	159(66.25)	50(46.30)	12.3623	<0.001
No	139(39.94)	81(33.75)	58(53.70)		
Education level					
None	17(4.89)	13(5.42)	4(3.70)	8.3904	0.078
Primary	79(22.70)	52(21.67)	27(25.0)		
Secondary	205(58.91)	148(61.67)	57(52.78)		
Tertiary	42(12.07)	26(10.83)	16(14.81)		
Unknown	5(1.44)	1(0.42)	4(3.70)		
Disclosure of HIV status to spouse					
Yes	205(58.91)	161(67.08)	44(40.74)	22.2946	<0.001
No	142(40.80)	78(32.50)	64(59.26)		
HIV status					
Negative	73(20.98)	66(27.50)	7(6.48)	29.5546	<0.001

Variables	N (%)	Controls (%)	Cases (%)	X^2	P- value
Positive	136(39.08)	98(40.83)	38(35.19)		
Unknown	139(39.94)	76(31.67)	63(58.33)		
Receiving ART					
Yes	102(29.31)	68(28.33)	34(31.48)	32.7266	<0.001
No	108(31.03)	96(40.0)	12(11.11)		
Religion					
Unknown	138(39.66)	76(31.67)	62(57.41)		
Christian	244(70.11)	163(67.92)	81(75.0)	1.7835	0.182
Moslem	104(29.89)	77(32.08)	27(25.00)		

3.3. Multivariate Analysis of Factors Associated with Infant HIV Infection

Table 7 shows that the infants who were exclusively breastfed were 5 times less likely to be infected with HIV from their HIV positive mothers than those who were mixed fed. (OR: 4.971, 95%CI: 1.71 - 14.48). Infants who were receiving ART (Nevirapine) up to 12 months were less likely to be infected with HIV from the HIV positive mothers than those who were not receiving ART up to 12 months. (OR: 0.0062, 95%CI: 0.002 - 0.019). Infants whose HIV positive mothers did not disclose their HIV status to their husbands were three times more likely to acquire HIV infection than infants whose HIV positive mothers disclosed their HIV status to their husbands. (OR:2.736, 95%CI:1.074 - 6.971). Infants whose fathers did not disclose their HIV status to their wives were four times more likely to acquire HIV infection than infants whose fathers disclosed their HIV status to their wives. (OR:4.38, 95%CI:1.764 - 11.235)

Table 7. *Multivariate analysis of the significant risk factors.*

Variable	N (%)	OR (95% CI)	P-value
IYCF options used			
Exclusive Breastfeeding	194 (52.43)	1(ref)	
Mixed feeding	56 (15.14)	4.971(1.71 – 14.48)	0.003
Infant on ART			
Yes	91(24.59)	0.0062(0.002 – 0.019)	0.000
No	278(72.14)	1(ref)	
Mother's disclosure of HIV status to spouse			
Yes	293(79.19)	1(ref)	
No	77(20.81)	2.736(1.074-6.971)	0.035
Father's disclosure of HIV status to spouse			
Yes	205(58.91)	1(ref)	
No	142(40.80)	4.38(1.764-11.235)	0.002

4. Discussion

Infant factors: Infants who were mixed fed were five times more likely to acquire HIV from the mother than an infants who were exclusively breastfed. That means that exclusively breastfed infants had lower risk of HIV infection than an infant who mixed fed. Mixed feeding which entails feeding the infant on both breast milk and other foods such as cow's milk, formula milk, juice, porridge, soup and water predisposes the infant to infection because other feeds other than breast milk when provided to an infant below 6 months have been associated with an increased likelihood of damaging and irritating the epithelial integrity of the infant's intestine as well as triggering food allergic reactions and illnesses such as diarrhea, hence infants who are mixed fed are at a high risk of exposure through breast milk and consequences of other feeds [7]. Studies have reported significantly high risk of HIV transmission rate among the infants who are mixed fed although other studies reported no significant difference in the risk of infection between exclusively breastfeeding and mixed fed infants [16, 17]. Infants who had their first DNA-PCR test done below 8 weeks had a lower risk of infection than those who tested later, this can be linked to the parents of the infant being responsible about their infants health, meaning that they have good medical care-seeking behavior together w ith those whose infants had completed immunization on time, therefore infant HIV infection may also be linked to behavior of the parents in seeking medical care and following medical prescriptions and instructions.

Maternal and male partner factors**:** Infants whose HIV positive mothers did not disclose their HIV status to their husbands were three times more likely to acquire HIV than the infants whose HIV positive mothers disclosed their HIV status. There is often significant partner support ranging from financial support, medication reminders, provision of adequate food at home to making vital decisions especially regarding the feeding options for the infant. A study in Zimbabwe revealed that the enrolment into the PMTCT program without disclosure exposed the infant to HIV infection as mothers found it hard to exclusively breastfeed and negotiate condom use during pregnancy and lactation. A strong relationship between mode of infant feeding and spouse's awareness was also reported because mothers who had disclosed their HIV status to their spouses were more likely not to breastfeed

their infants than mothers who had not disclosed their status [19]. Infants whose fathers did not disclose their HIV status to their wives were four times more likely to acquire HIV infection than infants whose fathers disclosed their HIV status to their wives. No studies were found at the time of the study on male partner disclosure in association with infant HIV infection.

5. Limitations

The results of this study may be generalized to infants below 24 months born to HIV positive mothers enrolled and active in HIV/ART care. Paternal information included was provided by the mother therefore, it may be possible that mothers did not provided correct spousal information especially regarding HIV testing.

6. Conclusions

The results of the study show that the HIV exposed infants who had a high risk of acquiring HIV were those that had been mixed fed during the first 8 weeks of life and those whose parents did not disclose their HIV status to the spouses while the infants who had a very low risk of infection were those who had received Niverapine syrup for the first 6 weeks of life, had exclusively breastfed and the parents had disclosed their HIV status to the spouses.

Mixed feeding should be discouraged for all HIV positive mothers because of its associated risk of infant HIV infection. Mothers should be encouraged to exclusively breastfeed their infants and HIV testing and disclosure of spouses should be promoted. Further research is recommended to examine the influence of partner disclosure of HIV status on HIV infection of children.

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