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Exclusive breastfeeding, maternal HIV disease, and the risk of clinical breast pathology in HIV-infected, breastfeeding women

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Abstract

Objective—To examine the relationship between breastfeeding patterns, markers of maternal HIV disease, and woman's breast pathology.

Study Design—Secondary data analysis from a randomized breastfeeding trial including 947 HIV-infected women (n=5,982 visits) from breastfeeding initiation until: 6 months post-partum; 1 month after breastfeeding cessation; or loss-to-follow-up/death. Generalized estimating equations assessed the effects of breastfeeding pattern and maternal HIV status on breast pathology.

Results—190 (20.1%) women had a breast problem; 86 (9.1%) had mastitis and 31 (3.3%) had abscess. After confounder adjustment, non-exclusively breastfeeding women increased risk of breast problems (OR: 1.98 95% CI: 1.33, 2.95) and mastitis (OR: 2.87 95% CI: 1.69, 4.88) compared to exclusive breastfeeders. Women with CD4 count <200 cells/uL tended to have increased risk of abscess.

Conclusions—Non-exclusive breastfeeding significantly increased the risk of breast pathology. Exclusive breastfeeding is not only optimal for infant health; it benefits mothers by reducing breast problems.

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Keywords

Abscess; CD4 count; Exclusive breastfeeding; HIV; Mastitis

Introduction

Breastfeeding is essential for the survival of children born to HIV-infected mothers in low resource settings,[1–4] and the efficacy of antiretroviral drugs in reducing HIV breast milk transmission allows women to protect their infants from both HIV and other infectious diseases that threaten their infant's lives.[5–7] Nevertheless, postnatal HIV transmission continues to occur and improving the safety of breastfeeding for HIV-infected women and their children remains important.

In several studies, postnatal HIV transmission increased in the presence of breast lesions, mastitis, and abscess, though exclusive breastfeeding reduced the risk of HIV transmission.[8–11] Globally, 10–33% of women experience mastitis, typically occurring in the early days of breastfeeding.[12–14] Mastitis and breast pathology are also reasons women cite for early cessation of breastfeeding.[15] In HIV-uninfected populations, milk stasis, due to mixed feeding or rapid weaning, is the predominant cause of mastitis while bacterial infections are relatively infrequent.[12, 13, 15–17] Other risk factors for mastitis include: nipple fissures, prior history of mastitis, use of nipple creams, stress, and fatigue.[13, 18, 19] Physiologically, mastitis and abscess alter the cellular tight junctions that regulate breast epithelial permeability,[20–23] resulting in increased sodium and chloride levels in breast milk. These changes have been associated with increases in breast milk HIV and an increased risk of transmission[24] and maternal morbidity,[16, 25, 26] highlighting the need for appropriate interventions.

Little is known about the predictors of breast problems, especially mastitis and abscess, in HIV-infected women. As HIV disease progresses, the risk of opportunistic infections also increases.[27, 28] Theoretically, a weakened immune system could increase the risk of mastitis due to bacterial infections, though reports in the literature are conflicting.[29,30] Most studies to date have focused on biochemically-defined "subclinical mastitis", or elevations in breast milk sodium or sodium/potassium ratio.[30–34] Two studies from sub-Saharan Africa identified HIV infection as a risk factor for subclinical mastitis, but markers of the severity as a function of HIV disease stage were not examined.[32, 35] A microbiologic study of subclinical mastitis in HIV-infected women did not find a relationship between HIV plasma viral load and the sodium/potassium ratio.[34] Thus, few data exist identifying either the specific HIV-associated factors or the variations in infant feeding that increase the risk of breast problems, mastitis, and abscess in HIV-infected women. Consequently, we hypothesized that both non-exclusive breastfeeding and advanced HIV disease would be associated with a higher risk of mastitis and abscess.

Materials and Methods

Population and Study Sample

This analysis includes all randomized mothers (n=958) enrolled in the Zambia Exclusive Breastfeeding Study (ZEBS), as described previously.[2, 36, 37] Briefly, ZEBS was a randomized trial designed to assess the impact on HIV-free child survival of exclusive breastfeeding for 4 months with abrupt weaning versus exclusive breastfeeding through 6 months with the normal weaning and full duration of breastfeeding based on the mother's choice. In this analysis, we analyzed breastfeeding behavior, not randomization assignment,

on the risk of breast problems. In an unpublished analysis, randomization assignment did not impact the risk of breast problems (data not shown).

Maternal single-dose nevirapine followed by infant dose was given per Zambian guidelines to prevent perinatal HIV transmission. Highly active antiretroviral therapy only became available near the time of study completion. Women and their infants were seen weekly for the first month post-partum, twice a month through 6 months post-partum and every three months until 24 months post-partum. The study received ethical approval from all investigators' institutions; all participants provided written informed consent.

In the cohort of 958 randomized women, four women initiated HAART during pregnancy and seven were missing data on infant feeding patterns. Therefore, the analysis was limited to 947 women. Women are at risk for mastitis or abscess during the breastfeeding period and for one month beyond breastfeeding cessation;[38, 39] thus, we included women from breastfeeding initiation (delivery) through 6 months postpartum (n=467) or until the mother-child pair: (a) completed a visit through one month after complete cessation of breastfeeding (n=292), (b) was lost to follow-up (n=113), (c) initiated HAART (n=9), or (d) the mother or child died (n=66). Data were censored at 6 months post-partum, the duration currently recommended for exclusive breastfeeding.[40, 41]

Assessment of Exposures

Breast Feeding Pattern—Women were categorized at each visit as: (1) exclusively breastfeeding; (2) mixed feeding; or (3) stopped breastfeeding. At each clinic visit, women were asked, "On how many days in the last week, did the baby consume …" and then each of the following items were asked: breast milk, plain water, non-milk liquids, non-human milk, semi-solids/solids, fermented milk/cereal, medicine, anything else. Women responses were categorized into "Not given, or given 1, 2, 3, 4, 5, 6, 7 (everyday) or Don't know." The previous week's feeding report was used to create the breastfeeding classification for each clinic visit.

Exclusive breastfeeding (EBF) was defined as the provision of breast milk only with allowance of prescription medication.[42] Provision of any other food/liquid, including water, along with breast milk identified the mother as mixed breastfeeding or non-EBF. Women who ceased breastfeeding and reported no provision of breast milk in the 1-week period prior to the visit were categorized as stopped breastfeeding.

In order to quantify the breastfeeding pattern, a variable defining breastfeeding pattern as full, high, low or stopped was developed. Women who provided only breast milk (and prescribed medicines) were categorized as full breastfeeding. For non-EBF, the number of days per week when something other than breast milk was given to the child was calculated (minimum of 1 day and a maximum of 7 days per week of mixed feeding). Women who mixed fed 1–4 days in the previous week were defined as high breastfeeding; women who mixed fed 5–7 days in the previous week were defined as low breastfeeding. Finally, women who provided no breast milk were categorized as stopped breastfeeding.

Maternal HIV Characteristics—Demographic and maternal health indicators were collected at enrollment. Maternal biological variables included: CD4 count (FacsCount, BD BioSciences), HIV-1 RNA copies/mL (Amplicor HIV-1 Monitor Test, v1.5, Roche), WHO clinical stage, hemoglobin (HemoCue System, HemoCue), and body mass index (BMI-kg/m^2). Women's CD4 counts were grouped using standard cut-offs (<200 cells/uL, 200–350 cells/uL, >350 cells/uL).[43] WHO Stage III illness was defined as report of any of the following: weight loss in the last 6 months, fever or cough or diarrhea for >30 days in the

past 6 months, or had ever been diagnosed with tuberculosis or thrush. BMI was calculated at one-month post-partum; women with BMI <18.5 kg/m^2 were considered underweight.

Assessment of Outcome

At each clinic visit, data were collected on the occurrence of a clinical breast problem. A standardized checklist guided the study nurse through a breast exam to assess the following: engorgement, red/shiny breast, swollen or sore nipples, cracked/bleeding nipples, blocked duct, white patches/*Candida*, abscess, and other problems with the breast/areola/nipple. Women were asked if they had any problems since the last visit and if their breasts were currently painful.

Three outcomes were utilized in this analysis: (1) breast complication, (2) mastitis, and (3) abscess. A **breast complication** was defined as the presence of any of the following: engorgement, red/shiny breast, sore/swollen nipples, blocked duct, cracked/bleeding nipples, white patches/*candida*, or current pain. **Mastitis** was defined as the presence of engorgement, red/shiny breasts, blocked duct(s), painful breasts, and reported or current fever (≥38°C). **Abscess** was specifically assessed by breast palpation at each clinic visit; current or reported fever was not required (Table 1).

All study subjects were offered comprehensive health care at the study facilities, minimizing the instances where care was obtained outside of the study. However, standardized questionnaires were not utilized for the sick visits. At the clinic visits, fever was treated as present with maternal temperature recorded at ≥38°C.

Statistical Analysis

For each visit to 6 months, the point prevalence of each breast problem was calculated. Variables analyzed with chi-square tests, t-tests or Kruskal-Wallis tests, as appropriate. Associations between each breast problem and the covariates of interest were investigated using generalized estimating equations (GEE), using an unstructured correlation matrix, for bivariate and multivariate logistic regression analysis.[44]

Breastfeeding pattern was first analyzed as a three-way categorical variable (Exclusive vs. Mixed vs. Stopped); mixed feeding was then further divided into high (1–4 days/weeks mixed feeding) or low (5–7 days/week mixed feeding) breastfeeding.

Potential confounders included maternal age, parity, gravida, history of mastitis in previous breastfeeding experience, and maternal nutritional status. Using forward selection, confounders that made a 10% difference in the odds ratios were retained in the final models. Maternal health indicators were included in all models. Analyses were completed in SAS version 9.1.3 (Cary, NC).

Results

Population Characteristics

Demographic and baseline health characteristics of the 947 women in this analysis are presented in Table 1. Women's mean age (± standard deviation) was 26.1±5.1 years and had on average 2.4±1.7 previous live births. Most (84%) were married and 56.7% had no formal or only primary education. 218 (23.0%) women reported food insecurity, defined by running out of food ≥1 day in the last 30 days. 103 (10.9%) women reported having mastitis during breastfeeding of previous children. The mean birth weight of children was 3004 grams (±485 g) and mean time of breastfeeding initiation was 42 minutes post-delivery.

In the cohort, 222 (23.5%) women had a CD4 count <200 cells/uL; 290 (30.7%) women had a CD4 count between 200–350 cells/uL; and 433 (45.8%) women had CD4 count >350 cells/uL. The mean plasma HIV RNA level at study enrollment was $\log_{10}$ 4.49 copies/mL (±0.81) and 368 (38.9%) women had WHO Stage III disease or higher.

Descriptive Characteristics of Breast Pathology

The 947 participants completed a total of 5,982 clinic visits through 6 months with a median of 7 visits (minimum 1, maximum 8). 268 (4.5%) instances of breast complications in 190 (20.0%) women were recorded. The most common breast complaints were: current pain (n=169, 2.9%), engorgement (n=87, 1.5%), and sore/swollen nipples (n=82, 1.4%). There were 107 (1.8%) cases of mastitis in 86 (9.1%) women; of those, in 7 (0.7%) women had 8 episodes of fever (≥38°C) at the clinic visit. In the cohort, 43 (0.7%) cases of abscess were diagnosed in 31 (3.3%) women (Figure 1 and Table 2). Most breast problems occurred in the first 30 days postpartum and the point prevalence of breast problems decreased over time. An increase in point prevalence of all breast problems occurred at the 4 and 4.5 month visits coinciding with when mothers were randomized to abruptly wean their children at 4 months (Figure 1).

Breastfeeding Patterns

Of the 5,982 visits, 5,061 (84.6%) were periods of exclusive breastfeeding and 921 (15.4%) were periods of mixed or stopping breastfeeding. Of the 921 non-exclusive periods, 161 (17.5%) were periods of high breastfeeding (1–4 days/week), 188 (20.4%) were periods of low breastfeeding (5–7 days/week), and 572 (62.1%) periods when women reported stopping breastfeeding.

Table 3 presents breast pathology (breast complications, mastitis and abscess) stratified by visit and infant feeding pattern. Women who practiced mixed feeding or stopped breastfeeding had higher proportions of breast complications and mastitis across all visits compared to exclusively breastfeeding women, but rates of breast abscess were similar.

Age-adjusted analysis

Several risk factors were examined for their individual associations with the three breast problems; the analysis was adjusted for child's age (Table 4). Similar risk factors for breast complications and mastitis were observed; risk factors for abscess were not as apparent but the outcome was rare (n=43). Mixed breastfeeding, or stopping breastfeeding increased the odds of a breast complication (OR: 2.04 95%CI: 1.38, 3.02) and mastitis (OR 3.11 95%CI: 1.88, 5.17) compared to exclusively breastfeeding women (Table 4). When mixed breastfeeding was further divided, women who had high, but not exclusive breastfeeding, were 2.84 times (95% CI: 1.71, 4.72) as likely to have a breast complication and 2.77 times (95% CI: 1.23, 6.24) as likely to have mastitis compared to exclusively breastfeeding women. Women who had low levels of breastfeeding were 3.24 times as likely to have mastitis (95% CI: 1.25, 8.37) than exclusively breastfeeding women. Women who stopped breastfeeding in the week prior to the visit were 2.11 times as likely to have breast complications (95% CI: 1.33, 3.35) and 3.86 times as likely to have mastitis (95% CI: 2.01, 7.39). None of the infant feeding pattern comparisons significantly affected the odds of breast abscess (Table 4).

Of the maternal HIV-related characteristics, women with a low CD4 count (<200) tended to have similar odds of all types of breast pathology as compared to women with higher CD4 counts (>350 cells/uL) (Table 4). For each $\log_{10}$ 1.0 copies/mL increase in HIV-1 RNA plasma viral load, odds of the breast complication (OR: 1.29, 95%CI: 1.05, 1.60) and abscess (OR: 1.96 95%CI: 1.01, 3.81) increased. Women who had WHO Stage III illness or

higher were 1.81 (95% CI: 1.32, 2.46) times as likely to have breast complication, 1.67 (95% CI: 1.06, 2.62) times as likely to have mastitis, and 1.70 (95% CI: 0.78, 3.73) times as likely to have abscess compared to those with Stage I or II disease (Table 4).

Multivariate analysis

After adjusting for the child's age, maternal CD4 count, hemoglobin, clinical stage, and history of mastitis, women who were practicing mixed feeding or who had stopped breastfeeding were 1.98 times as likely to have a breast complication (95% CI: 1.33, 2.95) compared to those who were exclusively breastfeeding, and 2.87 times as likely to have mastitis (95% CI: 1.69, 4.88) (Table 5). No effect was seen on the odds of breast abscess (OR: 1.09 95% CI: 0.34, 3.48) in multivariate analysis.

Women with low CD4 (<200 cells/uL) were 2.12 times (95%CI: 0.88, 5.15) as likely to have an abscess compared to women with CD4 >350 cells/uL, although this finding was not statistically significant. As baseline hemoglobin increased, the odds for breast problems (OR: 0.92 95% CI: 0.83, 1.01) and mastitis (OR: 0.85 95% CI: 0.74, 0.96) tended to decrease after adjustment for confounders. History of mastitis also increased the odds of a breast problem after adjustment for infant feeding pattern and HIV illness (OR: 1.74 95% CI: 1.10, 2.75).

Comment

Breast problems in lactating women can be painful, reduce the time of exclusive or any breastfeeding, and, in the presence of HIV, increase the risk of mother to child HIV transmission.[8–11, 16] Our data strongly indicate that in HIV positive mothers, the risk for clinical breast problems and mastitis increases with non-exclusive breastfeeding, as has been observed in studies of HIV-uninfected populations.[12, 13, 15, 16]

We hypothesized that advanced HIV disease would increase the risk of breast problems. Milk stasis has been associated with increased mammary epithelial permeability;[45] however, the effect of HIV disease, if any, on epithelial cellular tight junctions is unknown.[46] Bland et al found that South African HIV-infected and uninfected women had similar prevalence of breast problems;[29] our data suggests that lower CD4 counts are associated with an increased risk of abscess, though interestingly not for mastitis. ZEBS provided a carefully designed breastfeeding education program to support exclusive breastfeeding and participants were able to receive immediate attention should any problem arise, and this may have reduced the rate of breast problems, as has been reported in non-HIV studies.[37, 47, 48] The prevalence of severe mastitis/abscess in our cohort (4.0%) and in the South African cohort (1.0%)[29] were lower than the expected prevalence of mastitis (7.1%[8] and ~10%[12]).

Strengths of this study include the prospective collection of infant feeding data and serial breast examinations completed by a trained nurse. Prospective data collection also minimized the potential effect of recall bias. In the literature, quantification of mixed feeding has been determined by maternal recall, observation or a combination of methods.[49] Our data captured the number of days in a week a woman provided something other than breast milk and women were classified as exclusively, high, low, or stopped breastfeeding. This may have classified breastfeeding pattern more crudely than desired. However, with the high level of exclusive breastfeeding, dividing the women into smaller categories was not possible.

Most studies examining breast health and HIV have used laboratory-defined subclinical mastitis as the outcome of interest; subclinical mastitis does not allow for easy intervention, as simple measures of milk sodium are unavailable. In a Zambian study of sub-clinical

mastitis, risk factors included HIV infection, poor maternal health and short duration of exclusive breastfeeding; similar risk factors are presented in this analysis of clinical breast pathology.[32] Potentially the studies of sub-clinical mastitis provide insight to the risk factors for clinical mastitis, the next stage of pathology, on the spectrum of breast problems.

There were several other limitations. First, over 23% of the women with breast pathology did not have a body temperature recorded at the clinic visit, limiting our ability to assess mastitis with fever. Second, there may be some inaccuracy in the incidence of breast problems since not all sick visits were captured, and persistent breast problems across two or more visits could have been counted twice. To investigate this, analysis was repeated limited to the first breast complication in each woman and similar results to the full analysis were observed. Lastly, data on the duration of the breast problem prior to the clinic visit was unavailable. Data have been analyzed several ways (lagging infant feeding pattern data, time-to-event analysis, and using various infant feeding definitions) to address the temporality concerns; all analyses led to similar results.

Important breakthroughs have now shown antiretrovirals are effective in preventing mother to child transmission of HIV, including during the breastfeeding period.[5, 6] All efforts should be made to ensure that women have access to these interventions.[50] While antiretrorivals are an important and powerful tool for preventing vertical transmission of HIV, continued limitations in access to ART, non-adherence, and the possibility of drug resistance emerging over time make it clear that the quality of breastfeeding will remain important, not only for prevention of HIV transmission and improved infant well-being, but for maternal health and comfort. Our data suggest that programs supporting exclusive breastfeeding significantly reduces rates of breast pathologies in HIV-infected women. Focusing on education of the HIV-infected mother with respect to breastfeeding pattern may also prevent transmission by reducing two important risk factors, namely mastitis and breast complications, and improve the health of the mother by reducing breast problems.

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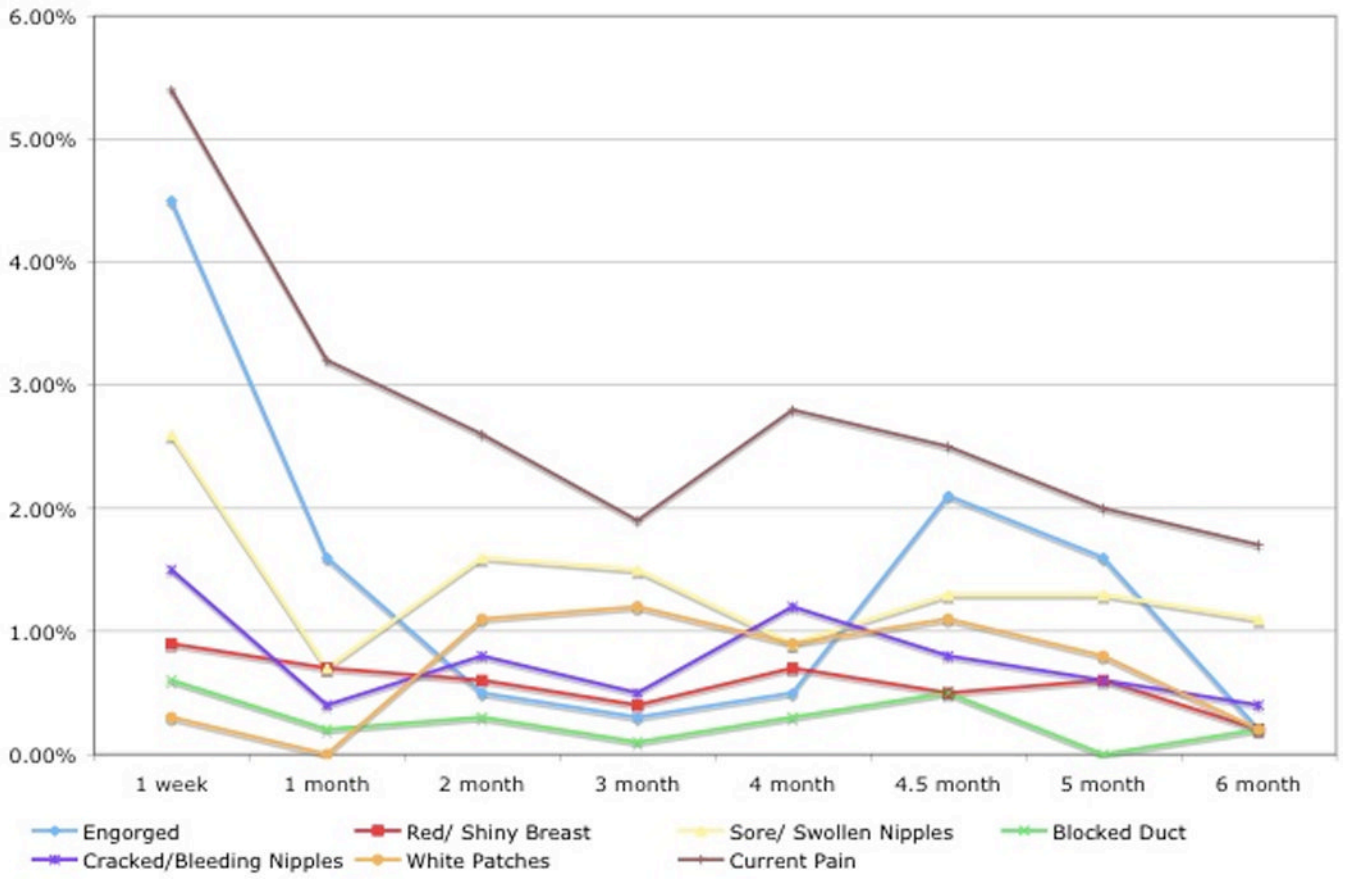

Figure 1.

Prevalence of breast symptoms in 947 HIV-infected breastfeeding women over the first 6 months postpartum in Lusaka, Zambia

HIV, human immunodeficiency virus.

Semrau. Exclusive breastfeeding, HIV, and breast pathology. Am J Obstet Gynecol 2011.

Table 1

Demographic characteristics of 947 HIV-infected, breastfeeding women in Lusaka, Zambia

Characteristic	Cohort (n=947)
Maternal Demographic Characteristics	
Mean Maternal Age (yr) (std. dev)	26.1 (5.1)
Married—no. (%)	804 (84.9%)
Electricity in Home—no. (%)	380 (40.1%)
Maternal Education-Primary or None—no. (%)	537 (56.7%)
Full-time employment—no. (%)	70 (7.4%)
Part-time employment—no. (%)	16 (1.7%)
Informal sector employment—no. (%)	229 (24.2%)
Ran out of food >1 day in the last 30 days—no. (%)	218 (23.0%)
BMI (kg/m^2) at one month post-partum—mean (std. dev); median (n=842)	21.7 (3.2); 21.4
Parity—mean (std. dev); median	2.4 (1.7)
History of mastitis in prior breastfeeding experience—no. (%)	103 (10.9%)
Maternal HIV-specific Characteristics	
Low CD4 Count (<200 cells/uL) —no. (%)**	222 (23.5%)
Mean CD4 Count (std. dev); median (IQR)**	361 (202); 330 (209–471)
Mean Plasma Viral Load (log_{10} copies/mL) (std. dev); median (IQR)**	4.49 (0.81); 4.59 (3.99–5.11)
Mean Hemoglobin (g/dL) (std. dev); median (IQR)*	10.6 (1.5); 10.6 (9.8–11.5)
WHO Stage III or higher—no. (%)	368 (38.9%)
Child Characteristics	
Mean child birth weight (g) (std. dev); median (IQR) (n=926)	3004 (485); 3000 (2700–3300)
Mean time to breastfeeding initiation (mins) (n=895) (std dev);median	42 (75); 30
Male sex in child—no. (%)*	488 (51.6%)

* Missing one sample

** Missing two samples

Table 2

Prevalence and timing of breast complication*, mastitis** and abscess in 947 HIV-infected breastfeeding women over the first 6 months post-partum in Lusaka, Zambia

Visit	N	Breast Pathology		
		N (%)		
		Breast Complication*	**Mastitis****	**Abscess**
1 week	896	78 (8.71%)	29 (3.20%)	1 (0.10%)
1 month	844	41(4.86%)	21(2.50%)	19 (2.30%)
2 month	804	32 (3.98%)	11 (1.40%)	8 (1.00%)
3 month	783	26 (3.32%)	10 (1.30%)	7 (0.90%)
4 month	750	30 (4.00%)	7 (0.90%)	3 (0.40%)
4.5 month	657	29 (4.41%)	17 (2.60%)	1 (0.20%)
5 month	698	21 (3.01%)	9 (1.30%)	4 (0.60%)
6 month	550	11 (2.00%)	3 (0.50%)	0 (0%)
TOTAL	**5,982**	**268 (4.48%)**	**107 (1.80%)**	**43 (0.70%)**

* Defined as presence of any of the following: engorgement, red/shiny breast, sore/swollen nipples, blocked duct, cracked/bleeding nipples, candida/white patches, or current pain.

** Defined as engorgement, red/shiny breasts, blocked duct, painful breasts AND current/reported fever

Table 3

Breast complication, mastitis, and abscess stratified by post-partum age and infant feeding pattern*

Visit	Feeding Pattern	N	Breast Complication		Mastitis		Abscess	
			n	%	n	%	n	%
1 week n=896	EBF	833	68	8.2%	27	3.2%	1	0.1%
	Mixed	58	9	15.5%	2	3.4%	0	0.0%
	Stopped	5	1	20.0%	0	0.0%	0	0.0%
1 month n=844	EBF	791	36	4.6%	19	2.4%	17	2.1%
	Mixed	45	5	11.1%	2	4.4%	2	4.4%
	Stopped	8	0	0.0%	0	0.0%	0	0.0%
2 month n=804	EBF	777	30	3.9%	10	1.3%	7	0.9%
	Mixed	21	1	4.8%	0	0.0%	0	0.0%
	Stopped	6	1	16.7%	1	16.7%	1	16.7%
3 month n=783	EBF	745	24	3.2%	8	1.1%	6	0.8%
	Mixed	31	2	6.5%	1	3.2%	1	3.2%
	Stopped	7	0	0.0%	1	14.3%	0	0.0%
4 month n=750	EBF	691	26	3.8%	6	0.9%	3	0.4%
	Mixed	39	2	5.1%	1	2.6%	0	0.0%
	Stopped	20	2	10.0%	0	0.0%	0	0.0%
4.5 month n=657	EBF	411	13	3.2%	3	0.7%	1	0.2%
	Mixed	53	4	7.5%	3	5.7%	0	0.0%
	Stopped	193	12	6.2%	11	5.7%	0	0.0%
5 month n=698	EBF	415	10	2.4%	4	1.0%	3	0.7%
	Mixed	47	2	4.3%	0	0.0%	0	0.0%
	Stopped	236	9	3.8%	5	2.1%	1	0.4%
6 month n=550	EBF	351	5	1.4%	2	0.6%	0	0.0%
	Mixed	115	3	2.6%	1	0.9%	0	0.0%

Am J Obstet Gynecol. Author manuscript; available in PMC 2012 October 1.

Visit	Feeding Pattern	N	Breast Complication		Mastitis		Abscess	
			n	%	n	%	n	%
	Stopped	84	3	3.6%	0	0.0%	0	0.0%
TOTAL		5982	268	4.5%	107	1.8%	43	0.7%

* Exclusive breastfeeding (EBF): Provision of breast milk and prescribed medicines only; Mixed breastfeeding (Mixed): Provision of breast milk and any other food/liquid, including water; Stopped breastfeeding (Stopped): No provision of breast milk in the week prior to the visit

Table 4

Determinants of breast complication, mastitis and abscess adjusted for child's age

OR (95%CI)	Breast Complication (n=268)	Mastitis (n=107)	Abscess (n=43)
Exclusive Breastfeeding	Ref	Ref	Ref
Mixed/stopped BF	2.04 (1.38, 3.02)	3.11 (1.88, 5.17)	1.13 (0.30, 4.28)
Degree of BF Exclusivity	Ref	Ref	
Breastfeeding	2.84 (1.71, 4.72)	2.77 (1.23, 6.24)	
High Breastfeeding	1.71 (0.81, 3.64)	3.24 (1.25, 8.37)	**
Low Breastfeeding	2.11 (1.33, 3.35)	3.86 (2.01, 7.39)	
Stopped Breastfeeding			
CD4 <200	1.28 (0.85, 1.94)	1.53 (0.87, 2.67)	2.43 (0.98, 6.02)
CD4 200–350	0.92 (0.65, 1.30)	1.08 (0.64, 1.84)	0.96 (0.37, 2.50)
CD4 >350	Ref	Ref	Ref
Plasma Viral Load (log_{10}) for each log_{10}1.0 increase	1.29 (1.05, 1.60)	1.25 (0.91, 1.72)	1.96 (1.01, 3.81)
Hemoglobin	0.89 (0.81, 0.99)	0.81 (0.71, 0.93)	0.88 (0.70, 1.10)
BMI at One Month Post-Partum	0.93 (0.89, 0.99)	0.92 (0.85, 1.01)	0.86 (0.73, 1.01)
WHO Stage III	1.81 (1.32, 2.46)	1.67 (1.06, 2.62)	1.70 (0.78, 3.73)
History of Mastitis in breastfeeding previous children	1.80 (1.13,2.85)	1.26 (0.64, 2.50)	0.86 (0.29, 2.53)

** Data too sparse for analysis

Table 5

Adjusted odds ratios for breast problem, mastitis and abscess

OR (95%CI)**	Breast Complication	Mastitis	Abscess
Exclusive Breastfeeding	Ref	Ref	Ref
Mixed/Stopped BF+	1.98 (1.33, 2.95)	2.87 (1.69, 4.88)	1.05 (0.32, 3.42)
CD4 <200β	1.19 (0.78, 1.80)	1.44 (0.82, 2.54)	2.34 (0.96, 5.71)
CD4 200–350	0.91 (0.64, 1.28)	1.03 (0.60, 1.78)	0.95 (0.36, 2.52)
CD4 >350	Ref	Ref	Ref
History of Mastitis in Prior BF experience∞	1.79 (1.13, 2.83)	1.26 (0.64, 2.47)	0.92 (0.30, 2.82)
WHO Stage IIIβ	1.75 (1.28, 2.38)	1.65 (1.06, 2.60)	1.66 (0.78, 3.58)
Hemoglobin°	0.91 (0.83, 1.01)	0.81, (0.73, 0.95)	0.90 (0.70, 1.16)

** All odds ratios presented are adjusted child's age.

+ Adjusted for all other variables in the table

β Adjusted for hemoglobin and history of mastitis

∞ Adjusted for hemoglobin and CD4 count

° Adjusted for CD4 count and history of mastitis