HIV-Positive Poor Women May Stop Breast-feeding Early to Protect Their Infants from HIV Infection although Available Replacement Diets Are Grossly Inadequate

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Abstract

Little is known about mothers’ perspectives and experiences of early breast-feeding cessation as a strategy to reduce postnatal HIV transmission in rural, resource-constrained settings. We conducted in-depth interviews (IDI) with 15 HIV-positive breast-feeding mothers of infants aged 3–5 mo about their plans for feeding their infants after age 6 mo. We also conducted IDI with 12 HIV-positive mothers who intended to stop breast-feeding after receiving their infant’s HIV-PCR negative test result at age 6 mo. Twenty-four-hour dietary recalls were conducted with the same 12 mothers and 16 HIV-negative or status unknown mothers who were breast-feeding their 6- to 9-mo-old infants. Of the 12 mothers who intended to stop breast-feeding, 11 did so by 9 mo. Median energy intake (percent requirement) was 1382 kJ (54%) among weaned infants compared with 2234 kJ (87%) among breast-feeding infants. Median intakes were <67% of the recommended levels for 9 and 7 of the 12 micronutrients assessed for weaned and breast-feeding infants, respectively.

Factors facilitating early breast-feeding cessation were mothers’ knowledge about HIV transmission, family support, and disclosure of their HIV status; food unavailability was the primary barrier. HIV-positive mothers in resource-constrained settings may be so motivated to protect their child from HIV that they stop breast-feeding early even when they cannot provide an adequate replacement diet. As reflected in the new World Health Organization guidance, HIV-positive mothers should continue breastfeeding their infants beyond 6 mo if replacement feeding is still not acceptable, feasible, affordable, sustainable, and safe. J. Nutr. 138: 351–357, 2008.

Introduction

A profound dilemma of the HIV epidemic is that breast-feeding, one of the most effective child survival interventions (1), also results in >200,000 pediatric HIV infections annually (2,3). Because the risk of breast-feeding-associated mother-to-child HIV transmission (MTCT)8 remains relatively constant over the entire breast-feeding period (~0.9%/mo (4–8)) whereas the odds ratio of death among non-breast-fed vs. breast-fed infants declines with infant age (9,10), early breast-feeding cessation has been recommended as a “best balance” between these competing risks. This reasoning was reflected in the 2000 WHO/UNICEF/United Nations Population Fund/Joint United Nations Programme on HIV/AIDS Guidance on infant feeding: “To minimize HIV transmission, breastfeeding (by HIV-positive women) should be discontinued as soon as feasible, taking into account local circumstances, the individual women’s situation and the risks of replacement feeding…” (11).

During early 2006, we conducted this study to examine the feasibility and safety of early breast-feeding cessation as a means of reducing breast-feeding-associated HIV transmission in rural Zimbabwe. Zimbabwe has an adult HIV prevalence of 18% (12) and is in the 9th y of a financial decline (13), with 17% of the rural population listing food aid as their major source of staple food when the study was being conducted (14). Our specific aims were to: explore the perspectives and experiences of mothers and their communities of early breast-feeding cessation; identify factors that facilitated or impeded early breast-feeding cessation by HIV-infected mothers; estimate nutritional adequacy of infant

8 Abbreviations used: AFASS, acceptable, feasible, affordable, sustainable, and safe; CSB, corn-soy blend; CSM, corn-soy milk; FGD, focus group discussion; FWF, fortified weaning food; IDI, in-depth interviews; MTCT, mother-to-child HIV transmission.

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diets following early breast-feeding cessation; determine whether it is possible to provide a nutritionally adequate diet for non-breast-fed infants comprised only of locally available foods; and assess acceptability of expressed and heat-treated breast milk and a fortified weaning food (FWF) for replacement feeding.

Following our study, in October 2006, WHO convened another technical consultation to review findings generated since the 2000 Guidelines. Preliminary analyses from Kenya, Malawi, Uganda, and Zambia were presented demonstrating substantial morbidity and mortality among HIV-negative infants born to HIV-positive mothers following early breast-feeding cessation (15–18). Reflecting these adverse outcomes, the Guidance was updated: “At six months, if replacement feeding is still not acceptable, feasible, affordable, sustainable, and safe (AFASS), continuation of breast-feeding with addition of complementary foods is recommended” (19). The results reported in this article lend additional support to this new policy.

Methods

The study was conducted from January to June 2006. Participants were recruited from the community served by St. Theresa Hospital, a drought-prone, subsistence farming region 250 km south of Harare. Prevention of MTCT services included antenatal HIV counseling and testing and maternal/neonatal single-dose nevirapine prophylaxis during the perinatal period. Postpartum HIV-positive mothers were encouraged to return monthly for clinical monitoring, infant feeding counseling, and infant cotrimoxazole. HIV-PCR testing was offered at 5–6 mo to inform subsequent infant feeding decisions.

Subjects. Three groups of breast-feeding mothers were recruited: 1) mothers who tested HIV-negative antenatally, or chose not to be tested, and whose infants were now 6–9 mo (group 1, n = 16); 2) mothers who tested HIV-positive antenatally, whose infants tested PCR-negative at 5–6 mo, and who expressed an intention to stop breast-feeding during the counseling session when they received this negative test result; these mothers were interviewed 2–4 wk following the counseling session (group 2, n = 12); and 3) mothers who tested HIV-positive antenatally and whose infants were 3–5 mo (group 3, n = 15).

Focus group discussions (FGD) were conducted with 5 groups: health workers (n = 8) and 4 groups of community members: 1) young (20–35 y) mothers attending St. Theresa’s maternal child health clinic (n = 8); 2) young (20–35 y) fathers from the commercial growth point adjacent to the hospital (n = 6); 3) mature (>35 y) men (n = 7); and 4) mature (>35 y) women (n = 8), including community leaders.

Dietary histories. Research nurse-counselors elicited 24-h infant diet histories from the 28 mothers of the 6- to 9-mo infants in groups 1 and 2. Breast milk intake was estimated for normally breast-fed infants at 615 g/d (20). Local utensils were used to help mothers estimate portion sizes of non-breast milk liquids and foods. The nutrient content of infant diets following early breast-feeding cessation; determine whether it is possible to provide a nutritionally adequate diet for non-breast-fed infants comprised only of locally available foods; and assess acceptability of expressed and heat-treated breast milk and a fortified weaning food (FWF) for replacement feeding.

A FFQ, including 48 potentially available foods, was administered to the groups 1 and 2 mothers to ascertain if and how often any family member ate each food.

Designing theoretical diets. Linear programming was used to construct theoretical diets that maximized nutritional quality for 6–9 mo non-breast-fed infants under several potential scenarios of food availability: 1) “readily-available foods” only (defined as foods consumed ≥3 times weekly by at least one-half of the families); 2) “readily-available foods” plus 1 supplemental food that potentially could be provided or promoted programmatically: cow’s milk, expressed heat-treated breast milk, corn-soy blend (CSB) or corn-soy milk (CSM), infant formula, or Plumphy Nut (Nutriset, Malunay, France), a commercially processed FWF; and 3) “potentially available foods,” defined as those consumed at least once weekly by at least 1 family.

In all analyses, no greater than 100 g (~95th percentile intake by the 28 infants) of maize meal, the primary staple food, was allowed to enter the models; 100 g was also the maximum allowed for CSM and CSB. Amounts of other foods were restricted to 90% of the maximum amount ever consumed by any child in a 5-country analysis reported by Dewey et al. (28). There are little data on volumes of breast milk women can express and heat-treat each day; 2 amounts (300 g and 600 g) were entered as estimates. The maximum amount of Plumphy Nut allowed was 64 g, which provides about one-half the energy needs of a 6–9 mo infant, an amount allowing for substantial nutritive intake while preventing dependence on a single food. Though Nutrisurvey can also develop adequate diets at lowest cost, we did not enter food prices, because rural Zimbabweans currently access most of their food by growing, bartering, or receiving it as food aid.

In-depth interviews. Research nurse-counselors conducted in-depth interviews (IDI) with each HIV-positive woman in groups 2 and 3 to assess knowledge, attitudes, and practices concerning early breast-feeding cessation and replacement feeding options. Enrollment of 12 and 16 women in groups 2 and 3, respectively, approximates the number required for common themes to emerge and become distinguishable from experiences limited to a minority of participants (30–32).

FGD. Separate FGD were conducted with health workers and each of 4 categories of community members using a semistructured questionnaire.

Analysis. FGD and IDI data were analyzed by a team of 5, including the 3 nurse-counselors who conducted them. Each interview/discussion was independently coded by ≥3 researchers. It was first divided into discrete sections based on content (30,31). Each time the topic of conversation changed, a new section was started. Each section was coded to reflect the topic covered; multiple codes were used when appropriate. After coding independently, the team met to resolve coding discrepancies. To assess between-researcher coding variability, all 5 independently coded the first 5 interviews; concordance rates of ≥80% were achieved. Data were managed using NVivo software (QSR International). Based on the original research questions, codes were grouped and frequencies tabulated for each interview group. Findings from FGD were compared with those of IDI to determine whether the opinions of community members were consistent with those reflected by mothers during IDI.

All participants provided written informed consent. IDI and FGD were conducted in the local language (Shona) and recorded, transcribed, and translated into English. Translations were checked by at least 1 nurse-counselor to ensure the original meaning had not changed.

Ethical approval. The study was approved by the Medical Research Council of Zimbabwe and the Institutional Review Boards of Johns Hopkins University Bloomberg School of Public Health, the Research Institute of the McGill University Health Centre, and University of Maryland School of Medicine.

Results

During the 6 mo before our enrollment period, 469 mothers delivered babies at St. Theresa Hospital and were potentially

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eligible to participate in group 1 or 2. Of these, 379 (81%) mothers had been HIV tested during pregnancy through the prevention of MTCT program: 67 (18%) were positive and 19 (28%) of these women had their infants for HIV-PCR testing at ~5 mo of age. This proportion was similar to the 32% of all delivered mothers who brought their infants for postnatal care to St. Theresa’s Hospital. Twelve of the 19 infants who were brought for PCR testing were PCR-HIV-negative and all of their mothers agreed to participate in group 2. At the time of IDI and infant’s diet history, 8/12 HIV-positive mothers had completely stopped breast-feeding. Of the remaining 4 mothers, 3 were trying to stop but had not done so (these mothers confirmed stopping during a follow-up interview 2–5 wk later) and 1 mother continued breast-feeding. Recruitment for groups 1 and 3 continued until ≥15 interviews were completed.

24-h infant diet histories
A total of 23 different foods were consumed by at least 1 infant in the preceding 24 h. Among group 1 infants, the most commonly consumed foods were breast milk (16/16), maize meal (15/16), soup (11/16), and sugar and oil (6/16, each); only 2 had received any animal source food. The most commonly consumed foods among group 2 infants who had been completely weaned included maize meal (8/8), sugar (7/8), and soup (5/8), followed by peanut butter and oil (4/8) and cooked pumpkin (3/8). Five of these infants had received a small amount of animal source food: 2 had received 120 and 240 mL infant formula, respectively, prepared from the single tin they had been given by the hospital at 6 mo to help bridge the gap from breast-feeding to family foods; 1 had consumed 150 mL cow’s milk and 15 g of fresh fish; 1 had received 50 g of egg; and 1 had received 10 g of fresh fish.

Median energy intake from non-breast milk foods was higher among the 8 infants in group 2 who had been completely weaned compared with breast-feeding infants in group 1 [1524 kJ (range, 553–2650) vs. 557 kJ (range, 0–1076)], demonstrating that mothers who had stopped breast-feeding were feeding larger amounts of replacement foods than those continuing to breast-feed normally. However, the greater intake of non-breast milk foods was not enough to offset the lack of breast milk. The median energy intake by the weaned group 2 infants was 1382 kJ, meeting only 54% (range, 21–103%) of their requirements (Fig. 1). Median intakes of protein and 3 micronutrients (thiamin, niacin, and vitamin B-6) were adequate, but median intakes of 9 other micronutrients were <67% of the recommended intake levels (Fig. 1). Assuming breast milk intake was 615 g/d by group 1 infants, median intakes were 2234 kJ, meeting 87% of energy requirements, and ≥67% of the requirements for 7 of 12 micronutrients assessed (Fig. 1).

Household FFQ
Five foods (maize meal, tomato, cooking oil, a green leafy vegetable, and sugar) were consumed ≥3 times weekly by at least one-half of the families and considered to be readily available. Twelve of the 28 families reported eating ≥1 animal-based food daily. One family reported ever eating liver, and 5 reported ever eating eggs. Sixteen of the 28 families owned at least 1 cow or goat, but only 5 reported consuming cow’s milk or yogurt ≥3 times weekly, and none reported consuming goat milk.

Theoretical diets with optimal nutritional quality
No nutritionally adequate infant diet could be constructed when only the 5 readily available foods were included in the linear regression model. The “best” diet provided 6, 46, and 30% of calcium, zinc, and iron requirements, respectively, and 0, 36, 55, and 54% of vitamin B-12, pantothenic acid, vitamin C, and vitamin A requirements, respectively (Table 1, diet 1). When cow’s milk was allowed to enter the model with the 5 readily available foods, the resulting diet was adequate in all nutrients except iron (27% of requirement) and vitamin C (69%) (diet 2). When 300 g of breast milk was entered with the 5 readily available foods, the diet was insufficient (percent requirement) in calcium (69%), zinc (64%), iron (33%), pantothenic acid (66%), and vitamin B-12 (60%); increasing the volume to 600 g yielded a nutritionally sufficient diet except for zinc (69%) and iron (27%) (diet 3). Allowing 100 g of either CSM or CSB (diets 4 and 5) or 104 g infant formula (740 mL reconstituted) (diet 7) to enter the model along with the 5 readily available foods yielded diets that were adequate in all nutrients. Allowing 64 g Plumpy Nut to enter with the 5 readily available foods resulted in a diet that was adequate in all nutrients except calcium (86%) (diet 6).

![FIGURE 1](https://academic.oup.com/jn/article-abstract/138/2/351/4665032) A Adequacy of nutrient intakes by 6- to 9-mo-old infants. Non-breast-fed infants (group 2) were born to HIV-positive mothers but tested HIV-PCR negative at 5 mo and were completely weaned shortly after 6 mo. Breast-fed infants (group 3) were born to HIV-negative mothers and were still being breast-fed. Nutrient composition and nutritional requirements were estimated using Nutrisurvey assumptions (24). Absorption of calcium, zinc, and iron were estimated according to the assumptions of Nutrisurvey program (24) for non-breast milk foods, and of Abrams (25) for breast milk.
Allowing a wider range of foods

Thirty-seven foods were eaten at least once weekly by at least 1 family. Offering all these foods to the linear programming model resulted in a diet that was nutritionally adequate but contained 7 different animal source foods and 6 different plant source foods. To evaluate more feasible solutions, further analyses were conducted allowing only the 3 most commonly eaten animal source foods (cow’s milk, yogurt, and dried fish) and the 5 most commonly eaten fruits or vegetables (green leafy vegetables, sugar beans, tomato, pumpkin, and peanut butter), plus cooking oil, maize meal, and sugar. The optimal solution was nutritionally adequate except for absorbed iron (48% of the infant’s requirement) (diet 8).

IDI

Motivated mothers can wean early. Eleven of 12 HIV-positive mothers in group 2 who had intended to stop breast-feeding immediately upon receiving their infant’s PCR-negative test result at 6 mo actually did so when their infants were 6–9 mo. The 1 mother who continued breast-feeding had the desire

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**TABLE 1** Linear programming results and nutritional adequacy for optimal diets according to potential food availability scenarios

<table>
<thead>
<tr>
<th>Food type</th>
<th>Readily available foods</th>
<th>(1)</th>
<th>(2) + Cow’s milk</th>
<th>(3) + Expressed breast milk</th>
<th>(4) + CSM</th>
<th>(5) + CSB</th>
<th>(6) + Plumpy Nut</th>
<th>(7) + Infant formula</th>
<th>(8) Common foods</th>
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</thead>
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<tr>
<td>Animal source foods</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
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<td>440</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Maize meal</td>
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<td>100</td>
<td>84</td>
<td>56</td>
<td>31</td>
<td>31</td>
<td>67</td>
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<td>Sugar beans</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>80</td>
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<td>Peanut butter</td>
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<td>0</td>
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<td>Fruits and vegetables</td>
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<td>Green leafy vegetable</td>
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<td>40</td>
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<td>40</td>
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<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
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<td>Fats and sugars</td>
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<td></td>
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<td></td>
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<td>Supplemental foods</td>
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<td>Expressed breastmilk</td>
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<td>Plumpy Nut</td>
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<td>0</td>
<td>64</td>
<td>0</td>
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</table>

**Nutritional adequacy, % recommended intake**

- Energy: 100
- Protein: 109
- Fat: 68
- Absorbed calcium: 6
- Absorbed zinc: 46
- Absorbed iron: 30
- Vitamin A: 54
- Vitamin C: 55
- Thiamin: 156
- Riboflavin: 84
- Niacin: 138
- Folic acid: 116
- Vitamin B-12: 0
- Vitamin B-6: 149
- Pantothenic acid: 36

1 Five readily available foods: maize meal, green leafy vegetables, tomato, oil, and sugar.
2 Diet 8 reflects foods from diet 7, limited to the 3 most commonly consumed animal sources and the 5 more commonly consumed fruits or vegetables.
3 Foods offered for diet 8 but not retained by the model: potato, white rice, cabbage, carrot, peach, dried fish, mango, margarine, onion, banana, cucumber, and fruit-flavored drink.
4 Nutrient composition and nutritional requirements estimated using Nutrisurvey assumptions (27).
5 Absorption of calcium, zinc, and iron were assumed to be 60, 50, and 20%, respectively (28).
6 Required daily amounts of absorbed calcium, zinc, and iron were assumed to be 81, 1.0, and 0.93 mg, respectively (31).
to wean but could not convince her husband to allow it. She quoted him as saying: “There is no child of mine who will be taken off breast milk.”

Eight of the 11 mothers who stopped breast-feeding did not have access to any replacement milk and the 3 who did could not sustainably provide adequate volumes. Similarly, 14/15 mothers of 3- to 5-mo-old infants in group 3 said they intended to abruptly wean their infants at 6 mo, yet only 5 (33%) had a plan for accessing replacement milk. Thus, of the 27 mothers in groups 2 and 3, 18 (67%) either planned to or had already weaned without access to any milk replacement.

“Milk is the real problem right now, the milk that I took [i.e. the donated infant formula] got finished this morning, so when it’s finished I just prepare mahewu [a fermented porridge beverage], the baby occasionally drinks mahewu and then eats sadza [a very thick porridge of maize meal].”

“I just said the baby will survive even without milk.”

**Enabling factors for early breast-feeding cessation.** Mothers were highly motivated to stop breast-feeding, because they understood that HIV is transmitted through breast-feeding; their highest priority was to avert transmission.

“What was clear was that if the baby continues breast-feeding she will contract the virus, so I saw it being better for my baby to stop…”

“That’s it; we want the baby’s life.”

Most (10/12) of group 2 mothers reported discussing infant feeding decisions with their husbands or a family member. Among the mothers of 3- to 4-mo-old infants (group 3), 7/15 had already begun discussing early breast-feeding cessation with their husband or family member. Among the 17 women in groups 2 and 3 who had discussed early cessation with their husbands, 13 reported they were supportive:

“When I got back with the baby from the results it was said the baby is negative. So the baby must stop breast-feeding; I went and told [my husband] and he said we should listen to whatever we are told.”

All 21 HIV-infected women who were currently living with their husbands had told them their HIV-status and the remaining 6 had disclosed their status to another family member in their household. Mothers said that disclosure was a prerequisite to implementing early breast-feeding cessation: “If they did not know my status they would ask why the baby was not breast-feeding.

Mothers were also empowered by their perception that HIV infection is common:

“I just see others who have the virus and are living and walking; it’s not just me: these things are everywhere.”

**Barriers to early breast-feeding cessation.** The most commonly mentioned barrier to early breast-feeding cessation was shortage of nutritious food. Twelve of 15 (80%) women in group 3 anticipated they could not obtain enough food for the baby and 8 (53%) said they did not have access to animal milk.

Among the 11 women in group 2 who weaned their infant, all but 1 felt they were unable to provide what they perceived as an ideal replacement diet for their infants and 8 (73%) said they either did not have animal milk or were not able to purchase an adequate amount. Three planned to wean their infant onto milk from livestock that they owned, but when the time came to wean, all these animals failed to provide milk.

“When I got home that evening [the goat] had died. It affected me. What would I give the baby since the goat had died? I was planning to give the baby its milk. So we thought it was better to keep the baby off breast milk although there was no more goat-milk and the baby would have whatever is there… I think Satan is challenging me.”

Most mothers (20/27) mentioned stigma about their HIV status and 19 said their feeding decisions resulted in involuntary disclosure of their status to the community. However, mothers said they were implementing their feeding decisions despite this stigma: “I don’t want to lie, they will talk until they are quiet, but I will know that my baby’s life is alright.”

One worrisome message expressed by 6 of 15 group 3 mothers was their intent to stop breast-feeding early regardless of their baby’s HIV status. One explained that she feared her milk would reinfect her baby in a similar way that reinfection may occur if infected couples do not use condoms: “The reason [I will stop breast-feeding even if my baby is HIV-infected] will be so that the baby will get less of the virus.”

Finally, 10 of 15 group 3 mothers said their plan to stop breast-feeding early was emotionally painful:

“So I will have to sacrifice. Better that I take him off the breast than giving him the virus, even if it pains me, I will know it will pain me for only that time but the baby will have good health.”

This difficulty was mentioned by 3 group 2 mothers who had actually weaned their child:

“I suffered heartache because I have stopped breast-feeding a young baby.”

**Acceptability of alternative feeding options.** Potential feeding options explored in the interviews/discussions were infant formula, cow’s milk, expressed and heat-treated breast milk, and Plumpy Nut. None of the mothers believed they could afford infant formula. Less than one-half (11/27) could afford cow’s milk or had access to a milking animal at the time of interview.

Three of 12 mothers in group 2 reported having tried to express and heat-treat their milk and none had done so successfully: “I tried it for 2 d but not much milk was coming out… I really find it repulsive.” Among group 3 mothers, 9 talked approvingly and 3 stated they planned to use this option. However, several remained skeptical:

“…Let us say you have traveled to somewhere and you do not have anywhere to cook, and then you ask from someone, May I have your utensils? I want to boil my breast milk. It will not work!”

All mothers were keen to try Plumpy Nut, although many (12/27) were concerned about the availability of supply even if it were provided free. Many (18/27) mothers wanted to learn more about it and how to use it, suggesting that instructions would be an important requirement for this food to be successfully incorporated into a public health program.

**FGD are consistent with the IDI**

FGD with other community members were largely consistent with the IDI with mothers. Most community members concurred that mothers are strongly motivated to do anything to prevent HIV infection in their infants and that HIV status disclosure and discussion with family members would be critical for success. All FGD concurred that the major barrier to early breast-feeding cessation is food insecurity. As a nurse explained:

“Most of those babies who have been weaned at 5 mo, they are developing malnutrition. You know the reason why? It is because of this shortage of milk. Most of them, almost three-quarters, don’t have milk, and they say they do not want to heat-treat [expressed breast milk]. They don’t have cows to give milk to the baby so the children are developing malnutrition. It is only maybe 1 in 5 or 10 who are having good health.”
This statement captured what was reflected in the IDI. Eight of 11 (73%) mothers who weaned had no milk source and only 2/11 were providing milk replacement appropriately.

There were a few deviations in the FGD from the core messages arising from the IDI. While most mothers interviewed had disclosed their status and received family support, most FGD participants predicted that disclosure and family support would be a problem for mothers who want to stop breast-feeding early. One health worker said, “Some of the wives would tell me that if she disclosed to her husband that there would be a threat to her marriage. Sometimes, the woman would be in a second marriage and would be uncertain whether if she discloses her status to her new husband if he would accept the HIV status or if he would blame her.”

Discussion

The primary factor motivating the HIV-positive mothers in this study to stop breast-feeding early was their clear understanding that HIV transmission occurs during breast-feeding and their focused determination to prevent HIV infection in their infants. Eleven of 12 HIV-positive mothers stopped breast-feeding their infants at ~6 mo of age, most within a week of receiving their infant’s PCR-negative HIV test results. All 12 mothers disclosed their HIV status and that of their infant to at least 1 immediate family member. Mothers seemed to worry less about the risks to infant health and survival associated with early breast-feeding cessation, perceiving that if only their infants avoided HIV infection, they would be healthy and survive.

None of the non-breast-fed infants were receiving a nutritionally adequate diet, based on the 24-h diet history. Of greatest concern was their inadequate energy intake (median intake was 54% of requirement). Because lean body tissue is calorically cheaper to synthesize compared with adipose tissue, infants fed low-energy diets are not only smaller but also leaner. During periods of anorexic illness, catabolized lean body tissue yields less than one-half the energy of adipose, so that such illnesses can precipitate substantial (even life-threatening) weight loss as described 30 y ago by Fomon (33). This phenomenon was recently exemplified by a diarrhea outbreak in Botswana in which ~52% of hospitalized infants had no weight gain for ~3 mo prior to becoming ill (due to inadequate diets) and the case fatality rate was 21% (34).

Furthermore, we may have overestimated the adequacy of these infants’ energy intake. In these analyses, the energy requirement for 6- to 9-mo-old infants was assumed to be 2575 kJ/d, a relatively new recommendation based on longitudinal measurements of 76 healthy, full-term, American children (35). However, HIV-negative infants of HIV-infected mothers are a particularly vulnerable group. Compared with children of HIV-negative mothers, uninfected but exposed children have lower birth weight (16,36,37), poorer growth (38), and higher mortality (37). A more realistic estimate of their energy requirements may be 2897–3220 kJ [1–2 SD greater than (35)]. Using these estimates, median energy intake for the non-breast-fed children in this study would have been only 43–48% of their needs.

Like many parts of sub-Saharan Africa, the study community had little dietary diversity: only 5 foods were consumed ≥3 times weekly by at least one-half of the 28 families. Linear programming demonstrated that diets containing only these foods would not be nutritionally adequate for infants. Nearly three-quarters of families in this study did not have a sustainable milk source. Although economic difficulties have decreased food availability, subsistence farming and receipt of food aid is not unique to Zimbabwe. Approximately 73% of the rural African population engages in subsistence farming (39), and >54 million sub-Saharan Africans were assisted by the World Food Program in 2006 (40).

This study highlights important opportunities for programs aimed at reducing postnatal MTCT. Such programs might subsidize provision of FWF, promote community-based animal husbandry projects that maintain lactating animals, and/or promote and support HIV-positive women to express and heat-treat breast milk for their infants. Coutououdis (41) suggests that encouraging mothers to express and heat-treat breast milk may be successful with a more comprehensive approach, including demonstration of the technique to mothers. Other potential strategies include providing antiretroviral therapy for mother (15) or infant (17,42) or an infant vaccine (17). Our study also supports previous studies noting the difficulty of implementing counseling programs that support mothers to properly balance risks in a resource-constrained environment (43). As a result of our findings, a week-long infant feeding workshop was conducted at St. Theresa Hospital to strengthen health workers’ AFASS counseling skills.

Throughout the world, malnutrition (especially growth failure and anemia) is highly prevalent in the 6- to 12-mo period, even for infants born to HIV-negative mothers who continue to breast-feed into the 2nd y of life (44,45). An important cause is poor complementary feeding practices: breast milk intake declines and is replaced by foods with low nutrient density and bioavailability (46). Diarrheal disease also peaks during this period, partly due to feeding foods that have been contaminated by unhygienic preparation or storage (47). Indeed, over the past decade, 3 independent analyses have determined that underweight malnutrition is the underlying or direct cause of 50–60% of all under-5 mortalities and nearly one-sixth of all disability-adjusted life years lost each year across all age groups (48,49). Thus, the 6- to 12-mo period is a high-risk time for breast-feeding infants of healthy mothers; non-breast-fed infants of HIV-positive mothers are exceedingly vulnerable. Our study indicates that early breast-feeding cessation must be accompanied by a strong program providing education, psychosocial support, and, in most cases, subsidized or free processed FWF to facilitate nutritionally adequate hygienic diets for these high-risk infants. It also provides support for the new WHO Guidance (19) recommending continued breastfeeding by HIV-positive mothers until an AFASS diet is available.

Literature Cited


43. Doherty T, Chopra M, Nkonki L, Jackson D, Greiner T. Effect of the HIV epidemic on infant feeding in South Africa: “When they see me coming with the tins they laugh at me.” Bull WHO. 2006;84:90–96.


