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**Determinants of Early Infant Feeding Practices of HIV-Positive and HIV-Negative
Mothers in Pretoria, South Africa**

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Abstract

Background: Exclusive breastfeeding (EBF) has been shown to result in lowered risk of postnatal vertical HIV transmission compared to mixed breastfeeding (Mixed BF). Early breastfeeding cessation, or not breastfeeding at all, is associated with an increase in morbidity and mortality amongst both HIV-exposed and HIV-unexposed infants. The South African tradition of giving nutritive and non-nutritive foods to breastfeeding infants in the first few months of life is unique among African nations and warrants closer examination to identify maternal determinants that lead to early mixed feeding practices, commonly used supplemental foods/liquids, the timing of supplemental food introduction, and maternal perceptions of what constitutes mixed feeding. Additionally, understanding the determinants of general early infant feeding intent and practices among HIV-positive and –negative mothers has become germane again in light of the most recent World Health Organization (WHO) guidelines and South Africa’s updated national recommendations on prevention of mother to child transmission (PMTCT) and infant feeding practices in the context of HIV. Having this information will better direct PMTCT counseling, infant feeding interventions, and HIV-exposed uninfected (HEU) child focused interventions.

Methods: Participants and data were gathered in a larger prospective cohort study focused on the health and development of children born to HIV-positive mothers from 11 PMTCT clinics in the Tshwane region of South Africa. The larger study followed women who gave birth between January and July of 2011 and their children, Women were enrolled in the study at the time of birth and follow-up was conducted with all HIV positive women and a sample of one-third of HIV-negative women at three months. This study used bivariate analyses to identify significant associations between maternal HIV status and self reported feeding choices at birth and feeding practices within the first 3 months of life.

Results: Of the 511 mothers followed to 3 months, 260 were HIV-positive and 251 were HIV-negative. 240 (98.4%) HIV-negative women intended to breastfeed their baby at baseline and only 4 (1.6%) intended to formula feed as compared to 203 (81.2%) and 47

(18.8%) HIV-positive mothers, respectively. By 3 months, the majority, 206 (86.2%), of HIV-negative women had combined Mixed BF with nutritive or non-nutritive supplemental foods, while 79 (30.9%) HIV-positive mothers maintained EBF, 78 (30.5%) had at some point applied Mixed BF, and 99 (38.7%) practiced formula feeding with no history of Mixed BF. Among HIV-positive women, those who had ever breastfed (n=198) by 3 months were more likely than those who had never breastfed (n=58) to: have a life partner (p=0.01), live in a home with fewer adults (p=0.02), report a higher degree of stigma (p=0.04), and possess a greater understanding of HIV transmission risk in breastfeeding (p<0.01). Additionally, compared to those who practiced Mixed BF (n=78), HIV-positive mothers who maintained EBF to 3 months (n=79) were more likely to report higher levels of stigma and negative support as well as possess a greater understanding of HIV transmission risks in breastfeeding. No significant differences were found between EBF HIV-positive mothers (n=79) and formula feeding HIV-positive mothers who had ever breastfed (n=41).

Discussion: While early infant feeding practices were poor among HIV-positive and – negative women, HIV-positive women did maintain safer infant feeding practices to 3 months. Yet, only 30.9% of HIV-positive women were able to maintain EBF to 3 months and those women who practiced EBF felt more stigmatized and reported support that was more domineering. The fact that Mixed BF is the dominant form of early infant feeding in this geographic region, complicates the goals of PMTCT programs and obscures local, national and international infant feeding recommendations of EBF until 6 months for HIV-positive mothers. Generally it is assumed that mixed feeding most often involves giving formula, but in fact the substance that was most commonly given to babies in this cohort was muti, which may be based on parental beliefs that they are benefiting the health of their infants. A better understanding is needed of the motivations for introducing nutritive and non-nutritive foods/liquids against clinical recommendations in South Africa. Educational and behavioral interventions are needed to promote safe infant feeding practices for the general population, as well as HIV-positive mothers.

Background

Infant feeding practices have been argued to be the most important modifiable factor influencing the health of children born to HIV-positive mothers (Coovadia & Bland, 2007). And exclusive breastfeeding (EBF) has been shown to be the single most effective intervention for reducing mortality in children under five years old in low-income settings (Jones, Steketee, Black, Bhutta, & Morris, 2003). Infants aged 0-5 months experience a 7-fold and 5-fold increased risk of death from diarrhea and pneumonia respectively if they are not breastfed (Black, Morris, & Bryce, 2003), or a 2-fold increased risk of death from diarrhea and pneumonia if they are non-exclusively breastfed (Bradshaw et al., 2008), as compared to infants who are exclusively breastfed. Early breastfeeding cessation, or not breastfeeding at all, is associated with an increase in morbidity and mortality amongst both HIV-exposed and HIV-unexposed infants (Taha et al., 2011; WHO, 2000; Kuhn et al., 2008; Shapiro et al., 2007). Furthermore, EBF has been shown to result in lowered risk of postnatal vertical HIV transmission compared to Mixed BF (Langa, 2010; Iliff et al., 2005). Additionally, HIV-exposed, uninfected (HEU) infants who are formula fed are at risk for dietary pathogens of potentially contaminated water and formula, altered immune functions, and potentially slower growth and development compared to HIV-unexposed infants (Filteau, 2009). Unfortunately, the message HIV-positive mothers have received on early infant feeding practices has been confusing and ever shifting.

In 2010, the World Health Organization released an updated version of their international recommendations on infant feeding practices in the context of HIV, stressing that mothers known to be HIV-infected (and whose infant is HIV-uninfected or of unknown HIV status) should exclusively breastfeed for the first six months of an infant's life, introducing complementary foods thereafter while continuing to breastfeed until a nutritionally adequate, feasible, affordable, sustainable and safe (AFASS) diet without breast milk can be provided. Antiretroviral (ARV) prophylaxis is to be given to infants while breastfeeding or to mothers in the form of highly active antiretroviral therapy (HAART), to reduce the risk of post-natal HIV transmission through breastmilk (WHO, 2010). In light of these international recommendations, the South African Department of

Health and the National AIDS Council (2010) released revised clinical guidelines for the prevention of mother-to-child transmission of HIV (PMTCT), adopting the new WHO recommendations. This message has evolved, both nationally in South Africa, and internationally, from previous recommendations where replacement feeding, or a non-breastmilk based diet, was prioritized in the context of HIV. Thus, the advice mothers have received from the medical community has continued to change, further obscuring the message.

Historically, EBF in South Africa has been extremely low, and continues to lag behind other developing nations in the region (Doherty et al., 2012). In 2003, the South African Demographic Health Survey found that fewer than 12% of infants were exclusively breastfed during their first three months, and this drops to 1.5% for infants aged between three and six months. Tylleskar et al. (2011) discovered the prevalence of EBF in South Africa to be 8% in their breastfeeding promotion intervention group vs 4% in the control group, as compared to 77% vs 23% in Burkina Faso and 77% vs 34% in Uganda, respectively. The reasons for such low rates are likely intricate and complex. Poor quality of antenatal breastfeeding counseling for HIV-positive women in South Africa has been well documented in South Africa (Langa, 2010; Matji et al., 2008). Previous studies on such topics have found potential breakdown of lay counselors correctly contextualizing and applying WHO's AFASS criteria (WHO, 2010), as it applies to individual mothers in South Africa (Matji et al., 2008). Additionally, Mixed BF is a long-standing cultural practice in South Africa, infant formula is provided free of charge as part of PMTCT programs, commercial infant formula is supported and provided through the government protein-energy malnutrition scheme, the Code of Marketing of Breastmilk Substitutes (WHO, 2008) has not yet been implemented in South Africa (Tylleskär et al., 2011), and until recently, there has been a lack of breastfeeding promotion in the lay and medical communities due to the high HIV prevalence (Goga et al., 2012).

While there is much literature analyzing the different types of infant feeding practices in South Africa, the effectiveness of PMTCT programs, HIV-free survival of HEU's receiving various feeding practices, and even determinants of infant feeding choices made by South African HIV-positive and –negative mothers, less is known about those

who choose Mixed BF, the practice with the greatest risks. The South African tradition of mixed feeding is unique among low-income, low-resourced nations and warrants examination to identify maternal determinants that lead to Mixed BF practices, commonly used nutritive or non-nutritive foods/liquids, the timing of supplemental food introduction, and maternal perceptions of what constitutes Mixed BF. Additionally, understanding the determinants of general infant feeding intent and practices among HIV-positive and –negative mothers has become germane again in light of the latest WHO guidelines and South Africa’s updated national recommendations on PMTCT and infant feeding practices in the context of HIV. Having this information will better direct PMTCT counseling, maternal education programs, and infant feeding interventions.

Methods

Study setting and context

At the time of data collection, South Africa had adopted WHO’s PMTCT recommendations and HIV-positive mothers were encouraged to exclusively breastfeed for the first 6 months of their infant’s life, introducing complementary foods thereafter while continuing to breastfeed until a nutritionally adequate and safe diet without breast milk can be provided, unless replacement feeding met AFASS criteria. In addition to EBF, HIV-positive mothers with CD4 counts <350 were given HAART, while HIV-positive mothers with CD4 counts >350 were given ARV prophylaxis or their infants received ARV prophylaxis and Nevirapine to be taken until 1 week post breastfeeding cessation. Yet free commercial formula was being offered to HIV-positive mothers for the first six months of life.

Study design and sampling

Data was collected through an existing research collaboration between Dr. Brian Forsyth, Professor of Pediatrics, Yale University and Dr. Jennifer Makin, Medical Researcher, Department of Obstetrics and Gynaecology of the University of Pretoria, South Africa. Their research was designed to examine the effects of a systems-level intervention conducted in the regional clinics to increase adherence to PMTCT. The present study uses data collected in the larger study to examine the feeding practices of study

participants. Patients were enrolled after they gave birth and baseline data was gathered. All HIV-positive mothers who answered the baseline survey were included in the study. One-third of HIV-negative mothers who answered the survey were invited to participate through a randomized selection process. Maternal HIV status was determined by patient report and confirmed by health records. Infant feeding practices at 3 months follow-up were gathered by self-reported recall.

Study procedures and data collection

260 HIV positive and 251 HIV negative women who gave birth between January and July of 2011 were followed, with consent, to three months post-delivery. Data collected at the time of delivery include socio-demographic data, data related to HIV (CD4, illness history, antiretroviral treatment and adherence), infant feeding intent, and obstetrical history. Data collected during follow-up to 3 months include HIV status of mother and infant including CD4 count and ARV timing/adherence, breastfeeding practices, involvement of partner (including disclosure status), and psychological measures.

Data definitions

Feeding Practices:

In analysis, infant feeding intent at baseline was categorized as: Breastfeeding, Formula, and Mixed Breastfeeding (breastfeeding and formula feeding). At 3 months follow-up, infant feeding practices were defined as: Exclusive Breastfeeding (breastmilk only, with no other supplemental foods/water), Mixed Breastfeeding (breastmilk given concurrently with supplemental foods at any point during 0-3 months), and Formula Feeding (formula or other non-breast milk with or without introduction of supplemental foods, mother may have initiated breastfeeding, but stopped without any overlap between breastmilk and formula/non-breast milk or other food/water). Supplemental foods (obtained through categorical and open-ended responses) included: formula or other non-breast milk such as cow or goat milk, water, porridge, and muti (Zulu-derived word used by most indigenous languages, as well as South African English and Afrikaans, generally meaning traditional medicine or plant/herbal-based natural products consumed for health reasons, often in the forms of teas). 'Ever Breastfed' means the mother initiated breastfeeding at any point

from 0-3 months, and 'Never Breastfed' means the mother had never initiated breastfeeding at any point from 0-3 months.

Sociodemographic factors:

Data on socio-demographic information included: age, educational status, marital status, employment status, partner providing some form of material support, and per capita income. A "housing score" of 0 to 5 was developed with one point assigned for each of the following: the house was built of bricks or cement, there was running water inside the house, there was a flushing toilet, the house had electricity and there was a fridge.

Depression score:

This was measured using the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). It is a 20- item scale, which assesses depressed mood, somatic symptoms, interpersonal problems and lack of positive affect. Results indicate a good internal consistency ($\alpha=0.88$). The cut off point for borderline depression is >16 in the 20 item scale.

Stigma scale:

From the work of Visser, Kershaw, Makin, & Forsyth (2008), two stigma scales were developed: the first, "Blame and Judgment" measures the degree to which an individual blames or passes judgment on herself for her HIV infection; the second, "Interpersonal Distancing" relates to an individual's subjective fear of stigmatization. Also, each 6-item sub-scale was added to get a "Total Stigma" score.

Social support:

This was measured by making use of the Multidimensional Social Support Inventory (MSSI) a scale developed by Bauman and Weiss (1995). This was adapted to create a 9-item scale which assessed affirmational, emotional and practical support providing the positive support scale. Results showed good internal consistency ($\alpha= 0.87$). Negative support included 3 questions on the negative aspects of support such as being treated like a child, getting too much unwanted advice and the women perceiving others as being over-protective. Results showed an adequate internal consistency ($\alpha=0.60$)

HIV Knowledge:

This was assessed by 12 questions related to overall HIV knowledge including 6 questions measuring a PMTCT sub-scale and 3 questions measuring an Infant Feeding Risks Knowledge sub-scale. The 3 infant feeding questions were assessed individually to determine specific gaps in HIV knowledge.

For additional data definitions of ‘maternal sociodemographics’ and ‘maternal psychological measures’, see Appendix A.

Data Analysis

Data were entered, managed, and analyzed in IBM SPSS Statistics version 20.

Descriptive statistics of the cohort were gathered using frequency commands. Feeding intent at baseline and feeding practices at 3 months of HIV-positive and -negative women were compared using χ^2 tests for categorical variables (Fisher exact test if expected cell count < 5) and t-tests for normally distributed continuous variables. Additionally, feeding intent at baseline, feeding practices at 3 months, and maternal and child characteristics within the HIV-positive group were compared using χ^2 tests and t-tests. Statistical significance was evaluated at a 95% Confidence Interval and p-values less than 0.05.

Ethics

Institutional review board approval for the study was obtained from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, South Africa and the Human Investigation Committee of Yale University School of Medicine.

Results

Feeding intention and 0-3 month feeding practices of entire cohort

As seen in Table 1, of the 511 mothers followed to 3 months, 260 were HIV-positive and 251 were HIV-negative. Baseline infant feeding intent was significantly different between the two groups of mothers ($p < 0.01$), with 240 (98.4%) HIV-negative women intending to breastfeed and only 4 (1.6%) intended to formula feed as compared to 203 (81.2%) and 47 (18.8%) HIV-positive mothers, respectively. Of those who intended to breastfeed, HIV-positive mothers intended to breastfeed for a significantly ($p < 0.01$) shorter duration (<1 year $n = 193$, 76.6%) (≥ 1 year $n = 32$, 12.7%) as compared to HIV-

negative mothers (<1year n=103, 41.5%) (\geq 1year n=139, 56.0%). By 3 months, the majority, 206 (86.2%), of HIV-negative women had applied Mixed BF with nutritive or non-nutritive supplemental foods, while 79 (30.9%) HIV-positive mothers maintained EBF, 78 (30.5%) had at some point applied Mixed BF, and 99 (38.7%) practiced formula feeding ($p<0.01$). HIV-negative women were significantly ($p<0.01$) more likely to introduce all supplemental foods to their breastfeeding babies by 3 months: Water (n=163, 86.2%), Formula/milk (n=86, 45.5%), Porridge (n=106, 56.1%), Muti (n=152, 80.4%) as compared to HIV-positive women: Water (n=24, 38.7%), Formula/milk (n=8, 12.9%), Porridge (n=20, 32.3%), Muti (n=38, 61.3%). There was no statistical difference in the timing at which HIV-positive and -negative mothers introduced these supplemental foods.

Feeding intention and 0-3 month feeding practices of HIV+ women

Of the 203 HIV-positive mothers who intended to breastfeed at baseline, 72 (36.2%) maintained EBF to 3 months, 72 (36.2%) had at some point applied Mixed BF with supplemental foods by 3 months, and 55 (27.6%) were formula feeding -including those formula feeding mothers who had ever breastfed (n=35, 63.6%). Among this group of Mixed BF HIV-positive women who intended to breastfeed at baseline, muti was the most common supplemental food and was introduced earlier than any other supplemental food. Of the 47 HIV-positive women who intended to formula feed at birth, 39 (83.0%) of them were formula feeding at 3 months, including those formula feeding mothers who had ever breastfed (n=5, 12.8%).

As seen in Table 2, among HIV-positive women, those who had ever breastfed (n=198) by 3 months were more likely than those who had never breastfed (n=58) to: have a life partner ($p=0.01$), live in a home with fewer adults ($p=0.02$), report a higher degree of 'interpersonal distancing' stigma ($p=0.04$), and possess a greater understanding of HIV transmission risk in breastfeeding ($p<0.01$). There was no statistical difference between HIV-positive mothers who initiated breastfeeding and those who did not in their age, employment, education, home environment (other than aforementioned number of adults living at home), pregnancy and birth history, HIV disclosure status, and maternal psychological factors (other than aforementioned Interpersonal Distancing Stigma scale).

Factors associated with mixed feeding

As seen in Table 3, some maternal psychological factors were significantly different between HIV-positive mothers who maintained EBF to 3 months (n=79) and HIV-positive mothers who applied Mixed BF by 3 months (n=78), but not between EBF mothers and formula feeding mothers who had ever breastfed (n=41). EBF mothers reported significantly higher ($p<0.05$) levels of Total Stigma (mean=10.5, SD=7.7) as compared to Mixed BF mothers (mean=7.5, SD=6.8). EBF mothers also reported significantly higher ($p<0.02$) levels on the Blame and Judgment Stigma sub-scale (mean=4.8, SD=4.0) as compared to Mixed BF mothers (mean=3.6, SD=3.6), as well as the Interpersonal Distancing Stigma sub-scale ($p<0.05$) (EBF mean=5.7, SD=4.0) (Mixed BF mean=3.9, SD=3.5). Additionally, EBF women reported significantly higher ($p<0.05$) levels of Negative Support (mean=0.9, SD=1.0) compared to Mixed BF women (mean=0.5, SD=0.9). Negative support should be interpreted as receiving domineering involvement from someone close to the respondent (see Appendix A and Appendix B). Also EBF (n=71, 89.9%) mothers are significantly ($p<0.02$) more likely to answer correctly: “All babies who are breast fed by women with HIV will get HIV”, compared to Mixed BF mothers (n=61, 78.2%). All other sociodemographics, and maternal and child characteristics at 3 months of age were not significant between EBF and Mixed BF HIV-positive mothers.

Discussion

Infant feeding choices differ significantly between mothers of HIV-positive and – negative status. At birth, HIV-positive women were more likely to intend to formula feed, and conversely, HIV-negative women were more likely to intend to breastfeed. HIV-positive women were also more likely to intend to breastfeed for a shorter duration than HIV-negative women. These intentions may be the result of residual beliefs and knowledge from previous national and international recommendations on infant feeding practices, where HIV-positive women were counseled to formula feed when possible and breastfeed for shorter durations.

By 3 months follow-up, HIV-negative women were more likely to practice Mixed BF than HIV-positive women, while HIV-positive women were more likely to maintain EBF or formula feed. Logically, since HIV-negative mothers were more likely to practice Mixed BF, they too were more likely to have introduced any nutritive or non-nutritive food/liquid by three months, including water, formula, porridge, and muti. Yet of those who did introduce these items, there was no difference in infant age when these were introduced between HIV-positive and –negative mothers. Muti was the most common supplemental food item given by HIV-positive mothers practicing Mixed BF and was given at 2.6 weeks of life, on average. This was earlier than all other supplemental food items given by mothers who applied Mixed BF. More investigation is required to understand exactly what ingredients typically comprise muti, and the motivations behind such early introduction to infants. Additionally, it would be helpful to know if mothers perceive the addition of muti as breaking of exclusive breastfeeding practices. It may be the case that mothers are unaware of the fact that introducing muti equates to mixed feeding.

These findings are significant because they indicate that the majority of HIV-positive women are practicing some form of safe feeding practice, which reduces the risk of HIV transmission from mother to child; either EBF or formula feeding with no point of Mixed BF. Yet there are still roughly one third of HIV-positive women practicing risky feeding practices by mixing breastmilk with other foods/liquids. It is imperative to understand what sets these women apart from the rest, and to identify potential areas for intervention.

Women who have ever breastfed are likely to initiate breastfeeding in the first few days of their infant's life, whether or not they go on to exclusively breastfeed, mix breastfeeding with formula or other supplemental foods, or switch to exclusive formula feeding. This sub-group of women is the one who can benefit most from effective EBF counseling since they have already made the choice to initiate breastfeeding. Intending to breastfeed at birth, having a life partner, living in a home with fewer adults, reporting a higher degree of 'interpersonal distancing' stigma, and possessing a greater understanding of HIV transmission risk in breastfeeding all differentiate HIV-positive mothers who had ever breastfed from HIV-positive mothers who had never breastfed. It

is understandable that HIV-positive women with a life partner, and those who live with fewer adults in the home, may experience increased support from a more nuclear family home composition. Yet the interpretation of a higher level of reported stigma is more nuanced. The interpersonal distancing stigma sub-scale assesses an individual's expected level of stigma or fear of being stigmatized (Visser, Kershaw, Makin, Forsyth, 2008). Therefore, it is possible that some HIV-positive mothers are motivated to initiate breastfeeding, like the majority of HIV-negative women, in order to avoid perceived stigmatization. HIV-positive women who have ever breastfed are also more likely to know that not all babies who are breastfed by HIV-positive women will get HIV, compared to those who have never breastfed. Consequently, these mothers tend to be better informed of postnatal HIV transmission risks.

Of those HIV-positive mothers who had ever breastfed, maternal and child characteristics were assessed by feeding type at three months for statistical significance. Remarkably, no statistical differences were found between HIV-positive mothers who maintained EBF and HIV-positive formula feeding mothers at 3 months. This suggests that women who maintain either one of the safe infant feeding practices are very similar in terms of sociodemographics, psychological factors, as well as birth history and child characteristics up to 3 months. These two groups of mothers may differ in ways that were not assessed in this study. As for HIV-positive EBF and Mixed BF mothers, psychological factors and knowledge of postnatal HIV transmission risks divide the two groups. HIV-positive EBF mothers were more likely to report higher levels of total stigma and higher levels of 'blame and judgment' and 'interpersonal distancing'. Perceived stigma, fear of being stigmatized, and internalized blame and judgment may all contribute to a mother's decision to exclusively breastfeed. HIV-positive women who do not maintain EBF and instead practice mixed feeding may not perceive or experience as much stigma as those who maintain EBF, and therefore may be more 'casual' in their approaches to early infant feeding. Whereas women perceiving or experiencing higher levels of stigma will likely be more premeditated and intentional in the behaviors they feel others may pass judgment upon, such as infant feeding practices. Additionally, the fact that HIV-positive mothers who adhere to EBF recommendations report higher levels of stigma may indicate a growing consensus of knowledge in the general population that

EBF is the suggested form of infant feeding for HIV-positive women. In other words, those HIV-positive women who are concerned about stigma are more likely to ‘follow the rules’ so as to attempt to avoid further stigmatization. Also, HIV-positive women practicing EBF reported higher levels of negative support than HIV-positive women who were practicing Mixed BF at 3 months. If the HIV-positive woman has someone in her life that appropriately advises her on feeding practices, even if this advice is delivered in a nagging or domineering manner, then she is more likely to maintain EBF practices. This interpretation holds less weight since it is often found, at least anecdotally, that a woman’s partner, mother, or in-laws encourage inappropriate feeding practices such as mixed feeding. Further investigation is required to fully understand the significance of this relationship. And finally, logically, EBF mothers were more likely to know that not all babies who are breastfed by HIV-positive women will get HIV, compared to those who practiced Mixed BF. Yet both groups scored similarly when responding to “If a woman breastfeeds her baby and also gives the baby other food it is more likely the baby will get HIV”, with no statistical difference between EBF and Mixed BF HIV-positive mothers.

Investigation into the tradition and practices of giving muti to infants is urgently needed. This may have a bearing on the health and well being of the general population as well as those who are affected by HIV. Educating mothers on the risks involved with practicing Mixed BF with ingredients believed to be healthful is essential to achieving improved adherence to WHO’s and South Africa’s infant feeding recommendations of EBF in the context of HIV. Also, maternal psychological factors are intricately involved in a mother’s ability to maintain EBF, and therefore require attention in PMTCT programs. Having a sense that others are vested in their life, even if perceived as stigmatizing or domineering, may have a protective effect in maintaining safe infant feeding practices for HIV-positive mothers. Finally, greater early infant feeding education is needed for the entire community, and not just vertically designed PMTCT programs, to reduce the overall prevalence of mixed breastfeeding in South Africa.

Strengths and Limitations

This study contains in-depth maternal psychological evaluations, some of which were developed specifically for this population. Trained research assistants conducted data collection in a very thorough manner, maintaining research integrity and confidentiality. Infant feeding recall could have been improved by more frequent interviews than 0 and 3 months. Having mothers keep a feeding journal or employing a 4-day recall method at the time of interview could improve the accuracy of feeding data. Additionally, feeding practices should be assessed at 6 months post-partum to evaluate adherence to national and international guidelines on infant feeding. We need a better understanding of what respondents mean by *muti*. Obtaining the exact ingredients used in *muti* preparations would be ideal but very difficult. Data has been collected at 12 months follow-up for these subjects and will be analyzed for health outcomes of HEU's compared to HIV unexposed children. Also, data is currently being collected at 21 months follow-up and will be processed for analysis.

Abbreviations

AFASS: Adequate, Feasible, Affordable, Sustainable and Safe

ARV: Antiretroviral

EBF: Exclusive Breastfeeding

HAART: High Active Antiretroviral Therapy

HIV: Human Immunodeficiency Virus

Mixed BF: Mixed Breastfeeding

PMTCT: Prevention of Mother to Child Transmission

WHO: World Health Organization

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Table 1. Infant feeding practices of HIV-positive and HIV-negative mothers at 3 months

	HIV Status of Mother		p-value
	HIV- N=251	HIV+ N=260	
Feeding practices			
Feed intent at baseline, n (%)			0.00
Breastfeeding	240 (98.4%)	203 (81.2%)	
Formula	4 (1.6%)	47 (18.8%)	
Intended Breastfeeding duration, n (%)			0.00
Unsure	6 (2.4%)	27 (10.7%)	
< 1yr	103 (41.5%)	193 (76.6%)	
≥ 1 Year	139 (56.0%)	32 (12.7%)	
Intended Breastfeeding duration in months, mean (SD)	6.1 (7.0)	5.4 (2.5)	0.10
Feeding Practice at 3mo, n (%)			0.00
Exclusive Breastfeeding	16 (6.7%)	79 (30.9%)	
Mixed Breastfeeding	206 (86.2%)	78 (30.5%)	
Formula Feeding	17 (7.1%)	99 (38.7%)	
Foods mixed with Breastmilk by 3mo			
Water, n (%)	163 (86.2%)	24 (38.7%)	0.00
Formula/Milk, n (%)	86 (45.5%)	8 (12.9%)	0.00
Porridge, n (%)	106 (56.1%)	20 (32.3%)	0.00
Muti, n (%)	152 (80.4%)	38 (61.3%)	0.00
If Breastfeeding, how old was infant when first introduced . . . Weeks			
Water, mean (SD)	3.0 (1.8)	2.9 (1.9)	0.62
Formula, mean (SD)	3.1 (2.6)	3.0 (2.1)	0.93
Porridge, mean (SD)	3.6 (1.9)	4.1 (1.6)	0.25
Muti, mean (SD)	2.8 (2.8)	2.6 (1.4)	0.37

Columns may not add up to 100% due to missing values

Significant $p < 0.05$

Table 2. HIV-positive mothers who have 'ever breastfed' vs 'never breastfed' their infants by 3 months

	Feeding practices at 3mo		p-value
	Ever Breastfed N=198	Never Breastfed N=58	
Sociodemographics and Child Characteristics at Birth			
Maternal Characteristics			
Age in years, mean (SD)	28.5 (5.5)	29.0 (4.9)	0.50
Still in School, n (%)	5 (2.6%)	2 (3.7%)	0.65
Working before baby, n (%)	76 (39.8%)	24 (43.6%)	0.61
Has life partner, n (%)	192 (97.5%)	49 (89.1%)	0.01
From Pretoria/Tshwane, n (%)	160 (82.5%)	46 (85.2%)	0.64
First Language of Mother: sePedi, n (%)	78 (39.6%)	28 (50.9%)	0.13
Education level, n (%)			0.24
Primary School	22 (11.4%)	5 (9.1%)	
Secondary School	166 (86.0%)	46 (83.6%)	
Tertiary School	5 (2.6%)	4 (7.3%)	
Home environment at baseline, mean (SD)	3.9 (1.6)	3.9 (1.6)	0.98
Number of Other Adults in Home, mean (SD)	2.6 (0.9)	2.9 (1.1)	0.02
Number of Children in Home, mean (SD)	1.4 (1.6)	1.7 (1.2)	0.26
Disclosure of HIV status to partner, n (%)	109 (61.9%)	36 (72.0%)	0.19
Disclosure of HIV status to anyone, n (%)	174 (93.0%)	50 (94.3%)	0.74
Pregnancy and birth history			
Mean gestational age (weeks), mean (SD)	38.0 (1.9)	38.2 (1.7)	0.61
Birth <37 weeks gestation, n (%)	36 (18.8%)	7 (13.2%)	0.35
Cesarean Section, n (%)	63 (33.0%)	19 (35.2%)	0.76
Child characteristics			
First-born child, n (%)	36 (18.4%)	7 (12.7%)	0.33
Birth weight in grams, mean (SD)	2984.4 (463.5)	2963.7 (373.2)	0.76
Birth weight <2500 grams, n (%)	23 (11.8%)	7 (13.0%)	0.82
Maternal and Child characteristics at 3 month Follow-up			
Maternal CD4 count at 3mo, mean (SD)	444.8 (202.0)	405.5 (186.0)	0.54
Maternal illness since HIV+ results, n (%)	14 (7.1%)	5 (8.6%)	0.69
Disclosure of HIV status to partner, n (%)	170 (85.9%)	53 (93.0%)	0.15
Disclosure of HIV status to anyone, n (%)	120 (60.6%)	41 (70.7%)	0.16
Maternal psychological factors			
CES-D Score, mean (SD)	8.6 (10.2)	10.0 (12.4)	0.38
Depressed, n (%)	51 (25.8%)	16 (27.6%)	0.78
Total Stigma, mean (SD)	9.2 (7.1)	7.3 (6.5)	0.07
Blame and Judgment (Stigma), mean (SD)	4.3 (3.7)	3.5 (3.5)	0.15
Interpersonal Distancing (Stigma), mean (SD)	4.9 (3.7)	3.7 (3.3)	0.04
Coping, mean (SD)	33.6 (4.2)	33.7 (5.2)	0.87
Total Support, mean (SD)	10.9 (1.9)	11.0 (1.9)	0.89
Negative support, mean (SD)	0.7 (1.0)	0.8 (1.1)	0.35
Self-Efficacy, mean (SD)	4.3 (1.6)	4.6 (1.5)	0.14
Experience of Violent Household, n (%)	30 (15.2%)	12 (20.7%)	0.32

HIV Knowledge, mean (SD)	10.2 (1.8)	10.0 (2.0)	0.49
PMTCT Knowledge, mean (SD)	5.1 (1.0)	5.0 (1.1)	0.54
Infant Feeding Risks Knowledge, mean (SD)	2.6 (0.6)	2.4 (0.7)	0.17
If a woman breastfeeds her baby and also gives the baby other food it is more likely the baby will get HIV	152 (77.2%)	45 (77.6%)	0.95
Bottle-feeding an infant can be dangerous if there is no access to clean water	185 (93.4%)	56 (96.6%)	0.37
All babies who are breast fed by women with HIV will get HIV (answered correctly)	167 (84.3%)	38 (65.5%)	0.00
Who decides what to feed baby?, n (%)			0.14
Respondent	128 (64.6%)	45 (77.6%)	
Partner or Other	19 (9.6%)	5 (8.6%)	
Respondent + Partner	51 (25.8%)	8 (13.8%)	

Columns may not add up to 100% due to missing values

p<0.05

Table 3. Infant feeding practices of HIV-positive mothers who initiated breastfeeding at any time before at 3 months

	Feeding practices at 3mo		
	EBF ¹ N=79	Mixed-BF ² N=78	Formula Feeding ³ N=41
Sociodemographics and Child Characteristics at Birth			
Maternal Characteristics			
Age in years, mean (SD)	28.9 (5.6)	28.1 (5.6)	29.4 (5.2)
Still in School, n (%)	3 (4.1%)	1 (1.3%)	1 (2.5%)
Working before baby, n (%)	29 (38.7%)	31 (41.3%)	16 (39.0%)
Has life partner, n (%)	77 (98.7%)	76 (97.4%)	39 (95.1%)
From Pretoria/Tshwane, n (%)	59 (76.6%)	66 (86.8%)	35 (85.4%)
First Language of Mother: sePedi, n (%)	28 (35.9%)	30 (38.5%)	20 (48.8%)
Education level, n (%)			
Primary School	11 (14.5%)	6 (7.9%)	5 (12.2%)
Secondary School	63 (82.9%)	68 (89.5%)	35 (85.4%)
Tertiary School	2 (2.6%)	2 (2.6%)	1 (2.4%)
Home environment at baseline, mean (SD)			
Number of Other Adults in Home, mean (SD)	3.7 (1.8)	4.0 (1.5)	3.8 (1.8)
Number of Children in Home, mean (SD)	2.5 (0.9)	2.7 (1.0)	2.6 (1.0)
Number of Children in Home, mean (SD)	1.4 (1.6)	1.4 (1.6)	1.4 (1.6)
Disclosure of HIV status to partner, n (%)	41 (57.7%)	47 (70.1%)	21 (55.3%)
Disclosure of HIV status to anyone, n (%)	70 (93.3%)	66 (90.4%)	38 (97.4%)
Pregnancy and birth history			
Mean gestational age (weeks), mean (SD)	38.0 (2.1)	38.3 (1.7)	37.8 (1.8)
Birth <37 weeks gestation, n (%)	15 (20.0%)	12 (15.8%)	9 (22.0%)
Cesarean Section, n (%)	22 (28.6%)	27 (36.0%)	14 (35.9%)
Intended to breastfeed at baseline, n (%)	72 (94.7%)	72 (94.7%)	35 (87.5%)

Child characteristics			
First-born child, n (%)	12 (15.4%)	17 (21.8%)	7 (17.5%)
Birth weight in grams, mean (SD)	2946.8 (518.7)	3001.1 (402.2)	3024.0 (469.2)
Birth weight <2500 grams, n (%)	11 (14.3%)	8 (10.3%)	4 (10.0%)
Maternal and Child characteristics at 3 month Follow-up			
Maternal CD4 count at 3mo, mean (SD)	419.6 (192.4)	493.9 (233.8)	385.8 (131.6)
Maternal illness since HIV+ results, n (%)	7 (8.9%)	7 (9.0%)	0 (0.0%)
Disclosure of HIV status to partner, n (%)	67 (84.8%)	66 (84.6%)	37 (90.2%)
Disclosure of HIV status to anyone, n (%)	43 (54.4%)	53 (67.9%)	24 (58.5%)
Maternal psychological factors			
CES-D Score, mean (SD)	8.6 (10.0)	9.1 (10.8)	7.8 (9.4)
Depressed, n (%)	20 (25.3%)	23 (29.5%)	8 (19.5%)
Total Stigma, mean (SD)	10.5 (7.7)	7.5 (6.8)**	10.0 (6.0)
Blame and Judgment (Stigma), mean (SD)	4.8 (4.0)	3.6 (3.6)*	4.8 (3.1)
Interpersonal Distancing (Stigma), mean (SD)	5.7 (4.0)	3.9 (3.5)**	5.1 (3.3)
Coping, mean (SD)	33.7 (4.0)	33.5 (4.5)	33.8 (4.0)
Total Support, mean (SD)	10.9 (2.0)	11.0 (1.7)	11.0 (1.9)
Negative support, mean (SD)	0.9 (1.0)	0.5 (0.9)**	0.6 (0.9)
Self-Efficacy, mean (SD)	2.8 (1.2)	2.8 (1.4)	3.1 (1.1)
Experience of Violent Household, n (%)	10 (12.7%)	11 (14.1%)	9 (22.0%)
HIV Knowledge, mean (SD)	10.2 (1.5)	10.0 (2.1)	10.6 (1.5)
PMTCT Knowledge, mean (SD)	5.2 (0.8)	4.9 (1.2)	5.3 (0.9)
Infant Feeding Risks Knowledge, mean (SD)	2.6 (0.5)	2.4 (0.8)	2.7 (0.5)
If a woman breastfeeds her baby and also gives the baby other food it is more likely the baby will get HIV	61 (77.2%)	56 (72.2%)	35 (85.4%)
Bottle-feeding an infant can be dangerous if there is no access to clean water	74 (93.7%)	70 (89.7%)	41 (100.0%)
All babies who are breast fed by women with HIV will get HIV. (Answered correctly)	71 (89.9%)	61 (78.2%)*	35 (85.4%)
Who decides what to feed baby?, n (%)			
Respondent	49 (62.0%)	53 (67.9%)	26 (63.4%)
Partner or Other	10 (12.7%)	6 (7.7%)	3 (7.3%)
Respondent + Partner	20 (25.3%)	19 (24.4%)	12 (29.3%)

1 Exclusive breastfeeding from 0-3 months with no introduction of water, formula/non-breast milk, porridge, muti, or other foods

2 Mixed breastfeeding with water or other foods including formula/non-breast milk at anytime before 3 months

3 Formula feeding with history of breastfeeding but no history of mixed breastfeeding at anytime before 3 months

* p<0.05

** p<0.02