

# Nutrition and HIV/AIDS in infants and children in South Africa: implications for food-based dietary guidelines

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## Abstract

The implications for food-based dietary guidelines (FBDGs) that are being developed in South Africa are reviewed in relation to HIV-exposed and -infected children. The nutritional consequences of HIV infection and nutritional requirements along with programmes and guidelines to address undernutrition and micronutrient deficiency in these children are also investigated. Based on studies for HIV-infected children in South Africa, more than 50% are underweight and stunted, while more than 60% have multiple micronutrient deficiencies. Nutritional problems in these children are currently addressed through the Prevention-of-Mother-to-Child Transmission Programme (PMTCT), the Integrated Nutrition Programme and Guidelines for the Management of HIV-infected Children which include antiretroviral (ARV) therapy in South Africa. Evaluations relating to the implementation of these programmes and guidelines have not been conducted nationally, although certain studies show that coverage of the PMTCT and the ARV therapy programmes was low. FBDGs for infants and young children could complement and strengthen the implementation of these programmes and guidelines. However, FBDGs must be in line with national and international guidelines and address key nutritional issues in these infants and young children. These issues and various recommendations are discussed in detail in this review.

**Keywords:** nutrition, food-based dietary guidelines, HIV, infants, children.

It has been estimated that there are 5.5 million people living with HIV infection in South Africa, of which

294 000 are children less than 15 years of age (Dorington *et al.* 2006). The most recent national antenatal survey showed that 30.3% of all pregnant women aged between 15 and 49 years were infected (Department of Health 2006a). HIV/AIDS was the leading cause of under-five mortality, accounting for 42 749 (40.3%) of all deaths in 2000 according to research by

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the National Burden of Disease study of the Medical Research Council (Bradshaw *et al.* 2003). Growth failure in HIV-infected children is associated with an increased risk of death (Carey *et al.* 1998; Bobat *et al.* 2001). Ensuring optimal nutritional status in HIV-infected children is hence crucial for their survival and quality of life. The objectives of this review were to discuss: the nutritional consequences of HIV infection on children; the nutritional requirements and feeding of HIV-exposed and infected infants and children; current programmes and guidelines aimed at addressing nutrition-related problems in HIV-exposed and -infected infants and children in South Africa; and implications for the development of food-based dietary guidelines (FBDGs) for these groups.

## Nutritional consequences of HIV infection on children

### Nutritional consequences in HIV-infected children

Growth and nutritional status of HIV-exposed children is affected in uterus, particularly towards the end of pregnancy and with increasing severity of maternal illness (Hira *et al.* 1989; Bulterys *et al.* 1994). Low birth weight is a frequently encountered problem. After birth, HIV infection causes early and progressive decrements in the rate of linear growth, which may be detected as early as 3 months of age. The consequences are stunting, underweight and wasting, which persist throughout childhood, unless antiretroviral (ARV) therapy is administered (McKinney & Robertson 1993). Those children who are born to HIV-infected mothers but who are uninfected will experience catch-up growth during childhood and with time their growth patterns could resemble those of healthy children. Undernutrition is a major problem in HIV-infected children in South Africa. This is illustrated by cross-sectional data on HIV-infected children before starting ARV therapy at Red Cross Children's Hospital in Cape Town. Table 1 indicates that more than 50% of children were stunted or underweight and that at least one in five had developed wasting during the course of the disease (Eley *et al.* 2006). Other South African

**Table 1.** The effect of HIV on the anthropometric status of children before starting antiretroviral therapy (Reddi *et al.* 2007)

Anthropometric indices	Number (%)
Moderate or severe stunting ( $n = 406$ )	271 (66.7)
Moderate or severe underweight ( $n = 408$ )	232 (56.9)
Moderate or severe wasting ( $n = 390$ )	81 (20.8)

$n$  = denominator; for stunting, underweight and wasting: Z-score  $< -2$  is moderate and  $< -3$  is severe.

studies have reported significant short-term nutritional gains in response to ARV therapy (Reddi *et al.* 2007).

Severe malnutrition is a frequent finding in HIV-infected children. Studies from several African countries have reported that severe wasting or severe wasting together with oedematous malnutrition are more commonly encountered in HIV-infected children than oedematous malnutrition alone (Kurawige *et al.* 1993; Beau & Imboua-Coulibaly 1997; Ticklay *et al.* 1997; Kessler *et al.* 2000). In the analysis undertaken recently at Red Cross Children's Hospital, 6.7% of HIV-infected children had severe wasting.

Low serum levels of vitamins A, E, B<sub>6</sub>, B<sub>12</sub> and C, beta-carotene, selenium, zinc, copper and iron deficiencies are common in HIV-infected individuals. Deficiencies have been documented during all stages of HIV infection. Vitamin A deficiency has been associated with increased morbidity and mortality (Semba & Tang 1999; Hussey *et al.* 2005). In one cross-sectional study, which included a cohort of 60 HIV-infected children from Cape Town, 80% had a serum retinol level of  $< 20$   $\mu\text{g/dL}$  and in 15% serum retinol was  $< 10$   $\mu\text{g/dL}$ . The percentage of children in this study with a serum retinol of  $< 20$   $\mu\text{g/dL}$  was greater than the 33% prevalence reported for children aged 6–71 months nationally (SAVACG 1995). Twenty per cent had zinc deficiency and 62% had a deficiency of two or more micronutrients (Eley *et al.* 2002a). In another South African study involving 60 HIV-infected children, 52% were iron-depleted and 18% had iron deficiency anaemia (Eley *et al.* 2002b).

Undernutrition and micronutrient deficiencies (zinc, copper, iron, selenium, magnesium, folic acid,

vitamins A, B6, B12, C and E and  $\beta$  carotene) can lead to impaired immunity, an increased risk of opportunistic and other infections, and progression to AIDS and death (Chandra 1990). HIV infection has also been linked to encephalopathy in 70–80% of children and using the Centers for Disease Control and Prevention (CDC) criteria, a study undertaken at Red Cross Children's Hospital prior to the commencement of ARV therapy showed that 70% of children had subnormal neuro-cognitive function (Smith *et al.* 2003). It is possible that undernutrition could contribute to impaired cognitive function in HIV-infected children. Significant associations have been found between stunting by 2–3 years, which is thought to occur in a third of pre-school children in developing countries, and later cognitive deficits, poor school achievement and dropout in uninfected children (Walker *et al.* 2007).

#### **Nutritional consequences in children affected by HIV infection**

The impact of HIV infection on childhood nutrition and growth status extends beyond those children with established infection. Studies evaluating the nutritional status of AIDS orphans, whose HIV status was not known, in Zimbabwe showed a three-fold increased risk of underweight, a twofold increased risk of stunting and a 1.5-fold increased risk of wasting compared with children cared for by their parents (Food and Nutritional Council and the Ministry of Health and Child Welfare 2004). However, besides the lack of parental care, other factors that seemed to contribute to poor growth of these children were poor feeding practices, food insecurity and lack of water and sanitation. In 2004, according to the Centre for Actuarial Research and the Medical Research Council of South Africa, it was estimated that there were 625 000 AIDS orphans in South Africa, but their nutritional status was not established (Dorrington *et al.* 2004). Studies from other African countries showed that the nutritional status of orphans supported by their extended families was similar to non-orphans (Ryder *et al.* 1994; Lindblade *et al.* 2003; Sarker *et al.* 2005).

## **Nutritional requirements and feeding in HIV-exposed and -infected infants and children**

### **HIV-exposed infants**

More than 95% of HIV infections in children are acquired through mother-to-child transmission (MTCT) during pregnancy, labour, delivery or breastfeeding with most infections occurring during the perinatal and postnatal periods (Newell 1998). Among untreated populations in developed countries perinatal transmission rates varied from 14% to 32% while in developing countries, rates ranged from 25% to 48%. Although several factors may account for these differences in transmission rates, the type of feeding is considered to be an important reason (De Cock *et al.* 2000). Exclusive breastfeeding, mixed breastfeeding and replacement feeding are associated with risks in HIV-exposed infants. Mixed breastfeeding has a higher risk of transmitting HIV infection (Leroy *et al.* 1998; Coutoudis *et al.* 1999). Recent research from KwaZulu-Natal showed that mixed breastfed infants were nearly 11 times more likely to acquire HIV infection than exclusively breastfed infants (Coovadia *et al.* 2007). Depending on the duration of breastfeeding, up to 50% of all perinatal infections may be acquired from breast milk (De Cock *et al.* 2000). Late postnatal transmission as a result of mixed breastfeeding has been documented in South Africa, reversing some of the effects of ARV prophylaxis. Inadequate counseling and support for new mothers was considered mainly responsible for this practice (Chopra *et al.* 2005). Replacement feeding may increase the risk for malnutrition and diarrhoeal disease, especially in impoverished communities. To determine the efficiency of exclusive breastfeeding vs. replacement feeding in preventing mother-to-child HIV infection, a large randomized trial was recently completed in Botswana. At 7 months of age, replacement-fed infants experienced a lower rate of HIV infection (5.6% vs. 9.0%), but a significantly higher cumulative mortality rate (9.3% vs. 4.9%) than exclusively breastfed infants (Thior *et al.* 2006).

The risk of mother-to-child HIV transmission is increased in the presence of a high maternal viral load, a low CD4 count and recent maternal infection

(Newell 1998). Maternal vitamin A deficiency has been associated with higher MTCT. However, there is no conclusive evidence that supplementation reduces transmission (Coutsoudis *et al.* 1997). A study on HIV-infected pregnant women in Tanzania randomly assigned to vitamin A or multivitamins excluding vitamin A showed increased HIV-1 vertical transmission in women receiving vitamin A supplementation. However, multivitamin supplementation of breastfeeding mothers significantly reduced HIV-1 transmission in immunologically and nutritionally compromised mothers as well as child mortality at 24 months (Fawzi *et al.* 2002).

#### **HIV-infected infants and young children**

According to recommendations of the World Health Organization (WHO), in asymptomatic HIV-infected children an increase of 10% in energy intake is needed to maintain growth. However, in the symptomatic HIV-infected child who is experiencing weight loss, energy intakes of 50–100% above the normal requirements may be needed for catch-up growth (WHO 2003a). There is no data to support an increase in protein intake, which should provide 12–15% of the energy requirements. With respect to micronutrients, because of methodological shortcomings in several studies, the data cannot be used to develop specific evidence-based dietary guidelines for micronutrients (Friis 2005). Randomized trials with high-dose vitamin A supplementation have resulted in reduced mortality and morbidity from diarrhoea in HIV-infected children (Coutsoudis *et al.* 1995; Fawzi *et al.* 1999). A recent randomized trial showed that daily zinc supplementation in HIV-infected children was associated with reduced morbidity from diarrhoea (Bobat *et al.* 2005). Another local study supports the routine use of zinc supplementation together with a standard multivitamin preparation. In that study, children receiving zinc plus multivitamins experienced fewer episodes of hospitalization and diarrhoea compared with those who received multivitamin supplements only. There is no conclusive evidence that other micronutrient supplements reduce morbidity and mortality (Hussey *et al.* 2005).

#### **Programmes and guidelines to address nutrition-related problems in the HIV-exposed and -infected children in South Africa**

The main programmes relating to the nutritional management of HIV-exposed and infected infants and children are the Prevention of Mother-to-Child Transmission (PMTCT) Programme and certain of the focus areas of the Integrated Nutrition Programme. Recently nutrition guidelines have been developed which include HIV-infected children by the National Department of Health (NDOH, Department of Health 2006b).

#### **Prevention of Mother-to-Child Transmission Programme**

In South Africa, nevirapine (NVP) alone is used in eight of the nine provinces and has been shown to reduce the risk of transmission by 41% in breastfed babies (Guay *et al.* 1999). In the Western Cape, dual NVP and zidovudine are used, as recommended by the WHO (2005). These are administered from 28 weeks' gestation onwards and may reduce the absolute transmission rates to approximately 2% in replacement-fed infants (Lallemant *et al.* 2004). Mothers on the PMTCT Programme are counselled about risks and benefits of exclusive breastfeeding and exclusive replacement feeding and if they decide to replacement feed, they are provided with acidified formula milk ('Pelargon') for 6 months (Department of Health 2004).

The PMTCT Programme was implemented at 18 pilot sites in the nine provinces in 2001. In 2002, an evaluation of the Programme showed that it covered 9% of all antenatal bookings; an average HIV testing rate of 56% (range 14–92%); an HIV-infection rate of 30%; and the provision of NVP to 55% of the HIV-positive women and to 99% of infants. Fifty-eight per cent of mothers said that they intended to exclusively breastfeed and 42% said that they intended to formula feed. Eighteen per cent of the 949 infants who were followed up were HIV-positive. The main problems identified included staff shortages; no standardization of training and employment conditions of

lay counsellors; lack of integration of PMTCT into primary health care; and disruptions in the supply of testing kits, NVP and replacement milk in some provinces. The main recommendations included implementation of national guidelines on infant feeding and testing; human resource development and collection of essential PMTCT data (Doherty *et al.* 2003). The extent to which the Programme is currently administered in South Africa is not known. One recent estimate suggested that the NVP coverage for pregnant women is less than 30% in South Africa (Meyers *et al.* 2006).

#### **Interventions aimed at addressing undernutrition and micronutrient deficiencies in HIV-infected young children**

Nutrition intervention for children with HIV (termed disease specific, treatment, support and counselling) is one of the key focus areas of the Integrated Nutrition Programme in South Africa (Department of Health, Directorate Nutrition 2002). Recent published guidelines for managing paediatric HIV infection in SA include a recommendation that food supplementation should be given to children whose weight is consistently below the third percentile. Furthermore, specific food supplements such as Philani Zymune, which is a lactose-free, gluten-free, enzymatically modified maize meal that is fortified with micronutrients and antioxidants distributed at ARV treatment sites to children who are underweight or faltering in growth (Department of Health 2005). Macro- and micronutrient guidelines have been published for HIV-infected children (Henderson & Saavedra 1995; Miller 2003). A recent study evaluated the role of home-based care for severe undernutrition using a nutrient dense fortified spread [ready-to-use therapeutic food (RUTF or Nutributter)]. This study showed that the intervention was highly successful (Manary *et al.* 2004). A similar approach is required to determine the effectiveness of dietary and nutritional interventions in SA to ensure optimal utilization of resources.

#### **Nutrition and antiretroviral treatment**

Antiretroviral therapy independently exerts a favourable effect on growth and body composition in HIV-

**Table 2.** Changes in growth in HIV-infected children <15 years after 1 year of antiretroviral therapy (Reddi *et al.* 2007)

Parameter	Baseline number (%)	1 year number (%)
Wasting ( <i>n</i> = 254)	52 (20.5)	6 (2.4)
Underweight ( <i>n</i> = 266)	149 (56.0)	51 (18.2)
Stunting ( <i>n</i> = 264)	178 (67.4)	123 (46.6)

infected children. Recovery from wasting and underweight precedes linear growth (Miller *et al.* 2001; Verweel *et al.* 2002) as illustrated by the results of a recent analysis of children receiving ARV therapy at Red Cross Children's Hospital (Table 2) (Reddi *et al.* 2007). The NDOH has developed Guidelines for the Management of HIV-infected Children which include ARV therapy for children who qualify for treatment (Department of Health 2005). Despite the beneficial effects of ARV therapy in improving the survival and nutritional status of HIV-infected children, the recommendation of the NDOH that at least 15% of all patients on ARV should be children has not been achieved in most provinces (Meyers *et al.* 2007).

The lipodystrophy syndrome characterized by dyslipidaemia, insulin resistance and fat redistribution develops after the introduction of ARV therapy in adults and children. Prevalence of this syndrome in children ranges from 1% to 43% although its extent in African children is unknown. Isolated lipid abnormalities have also been described in children. Although regimens containing protease inhibitors, one of the major ARV classes, have been implicated, fat maldistribution may occur with non-protease-inhibitor containing regimens (Miller 2003; McComsey & Leonard 2004). Attention should therefore be given to the quality of diets of HIV-infected children (Smit 2004). Nutritional interventions not yet adequately evaluated in HIV-infected children include food supplementation and the recommended daily allowances of macronutrients and micronutrients for children on ARV therapy.

#### **Implications for food-based dietary guidelines**

Feeding recommendations for HIV-exposed and -infected infants and children should be included in

FBDGs and should be consistent with existing current guidelines developed by the NDOH (Department of Health 2005, 2006b) and the WHO (2003b,c). FBDGs should aim to minimize the risk of MTCT and to ensure optimal nutritional status of the HIV-exposed and -infected infant.

### **HIV-exposed infants**

Food-based dietary guidelines need to support national and international recommendations on infant feeding during the first 6 months and provide information on the risks and benefits of both exclusive breastfeeding and exclusive replacement feeding so that mothers can make an informed choice about either method of feeding. It should support the recommendation of the Global Strategy for Infant and Young Child Feeding of the WHO and of the NDOH, that the HIV-positive mother should avoid breastfeeding if replacement feeding is acceptable, feasible, affordable, sustainable and safe (WHO 2003c; Department of Health 2005, 2006b). In resource-limited settings, where these criteria for replacement feeding cannot be met and where the risk of mortality from diarrhoea, respiratory infections and other infections is five to six times higher in non-breastfed than in breastfed infants (World Health Organization Collaborative Study Team 2000), mothers must be supported to exclusively breastfeed (i.e. to provide breast milk only and no other food or drink except vitamin and mineral drops, not even water). In enabling HIV-positive mothers to do this, it is important to ensure that their own nutritional requirements are met. It has been shown in undernourished mothers given a high energy supplement compared with those given a low energy supplement that there was a significant difference in milk production and in the duration of exclusive breastfeeding (Gonzalez Cossio *et al.* 1998). In South Africa, this is feasible through the provision of supplements to nutritionally at-risk lactating mothers and those with HIV by the Nutrition Supplementation Programme, which is implemented at primary healthcare facilities (Department of Health, Directorate Nutrition 2002).

All HIV-infected mothers should be strongly discouraged from practising mixed feeding (WHO

2003c; Department of Health 2006b). A study undertaken on 2060 infants born to HIV-positive mothers in Zimbabwe showed that the overall postnatal HIV transmission (PNT) rate was 12.1% with 68.2% of HIV transmissions occurring after 6 months. Compared with exclusive breastfeeding, early mixed feeding was associated with a 4.03, 3.79 and 2.6 greater risk of PNT at 6, 12 and 18 months respectively (Iliff *et al.* 2005). Awareness must also be created of the increased risk of MTCT of HIV with prolonged breastfeeding, breast conditions (mastitis, nipple lesions and breast abscesses), and oral/pharyngeal disease in the infant (e.g. candidiasis). In the presence of any of these conditions, mothers/caregivers should be advised to seek medical treatment and if possible to feed their infants heated-treated expressed breast milk by cup (WHO 2003b). The adapted method of breast milk pasteurization as developed in Pretoria could be used and has been shown to eliminate HIV. This entails boiling a pan of water, removing it from the heat source and immediately placing a covered glass jar of breast milk in the water for 20 min (Jeffrey *et al.* 2003).

Currently, in South Africa, the HIV status of all infants enrolled in the PMTCT Programme should be assessed at 6 weeks of age using polymerase chain reaction (HIV DNA PCR) testing. Those mothers who have elected to breastfeed their infants and who subsequently test HIV DNA PCR negative, should be supported and encouraged to exclusively breastfeed, and to wean their infants at 6 months, if replacement feeding is acceptable, feasible, affordable, sustainable and safe. Where these criteria for replacement feeding are not met, WHO recommends the continuation of breastfeeding with additional complementary foods and regular assessment of the mother and baby. Breastfeeding should stop once a nutritionally adequate and safe diet can be provided (WHO 2006). This approach has been recommended because of the risk of malnutrition with early cessation of breastfeeding (Dewey *et al.* 2004). The transition to replacement feeding should be done under the guidance of a health-care worker. During this time the infant should be weaned from the breast and fed expressed breast milk by cup, which is replaced by a suitable breast milk substitute once the infant is fully weaned (Department

of Health 2006b). After complete cessation of breastfeeding, these infants should be retested at about 6–12 weeks later to identify those who become HIV-infected during the latter part of breastfeeding.

With respect to replacement feeding, the only replacement milk that meets the nutritional requirements of infants <6 months is commercial infant formula. While home-prepared powdered milk and fresh full-cream milk (i.e. cow's milk) may be used for infants aged 6–12 months provided that iron-fortified foods or iron supplements are given (Dewey *et al.* 2004), these milks have been found to lack several micronutrients, including vitamins C and E, folic acid, iodine, selenium, zinc and pantothenic acid; as well as linoleic and  $\alpha$  linolenic acid (Papathakis & Rollins 2004). Mothers need access to a consistent and affordable supply of commercial infant formula, which is made available in certain of the provinces through the PMTCT Programme. Safe replacement feeding includes the availability of utensils for preparing formula, access to clean water, a refrigerator, fuel for boiling water, resources for hand washing, the ability of the mother/caregiver to follow instructions, caregiver time and cup feeding (HIV/AIDS 2004; Bland *et al.* 2006a,b; Doherty 2006).

In terms of complementary feeding of infants who are HIV-negative, mothers/caregivers should be advised to feed their children a variety of foods which are locally available and affordable in addition, preferably, to replacement milk. Feeding of foods that are energy-dense, rich in micronutrients (vitamin A, iron and zinc), given frequently (4–5 times daily), culturally acceptable and hygienically prepared should be encouraged (see paper on complementary feeding). Mothers/caregivers should also be encouraged to provide psychosocial stimulation to their infants by holding them, talking to them and playing with them. Health workers need to support and guide mothers/caregivers to deal with stigma linked to replacement feeding (HIV/AIDS 2004). These children should also attend the primary healthcare clinics regularly for immunization, growth monitoring and promotion (monthly during the first 2 years and then 3-monthly until 5 years of age) and vitamin A supplementation as currently recommended (Department of Health, Directorate Nutrition 2003).

### **HIV-infected infants and young children**

In addition to continuation of breastfeeding or replacement feeding as recommended in the PMTCT guidelines, FBDGs should include relevant information on complementary feeding for the HIV-infected infant and child. The main principles relating to complementary feeding in these children are outlined below:

#### *Consistency and quantity of complementary feeds*

Mothers/caregivers should be advised to introduce small quantities of feeds (one to two teaspoons) and gradually increase the amount and consistency of feeds between 6 and 12 months in relation to the infant's requirements and abilities. There should be a transition from semisolid foods at 6 months, to 'finger foods' (i.e. foods that the infant can hold) at 8 months; and to family foods at 12 months (Dewey *et al.* 2004).

#### *Energy density and meal frequency*

In asymptomatic and symptomatic HIV-infected children, the increase in dietary energy requirements should preferably be met through locally available and affordable foods. FBDGs should promote an increased intake of energy through an increase in the energy-density of feeds, frequency of feeds and/or portion sizes (LINKAGES Project 1998). This may, for example, include the provision of maize meal cereal with added oil/fat and sugar and at least five to six feeds a day, with additional one to two snacks (e.g. fruit or bread) to ensure an adequate energy intake (Department of Health 2006b).

#### *Nutrient content of food*

Food-based dietary guidelines should promote the consumption of a varied diet to ensure that the HIV-infected child's nutrient needs are met. Ideally, animal-source foods such as meat, poultry, fish or eggs, which are rich in protein, iron and zinc should be eaten daily. Where adequate quantities of animal-source foods are consumed, the amount of milk needed is 200–400 mL per day; otherwise 300–500 mL

of milk per day is required. If animal-source foods are not consumed in adequate amounts, the daily consumption of grains and legumes should be encouraged (Dewey *et al.* 2004). The bioavailability of zinc can be increased by reducing the phytate content through soaking and decanting the soaked water (Gibson 2006). An adequate micronutrient intake should also be ensured through a diet that includes the daily consumption of vitamin A-rich foods (carrots, sweet potato, pumpkin and green leafy vegetables), vitamin C-rich foods (citrus fruit, cabbage, broccoli and potatoes), vitamin B-rich foods (animal-source foods, dairy products and green leafy vegetables) and staples such as maize meal and bread which are fortified with multiple micronutrients (Dewey *et al.* 2004; Labadarios *et al.* 2005).

#### *Use of fortified foods and micronutrient supplements*

In addition to a varied diet, the consumption of fortified complementary foods is recommended in addressing micronutrient deficiencies. All maize and wheat flour in South Africa are fortified to provide at the recommended daily allowance, vitamin A (13%), thiamine (25%), niacin (25%), riboflavin (17% for maize and 20% for wheat flour), pyridoxine (25%), folate (50%), iron (25% for unsifted maize meal, 50% for maize meal) and zinc (20%) (Labadarios *et al.* 2005). Other ways in which complementary foods can be fortified are through the use of complementary food supplements, e.g. Nutributter (a fat-based, fortified and nutrient-dense spread which contains no water thereby preventing bacterial contamination); Foodlets (micronutrient-enriched, crushable and water-soluble tablets); Sprinkles (microencapsulated micronutrients) and Corn-Soy blend flour (Dewey *et al.* 2004). Foodlets and Sprinkles can be added to complementary foods after cooking and consumed soon after to avoid destruction of heat-labile micronutrients. It is recommended that where the under-five mortality is more than 50 per 1000 live births and where vitamin A deficiency is prevalent, that high-dose vitamin A supplementation be provided to children, especially between 6 and 24 months (Carey *et al.* 2006). In South Africa where there is a public health problem of vitamin A deficiency, where the

current under-five mortality is estimated to be 95 per 1000 (Bradshaw *et al.* 2003), and where HIV and diarrhoea are among the main causes of under-five deaths, high-dose vitamin A supplementation could contribute to reducing mortality and morbidity from these conditions as well as the all-cause mortality (Coutsoudis *et al.* 1995). FBDGs should therefore support vitamin A supplementation of both HIV-infected and uninfected children under the age of 5 years as part of the Integrated Management of Childhood Illness strategy currently implemented at all primary healthcare facilities (Department of Health, Directorate Nutrition 2002). There are currently no targeted zinc supplementation programmes; however, WHO recommends zinc together with oral rehydration solution during episodes of acute diarrhoea (Gibson 2006).

#### *Fluid needs*

Non-breastfed infants need extra fluids: 400–600 mL day<sup>-1</sup> in a temperate climate and 800–1200 mL day<sup>-1</sup> in a tropical climate. In ensuring that the infant's fluid requirements are met, clean water should be offered several times a day (Carey *et al.* 2006).

#### *Responsive feeding*

Food-based dietary guidelines should promote active or responsive feeding. This entails feeding infants directly and assisting older children to feed themselves; encouraging children to eat; talking to children during feeding; not forcing children to eat; and using different food combinations, tastes and textures where children refuse to eat (LINKAGES Project 1998).

#### *Hygiene and proper food handling*

This includes washing caregivers' and children's hands before food preparation and eating; serving foods immediately after preparation and safe storage of food; the use of clean utensils to prepare and serve food; and avoiding the use of feeding bottles (LINKAGES Project 1998).



### Feeding of the child with undernutrition and during illness

There are guidelines for the medical management and therapeutic feeding of HIV-infected children with moderate and severe undernutrition. In the presence of oral lesions, e.g. candida or herpes simplex, in addition to the necessary medication, high calorie, smooth and non-irritating foods such as creamed cereal, mashed bananas or yoghurt should be offered. During these times it is also necessary to avoid foods that are spicy, hot or have a high acid content (Heller & Shattuck 1997). Application of topical medication is recommended (HIV/AIDS 2004). FBDGs should include increased intake of soft, varied, appetizing and favourite foods during illness; after illness the child should be encouraged to eat more energy-dense and micronutrient-rich foods to ensure catch-up growth after recovery from infections or illness (HIV/2004).

### Antiretroviral treatment

As highly active ARV therapy can improve the nutrition status of HIV-infected children, FBDGs should also promote dietary advice that will enhance treatment (e.g. administration of protease inhibitors with food enhances absorption and reduces gastrointestinal side effects) and optimize the nutritional outcome of these children (Heller & Shattuck 1997). In children on highly active antiretroviral therapy further research is needed to determine whether specific dietary recommendations can prevent or modify metabolic derangements such as the lipodystrophy syndrome during ARV therapy.

### Other measures to support growth

This includes regular visits to primary healthcare facilities for growth monitoring and promotion, immunizations and psychosocial support for mothers/caregivers as outlined for the HIV-exposed infant.

## Conclusion

There are important nutritional issues, which specifically confront clinicians and caregivers involved with the care of HIV-exposed and -infected infants and

children. It is essential that FBDGs are consistent with and address gaps within existing guidelines.

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