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TERMINOLOGY AND ACRONYMS

ACT	Alpha 1-antichymotrypsin
AFASS criteria	Acceptable, feasible, affordable, sustainable and safe
AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
ARV	Anti-retroviral drugs or therapy
BF	Breastfeeding
BIS	Bio-impedance spectroscopy
BMI	Body Mass Index
CD4 count	A measure of the absolute CD4 T cell count/cubic mL of blood
CDC	Centres for Disease Control
CI	Confidence Interval
CRP	C-Reactive Protein
CTA	Classification Tree Analysis
DHS	Demographic and Health Survey
EBF	Exclusive Breastfeeding
EFF	Exclusive Formula-Feeding
FF	Formula-Feeding
FFM	Fat free mass
FM	Fat mass
HAART	Highly active antiretroviral therapy
HARS	HIV-associated adipose redistribution syndrome
HIV	Human Immunodeficiency Virus
HR	Hazard Ratio
HST	Health Systems Trust
HR	Hazard Ratio
Ht/age	Height for Age
IVACG	International Vitamin A Consultative Group
MF	Mixed Feeding

MRC	Medical Research Council
MTCT	Mother–to-child-transmission (of HIV)
MUAC	Mid-upper arm circumference
NAIDS	Nutritionally acquired immune deficiency syndrome
NNRTI	Non-nucleoside reverse-transcriptase inhibitors
NRTI	Nucleoside reverse-transcriptase inhibitors
NVP	Neviropine
OI	Opportunistic Infections
OR	Odds Ratio
PCR	Polymerase Chain Reaction
PLWHA	Person/people living with HIV and AIDS
PMTCT	Prevention of Mother to Child Transmission (of HIV)
RDA	Recommended Dietary Allowance
RF	Replacement Feeding
ROI	Reactive oxygen intermediates
SA	South Africa
SADHS	South African Demographic and Health Study
SD	Standard Deviation
TAG	Technical Advisory Group
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
VCT	Voluntary Counselling and Testing
Wt/age	Weight for age
Wt/height	Weight for height
WHO	World Health Organization
Z	Z-score

CHAPTER 1 - INTRODUCTION

At the time that the research documented in this thesis was conducted, HIV prevalence among pregnant women in Gauteng Province for 2003 was 29.6%, in 2004 33.1% and in 2005 32.5%.[1] More recently, the 2006 UNAIDS global report indicated that 5.5 million people in South Africa were infected with HIV, representing about 14% of the global burden; one out three South African pregnant women attending antenatal care in public health facilities is HIV-infected and the country accounts for 19% (100,000) of all new mother-to-child transmitted infections.[2] In addition, 13% (294,000) of all HIV infections in children and 10% (1.5 million) of all children orphaned by AIDS are in South Africa.[2]

Given this huge impact of HIV on infant and maternal health, there is now an extensive body of knowledge that has been compiled by South African researchers on mother-to-child transmission of HIV (MTCT) and, in particular, on the trends in infant feeding practices in the HIV context.

HIV infection has an unmeasured effect on a woman's mothering ability towards her newborn baby. The factors that could influence a mother's ability to care for her offspring include: her own disease status and progression[3,4,5], nutritional status[6-8], or depression and other psychosocial issues, like disclosure[9,10,11,12]. Data indicates that the infant's own infection and disease status and progression may also impact on maternal caring capacity[13,14,15].

One of the strategies to improve declining or weak caring capacity among families that are exposed to HIV would be to ensure that HIV-infected mothers are provided with sufficient health care to delay HIV disease progression. Most of the previous international studies conducted on nutritional status and HIV have been conducted in the USA among HIV-infected homosexual males or drug

users.[16,17,18] Recent published studies on nutritional status and HIV in South Africa have had shorter follow-up times and used relatively complex and invasive methods to determine nutritional status.[19]

There are no South African studies that have systematically documented, over a two year period post-delivery, the trends in nutritional status of HIV-infected women. There are even more limited studies that attempt to link nutritional status of postpartum HIV-infected women to measurements of psychosocial wellbeing and to infant feeding practices and health outcomes for their children.

CHAPTER 2 - BACKGROUND AND LITERATURE REVIEW

2.1 HIV AND INFANT FEEDING CHOICES

2.1.1. Mother-to-child transmission of HIV

It is estimated that nearly 1800 children worldwide, and especially newborns, contract HIV on a daily basis and, of these children, more than 85% live in Sub-Saharan Africa[2]. The Prevention of Mother-to–Child Transmission of HIV strategy (PMTCT) was adopted globally as a means of addressing vertical transmission of HIV from parent to child, yet in Sub-Saharan Africa to date just less than 6% of pregnant women are offered or receive PMTCT interventions.[2]

In South Africa the annual national antenatal clinic sero-prevalence surveys conducted among pregnant women reported HIV prevalence rates of 27.9%, 29.5% and 30.2% between the years 2003, 2004 and 2005 respectively. However, Gauteng Province, in which the study reported on in this thesis was conducted, was amongst the provinces with higher rates.[1]

Evidence emerged in scientific literature in mid-1996 that HIV can be transmitted though breastfeeding. Since that time several studies have been conducted in developing countries to assess the biological and programmatic implications of HIV transmission through breastfeeding. The estimated risk of transmission is 5-10% during pregnancy, 10-20% during labour and delivery, and 5-20% through breastfeeding.[3]

2.1.2. Infant feeding choices and prevention of HIV transmission

At the same time, the dilemma posed by infant feeding options in the context of HIV is that replacement feeding (RF) and its safety can only be assured if strict criteria are met such as affordability, feasibility, acceptability and sustainability (the so-called AFASS criteria)[20]. In most resource-poor settings these conditions are difficult to meet, and avoidance of all breastfeeding carries additional mortality risks. The evidence from a World Health Organization (WHO) meta-analysis indicates that in the poorest countries children who are not breastfed during the first two months of life are six times more likely to die from infectious diseases[21], irrespective of HIV status.

A study from Botswana documented trends in infant feeding practices from the PMTCT pilot sites.[22] In this study, data were obtained from women who were either randomised to formula-feed their infants or to exclusively breastfeed while being given prophylactic zidovudine. Women who chose to formula-feed independently were also followed. In this population, similar to South Africa, exclusive breastfeeding practice is not the norm and hence they found that none of the 31 women assigned to breastfeed did so exclusively for five months. There were also observations that 22% of the women assigned to formula-feed were highly likely to have breastfed starting within the maternity ward and this was confirmed by breast examination results. The authors concluded that none of the breastfeeding-arm mothers ever adhered to exclusive breastfeeding for five months and even those who had been assigned to formula-feed did not do so exclusively. This study thus challenged the global recommendations on infant feeding in the context of HIV as they differed from the normal infant feeding practices inherent in this community.

Before the introduction of simple short-course antiretroviral drug regimens, such as nevirapine (NVP), prolonged breastfeeding contributed to less than a half of

mother-to-child HIV transmissions in the developing world.[3] Currently, prophylactic short-course treatment options are available to reduce mother-to-child-transmission, however, prolonged breastfeeding exposure continues as a leading cause of HIV infection in infants. A clinical trial of 425 women in Nairobi reported that without short-course antiretroviral treatment, breastfeeding for two years or more doubles the overall risk of mother-to-child transmission of HIV to about 40%.[23] Other studies have documented that both the volume of milk ingested and the length of exposure are factors in transmission.[24-26]

Breastfeeding transmission can occur early in the postnatal period or later on. A meta-analysis of data from nine mother-to-child transmission studies involving over 5000 infants has found that 1509 infants were breastfed and that breastfeeding continued for an average of 6.8 months. The number of HIV infections attributed to breastfeeding was 179, giving a transmission rate of 12%. HIV transmission occurred before 4 weeks of age in 64% of cases.[21] Even though it is established that there is a heightened risk of transmission in the postpartum period, a meta-analysis of nine major studies of mother-to-child HIV transmission has shown that there is a significant and sustained risk of late HIV transmission to breastfed children. Of the 4085 children included in the analysis, 42% acquired infection after day 28. The risk of late postnatal transmission continued throughout the breastfeeding period and was relatively constant. The risk for transmission was significantly higher among male infants and infants born to women with low CD4 cell counts.[27]

A study in Botswana compared the efficacy and safety of two infant feeding strategies for the prevention of mother-to-child HIV transmission. All pregnant women received zidovudine 300mg orally twice daily from 34 weeks of gestation and in labour. Mothers and infants were randomised to receive single-dose nevirapine or a placebo. Infants were randomised to six months of breastfeeding plus prophylactic infant zidovudine, or formula-feeding with one month of infant

zidovudine. They found that by the seventh month HIV infection rates were 5.6% (32 infants in formula group) versus 9% infants in the breastfed group. Furthermore, they found cumulative infant mortality at seven months to be significantly higher in the formula group than the breastfed group (9.3% vs 4.9%; p=0.003), but these differences diminished with time and by 18 months there was no significant mortality differences between the two groups.[28]

Exclusive breastfeeding is recommended as a protective option of infant feeding primarily as it provides protection for infants from morbidity or mortality regardless of the HIV status of the mother. Increasingly the literature acknowledges that safe and exclusive breastfeeding among HIV exposed infants is a key intervention contributing to HIV free survival.[61] HIV free survival is a term applied to estimate the number of infants alive and who have tested HIV negative following interventions including safe and exclusive infant feeding, and provision of ARV prophylaxis to prevent mother to child transmission of HIV.

2.1.3. HIV and infant feeding policy guidelines

In 1997 the WHO, UNICEF and UNAIDS issued a joint policy statement on HIV and infant feeding which served as the source document for countries to begin to apply infant feeding options for HIV-infected mothers in a practical setting. Subsequently, the WHO and UNICEF first issued international guidelines on HIV and infant feeding as part of PMTCT programmes in 1998.[29] The guidance from this was that HIV-infected mothers should be counselled to completely avoid breastfeeding and if this is not possible, the WHO and UNICEF recommend exclusive breastfeeding (EBF) during the first few months of life. Based on several studies, including a recently published study conducted in KwaZulu-Natal,[30] the WHO and UNICEF have now revised the period of exclusive breastfeeding to six months amongst HIV-infected mothers choosing this feeding option.[31]

The KwaZulu-Natal study[30] was conducted to assess the survival and HIV-transmission risk associated with exclusive breastfeeding and other types of infant feeding in KwaZulu–Natal, South Africa. It consisted of 2722 HIV-positive and HIV-negative pregnant women attending antenatal clinics who were enrolled in a non-randomised intervention cohort study that offered intensive infant feeding support. There were 1372 infants born to HIV-positive mothers and of these mothers 1132 initiated EBF from birth. The median duration of cumulative EBF was 159 days. The estimated risk of postnatal transmission of HIV by 6 months of age in exclusively breastfed infants who were negative at 6 weeks of age was 4%. Mixed feeding before or after 14 weeks nearly doubled the risk of transmission and the addition of solids increased the risk 11-fold. Cumulative three-month mortality in exclusively breastfed infants was 6.1% compared to 15.1% in infants who were given replacement feeds (p=0.051). This study has been cited as being important in providing further clarity on the benefits to early child survival of exclusive breastfeeding among HIV-infected mothers and the risks posed by mixed feeding.

2.1.4. Recall bias in estimating exclusivity or duration of infant feeding practices

Research studies on HIV and infant feeding depend on recall of breastfeeding practices in order to establish whether infants are being breastfed exclusively or not. However, recall is highly subjective and may result in bias. A study on infant feeding practices conducted in rural Zimbabwe acknowledged that self-reporting on infant feeding practices has the potential of leading to recall bias especially in recalling the age at which solids were introduced into the diets of the infants.[32]

Recall bias occurs and continues to constitute a potential bias in the data on infant feeding. In an attempt to validate methods of collecting infant feeding

data a study was undertaken in KwaZulu-Natal in 2003 where 130 postnatal mothers were interviewed weekly and, at every interview, a four-hour and a seven-day recall breastfeeding history was taken.[33] A subset of 70 mothers also received two intermediate visits per week during which additional 48-hour recall interviews were conducted. Ninety three infants were revisited at 6 to 9 months of age when mothers' recall of exclusive breastfeeding duration from birth was taken. They found that the reported breastfeeding practices over the previous 48 hours did not reflect exclusive breastfeeding practices since birth (specificity 65-89%; positive predictive value 31-48%) and that six-month exclusive breastfeeding-duration recall was equally poor (sensitivity at two weeks 79%; specificity 40%). Seven-day recall accurately reflected EBF practices compared with thrice weekly recall over the same time period (sensitivity 96%; specificity 94%). The authors concluded by recommending that, in order to minimise recall bias, data on duration of exclusive breastfeeding be collected prospectively at intervals of no longer than one week (seven days).

2.1.5. Unsafe formula-feeding

Given the socio-economic conditions under which most HIV-infected women in the developing world live, there is also a substantial risk of bacterial infections when formula-feeding is practiced under unsafe or unhygienic conditions. In a sub-study of the South African National PMTCT Cohort the preparation of formula-feeds by HIV-infected mothers was observed and laboratory analysis was conducted on the samples to assess levels of bacterial contamination.[34] In this study Escherichia coli were isolated from 64% of the milk feeds and Enterococci from 26% and 67% of the samples had at least one of these contaminants. The researchers found less contamination of samples from mothers who cleaned and sterilised feeding utensils for the infants. An additional safety concern identified in this study was over-dilution of 28% of the milk

samples collected at the clinic and 47% of the samples collected in the homes. The risk of over-dilution of feeds was found to be greater for older infants and when there was no access to running water in the house. More recent data on contaminated and over-diluted infant formula-feeds in South Africa has been obtained from rural KwaZulu-Natal.[35]

2.1.6. Problems and risks in the PMTCT programme

In South Africa the PMTCT programme, which began in 2001[36], provides two infant feeding options to HIV-infected pregnant women subsequent to pre- and post-test counselling. These options are:

- Exclusive breastfeeding with early cessation. Women who choose to breastfeed are expected to have been counselled on the benefits of exclusive breast feeding for a limited duration up to four months, followed by abrupt cessation.
- Provision of free infant formula for the first six months after delivery.

There has been extensive documentation of the experiences of implementing PMTCT in South Africa since the inception of the programme. One of the first reports was prepared by the Health Systems Trust (HST) and it reported that only about 51% of women agree to test for HIV, with a wide range of uptake figures across sites.[37] Regarding infant feeding, the researchers reported at this time that most women chose to replacement feed (RF) using infant formula, although there was considerable variation across sites. Breastfeeding practice was found to be more prevalent in rural areas. Additional recommendations made by the study group included reviewing the provision of free infant formula as they felt this may contribute to increased mortality and morbidity and may encourage mixed feeding. Alternatively, they proposed that infant formula should

only be availed to those mothers who could afford to do so and all other mothers should be supported to exclusively breastfeed.

Other researchers[38] raise concerns over the possible detrimental effects on child survival by providing free infant formula in the PMTCT programmes, especially in resource-poor settings. They suggested that free infant formula may compromise any woman's sense of reasoning and thus she might be inadvertently coerced into formula-feeding. Further, the researchers warn that it is possible that it will be only the most advantaged groups in society that will benefit from the free formula, therefore there is no assurance of compliance to exclusive formula-feeding by the sero-positive mothers and that there are hidden costs associated with the provision of formula milk.

One of the pre-conditions for the provision of infant formula on the PMTCT programme is that the recipient mothers will have received a detailed counselling session providing information on the merits and demerits of this infant feeding choice. A study in three PMTCT sites in South Africa[39] reported that on average only 18 minutes were spent counselling and that in all sites the counsellors had good communication skills. However, the infant feeding counselling was the weakest component in all sites, with only 35% (12 out of 34) of mothers informed about the risks of HIV transmission by mode of transmission. Frequency of contact between the counsellor and the HIV-infected pregnant mother during antenatal visits and follow-up support on infant feeding practices at the household level have been proposed as ways of ensuring that mothers adhere to their original infant feeding choice and practice safe feeding. [40]

2.1.7. Practical considerations in the application of HIV transmission and infant feeding guidelines

Whilst there is sufficient scientific evidence on the risks of breastfeeding and replacement feeding in the HIV context, which has resulted in programmatic

guidance in the PMTCT programmes, there has not always been sufficient consideration of the practical application of these recommendations at household level. It is clear that household and socio-cultural influences remain important determinants of actual infant feeding practices of HIV-infected women. Research conducted in KwaZulu-Natal indicated that women who delivered in hospitals were faced with the immediate dilemma on infant feeding at delivery as most felt that hospital personnel were insisting on breastfeeding, especially in those facilities that are designated "Baby Friendly" (in accordance with the WHO/UNICEF Global Criteria) and that a decision not to breastfeed would amount to public disclosure. Further, it emerged that younger women felt more pressured to breastfeed as the family expected the baby to be constantly breastfed. In this study it was predominantly the mothers aged over 19 that chose to replacement feed.[41]

Pressures from partners and family members on infant feeding choices of HIV-infected mothers have also been documented in the Ivory Coast in 2007[42]. In this study the researchers found that of the 580 women who delivered, 309 (53%) planned to formula-feed and 256 (44%) planned to breastfeed and 15 (3%) had not indicated feeding intent. Adherence to the initial formula-feeding intent in this cohort was over 90%. In terms of actual feeding practice, they found that of the 295 mothers who formula-fed, 93.6% were successful (refrained from breastfeeding) by day two and 84.2% by 12 months, but 15.6% of the formula-feeding group had breastfed their babies at least once. Researchers found that the mothers who hesitated to choose formula-feeding for their infants predominantly feared the partner's reaction (39%) and the family circle reaction (31%), were Muslim and were of low educational level. However, regardless of this there were many more women who chose to formula-feed in this cohort and they were also availed with the equipment to prepare formula feeds safely.

Additional data from a cohort study of three PMTCT sites in South Africa indicates that amongst mothers who had chosen to breastfeed their infants, the decision lay in the entrenched knowledge that breast milk is best and this often outweighed the perceived risk of HIV transmission through breast milk. The study also found that health workers were themselves misinformed on the HIV transmission risk from breastfeeding, resulting in them imparting mixed messages and exerting undue authority over the mothers in terms of infant feeding choices.[43] The same study has reported that an additional challenge in sustaining infant feeding choices in the context of HIV arises when mothers who have selected to replacement-feed their infants run out of formula feeds prior to their next scheduled clinic visit.

Such studies highlight the importance of counselling on HIV and safe infant feeding to all family members but especially to the partners and the health care providers. Data from Khayelitsha, an informal settlement in the Western Cape Province of South Africa, indicated that whilst mothers were aware of HIV transmission through breastfeeding, 90% of them said that this would not impact on their infant feeding decision-making. Healthcare workers who were included in this study, however, were not able to indicate correctly the risk of HIV transmission through breastfeeding and stated that this subject was confusing to them.[45] These findings indicate the challenges health workers experience in counselling women individually on the acceptability, feasibility, affordability, sustainability and safety (the AFASS criteria) of infant feeding options in the context of HIV. The practical application of these criteria, particularly when counsellors attempt to communicate the balance of risks of either replacement feeding or exclusive breastfeeding whilst imparting accurate information, has proven to be most challenging. In particular, health workers face particular difficulty in communicating the individual components of the AFASS criteria. These difficulties ultimately contribute towards inappropriate choices of infant feeding practices on mortality as reported by Jackson et al.[24]

2.1.8. Practical issues associated with early cessation of breastfeeding

As previously mentioned, the South African PMTCT protocol states[36] that those mothers who select to breastfeed their infants should do so for a limited period of time, followed by early or abrupt cessation, provided adherence to the AFASS criteria can be assured for replacement feeding.

A study in the Ivory Coast[45] assessed the uptake of a nutrition intervention that promoted exclusive breastfeeding with early cessation which was set at between 3 and 4 months of age and also offered replacement feeds as a means of reducing postnatal HIV transmission. Mother-infant pairs in this study were followed up for two years and provided with nutritional counselling. Of the 557 mothers enrolled, 262 (47%) initiated breastfeeding with the probability of practicing exclusive breastfeeding from birth being 18% and 10% at 1 and 3 months of age respectively. Complete cessation of breastfeeding was obtained in 45% and 63% by 4 and 6 months of age respectively. They found that societal and family pressures, such as living with a partner's family, were associated with failure to achieve early cessation of breastfeeding.

In reviewing issues, risks and challenges of early breastfeeding cessation as a means of reducing postnatal transmission in Africa, researchers call for caution as the practice of early and abrupt breastmilk cessation is not as yet entrenched within the cultural feeding norms on the Continent and thus its implementation may need to be done cautiously. They further mention that one of the risks associated with abrupt cessation of breastfeeding is psychological trauma for both mothers and infants and potential mastitis in the mothers.

In a qualitative study in Nigeria[47] HIV-infected respondents did not anticipate that early cessation of breastfeeding would be problematic as the mother would have at least provided her newborn with some of the protection provided from breastfeeding.

From this review it is apparent that in African populations a decision to avoid breastfeeding among HIV-infected women is made complex by the family situation, health worker bias in the counselling sessions, practical challenges posed by infant formula preparation and a difficulty in translating the AFASS criteria into practice when selecting the infant feeding method. Furthermore, even amongst those HIV-infected women choosing to breastfeed, adherence to exclusive breastfeeding followed by rapid cessation does not appear to be easy to implement practically at household level.

2.1.9. Maternal viral load and mastitis as risk factors for HIV transmission

An additional risk factor to increased HIV transmission through breastfeeding is poor maternal health, which includes a mother's own disease state, levels of immune factors in the breast milk and possible breast pathologies or abnormalities, such as cracked nipples and mastitis.[48,49,50]

Researchers investigated the determinants of RNA viral load among HIV-infected women and the effects on infant feeding and mastitis. Samples of breast milk were obtained from 145 HIV-infected breastfeeding mothers at one, six and 14 weeks postpartum and measurements of the sodium/potassium ratio in the milk was used as an indicator of mastitis. There was a variability of between 13% and 26% in milk viral load in the first 14 weeks. They also found that low blood CD4 cell counts (<200cells/mm^3) during pregnancy and elevated sodium potassium ratio was significantly associated with increased levels of milk RNA viral load. It

was concluded that whilst breast milk RNA viral load varied in the first 14 weeks postpartum, elevated levels were associated with sub-clinical mastitis and severe maternal immuno-suppression [51]. The findings of this study together with those from other research[52,53] placed further emphasis on the importance of maintaining optimal breast health in the context of HIV and this may be achieved with sufficient counselling on lactation management being provided to HIV-infected mothers.

More data on the contribution of maternal viral load and low CD4 cell counts to HIV transmission comes from Tanzania. It has been reported that infants who are not infected at birth have a 4% risk of contracting HIV at 4 months and an 18% risk of HIV infection at 2 years if they breastfeed.[54] Provision of antiretroviral therapy during breastfeeding, together with adequate lactation management could be possible interventions for preventing vertical transmission of HIV through breastfeeding.

2.1.10. Breastfeeding and maternal outcome

The concern over maternal health and nutritional status especially during the postpartum period has been particularly driven by the findings from Nairobi, Kenya[23], which indicated that HIV-positive mothers had higher mortality rates if they breastfed their infants. These results arose from a secondary analysis of a randomised trial of breastfeeding compared with formula-feeding conducted in Nairobi, Kenya between 1992 and 1998. The trial was designed to assess the rates of mother-to–child transmission of HIV according to mode of infant feeding. Eighteen of 197 women randomly allocated to breastfeed their infants died within 24 months of delivery compared with six of the 200 women allocated to the formula-feeding group. The cumulative 24-month mortality rates were 11% and 4% respectively, corresponding to a 3.2-fold higher risk of death (95% confidence interval [CI]: 1.3–8.1).

The researchers suggested that the demands of breastfeeding in HIV-infected mothers might accelerate the progression to HIV-related death. However, this finding was not consistent with studies examining exclusive breastfeeding, which have not found higher death rates in breastfeeding women.[50] Furthermore, prospective studies in Tanzania[54] and Zambia[55] found no evidence that breastfeeding was detrimental to the health of HIV-positive mothers, except among mothers with advanced HIV disease and severe immuno-suppression.

Eleven percent (11%) of children and 3% of mothers died. This is comparable to a study in Malawi which found that of the 2000 HIV-infected women, 2.2% had died and 15.5% of their children had died during a two-year follow-up period. The median duration of breastfeeding in this cohort was 18 months, exclusive breastfeeding was two months and mixed feeding was 12 months. This study did not find any association between breastfeeding and maternal mortality or morbidity, even after adjusting for maternal viral load and other covariates.[4] Instead, it was found that breastfeeding was associated with significant reductions in mortality among the children born to HIV-positive mothers. This protective effect of breastfeeding could be from the immunological and anti-bacterial factors in breast milk.

More recently, a study from Kenya documented over a two-year period HIV-1 disease progression in breastfeeding and formula-feeding mothers.[5] This study was undertaken to further substantiate the earlier findings in Kenya[23] on the three-fold increase in mortality risk that was associated with breastfeeding. Mothers in Nairobi were allowed to self-select whether to breastfeed or formula-feed their newborns and they were followed-up for a period of 24 months postpartum to assess CD4 counts, HIV-1 RNA levels and Body Mass Index (BMI). Thirty three percent of the 296 women elected to formula-feed and 67% chose to breastfeed. Women most likely to formula-feed were more educated and had

a flush toilet at home and had reported a history of HIV-1-related illness. At 36 weeks of gestation, which was the baseline assessment in this study, there was no significant difference between the formula-feeders and breastfeeders. Changes in CD4 cell counts, HIV-1 RNA levels and BMI between 32 weeks of gestation and one month postpartum were not significantly different by feeding choice.

Overall, the researchers found that CD4 cell counts declined 3.9cells/µl/month between month one and 24 ($p<0.001$) and CD4 cell percentages declined 0.11% per month ($p<0.001$). They found that the mothers who continued breastfeeding had a significantly higher rate of CD4 cell count decline than did those who had breastfed for a shorter time (-7.7 vs -4.4cells/µl/month; $p=0.014$). After cessation of breastfeeding, former breastfeeders were found to have a significantly lower rate of CD4 cell count decline (-3.2cells/µL/month) than current breastfeeders ($p=0.003$) and a rate similar to that of never breastfeeders ($p=0.3$). Mortality was significantly associated with baseline CD4 count (hazard ratio [HR] of 2.7 per 100-cell/uL; $p<0.001$). Women with baseline CD4 cell counts <200 cells/µL had a HR of 1.7 ($p=0.002$) for death during the two–year follow-up period. They concluded that whilst breastfeeding may accelerate the decline in CD4 cell counts, it did not have a long-term effect on HIV-1 RNA level or mortality.

The most significant decrease in CD4 cell counts was between months one and 24 postpartum (estimated decrease of 3.9cells/µL/month or 48cells/µL/year). CD4 cell count decline was highest among current breastfeeding women (-7.7cells/µL/month) and this was significantly higher than for formula-feeders (-4.4cells/µL/month) and for women who ceased breastfeeding, the rate of CD4 cell count decline was -3.2cells/µL/month. This implies that there is a mechanism that spares the decline in CD4 cells count once lactation ceases. From the study findings it was deduced that the accelerated CD4 cell count decline during

breastfeeding could result from hormonal changes, nutritional and metabolic changes or the numeric loss of CD4 cells as part of the process of breastfeeding.

The researchers state that the levels of CD4 cell count decline they observed, whilst statistically significant, may not be clinically relevant especially for women who breastfed for short periods of time. The CD4 cell count decline in women who breastfed for six months did not differ significantly from the decline in those who never breastfed. There was no difference in mortality in the formula or breastfed groups and it is possible that the women were less immuno-compromised to start off with in both groups. It would therefore appear that although breastfeeding may affect CD4 cell count and BMI in HIV-1 infected women with extended maternal care, breastfeeding is not necessarily associated with a significant decline in maternal health. The authors conclude that their data therefore supports the recommendation by the WHO that women who are HIV-infected and choose to breastfeed should do so for six months as it appears breastfeeding has minimal adverse effect on maternal CD4 cell count.

Another meta-analysis[21] which used data from HIV-1 infected women has found no differences in mortality between HIV-positive mothers who breastfed compared to those who never did after 18 months. However, amongst the women who did start breastfeeding, the study found a lower risk of death among those who were still breastfeeding after 18 months (HR = 0.05, 95% confidence interval: 0.03;0.09; $p < 0.0001$). This is probably due to the fact that the women who are able to breastfeed for longer are the women who are healthier rather than mortality being affected directly by the mother's choice of feeding method.

2.1.11. Infant Feeding practices in South Africa

In South Africa the Demographic and Health Survey (DHS) provides national data on breastfeeding trends. According to the 1998 DHS report[56], whilst breastfeeding continues to be the cultural norm with 88% of South African mothers reported to have ever initiated breastfeeding, the low prevalence of exclusive breastfeeding was a cause for concern. In the first three months of life only 10% of infants were exclusively breastfed. Overall the rate of formula-feeding was 48.3% nationally. Of nutritional concern is that approximately 70% of children in this age category had received complementary feeds before the age of 6 months.

In 2003 the DHS[57] reported that 12% of infants are exclusively breastfed from 0-3 months (a 2% increase from the 1998 SADHS). Only 1.5% are exclusively breastfed at 4 to 6 months, and 28.5% of infants are bottle-fed with a nipple, 6% of babies less than 4 months old and 27% of babies aged 4-6 months are given semi-solid food. It is clear from the data that in South Africa, and indeed in several other African countries, mixed feeding is practiced as the "normal" standard of infant feeding.

Analysis of DHS data from 14 countries has found that in societies where prolonged breastfeeding is the norm women are less likely not to breastfeed and, if they fail to initiate breastfeeding, they are more likely to do so because of preceding morbidity, as compared to societies with shorter median breastfeeding durations.[58]

A separate study among women in rural KwaZulu-Natal found exclusive breastfeeding of very young infants to be uncommon, at a rate of 5%.[59] The low prevalence of the practice of exclusive breastfeeding is a phenomenon that is common in both urban and rural settings alike. Researchers investigated the factors that were conducive to women adhering to their selected infant feeding mode in three PMTCT sites in South Africa. They found that among women who

were able to adhere to exclusive breastfeeding, a firm belief in the benefits of breastfeeding and a supportive home environment were prerequisites. Formula-feeders found this practice easier to adhere to if they accessed electricity, owned a kettle and a flask, which made night feeding easier.[43]

Nevertheless, in the context of HIV, mixed feeding is a high risk behaviour that can result in increased transmission rates. A study conducted in KwaZulu-Natal Province, where 551 women were counselled on the risk of HIV transmission through breastfeeding and offered formula at a subsidised price, found that after 15 months transmission rates were 19% for formula-fed infants, 25% in exclusively breastfed infants, and 35% in mixed-fed infants. The researchers attributed the higher infection rate posed by mixed feeding to greater exposure to allergens, causing inflammation and damage to gut mucosal barriers, and to HIV, which in turn led to a higher infection rate. [60]

The negative impact of mixed feeding is further substantiated in research conducted in Zimbabwe as part of the Zvitambo study wherein over 14100 mothers were enrolled at the time of delivery and had an overall postnatal HIV transmission rate of 12.1%. The researchers found that, when compared to exclusive breastfeeding, mixed feeding resulted in a fourfold (4.03, 95% CI: 0.98;16.61) greater risk of HIV transmission after six months. By 12 months this risk was 2.60 (95% CI: 1.21-5.55) and by 18 months it was 2.63 (95% CI: 0.59-11.67).[61]

2.1.12. Summary

The data presented above on HIV and infant feeding indicate that even where technical guidance on the implications of safe infant feeding in the HIV context is provided, for an individual mother her personal household and family dynamics

are ultimately the most significant determinants of how she feeds her baby. There are however few studies that specifically document over time the impact of psychosocial factors on infant feeding choices and practices of mothers.

2.2. NUTRITIONAL STATUS AND HIV INFECTION AMONG WOMEN

2.2.1. Interactions between Nutrition and HIV infection

"Nutritional health is maintained by a state of equilibrium in which nutrient intake and requirements balance".[62] Once this equilibrium is upset, with nutrient intake being less than nutrient requirements, the result is malnutrition. Although not all HIV-infected persons are significantly malnourished or display severe wasting, the development of malnutrition may lead to clinical immuno-compromise and resultant HIV disease progression.[6]

Malnutrition is a common manifestation among persons living with HIV and AIDS and its causes are multi-factorial. On account of this, the effective management of the HIV-infected individual requires a multifaceted approach.[63] The malnutrition-infection cycle has been thoroughly explored[64] to explain the mechanism by which nutrition influences infection and the factors wherein infections lead to growth failure and clinical malnutrition. Others refer to the relationship between nutritional status and the course of HIV disease as "bi-directional" with HIV infection leading to wasting and progressive loss of both fat and lean body mass and, at the same time, wasting among HIV-infected people can be considered an independent risk factor in disease progression. [65]

The relationship between HIV infection, nutritional status and immune function has also been referred to as a "triad", whose main outcome, until the advent of antiretroviral drugs, was wasting.[66] It is known that inadequate dietary intake

can lead to loss of weight, wasting and low stores of essential nutrients. This situation is associated with a lowered immune system and poor ability to fight off any infections, leading to accelerated disease progression and severity.[67]

Optimal intake of micronutrients is likely to be affected by anorexia or difficult and painful swallowing during HIV infection. Decreased food intake, together with insufficient consumption of micronutrients has also been noted among asymptomatic HIV-infected adults, resulting in a significant loss of weight along with reported increased gut permeability in about 25% of such persons.[68, 69] There is documentation that HIV-infected persons do not consume the required levels of essential micronutrients.[70-73,74,75]

2.2.2. Body composition and HIV infection

The first formal assessment of body composition using high precision techniques among HIV-infected and AIDS patients was published in 1985 on the basis of mounting evidence of both visceral and somatic protein depletion.[75] However, it has also been stated that "despite the many women of reproductive age who are HIV positive, few studies have investigated the relationship between HIV infection during pregnancy or lactation with a focus on maternal nutritional status and health".[76] The wasting associated with HIV occurs as intermittent episodes of weight loss, lasting weeks or months and is often associated with acute opportunistic infections.[66]

The association between HIV-related wasting and opportunistic infections, such as tuberculosis, was demonstrated in a study conducted among HIV-infected persons in Malawi.[77] In this study of 579 HIV-positive women and men with sputum-positive pulmonary tuberculosis, severe wasting was common with 59% having a BMI of less than 18.5 kg/m², 32% of the subjects had a BMI less than

17.0 kg/m², and 17% of all the subjects were severely wasted as defined by a BMI of less than 16. Kg/m². In addition to wasting, most of the study participants were deficient in vitamin A, zinc and selenium.

2.2.2.1. Prenatal and postnatal body composition trends among HIV-infected women

It is known that HIV infection can have an effect on body composition from pregnancy through to the postnatal period. There are researchers that had previously disputed the fact that the postpartum changes in body composition were related to the energy demands of lactation, rather they concluded that weight loss observed among postpartum mothers was independent of the length of breastfeeding and an overall negative energy balance. Furthermore, these authors mention that the weight loss amongst these women could have been attributable to metabolic, hormonal or deliberate food deprivation. [78]

Additional data [79] indicate that the hydration and density of fat free mass does not return to pre-pregnancy values by two weeks and that it differs between lactating and non-lactating women. A study undertaken among healthy, HIV-free women in the United States used more sophisticated methods of determining body composition, namely total body water, underwater weighing, skinfold thickness, total body potassium, dual energy X-ray absorptiometry and total body electrical conductivity, with these measurements repeated till 12 months postpartum. The weight measurements in this cohort were 64.6kg at three months, 63.4 Kg at six months and 62.4kg at 12 months postpartum. They found that 10% of the women at each postpartum interval either gained weight or remained weight stable. They concluded that by three months postpartum the relative composition of fat free mass had returned to within the normal range between both lactating and non-lactating women. This study cannot be extrapolated to HIV-infected women in a developing country context as they are more likely to be nutritionally vulnerable than their US counterparts. However,

there is now a growing evidence base from Africa on the body composition changes among HIV-infected pregnant women and also postpartum women.

In Zimbabwe-based research[80] it emerged that, independent of CD4 counts, weight loss is a common manifestation of human immunodeficiency virus infection and that it is strongly correlated with predicting survival. In this study it was found that among 526 HIV-positive pregnant women and 1113 pregnant HIV-negative women, neither HIV infection (95% CI: -1.44;0.35, p=0.23) nor malaria (95% CI: -3.93;8.35, p=0.48) was a predictor of weight when gestational age, age, gravidity and season were controlled for in multiple regression analysis. However, women with viral load greater than 5log10 had 2.5kg (95% CI: -0.1;5.1) lower mean body weight than uninfected women if elevated serum ACT (alpha1-antichymotrypsin - an acute phase protein) was not controlled for. Elevated serum ACT was strongly inversely associated with weight as women with levels between 0.3 and 0.4, 0.4 and 0.5 and >0.5 g/L had almost 1, 2 and 6kg respectively lower mean body weight than women with levels <0.3g/l. Women with HIV infection had a 0.39cm lower arm circumference than uninfected women and they were also found to have 0.62cm lower triceps skinfold thickness than uninfected women, but this was also related to higher viral loads among the former. HIV status was found to be a predictor of arm fat area and all other anthropometric measurements and indicators declined with increasing viral load.

A study was conducted in Tanzania among HIV-infected women to investigate both the pattern and predictors of pregnancy weight gain.[65] This study found that those women who had a low CD4 count at baseline (12 weeks of gestation) had lower rates of weight gain in the second and third trimester compared to their counterparts with CD4+ counts of greater than or equal to 200cells/mm^3. They also found an average decrease in Mid Upper Arm Circumference (MUAC)

between weeks 12 and 38 of 1cm. It appeared that the women who at baseline had a MUAC greater than 29cm experienced the largest decrease in MUAC during pregnancy, overall 2.7cm. The decline in MUAC was influenced by other parameters such short maternal stature, conception during the rainy season and low selenium concentration.

To further investigate changes in body composition during the postpartum period, researchers set out to establish the effect of breastfeeding on the body composition of HIV-infected mothers. They found no significant differences in reported illnesses between the breastfeeding HIV-infected and breastfeeding non-infected mothers, with the exception of two women who had tuberculosis. In their group of mothers, at eight weeks, only 1.3% of the 92 HIV-infected mothers had low CD4 counts (i.e. <200cells/μL) and at 24 weeks only 3.3%. Median CD4+ cell counts at eight weeks and 24 weeks were 658 and 590 cells/μL respectively. As would be expected they found higher CRP levels (CRP>0.01g/L) in the HIV-positive mothers at 24 weeks (p=0.056). In terms of anthropometry, they found that none of the mothers at eight weeks could be classified as underweight or having a BMI <18.5kg/m2, but by 24 weeks two mothers (one HIV-positive mother and one HIV-negative mother) had a BMI <18kg/m^2. This may imply that with time there were some observable weight changes in the mothers. For MUAC measurement, at eight weeks postpartum, six mothers had MUAC measurements of less than 23cm (fifth percentile of US National Health and Nutrition Examination Survey) and at 24 weeks only three had low MUAC measures and one of these was HIV infected. They found that 26.4% of the HIV-infected mothers and 29.8% of the HIV-negative mothers were classified as mildly to moderately overweight with BMI of greater than 26kg/m2) at eight weeks. By 24 weeks the proportion of overweight HIV-infected mothers decreased slightly but increased in the HIV-negative mothers (22.9% vs 37.7% respectively; p=0.176). For general changes in weight it was found that

more HIV-infected mothers than those who were not infected lost weight between eight weeks and 24 weeks (70.0% vs 46.7% respectively; p=0.05). Overall, with time, the HIV-positive mothers lost weight whereas the HIV-negative mothers gained weight slightly (-1.4±3.1kg vs 0.4±3.3kg respectively, p=0.0004). These differences between the groups remained, regardless of baseline characteristics. There was also a noted non-significant weight loss amongst those mothers who had reported any illnesses during follow-up, compared to those who were never ill.[81]

In Tanzania it was found that HIV infection among pregnant women was a significant risk factor for wasting, especially if the women were of a low socio-economic status.[82] Studies on body composition and HIV vary, with some documenting the changes among asymptomatic HIV-infected persons whilst others focus on persons with more advanced HIV disease and compare them to HIV-negative persons. Research conducted to assess the trends in body composition within the African context was done in Rwanda[83]. Between 1992 and 1993 the study recruited both HIV-infected (n=101) and non-infected women (n=106) and followed them up for a period of nine months after delivery. Each woman provided an indication of their pre-pregnancy weight. They found that the weight (58.5kg) and BMI (24.1kg/m2) were lower among the HIV-infected pregnant women as compared to their HIV-negative counterparts (weight=59.3kg and BMI= 24.5kg/m2). The differences, when compared to the pre-pregnancy weight, between the two groups of women were larger at five months post-delivery, with the mean weight variation being -2.2kg (SD=5.9kg) in HIV-infected women and +0.2kg (SD=6.6kg) in the HIV-negative women and this difference was significant (p=0.007). This study found that during the post-delivery period significant differences in weight between HIV-infected (55.8kg) and non-infected women (58.7kg) were noted at three months; however, after nine months post-delivery the differences in weight between the two groups was non-significant. The authors concluded that the HIV-negative women tended to

recover their pregnancy weight by five months postpartum, whereas the HIV-positive mothers never regained their pre-pregnancy weight, yet in terms of disease progression none of them developed full blown AIDS.

Other researchers[84] studied the gender-specific changes in body composition that characterise AIDS wasting in women. They assessed body composition of three groups of women according to stage of wasting. The three stages were non-wasting defined as weight >90% ideal body weight, weight loss <10% of pre-illness body weight; early wasting defined as weight >90% ideal body weight, weight loss >10% of pre-illness weight; and late wasting as weight <90% of ideal weight. The CD4 counts of each of the groups were determined as well as lean, fat and muscle mass and BMI. The BMI for the non-wasted group was 24.4%, for the early wasting group 22.2 kg/m², and in the late wasting group 18.2 kg/m². The authors concluded that, unlike their male counterparts, women lose fat mass disproportionately to lean mass in the early and late stages of AIDS wasting. The explanation for this loss of fat mass could be related to an androgen deficiency, which was found to be common among women with AIDS-related wasting. However, there is a need for caution in extrapolating the findings of this research as its participants were at a more advanced stage of HIV disease.

The role of hormonal changes among HIV-infected women has been reported in the literature. HIV-infected underweight women preferentially lose fat mass and tend to preserve body cell mass, even in advancing HIV disease state determined by HIV RNA levels CD4 lymphocyte counts.[85] The authors propose that women tend to lose more fat mass possibly due to growth-hormone resistance. Additional data on the gender difference in either fat or lean body mass loss among HIV-infected women and men have been reported.[86] Using bio-electrical impedence analysis, researchers found that among men, fat free mass accounted for 51% of the weight whereas in women this was only 18% and these

differences were noted across African (Zairian) and American race groups. These researchers attribute the sex-related differences in body composition to hormonal "disease-induced hypogonadism" differences between males and females that begin from puberty onwards. From this stage girls tend to gain more fat and boys gain more body cell mass and skeletal muscle mass. The authors concluded that more data on the specific sex hormones that influence these body composition changes in HIV infection are required. It would appear that among men with HIV, wasting is characterised by loss of lean body mass, and sparing of fat stores. Others contend that it may be dependent on the predominant stores, either lean or fat in an individual i.e. that determines what component is lost at higher levels.[87]

In the USA several studies have been conducted on body composition changes primarily using bio-electrical impendence amongst men and women. These studies included complex analyses of body composition in that they were able to determine the fat free mass changes and percent body fat changes. According to one study, any weight loss seen among HIV-infected women was predominantly body fat, a high degree of individual variability in their data, and loss of fat mass among their study participants depended upon whether one had greater levels of body fat versus fat free mass initially.[87] However, they conclude that more studies are required to examine the relation of the initial body fat percentage and the subsequent loss of fat free mass in women with HIV and that these studies should include women who start off with a low initial percentage of body fat. Such data will assist in formulation of diets that assist in preservation of lean mass in HIV disease.

There is concern over the impact of infant feeding choices on maternal health and HIV disease progression because HIV-positive mothers who choose to breastfeed may be predisposed to greater body composition changes due to possible inadequate dietary intake as well and the increased nutrient

requirements and demands that are posed by breastfeeding itself as well as the HIV disease state.

Studies referred to earlier from Nairobi and South Africa[23,50] have provided differing evidence on the impact of infant feeding choices on HIV disease progression among women. However, neither of these studies at the time led to any global policy changes or recommendations on infant feeding in the context of HIV and AIDS. A more recent study from Nairobi that assessed HIV disease progression among breastfeeding and formula-feeding mothers found a significant decrease in BMI among current breastfeeders (-0.065) not formula-feeders (-0.027). This could be due to the caloric costs of lactation and the required increased energy requirements and weight loss.[5]

One of the challenges in assessing body composition trends among postpartum women is that it takes time for the pregnancy related over-hydration to return to pre-pregnancy levels. Researchers have mentioned that body composition measurements taken after pregnancy are more accurate when taken at least four to six weeks after delivery, due to the fact that hydration and density of fat free mass (FFM) do not return to pre-pregnancy values before this time.[8] Other authors state that it is only at three months postpartum that the relative composition of fat free mass returns to within the normal range, between both lactating and non-lactating women.[79]

A team of researchers in KwaZulu-Natal, South Africa[19], compared two methods of determining body composition changes among HIV-infected women, namely bio-impedence spectroscopy (BIS) and anthropometry with isotope dilution using doubly-labelled water to measure fat free mass (FFM) and fat mass (FM) in both HIV-infected and uninfected breastfeeding mothers. According to the authors, HIV-infected breastfeeding mothers, 95% of whom had >200 cells/μL CD4 counts on average lost weight between eight and 24 weeks postpartum, whereas

their HIV-negative counterparts gained weight, but remained within the normal cut-off points of BMI. The loss in weight among the HIV-infected mothers was due to a loss of fat mass, as the HIV-infected mothers had less subcutaneous fat. The greatest predictor of weight loss among the HIV-infected mothers was reported illnesses, whereas for HIV-negative mothers the predictor was the initial levels of weight. They found little evidence of the typical HIV wasting in this group of women because most women remained within normal BMI ranges, but it was also noted that the mean percentage body fat in all mothers at 24 weeks in this study (32%) was considered to be generally higher than that of lactating women elsewhere.

2.2.2.2. Body composition trends, survival and initiation of HAART

Prior to the global initiation of highly active antiretroviral therapy (HAART), HIV-related wasting was regarded as one of the main manifestations of disease progression. However, with the introduction of HAART there has been an observation of "HIV-associated adipose redistribution syndrome (HARS)". HARS results in subcutaneous fat distribution and abdominal obesity which are related to disorders of the metabolic system.[88] It has been stated that that whilst the severe wasting and malnutrition that characterised the earlier depiction of HIV and AIDS has diminished given the anti-retroviral (ARV) therapies available, it has not totally disappeared as some patients either choose not to take combination therapies or some are now treatment resistant.[75] This statement is further corroborated by data from a cohort study among HIV patients[89] in the USA which found that even with the availability of HAART there is a risk of $\geq$ 5% increase in unintentional weight loss over six-month periods, even though the participants had better control over their HIV disease state and opportunistic infections.

The effect of HAART on body composition has been studied by researchers [90,91,92] in varying settings resulting in different outcomes reported on whether lean body mass increases or decreases when HAART is provided. The body composition changes are likely to be influenced by the particular drug regimen used whether it is mainly the protease inhibitors or nucleoside reverse-transcriptase inhibitors (NRTI) and non-NRTI (NNRTI). A lower CD4+ cell count at baseline predicted a greater loss of trunk and limb fat and it was found that lipo-atrophy that is observed is the unique physical manifestation of HIV infection, but it was not possible in this study to separate out the individual effects of anti-retroviral therapy as they are often used in combination. Investigators reported that they are unable to attribute the loss in weight to decreased energy intake, malabsorption, increase physical activity or energy expenditure associated with the HIV disease state or other illnesses or a combination of all these factors.[90]

Data from several studies have indicated that the length of survival in persons living with HIV and AIDS and their nutritional status are related. However, it is still important to establish whether nutritional status is an independent predictor of survival in infected HIV-infected women.[90,92]

To analyse the relationship between nutritional status and disease progression a US study stratified HIV-infected persons by the levels of CD4 counts. They also scored age at either<35 or ≥35 because this classification had been shown to have prognostic significance for survival of HIV patients in previous research. The majority of subjects in this study were men. This study highlighted that there is a lot of individual variability as some people with low CD4 counts can remain of normal weight whereas others may become severely malnourished.[92] Thus, weight loss alone might not be a strong predictor of survival among HIV-infected persons; instead, it is important to ascertain the percentages of body cell mass or fat free mass as well. They found that their study agreed with

previous research that indicated that HIV-infected individuals who are older, have lower CD4 counts or have more advanced malnutrition have decreased lengths of survival. However their research was in males and it is uncertain if the same conclusion about women's age could be reached in a similar study involving younger women.

2.2.2.3. Summary

From the data it is apparent that HIV disease influences body composition changes starting in pregnancy and during lactation. Additional data is drawn from infected women and men primarily in the USA where more invasive methods of assessing body composition were used. There appears to be a preferential loss of fat mass over lean body mass in women and some researchers have associated this with hormonal levels and others have postulated that this could be related to the initial levels of fat mass that the women had before HIV disease.

2.2.3. Maternal micronutrient status and HIV infection

There is now a growing research base within the developing world, and primarily from Africa, on the role of micronutrient deficiencies in mother-to-child transmission of HIV and in HIV disease progression.[93,94,95] Micronutrient deficiencies, even in the absence of HIV infection, have been documented to affect global health outcomes, incurring substantial economic costs. With specific reference to women and female adolescents and children, the socio-economic costs associated with these deficiencies are considerable, though not always well quantified.[96] For a full assessment of the impact of micronutrient deficiencies on maternal health there should be consideration of the functional and health

outcomes, mental aspects, immuno-competence, physical work capacity, morbidity and mortality.

2.2.3.1. Mechanisms by which HIV infection impacts on blood micronutrient levels

In 2003, the WHO established a Technical Advisory Group (TAG) on Nutrition and HIV/AIDS comprised of international experts in nutrition and HIV/AIDS research, policies and programmes. One of the mandates for the TAG was to review the current evidence and science on the role of micronutrients in HIV disease.[97] The literature review below will prioritise the impact of micronutrient deficiencies among HIV-infected women.

By the late 1980's and 1990's there was still a dearth of research documenting the estimated effects of micronutrient deficiencies on infectious disease morbidity and mortality. Human immuno-deficiency virus is an infection which has been documented to impact negatively on the nutritional status of the infected person. The malnutrition-infection cycle acknowledges that this impact is two-fold and cyclical, with infections such as HIV leading to reduced food intake, lowered absorptive capacity of essential nutrients and it may also increase the levels of nutrient requirements.[98] Figure 1 has been developed to illustrate the relationship between micronutrient deficiencies and HIV disease progression.

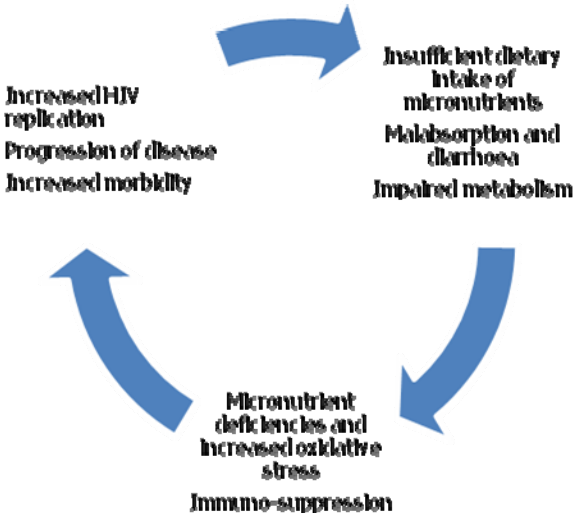


Figure 1: Vicious cycle of micronutrient deficiencies and HIV pathogenesis [98]

The full impact of micronutrient deficiencies is dependent on the nutritional status of the infected person prior to infection. One review[99] describes the impaired immune functions resulting from lack of micronutrients as "nutritionally acquired immune deficiency syndrome" or NAIDS. NAIDS "contributes to the depletion and dysfunction of CD4+ cells and make the host susceptible to other infections which may increase viral replication, thus accelerating HIV disease progression". Other authors[100] state that NAIDS is the most prevalent immuno-suppressive disorder globally. The literature acknowledges that deficiencies of micronutrients begin in early HIV infection and, in particular, there is growing evidence of deficiencies among HIV-infected pregnant women, who by virtue of their pregnancy are likely to have increased micronutrient requirements. It has been shown[93,98,101] that a malnourished person has greater susceptibility to HIV-related infections and thus a worse prognosis. However, it is difficult to demonstrate that specific nutritional deficiencies contribute to poor clinical outcomes in the presence of HIV.

It is known that micronutrient deficiencies may lead to nutritionally-related immuno-suppression and oxidative stress, which results in accelerated HIV disease progression.[98] The exact mechanism by which infections such as HIV impact on nutrition is "mediated by the acute phase response which is a stereotypic host response to infection, inflammation and accidental trauma due to the release of pro-inflammatory cytokines from activated macrophages"[102]. Thus any assessment of the role of micronutrients in HIV disease needs to factor in the acute-phase response. This acute-phase response is attributable in part to the free radical theory. It is believed that micronutrient deficiencies can precipitate oxidative stress, a condition that results from an imbalance between pro-oxidants and antioxidants, resulting in overproduction of reactive oxygen intermediates (ROI). The ROI produced can themselves induce cellular injury and lysis because the free radicals can cause "oxidation of nucleic acids, chromosomal breaks, peroxidation of lipids in cell membranes and damage to collagen, proteins and enzymes."[98,103]

Specifically in relating HIV infection to micronutrients, it has been found that HIV infection itself increases oxidative stress leading to oxidative damage, and the extent of this depends on the body's own antioxidant enzymes to whose activity select micronutrients such as vitamin A, E, and selenium contribute.[104]

Researchers have emphasised that any assessment of the role of micronutrients in HIV disease state and progression needs to factor in the acute-phase response, as there is evidence of a nutritional cost of the acute-phase (or inflammatory) response.[102] In severe infection the acute-phase response may result in infection-induced malnutrition, due to increased nutrient requirements and also decreased food intake and absorptive capacity. Other authors[105] mention that in recent years there has been growing interest to study host inflammatory response to infections. They explain that "during infection, cytokines are released by the activated cells, thus generating and maintaining

innate and specific immunological responses," one of which results in the production of acute-phase proteins such as C-reactive protein or CRP. In the literature, researchers either use CRP or alpha acid glycoprotein, or alpha-antichymotrypsin or ferritin to measure the acute phase response. [101,106].

2.2.3.2. The role of vitamins and minerals on pregnancy outcome and MTCT of HIV

Maternal macro- and micro-nutrient status during pregnancy is an important predictor of birth weight and intrauterine growth retardation, even in the absence of HIV infection.[107, 108,109,]

Data from Africa documents the role of HIV-disease state and of maternal nutritional status before and during pregnancy in predicting pregnancy outcomes and vertical transmission of HIV. Research was conducted in Tanzania to assess the socio-demographic, nutritional and infant risk factors for low birth weight and small-for-gestational-age status among a cohort of 822 HIV-positive women who were part of a clinical trial of vitamin A supplementation and pregnancy outcomes in Tanzania. Women with very low serum retinol concentrations (<0.35µmol/L) delivered infants with significantly lower birth weight than those women with higher serum retinol concentrations (≥ 0.70µmol/L). In addition, it was found that HIV-disease progression impacted negatively on low birth weight incidence in this study, with infant birth weight being significantly lower in women in stage III HIV state than in women in stage I (-463g; 95% CI: -821, -105g). Findings from this study lead to the conclusion that immuno-suppression in HIV-positive women may contribute to low birth weight by increasing women's susceptibility to infection and by compromising their nutritional status, however the mechanism by which this occurs has not yet been established.[109]

Additional data from Tanzania[65] showed that not only did weight gain among HIV-infected pregnant women decrease during a 15-week observation period, but significant risk factors for low rates of weight gain during pregnancy included having a low education level, reduced financial expenditure on food, short stature, low serum retinol (<0.35µmol/L) or selenium concentrations and advanced HIV-disease state.

Whilst maternal vitamin A deficiency has been associated with a higher risk of MTCT of HIV, the relationship is not a causal one as plasma vitamin A concentrations may be poorly associated with plasma HIV load.[103] One observational study suggested that low serum retinol increases the risk of mother-to-child transmission of HIV[110] but this was not confirmed by other trials of vitamin A and beta-carotene supplementation.[111] Data from Malawi[107], where HIV-infected pregnant women were supplemented with 10,000IU vitamin A pre-natally or received a placebo, did not show any effect of the vitamin on HIV transmission at six weeks or 12 months, but resulted in an improvement in birth weight. A study from South Africa similar to the Malawi study showed a significant reduction in the rate of premature births but no effect on birth weight.[113]

Selenium deficiency has been cited as a risk factor in mother-to-child transmission of HIV through all three possible routes of transmission, namely in pregnancy, at delivery and through breastfeeding.[113] In a study conducted among HIV-infected women in Tanzania, in which plasma levels of selenium were measured and CD4 counts were determined, levels of selenium were found to be proxy indicators for levels of other micronutrients among the women. In particular, high selenium levels were found to be marginally associated with higher vitamin A levels and lower vitamin E and haemoglobin levels. The HIV transmission risk in this study was found to be 34%. In particular, the study found the blood levels of selenium were inversely associated with the risk of

transmission during delivery and the early breastfeeding period (p=0.01). There was no association between low selenium levels and preterm or low birth weight deliveries; however, those children born to women with low levels of selenium were at increased risk of foetal death and child deaths within the first two years of life.

2.2.3.3. Micronutrient deficiencies and HIV disease progression

In reviewing the literature, it emerged that some of the initial data relating micronutrient status to HIV-disease progression were primarily undertaken in the developed world, mostly in the USA among homosexual males and drug users.[114,115,116] However, from the early 2000's the data began to evolve on the specific role of specific micronutrient deficiencies among HIV-infected women, starting in adolescence[117] and into pregnancy[118,93,101] In addition, there are now several reviews that have documented the role of vitamins and minerals in HIV.[100,102,119,120,121] There is inconsistent evidence that nutrition interventions improve nutrition outcomes. However, it is true that impaired nutritional status is associated with worse outcomes, but this can probably be attributed to an HIV effect which may or may not respond to nutritional interventions.

It has also been documented[122] that nutrient deficiencies tend to be highly prevalent in asymptomatic HIV-1 infected individuals and, in particular, zinc, along with vitamins A, E, B6 and B12 have each been found to play a role in optimal immune function. In research undertaken among 125 HIV-infected female drug users, who were examined every six months for a total of 3.5 years with blood parameters of nutritional status and immune function being collected at the same time, it was found that, with advanced HIV-1 disease, nutritional alterations were particularly marked by significantly lower plasma levels of vitamins A and E, selenium, retinol-binding protein and pre-albumin in

comparison to their male counterparts. The authors of this study furthermore mention that although nutritional factors are unlikely to be the most important aetiological determinants of HIV disease, they influence the initial susceptibility and subsequent disease progression.

Evidence from Zimbabwe[101] indicates that vitamin A, beta-carotene and folate and several other micronutrients are lowered in HIV-infected pregnant women. Vitamin A deficiency among women during pregnancy and lactation is known to have adverse effects of morbidity and mortality on both the mother and the infant. Among well-nourished mothers there is sufficient (>2µmol/L) vitamin A in the breast milk to benefit the newborn breastfed infant.

An intervention study on the effects of multiple micronutrient and vitamin A supplementation was undertaken in Tanzania[123]. In this study, 1078 pregnant women infected with HIV were enrolled in a double-blind placebo controlled trial in Dar es Salaam, Tanzania. The study was conducted to examine the effects of daily supplements of vitamin A, multivitamins (B, C, E) or both on disease progression using survival models. The follow-up period in the study was 71 months. Of the 1078 women, 299 progressed to stage 4 (or AIDS) or died. Of the women who died, 24.7% were on multivitamins, 26.1% were on multivitamins and vitamin A, 29% were on vitamin A alone and 31.1% received placebo. The authors concluded that as compared to placebo, women who received multivitamins were less likely to progress to stage 4.

A concern that arose from the findings of this study was that vitamin A supplements given alone had no significant effects on improving CD4 counts or reducing viral load. Furthermore, this study found that adding vitamin A to the multivitamin supplement reduced the overall benefit of multivitamins alone. However, the global recommendations from WHO, UNICEF and the International Vitamin A Consultative Group, 1997[124] remain that in areas where vitamin A

deficiency is endemic, women should receive a single dose of vitamin A (200,000IU) as soon as possible after delivery and not later than six to eight weeks post-delivery. The United Nations (UN) also recommends that in communities where there are multiple micronutrient deficiencies, appropriate supplements should be provided for pregnant and lactating women that cater for all the deficiencies.

Selenium has been documented as one of the minerals that may delay HIV-disease progression. This function arises from the roles of selenium as an antioxidant, in thyroid hormone metabolism and in reproduction and immune function.[125] There has been expansion on the role of selenium in regulating the activity of the antioxidant enzyme glutathione peroxidase. Low blood levels of selenium in HIV disease have been associated with low glutathione peroxidase activity, but with selenium supplementation it has been possible to reverse this trend.[105] There is evidence from Tanzanian HIV-infected pregnant women indicating that those followed-up over a 5.7 year period and who had low blood levels of selenium had significantly increased mortality ($p=0.01$).[126]

An exploration of the role of micronutrient supplements in HIV disease is obtained from studies assessing the effect of dietary intake of micronutrients, whilst others document the effect of micronutrient supplements (either as a single nutrient or a combination of nutrients) on HIV disease progression among adult men and women. The micronutrient supplementation studies can be categorised broadly into either longitudinal observational studies or observational and randomised placebo controlled studies. Thus, given the differences in methodological approach of the studies, the formulation and dosage of micronutrients offered in the supplement, the findings can at times be contradictory. For instance, a randomised controlled trial evaluating the effects of multivitamin supplements on HIV-disease progression in Tanzania found that inclusion of vitamin A as one of the arms of the trial resulted in lower CD8+ and

CD3+ cell counts, whereas multivitamin supplementation with the B-complex vitamins, vitamins C and E significantly slowed disease progression, thus raising concern that vitamin A supplements may produce adverse outcomes in HIV-infected populations.[123]

On the other hand, earlier studies on vitamin A deficiency and disease progression[127] among HIV-infected male drug users found low vitamin A levels led to faster HIV - disease progression. Yet, among HIV-infected, vitamin A-replete males in the USA[128], there was a less clear association between lower levels of serum vitamin A and HIV-disease progression. This latter population, however, was taking vitamin A supplementation. But among HIV-infected lactating women in South Africa it was found that, on average, retinol was significantly lower in HIV-positive mothers, even after controlling for the acute phase response.[129]

In a randomised placebo controlled trial in Zimbabwe to assess whether a single high-dose vitamin A supplement (400,000IU) can reduce the HIV incidence among postpartum women, it was found that the supplement had no effect on the HIV incidence (Hazard ratio [HR]: 1.08; 95% CI: 0.85-1.38]. However, the high-dose supplement did have a protective effect if the women were found to have low serum vitamin A levels (<0.7µmol/L) prior to commencement of the trial.[130]

Regarding serum vitamin B12[68] and vitamin E[128] there is documentation that deficiencies of both these vitamins can lead to faster HIV disease progression among adult males in the USA. In a study conducted among HIV-infected lactating women in South Africa[7], who were followed-up until 24 weeks after delivery, it was found that less than 45% of the mothers had sufficient serum levels of either vitamin B12 or folate. Significantly more HIV-positive (70.5%) than HIV-negative (46.2%) mothers had marginal vitamin B12 status ($p< 0.05$).

At 24 weeks, 70% of the infected and non-infected mothers had an alpha-tocopherol deficiency (< 11.6 micromol/L), but the difference was not significant.

In a review of a large retrospective observational database of HIV-infected patients in a Johannesburg Hospital, prior to the introduction of ARV therapy, it was established from a classification tree analysis (CTA) model that those African patients who received therapeutic doses of multivitamins, B complex vitamins or pyridoxine had delayed HIV disease progression. The median time to HIV disease progression was 32 weeks for those persons not on any vitamin supplementation, whilst for those patients who received supplementation the time to disease progression was 72.7 weeks. The differences between the groups getting vitamin supplements and those not getting them were significant for both median duration to AIDS (p=0.004) and median survival time (p=0.001).[131] It is possible, however, that the marked impact of vitamin supplementation may also be reflective of prior vitamin deficiencies in the group of persons being studied.

One of the fundamental flaws in micronutrient supplementation trials is the assumption that, for the population under review, everyone is deficient in the micronutrient being supplemented and therefore the intervention will have a positive effect on this.[120] Some of the trials, including both observational and randomised placebo controlled trials, which have been conducted in the past, focused on supplementation with a single nutrient. Yet, it must be realised that most nutrients interact with each other and therefore any supplementation trial should focus on a multiple micronutrient approach. In a review of the supplementation trials in women and children with HIV infection, which compared vitamin A, and ß-, carotene supplements with placebos, none showed a demonstrable effect on mortality, morbidity, CD4 and CD8 counts or on viral load.[132]

Studies previously undertaken among homosexual males and drug users concluded that HIV-infected men and women with nutritional deficiencies have a high risk of mortality. It was also established that sub-clinical malnutrition measured by serum albumin concentration and levels of vitamin A, B12 and selenium deficiency over time were each associated with HIV-related mortality, independent of CD4+ lymphocyte count <200cells/mm³ at baseline and over time. In addition, only selenium deficiency was associated with decreased HIV-disease survival and this effect remained when controlling for overall deterioration of nutritional status and baseline and over-time CD4 counts.[133]

Other research teams[102] mention that iron deficiency is the most common cause of low haemoglobin concentration, but vitamin A, riboflavin, vitamin B-12, folate and zinc are also important to erythropoiesis. Investigations have been conducted to determine the effects of zinc supplements on birth outcomes, haematologic indicators and counts of T-lymphocyte subsets among 400 HIV-infected pregnant women in Tanzania[134]. They found no beneficial effects of zinc supplements on pregnancy outcomes and instead found that zinc supplementation has a negative effect on haemoglobin concentration, which was used as a proxy indicator of HIV disease stage. Whilst both the group of women who received zinc supplements and the placebo group experienced an increase in haemoglobin concentration between baseline and six weeks postpartum, the increase was lower in the zinc supplemented group (11.5$\pm$ 17.9g/L) vs (15.2$\pm$18.6g/L). It has been proposed that increased levels serum zinc are likely to have a negative effect on iron absorption.

High serum levels of iron or zinc have been found to contribute to accelerated HIV disease progression.[135] Iron has been shown to accumulate in several tissues in the body during HIV infection and the levels increase with more advanced disease progression.[136] The accumulation of iron is attributable to the chronic

inflammatory response that results in increased storage of iron away from the circulatory system. There is also evidence that the accumulation of iron among HIV-infected persons may lead to the development of opportunistic infections and general weakening of the immune system. On account of this there are some researchers that believe that iron intake should be restricted among HIV-infected persons. Yet in a randomised placebo controlled double blind trial of iron supplementation (60mg elemental iron, twice weekly for four months) among HIV-infected persons in Kenya, HIV viral load did not increase[137]. The authors suggest that this may be because the levels of iron in the supplement were lower than those usually distributed in routine supplementation programmes.

To assess the impact of B-vitamins on HIV disease progression, researchers[114] examined the association between serum concentrations of vitamins B6, vitamin B12 and folate and the risk of progression to first acquired immuno-deficiency syndrome (AIDS) diagnosis and CD4+ cell decline over a nine-year period. Findings were that participants with low serum vitamin B12 concentrations (<120pmol/L) had significantly shorter AIDS-free time than those with adequate B12 concentrations (median AIDS-free time). Additional findings were that low vitamin B12 concentrations preceded disease progression. On the other hand, low serum concentration of vitamin B6 and folate were not associated with either progression to AIDS or decline in CD4 and lymphocyte count.

2.2.3.4. Dietary micronutrient intake, blood micronutrient levels and HIV disease

There are also studies that have assessed the dietary intake of persons living with HIV in order to determine adequacy of intake relative to the recommended dietary intake. One such study[114] assessed dietary intake of the study population and correlated the findings with serum levels of micronutrients. Mean and medium intakes from food and supplements combined were found to be above

the Recommended Dietary Allowances (RDA) for all three micronutrients studied. The same was not, however, the case among HIV-infected South Africans, whose micronutrient intakes were lower than the RDA levels.[74,138]

Other data relating dietary intake of micronutrients to biomarkers of nutritional status and disease progression amongst homosexual/bisexual males was obtained in the United States.[18] The highest levels of total dietary intake from food and supplements of vitamins C and B and niacin were associated with a significantly decreased progression to AIDS. They also noticed adverse effects of a high or low intake of vitamin A on disease progression. In a final multi-nutrient model they found only vitamin A, niacin and zinc deficiencies and low dietary intakes were significantly associated with progression to AIDS. Within the African context, vitamins and mineral supplements may not be as easily accessible or affordable as in the USA, thus fewer HIV-infected persons will be taking such supplements.

One of the earlier studies to understand the relationship between nutritional status, including micronutrients, and HIV infection in South Africa was undertaken in the Free State Province[74]. The impact on nutrition was assessed through laboratory parameters. In this study they recruited 90 HIV-1 sero-positive patients (male and female) from the immunology clinic between January and May 1995 and obtained blood samples to determine nutrient levels. Whilst the follow-up period among these patients was short, with only 16 patients followed-up in 1997, the researchers nonetheless found abnormal levels for several biochemical and haematological parameters among the HIV-infected persons as compared to the standard laboratory reference values.

Patients enrolled were deficient mainly in the antioxidant nutrients, namely albumin, vitamin C, vitamin E and retinol. About 60% of the patients had a significant decrease in haemoglobin levels, 55.5% had low serum ferritin, and

also low levels of vitamin B12 and serum folate. The study participants in this study were divided into 3 groups according to their CD4 counts, namely group 1: ≥ 500 cells/mm³, group 2: 200-499cells/mm³ and group 3: <200 cells/mm³. The majority of the patients had TB co-infection (30%), syphilis (10%), pneumonia (4.4%), dermatologic complaints (11.1%) and candidiasis (6.6%) and 15.5% were completely asymptomatic. Significant differences were noted for serum albumin (group 3 having significantly lower levels than group 2 (95% CI: -10;-1), serum ferritin (values for group 3 (95%CI: 3;128) and group 2 (95% CI: 10;158) significantly higher than for group 1. For vitamin E, there were significantly lower levels in group 2 than in group 1. The authors acknowledge that the differences in serum levels may be due to an acute phase response to HIV co-infections rather than a direct reflection of a deficiency. This study also attempted to correlate dietary intake of specific nutrients, anthropometry and biomarkers in a sub-group of 35 patients, however, given the small sample size it was not possible to observe any meaningful relationships.

Another study in the North West Province of South Africa compared nutrient intakes (using a validated quantitative food frequency questionnaire and biomarkers of nutritional status among 216 asymptomatic HIV-infected men and women and controls).[139] No statistically significant differences in mean nutrient intakes among the HIV-infected and non-infected study participants were found. However, the micronutrient intakes were sub-optimal. Furthermore, this study found that total body fat percentages also did not differ significantly between HIV-infected and non-infected subjects.

More recent data also from the Free State Province in South Africa[138] indicates that amongst HIV-infected women aged between 25 to 44 years, between 46.6% and 70.7% consumed ≤67% of the RDA for the essential minerals and vitamins namely total iron, selenium, folate and vitamin C. In addition, a quarter of the women in this study consumed sub-optimal levels of vitamins A, D and E.

The authors recommend that, on the basis of their study findings, HIV-infected women should be supplemented with essential vitamins and minerals.

2.2.3.5. Micronutrient levels and initiation of HAART

There is some data indicating that ARV therapy may alter the host response to some micronutrient biomarkers, by either increasing or decreasing the levels. Researchers investigated the effect of HAART on micronutrient levels among men and women in the USA.[140] This study consisted of 171 men and 117 women recruited between 2000 and 2003, with 62-69% having undetectable viral loads, most were in their mid 40's and had been infected for an average of 10 years. Most of the study participants were classified as poor.

The researchers found that with the exception of zinc, micronutrient deficiencies were less common than amongst persons not on anti-retrovirals. None of the micronutrient levels significantly affected CD4 counts and viral loads tended to be lower in persons with higher zinc and selenium levels, though not statistically significant. None of the women were deficient in vitamin E (<500µg /dL), but 36% of the women were deficient in zinc (less than 670µg/L). Selenium deficiency (<85µg/L) was observed in 3% of the women, and a vitamin A deficiency prevalence of 14% was also observed. In women the lowest retinol levels were found in the women with the lowest viral loads and this was statistically significant ($p<0.05$).

In a review paper on the relationship between micronutrient levels and HAART, researchers confirmed that micronutrient supplements can be used as an adjunct to HAART, however in some cases it has been established that micronutrient levels may become replete after HAART initiation. Because of the contradictory evidence reviewed by these researchers they recommend the need for further

studies to assess whether micronutrient supplementation is both essential and beneficial when providing HAART or is more likely to have adverse effects.[141]

2.2.3.6. Summary

There is sufficient evidence to indicate that micronutrients are important in the optimal functioning of the immune system, however, due to complexities in studying the contribution of individual or combinations of micronutrients, it is not possible "to define the areas where micronutrients may help in maximising the clinical status of HIV-infected patients".[135]

The role of micronutrients in prevention of mother-to-child-transmission and in delaying disease progression is well documented both in developed countries and on the African continent. However data on the consistent benefits of micronutrient supplementation among persons living with HIV is more ambiguous. Some studies include an assessment of multiple deficiencies because seldom do single deficiencies of any micronutrient occur alone. There are, however, differences in the length of follow-up, especially in those studies that are relating either dietary micronutrient intakes and or serum micronutrient levels to disease progression. Some studies ensured that when measuring serum levels of micronutrients amongst HIV-infected persons there is an adjustment for the acute phase response and various studies have used different acute phase response proteins, like CRP or serum ferritin, whilst others used alpha-1 antichymotrypsin. Furthermore, there are intervention studies where micronutrients are provided as prenatal supplements to assess the impact on birth outcome or on mother-to-child-transmission of HIV-1. Others have pleaded for evaluation of the effects of micronutrients in larger populations, especially among persons who are at more advanced HIV-disease states.[142]

Among HIV-infected pregnant women, optimal levels of micronutrients may affect maternal weight gain and also may influence birth outcomes such as birth weight and neonatal survival. In a study including zinc supplementation to HIV-infected women it was found that the supplement resulted in decreased concentration of iron and red blood cell count and had no effect on CD4 counts. This negative impact (especially on haemoglobin concentration) of the zinc supplement led the researchers to recommend avoidance of prenatal supplements for HIV-infected women.[134]

In HIV-infected adults, low CD4 counts over time and deficiency in vitamin A, vitamin B12, zinc and selenium may result in increased mortality. In particular, selenium deficiency was the only independent predictor of survival after controlling for baseline CD4 counts and CD4 counts ≤200/mm³.[143]

As more eligible HIV-infected persons across the world access ARV therapy, researchers have also assessed the effect of treatment on micronutrient levels. Presently it would appear that there is a need for more evidence from randomised controlled trials to fully assess whether micronutrient levels are enhanced or depleted amongst persons receiving HAART, as the current evidence base is not yet conclusive.[106]

2.3. MATERNAL HEALTH, HIV AND GROWTH OF HIV-EXPOSED CHILDREN

2.3.1. Overview of maternal HIV infection and nutritional status on child outcomes

Maternal nutritional status during pregnancy is an important predictor of birth weight and intrauterine growth retardation independent of clinical HIV disease progression, as described earlier. It is acknowledged that maternal nutritional

status before and during pregnancy is an important predictor of poor pregnancy outcomes and studies are appearing in the literature to examine these relations in the presence of HIV infection. It is also known that HIV infection increases micro- and macronutrient requirements as part of the body's immune response. Thus women who are both pregnant and HIV-positive are likely to be at an additional health and nutrition risk. According to one author, the direct and indirect causes of maternal morbidity and mortality may be more severe or debilitating in HIV-positive women, especially those with symptomatic HIV disease or AIDS.[144]

It appears that infants who become HIV infected in utero, at birth or postnatally through unsafe infant feeding are at a high risk of poor growth, frequent infections and early death.[145] The poor growth patterns of the HIV-exposed infants may be apparent even if they themselves are not infected with HIV. Furthermore, it has been shown that when the caring ability of a parent infected with HIV is compromised, this has a direct bearing on optimal growth and development of their infants.[146]

2.3.2. Trends in child mortality and HIV prevalence

Within South Africa there have been significant reversals in the trends of national indicators on infant and child mortality since the advent of HIV and AIDS. According to the Medical Research Council (MRC) of South Africa, 13% (294,000) of all HIV infections in children are in South Africa.[147] The 2003 South African Demographic and Health Survey[57] shows a 3% under-five mortality reduction, from 60 per 1000 live births in 1990 to 58 per 1000 live births in 2003. However, other sources[147] cite much higher under-five mortality estimates of 95 per 1000 live births.

The 2003 Burden of Disease Study[147] identified the top twenty mortality causes for children under the age of 5 years, with HIV/AIDS as the leading cause of death among young children, accounting for 40% of the deaths in 2000. Diseases associated with poverty (diarrhoea, lower respiratory tract infections and malnutrition) account for 20% of all deaths, and neonatal causes (low birth weight, asphyxia and infections) are responsible for another 16.4% of all deaths. In addition, in high HIV-prevalence settings child mortality has been associated with maternal illness and death.[148]

Whilst South African trends on infant mortality and HIV status exist, the effect of the HIV/AIDS epidemic on infant and child mortality is not easily measurable as the survival of the children exposed to HIV depends on their own parents and caregivers' health and HIV status.[149] A study to estimate the effects of maternal HIV status and other factors on infant mortality was undertaken and it established that infants born to HIV-infected mothers were three times more likely to die during infancy as compared to those born to uninfected mothers (HR=3.01; 95% CI: 1.64,5.50). The study concluded that, in Ghana, maternal HIV infection was a strong predictor of infant mortality. In addition, this study established that one in every ten children in the survey was born to an underweight mother (having a BMI <18.5 kg/m2). There was also a significantly higher infant mortality rate among boys (71) than girls (56). Being born with low birth weight was of greater mortality risk than children born with a normal birth weight. This finding was established regardless of infant feeding practice. This study did not include any analysis of the infant HIV status in relation to maternal health.

2.3.3. Child growth, morbidity, mortality and HIV infection

A study conducted in Zambia set out to investigate the factors contributing to poor growth of infants born to HIV-infected mothers between 2001 and 2003.

This study was conducted within a community where the preferred choice of infant feeding for HIV-infected mothers is breastfeeding, primarily due to the very high cost of infant formula. During the 16-week follow-up period, infant growth was measured through weight and height determinations and maternal health was assessed, including breast health, and haemoglobin status was also assessed in the women.[150] The data presented in this study was on 85 of 211 infants (40%) due to loss-to-follow-up or early infant death of some of the infants. Nineteen percent (19%) of the infants born to HIV-infected mothers and 11% born to un-infected mothers were born prematurely before 37 weeks gestation. Of these preterm children, 31% had a birth weight (<2.5kg) whilst of the term babies there were 7% who were of low birth weight. Between the six and 16 weeks follow-up period it was found that infants of HIV-infected mothers tended to have a lower weight/age and length/age Z-score than infants born to non-HIV-infected mothers and this difference was statistically significant ($p=0.04$) for weight at 6 weeks. However, when the infant birth weight Z-score was included in the analysis the effect of maternal HIV status on weight at six weeks ceased to be significant ($p=0.13$). In terms of infant feeding practices this study found that infants who were exclusively breastfed between 6 and 12 weeks had consistently lower Z-scores compared with infants exclusively breastfed for less than six weeks or for at least 16 weeks.

The authors of this paper concluded that HIV-exposed, uninfected Zambian infants displayed poor growth from as early as 6 weeks postpartum, primarily due to low birth weight. This study therefore placed emphasis on optimal maternal health interventions as a child survival intervention. This study did not, however, assess maternal CD4+ counts and viral load and it was not possible to determine the role of maternal disease burden on growth trends of the children in this study.

An additional study from Zambia investigates the linkages between maternal HIV status and infant health[151]. In this study they followed-up a cohort of 620 HIV-infected infants born to HIV-infected mothers in order to investigate associations between markers of more advanced maternal HIV-disease, child mortality and hospital admissions and infant weight till 4 months of age. They found mortality among the uninfected infants to be 4.6% (95% CI: 2.8-6.3) till 4 months of age. Infants whose mothers had $CD4^+$ T-cell counts of <350 cells/μL were more likely to die (HR: 2.87; 95% CI: 1.03–8.03) and were more likely to be hospitalised (HR: 2.28; 95% CI: 1.17–4.45) after adjusting for other factors, including maternal death and low birth weight. They also found that a maternal viral load >100,000 copies/mL was associated with significantly lower child weight up till 4 months of age.

In order to calculate the excess risks of child mortality as a result of maternal HIV status data was pooled from three longitudinal community-based studies that classified births by maternal HIV status from Uganda, Tanzania and Malawi.[15] The excess risk of child deaths associated with having an HIV-infected mother is 2.9 (95% CI: 2.3-3.6) and this effect lasts throughout childhood. On the other hand, they found that the excess risk associated with a maternal death is 3.9 (CI: 2.8-5.5) in the two-year period centred on maternal death. This study demonstrated that HIV impacts on infants through vertical transmission but also through higher child deaths associated with maternal death.

Given that in several countries in Southern Africa large numbers of the population are faced with hunger, food insecurity and malnutrition, HIV further exacerbates the situation. In reviewing trends in child nutritional status in Lesotho, Malawi, Mozambique, Swaziland, Zambia and Zimbawe from 2001, it was found that areas of higher HIV/AIDS prevalence showed more deterioration in child nutrition, particularly due to the drought that was ongoing in these areas at this time. In addition it was found that the most vulnerable households in

these countries were in more modern areas nearer towns and resources needed to be directed to them.[152] Whether this finding would hold true in the South African context is not known.

A study was undertaken in Uganda to assess the extent to which HIV infection predisposes children with malnutrition to recurrent bacterial infections.[153] In following 134 severely malnourished children, 22.4% had bacteraemia, mainly those less than 24 months of age. The study did not find a significant difference in mean weight, height and MUAC among the children with bacteraemia and those without. They also found that bacteraemia was a significant prognostic indicator of death in children with severe malnutrition; however, there was no association between bacteraemia and HIV in their cohort.

A review of available data on child mortality in Africa according to the HIV status of the mothers and the children was undertaken.[145] The analysis of this data indicated that the MTCT rate varied from 15% to 45%, of which 15 to 20% is from breastfeeding. Based on child mortality estimates for community-based cohorts, children of HIV-infected mothers have higher mortality rates than children of uninfected mothers. This same data was expanded to estimate child mortality associated with reasons for non-breastfeeding and weaning. Child mortality rate for children never breastfed was 221.3 per 1000. The main reported reason for not breastfeeding cited by 63.9% of the mothers was preceding maternal-infant morbidity. They also found mortality to have been higher among children who were weaned because of preceding morbidity compared to those who were weaned for reasons other than health (19.2 per 1000 versus 9.3 per 1000) respectively. The authors extrapolated from their findings that mortality among those children who were voluntarily not breastfed or weaned could provide the best estimate of the potential risk if HIV-infected mothers decided not to breastfeed or to stop breastfeeding in order to prevent vertical transmission. Using their data they concluded that if infants born to HIV-

infected mothers are breastfed, they would expect 16% to become HIV infected and 0.9% to die (16.9%), resulting in a net HIV-free survival of 83.1%. However, if HIV-positive mothers voluntarily decided not to breastfeed the expected mortality would be 3.5% and the net HIV-free survival would be 96.3%. This would then imply a net positive benefit to HIV-free survival of 13.2% through self-selected avoidance of all breastfeeding.

The linkage between poor maternal health and HIV and child health outcomes has also been documented from urban medical centres in the USA. Data indicates that HIV-1-infected infants born to women with advanced HIV-1 disease were at increased risk for rapid disease progression.[13] Specifically, the researchers found that children born to mothers with CD4 cell counts above 100 000 copies/ml progressed more rapidly than children born to mothers with less advanced HIV disease, controlling for child antiretroviral therapy and year of birth.

According to the Ghent Group, 2001, whilst child mortality may be an outcome in PMTCT, in the conduct of any research in order to observe a "meaningful" difference in mortality a follow-up period of up to five years after birth is required. These authors suggest that an assessment of HIV-free survival may thus be an alternative to measuring HIV transmission risk only.[154]

2.3.4. Maternal caring capacity, psychosocial wellbeing and child growth

The caring capacity of HIV-infected mothers for their children may also be compromised by their own psychosocial state post-delivery. Others allude to growing interest in the scientific literature to establish whether depression and stress account for variability in HIV disease progression.[155] Further, it is mentioned that while there appears to be an association between depression,

stress and HIV disease progression, the actual biological mechanisms that precipitate this are not fully understood. More recent research acknowledges, however, that there is contradictory evidence on the association between depression and biomarkers of HIV disease progression, especially when the assessments are being carried out over a long period of time.[11] Other researchers[9] state that "the impact of depression on morbidity and mortality among women with human immunodeficiency virus (HIV) has not been examined despite the fact that women with HIV have substantially higher rates of depression than their male counterparts".

A longitudinal prospective study among HIV-infected women in the USA determined the association between depression and HIV-related mortality and disease progression (measured by changes in CD4 lymphocyte counts).[10] A standardised depression scale was applied in this research. It was found that women with depressive symptoms were twice as likely to die as women with limited depressive symptoms (Relative Risk [RR]: 2.0; 95% confidence interval [CI], 1.0-3.8). Amongst those women with CD4 cell counts <200cells/mm^3, HIV-related mortality was 54% if they were chronically depressed, for those with intermittent depression it was 48% and for those with limited or no depressive disorders it was 21%.

Overall it was found that the more depressed mothers displayed a greater decline in CD4 cell counts. Other authors have investigated the impact of depressive symptoms on more advanced HIV disease in women and found that those women who had chronic depressive symptoms were more than twice as likely to die compared to those with limited or no symptoms. AIDS-related mortality was highly likely amongst women who had low baseline CD4 counts, high viral loads and HIV-related symptoms at baseline.[12]

Data from Tanzania reported on depressive symptoms among HIV-infected women from pregnancy and followed them up for more than 12 months postpartum.[11] They found that during the follow-up period 57% of the women in the study had experienced some symptoms typical of depression. In addition, this study found an association between depression and HIV disease progression (HIV clinical stage 3/4 [HR = 1.61, 95% CI: 1.28 to 2.03] and mortality [HR = 2.65, 95% CI: 1.89 to 3.71].

2.3.5. Summary

This review assists in linking the maternal wellbeing, health and nutritional status to the mother's ability to care for her newborn child. HIV-infected women may, due to their disease state, display increased levels of depression and poor coping ability with their maternal role by virtue of their diagnosis. In addition, it is clear that there is an interaction between the psychosocial wellbeing of a mother, her HIV disease progression and also her caring capacity for her child.

CHAPTER 3 - SCOPE OF RESEARCH AND HYPOTHESIS/PROBLEM STATEMENT

3.1. INTRODUCTION

Maternal nutritional status during pregnancy is an important predictor of birth weight and intrauterine growth retardation, independent of clinical HIV disease progression.[156,157] On account of this, there is a growing body of literature from Africa that examines these relations in the presence of HIV infection. It is also known that HIV infection increases micro- and macronutrient requirements as part of the body's immune response, making women who are both pregnant and HIV-positive more likely to be at an additional health and nutrition risk. The direct and indirect causes of maternal morbidity and mortality may be more severe or debilitating in HIV-positive women, especially those with symptomatic HIV disease or AIDS.[158]

There is limited data from Africa on the effect of HIV on body composition (anthropometry) during pregnancy and even postpartum. However, it is well documented that both pregnancy and lactation are periods of rapid changes in the body composition of women. Research from Zimbabwe[80] indicates that, independent of CD4 counts, weight loss is a common manifestation of HIV infection and that it is strongly correlated with predicting survival. It is for this reason that the nutrition component of the Serithi study sets out to examine the interaction between psychosocial factors and maternal nutrition on disease progression, infant feeding and growth of the HIV-exposed baby over two years.

The concern over maternal health and nutritional status, especially during the postpartum period, has been particularly driven by the findings of Nairobi-based researchers.[23] The findings of this study indicated that HIV-positive mothers had higher mortality rates if they breastfed their infants. Interestingly, in this study

mothers did not self-select the infant feeding option but were being randomised into either feeding arm. It was also found that maternal death was associated with subsequent infant death and this effect was even stronger after controlling for infant HIV-1 infection status. The Nairobi study findings were in total contrast to those from Durban, South Africa[49], which included an analysis of morbidity and mortality in mothers enrolled in a randomised study of Vitamin A supplementation. Neither of these studies provided detailed information on the mode, duration and quantity of breastfeeding and the associated mortality risks. In addition, the two groups of women enrolled in the trials are not directly comparable. Despite the limitations in these studies, they did highlight the need to monitor nutritional status of women who are HIV positive, regardless of their infant feeding choice.

Documentation from studies that have followed both mothers and their infants and the separate assessment of the benefit of HIV prevention interventions to one or the other is limited.[158] This has often been cited as one of the major flaws of prevention of mother-to-child-transmission of HIV (PMTCT) programmes, which seem to focus only on ensuring infant survival but seldom assess the health outcomes for the HIV-infected mother. This thesis will report on the impact of HIV infection among mothers on the childhood outcomes over a two year follow-up period.

Whilst the effect of HIV on micronutrient status is known, there is limited data on the relative importance of the effect over time. One review[100] mentions that micronutrient deficiencies, whether existing before HIV infection or directly resulting from HIV, may affect the transmission and progression of HIV. The most challenging aspect of the importance of micronutrients is the need to establish which micronutrients would be likely to have a positive effect in slowing HIV disease progression and the conditions under which this occurs. Further it is also important to understand the contextual issues such as the predominant

dietary practices and diets including the intakes of inhibitors of micronutrient absorption and the impact of seasonality on diets as they may all contribute to the outcomes of nutritional interventions.

3.2. SCOPE OF RESEARCH

Maternal nutritional status is an acknowledged risk factor for pregnancy outcome. The additional influence of socio-economic and psychological factors associated with HIV disease progression, mothering capability and infant outcomes have not been extensively studied on mothers in the African context. Given that the PMTCT programme in SA provides for two options of infant feeding, it was of interest to assess what the feeding intent and actual practices would be. This research provides information on factors associated with the selection of either of the two choices on infant feeding in a peri-urban setting and adherence to the prenatal infant feeding choices of HIV-infected women in comparison to actual infant feeding practice after delivery.

This thesis describes associations between nutritional status, as assessed through anthropometric measurements and micronutrient levels in the blood, and HIV disease progression among women enrolled in a prevention of mother–to-child-transmission of HIV-1 programme. It also explores how far psychosocial factors were related to infant feeding practices and outcomes. This thesis will also document whether those mothers who chose to breastfeed were of better or poorer nutritional and immuno-status (determined through CRP, ferritin and CD4 counts) than those mothers who selected to formula-feed and to assess what the trends in nutritional status and CD4 counts were over a 24 month follow-up period.

Concern over the nutritional status of HIV-infected mothers is growing[81], primarily due to the realisation that maintaining good health and nutritional status of mothers post-delivery is one of the key contributors to reversing the trends in maternal orphanhood in the HIV context. Within South Africa there is, as yet, no study that has systematically documented, over a two year period, trends in body composition, micronutrient status and CD4 counts and early infant feeding practices in a peri-urban setting.

The value of the study being reported on in this thesis is that it measures long - term changes up to 24 months post-delivery among a cohort of HIV-infected women living in peri-urban and urban settings, using non-invasive methods. Further, this study provides a unique opportunity to link anthropometric measurement changes with disease progression, which is measured through CD4 count determinations at intervals of six weeks and 6, 12, 18 and 24 months, as well as psychosocial variables of wellbeing. This study includes an assessment of whether in the first three postnatal months there are significant anthropometric measurement changes by infant feeding method of the mothers. Based on the findings from research, such as that conducted in KwaZulu-Natal[8,160] in a predominantly rural setting, it might be expected that the trends in nutritional status in an urban setting among HIV-infected women would be different i.e. that the women would be better off from a nutritional point of view. The value of this research in this thesis is that it assesses the trends in anthropometry (body composition) using simple measurements that can be applied in the normal delivery of health services in South Africa.

There is extensive documentation on psychosocial variables impacting on HIV disease[10, 11,12,160-163]. This thesis is unique in the South African context in that it determines the levels of psychosocial wellbeing and trends over time and relates this to infant feeding choices and practices. This thesis will assess the

relationship between HIV disease progression (measured by CD4 cell count) as well as the caring capacity of the mothers (manifesting as optimal infant growth).

3.3. RESEARCH QUESTIONS

In summary, the following questions were posed in the research to be described in the subsequent chapters of this thesis:

a. What were the prenatal feeding choices and postnatal infant feeding practices of HIV-infected women in Tshwane and what factors including nutritional status of the mother determined their selection?

b. What were the infant feeding practices of postnatal HIV-uninfected women and how do they compare to those of the HIV-infected women?

c. What were the longitudinal changes in body composition and determinants thereof amongst a cohort of HIV-infected women from six weeks postpartum until 24 months?

d. Were there any differences in the first six weeks post-delivery between the anthropometric and biomarker status of breastfeeding and non-breastfeeding HIV-infected mothers?

e. What were the psychosocial determinants of well-being and stigma over time among HIV infected mothers?

f. What was the HIV transmission rate among children born to HIV-infected mothers over a two-year period?

g. What was the outcome for mothers and babies and how was this linked to maternal health factors and infant feeding practices of the HIV – infected mothers?

CHAPTER 4 - PARTICIPANTS AND METHODS

4.1. INTRODUCTION

This was a prospective, longitudinal, descriptive study in which pregnant women (aged 14 years and above) were enrolled within an average time of four weeks after testing positive for HIV-1. Women participated in interviews at the time of study enrolment along with additional interviews up to 24 months post-delivery. The eligible women were generally at 28 weeks of gestation at recruitment between June 2003 and June 2005 and were from four antenatal clinics in townships serving two large, demographically similar communities in Tshwane (Pretoria), South Africa. The clinics provided health services to a primarily black, low to middle socio-economic class, urban population and were thus representative of a large portion of the urban community in South Africa.

Trained HIV counsellors, employed by the clinics, provided post-test counselling using standard PMTCT procedures and referred women to the research project. All study participants provided written, informed consent. A separate appointment was made for the first study interview to clearly separate the study from the service. In the recruitment interview at around 28 weeks of pregnancy information was gathered on age, education, socio-economic and marital status and obstetric history, and the psychosocial status of each participant was assessed.

Selection of study participants was based on the assumption that HIV infected women who self selected for enrollment into the study would not differ in characteristics from other HIV infected women who choose not to be included in this study.

Inclusion criteria:

- Sero-positive women, who have undergone voluntary counseling and testing and are aware of their HIV status. The women were expected to be be residing in Pretoria.

***Exclusion criteria*:**

- Women with an AIDS defining illness. Women who are not permanently resident in Pretoria and women who will not be staying with their infants for the first 6 months post delivery.

This study is an exploratory, descriptive study aimed at seeing which of a number of nutritional status variables predict HIV progression. An attempt wasl be made to recruit sufficient subjects so that multiple regression models can be fitted to examine the relationship between the explanatory variables and disease progression as defined by the decline in CD 4 counts. The study population of the Serithi project was therefore estimated to comprise of approximately 800 women recruited at the 4 clinics, however for the nutrition related study, a subset of 150 to 200 of these subjects were to be included.The final numbers of women recruited was 317.

Interviews were conducted in the subjects' home language, either Sepedi, isiZulu or Setswana, which are the most common languages spoken in the areas served by the clinics.

The follow-up interviews for the nutrition component of the study were conducted at three days, six weeks, three months, six months, 12 months, 18 months and 24 months post-delivery. See Table 4.1 for an outline of the assessments conducted at each of these visits. All the questionnaires administered at each of the visits are appended to this thesis in Annexure 1. At these follow-up visits a physical examination was conducted, anthropometric measurements were taken and blood samples were collected and a detailed

infant feeding questionnaire was administered up to three months postpartum. At every visit women were also asked to indicate if they had had any illnesses in between the visits.

A subset of 53 confirmed HIV-negative mothers was recruited from the same four clinics where the main cohort of mothers came from. The comparison mothers had undergone routine voluntary counselling and testing at the clinics and were thus assumed not to differ from the study mothers in all other respects. This was to form a comparison group for feeding practices and for the assessment of biomarker levels. The HIV-negative women were interviewed only at six weeks postpartum.

The Serithi Study consisted of a variable number of between 10 and 12 field workers or research assistants who were responsible for the collection of data. There were four supervisors of whom three were retired nurse midwives and one a medical doctor. Training was conducted periodically on the questionnaires, on blood collection techniques and on ethics and ethical considerations pertaining to confidentiality of the data and patients' rights. Questionnaires were divided into those that focused on psychosocial data and those that were medical/of nutritional content. Actual field work in Serithi commenced after the pilot study in June 2003.

Once enrolled into the study the mothers and babies were expected to attend all scheduled visits. In addition, there was a request for mothers to bring the antenatal card to the first and second visit, and the infant's "road-to–health" card to all visits after birth. If the baby was cared for by another person, then that person was expected to bring the baby for visits. If a baby died at any time during the follow-up period, the mother was expected to continue her scheduled visits. The details of the assessments at each visit are contained in Table 4.1.

In order to minimise loss-to-follow-up, the Serithi Project applied an active system to trace the missing participants. Household visits were undertaken to the community by a dedicated research assistant every Tuesday and Wednesday in an attempt to trace those mothers who had not been coming for regular visits.

4.2. METHODS

Table 4.1: Assessments undertaken at scheduled visits

Time of visit	Tasks performed
28 weeks pregnancy (recruitment interview)	28-week questionnaire
3 days after birth of infant (early infant feeding data)	PCR heelprick to infant. Birth infant feeding questionnaire
6 weeks (nutrition study baseline values for biomarkers)	6-week infant feeding and growth questionnaire. PCR heelprick to infant. Blood from mother and maternal anthropometry
3 months	3-month psychosocial questionnaire. Heelprick to infant Infant feeding questionnaire
6 months	6-month questionnaire. Bloods from mother and maternal anthropometry If the baby was ever breastfed, repeat heel prick
12 months	12-month questionnaire. Bloods from mother and maternal anthropometry.
18 months	18-month questionnaire and blood from the mother. Infant growth and health assessment. Psychosocial assessment.
24 months (final interview)	Nutritional and medical questionnaire and bloods from the mother. Infant growth and health assessment.

4.2.1. Socio-demographic information

Socio-demographic information included questions concerning the woman's age, marital status, level of schooling, employment status, type of house, whether running water was available inside the house, a flushing toilet, electricity and a refrigerator. As a measure of socio-economic status a "housing score" of zero to five was developed by assigning one point to each of the following, if available: if

the home was constructed of brick or concrete, had running water, a flushing toilet, electricity and a refrigerator.

In order to assess the changes in the socio-economic and living circumstances, questions were included at the three month visit. This included questions on whether the participant lived with her partner and was receiving financial support from him.

4.2.2. Anthropometric measurements

Anthropometric measurements were taken of both the mothers and children over the post-delivery two-year period. For the mothers, weight was measured in light clothing, to the nearest 100g using an electronic digital scale (Scales 2000, Durban, South Africa), whilst height was taken without shoes to the nearest 0.1cm using a stadiometer (Scales 2000, Durban, South Africa). Validation of equipment was performed every 2 months using standard weights to ensure correct calibration of the weighing equipment. Further the researcher and the medical doctors on the team re-assessed the weighing and measuring techniques of the research assistants at all 4 clinics every other week.

A non-stretchable tape measure was used to take the mid-upper arm circumference measurement (MUAC). MUAC is the circumference of the left upper arm measured at the mid-point between the tip of the shoulder and the tip of the elbow (olecranon process and the acromium). These measurements were taken at six weeks as well as at six, 12, 18 and 24 months (see Table 4.1).

Weight and height measurements were later computed into Body Mass Index (BMI). BMI is a ratio of weight in kilograms divided by height in meters squared

and is a measure of current nutritional status and is not age dependent.[62] Table 4.2 indicates the classification of BMI.

Table 4.2: Classification of BMI

Classification	BMI category
Underweight	<18.5
Normal weight	18.5-24.9
Overweight	25.0-29.9
Obese class 1	30.0-34.9

Adapted from: Gibney, MJ, Ljungqvist, O and Dowsett, J (2005) [62]

Mid upper arm circumference was used as a measurement of body composition. Cut-off points for MUAC as an indicator of undernutrition are indicated in Table 4.3.

Table 4.3: Classification of Mid-Upper Arm Circumference

Level of undernutrition	Mid-upper arm circumference
Moderate	18.5 cm
Severe	16.0 cm
Normal	>18.5cm

Adapted from: http://www.unsystem.org/SCN/archives/adults/ch06.htm accessed May 02, 2008

For the children, weight was measured to the nearest 0.1kg using an electronic scale (Durban Scales, 2000) in 100g increments. To measure the height of the children who could not yet stand unassisted, supine length measurements (using non-stretchable tapes affixed to the bed) were taken, with the child lying on an examination bed. For those children who could stand unassisted, height was measured in a standing position. The height measurements were taken to the nearest 0.1cm with a tape measure affixed to the wall.

Nutritional status was assessed using algorithms developed by the WHO and CDC's anthropometrical programme (Nutristat). The raw anthropometric data were transformed into Z-scores and the data was evaluated using the National Centre for Health Statistics/WHO reference data. These anthropometric

measurements were used to compute weight-for-height (w/ht), weight-for-age (w/a) and height-for-age (ht/a). Table 4.4 indicates the interpretation of each of the Z-scores.

Table 4.4: Interpretation of Anthropometric Z-scores

Z-score	Interpretation
Low weight-for-height Z-score (WHZ)	A WHZ score below -2SD is wasting, an indicator of acute, severe weight loss
Low height-for-age Z-score (HAZ)	A HAZ below -2SD indicates stunted growth, and reflects chronic malnutrition
Low weight – for – age Z score (WAZ)	A WAZ score below -2SD is reflective of underweight

WHO (http://www.int/nut-growthdb/intro_text.htm (accessed May 02, 2008).

4.2.3. Infant feeding assessment

In accordance with the National PMTCT protocol, trained HIV counsellors, employed by the clinics, provided post-test counselling using standard procedures and referred women to the research project. The post-test counselling provided women with information on the two infant feeding options available in the SA PMTCT programme, namely exclusive breastfeeding, followed by early, abrupt cessation or exclusive formula-feeding for six months. In the routine PMTCT counselling sessions women were informed of the availability of free infant formula if this was the method of feeding that they opted for.

During the first Serithi Study interview during pregnancy, women would then, on the basis of information imparted during the PMTCT counselling session, inform the counsellor which feeding option they intended to feed their baby with. All women participating in this research received routine antenatal care and were offered a single dose of nevirapine, which they were instructed to take during labour to reduce mother to child transmission. Upon delivery, their newborn infants were also to be offered a single dose of nevirapine within 72 hours.

At each of the subsequent study interviews mothers were also asked to indicate which additional foods (liquids and semi-solids) they were feeding their infants to supplement breastmilk or formula milk. At every visit, HIV-infected mothers who selected to breastfeed their infants were requested to indicate the age of the infant, when they stopped, and the process they followed in ceasing to breastfeed. Mothers who breastfed at any time during the follow-up were classified as breastfeeders and those who never breastfed were classified as formula-feeders.

4.2.4. Clinical assessment

Clinical medical assessments were conducted on the women and a medical history on illnesses since the last visit was collected through a standardised questionnaire.

4.2.5. Nutritional biomarkers and immunological assessment

A non-fasting venous blood sample was collected from the mothers by venipuncture during the regularly scheduled participant visits, as tabulated in Table 4.1. All clinics used as study sites were provided with the same blood collection and processing tubes from the Ampath Central Laboratory in Pretoria by Ampath Clinical Trials. Details of the lab collection flow chart are contained in Figure 2. Blood samples were protected from bright- and direct light and immediately placed into a cooler box prior to collection by laboratory personnel.

Blood specimens collected at six weeks (baseline), six months, 12 months, 18 months and 24 months were used to examine haemoglobin, T-lymphocyte count, and serum concentration of select nutrients. Table 4.5 shows the measurements,

instruments used and the methods for assessing each blood specimen as well as the cut-off points for the normal ranges of each biomarker.

Table 4.5: Methodologies for Micronutrient, biomarker and immunological parameter assessment (Ampath Clinical Trials, Pretoria)

TEST	INSTRUMENT	PRINCIPLE OF THE METHOD	REFERENCE RANGE
CRP	DADE BEHRING BNII (before 5/6/2006)	Nephelometry	0.00 - 5.00
	Roche Modular P800 (from 5/6/2006)	Immunoturbometric	0.0 – 4.9
Vitamin A	Waters 2690 HPLC	High performance Liquid Chromatography	260 - 720 µg/L 300 – 800 mg/L
Vitamin E	Waters 2690 HPLC	High performance Liquid Chromatography	6 - 10 µmol/L 5 – 18 µmol/L
Iron	Roche Modular P800	Electrochemillminescence	9 – 30µmol/L
Transferrrin	Roche Modular P800	Electrochemiluminescence	2 - 3.6 g/L
%Saturation	Manual	Calculation	15 – 50%
Ferritin	Roche Modular E170	Electro-chemi iluminescence Immunoassay	13 – 150ng/mL
Vitamin B12	Roche Modular E170	Electrochemiluminescence Immunoassay	145 – 637pmol/L
Red cell folate	Roche Modular E170	Electrochemiluminescence Immunoassay	597 – 2334nmol/L
Selenium	ICPMS (before Jan 2006)	Inductive Coupled Plasma Mass Spectrometry	46 – 143 µg/L
	Agilent 7500 ce (since Jan 2006)	Inductive Coupled Plasma Mass Spectrometry	70 – 130 µg/L
Haemoglobin	Beckman Coulter HmX	VCS Flow Cytometry	12 – 16g/dL
CD4 lymphocytes	FACS caliber	Flow Cytometry	500 – 2010cells/µL
Iron	Roche Modular P800	Electrochemiluminescence	6.6 – 26

At subsequent visits to the Serithi Project, the women were asked if they had commenced HAART and, if so, the date of commencement and whether they were continuing to take the medication as prescribed. Records at the Immunology clinic at Kalafong Hospital were reviewed to verify the information supplied on HAART by the mothers.

4.2.6. HIV transmission assessment

Within a period of three days postpartum, HIV-1 infection status of the children was determined by collecting heel prick blood and using a nested HIV-1 DNA PCR assay performed on filter paper (Roche Amplicor version 1.5 HIV DNA PCR; Roche molecular systems, Basel, Switzerland). Tests were repeated at three days postpartum, 6 weeks, and 3 months of age. Subsequent PCR testing was performed on breast fed infants, until 3 months after cessation of breastfeeding. The blood specimen was collected on absorbent filter paper and kept in the Project offices for collection every fortnight. Sufficient blood to saturate at least three of the five circles with blood collected from an infants heel prick was collected. The DBS were collected fortnightly by the National Institutes of Communicable Diseases personnel. Each sample, upon drying, was placed in an individual, sealed envelope to avoid contamination with other samples.

4.2.7. Measures of Psychosocial well-being

Table 4.6 describes all the constructs of psychological well-being that were applied to the study participants.

4.2.7.1. Disclosure

At both the 28 week and three month Serithi interviews, data were gathered on whether women had disclosed their HIV status and to whom and reasons for disclosure or non-disclosure. Early disclosure refers to disclosure during the pregnancy but before the baseline interview and late disclosure refers to disclosure subsequent to the baseline interview up to the interview performed three months postpartum. Disclosure was reported on as a percentage.

4.2.7.2. Stigma

Two scales were used to assess stigma: personal or internalised stigma, which refers to the person's experience of or fear of being stigmatised (12 items α = 0,72) and perceived community stigma, which is a person's perception of the stigmatising attitudes existing in the community (12 item α = 0,75). The stigma scales were adapted from research conducted in the United States[163] and pre-tested in a community sample of 1077 subjects in Tshwane. The scales were adapted in such a way as to make them more culturally acceptable to our population. Stigma was reported on as a score.

4.2.7.3. Depression

The Center for Epidemiologic Studies Depression scale[164] consists of 20 items designed to measure depressive symptoms experienced during the previous week. The measurement excluded somatic items, which are confounded by medical symptoms, as recommended by others (15 items α = 0.88).[162]

4.2.7.4. Coping

Active and negative coping styles were assessed using an adapted version of the Brief Cope Scale[165], based on a model of coping behaviour.[166] Positive or active coping is regarded as constructive ways of coping, such as acceptance and positive reframing (13 items α = 0.75). Avoidant or Negative coping involves avoidance, denial, self-distraction and substance use (8 items α = 0.54). Table 4.6 summarises these psychosocial measures.

4.3. STATISTICAL ANALYSES

The statistical evaluation was performed with the help of a biostatistician from the Medical Research Council of South Africa and from a data manager from the University of Pretoria. Descriptive statistics and chi-square tests were conducted. Bivariate and multivariate logistic regression models were also undertaken. In addition, analysis of co-variance was undertaken to assess differences in micronutrient levels while controlling for the CD4 count. Detailed methods of analysis are presented in the individual component chapters of this thesis.

Baseline demographic and nutritional status variables between HIV-infected and HIV-uninfected mothers were tested for significance using the Chi-square test for categorical variables and the Student t-test for continuous variables.

To analyse the factors associated with weight changes for the HIV-infected mothers over time, stepwise regression analyses using the following independent variables were performed: CRP, CD4+cell count, changes in CD4+cell count, nutritional biomarkers.

Feeding practices amongst women were assessed as early as three days after delivery and at this time we found that there were 21 mothers who only breastfed for between one and seven days. These mothers were categorised as neonatal breastfeeders. These 21 women were eventually re-categorised into their infant feeding practice that prevailed after this neonatal period. Detailed methods of analysis are presented in the individual component chapters in this thesis.

Maternal baseline characteristics were summarised using means for continuous variables and proportions for categorical variables. Continuous variables were

compared using Student t-tests for means and categorical variables were compared using Chi-square tests.

In the analysis of absolute CD4 cells, counts for the study participants were stratified in accordance with the CDC Prevention Criteria for HIV/AIDS classification namely (>500, 201-499 and <200 cells/mm^3)

Adjustments were made for CD4 cell counts, CRP and serum ferritin as a means of controlling for the confounding effect of the acute phase response in multivariate analysis.

4.4. ETHICAL CONSIDERATIONS

Institutional review board approval for this study was obtained from the Faculty of Health Sciences' Research Ethics Committee at the University of Pretoria, South Africa (Number 209a) and the Human Investigation Committee of Yale University School of Medicine, USA (Number 2235). All study participants provided written informed consent and were provided with a travel allowance of ZAR30.00 per interview.

To comply with internationally accepted ethical standards, researchers undertook the following measures:

- Names of participants and their offspring were recorded on questionnaires or blood specimens only once prior to recording this information in the data base. Thereafter unique patient identification numbers were assigned and used for labelling of samples.
- Whenever CD4 counts and other biomarker data were received from Ampath or NICD, the unique patient identification number was utilised.

- Participants who requested to know the HIV status of their children were individually issued with the result sheet as received from the NICD.
- During analysis the results were reviewed only from the participant number and not by the clinic name.
- Enrolled participants continued to receive care from the clinics and hospitals to treat any opportunistic or other illnesses that might have occurred during the follow-up period.

After April 2004, when HAART became available in the public health sector in SA, study participants found to have severe immuno-suppression (CD4 cell count < 200cells/μL) were referred to the immunology clinic at Kalafong Hospital, a referral hospital serving the clinics included in the study, for continued care.

Prior to the conducting of the study, letters of request were sent to the Tshwane Municipal Government, the Gauteng Department of Health (Superintendent), Clinic managers and senior officials at clinic level in all the four clinics. The letters served to inform the recipients about the Serithi study protocol and to seek permission for the conduct of the survey in Tshwane.

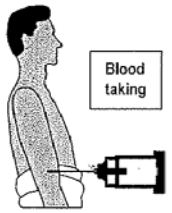
Table 4.6 Constructs of Psychosocial Wellbeing applied

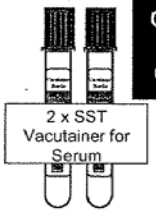
Construct	Scale	Comments	No. of items	Cronbach alpha (present study)
Internal stigma	Perceived stigma of HIV/AIDS: Personal view	Adapted from scales developed by Westbrook and Bauman [28] [Visser, Kershaw, Forsyth & Makin, Development of an HIV Scale –in press]	12	0.75
Support	Multidimensional Social Support Inventory (MSSI) [29]	Two aspects positive and negative		
Positive		Scale created using "practical, affirmational and emotional support"	9	0.87
Negative		Excluded one item	3	0.56

Self-esteem	Rosenberg Self-Esteem Scale [30]	Minor changes in wording for cultural appropriateness	10	0.75
Depression	Center for Epidemiologic Studies Depression (CESD)[31].	Excluded somatic items which are confounded by medical symptoms as recommended by Kalichman, Rompa & Cage[32]	15	0.88
Coping	Brief Cope [33]	Fifteen items from original scale included with minor wording changes. 9 items added to make the measure more HIV-specific. An exploratory factor analysis identified two factors - positive and avoidant Two separate scales then created		
Positive			13	0.75
Avoidant			8	0.54
Power Scale		This is a scale that has been developed by the Serithi group to measure the degree of autonomy a woman has within her household.	7	0.60
Knowledge score		This scale includes questions on various aspects of HIV/AIDS and was developed by the Serithi group to assess a woman's knowledge about her disease	15	0.64

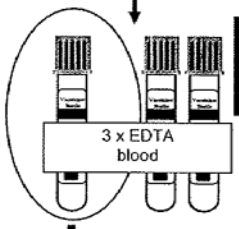
SERITHI Project **Figure 2: Ampath Flow Diagram** **C161**

Visits: Week 6, Month 6, 12, 18, 24, 30, 36, 42 and 48





Gently invert tubes 6 times. Allow to clot for 30-45 min.



Gently invert tubes 5-10 times.

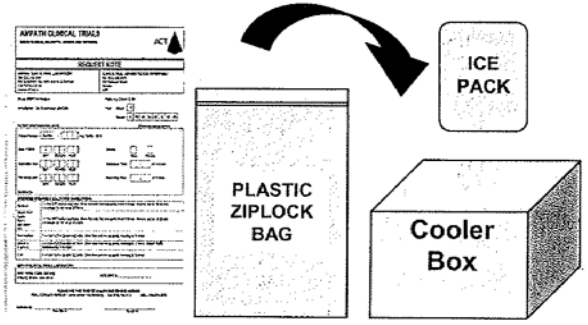
WRAP 1 TUBE IN FOIL!

SPECIMEN HANDLING PROCEDURES

- Complete the request note
- Write patient number and visit on **ALL** barcode labels – including tubes and request note copies
- Place the WHITE COPY of the completed request note in the side pouch of the plastic zip-lock bag
- Place the specimens in the zip-lock bag
- Place the zip-lock bag in the cooler box
- Take ice pack wrapped in bubble wrap from the freezer and place in cooler box with specimens
- Close the lid
- Contact Ampath for pick-up of specimens at:

012-427 1802/4/6

Figure 2: Ampath flow chart



CHAPTER 5 - FACTORS AFFECTING HIV-INFECTED WOMEN'S ANTENATAL CHOICE AND POSTNATAL PRACTICE OF INFANT FEEDING IN TSHWANE

5.1. OBJECTIVES

1. To describe prenatal infant feeding choices and actual feeding practices of HIV-positive women up to three months post-delivery and to establish the psychosocial and economic determinants thereof.
2. To describe the infant feeding patterns from birth to 6 weeks of HIV-negative mothers and to establish the social and economic determinants thereof.

5.2. SUBJECTS AND METHODS

The Serithi research project was conducted in the Mamelodi and Atteridgeville communities in Tshwane, the administrative capital of South Africa. These are both historically disadvantaged communities with a mainly African population and a large number of people living in informal housing. Mamelodi is a township situated on the eastern side of Tshwane, whilst Atteridgeville is on the western side. All sites chosen for inclusion in the Serithi Project were fully implementing PMTCT services when the study commenced in July 2003. The clinics selected included Mamelodi West Clinic, Saulsville Clinic, Phomolong Clinic and Pretoria West Clinics.

In a sub-component of this study, 53 HIV-negative women were interviewed on infant feeding practices between birth and 6 weeks postnatally, and the nutritional status of the mothers was assessed for comparison with the larger cohort.

Continuous and categorical variables that have been included as possible determinants of infant feeding choices and practices in this Chapter are tabulated in Table 5.1, highlighted with an asterisk. These include socio-demographic and psychosocial indicators. Personal variables such as parity, age, self-esteem, disclosure and other psychological measures of well-being were included as was water source, electricity and availability of a refrigerator - these three items being considered necessities that women would require to prepare safe infant formula.

5.3. STATISTICAL ANALYSIS

Data from the study were entered into a MS Access 2000 database (Microsoft ® Corp., Redmond, WA, USA) and analysis was performed using SPSS for Windows version 13.0 (SPSS Inc, Chicago, IL, USA).

Associations between independent variables change from formula-feeding intent to actual breastfeeding practice were examined using the Chi-squared test for categorical data and the Student t-test for continuous data. Factors associated with feeding intent that had a *p*-value of less than 0.25 were subsequently entered into a logistic regression (enter method) to determine which factors were independently associated with breastfeeding intent and practice and with a change from initial feeding intent. A p-value less than 0.05 was considered statistically significant.

A second analysis was undertaken, making use of similar variables but having the outcome variable as breastfeeding practice. In a third analysis, to determine factors associated with a change from formula-feeding intent to breastfeeding practice, the association between variables at the recruitment interview with the subsequent change in feeding was examined. Regarding the individuals that

changed to breastfeeding practice from an original formula-feeding intent, it was hypothesised that socio-economic factors, especially the availability of a refrigerator, piped water in the house and electricity, as well as disclosure and stigma levels would be independently associated with breastfeeding practice. As with the previous two analyses (Chi-squared test and T-test), factors with a *p* value of <0.2 were entered into a logistic regression model to establish the factors that were associated with the change.

Table 5.1: Variables included in the analysis of factors associated with prenatal feeding intent.

Variable	Postulated direction
Continuous variables	
Parity	Increased parity may lead to increased breastfeeding
SE status (housing score)* • Formula-feeding score	Low socio-economic score may result in more breastfeeding
Age	Increasing age, more experience with breastfeeding, therefore increasing breastfeeding
Per capita income (rands)*[4]	More finances in house, more likely to formula-feed
Household decision-making power score	Participants with more power in the household are less likely to breastfeed
Support score (positive)	Participants with less support more likely to breastfeed
Support score(negative)	More negative support or domineering support to participants is likely to lead to more breastfeeding
Knowledge*[2] score	Low knowledge score on modes of transmission, less breastfeeding
Self-esteem score	Low self-esteem may lead to less breastfeeding
Depression	High depression may lead to more breastfeeding
Active coping	Low active coping may lead to more breastfeeding
Avoidant coping	High avoidant coping may lead to more breastfeeding
Weeks from diagnosis to first interview	Less time interval between diagnosis and interview may lead to more breastfeeding
Personal stigma	Higher personal stigma, higher breastfeeding
Community stigma	Higher community stigma, higher breastfeeding

* Individual items making up se score shown in table below
*[2]Knowledge question specifically related to breastfeeding transmission shown in table below

Categorical variables	Postulated direction
Marital status • Single with partner • Married • No Partner	Single = more breastfeeding
Maternal education • Primary and below • Secondary • Tertiary	Those with lower level of education more likely to breastfeed
*Brick house	More formal housing, more resources, less likely to breastfeed
*Flushing toilet	Access to resources, less likely to breastfeed
*Piped water inside house	Access to resources, more likely to formula-feed
*Electricity	Access to resources, more likely to formula-feed
*Fridge	Access to resources, more likely to formula-feed
Living with Partner (does not include those without partners)	If no disclosure less likely to breastfeed
Living with relatives	More pressure from relatives, more likely to breastfeed
Living with others, not related	More pressure, more likely to breastfeed
Maternal regular income	More access to resources, less likely to breastfeed
Partner regular income (does not include those without partners)	More access to resources, less likely to breastfeed
Partner providing support (does not include those without partners)	More supportive environment, less likely to breastfeed
Partner education • Primary and below • Secondary • Tertiary (does not include those without partners or those who did not know their partner's education level	Higher partner education, less likely to breastfeed
Time from diagnosis Categorised • < 1 week • 1-4 weeks • >4weeks	More time to think about risks of breastfeeding, less likely to breastfeed
Know someone with HIV • Family • Frequent	Knowing a person living with HIV, less likely to breastfeed

contact	
Disclosure • Disclosure to partner • Disclosure to others	More disclosure, less likely to breastfeed
Knowledge specific to transmission via breastfeeding. This is assessed by answering true or false to the statement "all babies born to HIV-infected mothers if breastfed will get HIV"	Increased belief that all babies born to HIV-infected women, if breastfed, will get HIV is likely to result in increased formula-feeding.
Per capita income • < 320 • >=320	More income, less likely to breastfeed.

5.4. RESULTS

5.4.1. Description of the Study Population

Three hundred and seventeen (317) pregnant women were recruited between July 2003 and May 2005. Preliminary analysis of the data indicated that there were 24 study participants who had positive HIV results prior to testing for enrolment into the Serithi Study. Given that the 24 women could be classified as "experienced" with living with HIV, they were excluded from the analysis.

Table 5.2 depicts the socio-demographic characteristics of the 293 women who were included in the study. The average age of the women was 26.4 years (range 16-32). Most (89.1%) of the women had attended school, with the majority (75%) having some form of secondary schooling. Eighty percent of the study participants used electricity for cooking, 62.8% had a refrigerator, 67.2% had a flushing toilet in the yard but only 30% had direct access to piped water for cooking purposes in their homes. The median per capita monthly income in the households was R320.00 and the Inter-quartile Range (IQR) was R345.97. There were 185 (63%) participants whose per capita income was below R431.00, the national poverty line in 2006. The median time from HIV diagnosis to the recruitment interview was one week. The majority of women (68.3%) were not married and almost half (47%) were living with their husband or partner.

At the time of the recruitment interview, 173 (59%) of the women had disclosed their HIV status to others. Of those who disclosed, only 124 had disclosed to their partners, whilst 49 had disclosed to others. One hundred and five (36%) subjects reported knowing someone who was HIV-positive.

Table 5.2: Baseline Characteristics of Study Participants (N=293)

A. CONTINUOUS VARIABLES	
Socio- demographics:	
Age in years: [mean (SD)]	26.5 (5.1)
Marital status:	
Single, with partner	68.3%
Married	20.5%
No partner	11.2%
Housing	
Electricity	80.0%
Flushing Toilet	67.2%
Fridge	62.8%
Brick or concrete house	30.4%
Running water indoors	30.4%
Socio-economic score [mean (SD)]	2.9 (1.76)
Household Income	
Per Capita income (rands)	441.8 (458.1) Median 320 Range (0-3600)
Subject has regular income	24.2%
Partner has regular income	77.7%
Partner provides money	82.3%
Psychosocial Measures	
Power score	4.4 (1.8)
Support score (positive)	18.8 (6.3)
Support score (negative)	2.0 (2.3) Median 2.0 Range (0-9)
Self-esteem score	31.7 (4.0)
Depression level	11.8(8.5)
Active coping	31.1 (4.3)
Avoidant coping	16.2 (2.7)
Personal stigma	4.6 (2.7)
Community stigma	9.8 (2.4)
Knowledge Score related to breastfeeding transmission	10.1 (2.5)
Interval since HIV diagnosis and first interview	
Mean interval in weeks (SD)	4.1 (6.2)
Median interval in weeks	1.0
Range in weeks	0-36

B. CATEGORICAL VARIABLES	**N (%)**
Marital status	
Single with partner *	200(68.3)
Married	33(11.2)
No Partner	60 (20.5)
Maternal Educational level	
Primary and below	32 (10.9)
Secondary	221(75.4)
Tertiary	40 (13.7)
Partner Educational level	
Primary and below	25(10.5)
Secondary	169 (71.3)
Tertiary	43 (18.2)
Living conditions	
Brick house	157 (53.6)
Flushing toilet	197 (67.2)
Piped water inside house	89 (30.4)
Electricity	234 (79.9)
Fridge	184 (62.8)
Living with Partner (excludes those without partners)	138 (53.1)
Living with relatives	229 (78.2)
Living with others (non-relatives)	8 (2.7)
Maternal regular income	71(24.2)
Partner regular income (excludes those without partners)	202 (77.7)
Partner providing support (excludes those without partners)	214 (82.3)
Time from HIV diagnosis to first interview	**N (%)**
< 1 week	78 (26.6)
1-4 weeks	138 (47.1)
> 4 weeks	77 (26.3)
Know someone with HIV	105(35.8)
Family member with HIV	49 (16.7)
Someone participant has frequent contact with	76 (25.9)
Disclosure	173(59)
Disclosure to partner	129(44)
Disclosure to others	89(30.4)
Knowledge specific to transmission of HIV via Breast-feeding	83 (28.3)
Per capita income (monthly)	
Median per capita income (rands)	320
<320 (rands)	141(49.3)
>=320 rands	145(50.7)
Interquartile Range (rands)	345.97

5.4.2. Prenatal infant feeding intent

Of the 293 study participants, 218 (74%) stated that they were planning to formula-feed, while 75 (26%) planned to breastfeed or mixed feed. Seventy-nine percent of the women choosing formula had already disclosed to their partners and other persons by the time of recruitment. The most commonly cited reasons for formula-feeding intent included: best for baby's health - 161 (74%), the need to return to work or school, poor maternal health or breast health problems collectively cited by 43 (20%) women and 14 (6%) found breastfeeding to be "too complicated".

Most of the mothers planning to breastfeed (71%) felt it was best for the baby's health. Twelve percent had breastfed before and another 12% felt it was the most affordable option. In 5% of cases the stated reasons included "did not know how to measure formula", "I want my baby to feel my love for it", "advised by others to breastfeed" and "I am working and do not want to mix feed".

In order to assess a woman's ability to make decisions on infant feeding, we asked who in the household made decisions on the feeding method for the baby. Two hundred and ninety one women responded to this question and of them 78% (229) stated that they made the decision, but this was not the case for the remaining 62 women (22%). Twelve women (4%) stated that the partner decided on infant feeding and 6.4% (19) said they made the decision jointly and the remaining 10.6% (31) named a caregiver and other relatives besides herself or her partner.

5.4.3. Factors associated with prenatal feeding intent

The factors associated with the pre-natal intended feeding choices appear in Table 5.3 ($p<0.25$). Only "knowledge" and "actively coping" were significantly different between the two groups. Logistic regression analysis was undertaken to further explore the factors associated with breastfeeding intent.

Table 5.3: Factors associated with prenatal infant feeding choice (Formula-feeding or Breastfeeding)

Variable	**Formula (218)**	**Breast (75)**	**P value**
Continuous variables	**Mean (SD)**	**Mean (SD)**	
Depression	12.2(8.7)	10.8(8.1)	0.24
Active coping	31.7(3.9)	29.5(5.1)	**<0.01***
Categorical variables	**Number (percentage)**	**Number (percentage)**	
Marital status	40(18.3)	20(27)	0.12
Mother tertiary education	34 (15.6)	6(8.0)	0.10
Time from diagnosis to interview >4wks	53(24.3)	24(32.0)	0.19
Know someone with HIV	85(38.9)	20(26.7)	0.06
Disclosure to partner	103(47.2)	26(34.7)	0.06
Disclosure to others	71(32.6)	18(24.0)	0.16
Knowledge about HIV transmission via breast milk	54(25.0)	29(38.7)	**0.02***

* Denotes those variables for which $P<0.05$.

Table 5.4 indicates those factors that were independently associated with breastfeeding intent. Women who intended to breastfeed tended to have lower active coping scores, were twice more likely to be married and were less likely to have disclosed their HIV status to their partners than those intending to formula-feed. Women intending to breastfeed were twice as likely to have the correct knowledge regarding HIV transmission than those women planning to formula-feed. This implies that mothers planning to formula-feed were more likely to

believe that "all babies who are breastfed" by an HIV-infected mother will themselves be infected

Table 5.4: Logistic regression to identify factors associated with breastfeeding intent.

Variable	Adjusted Odds Ratio (CI)	P value
Active coping	0.88 (0.82,0.94)	0.01
Marital status	2.06 (1.03, 4.12)	0.04
Disclosure to partner	0.54 (0.30, 0.99)	0.04
Knowledge on HIV transmission through breastfeeding as assessed by the statement "all babies who are breastfed by an HIV infected mother will get HIV"	2.11 (1.14, 3.90)	0.02

5.4.5. Postnatal infant feeding practices

5.4.5.1. Neonatal breastfeeders

Feeding practices amongst women were assessed as early as three days after delivery and at this time we found that there were 21 mothers who only breastfed for between one and seven days. These mothers were categorised as neonatal breastfeeders. These 21 women were eventually re-categorised into their infant feeding practice that prevailed after this neonatal period. There were four mothers who had antenatally planned to breastfeed, and did breastfeed but only in the neonatal period, and they were re-categorised into formula-feeders, as this was the predominant feeding option eventually. There were also 17 mothers who had antenatally planned to formula-feed, but breastfed only in the neonatal period and eventually formula-fed as the predominant form of feeding. Table 5.5 indicates the reasons why the early neonatal breastfeeders opted for this feeding practice.

Table 5.5: Reasons for Breastfeeding in the Early Neonatal Period (≤ 7days)

Reason	Number (%)
Forced in hospital: non-disclosure or no formula available in hospital	9 (42.9)
Breastfeeding is healthier, cultural norm, and easier to cope with, and it is affordable	7 (33.3)
Unaware of HIV transmission risk	2 (9.52)
Baby premature or got ill from Nan Pelargon	2 (9.52)
Forced at home by family members	1 (4.76)
Total	**21 (100)**

5.4.6. Comparison of antenatal infant feeding choices and postnatal feeding practices.

In assessing postnatal infant feeding practices, 71 cases from the 293 subjects had to be excluded due to incomplete infant feeding data, allowing analysis of 222 subjects for infant feeding practices. These women differed from those with complete information in terms of the following, measured at the first interview: They were more likely to indicate they were going to stay with someone else after the birth of the infant (34% vs 44 20%, p=0.001). Their housing score was 2.1 vs 3.2 (p= 001) and they were less likely to have disclosed (47% vs 63%, p=0.013). They did not differ in terms of feeding intent as 68% vs 77% intended to formula-feed (p=0.13).

The comparison of feeding practices shows that the vast majority (94%) of HIV-uninfected mothers were breastfeeding their babies at age 6 weeks, while 69% of study mothers were formula-feeding. Five (7.4%) of the HIV-infected mothers claimed to be exclusively breastfeeding by 6 weeks, whilst among the HIV-negative mothers 14% had already introduced solids or semi-solid food by 6 weeks. Only 1 HIV-infected mother had stopped breastfeeding by 6 weeks as she stated that she had to return to work.

Of the 222 women, 170 (74%) intended to formula-feed but 25% changed their mind and breastfed, while 50% of 52 women planning to breastfeed switched to formula-feeds. This left 154 formula-feeders (69%) and 68 breastfeeders (31%) (see Figure 5.1).

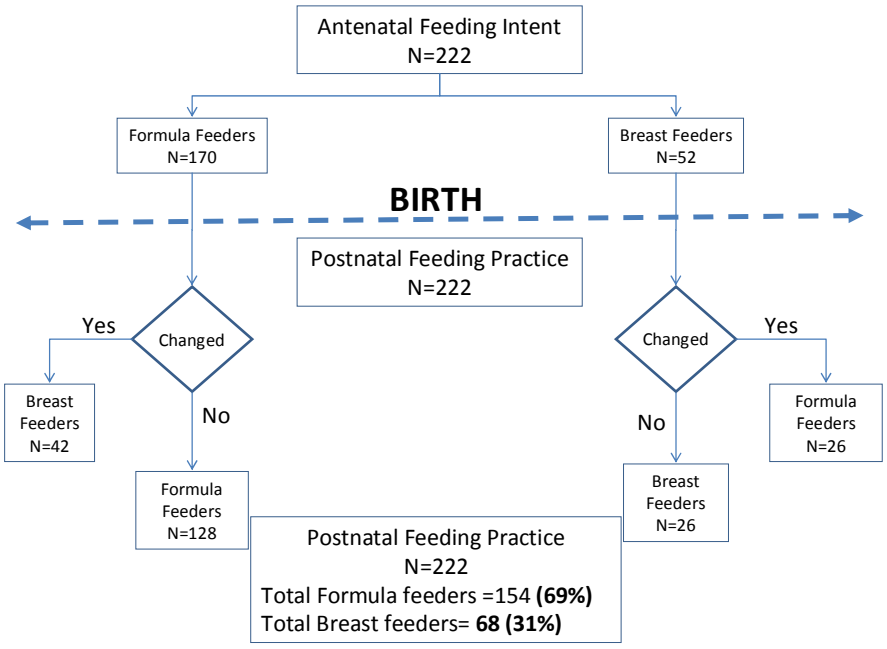


Figure 5.1: Comparison between prenatal infant feeding intent and postnatal feeding practice

5.4.7. Reasons for the change from formula-feeding intent to breastfeeding practice

We determined those factors that were associated with this change and these are presented in Table 5.6. Logistic regression analysis (see Table 5.7) showed mothers that did not adhere to their original formula-feeding intention were significantly younger than those who remained with their original choice, were more likely to have received negative or domineering support, and shared their home with somebody else other than a partner.

Table 5.6: Determinants of change from antenatal formula-feeding intention to breastfeeding practice

Variable	FF** choice to FF practice(N=128)	FF choice antentally to BF*** practice (N=42)	P-value
Continuous variables	**Mean(SD)**		
Age mean (SD)	26.5(4.9)	24.7(4.7)	**0.03**
Negative Support Mean (SD)	2.2(2.3)	1.4(2.1)	0.07
Active coping Mean (SD)	31.5(3.6)	32.4(4.1))	0.17
Categorical variables	**Number(percentage)**		
Disclosure to others other than partner	51(39.8)	10(23.8)	0.06
Partner providing support	86(67.7)	35(83.3)	**0.05**
Share home with anybody except partner	108 (84.4)	30 (71.4)	0.06
Partner schooling (tertiary or not)	22(17.2)	2(4.8)	**0.05**
Maternal schooling (tertiary or not)	26(20.3)	3(7.1)	**0.05**

*Highlighted p-value indicates variables with p≤0.05 ** FF – formula feeding *** BF – breast feeding

Table 5.7: Logistic regression on factors associated with change from formula-feeding intent to breastfeeding practice among HIV-infected mothers.

Variable	AOR (CI)	P-value
Age	0.89 (0.82, 0.97	0.01
Negative support	0.80 (0.65, 0.98)	0.03
Staying with someone other than partner	0.38 (0.14, 0.97)	0.04
Partner schooling (tertiary or not)	0.16 (0.03, 0.81)	0.02

In an attempt to gain greater understanding as to what motivated the 42 (25%) mothers to change from their original intention of formula-feeding to practicing breastfeeding, 16 (38%) of respondents stated that were forced to breastfeed in hospital, six (14.3%) for comforting a crying baby and four (10%) were forced by family members. We were unable to identify any factors that were independently associated with a change from breastfeeding intention to formula-feeding practice, due to the small number of mothers that fell into this category.

There was no significant association found between disclosure or measures of stigma at recruitment and change from formula-feeding intention to breast practice (Table 5.8). However, the majority of women who formula-fed stated that they felt it necessary to give an excuse when asked by others why they were not breastfeeding. At six weeks postnatally, 69 of 154 formula-feeding mothers responded to a question about people asking why they were not breastfeeding. Only eight of 69 (11%) admitted to being HIV-positive rather than giving reasons like ill health (including breast cancer, TB, sore or itchy breasts), work, school, breast refusal or personal choice.

Table 5.8 shows that of the 26 women who remained with their original breastfeeding intent, 56% of them had disclosed at the recruitment visit and these women had a personal stigma score of 4.31 and a community stigma score of 9.98. Of the 128 women that had planned to formula-feed and actually formula-fed postnatally, 67% had disclosed at recruitment and the personal stigma score for these women was 4.48 whilst the community stigma score was 9.86. More formula-feeders than breastfeeders had disclosed at the recruitment visit. It was found that of the 26 women that had planned to breastfeed but later actually formula-fed, fewer (39%) had disclosed in pregnancy, whilst for those 42 women that had intended to formula-feed but actually breastfed, 63% had disclosed their HIV status and these women had a mean personal stigma score of 4.47 and a community stigma score of 9.56. Statistically there were no

significant differences according to the psychological measures between the groups of women.

Table 5.8: Comparison between stigma and disclosure levels at recruitment by infant feeding intent and practice.

Feeding intent to Feeding practice	Disclosure level (% at recruitment)	Personal stigma score	Community stigma score
Breastfeeding intent to Breastfeeding practice (n=26)	55.6	4.32	9.99
Breastfeeding intent to Formula-feeding practice (n=26)	60.9	4.89	9.91
Formula-feeding intent to Formula-feeding practice (n=128)	67	4.48	9.86
Formula-feeding intent to Breastfeeding practice (n=42)	62.8	4.47	9.56

5.4.8. Supply of infant formula

Respondents who selected to formula-feed their infants were asked whether they had ever run out of infant formula and, if so, the reasons. By six weeks postnatally, 32 (20.8%) of 154 formula-feeding mothers stated that they had run out of formula milk supply. The main reasons for running out of supply were: insufficient formula supply from the clinic and "baby eats a lot more than is supplied" - 25 (78%), four (13%) mothers said they did not know they could collect milk before the replenishment date, and three (9%) had run out of supplies over the weekend or before their scheduled visit and were thus unable to access the health facility for replenishment.

Mothers were also asked what they fed their infants during the period when they ran out of formula. Infants were most commonly offered formula milk, 16 (51%), with some mothers specifically mentioning that they bought "Nan", "Lactogen" or "S26" and not "Pelargon" as it was "expensive" in the shop. One mother mentioned that she had "borrowed Pelargon" from another mother who she

knew was on the PMTCT programme. Eleven mothers fed glucose water, water or rooibos tea. Two mothers fed "cream of maize" or porridge. Four mothers stated that they breastfed their infants as an alternative to the formula milk and five mothers said they collected formula from the clinic.

Amongst the HIV-negative mothers who had selected to breastfeed, only one had stopped breastfeeding by 6 weeks as she stated that she had to return to work.

We included questions for the HIV-negative mothers which would provide an indication of the quality of counselling provided during Voluntary Counselling and Testing (VCT), especially as it pertains to infant feeding (Annexure 1). We established that 20 (37.7%) of the HIV-negative controls had been counselled on the benefits of breastfeeding whilst two (3.77%) had been counselled on safe formula-feeding. There were 36 (67.9%) women who stated that the counsellor had recommended that they exclusively breastfeed, though 46 (86.8%) had planned to breastfeed even prior to the counselling session.

5.5. DISCUSSION

This is one of only a few studies in South Africa considering factors that might influence mothers in their infant feeding decisions and assesses their psychological circumstances in the context of the "real life" situation of the PMTCT Programme as it was being applied in four health facilities in a peri-urban setting in Pretoria. Our study was therefore not an intervention study and no effort was made to repeat the counselling process and sharing of information to reinforce this. Earlier studies in South Africa, which reviewed progress of the PMTCT sites, found considerable variation across PMTCT sites, with high uptake of replacement feeds in urban settings whereas in rural settings mothers opted

for breastfeeding.[37] Subsequent research from PMTCT sites in KwaZulu-Natal, Eastern Cape and Western Cape Provinces in 2005 documented that infant feeding counselling was the weakest programmatic component in all three sites with only 35% (12 out of 34) of mothers informed on the HIV transmission risks by mode.[39] Our study provides information on infant feeding choices prenatally and postnatally among HIV-infected women and links this data to indicators of psychosocial wellbeing as well as socio-economic factors. We also compare prenatal feeding intentions with postnatal feeding practice and explore the factors that influenced adherence or non-adherence to the original choice.

This study again demonstrates that decisions on infant feeding choices within the South African National PMTCT programme are individually made and very complex, thus continuing to pose challenges, as has been extensively documented elsewhere.[41,167,168] There are both internal (mother's own choice) and external influencers (family and health care workers) that impact on HIV-infected women's infant feeding decisions. We found in our study that 14.6% of mothers are not empowered to independently make decisions concerning their infant feeding choices. This clearly has profound implications for the process and content of counselling about infant feeding. Women recruited into our study were exposed to only two counselling sessions as part of VCT, in accordance to the standard PMTCT guidelines.[36] Our study did not attempt to verify the quality of the antenatal counselling provided. All the counsellors who had contact with mothers in the four clinics had undergone a five-day training course on VCT, which included one day of infant feeding counselling. In assessments from elsewhere it has been documented that this five-day training is inadequate[173] whilst other authors report that the ideal counselling training should be as long as 22 days.[170]

In the more urban and peri-urban settings in which this study was conducted, more women (76%) chose to formula-feed, regardless of the fact that only 30%

of these same women had direct access to piped water in their homes and that the median per capita income in the households was only R320.00. In addition, 75.8% of the women in this study were unemployed. Whilst the majority of HIV-infected mothers (80%) had access to electricity and 63% had a refrigerator, these two items alone would not guarantee that formula-feeds would be safely prepared, especially as direct access to clean water would have been problematic for 70% of the women. Indeed, other data from PMTCT sites in South Africa raise a growing concern over bacterial contamination of formula-feeds.[34,35]

The fact that a large majority of mothers in our study indicated the intention to formula-feed may be reflective of the strong influence of the counselling they had received in the PMTCT programme and points towards a need for more in-depth training and attitudinal support of the counsellors. Research from Tanzania demonstrates the influence and power of the counsellor in that 82% of urban and rural mothers felt confident to formula-feed if advised to do so by a health worker and if the formula milk was made available free of charge.[171] The statement cited by 70% of the study respondents that "formula feeding is best for a baby's health" clearly shows the misunderstanding that might have arisen in the counselling process. In light of the research evidence that early exclusive breastfeeding is not more risky for vertical transmission and contributes to HIV-free survival[28,30,61,172] as compared to formula-feeding, it is important that HIV-infected mothers should receive adequate and thorough counselling on the risks of formula-feeding and not be unilaterally directed towards it without the full application of the AFASS criteria.

Others have found that health workers themselves are misinformed about the HIV transmission risk from breastfeeding and in some cases lack simple lactation management guidance, and this results in them imparting mixed messages and exerting misguided authority over the mothers.[173,174,175] It is of concern that in a review of four PMTCT country programmes, namely Kenya, Malawi, Botswana

and Uganda, it was found that 70% of all the health workers were unable to correctly estimate the HIV transmission risk through breastfeeding. In addition it was found that infant feeding options were mentioned in only 307 out of 640 (48%) of the observations of PMTCT counselling.[169]

We found a significant association between measures of active coping, disclosure to partner, marital status and intention to breastfeed. Women who intended to breastfeed had a lower active coping ability (adjusted odds ratio - AOR 0.88, 95% CI: 0.82-0.94) than those selecting to formula-feed and were thus less likely to reframe their current situation in a positive light. These women selecting to breastfeed were less likely to have disclosed their status to their partners or husbands (AOR 0.54, 95% CI: 0.30-0.99), were twice as likely to be married (AOR 2.06, 95% CI: 1.03-4.12) and were twice more likely to know that not all breastfed babies are infected with HIV (AOR 2.11, 95% CI: 1.14-3.90). These findings indicate that even among married women, non- disclosure of HIV status continues to be a hindrance to exclusive breastfeeding, despite the woman's own knowledge of the risks of HIV transmission through breastfeeding.

Of those mothers who were planning to breastfeed, 70% considered this method "best for baby's health." This finding is similar to that of others documenting that this decision lay in the entrenched knowledge that breast milk is best and this often outweighed the perceived risk of HIV transmission through breast milk.[176] Twelve percent of the mothers planning to breastfeed stated that this option was more affordable. This response may imply that the women were not aware at this time that formula milk was available "free of charge" from the health facility or that they had already factored in the cost of purchasing the equipment that is required for preparation of formula-feeds such as teats, bottles and cleaning materials. Alternatively, the mothers may have been considering the additional cost of travelling to health facilities to collect milk at regular intervals from the

health facilities. Similar complexities around the provision of free infant formula have been alluded to elsewhere.[38,177]

In our study we established that mothers who at the antenatal stage planned to formula-feed were more likely to have had greater exposure to HIV either through knowing a family member with HIV or having frequent contact with a person living with HIV. Furthermore, almost 50% of the mothers planning to formula-feed had disclosed their status to their partners. Other studies in South Africa have also emphasised that HIV disclosure remains a challenge that is of even greater significance in the context of infant feeding decisions.[178] In other countries it has been observed that 39% of mothers who hesitated to choose formula-feeding for their infants predominantly feared the partner's reaction and 31% feared the family circle's reaction.[42]

It is of interest to note that 8% of mothers planning to formula-feed prenatally stated that breastfeeding was "too complicated" and some explained this by specifically mentioning that adherence to exclusive breastfeeding with abrupt cessation would "be difficult" for them to practice. This finding is similar to documentation from other Southern African countries where the phenomenon of exclusive breastfeeding followed by abrupt cessation was not a cultural norm and not everyone had the skills to carry out this process whilst reducing the likelihood of breast health problems.[179,180]

Our study also provides information on infant feeding by HIV-infected mothers and how feeding choices change in practice after the baby is born as compared to prenatal feeding intent. This study found that significantly more mothers (75%) adhered to their prenatal infant feeding choice of formula-feeding whilst only 50% of mothers antenatally selecting to breastfeed adhered to this after the birth of their babies ($p<0.001$). This finding is in total contrast to the findings in KwaZulu-Natal where there was 78% adherence to breastfeeding and only 42%

adherence to replacement feeding.[170] Low adherence to replacement feeding was also observed in pilot PMTCT programmes in Botswana.[22]

It is highly likely given the more peri-urban setting of our 4 study sites that women may have perceived formula feeding to be "more feasible" and that they might have been better able to adhere to the AFASS criteria if they were practicing replacement feeding. Further it is possible that the quality of counselling that was offered to mothers in the 4 study sites, was such that there was a bias towards encouraging replacement feeding given that 80% of our study participants used electricity for cooking and more than 60% owned a refrigerator. Yet not all the conditions required for AFASS would have been met given that only 30% of our study participants had direct access to piped water for cooking.

The factors that were significantly associated with the change from formula-feeding intent to breastfeeding practice were younger age of the mother, limited disclosure to others, limited partner support and sharing of the home with anyone else other than a partner ($p<0.05$). These findings, similar to others documented elsewhere, indicate that infant feeding practices become even more complex without the necessary support that can only be obtained through disclosure of one's HIV status.[168,188,181,182]

Though the standardised stigma scales that we applied in this research did not identify differing levels of stigmatisation among formula- and breastfeeders, the existence of stigma related to formula-feeding is shown by the number (69 out of 154) of women stating that they make up "excuses" to explain why they are not breastfeeding. Clearly the fact that women responded to this statement emphasises that choosing to formula-feed is not always the "easier" or more acceptable option even in a peri-urban setting where our research took place. The implication is that there is still persistence of formula-feeding-related stigma

in the community. This has also been documented in other PMTCT sites in South Africa.[183]

Whilst the overall uptake of breastfeeding among the HIV-negative women was as high as 94%, none of these mothers practiced exclusive breastfeeding, similar to findings highlighted in studies elsewhere in Africa.[176,184,185] Only a third of these mothers initiated breastfeeding within one hour of birth, 24.5% within two hours and there were 21% who initiated breastfeeding a day after birth. Such delays in breastfeeding initiation demonstrate that sub-optimal feeding practices prevail in the communities where this study was undertaken. Data from Ghana points to the merits of early initiation of breastfeeding and adherence to exclusive breastfeeding as an intervention to contribute to the reduction of neonatal mortality.[186]

It is important to note that in gathering data on postnatal feeding practices, this study tried to overcome recall bias by ensuring that at each of the three visits up to three months the same question was repeated to assess if the mother had ever breastfed. It is still possible, however, that even with this intervention, not all mothers would recall adequately their true adherence to exclusive breastfeeding, let alone fully understand the importance of this feeding practice. Futher mothers may find it difficult to recall exactly when they ceased altogether to feed their infants breastmilk; a factor that may lead to exaggerated duration of exclusive breastfeeding, given our wide range of 42 days. Others have noted that recall bias persists when gathering data on infant feeding practices with mothers often forgetting the actual duration of exclusive breastfeeding.[33]
In addition, the HIV-negative mothers as well as the HIV-infected mothers introduced semi-solids and other liquid foods to the infant diet as early as one day after birth. When HIV-infected women ran out of free formula supplies they reported substituting this milk with foods or liquids of lower nutrient density from as early as six weeks after birth. This finding is similar to that from the Ivory

Coast where it was documented that, following cessation of exclusive breastfeeding, mothers introduced foods of insufficient dietary diversity to the diet of their children at six months and this inadequate complementary diet resulted in impaired growth and 37% stunting rates in the next 12 months.[189] In Zimbabwe, HIV-negative mothers also introduced fluids or food other than breast milk significantly sooner than recommended.[32] On the basis of the findings among the HIV-infected and non-infected mothers it would appear that sub-optimal infant feeding practices were common within the setting of our study.

Some of the early breastfeeders or mothers who only breastfed between day one and seven stated that they were forced to breastfeed in the hospital as they had not disclosed or there was no formula milk available (38%), whilst 6% said they were forced by family members to breastfeed and 18% breastfed as a means of comforting the newborn baby. It is of concern that mothers in our study and in other studies conducted elsewhere in South Africa [183] who delivered in hospitals faced an immediate dilemma at delivery as not breastfeeding would amount to disclosure of their HIV status, because hospital personnel were expecting them to breastfeed. As a result mothers reported that they were "forced" to breastfeed by hospital staff after delivery. Clearly the PMTCT programme has fallen short of identifying those women who are HIV-positive through the records, but most importantly there presently does not seem to be a facilitated process that enables women to be confident enough to disclose their status and preferred infant feeding choice.

Data from Africa has revealed discrepancies between the knowledge on infant feeding and HIV transmission and the actual beliefs of health care workers. A study in Malawi found that even though 18 health care workers understood the benefits of exclusive breastfeeding on child health, only 11 of them believed that children should be exclusively breastfed for six months. Further, in the focus group discussions it emerged that though the health care workers understood

the various modes of HIV transmission, they, together with a sample of mothers, over-estimated the transmission risk from breastfeeding. The health care workers also found the recommendation on early cessation of breastfeeding among HIV-infected women to be against the cultural norm in Malawi where breastfeeding continues for up to two years.[188] In South Africa there is additional documentation on the difficulties that are posed by early cessation of breastfeeding in the PMTCT context.[189] Others have developed culturally sensitive and appropriate counselling tools that incorporate the belief systems of the counsellors and the local context as a means of addressing counsellor bias.[192]

We found that by six weeks postnatally 21% of the formula-feeding mothers had run out of formula milk supply on occasions. On the basis of the reasons they cited for the shortage it would appear that the calculations for the number of tins that a woman should be entitled to may not be sufficient in relation to the actual nutritional needs of the children. The issue of formula supply also raises concern that, since so few of the mothers in our study mentioned that when they ran out they would buy formula, it may mean that mothers who selected this feeding option were not necessarily better-off financially. Affordability of infant formula is one of the criteria that are supposed to be assessed when counselling a HIV-infected mother who selects this feeding option. Another reason mothers cited for formula shortage was that the supply at the health facility ran out. The inconsistent formula supply at the clinics in our study led mothers to provide other lower nutrient and energy density replacement feeds such as water, glucose water or rooibos tea. In other cases the mothers mentioned that they would feed their infants semi-solid porridge as a substitute to infant formula.

Thus our findings are consistent with the predicted risks that the provision of free infant formula may lead to more women practicing mixed feeding[30] due to the inconsistent formula supply. Other studies in South Africa have documented that inconsistent formula supply from health facilities to HIV-infected mothers

remains a constraint, primarily attributable to "inflexible" health facility policies and a "lack of formula supplies at the clinics".[183] Beyond the health system constraints in the supply of infant formula, in Nigeria it was felt that some of the barriers to formula-feeding included high cooking fuel costs, unreliable electricity supplies, poor access to safe water and poor storage facilities.[47] Other data from the PMTCT programme in Botswana indicated that adherence to either exclusive breastfeeding or exclusive formula-feeding was "sub-optimal" as mixed feeding is considered the cultural norm in these communities.[22] During the conduct of this research between June and August 2005 there were reported cases of formula milk shortage in South Africa, including at two of the clinics falling under the Serithi Project[191]. This situation made health workers raise questions on the lack of sustainability of the provision of free formula, the need to provide access to more than one branded formula in the PMTCT programme and the resurgence of the debate as to whether, instead of free formula, HIV-infected mothers choosing this method of infant feeding could not be given a choice of the type of formula they select for their infants rather than over-relying on only one infant formula whose availability is not always guaranteed.

5.6. SUMMARY

Our study findings corroborate the UNAIDS statement of 2006 that "the complex relationship between breastfeeding and HIV transmission risk to the newborn underscores the importance of extensive, culturally appropriate counselling on breastfeeding to new mothers who are living with HIV".[2]

This study re-affirms that counselling on feeding choices for HIV-exposed infants must be extremely sensitive to numerous internal and external factors impacting on that decision. We found that HIV-infected women who had better coping skills, more education (though not statistically significant), who were married and

who had disclosed to their partners tended to choose formula-feeding after undergoing the routine PMTCT counselling process. This study further emphasises the importance of support to HIV-infected women in their infant feeding decisions, to enable disclosure and improved coping. Community-wide efforts are needed to enable HIV-infected women to independently make their infant feeding choices, relative to their own household circumstances. Such support may be in the form of frequent counselling sessions, regular antenatal contact with the mother and including, where possible, home visits. Without this package of interventions mothers will continue to find it difficult to address the psychosocial issues pertaining to their status and to make truly independent and informed infant feeding decisions.

Our findings on postnatal infant feeding practices in comparison to antenatal choices have highlighted the challenges posed by the application of PMTCT guidelines in relation to the socio-cultural complexity of advice on infant feeding. The poor adherence to exclusivity of either infant feeding choice reflects either poor maternal knowledge on the importance of exclusive feeding or limited knowledge of counsellors. Without adequate counselling support to enable mothers to assess the optimal infant feeding option that is suitable for her own individual and household setting, HIV infected women will continue to struggle with selection of the appropriate method of feeding. Frequent training and mentorship of counsellors, including periodic updates needs to be made an essential component of the PMTCT package in South Africa. Indeed counselling support needs to be provided antenatally, and especially postnatally to enable mothers to adhere to exclusive infant feeding. Our study findings point to the fact that the support that HIV-infected women need in making their infant-feeding decisions will entail psychosocial, community-wide interventions and frequent counselling sessions to assist them in coping with and disclosing their status. Improving the quality of infant feeding counselling for all mothers and the

promotion of exclusive breastfeeding at family level are key to enhancing HIV-free survival.

CHAPTER 6 - ANTHROPOMETRIC MEASUREMENTS AMONG HIV-INFECTED WOMEN OVER A 24 MONTH PERIOD

6.1. OBJECTIVES

1. To establish the longitudinal changes in body composition, as measured by select anthropometric measurements, amongst a cohort of HIV-infected women from six weeks until 24 months after delivery.
2. To determine the factors that impact on maternal anthropometric measurements over a 24-month period of postnatal follow-up.

6.2. SUBJECTS AND METHODS

HIV-infected women were consecutively recruited from four clinics offering antenatal care (ANC) and PMTCT services in Tshwane between 2003 and 2005 and were followed-up for a period of 24 months after delivery. The four clinics from which the women were recruited are in the peri-urban Mamelodi and Atteridgeville townships. Details on the methodology are described in Chapter 4.

A sample of 53 HIV-negative women was recruited as a comparison group at six weeks postpartum and they were assessed on nutritional status, biomarkers and infant feeding practices at this time only.

6.2.1. Anthropometric measurements

Anthropometric measurements were taken of mothers during the six-week visit as proxy indicators of body composition. These included mid-upper arm circumference measurements (MUAC) and determination of body mass index.

Body mass index (BMI) was calculated as weight in kg divided by height in metres squared. MUAC is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow (olecranon process and the acromium). Mid-upper arm circumference was measured using a non-stretchable tape.

Height was taken without shoes and measured to the nearest 0.1 cm using a stadiometer (Scales 2000, Durban, SA) and weight was measured in light clothing to the nearest 100g using an electronic digital scale (Scales 2000, Durban, SA). The control mothers were only measured at six weeks postnatally whilst the HIV-infected mothers were measured at intervals between six weeks postnatally and 104 weeks (equivalent to 24 months).

6.3. STATISTICAL ANALYSES

Distributions of anthropometric measurements and indices by HIV status were determined. Anthropometric measurements among HIV-negative women were only taken at six weeks after delivery and not continued thereafter. All the anthropometric measurements that were not normally distributed were logarithmically transformed. Adjusted differences by HIV status were obtained from ANOVA models for repeated measures, in which CD4 count and ferritin were covariates. The same analysis was repeated by infant feeding practice of the mothers. Differences were considered to be statistically significant between the groups at $p \leq 0.05$. All analyses were carried out using the STATA statistical software package version 9.

To compare differences in anthropometric measurements and body composition between the HIV-infected and non-infected women, the t-test was used. The

next phase was to compare groups controlling for ferritin and CD4 cell count, both of which are measures of the inflammatory response.

6.4. RESULTS

6.4.1. Comparison between the baseline anthropometric measurements of HIV-infected and un-infected women at six weeks post-delivery

Table 6.1 indicates that at six weeks postpartum, the HIV-negative women weighed on average less and had lower BMI than HIV-infected women. The differences between the groups was significant only for MUAC ($p<0.05$). The differences between the two groups of women remained significant only for BMI ($p=0.037$), with HIV-infected women having a greater BMI than their HIV-negative counterparts. The differences were not significant for MUAC and weight after controlling for baseline CD4 count. Using ferritin concentration as a marker of the inflammatory response and controlling for it, there was no significant difference between the groups for weight ($p=0.6549$) and for BMI ($p=0.148$), however for MUAC the difference remained significant ($p=0.0466$). Both groups of mothers had a mean BMI falling into the overweight category of BMI$\geq$25 and none of the mothers at six weeks postpartum had a MUAC $\leq$ 23 cm, which is the cut-off for underweight. Both comparison and study subjects were well nourished.

Table 6.1: Comparison of Anthropometric measurements at six weeks postpartum between HIV-infected and HIV-uninfected mothers

Anthropometic Indicator	HIV-infected	N	HIV-un-infected	N	p-value
Mean Wt (SD) Kg	66.4 (12.7)	191	64.7 (12.8)	49	0.4048
Mean BMI (SD) kg/m²	26.3 (5.67)	187	25.0 (4.85)	49	0.1236
Mean MUAC(SD) Cm	29.9 (3.79)	157	28.5(3.69)	47	**0.0250**

6.4.2. Anthropometric measurements and infant feeding practices

In order to determine if there was any effect of infant feeding practice on anthropometric measurements, we assessed anthropometric data at six weeks and also at six months between HIV-infected formula- and breastfeeding women (see Table 6.2). The sample sizes differ between the two tables as measurements because of missing data.

As depicted in Table 6.2, at six weeks and at six months after delivery the most significant differences in anthropometric measurements between formula-feeding mothers and their breastfeeding counterparts were for BMI and MUAC ($p<0.05$). At both visits, the BMI and MUAC of the breastfeeding mothers were lower. At this same time there was no significant difference in CD4 cell count by feeding group.

Table 6.2: Anthropometric measurements and CD4 counts by feeding mode at six weeks and at six months postpartum

At 6 weeks:

Anthropometric Indicator	Formula feeding	N	Breastfeeding	N	P-value
Mean Wt (SD) Kg	67.68 (13.17)	124	64.28 (11.63)	56	0.0994
Mean BMI (SD) kg/m²	26.82 (5.55)	121	24.83 (4.57)	56	**0.0203**
Mean MUAC (SD) Cm	30.41 (3.74)	103	28.96 (3.69)	45	**0.0225**
Mean CD4 cell count (SD)	457 (247)	125	458 (251)	56	0.9793

At 6 months:

Anthropometric Indicator	Formula feeding	N	Breastfeeding	N	P-value
Mean Wt (SD) Kg	67.78 (14.53)	120	63.28(13.43)	41	0.0831
Mean BMI (SD) kg/m²	27.1 (6.29)	117	24.81 (5.51)	41	**0.0392**
Mean MUAC (SD)	30.6 (3.96)	96	28.92 (4.18)	34	**0.0345**

Cm					
Mean CD4 cell count (SD)	390 (210)	134	399(226)	56	0.7733

Between the six week and six month visit the HIV-infected breastfeeding women lost almost 1kg of weight from an average of 64.27kg to 63.28kg, whilst the formula-feeding women gained 0.10kg between six weeks and six months.

6.4.3. Comparison between anthropometric measurements of HIV-infected women from six weeks to 24 months after delivery

Table 6.3 indicates that over a 24-month period the HIV-infected women in this study significantly gained weight and had higher BMI levels as compared to the baseline measurement ($p<0.05$). The MUAC levels tended to remain almost constant with an increment of only 0.3cm between the first and last visits.

Table 6.3: Trends in anthropometric measurements among HIV-infected women between the first (baseline) visit and the last visit (24 months postnatally)

Indicator	**First visit Mean (SD)**	**Last visit Mean (SD)**	**Change**	**p-value**
Weight (kg)	66.4 (12.7) Range: Min: 41 Max: 109 N = 191	68.2 (15.4) Range: Min: 38 Max: 139 N = 162	+1.8	0.0028
BMI (Kg/m²)	26.37 (5.67) Range: Min: 17.9 Max: 57.2 N=187	26.94 (6.13) Range: Min: 16.5 Max: 55.3 N=147	+0.57	0.0038
MUAC (cm)	29.8 (3.79) Range: Min:16 Max:41 N=157	30.1 (4.45) Range: Min:20.5 Max:49 N=137	+ 0.3cm	0.4439

Given that BMI differences between the baseline and the last visit 24 months after delivery remained significant, there was also interest to asses the BMI levels in relation to the reference categories.

6.4.4. Comparing the BMI between the first visit and the last visit by the reference categories

As depicted in Figure 6.1, very few of the study women fell within the underweight category at baseline and the final visit. However, there was a slight decline (10.2%) over 24 months in the percentage of women falling into the normal BMI range and also in the overweight range (6.8%). However, there was notable increase in the percentage of women from baseline to the final visit who were categorised as obese (16.7%).

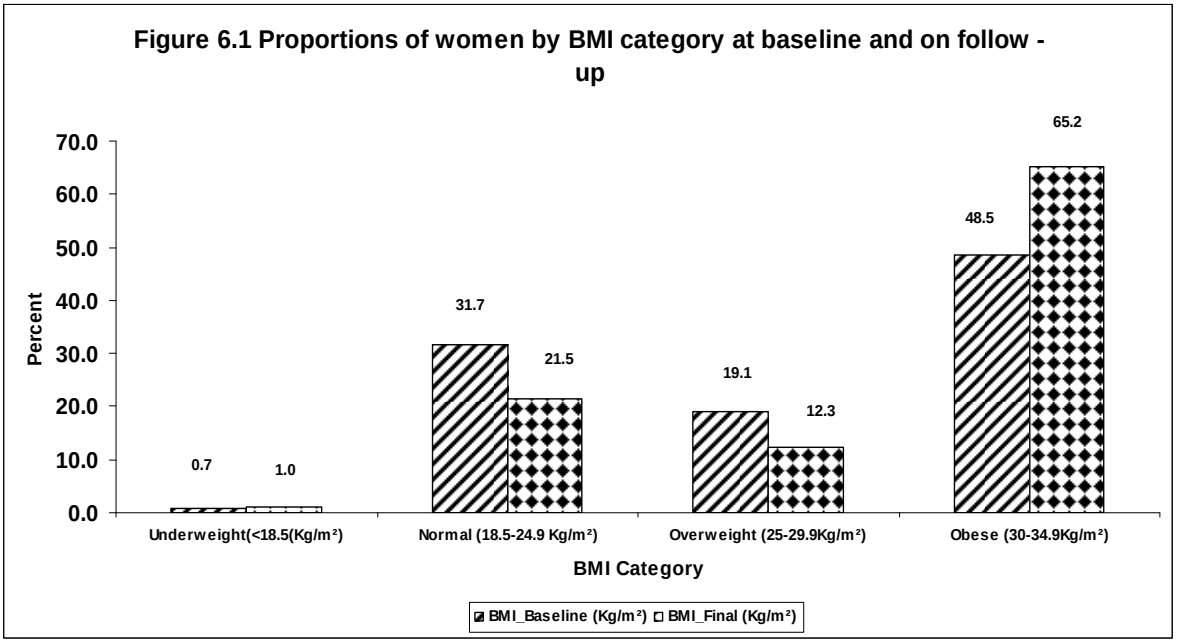


Figure 6.1: Proportions of women by BMI category at baseline and on follow-up

6.4.5. Health status of HIV-infected women over a 24 month period

In order to determine the current state of health of the mothers we asked about the existence of any illnesses since the previous visit date. The types of reported illnesses that the mothers stated included the following: 28 (29.79%) mentioned influenza, 17 (18.09%) diarrhoea, ten (10.64%) each mentioned STI's, headache and rash and five (5.32%) mentioned oral thrush. Only one mentioned having tuberculosis. None of this data was verified by a review of medical records of the mothers.

Due to the poor quality of the dietary intake data it was not possible to assess the trends over time in dietary intake in comparison to the anthropometric data of the mothers enrolled in this study.

6.5. DISCUSSION

Our study findings are important in that, unlike other studies in Africa that have documented anthropometric measurement changes among HIV-infected women in pregnancy[80,83],[192,] or among rural HIV-infected lactating women[8], we investigated anthropometric measurement changes as proxy measures of body composition among peri-urban women over a 24-month period after delivery.

Selection of both MUAC and BMI as measures of body composition among the study participants was primarily based on the simplicity of their collection at the clinics and the fact that they are less invasive techniques and affordable within the public health system. However, some researchers[19,193] state that whilst both BMI and MUAC are useful in predicting fat mass they are not useful for determining fat free mass among HIV-positive women and that bio-impedence spectroscopy (BIS) may be a better alternative for this purpose. Others have used skinfold measurements to assess body composition, however this measurement is considered problematic and unreliable as there is a need for

"fastidious attention to standardisation and significant training and practice in order to obtain accurate results."[63]

In accordance with recommendations made by others[8,79] , we undertook baseline measurements of all the HIV-infected and non-infected women at six weeks postpartum, by which time we had estimated that the anthropometric measurements indices would have returned to pre-pregnancy values.

In comparison to the cut-off points for BMI, very few of the study mothers and the control group were underweight (BMI $\leq$ 18.5). Most of the study mothers had BMI ranges falling into the normal range (18.5 to 24.9 kg/m²) and even the overweight range (25.0 to 29.9 kg/m²).[62] These findings may indicate that the pre-pregnancy body weight measurements of the women in this study were either high or within the expected range for their height. This is similar to findings from Rwanda where none of the HIV-infected and non-infected women suffered from chronic energy deficiency in the pre-pregnancy period.[83]

The finding that BMI levels were high but not significantly different (p = 0.1236) among the HIV-infected women (26.3kg/m²) as compared to the HIV-negative controls (25.0kg/m²) in this study is consistent with findings from the North West Province, where the mean BMI among HIV-infected women was 26.1kg/m² and for the uninfected women 27kg/m². These North West study researchers attributed the high BMI to the fact that most of the infected women were asymptomatic and in the early stages of the disease.[139] This same explanation could be the case for our study participants who were also at the asymptomatic stage of HIV disease for the most part for the first two years.

Our findings of a relatively small (1kg only) weight loss among the breastfeeding HIV-infected mothers between six weeks and six months is highly similar to data in KwaZulu-Natal where weight loss (1.4kg between eight weeks and 24 weeks)

amongst lactating women occurred, even though 95% of the mothers in their study had CD4 cell counts above 200cells/mm^3. The KwaZulu-Natal study established that whilst the breastfeeding women lost weight between the two visits, their BMI levels remained high, BMI > 20kg/m^2.[8] Similarly, we found that the mean CD4 cell count among the breastfeeding mothers at six weeks and six months was greater than 200 cells/mm^3, implying that there was no evidence of severe immuno-suppression at this time. Even at six months the breastfeeding mothers still had mean CD4 cell counts (399 cells/mm^3) that were slightly higher than amongst the formula-feeders at this time. The difference in weight was due to breastfeeding even though there was no effect on the immune status. From a socio-economic perspective, the formula-feeding HIV-infected mothers had an insignificantly higher socio-economic score than their breastfeeding counterparts and this may have had a positive or protective effect on their weight as they could have also had a greater food-purchasing power, though this aspect was not fully investigated in this study.

All lactating women have physiologically increased energy needs post-partum regardless of their HIV status. If these physiological needs for energy are not met, it is possible that the energy cost of lactation that may result in weight loss due to increased energy requirements.[5] It has also been reported elsewhere that the weight and fat loss that is observed among women during lactation is independent of the length of breastfeeding, but rather that it results from a negative energy balance and dietary restriction that is self-imposed by mothers wanting to lose body fat accumulated during pregnancy, or it may be attributable to metabolic or hormonal influences.[78] We did not investigate these factors. Regardless of our findings, wherein we had a minority of mothers chosing to breastfeed and where post-partum weight loss was minimal, it has been recommended by other authors that in particular breastfeeding HIV-infected mothers should be provided with nutritional support to avoid any risks to maternal health such as weight loss due to fat mass loss or fat free mass

reduction.[185] Whilst our findings did not necessarily corroborate these recommendations, on a public health level it may be more appropriate to support a targeted nutritional supplementation approach, prioritising HIV infected women with low anthropometric indices and multiple micronutrient deficiencies.

There is a need for caution in the interpretation of the results in this study, especially when comparing anthropometric measurements between HIV-infected and non-infected breastfeeding women, as there were very few HIV-infected breastfeeding women in the study and this may have had an effect on the results.

Furthermore, this study did not assess trends in anthropometry among the HIV-negative mothers beyond the six weeks after delivery. Perhaps if this had been done it would have provided a better indication as to whether the trends in weight loss among breastfeeding HIV-infected mothers fall within a physiological norm or whether this change is only attributable to the HIV infection itself. Given the fact that our research was conducted in a peri-urban setting, it is possible that there was access to greater variety of foods and possibly more energy-dense sources, which could have resulted in greater weight gain in our study mothers. Our study findings reflect that there was a true difference between HIV-infected breastfeeding women and non-breastfeeding HIV-infected women, with the former losing 1Kg of body weight, whilst the latter remained at the same weight between six weeks and six months. However caution is warranted in the interpretation of this result as this difference may be reflective of a normal physiological occurrence and is to be expected regardless of the HIV status of individual women.

Regardless of infant feeding practice, overall, formula-feeding mothers had no significant change in weight, MUAC and BMI. Similarly, anthropometric trends among the breastfeeding mothers also did not change significantly between six

weeks and six months. As such, it is not possible to attribute the observed 1kg weight loss among breastfeeding mothers to feeding mode only. It is possible that the weight loss was in line with the expected levels postpartum or that the mothers were returning to their pre-pregnancy weight levels.

Our research did not use more sophisticated and accurate measurements of body composition which have been used in other studies of this nature and thus could not determine if the weight loss was attributable to greater lean or fat mass loss. Others have documented, using bioelectrical impedence analysis, that HIV-infected underweight women in the USA tended to preferentially lose fat mass whilst conserving their body cell mass.[85]

Interestingly there was a significant difference between the first and the last mean BMI measurements in the study group, reflecting an overall increase of 0.57kg/m². This could, in part, be attributable to a better disease profile, increased access to a varied diet or fewer reported opportunistic infections. However, considering that several of the mothers in this study were also accessing micronutrients and other dietary supplements (see Chapter 7), this may have also resulted in the changes observed. The study findings are similar to those from the Free State Province, which did not find significant reductions in anthropometric measurements among HIV-infected patients and HIV-negative patients, primarily because the former were asymptomatic and in the early stages of disease progression.[139]

The South African Demographic and Health Survey (SADHS) of 2003[57] indicated that in the age group 15–24 years, 11.2% of South African women were classified as obese; this age group being the one closest to the ages of our study participants. Furthermore, the SADHS indicated that 23% of all women were obese with a BMI > 30kg/m² and 29% of these women were classified overweight with a BMI between 25kg/m² and 29.9kg/m². It would appear that

being overweight is particularly prevalent among black women, of whom 28.4% were obese and 27.8% were overweight. It is important to note, however, that the HIV sero-status of these women in the SADHS was unknown and it was assumed that most were healthy persons. In our study, 48.5% of women were considered obese by six weeks postpartum. It is possible that HIV infected women in our study were over-compensating for their HIV status by consuming a higher energy dense diet or that based on local health messaging they too had come to believe that HIV infected persons required increased intake of energy sources. Given that the prevalence of obesity increased to 65% at the end of the follow-up period, there is a need to promote consumption of a prudent diet for all persons in the South African society regardless of HIV status. The notable increase in mean BMI levels among our study group was surprising considering that the claimed median per capita monthly income in the households in which the study mothers resided was R320.00 and the Inter-quartile Range (IQR) was R345.97. There were 185 (63%) participants whose per capita income was below R431.00, the national poverty line in 2006. Given the poverty data we found, it is probable that mothers were able to consume foods or lead sedentary lifestyles which could have resulted in the higher BMI levels we observed. It is of concern that some researchers have found very few overweight or obese African women in South Africa who view themselves as being overweight and instead associate thinness with HIV and AIDS. [194]

The assessment of body composition among HIV-infected persons needs to take into consideration any other co-infections that may be present.[65] Whilst we did not systematically verify the illnesses that the mothers in our study had, at every visit they were asked to state any illnesses they had experienced since the last visit. Unlike other findings among HIV-infected men and women, it would appear that there was minimal co-infection in our study mothers.

An additional factor that may have influenced the trends we observed in anthropometric measurements among the study mothers could have been that some of the study participants had initiated HAART. In South Africa, HAART was introduced within the public health institutions from 1 April 2004, halfway through this study's follow-up period. By the end of the 24 month follow-up period there were 31 women who were on HAART. It has been documented that amongst persons on HAART disturbed fat compartmentalisation and elevated CRP levels may occur.[195] Others have not found fat mass changes amongst persons on HAART, but rather increased bone mass loss.[90] Considering that none of our patients had been on HAART for longer than two years, it is highly unlikely that during the 24-month period of observation these metabolic changes would have been observed. Our study was also not designed to determine the levels of adherence to ARV therapy among the clients and the impact on anthropometry, so we relied on hospital records and the participants' own recall of taking ARV therapy.

The importance of continued monitoring and assessment of nutritional parameters among HIV-infected persons has been emphasised to enable early intervention as required and to avoid more detrimental consequences of HIV-related immuno-suppression and malnutrition.[196] Others have recommended that in South Africa the prevention and treatment of obesity should focus on, amongst other interventions, high level political support and community mobilisation, and behaviour change communication. Further, there should be emphasis on healthy weight goals, increasing levels of physical activity, and identification of persons at risk of obesity at the primary health care level through routine monitoring.[194] Whilst our follow-up period was limited to 24 months, we observed minimal weight loss in our study cohort and, instead, we observed that the majority of the mothers enrolled fell into the overweight and obese BMI categories, which in itself raises concern and requires further monitoring to prevent the onset of non-communicable diseases of lifestyle.

6.6. SUMMARY

The value of our study is that it provides information on changes in anthropometric measurements over a period of two years among HIV-infected women living in a peri-urban setting of South Africa, whereas other studies conducted among the same women had shorter follow-up periods. Whilst we did not detect under-nutrition and wasting, as documented in other studies among HIV-infected persons, our findings point to the importance of continued monitoring and assessment of nutritional parameters, such as anthropometry, among HIV-infected women from as early a stage as possible and preferably at the community level. The follow-up care for HIV-infected mothers should also aim at preventing obesity and ensure that optimal nutritional status, as close as possible to the normal BMI ranges, is maintained.

Our study points to a high prevalence of obesity even among HIV-infected, though asymptomatic, women in Tshwane. We have not observed a significant decline of nutritional status with time even amongst those women where immune status was compromised.

CHAPTER 7 - MICRONUTRIENT STATUS AMONG HIV-INFECTED MOTHERS IN TSHWANE, 2003-2005

7.1. OBJECTIVES

1. To compare the six-week postnatal levels of micronutrients among HIV-infected and HIV-uninfected women.
2. To describe any changes in micronutrient status over a 24-month period of follow-up.
3. To determine the factors that impact on maternal micronutrient status over a 24-month period of follow-up after delivery.

7.2. SUBJECTS AND METHODS

The enrolled HIV-infected women in the Serithi project provided a venous blood sample at six weeks postpartum and at six, 12, 18 and 24 months after delivery. The blood collected was used to measure selected vitamins and minerals as well as biomarkers of immune status. Any woman who was found to be sick, have very low indices of micronutrient status or was immuno-compromised was immediately referred to the Kalafong Hospital Immunology Clinic for further care.

Blood was also collected and analysed for the same parameters from a sub-set of 53 HIV-negative women at six weeks postpartum, to serve as a control group.

7.2.1. Sampling and measurement parameters

Non-fasting venous blood was collected from the women at any time that they reported to one of the clinics for their scheduled visit. All assays were collected in

accordance with the manufacturers' instructions. Samples were placed into mineral-free gel separator tubes for CRP, vitamins and minerals. EDTA tubes were used to collect blood for analysis of vitamins A and E. C-reactive protein (CRP) was used to measure the inflammatory response. The samples were labelled, protected from light by a foil paper and immediately placed in ice-cooled insulated boxes after collection and delivered to the Ampath Laboratory in Pretoria within four hours. The flow diagram used by Ampath for collection of samples is represented in Figure 2. All the analyses were carried out at the Ampath Laboratory using methodologies described in Table 4.5. The normal reference values for each vitamin and mineral and for CRP are also provided in this table.

7.3. STATISTICAL ANALYSIS

STATA package version 9 was used to analyse all the biomarker data. As the distributions of some of the biomarker variables was non-Gaussian, data were log transformed before comparing variables. Differences in biomarker levels between HIV-infected and non-infected women were tested for significance using the Student's t-test for continuous variables. In addition, the t-test for continuous variables was used to assess trends in micronutrient and biomarker levels over the 24-month period. By using the two sample t-tests it was also possible to compare study participants whose biomarker variables fell below or above the cut-off values according to infant feeding practice at six weeks, six months postpartum and at 24-months. These comparisons were made using the Chi square (X^2) test. Statistical significance was set at a probability level of 0.05 ($p<0.05$). Ferritin concentration levels were used as a marker of the inflammatory response and were controlled for in some of the analyses.

7.4. RESULTS

At each of the scheduled visits, at six weeks, six months, 12 months, 18 months and 24 months there were a varying number of HIV-infected mothers who attended the visits, as reflected in Table 7.1. All micronutrients and biomarker levels are presented as a mean concentration +/- SE. The normal reference ranges are also provided in this table.

7.4.1. Comparison of indicators of HIV-infected and un-infected women at six weeks postpartum

As shown in Table 7.1, significant ($p<0.05$) differences in micronutrient and biomarker levels existed between HIV-infected and HIV-uninfected women at the baseline visits for CD4 lymphocytes, red-cell folate, transferrin, transferrin saturation, selenium and vitamin A. In comparison to the normal reference ranges, the mean red-cell folate, transferrin and transferrin saturation concentrations were lowered amongst the HIV-infected women. In relation to the HIV un-infected mothers, HIV-infected women had significantly lower concentrations of folate, transferrin, transferrin saturation and CD4 cell count ($p<0.05$), but significantly higher concentrations of selenium and vitamin A. The HIV-negative mothers had insignificantly higher levels of iron, vitamin B12, vitamin E and haemoglobin.

When controlling for ferritin as a marker of the inflammatory response we noted significant differences ($p<0.05$) among HIV-infected and non-infected women for serum transferrin, vitamin B12, red-cell folate, haemoglobin and iron concentrations. When controlling for baseline CD4 cell counts, significant differences between HIV-infected and HIV-negative women were noted for red-cell folate and haemoglobin concentrations. Therefore, the HIV-infected women had marginally less optimal levels of micronutrients than their HIV-negative

counterparts. Vitamin A and selenium concentrations were elevated among the HIV-infected women, compared to the HIV-negative controls, but were still within the normal ranges. It should be noted that while there were differences, all values were within the normal ranges except transferrin and percentage transferrin saturation.

Table 7.1: Comparison of indicators of HIV-infected and un-infected women at 6 weeks postpartum

Micronutrient or biomarkers	HIV-infected Women Mean (SE)	Number	Range	HIV-uninfected Women Mean (SE)	Number	Range	p-value	Reference range
Vitamin A µg/L	514.63 (154.66)	164	142-1077	469.23 (124.49)	52	263-855	**0.0344**	260-720 µg/L (18-19yrs) 300-800µg/L (≥ 20yrs)
Vitamin E mg/L	8.62 (3.06)	164	2.8-20.8	9.32 (3.40)	52	2.4-17	0.1930	6-10mg/L (18-19yrs) 5-18 mg/L(≥ 20yrs)
Iron µmol/L	10.56 (5.22)	169	3.0-30.4	11.8 (5.82)	53	2.70 - 24.60	0.1705	6.6-26.0 µmol/L
Transferrin g/L	1.52 (1.34)	290	1- 3.1	2.77 (.45)	53	1.90- 4.10	**0.0000**	2.0-3.6 g/L
Transf sat. %	9.80 (11.1)	290	7-51	18.1 (9.99)	53	3-43	**0.0000**	15-50%
Ferritin ng/mL	35.88 (31.55)	167	2- 188.8	33.56 (30.60)	53	4-166	0.6377	13-150 ng/mL
Vitamin B12 pmol/L	336.65 (113.71)	169	156-715	356.07 (163.68)	53	172.00 - 1065.00	0.4235	145-637 pmol/L
Red cell folate nmol/L	588.18 (526.97)	288	511-2405	988.47 (320.41)	53	441.3-1999.2	**0.0000**	597-2334 nmol/L
Selenium µg/L	96.84 (19.8)	167	59.6-164.4	91.45 (15.7)	53	64.60 - 139.20	**0.0442**	70-130 µg/L
Haemoglobin g/dL	12.65 (1.39)	166	8.5-16.9	12.93 (1.47)	53	7.80- 15.50	0.2198	12-16 g/dL
CD4 lymphocytes cells/µL	459.9 (240.4)	134	5 1482	879.51 (283.14)	53	42 - 1289	**0.0000**	500-2010 cells/µL

7.4.2. Comparison of micronutrient and biomarker levels by infant feeding mode at six weeks and six months

At the six-week post-visit it was found that mean vitamin E concentration was significantly higher among HIV-infected mothers who were formula-feeding as compared to those who were breastfeeding ($p<0.05$), even though the mean concentration in both groups was within the normal reference range. Formula-feeders had slightly lower CD4 cell counts (445.9cells/mm^3) than their breastfeeding counterparts (494.9cells/mm^3) as indicated in Table 7.2. Between six weeks and six months there were no significant differences in micronutrient and biomarker levels between the formula-feeding and breastfeeding HIV-infected women, with most mothers' micronutrient concentrations falling within the normal range.

Table 7.2: Micronutrient and biomarker levels by feeding mode at six weeks post-delivery

At 6 weeks:

Micronutrient or biomarkers	**Formula Feeding - mean (SE)**	**Number**	**Breastfeeding - mean (SE)**	**Number**	**P-value**
Vitamin A µg/L	508 (14.9)	91	503 (35.7)	21	0.8956
Vitamin E mg/L	9.13 (0.34)	91	6.97 (0.44)	21	**0.0040**
Iron µmol/L	9.80 (0.52)	92	11.46 (1.06)	21	0.1703
Transferrin g/L	1.83 (0.11)	127	2.11 (0.22)	26	0.2783
% Transf sat.	11.6 (0.97)	127	15.1 (0.22)	26	0.1454
Ferritin ng/mL	36.8 (3.28)	91	35.03 (6.55)	21	0.8140
Vitamin B12 pmol/L	349.6 (12.9)	92	297.8 (19.9)	21	0.0749
Red cell folate nmol/L	732.3 (44.6)	126	799 (87.82)	26	0.5296
Selenium µg/L	97.6 (1.88)	91	95.9 (5.92)	20	0.7282
Haemoglobin g/dL	12.5 (0.153)	90	12.82 (0.306)	19	0.4535
CD4 lymphocytes cells/µL	445.9 (21.7)	106	494.9 (64.4)	23	0.3768

7.4.3. Comparison of micronutrient concentration levels between the 6 weeks baseline visit and the final visit (24 months)

As shown in Table 7.3, significant changes occurred for vitamin A, Vitamin B12, selenium, haemoglobin and CD4 cell counts, over the 24 month period.

Table 7.3: Change in micronutrient and biomarker levels among HIV-infected women over the 24-month period postnatally.

Micronutrient/ Biomarker (N)	Baseline level Mean (SE)	Range	Final level Mean (SE)	Range	Mean Difference	P-value
Vitamin A (µg/L) (106)	514.63 (154.66)	142-1077	372.0 (115.3)	113-851	-146.4	**0.000**
Vitamin E (mg/L) (106)	8.62 (3.06)	2.8-20.8	8.74 (2.57)	3.5-16.8	+0.148	0.6396
Iron (µmol/L) (111)	10.56 (5.22)	3.0-30.4	12.48 (6.50)	3.2-32.9	+1.71	**0.0207**
Transferrin (g/L) (152)	1.52 (1.34)	1- 3.1	2.72 (0.468)	1.8-4.07	+0.84	**0.0000**
Transferrin Saturation (%) (152)	9.80 (11.1)	7-51	40.0 (25.8)	3.0-32	+27.4	0.1945
Ferritin (ng/ml) (110)	35.88 (31.55)	2- 188.8	39.50 (39.3)	4-249	+4.45	0.2659
Vitamin B12 (pmol/L) (113)	336.65 (113.71)	156-715	322.3 (179.8)	122-1476	-5.4	0.6909
Red Cell Folate (nmol/L) (150)	588.18 (526.97)	511-2405	1168.2 (323.8)	233-2646	+430.0	**0.0000**
Selenium (µg/L) (106)	96.84 (19.8)	59.6-164.4	96.9 (28.3)	43.5-199.0	-0.90	0.7949
Haemoglobin (g/dL) (108)	12.65 (1.39)	8.5-16.9	12.30 (1.36)	8.6-15.2	-0.42	**0.0085**
CD4 lymphocytes (cells/µL) (134)	459.9 (240.4)	5 -1482	414.4 (227.9)	42-1289	-45.5	**0.0138**

For those biomarkers or micronutrients for which there was a significant difference between the baseline and final measurement, as depicted in Table 7.3, we undertook further analysis to compare these differences with the cut-off ranges for each. Most mothers fell within the normal cut-off range of 260-800µg/L for vitamin A concentration. However, the mean vitamin A concentration levels dropped significantly but remained within the normal range. At baseline, 1% of mothers had a vitamin A concentration less than 260µg/L and this changed to 8.2% by the last visit. Almost 50% of the mothers also had blood vitamin A concentration above 800µg/L. A similar pattern was observed for iron concentration levels, though more (12.3%) women at baseline than at the final visit (9.9%) were iron deficient (<6.6µmol/L).

Almost 50% of the study participants had low concentrations of transferrin at the baseline visit. However, by the final visit at 24 months this percentage had lowered to less than 1%. Fifty percent of the study participants were within the normal range for transferrin at both baseline and final visits. A similar trend emerged with regard to red cell folate concentrations, with 42% of women at the baseline visit deficient, but by the final visit only 0.7% had levels lower than the normal range of folate concentration, namely <2.0g/L. For both transferrin and red cell folate almost 50% of the study participants had excess concentrations (>3.6g/dL and >2334nmol/L respectively).

As shown in Figure 7.1, at both the baseline and final visits almost 8% of the study population had a CD4 cell count <200cells/mm^3. Sixteen percent (16%) of the women at the baseline visit had a CD4 cell count between 200-350cells/mm^3, but by the last visit this number increased to 19.1%. The proportion of women in the different CD4 categories did not change significantly over time. Almost 60% of the study population fell within the CD4 cell count

category greater than 500cells/mm³, implying that there was not a significant deterioration in CD4 cell counts over time.

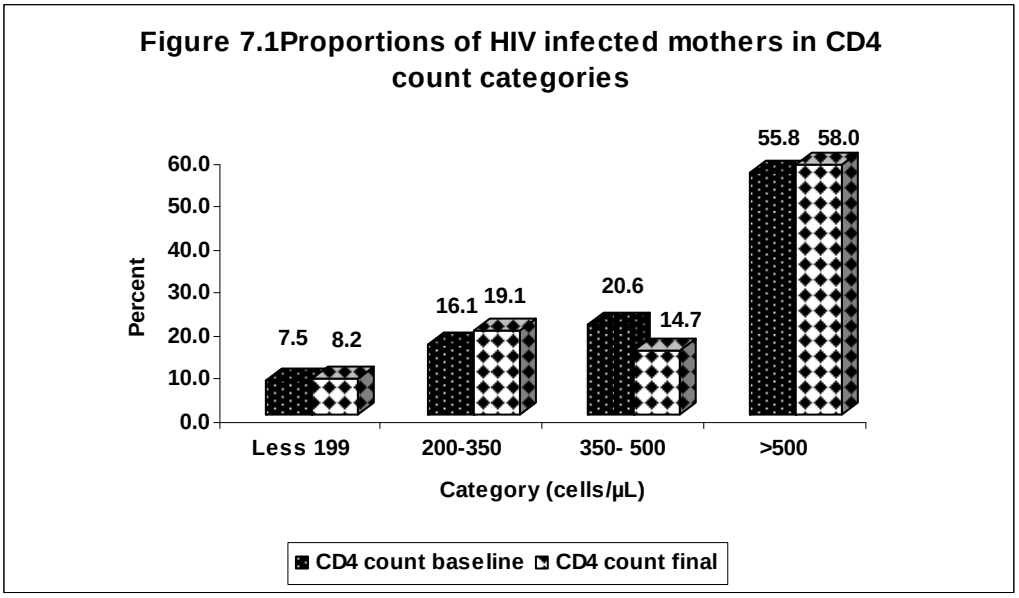


Figure 7.1: Proportions of HIV-infected mothers by CD4 count categories

7.4.4. Assessment of micronutrient supplementation usage amongst HIV-infected women

At the recruitment visit during pregnancy 92.4% of the mothers mentioned that they had received iron and folate supplements during pregnancy, and of these women, 91% stated that they did actually take the tablets. However, this information was not verified. Forty three of the 293 HIV infected women (15%) in our study acknowledged taking immune-boosters and micronutrient supplements, as shown in Table 7.4.

Table 7.4: Micronutrient supplements and traditional "immune boosters" taken by clients.

Category of Immune boosters or vitamin and mineral preparations taken	Number
Vitamin-enriched porridge, "Morvite"	2
"Vuselela" tablets, "Izifo zonke", "Amandla" (traditional preparations/tonics)	4

Spirulina, aloe vera, "Herbal cure", "Stress Active", "Immunadue", (Herb-based remedies)	10
"Centrum", multivitamins, "Moducare", "Bioplus", "Cal-c-vita", Vitamin B6, folic acid, "Viral Guard"	16
Cannot remember the name of the supplement	5
Taking a combination of therapies (Over-the-counter tablets and herbal preparations).	6
Total	43

7.4.5. Sources of information on nutrition and HIV/AIDS

All mothers were asked where they obtained nutritional or health guidance or information to assist them to cope better with their HIV disease. Eighty-five (85) mothers responded to this question. For less than half, 39 (45.9%), the clinic was the primary source of information, for 25 (29.1%) printed matter (magazines and newspapers), for 14 (26.5%) the radio and six (7.1%) relied on the television. One mother mentioned that she obtained information from her community.

A follow-up question to all 293 mothers was "what was the main message" on living better with their HIV. The majority of women did not answer this question correctly. However, of those that did, sixty-five (22%) felt that having a "healthy body of the correct weight" was important, 62 (21%) felt that "improving one's immune system to fight off HIV and to increase CD4 count" was essential, 17 (5.8%) understood the main message to be "eating a variety of fruits and vegetables," 4 (1%) stated that "caring for oneself" was most important and 1 felt that using a condom and leading a healthy lifestyle were the most important messages. Mothers could give more than one response to each of these options.

7.5. DISCUSSION

This study provides information on trends over a 24-month follow-up period among HIV-infected women following delivery in a peri-urban setting. A substantial amount of literature on HIV infection and micronutrient status tends to be focused on pregnancy. [118,119,197,198]

The finding of normal biomarker and micronutrient levels among the study population and the HIV-negative group is similar to the anthropometric trends reported on in Chapter 6. This suggests that our study population was well nourished and not severely immuno-compromised on the whole.

We found few differences in mean serum levels of micronutrients among the HIV-infected and non-infected study participants, unlike several studies in the literature[7,139,199]. At six weeks postpartum most HIV-infected women were replete in micronutrient concentrations with the exception of the mean red cell folate, transferrin and transferrin saturation concentrations. The HIV-infected participants had marginally lower serum levels of vitamin A and El. Vorster et al[139], in their data comparing HIV-infected and non-infected men and women, found only haemoglobin levels among HIV-infected participants to be significantly lower than among non-infected participants. In our study population the levels of haemoglobin of the HIV-infected participants and the controls were almost similar, with significantly higher vitamin A concentration levels, but vitamin E concentrations were lower than amongst the controls.

There were minimal differences in micronutrient concentration levels by feeding mode, unlike others who found that, on average, retinol was significantly lower in HIV-positive lactating mothers, even after controlling for the acute phase response.[129] We found that at the six weeks postnatal visit there was a slightly lower serum retinol concentration amongst breastfeeding women, but this was within the normal range and not significant. The only antioxidant vitamin for which there were significantly lower levels among the breastfeeding mothers was vitamin E, however given the small numbers of mothers with low levels , this

difference is unlikely to be of clinical significance. Others in Tanzania have found higher plasma levels of selenium among HIV-infected women to be marginally associated with higher vitamin A levels and lower vitamin E and haemoglobin levels.[113]

It has been documented that deficiency in selenium as an antioxidant may increase HIV disease progression, increase viral load and increase the risks of infection.[199,200] Similar to findings by others[104] we did not find any of our study participants displaying low levels of selenium. Plasma selenium as an assessment of selenium status is reflective of short term selenium status and tends to respond to changes in intake within a short period, unlike erythrocyte selenium which is more reflective of long term status[100]. During an acute phase response or infections such as HIV, plasma selenium may become a less adequate measure of selenium status as it tends to decline under such situations. The plasma levels of selenium in the HIV-positive mothers at six weeks were higher than among their HIV-uninfected counterparts ($p=0.0442$); this finding is unexplained. Drain[106] found that women with an acute phase response had low levels of selenium but these were women at a more advanced HIV disease stage. In addition Ogunro[201] established that plasma selenium levels were significantly reduced ($p<0.0001$) in HIV-infected patients with a CD4 cell count <200cells/mm³ and that the levels of selenium reduced with advancing HIV disease progression.

Whilst this study was not designed to assess the extent to which the levels of micronutrients suppressed or improved HIV-related immune response, we have noted after the two year follow-up period only 8.2% of mothers in our study could be categorised as severely immuno-compromised (CD4 cell count<200cells/mm³).

Over the 24-month follow-up period specific micronutrient levels declined among the HIV-infected women, with the differences in haemoglobin and vitamin A concentration compared to the baseline becoming significant ($p<0.05$). In a proportion of the women, the vitamin A concentration was indicative of deficiency. This latter finding is consistent with the trends observed in KwaZulu-Natal wherein mean serum retinol concentrations in HIV-infected women were lower by six months after delivery, even after controlling for the acute phase response.[7] Whilst very few of the mothers in our study had a BMI level <18.5kg/m², others have found this lower BMI level to be associated with increased risk of vitamin A and selenium deficiency.[202] In Cape Town the following independent predictors of low levels of serum retinol among untreated HIV-infected included: WHO stage 4 (Odds Ratio: 3.4; 95% CI: 2.1,5.7) and body weight (Odds Ratio: per 5kg decrease 1.15; 95% CI: 1.08,1.25).[203].

Folate deficiency attributable to low dietary intake has been found to be common among women of childbearing age (but unknown HIV status) in South Africa.[206] However, since October 2003, mandatory regulations on flour fortification (including the addition of 25% folic acid to 200g raw maize meal and wheat flour) were promulgated in South Africa. It is also known that since the implementation of this national programme there has been improved folate status (namely a 92.8% reduction in the prevalence of red cell folate deficiency from 26.4% to 1.9%) among women of childbearing age in provinces where folic acid deficiency has been documented.[205] Whilst the dietary intake data in our study was considered unreliable, we noted that most of the women in the study consumed high intakes of bread and maize meal daily. Thus it is possible that the trends observed with regard to red cell folate over a period of 24 months may have been attributable to the increased intake levels through the staple food fortification programme.

Iron deficiency has been documented among women of child-bearing age in South Africa. Our study population had normal serum iron but low serum transferrin and low transferrin saturation at baseline. In the absence of accurate dietary intake data, we are unable to comment on the intake of inhibitors or enhancers of iron absorption in our study population, thus it is possible that the lower iron levels could be attributable to either poor dietary intake or the overall inflammatory response in our study population. Furthermore, as suggested by others[208], the methods we used to determine iron status, namely serum ferritin, haemoglobin and iron concentrations, may not be the most suitable to use in the presence of a possible inflammatory response that manifests itself in the presence of a disease like HIV.

An additional complication is that during inflammation (or acute phase reaction) the levels of serum ferritin are elevated. It is thus difficult to interpret levels of serum ferritin between 12 and 100µg/L as it is not clear whether this reflects a deficiency or is rather a manifestation of inflammation. Serum ferritin levels among our HIV-infected mothers and controls were within the normal range. Given that serum ferritin is also used as a surrogate marker of the inflammatory response, the levels of this biomarker may have been more reflective of disease state than of deficiency. Data collected among HAART-naïve women in the USA indicate that higher serum ferritin concentrations may result in a 1.67 fold increase in the odds of death (95% CI: 0.98;2.86).[207]

This study deliberately did not focus on assessments of maternal biomarkers of nutritional status during pregnancy given that the interpretation of micronutrient status would have been influenced by possible haemo-dilution and thus analysis would have been complex. The US Assembly of Life Sciences[208] indicates that "during pregnancy the concentrations of water-soluble vitamins tend to be lower whereas concentrations of fat-soluble vitamins remain unchanged or are elevated."

Most studies assessing biomarker levels of nutritional status use the serum or plasma level of each nutrient. Semba and Tang[98] state, however, that this methodology has its limitations in small sample sizes or where study participants are acutely ill. Further, for some micronutrients, serum or plasma levels may not be the most sensitive indicators of nutritional status especially in the absence of agreement on cut-off points used to define deficiency levels.

We faced a number of technical challenges in the collection of blood samples. At times there was insufficient blood collected to allow for the analysis of all the variables of micronutrient status. Sometimes samples were haemolysed. At other times mothers were reluctant to have their blood taken or it was deemed inappropriate on medical grounds (for example if the mother appeared clinically lethargic after a medical assessment) to take blood samples from the mothers. This caused the fluctuation in the number of total samples per micronutrient or biomarker collected per visit and thus the analysis of trends could have been flawed to some extent. We also acknowledge that the periodic measurement of CD4 cell counts and the fluctuations in the levels may not have been the ideal method of determining immuno–status or the ideal period for HAART initiation among our participants. Indeed, others have instead recommended that the CD4 percentage could be more reliable than the absolute count.[209]

The Operational Plan for Comprehensive HIV and AIDS Care, Management and Treatment in South Africa[210] includes the provision of a multi-micronutrient supplement and a food supplement to all persons who have a CD4 count below 200cells/mm^3 as the standard of care. On account of this it is possible that the measured levels of micronutrients actually reflected the effect of supplements in these HIV-infected women. In addition, a wide variety of supplements was being consumed by about 15% of our study population, although we have no information on the frequency, dosage and composition of these self–obtained

supplements that the women were taking. The researcher categorised these preparations according to those that had traditional names, those that were based on a herbal substance and the more western registered vitamins and mineral preparations. Some of the study participants reported taking combinations of the various preparations. It is possible that some mothers displayed recall bias in the listing of the types of supplements they were taking or because some were taking traditional herbs, they did not necessarily name them specifically. It is thus not known what the medical and nutritional contributions of all these herbs was in relation to the overall diet and health of the mothers or whether any of these medications and supplements could have had any adverse effects on the mothers. It is concerning to notice that some of the mothers took a combination of the various preparations, a situation that could have resulted in adverse drug-nutrient interactions or nutrient-nutrient interactions.

The consumption of nutritional supplements and immune boosters among HIV-infected persons has also been documented in the USA, where extreme intakes (often above the tolerable levels) were observed. The use of such supplements among both men and women was associated with higher levels of affluence, being white, well educated, being on HAART and having higher CD4 cell counts.[211] We show that this practice is also common in semi-urban people, non-affluent people in this country.

Our follow-up period was much longer than in other studies on micronutrient status of HIV-infected women in South Africa. We observed no significant deficiencies developing over time, possibly because 31 of our study participants had already commenced HAART and reported taking supplements of various forms. We conclude that the micronutrient status of our study population was satisfactory, possibly as a result of supplementation and even because most of the mothers in our study were overweight and not under-nourished.

On an individual patient level, it is possible that antioxidant micronutrients may be an important contribution to the the optimal management of persons living with HIV; however, a prudent approach is required in recommending extent and dosages of micronutrient supplementation among HIV-infected patients, as this will be informed by their current nutritional status. This targeted or more focussed approach to nutritional supplementation of personsl living with HIV will have to be balanced with facilitating a reduction in viral load and enhancement of the immune status. Within resource-constrained environments the improvement of the quality and diversity of dietary intake is the most economically sustainable intervention towards optimal nutritional status among persons living with HIV.

Prior to making population-based recommendations on large scale micronutrient supplementation, full assessments on current intake levels enhancers or inhibitors of absorption are essential. With increasing access to HAART in South Africa there will be a need to continue to research the role of micronutrients in advancing HIV disease and any biochemical changes (such as insulin resistance, lipid abnormalities) that may arise.

We acknowledge that using biochemical markers alone does not provide the true overview of nutritional status. Further, it has been mentioned that low levels of micronutrients may be indicative of HIV disease stage and not necessarily a deficiency of the particular micronutrient in question. Alternatively, the extent of HIV disease may itself compromise micronutrient absorption and utilisation leading to low serum levels of the micronutrient. We did not identify significantly low serum micronutrient levels, and this correlated with the generally good nutritional state of the study subjects as measured by anthropometric indices. Our data corroborates the cautious stance of the leading authors in the field of

HIV and micronutrients that nutritional interventions alone are insufficient in preventing the impact of HIV.[76]

7.6. SUMMARY

We have not observed widespread micronutrient deficiencies among our study participants, even when compared to other data generated within South Africa. This is similar to the findings in Chapter 6, where there were hardly any women who could be categorised as malnourished. Thus, it is possible that in an urban setting, where women have greater access to information, including information on HIV and nutrition, they are in a better position to access a more varied diet which is augmented by micronutrient supplementation. Our findings substantiate the need for continuous monitoring and issuance of cautionary advice against the intake of a wide spectrum of immune boosters. This information would need to be imparted in counselling sessions, upon assessment of current dietary intake patterns and provided to persons who are immuno-suppressed, regardless of whether they had initiated HAART.

CHAPTER 8 - CHILD OUTCOMES IN RELATION TO MATERNAL HEALTH

8.1. OBJECTIVES

1. To determine the HIV transmission rate attributable to infant feeding practices among children born to HIV-infected mothers over a two year period.
2. To describe the outcome of mothers and children over a period of 24 months and link this to maternal health factors and feeding patterns of HIV-infected mothers.

8.2. SUBJECTS AND METHODS

Within a period of three days postpartum the HIV-1 infection status of the children was determined by collecting heel prick blood and using a nested HIV-1 DNA PCR assay performed on dried blood on filter paper (Roche Amplicor version 1.5 HIV DNA PCR; Roche molecular systems, Basel, Switzerland). Tests were repeated at 6 weeks and 3 months of age. Subsequent PCR testing was performed on breastfed infants until three months after cessation of breastfeeding.

Children enrolled in the study had their weight and length measurements taken at various intervals between birth and 24 months of age. Table 8.1 depicts the schedule of each of the five visits. Birth weight of each of the children was obtained from the first visit records or from the "road to health" chart. Weight was measured to the nearest 0.1kg using an electronic scale (Durban Scales, 2000) in 100g increments. To measure the length of the children who could not

yet stand unassisted, supine length measurements (using non-stretchable tapes affixed to the bed) were taken, with the child lying on an examination bed. For those children who could stand unassisted, height was measured in a standing position. The height measurements were taken to the nearest 0.1cm with a tape measure affixed to the wall.

Table 8.1: Schedule of visits for growth assessment

Visit	Approximate age of infant or child
0	Birth or within 3 days of delivery
1	6 weeks after birth
2	6 months
3	12 months
4	18 months
5	24 months

Infant feeding practices of all the children enrolled in the study were also assessed and the methods used have been described in Chapter 5.

A thorough review of the patient records was undertaken so as to establish as accurately as possible the actual administration of and timing of the mother and newborn nevirapine dose and also to verify the feeding practice immediately after birth. For this study it was possible to review 258 of the 293 mother and child records. In 35 cases, no hospital records could be identified in the hospitals serving the local population. The data on HIV transmission will thus be based on 258 cases only. There was no identifiable systematic difference between this group of 35 missing data and the main study group.

8.3. STATISTICAL ANALYSES

Nutritional status was assessed using algorithms developed by the WHO and CDC's anthropometrical programme (Nutristat). The raw anthropometric data were transformed into Z-scores and the data were evaluated using the sex-specific 1978 CDC/WHO normalised version of the 1977 NCHS reference curves. These anthropometric measurements were used to compute weight-for-height (w/ht), weight-for-age (w/a) and height-for-age (ht/a).The interpretation of each of the Z-scores is given in Table 8.2.

Table 8.2: Z-scores and their interpretation

Z- score	**Interpretation**
Low weight for height Z-score (WHZ)	A WHZ score below -2SD is wasting, an indicator of acute weight loss
Low weight for age Z-score (WAZ)	A WAZ below -2SD indicates underweight or poor weight gain
Low height for age Z-score (HAZ)	A HAZ below -2SD indicates stunted growth, and reflects chronic malnutrition

8.4. RESULTS

8.4.1. HIV transmission

Of the 258 children, 39 (15.1%) were HIV-infected, 205 (79.5%) uninfected, and 14 (5.4%) had incomplete data on HIV status at the end of 24 months follow-up. See Figure 8.1

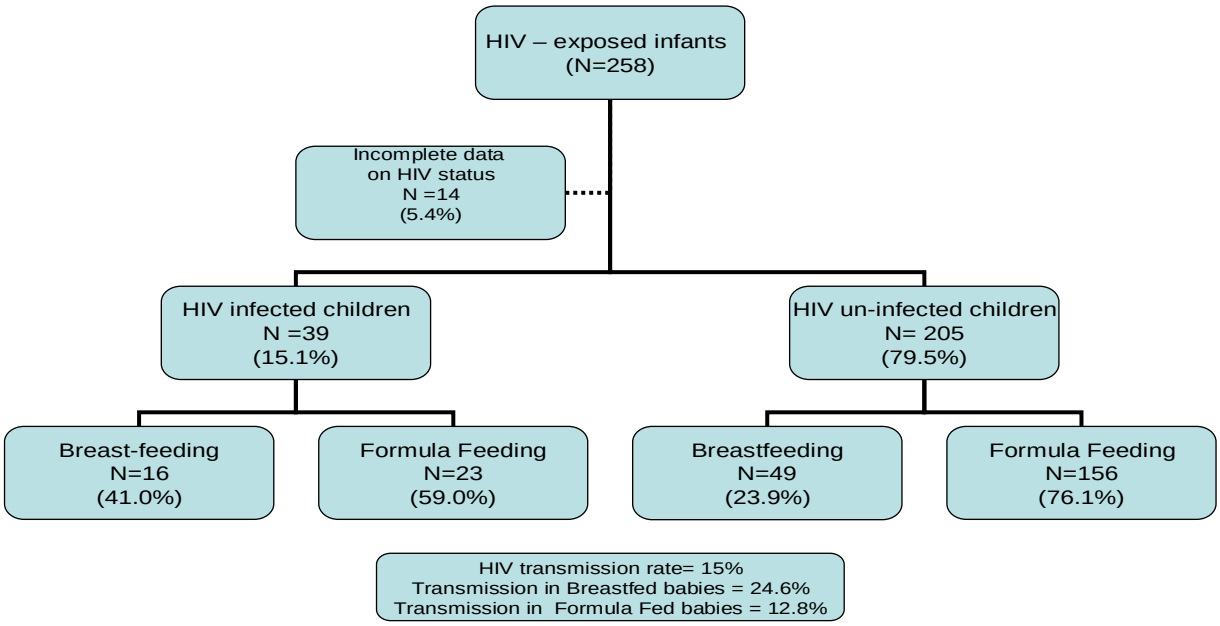


Figure 8.1: Flow Diagram on HIV transmission and infant feeding practices

There were no differences between HIV-infected and uninfected babies with respect to socio-demographic variables, except that mothers of infected babies were more often single (89.5%) than the uninfected mothers (79.5%), although the difference was not statistically significant (p=0.15).

The majority of babies were term infants (77.9%) and about 18.1% were under 2.5 kg at birth, with an overall mean gestational age of 38.2 weeks, with no difference between HIV-infected and uninfected children. There was a larger percentage of HIV-infected infants who were born prematurely (29.4%) than in the HIV-uninfected group of children (16.3%).

Nearly 72% of infants were never breastfed, with a statistically significant difference in the rate of breastfeeding among HIV-infected and uninfected infants (41.0% vs.24% respectively; p=0.03). Of the children who had ever been

breastfed (n= 65), 16 were found to be HIV-infected (24.6%), compared to 23 of 179 children never breastfed (12.8%).

8.4.2 Nevirapine Administration

Of the 252 mother-child pairs on whom either hospital record or Serithi interview data for either the mother, child, or both was available, nevirapine (NVP) was taken by 230 mothers (91.3%), in 2.4% of women (N=6) it was unknown if NVP was taken, and in 16 cases the NVP dose had been missed by the mother. The record-keeping was woefully inadequate in the medical records. For the 230 women reported as having received NVP, 111 (48.3%) were reported by the mother and also documented in the medical records, 101 (nearly 43.9%) were reported by the mother alone (N=101), and 18 (7.8%) were documented in the medical record, but information from the mother was missing.

Similarly, 229 (88.7%) of 258 babies received NVP, and it was unknown if the child received his/her dose of NVP in four (1.7%) cases. Of the 229 children that had received NVP, 56.8% (N=130) had documentation from both sources, 28.8% were reported by the mother alone, and for 14.4% documentation of NVP was only from the medical record review. Five percent of children had no recorded dose of NVP, even though the file was available.

8.4.3 HIV-infected study participants on HAART

At the end of the follow-up period of 24 months there were a total of 31 mothers on ARV therapy in the study. Of these mothers on HAART, 15 claimed that they had experienced side effects from taking the medication, including dizziness, headaches, nausea, loss of appetite, skin rash and swollen feet.

The commonly advised system of "treatment buddies" as support and reminder for people on HAART was found to be only moderately effective. At least 4 mothers claimed they did not have a treatment "buddy". Of those mothers on regular treatment, 12 (38.7%) named a sister as the most common treatment "buddy", followed by 19.4% who relied on partner or husband. Four (12.9%) had a friend or mother as the treatment "buddy" of choice. For 16 (69.6%) of the mothers the most common means of communication with the treatment "buddy" was via cell phone text message reminding them to take their medication. Four mothers (17.4%) stated that the treatment "buddy" cared for them and 28 (70%) stated that the "buddy" provided advice to them on healthy living.

The study highlighted a serious problem with compliance to treatment, with nine mothers (29%) stating that they had missed going to replenish their supply of ARVs. Five of these (56%) stated they had no money for transport to the health facility, two stated that they avoided the long queues, one stated that the administrative fee of R45.00 for the file was too high and one stated that she was unable to get time off from work to collect her treatment.

8.4.4. Child Growth

Data on child growth was available at all the five scheduled visits. However, large gaps in the data occurred because babies were not always available at each of the mother follow-up visits for assessment of growth. Accordingly, the data was presented as a series of cross-sectional measurements at each of the time points, rather than as a longitudinal follow-up. The anthropometric indices of weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ) and weight-for-height Z-score (WHZ) are presented in Figures 8.1 and 8.2. Over the 24-month period, it was possible to compute the WHZ score for 725 contacts, the HAZ score for 718 and the WAZ score for 797 contacts.

At the first three time points (corresponding to the first 12 months of follow-up) the mean WAZ was -2.03, the mean HAZ was -1.60 and the mean WHZ score was -1.22. However, at the next two time points up to 24 months, there was an improvement towards the reference range in all three indices. At 24 months, the mean WAZ score was 0.38, the mean HAZ was 0.76 and the mean WHZ was 0.14. See Figures 8.2 and 8.3.

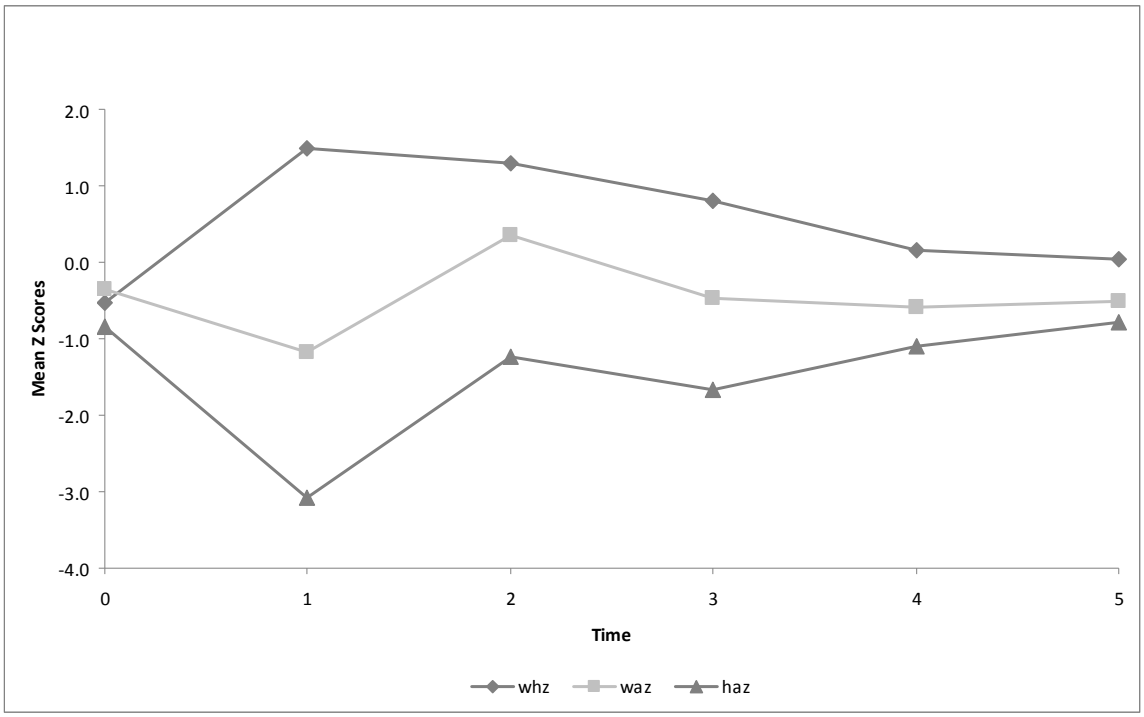


Figure 8.2: Mean Z-scores of HIV-exposed girls over time

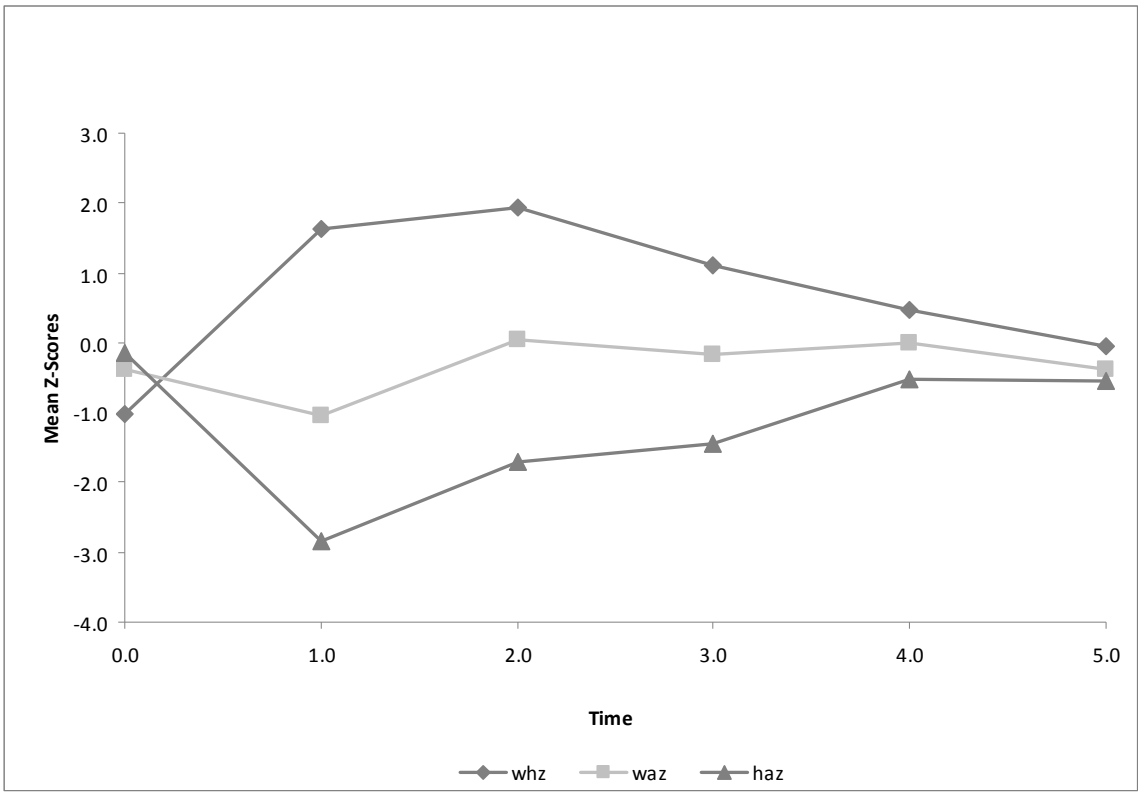


Figure 8.3: Mean Z-scores of HIV-exposed boys over time

Weight for age Z-scores (WAZ)

For both the girls and the boys at around birth the mean WAZ scores were close to the reference population, but by six weeks after birth there was a decreasing trend for both. After six weeks after birth there was evidence of catch-up growth (which was higher for the boys). However, even with the catch-up growth the mean WAZ-score for both sexes remained slightly lower than the reference population for the remainder of the 24-month follow-up period. Overall, however, this group of children had a normal early growth pattern.

Height for age Z–scores (HAZ)

The HAZ-scores for both girls and boys were very close to the reference population at birth, but showed a decline by six weeks and, similar to WAZ-

scores, there was evidence of catch-up growth thereafter. By 24 months, the mean HAZ-score was approaching the reference population. In view of the recognised variability in the accuracy of length measurements under routine service conditions, some of the length measurements were excluded from the data analysis..

Weight for height Z-scores (WHZ)

The computation of WHZ scores is dependent on the accuracy of the component weight and height measurements. In view of the low early HAZ score obtained in this study, high WHZ scores should be expected and indeed were found. The mean WHZ scores of both the girls and the boys at birth were lower than the reference population. However, from the six weeks visit onwards they remained higher than the reference population, declining slightly by 24 months. These data do not suggest significant wasting to be present in this population.

8.4.4.1 Comparison of Growth of HIV-exposed boys and girls according to feeding mode

The growth of all the boys and girls was assessed according to whether the children had ever been breastfed or not, as depicted in Tables 8.3 and 8.4. Differences in growth according to the three indices (WAZ, HAZ, and WHZ scores) between the six-week and 24-month visit for all the children were also determined. Table 8.3 and 8.4 show the values for WAZ and WHZ scores. They show the same tendencies as demonstrated for the whole group and no significant differences according to feeding mode.

Table 8.3: Growth of HIV-exposed boys according to feeding mode at visit 1 and 5

		Visit 1		Visit 5	
		Breastfed	**Not breastfed**	**Breastfed**	**Not breastfed**
	Mean	**-0.72**	**-1.18**	**0.94**	**-0.31**

WAZ	**SD** **(N)**	**2.26** **(12)**	**2.33** **(53)**	**0.72** **(14)**	**1.16** **(53)**
WHZ	**Mean** **SD** **(N)**	**1.95** **1.40** **(18)**	**1.43** **1.27** **(60)**	**0.12** **0.58** **(12)**	**0.10** **1.37** **(52)**

We also set out to establish whether initial breastfeeding changed the growth patterns of HIV-infected babies between the six-week and 24-month visits. Significant changes in the mean WHZ-score ($p<0.05$) among breastfed boys and girls between the six-week visit and the 24-month visit were observed. The mean WAZ-score was not significantly different among breastfed girls and boys from the six-week visit to the last visit, again showing that both groups of babies seemed to grow equally well on follow-up.

Table 8.4: Growth of HIV-exposed girls according to feeding mode at visit 1 and 5

		Visit 1		Visit 5	
		Breastfed	Not breastfed	Breastfed	Not breastfed
WAZ	Mean	-1.34	-0.87	-0.57	-0.25
	SD	2.33	1.87	1.18	1.09
	(N)	(22)	(34)	(24)	(35)
WHZ	Mean	1.92	1.43	-0.14	0.02
	SD	1.76	1.57	0.92	1.06
	(N)	(28)	(37)	(23)	(34)

8.4.4.2 Comparison of the growth of HIV-infected and non-infected children

A comparison of the growth of HIV-infected babies with those that were uninfected showed no significant differences. Both groups grew normally and there was no significant cross-sectional difference. There was a significant increase in the WAZ-score among PCR-positive and negative children between visit one and visit five ($p<0.05$). From Table 8.5 there appears to be a decline in the mean WHZ for both the PCR-positive and PCR-negative children.

Table 8.5: Comparison of growth among HIV-infected and non-infected children by visits

		Visit 1		Visit 5	
		PCR positive	PCR negative	PCR positive	PCR negative
	Mean	-1.68	-1.21	-0.57	-0.35

WAZ	**SD** **(N)**	**(2.36)** **25**	**(2.31)** **104**	**(1.00)** **34**	**(1.11)** **115**
WHZ	**Mean** **SD** **(N)**	**1.78** **(1.61)** **35**	**1.52** **(1.47)** **123**	**0.05** **(0.71)** **33**	**0.08** **(1.13)** **112**

8.4.4.3. Growth of boys and girls in relation to maternal CD4 count

We assessed the growth of the children of mothers who had severe immuno-suppression, as indicated by a CD4 cell count of less than 200cells/mm³, and compared this with the growth of children whose mothers had a CD4 cell count greater than 200cells/mm³. At around the six-week visit there were only 30 children whose mothers had a CD4 cell count less than 200cells/mm³. There were no significant differences in the anthropometric indices between children born to mothers with a low CD4 cell count (<200cells/mm³) as compared to those born to mothers with a higher CD4 cell count (>200cells/mm³).

We also assessed the rate of decline of CD4 count according to feeding mode. By 24 months we found the mean CD4 cell count amongst mothers who had ever breastfed to be 390cells/mm³ whereas for the mothers who had practiced formula-feeding the mean CD4cell count was 400cells/mm³. Our findings report on observations and given that few mothers practiced breastfeeding there would not be sufficient data to conduct more extensive analysis on the role of , breastfeeding on immunological progression of HIV in this study.

8.4.5. Maternal and child deaths and morbidity

During the 24-month follow-up period, eight HIV-infected mothers died. The cause of death was known only for three mothers, namely neurological AIDS-related disorder, tuberculosis and smoke inhalation. We found equal numbers of deaths amongst mothers who either chose to breastfeed or formula-feed their infants, specifically four in each group. In Chapter 5 we obtained postnatal feeding practices from 222 mothers, of whom 154 practiced formula-feeding whilst 68 breastfed. Thus, while 2.59% (4/154) of the women who had formula-feddied, compared to 5.88% (4/68) of those who had ever breastfed, the data does not allow for Cox regression or further analysis. It is possible though that the mothers who chose to breastfed may have been sicker and at greater risk of death.

All mothers were asked to name the most common illnesses they had experienced during the course of the follow-up. There were a total of 94 mothers who responded to this question. However, this information was not verified by review of hospital records. The main reported illnesses were: influenza - 28 (29.79%); diarrhoea - 17 (18.09); STI's, headache and rash - 10 (10.64%) each; and five (5.32%) mentioned oral thrush. One mother mentioned tuberculosis.

During the 24 months of follow-up, there were a total of 33 (11.2%) neonatal and infant deaths in the total study of 293. Of the 33 children who died, 12 (36%) had at least one positive PCR result. The remaining 21 children who died were PCR-negative. Accordingly, the mortality rate for HIV-infected children in this study was at least 12 of 39 (30.7%), and 21 of 254 (8.3%) of uninfected children died. HIV uninfected children also had unacceptably high mortality. This indicates serious risk to these children, possibly related to poor feeding practices and inadequate care. At the end of the 24 months of follow-up 21 children were on ARV therapy in our study. It was possible to obtain the cause of death of the child from the mother or through the hospital records for 15 of the study participants. The reported causes of death included

pneumonia/bronchitis/respiratory infection (9), foetal distress, stillbirth or congenital malformations (3), diarrhoea (2), and other cause (1).

8.5. DISCUSSION

We have observed that in our study the HIV transmission rate by 24 months was 15%. This finding is not that different from many other studies in Africa. In an operational setting in South Africa the rate of early (3 to 4 weeks) transmission ranged from 8.6% in an urban site to 13.7% in a rural site.[212] In another operational PMTCT setting in Kenya in similar conditions to those under which our study was conducted, the HIVNET 012 regimen was found to yield a perinatal HIV-transmission rate at 14 weeks postnatally of 18.1%, whereas before the introduction of nevirapine it had been 21.7%.[213] The HIV transmission rate by 24 months in our study was slightly higher than the HIV transmission rate in the SAINT trial. That trial included a second dose of nevirapine to the mother between 24 and 48 hours after delivery and resulted in an early 12.3% transmission rate by 8 weeks among children who had received a short course of nevirapine.[214] The PETRA Study found a transmission rate of 11.6% at 6 weeks.[215]

Several trials demonstrating the efficacy of short course ARVs in reducing intrauterine and intrapartum transmission have been conducted among breastfed populations in Burkina Faso, Ivory Coast and Uganda.[216,217,218] However, most of these studies are different from ours as they are predominantly reporting on early HIV transmission rates and not for a period as long as 24 months after delivery. At the time that this study was conducted the PMTCT protocol made reference only to the use of single doses of NVP given to the mother during labour and to the newborn within 72 hours of delivery. Research drawn from a pooled analysis to determine the efficacy of peripartum anti-retroviral regimens

in the reduction of MTCT[219] indicated that combination therapy of ZDV and 3TC from 36 weeks of pregnancy had a greater efficacy in preventing MTCT than the monotherapy that was provided as part of policy when our study was undertaken. It is thus highly likely, given the low breastfeeding rates in our study population, that we would have observed even lower transmission rates if dual therapy was practiced as the policy during the conduct of this study.

There is a need for caution in the comparison of HIV transmission rates between studies as this may be complicated by the location of the study, the type of study (whether an observational study or a clinical trial), usage of different prophylactic ARV drugs, and differences in infant feeding practices and in the length of follow-up to assess long-term transmission rates.

We found that breastfeeding is a risk for transmission, as it approximately doubled the risk for transmission (16 of 65 ever breastfed versus 23 of 179 never breastfed; 24.6% vs 12.8%). This finding is consistent with other studies that show that breastfeeding almost doubles the risk of MTCT[220,221,222]. Of greater concern is our finding that ever breastfeeding doubled the risk of death amongst the mothers in this study. However, this finding may not necessarily have clinical significance given that the breastfeeding mothers in our study did so for a limited period of time. Our findings show less risk of mortality than that found in Kenya[23], but are comparable to those found by Otieno[5] with respect to feeding and health outcomes for the mother and the child.

The findings from a larger study in KwaZulu-Natal among HIV-infected breastfeeding mothers found that infants who were breastfed and also given solids were significantly more likely to be HIV-infected than children who were exclusively breastfed (HR 10.87, 1.51-78.00, p=0.018), in comparison to children who by 12 weeks were fed both breastmilk and formula milk (1.82, 0.98-3.36, p=0.057).[30] Almost none of the mothers in our study were practicing exclusive

breastfeeding. The practice of mixed feeding has been shown to increase the risk of HIV transmission, and their babies were also likely to receive complementary foods by as early as 6 weeks after delivery. In Malawi[223] it was found that even though complementary foods were introduced to 40% of infant diets by 2 months and 65% by 3 months, this still resulted in children displaying a lower weight-for-age at 3 and 6 months ($p<0.05$) and this resulted in an increased risk for respiratory infections($p<0.05$).

Even though antiretroviral therapy can contribute to a significant reduction in MTCT in breast feeding populations, the risk of HIV transmission remains as long as breastfeeding continues[224]. In our study the median duration of breastfeeding in our cohort was 42 days, with the range being 1 to 360 days. As reported in Chapter 5 almost none of the mothers in our study were practicing exclusive breastfeeding and, in fact, complementary foods were introduced as early as 6 weeks after delivery.

It is of interest that despite the recommendation from the PMTCT programme that mothers cease breastfeeding early, there were mothers in our study that continued to breastfeed well beyond the first three or four months of life. One mother who continued to breastfeed for 360 days specifically stated that she was forced to do so by her grandmother. In a review of 14 Demographic and Health surveys from developing countries, Brahmbatt and Gray[225] found mortality to be highest amongst never breastfed children as compared to mothers who had breastfed before and stopped.

Given that our study was not an intervention study, it provides valuable data on the quality of record keeping in the programme within the clinics at the time. The recording of nevirapine administered was an unacceptably low, 8% for the maternal dose and 14% for the neonatal dose. It has been shown within operational PMTCT sites in three provinces in South Africa that women of higher

socio-economic status and those who had received a better quality of counselling were more likely to have received the nevirapine dose within the standard time frames.[226] A study undertaken at Coronation Hospital also highlighted that with good record keeping it was possible to document accurately the HIV transmission rate[227]. Our study highlights that even two to three years after the introduction of PMTCT in South Africa, the record-keeping and data management pertaining to the programme were so poor in the clinics studied that routine monitoring and evaluation aspects of this national programme were severely compromised.

HAART treatment adherence among the mothers in this study was sub-optimal. Similar to our findings, Maskew et al[228] found that the main reasons cited by 182 patients on HAART who failed to return for follow-up visits in Johannesburg included financial reasons (34% of patients) as well as transport and administrative costs entailed in opening a file each time they visited the health facility. We found almost a third (29%) of mothers were not compliant for HAART for similar reasons but also it would appear that non-disclosure could have made them less amenable to the "buddy system" with more than 10% stating they did not have a treatment "buddy".

In this study at four clinics in the Tshwane area we have shown serious defects in the implementation of the national PMTCT programme. This is in line with a published global review of PMTCT programmes and access to paediatric ART, which showed that although PMTCT coverage increased from 7% in 2004 in 58 countries to 11% in 2005 in 71 countries, only 38 countries had complete data on ARV access for mothers on the PMTCT programme and in these countries only 28% of mothers eligible for HAART were accessing it.[229] In order to increase compliance of patients to HAART within a developing country context, efforts should be directed towards making ARV therapy free to those patients requiring it and more accessible by ensuring that treatment is made available at the primary health care facility level[229]. A similar recommendation has also been

made by the World Health Organisation, suggesting that a public health approach is required with less dependence on the physician specialist to administer the drugs.[231]

We have found that almost one third of children born prematurely in our study contracted HIV. Low birth weight and prematurity are known to be a consequence of MTCT.[198,232,233] It is likely that as more HIV-infected mothers are placed on HAART with time there will be fewer low birth weight or preterm deliveries, as has been reported in the USA where over a 15-year period ARV uptake increased from 2% to 84% and the low birth weight prevalence decreased from 35% to 21% and the preterm birth decreased by almost the same percentage.[234]

In this study we attempted to assess the growth pattern of HIV-exposed infants and children over a two-year period and to also determine those factors, such as maternal health, that may impact on growth. It is well established that HIV disease negatively impacts on optimal infant and child growth parameters and may lead to faster disease progression and mortality. Our study emphasised maternal follow-up and we therefore did not achieve adequate regular longitudinal follow-up of the children, having to rely on cross-sectional estimates of growth. It is highly likely that this approach may have missed important trends. It is also possible that those children that did not attend all follow-up visits could have been those who were most ill or malnourished.

We found that the growth of infected children is comparable to that of uninfected children in our environment and that it is relatively normal up to age 2 years. This may suggest that, overall, the maternal HIV status did not interfere with the mothers' ability to feed and care for their children. Clearly, those mothers who were themselves critically ill or who died and their children were not captured in this approach.

The growth pattern and specifically the weight-for-height Z-score seen in this study correlated with that found in a study conducted among the same communities from which our study population was drawn[235,236,237]. Although that study was not conducted among HIV-exposed infants, it did establish that 92% of the children were exclusively breastfed by 1 month, by 3 months 35% and by 6 months only 7% were exclusively breastfed. This is comparable to the findings among our HIV-negative mothers, and may also illustrate the influence of the counselling received in the PMTCT programme. Delport found in her study that growth faltering was evident from as early as 3 months and continued till 15 months. [237]

In an earlier study assessing the growth of HIV-exposed infants and children participating in routine PMTCT programmes in a peri-urban setting in Kwazulu-Natal, HIV-infected children manifested early and sustained low mean Z-scores for length-for-age and weight-for-age but not for weight-for-length. Those HIV-infected children who died earlier were found to be more severely stunted, wasted and underweight than those who survived[237]. The authors suggested that this may be in part attributable to poor mothering capacity due to the HIV status of the mother and her possible illness. However, it must be noted that none of the children in that study received ARV prophylaxis unlike in our study. In addition, unlike in our study there was evidence of growth faltering in the Durban study among HIV-uninfected children.

The decline in growth (ht/age and wt/age) seen in our study at around the 6 week period may have arisen as a consequence of inappropriate and early introduction of complementary foods at this stage, affecting the optimal growth of the children. There is ample evidence from Africa highlighting that poor infant feeding practices together with low energy and nutrient dense complementary

feeds, coupled with frequent infections can contribute to high infant and young child mortality. [223,238,239]

An earlier study in Uganda found evidence of growth faltering among the HIV-infected children, in particular the mean weight-for-age and length-for-age curves were significantly lower than those of non-infected children over a 25 month period, but more than half (54%) of the HIV-infected infants died prior to 24 months whereas among the HIV-negative group mortality was only 1.6%.[240] That study cannot be compared to our findings because of the much higher mortality rate.

It is possible that we were not seeing evidence of extensive malnutrition among the children in this cross-sectional study as most of the children were asymptomatic or had minor illnesses that were treatable in out-patient hospital departments, and any severely immuno-compromised and malnourished children could be amongst the 33 that died. Others have found that wasting is a common occurrence among children who are categorised as severely malnourished.[243] In Uganda[240] and Tanzania[242] where rates of malnutrition among children (regardless of HIV status) are likely to be higher than in peri-urban settings in South Africa, it was found that wasting, stunting and underweight were strong predictors of mortality among HIV-exposed children.

It has been suggested that given the non-invasive nature of anthropometric measurements, there should be regular nutritional assessment of HIV-exposed children followed by nutritional and energy supplementation where indicated.[243]

More than 11% of the infants and children died during our follow-up period. The main reported causes of death included pneumonia/bronchitis/respiratory infection (60%), foetal distress, stillbirth or congenital malformations (20%), diarrhoea (13%), and other causes, like high fever and sores on the chest (7%).

A positive PCR was found in only 12 of the 33 child deaths, and AIDS was never mentioned as the cause of death in any of our study participants but this could be due to the ongoing stigma about HIV and AIDS when the study was conducted. A study conducted in Malawi found that after two years of follow-up of children born to HIV-infected mothers, 2.2% of mothers and 15.5% of children died.[4] This finding is disturbing considering that in Malawi the socio-economic conditions are likely to be more adverse than in a peri-urban setting in South Africa. Newell has made the point that it will become increasingly important for the monitoring of the PMTCT programmes in future to focus not only on HIV prevention but also on survival of HIV-exposed children as a major outcome.[244]

There are a number of studies that have assessed mortality of children born to HIV-infected women, both within the era of HAART and prior to this. According to Newell et al, in low income countries estimates are that 50% of all HIV-infected infants will die before the age of 2 years if no ARV therapy is made available.[149] In the South African context there is increasing concern over the high rates of child mortality that are attributable to HIV. In a study conducted at community level through a surveillance system in a rural population in KwaZulu-Natal Province, which at the time had the highest prevalence rate of HIV, it was found that HIV and AIDS was attributable to 40% of deaths among children under five. Among these deaths, neonatal deaths accounted for 13% of the total whilst infant deaths accounted for 61% of total deaths. Most deaths were found to occur in the neonatal period and specifically the first day of birth.[245]

A study conducted in Botswana[246] found that after a 24-month follow-up of infants born to HIV-infected mothers the mortality was 29.5% among HIV-infected infants, who were also more likely to have had pneumonia, and this rate declined to 6.7% among HIV-uninfected infants. These findings are comparable

to those of our study, where we found 12 of 39 infected infants to have died (30.7%) compared to 21 of 254 uninfected children (8.3%).

We found that by the end of the 24-month follow-up period a total of 21 children had begun ARV treatment out of 27 surviving HIV-infected children. There is evidence to show that HIV-infected children who are placed on HAART, with a resultant improvement in their viral load and CD4 cell counts, display improvements in weight and height Z-scores when followed up for a period of 96 weeks. The improvements in anthropometry, particularly BMI, were more marked if the children had been of poor nutritional status at baseline.[247] Such a finding raises hopes that with close nutritional-status monitoring and treatment-adherence support, the 21 children on HAART should not experience any deterioration in nutritional status. A global review of the progress in PMTCT and paediatric HAART acknowledges that provision of comprehensive health care packages for HIV-infected children will depend on availability of quality health care services, especially in low income countries.[248]

In this study we set out to assess the impact of HIV-infection on mothering capacity. As previously reported in Chapters 6 and 7, most of the mothers in this study were asymptomatic, not seriously ill and they were not yet at an advanced HIV disease state at the end of the 24-month follow-up. The low breastfeeding rate observed in our study was therefore unlikely to be due to poor maternal health. Studies in some African countries like Zambia have suggested that poor maternal health among HIV-infected women is associated with a shorter duration of exclusive breastfeeding[185]. Other data from Malawi[249] suggest that HIV-infected women themselves believe that breastfeeding may lead to HIV-disease progression, especially if they also believe that their own nutritional status is sub-optimal. Earlier South African and Kenyan data on the influence of infant feeding choices on maternal HIV disease progression were contradictory.[23,50] Given that so few mothers opted to breastfeed in our study, and none of those who were

formula-feeding claimed that they did so for their own health, and that the nutritional health of the mothers as described in Chapter 6 was very good, we have found no linkage between poor maternal health and shorter breastfeeding duration.

By 6 weeks after delivery there were 30 children whose mothers had a CD4 count lower than 200cells/mm³. A large prospective study in Tanzania that followed-up HIV-infected mothers and their children for 24 months after delivery found that the CD4 count of mothers taken during pregnancy was a predictor of increased child mortality among both HIV-infected and non-infected children.[242]

Given that few mothers died during the study period, we were not able to establish any association between maternal death and increased child mortality. This is in contrast to other studies conducted in Uganda, Tanzania and Malawi[15] which found a three times higher mortality rate among children born to HIV-infected women compared to their HIV-negative counterparts. Further, when a mother dies the risk of child mortality is trebled, regardless of the mother's HIV status. The risk of maternal death is higher in these countries as there is greater dependence on breastfeeding.

One of the benefits of the Serithi Project was to enable periodic and regular follow-up of mothers and infants so as to be able to facilitate speedy referral to the paediatric ART clinic at Kalafong for management and treatment where indicated. However, the development of a project that is geared toward close follow-up of mothers and children and is designed to reinforce existing PMTCT programmes is not representative of the "typical" situation in South Africa and highlights the question of generalisability of this study. For example, it has been documented[229] that more than 30% of infants and more than 70% of children were lost to follow-up by four months due to poor follow-up rates at Government PMTCT sites, with consequently poor ability to assess the efficacy of local PMTCT

programmes[227]. The lack of follow-up of HIV-exposed and infected children denies them access to adequate medical care. Understanding the socio-economic factors that affect the ability of communities to comply with PMTCT and long-term ARV programmes is critical in assisting resource-poor countries to develop strategies to achieve follow-up of HIV-exposed infants.[250]

8.7 SUMMARY

Our study findings show that PMTCT in this cluster of clinics in Tshwane resulted in a poor outcome, given the high HIV transmission rate, missed doses of NVP to mother and missed doses of NVP to the baby. It is disappointing that our findings are not too dissimilar to other developing countries in Sub-Saharan Africa in the early stages of the PMTCT programme implementation. At the time that our study was conducted there was no dual ARV therapy or HAART for pregnancy. Yet, it is known that if this was available it would have contributed to improved outcomes for mothers and their children. Poor record-keeping in hospitals was noted and would need to be addressed by ensuring that personnel is better trained and held accountable for recording administration of any ARV medication. It is also clear that at the time this study was conducted mothers on HAART were not fully sensitised on the risks of non-adherence to treatment on the long-term efficacy of the therapy, given that almost a third had treatment interruption.

Our study has shown the continuing risk of HIV transmission through breast feeding, but has also highlighted serious problems with the way in which mothers respond in their feeding choices. Exclusive breastfeeding is seldom practised and mothers commonly choose mixed feeding options, recognised to be the most risky for HIV transmission.

In order to increase HIV-free survival among HIV-exposed children it will be important to increase the access to dual therapy, improve the documentation of the programme, ensure that eligible mothers are placed on HAART without much delay and that frequent quality counselling is provided postnatally on exclusive infant feeding practices. Optimal effectiveness and scaled-up coverage of the PMTCT programme interventions will be assured if there is detailed and consistent follow-up and early HIV diagnosis of all infants born to HIV-infected mothers at the primary health care level. This will minimise missed opportunities for the children to be placed onto ARV therapy as deemed necessary and for those eligible mothers to be referred for HAART initiation.

CHAPTER 9 - CONCLUSIONS AND RECOMMENDATIONS

The overall objective of the study was to determine prenatal and postnatal infant feeding practices of HIV-infected women and the factors that determined choices and adherence. Futhermore, the study set out to determine the longitudinal changes in anthropometry and micronutrient status and the determinants thereof from six weeks after delivery until 24 months. To assess whether maternal HIV status influences her mothering capacity, the study determined the growth patterns of children born to HIV-infected mothers over a two-year follow-up period and the influencers thereof.

In order to achieve the main objective it was necessary to conduct a series of interlinked assessments, each of which contributed to the main objective. This Chapter will summarise each of these studies and assess the extent to which they assist in meeting the main objective.

9.1. CONCLUSIONS

9.1.1. Prenatal and Postnatal infant feeding choices and practices of HIV-infected women

This study re-affirms that counselling on feeding choices for HIV-exposed infants must be extremely sensitive to numerous internal and external factors impacting on that decision. We found that HIV-infected women who had better coping skills, more education (though not statistically significant), who were married and who had disclosed to their partners tended to choose formula-feeding after undergoing the routine PMTCT counselling process. This study further emphasises the importance of support to HIV-infected women in their infant

feeding decisions, to enable disclosure and improved coping. Community-wide efforts are needed to enable HIV-infected women to independently make their infant feeding choices, relative to their own household circumstances. Such support may be in the form of frequent counselling sessions, regular antenatal contact with the mother and including, where possible, home visits. Without this package of interventions, mothers will continue to find it difficult to address the psychosocial issues pertaining to their status and to make truly independent and informed infant feeding decisions.

Our findings on postnatal infant feeding practices in comparison to antenatal choices have highlighted the serious challenges posed by the application of PMTCT guidelines to the socio-cultural complexity of advice on infant feeding. The poor adherence to exclusivity of either infant feeding choice reflects either poor maternal knowledge on the importance of exclusive feeding, or limited knowledge of counsellors. The support that HIV-infected women need in making their infant feeding decisions will entail psychosocial, community-wide interventions, and frequent counselling sessions to assist them in coping with and disclosing their status. Improving the quality of infant feeding counselling for all mothers and promotion of exclusive breastfeeding at family level are key to enhancing HIV-free survival.

9.1.2. Maternal outcomes

We observed a well-maintained nutritional state amongst most HIV-infected mothers in this study over a period of two years after giving birth. A tendency to develop obesity was noted, and the micronutrient status was well maintained or even improved.

We noted a high postnatal maternal mortality of 3.6% over two years. While more mothers who ever breastfed had died (5.9%) compared with formula-feeding mothers (2.9%), the possibility of sicker mothers choosing to formula-feed was not excluded and small numbers precluded statistical comparison. We also noted a poor compliance rate of only 71% with HAART among those mothers who were eligible and who had started treatment.

9.1.3. Child outcomes in relation to maternal health

Our study has identified several missed opportunities in the delivery of optimal PMTCT services for both mothers and their children in select clinics in Tshwane during our two-year follow-up period. Poor recording of both the mother and child nevirapine dose, poor infant feeding practices such as mixed breast- and formula-feeding, together with early introduction of complementary feeds, are all factors that have compromised the PMTCT services and led to high HIV transmission rates. We found a 15% vertical transmission rate of HIV infection by 2 years of age.

We found that 11% of the children in this cohort had died by age 2 years. This included both HIV-infected and uninfected children. Nearly one third of the HIV-infected children (30.7%) had died, compared with 8.3% of uninfected children. This illustrates the very high risk to children of HIV-infected mothers, even though on the whole there was no evidence in our cross sectional data of extensive malnutrition among the children in this study.

On the positive side, of the 27 surviving HIV-infected children, more than 75% had begun ARV therapy. This is the only hope for an improved outcome for the infected children of this cohort following the failure of the PMTCT programme for

them. Given the poor compliance with HAART by the mothers, a special effort is needed to guarantee child compliance.

9.2 RECOMMENDATIONS

Enhancement of the quality of infant feeding counselling offered antenatally and postnatally to HIV-infected women. It is essential that HIV-infected women gain access to several counselling opportunities focusing on infant feeding choices and adherence during pregnancy and soon after delivery. The counselling process needs to address the family context and be tailor-made to suit the individual context of the mother being counselled, bearing in mind that infant feeding-related stigma is still prevalent in the society. Counsellors will need to receive continuous training and skills development to ensure that the quality of the counselling they are rendering is applicable to the socio-economic and cultural background of each mother that has to decide the optimal feeding option for their children.

Monitoring at regular intervals maternal anthropometric indices and determining HIV disease progression is important. Within a peri-urban environment it is important to prevent both undernutrition and overnutrition and ensure reinforcement of the prudent diet in the HIV context. Evidence-based nutrition messages on healthy lifestyles (including exercise and physical activity) and the food-based dietary guidelines need to be emphasised for persons living with HIV in order to minimise their vulnerability to consuming unprescribed supplements and immune boosters.

As more mothers become eligible and enroll for HAART, it will be essential to **ensure adherence to treatment** by making such services more affordable and accessible at the primary health care level. Health systems management may have to review the fee structure for patients to access their files as the cost

inherent in this hinders patient compliance with HAART. **Counselling on stigma** and disclosure for mothers on HAART will continue to be an essential and continuous element of the Comprehensive Care, Management and Treatment Plan on HIV and AIDS in South Africa.

More intense efforts should be made to address the high levels of mortality among HIV-exposed infants and their infected mothers, and more PMTCT programme managers need to view "HIV-free survival" as an outcome indicator. All HIV-infected mothers need to be encouraged to bring their children for regular growth monitoring after delivery and to also be aware of the availability of the DBS PCR test for determination of the child's HIV. Whilst we found that the follow-up to ensure access of children to HAART was good, there is still a need to ensure that at each clinic visit a thorough assessment of the children's growth pattern is performed to detect any growth faltering or changes in disease state. Along with this, reinforcement of adherence to exclusive formula-feeding or exclusive breastfeeding and access to prophylactic treatment especially for the first 6 months of life should be enforced. Every effort should be made to increase maternal awareness of the dangers of mixed feeding and early introduction of poor nutrient-quality complementary food on optimal growth of the children.

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SERITHI PROJECT
3 DAY POST DELIVERY QUESTIONAIRE

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW		
	INTERVIEW	RESULT CODES
DATE IN FULL:	DD /MM/YY	1. COMPLETED: ☐
		2. REFUSED: ☐
		3. PARTIALLY COMPLETED: ☐
		4. OTHER: ☐
INTERVIEWER'S NAME:		

LANGUAGE		
LANGUAGE OF INTERVIEW:		
HOME LANGUAGE OF RESPONDENT:		
LANGUAGE CODES		
1 ENGLISH	5 IsiXhosa	9 ziTSONGA
2 sePEDI	6 isiZULU	10 isiNDEBELE
3 seTSWANA	7 seSOTHO	11 seSWATI
4 AFRIKAANS	8 tshiVENDA	

SUPERVISOR	DATA CAPTURER	OFFICE EDITOR
NAME:	NAME:	KEYED BY:
DATE:	DATE: DATE:	

INSTRUCTIONS:
This questionnaire will be administered to assess baby feeding practices soon after delivery. Several of the questions will also attempt to establish whether the mother is exclusively feeding the infant regardless of her choice.

Child Date of Birth_____Name of Child_____
SEX OF CHILD…….(M/F) BIRTH WEIGHT_____KG.

NEVIRAPINE ADMINISTRATION
(circle appropriate answer)

Mother:
a) Yes
b) No
c) do not know

Child:
a) Yes
b) No
c) do not know

B1. Did you ever breastfeed your baby?
(a) yes----------if yes go to B2
(b) no----------if no go to B3

B1.1 Did you ever put the baby to the breast to suckle?
(a) yes
(b) no

B2. If yes, how soon after delivery was your baby first put to the breast

(a) within 30 minutes after delivery
(b) after 1 hour post delivery
(c) after 2 hours post delivery
(d) after 1 day (24 hours)
(e) don't know
(f) other (specify)…….

B3. After delivery, did your baby receive anything to eat or drink (including medicines) before being put to the breast or before being formula fed?
(1) yes
(2) no
(9) do not know

B3.1. If yes, specify all the food or medicines the baby was given
:……..

B4. . What is the **main** type of milk you are currently feeding your baby (one response)
(a) breast milk
(b) commercial breast milk substitute/formula
(c) cows milk
(d) other, specify…….

B5. How many times over the past day, did you feed the baby this milk?
a) once

b) twice
c) three times
d) five times
e) more than five times?
f) Other, specify……

Date of Next appointment:_____

SERITHI PROJECT
Cohort 1 and 2
6 WEEK VISIT QUESTIONAIRE

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW		
	INTERVIEW	RESULT CODES
DATE IN FULL:	DD /MM/YY	1. COMPLETED: ☐
		2. REFUSED: ☐
		3. PARTIALLY COMPLETED: ☐
		4. OTHER: ☐
INTERVIEWER'S NAME:		

LANGUAGE		
LANGUAGE OF INTERVIEW:		
HOME LANGUAGE OF RESPONDENT:		
LANGUAGE CODES		
1 ENGLISH	5 IsiXhosa	9 ziTSONGA
2 sePEDI	6 isiZULU	10 isiNDEBELE
3 seTSWANA	7 seSOTHO	11 seSWATI
4 AFRIKAANS	8 tshiVENDA	

SUPERVISOR	DATA CAPTURER	OFFICE EDITOR
NAME:	NAME:	KEYED BY:
DATE:	DATE: DATE:	

Mother Date of Birth:_____
Child Date of Birth:_____**Name of Child**_____

NEVIRAPINE ADMINISTRATION:

Mother:
a) Yes
b) No
c) Do not know

Child:
a) Yes
b) No
c) Do not know

INSTRUCTIONS:

The questionnaire administered at this time will establish the nutritional status of the mother (through measurements of her height and weight and mid- upper arm circumference and also through collection of blood samples which will be analysed for the levels of different vitamins and minerals. All this information will provide us with a more complete picture of the mothers own health.
In addition this questionnaire will be used to find out if the baby is growing well (by measuring weight and length) and finding out as accurately as possible from the mothers what the baby is currently being fed.

Anthropometric measurements

Mother	***Baby***
Weight…….kg	weight……..kg
Height……...m	length……...cm
Mid upper arm circumference……..cm	
Sex of the baby…….	

ASSESSMENT OF HEALTHY EATING AND LIVING PRACTICES:

A. Since you were informed of your HIV status, did you receive any information on what foods to eat to stay healthy:

(a) yes
(b) no
(c) don't know

B. Where did you obtain the information from?

(a) Serithi Project
(b) Counselling session
(c) Self
(d) Magazine/ other printed material
(e) Radio
(f) Television

(g) Other (specify)……

C. From your viewpoint what is the main message on healthy eating for persons living with HIV?

……..

D. Have you followed the advice you were given on healthy eating habits?

(a) yes
(b) no
(c) don't know

E. If no, why not?
…….

ASSESSMENT OF INFANT FEEDING PRACTICES

Instructions:

The following questions are going to help us find out how you are currently feeding the baby since the last visit and to find out if the baby is growing well.

C1. Did you ever breastfeed your baby
(a) yes – if yes continue from C1.1
(b) no--------- answer question below

C1.1 If no, why did you <u>choose not to</u> breastfeed your baby?

a) fear of transmitting the virus through breastmilk
b) did not think I could cope with breastfeeding exclusively
c) other (specify)……..

PROCEED TO FORMULA FED BABIES SECTION (C20)

<u>BREAST FED BABIES (only):</u>

C1.1 Why did you choose to breastfeed your baby?

a) it is the healthier option for my baby
b) I will be able to cope with exclusive breastfeeding
c) It is the cultural norm
d) I breastfed previous children successfully
e) Other (specify)…….

C1.1How soon after delivery did you put the baby to the breast to suckle?)
a) within 1 hour after delivery
b) 2 hours after delivery
c) after a day (24 hours)
d) don't know
e) other (specify)…….

C2. What do you to comfort the baby when the baby cries?
(a) give a pacifier
(b) other, specify……

C3. Do you live with the baby currently?
(a) Yes

(b) No

C4. If yes have you ever been separated from the baby since the last visit?

a) yes
b) no

C5. During the time you were separated from the baby, do you know what the baby was fed?

a) yes
b) no
c) don't know

C6. If yes, was your baby fed:

(a) your own expressed breastmilk
(b) other milk or semi-solids
(c) other (specify)…….

C7. Has anyone else beside yourself ever breastfed your baby since the last visit?

1.yes
2. no
9. do not know

C8. If yes why did the other person breastfeed your baby?

(a) mother ill/weak
(b) breast or nipple difficulty
(c) not enough milk
(d) work
(e) has to go out/separated from infant
(f) advised by husband/family member
(g) do not want to infect child with HIV
(h) Other specify……..

C9. Was the other person who wet nursed your baby …..

(1) HIV positive
(2) HIV negative
(9) do not know

C10. Is the baby still being breastfed?

(a) Yes- proceed to C11
(b) No----continue with **cessation of breastmilk section**

C11. In addition to breastmilk are you feeding the baby any of the following foods and how many times in a day?

FOOD	**YES (TICK)**	**TIMES PER DAY**
commercial infant formula		
commercial semi-solid infant food such as purity		
home prepared cereals/porridge/ mashed fruit/vegetables		
traditional medicine		
over the counter unprescribed		

medicine such as Umuti wenyoni or gripe water – specify		
Medicine prescribed by a doctor or		
water/sugar water		
juice/tea		
other food / fluid, specify		

.

Cessation of breastfeeding:

The following questions are for the mothers who have stopped/ are in the process of stopping breastfeeding. If the mother has not reported any breastfeeding in the last few days ask the following:

C12. Have you completely stopped breastfeeding, every night and every day?
(a) yes
(b) no
(9) Don't know

C13. How old was the baby when you completely stopped breastfeeding every night and every day?
(a) age in days……..
(a) age in weeks…….
(b) Age in months……..

C14. Do you still put your baby to the breast to suckle occasionally?
(a) yes
(b) no

C13. How long did it take for you to completely stop breastfeeding your baby from the day you decided and began to stop to the day he or she no longer suckled from your breasts?
……..number of days
……..number of weeks

C14. What was the main reason for you stopping breast feeding?. Tick one appropriate response

Reason	**Tick**
a. infant no longer wanted to breastfeed	
b. to encourage infant to eat solid food	
c .pregnancy	
d. fear of transmitting HIV	
e. mother can afford replacement feeding	
f. advised by health care worker	
g. advised by husband or partner	
h. resumption of sexual relationship	
i. advised by other person	
j. separation from infant for other reasons	

k. mother too sick to breastfeed	
l .infant too sick to breastfeed	
m. infant not growing well	
n. other reason, specify…….	

C15. How did you stop breastfeeding your baby. Tick answer/s given **(can be more than 1 response)**

(a) put something to breast
(b) sent infant to relative or friend or neighbour
(c) took medicine to stop milk
(d) gave infant other milk
(e) gave infant a feeding bottle
(f) did nothing special
(g) other method, describe…….

C16. When you stopped breastfeeding totally how long did it take you to stop?

(a) 1 day
(b) less than a week
(c) more than a week.

C17. During this time **when you were stopping breastfeeding** what were you feeding the baby?

(a) breastmilk
(b) cows milk
(c) formula milk
(d) Other food, specify……

C18. Did you encounter any problems when you stopped

(a) yes
(b) no

C19. If yes, what problems did you encounter when you stopped breastfeeding your baby? **Tick answer/s given. Can be more than one response**

(a) infant cried or unhappy
(b) breast pain
(c) breast engorgement
(d) mother became ill
(e) infant became ill
(f) disapproval by partner, family or neighbours
(g) disapproval by health worker
(h) no food or milk to feed the infant
(i) other problems, specify……

If the baby has stopped being breast fed and is now formula fed, answer ALL the questions below:

FORMULA FED BABIES:

C20. Specify the types of food given to the baby since the last visit **(tick against response)**

FOOD	**YES**
commercial infant formula	
commercial semi-solid infant	

food such as purity	
home prepared cereals/porridge/ mashed fruit/vegetables	
traditional medicine	
over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify	
Medicine prescribed by a doctor or	
water/sugar water	
juice/tea	

C21. Where did you obtain the formula feeds for the baby?

(a) health facility (PMTCT) programme
(b) Shop
(c) Chemist
(d) Other (specify)……
(9) Don't know

C22. Why did you **not** get formula feeds from the clinic?

(a) Do not want to be seen carrying milk from the clinic
(b) People will know I am HIV positive
(c) Can afford to buy milk
(d) Prefer other types than what is in the clinic
(e) Do not like health workers attitude
(f) Clinic does not stock/distribute milk
(g) Too difficult to return to clinic
(h) Other (specify)…….
(i) Don't know

C23. Have you ever run out of formula milk?

(a) yes
(b) no
(c) don't know

C24.Why did you run out of formula milk? (**one or two reasons only)**

(a) Insufficient supply from clinic
(b) Unable to get to clinic
(c) Ran out of money to buy own
(d) Used milk for other children
(e) Used formula milk for other purposes eg tea
(f) Other**,……..(specify)**

C25. What did you **feed** the baby when you ran out of formula?

(specify)……

C26. What do you to comfort the baby when the baby cries?

(a) give a pacifier

(b) other, specify……

C26.1 Do you live with the baby currently?
(c) Yes
(d) No

C26.2 If yes, have you ever been separated from the baby since the last visit?
a) yes
b) no

C26.3. During the time you were separated from the baby, do you know what the baby was fed?
a. yes
b. no
c. don't know

C26.4. If yes , was your baby fed:
(d) your own expressed breastmilk
(e) other milk or semi-solids
(c) other (specify)…….

C27.Do you have privacy where you stay for feeding the baby?
(a)yes
(b)no

C28. Does anyone (family or friends) ask why you do not breast – fed your baby?
(a) yes
(b) no

C29. If yes, what reasons do you give them for not breastfeeding?

(a) advised by health staff not to breastfeed
(b) insufficient breast milk
(c) ill health does not allow me to breastfeed
(d) Other…….(specify)

Infant health: The following questions will provide us with information on the general health of your baby:

C30. Since the last visit has your baby had diarrhoea?
(a)yes
(b)no
©don't know

C31. Since the last visit has your baby had any sores in the mouth?
(a) yes
(b) no
(c) don't know

C31.1 Since the last visit has the baby had any other illness?
(a) yes
(b) no
(c) do not know

C31.2 If yes, specify……..

C32. When your baby was ill did you consult the following:

(a) clinic/hospital
(b) private doctor
(c) a traditional healer
(d) chemist
(e) other……(specify)
(f) not applicable

C33. What if any kinds of medicine were you given?

(a) oral rehydration solution
(b) vitamins
(c) prescribed medicines
(d) non-prescribed medicines
(e) other……..(specify)
(f) not applicable

C34. Since the last visit has your baby been admitted to hospital?

(a) yes
(b) no
(c) don't know

C35. If yes, how many times?

(a) once
(b) more than once
(c) do not know
(d) not applicable

PROCEED WITH THE MEDICAL ASSESSMENT BELOW

MEDICAL ASSESSMENT

The following section helps us to asses the health of the mother (pls answer all questions)

E2			YES	NO
1. Skin	1. Acne	Face		
		Back		
	2. Herpes Zoster	Current		
		Scar		
	3. Dermatitis	Non specific		
		Seborrhoeic		
	4. Kaposi Sarcoma			
	5. Nail fungal infections			
2. Mouth	1. Oral candidiasis	White		
		Red		
		hypertrophic		
		periorbital		
	2. Oral hairy leukoplakia			
	3. Oral ulceration			
	4. Gingivitis			
3. Lymph Nodes	1. Small			
	2. Large			
	3. Matted			
4. CNS	1. Appropriate			
	2. Inappropriate			
	3. Peripheral Neuropathy			
5. Chest	1. Dyspnoea			
	2. Tachypnoea			
	3. Cough	Dry		
		Productive		
6. CVS	1. Normal			
	2. Tachycardia			
	3. Other			
7. GIT	1. HSM			
	2. Ascites			
	3. Diffusely tender			
8.	1. Oedema			
	2. Clubbing			
9.	1. Loss of weight			
	2. Cachexia			
STAGE				

E3.0. Any new problems (medical)_____

_____

_____

_____

_____

E3.1. Action taken_____

_____

_____

_____

_____

_____

FUNCTION	SCORE
NORMAL, NO EVIDENCE OF DISEASE	100
ABLE TO PERFORM NORMAL ACTIVITY WITH ONLY MINOR SYMPTOMS	90
NORMAL ACTIVITY WITH EFFORT, SOME SYMPTOMS	80
ABLE TO CARE FOR SELF BUT UNABLE TO DO NORMAL ACTIVITIES	70
REQUIRES OCCASIONAL ASSISTANCE, CARES FOR MOST NEEDS	60
REQUIRES CONSIDERABLE ASSISTANCE	50
DISABLED, REQUIRES SPECIAL ASSISTANCE	40
SEVERELY DISABLED	30
VERY SICK, REQUIRES ACTIVE SUPPORTIVE TREATMENT	20
MORIBUND	10

BLOOD FOR CD4: ……..(TAKEN OR NOT TAKEN)

STAGE:……

KARPOSKY SCORE:…….

DATE OF NEXT APPOINTMENT:_____

SERITHI PROJECT
6 Months QUESTIONAIRE

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW		
	INTERVIEW	RESULT CODES
DATE IN FULL:	DD /MM/YY	1. COMPLETED: ☐
		2. REFUSED: ☐
		3. PARTIALLY COMPLETED: ☐
		4. OTHER: ☐
INTERVIEWER'S NAME:		

LANGUAGE		
LANGUAGE OF INTERVIEW:		
HOME LANGUAGE OF RESPONDENT:		
LANGUAGE CODES		
1 ENGLISH	5 IsiXhosa	9 ziTSONGA
2 sePEDI	6 isiZULU	10 isiNDEBELE
3 seTSWANA	7 seSOTHO	11 seSWATI
4 AFRIKAANS	8 tshiVENDA	

SUPERVISOR	DATA CAPTURER	OFFICE EDITOR
NAME:	NAME:	KEYED BY:
DATE:	DATE: DATE:	

Mother Date of Birth:_____
Child Date of Birth:_____**Name of Child**_____

NEVIRAPINE ADMINISTRATION:

Mother:
a) Yes
b) No
c) Do not know

Child:
a) Yes
b) No
c) Do not know

INSTRUCTIONS:

The questionnaire administered at this time will establish the nutritional status of the mother (through measurements of her height and weight and mid- upper arm circumference and also through collection of blood samples which will be analysed for the levels of different vitamins and minerals. All this information will provide us with a more complete picture of the mothers own health.
In addition this questionnaire will be used to find out if the baby is growing well (by measuring weight and length) and finding out as accurately as possible from the mothers what the baby is currently being fed.

Anthropometric measurements

Mother	***Baby***
Weight…….kg	weight……..kg
Height……...m	length……...cm
Mid upper arm circumference……..cm	
Sex of the baby…….	

ASSESSMENT OF HEALTHY EATING AND LIVING PRACTICES:

A. Since you were informed of your HIV status, did you receive any information on what foods to eat to stay healthy:

(a) yes
(b) no
(c) don't know

B. Where did you obtain the information from?

(a) Serithi Project
(b) Counselling session
(c) Self
(d) Magazine/ other printed material
(e) Radio

(f) Television
(g) Other (specify)……

C. From your viewpoint what is the main message on healthy eating for persons living with HIV?

……..

D. Have you followed the advice you were given on healthy eating habits?

(a) yes
(b) no
(c) don't know

E. If no, why not?
……

ASSESSMENT OF INFANT FEEDING PRACTICES

Instructions:

The following questions are going to help us find out how you are currently feeding the baby since the last visit and to find out if the baby is growing well.

C1. Did you ever breastfeed your baby
(a) yes – if yes continue from C1.1
(b) no--------- answer question below

C1.1 If no, why did you <u>choose not to</u> breastfeed your baby?

a) fear of transmitting the virus through breastmilk
b) did not think I could cope with breastfeeding exclusively
c) other (specify)……..

PROCEED TO FORMULA FED BABIES SECTION (C20)

<u>BREAST FED BABIES (only):</u>

C1.1 Why did you choose to breastfeed your baby?

a) it is the healthier option for my baby
b) I will be able to cope with exclusive breastfeeding
c) It is the cultural norm
d) I breastfed previous children successfully
e) Other (specify)…….

C1.1How soon after delivery did you put the baby to the breast to suckle?)
a) within 1 hour after delivery
b) 2 hours after delivery
c) after a day (24 hours)
d) don't know
e) other (specify)…….

C2. What do you to comfort the baby when the baby cries?
(a) give a pacifier
(b) other, specify……

C3. Do you live with the baby currently?

(a) Yes
(b) No

C4. If yes have you ever been separated from the baby since the last visit?

a) yes
b) no

C5. During the time you were separated from the baby, do you know what the baby was fed?

a) yes
b) no
c) don't know

C6. If yes, was your baby fed:

(a) your own expressed breastmilk
(b) other milk or semi-solids
(c) other (specify)…….

C7. Has anyone else beside yourself ever breastfed your baby since the last visit?

1.yes
2. no
9. do not know

C8. If yes why did the other person breastfeed your baby?

(a) mother ill/weak
(b) breast or nipple difficulty
(c) not enough milk
(d) work
(e) has to go out/separated from infant
(f) advised by husband/family member
(g) do not want to infect child with HIV
(h) Other specify……..

C9. Was the other person who wet nursed your baby …..

(1) HIV positive
(2) HIV negative
(9) do not know

C10. Is the baby still being breastfed?

(a) Yes- proceed to C11
(b) No----continue with **cessation of breastmilk section**

C11. In addition to breastmilk are you feeding the baby any of the following foods and how many times in a day?

FOOD	**YES (TICK)**	**TIMES PER DAY**
commercial infant formula		
commercial semi-solid infant food such as purity		
home prepared cereals/porridge/ mashed fruit/vegetables		
traditional medicine		

over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify		
Medicine prescribed by a doctor or		
water/sugar water		
juice/tea		
other food / fluid, specify		

.

Cessation of breastfeeding:

The following questions are for the mothers who have stopped/ are in the process of stopping breastfeeding. If the mother has not reported any breastfeeding in the last few days ask the following:

C12. Have you completely stopped breastfeeding, every night and every day?
- (a) yes
- (b) no
- (9) Don't know

C13. How old was the baby when you completely stopped breastfeeding every night and every day?
- (a) age in days……..
- (a) age in weeks…….
- (b) Age in months……..

C14. Do you still put your baby to the breast to suckle occasionally?
- (a) yes
- (b) no

C13. How long did it take for you to completely stop breastfeeding your baby from the day you decided and began to stop to the day he or she no longer suckled from your breasts?
……..number of days
……..number of weeks

C14. What was the main reason for you stopping breast feeding?. Tick one appropriate response

Reason	**Tick**
a. infant no longer wanted to breastfeed	
b. to encourage infant to eat solid food	
c .pregnancy	
d. fear of transmitting HIV	
e. mother can afford replacement feeding	
f. advised by health care worker	
g. advised by husband or partner	
h. resumption of sexual relationship	
i. advised by other person	

j. separation from infant for other reasons	
k. mother too sick to breastfeed	
l .infant too sick to breastfeed	
m. infant not growing well	
n. other reason, specify…….	

C15. How did you stop breastfeeding your baby. Tick answer/s given **(can be more than 1 response)**

(a) put something to breast
(b) sent infant to relative or friend or neighbour
(c) took medicine to stop milk
(d) gave infant other milk
(e) gave infant a feeding bottle
(f) did nothing special
(g) other method, describe…….

C16. When you stopped breastfeeding totally how long did it take you to stop?

(a) 1 day
(b) less than a week
(c) more than a week.

C17. During this time **when you were stopping breastfeeding** what were you feeding the baby?

(a) breastmilk
(b) cows milk
(c) formula milk
(d) Other food, specify……

C18. Did you encounter any problems when you stopped

(a) yes
(b) no

C19. If yes, what problems did you encounter when you stopped breastfeeding your baby? **Tick answer/s given. Can be more than one response**

(a) infant cried or unhappy
(b) breast pain
(c) breast engorgement
(d) mother became ill
(e) infant became ill
(f) disapproval by partner, family or neighbours
(g) disapproval by health worker
(h) no food or milk to feed the infant
(i) other problems, specify……

If the baby has stopped being breast fed and is now formula fed, answer ALL the questions below:

FORMULA FED BABIES:

C20. Specify the types of food given to the baby since the last visit **(tick against response)**

FOOD	**YES**
commercial infant formula	

commercial semi-solid infant food such as purity	
home prepared cereals/porridge/ mashed fruit/vegetables	
traditional medicine	
over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify	
Medicine prescribed by a doctor or	
water/sugar water	
juice/tea	

C21. Where did you obtain the formula feeds for the baby?

(a) health facility (PMTCT) programme
(b) Shop
(c) Chemist
(d) Other (specify)……
(9) Don't know

C22. Why did you **not** get formula feeds from the clinic?

(a) Do not want to be seen carrying milk from the clinic
(b) People will know I am HIV positive
(c) Can afford to buy milk
(d) Prefer other types than what is in the clinic
(e) Do not like health workers attitude
(f) Clinic does not stock/distribute milk
(g) Too difficult to return to clinic
(h) Other (specify)…….
(i) Don't know

C23. Have you ever run out of formula milk?

(a) yes
(b) no
(c) don't know

C24.Why did you run out of formula milk? (**one or two reasons only)**

(a) Insufficient supply from clinic
(b) Unable to get to clinic
(c) Ran out of money to buy own
(d) Used milk for other children
(e) Used formula milk for other purposes eg tea
(f) Other**,……..(specify)**

C25. What did you **feed** the baby when you ran out of formula?

(specify)……

C26. What do you to comfort the baby when the baby cries?

(a) give a pacifier

(b) other, specify……

C26.1 Do you live with the baby currently?
(c) Yes
(d) No

C26.2 If yes, have you ever been separated from the baby since the last visit?
a) yes
b) no

C26.3. During the time you were separated from the baby, do you know what the baby was fed?
a. yes
b. no
c. don't know

C26.4. If yes , was your baby fed:
(d) your own expressed breastmilk
(e) other milk or semi-solids
(c) other (specify)…….

C27.Do you have privacy where you stay for feeding the baby?
(a)yes
(b)no

C28. Does anyone (family or friends) ask why you do not breast – fed your baby?
(a) yes
(b) no

C29. If yes, what reasons do you give them for not breastfeeding?

(a) advised by health staff not to breastfeed
(b) insufficient breast milk
(c) ill health does not allow me to breastfeed
(d) Other…….(specify)

Infant health: The following questions will provide us with information on the general health of your baby:

C30. Since the last visit has your baby had diarrhoea?
(a)yes
(b)no
©don't know

C31. Since the last visit has your baby had any sores in the mouth?
(a) yes
(b) no
(c) don't know

C31.1 Since the last visit has the baby had any other illness?
(a) yes
(b) no
(c) do not know

C31.2 If yes, specify……..

C32. When your baby was ill did you consult the following:

(a) clinic/hospital
(b) private doctor
(c) a traditional healer
(d) chemist
(e) other…….(specify)
(f) not applicable

C33. What if any kinds of medicine were you given?

(a) oral rehydration solution
(b) vitamins
(c) prescribed medicines
(d) non-prescribed medicines
(e) other……..(specify)
(f) not applicable

C34. Since the last visit has your baby been admitted to hospital?

(a) yes
(b) no
(c) don't know

C35. If yes, how many times?

(a) once
(b) more than once
(c) do not know
(d) not applicable

PROCEED WITH THE MEDICAL ASSESSMENT BELOW

MEDICAL ASSESSMENT

The following section helps us to asses the health of the mother (pls answer all questions)

E2			YES	NO
1. Skin	1. Acne	Face		
		Back		
	2. Herpes Zoster	Current		
		Scar		
	3. Dermatitis	Non specific		
		Seborrhoeic		
	4. Kaposi Sarcoma			
	5. Nail fungal infections			
2. Mouth	1. Oral candidiasis	White		
		Red		
		hypertrophic		
		periorbital		
	2. Oral hairy leukoplakia			
	3. Oral ulceration			
	4. Gingivitis			
3. Lymph Nodes	1. Small			
	2. Large			
	3. Matted			
4. CNS	1. Appropriate			
	2. Inappropriate			
	3. Peripheral Neuropathy			
5. Chest	1. Dyspnoea			
	2. Tachypnoea			
	3. Cough	Dry		
		Productive		
6. CVS	1. Normal			
	2. Tachycardia			
	3. Other			
7. GIT	1. HSM			
	2. Ascites			
	3. Diffusely tender			
8.	1. Oedema			
	2. Clubbing			
9.	1. Loss of weight			
	2. Cachexia			
STAGE				

E3.0. Any new problems (medical)_____

_____

_____

_____

_____

E3.1. Action taken_____

_____

_____

_____

_____

_____

FUNCTION	SCORE
NORMAL, NO EVIDENCE OF DISEASE	100
ABLE TO PERFORM NORMAL ACTIVITY WITH ONLY MINOR SYMPTOMS	90
NORMAL ACTIVITY WITH EFFORT, SOME SYMPTOMS	80
ABLE TO CARE FOR SELF BUT UNABLE TO DO NORMAL ACTIVITIES	70
REQUIRES OCCASIONAL ASSISTANCE, CARES FOR MOST NEEDS	60
REQUIRES CONSIDERABLE ASSISTANCE	50
DISABLED, REQUIRES SPECIAL ASSISTANCE	40
SEVERELY DISABLED	30
VERY SICK, REQUIRES ACTIVE SUPPORTIVE TREATMENT	20
MORIBUND	10

BLOOD FOR CD4: ……..(TAKEN OR NOT TAKEN)

STAGE:……

KARPOSKY SCORE:…….

DATE OF NEXT APPOINTMENT ……..

12th Month Interview

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT FULL NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW
DATE IN FULL: DD/MM/YY
INTERVIEWER'S NAME:

LANGUAGE OF INTERVIEW:
HOME LANGUAGE OF RESPONDENT:

Thank you for being willing to talk to us again. In this interview we want to find out how you have been since the last interview, how the baby has been and if there have been any changes in your life since we last saw you. We will also examine you and the baby and take some blood from you
First we would like to ask you some medical questions

A. Since you were informed of your HIV status, did you receive any information on what foods to eat to stay healthy:

YES	1
NO	0
DO NOT KNOW	2

B. From where did you obtain the information?

Serithi Project	1
Counselling session	2
Magazine/ other printed material	3
Self	4
Radio	5
Television	6
Other (specify)	7

C. From your viewpoint what is the main message on healthy eating for persons living with HIV?
_____
____

D. Have you followed the advice you were given on healthy eating habits?

YES	1
NO	0
DO NOT KNOW	2

E. Have you lost a lot of weight in the past 6 months

YES	1
NO	0
DO NOT KNOW	2

IF YES
F. If you have lost a lot of weight would you say the change has been in :

One dress size	1
More than 1 dress size	2
Do not know	3

Other (specify)	4

M1. Are you sexually active?
IF NO go to M2

YES	1
NO	0

If YES
M1.1. Are you using contraception?

YES	1
NO	0
NA	5

IF YES
M1.2. What are you using?

CONDOMS	1
INJECTION	2
PILL	3
OTHERS - SPECIFY	4
N/A	99

IF YES OR NO TO M1.1

M1.2 Are you using a condom now?

ALL THE TIME	2
SOMETIMES	1
NEVER	0
N/A	99

M2. Have you been pregnant since the birth of your “Serithi baby”?

YES	1
NO	0

IF YES
M2.1 Did you plan the pregnancy?

YES	1
NO	0
N/A	99

M2.2 Are you pregnant now?

YES	1
NO	0
DON”T KNOW	2

M 3. Are you planning another child?

YES	1
NO	0

IF YES
M3.1 whose decision is this?

RESPONDENT	1
PARTNER	2
JOINTLY	3
PRESSURE FROM FAMILY	4
OTHER (SPECIFY)	5
N/A	99

M4. Have you been ill since we last saw you?

IF NO go to M5

YES	1
NO	0

IF YES
M4.1. What was wrong_____

M4.2
Were you admitted to hospital?

YES	1
NO	0
N/A	99

M5. We acknowledge the work that traditional/spiritual healers do and respect their practices and are interested in hearing about their contribution in dealing with HIV so would like to hear from you if you have ever been to a traditional/spiritual healer about your HIV?

YES	1
NO	0

M5.1 What did he/she do to try and help you? _____.

M5.2 Do you think it helped you?

YES	1
NO	0
NA	99

M6. Are you on antiretrovirals?

YES	1
NO	0

IF NO GO TO M7

Now I wish to ask you about the possible problems with the medication. This will possibly help us to develop methods to try and solve these problems

M6.1 When did you start the medication? _____

M6.2 Have you seen any change in your condition?

YES	1
NO	0
NOT SURE	2
N/A	99

M6.3 Have the medicines made you feel ill?

YES	1
NO	0
N/A	99

M6.31 Can you describe the symptoms?
_____

M6.4. Have you ever missed taking any tablets

YES	1
NO	0
N/A	99

M6.5 Are still taking the tablets?

YES	1
NO	0
N/A	99

IF NO
M6.6 WHY WAS THIS_____

M6.7 The ARV treatment requires that you have a person who is your treatment "buddy"?_____

M6.8
Is he/she helping you

YES	1
NO	0
N/A	99

IF NO
M6.9 Why is this?_____

IF YES
M6.10 How is your buddy helping you?_____

_____
___

M6.10 Is it a difficult to get to the clinic every month for the tablets?

YES	1
NO	0
N/A	99

IF YES
M6.11 Why is this?_____

M6.12 Other than your treatment buddy does anybody else know you are on medication?

YES	1
NO	0
N/A	99

M6.13 Have you had to disclose to more people because you are taking tablets?

YES	1
NO	0
N/A	99

IF YES
M6.14. To whom did you have to disclose
_____

M6.15. Why was it necessary to disclose to these people/person?
_____

M6.16. Have people asked you why you have to keep on taking tablets

YES	1
NO	0
N/A	99

IF YES
M6.17. What do you tell them?
_____

Now I wish to ask you some questions about your baby

M7. Since we last saw you has the baby been ill?

IF NO go to M8

YES	1
NO	0

IF YES
M7.1. What was wrong with the baby?
_____

M7.2 Was the baby admitted to hospital?

YES	1
NO	0
N/A	99

M8. Have you taken the baby to a traditional/spiritual healer

YES	1
NO	0

N/A	99

IF YES
M8.1 Why did you take the baby?
_____

M8.2 What did he/she do?
_____

M8.3. Do you think it helped the baby?

YES	1
NO	0
N/A	99

M9. Is the baby HIV +ve**?**

If NO go to M10

YES	1
NO	0

IF YES
M9.1 What treatment is the baby receiving?

None	0
Bactrim	1
Multivits	2
Antiretrovirals	3
Other (Specify)	4
N/A	99

(Can tick more than 1)

M9.2 Are you managing to remember to give the baby the antiretroviral medicine every time

YES	1
NO	0
N/A	99

M9.3 Has the baby been ill because of the treatment

YES	1
NO	0
NOT SURE	2
N/A	99

IF YES
M9.4
Specify_____

M9.5 Do you find it difficult to come to the clinic every month for the medication

YES	1
NO	0
N/A	99

IF YES
M9.6
Why_____

-
_____
___

M9.7 Who is taking care of the child?_____

M9.8. With whom is the child during the day?_____
M9.9 Are they responsible for giving the child the medication?

YES	1
NO	0
N/A	99

M9.8 Do they manage to give the baby the medication

YES	1
NO	0
DON'T KNOW	2
N/A	99

M10 . What are you currently feeding the baby and how many times in a day?

FOOD	**YES (TICK)**	**TIMES PER DAY**
Breastmilk		
commercial infant formula		
commercial semi-solid infant food such as purity		
home prepared cereals/porridge/ mashed fruit/vegetables		
traditional medicine		
over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify		
Medicine prescribed by a doctor or		
water/sugar water		
juice/tea		
other food / fluid, specify		

EXAMINATION MOTHER

OE1. Anthropometric measurements

Mother Height……...m Mid upper arm circumference……..cm Weight……...kg

0E2

STAGING.			YES	NO
1. Skin	1. Acne	Face		
		Back		
	2. Herpes Zoster	Current		
		Scar		
	3. Dermatitis	Non specific		
		Seborrhoeic		
	4. Kaposi Sarcoma			
	5. Nail fungal infections			
2. Mouth	1. Oral candidiasis	White		
		Red		
		hypertrophic		
		periorbital		
	2. Oral hairy leukoplakia			
	3. Oral ulceration			
	4. Gingivitis			
3. Lymph Nodes	1. Small			
	2. Large			
	3. Matted			
4. CNS	1. Appropriate			
	2. Inappropriate			
	3. Peripheral Neuropathy			
5. Chest	1. Dyspnoea			
	2. Tachypnoea			
	3. Cough	Dry		
		Productive		
	4. Crepitations			
	5. Consolidation			
	6. Effusion			
6. CVS	1. Normal			
	2. Tachycardia			
	3. Other			
7. GIT	1. HSM			
	2. Ascites			
	3. Diffusely tender			
8.	1. Oedema			
	2. Clubbing			
9.	1. Loss of weight			
	2. Cachexia			
Stage				

OE3. Any new medical problems_____

_____

OE4. Action taken_____

BABY

OB1. Baby weight_____

OB2. Baby length_____

OB3 Sex of baby

MALE	1
FEMALE	2

OB4. Any obvious illness

YES	1
NO	0

P1. Any new medical problems_____

_____

P2. Action taken_____

_____

18th Month Interview

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT FULL NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW
DATE IN FULL: DD/MM/YY
INTERVIEWER'S NAME:

LANGUAGE OF INTERVIEW:
HOME LANGUAGE OF RESPONDENT:

Thank you for being willing to talk to us again. In this interview we want to find out how you have been since the last interview, how the baby has been and if there have been any changes in your life since we last saw you. We will also examine you and the baby and take some blood from you
First we would like to ask you some medical questions

A. Since you were informed of your HIV status, did you receive any information on what foods to eat to stay healthy:

YES	1
NO	0
DO NOT KNOW	2

B. From where did you obtain the information?

Serithi Project	1
Counselling session	2
Magazine/ other printed material	3
Self	4
Radio	5
Television	6
Other (specify)	7

C. From your viewpoint what is the main message on healthy eating for persons living with HIV?

_____

D. Have you followed the advice you were given on healthy eating habits?

YES	1
NO	0
DO NOT KNOW	2

E. Have you lost a lot of weight in the past 6 months

YES	1
NO	0
DO NOT KNOW	2

IF YES
F. If you have lost a lot of weight would you say the change has been in :

One dress size	1
More than 1 dress size	2
Do not know	3
Other (specify)	4

M1. Are you sexually active?
IF NO go to M2

YES	1
NO	0

If YES
M1.1. Are you using contraception?

YES	1
NO	0
NA	5

IF YES
M1.2. What are you using?

CONDOMS	1
INJECTION	2
PILL	3
OTHERS - SPECIFY	4
N/A	99

IF YES OR NO TO M1.1

M1.2 Are you using a condom now?

ALL THE TIME	2
SOMETIMES	1
NEVER	0
N/A	99

M2. Have you been pregnant since the birth of your "Serithi baby"?

YES	1
NO	0

IF YES
M2.1 Did you plan the pregnancy?

YES	1
NO	0
N/A	99

M2.2 Are you pregnant now?

YES	1
NO	0
DON"T KNOW	2

M 3. Are you planning another child?

YES	1
NO	0

IF YES
M3.1 whose decision is this?

RESPONDENT	1
PARTNER	2
JOINTLY	3
PRESSURE FROM FAMILY	4
OTHER (SPECIFY)	5
N/A	99

M4. Have you been ill since we last saw you?

IF NO go to M5

YES	1
NO	0

IF YES
M4.1. What was wrong_____

M4.2
Were you admitted to hospital?

YES	1
NO	0
N/A	99

M5. We acknowledge the work that traditional/spiritual healers do and respect their practices and are interested in hearing about their contribution in dealing with HIV so would like to hear from you if you have ever been to a traditional/spiritual healer about your HIV?

YES	1
NO	0

M5.1 What did he/she do to try and help you? _____.

M5.2 Do you think it helped you?

YES	1
NO	0
NA	99

M6. Are you on antiretrovirals?

YES	1
NO	0

IF NO GO TO M7

Now I wish to ask you about the possible problems with the medication. This will possibly help us to develop methods to try and solve these problems

M6.1 When did you start the medication? _____

M6.2 Have you seen any change in your condition?

YES	1
NO	0
NOT SURE	2
N/A	99

M6.3 Have the medicines made you feel ill?

YES	1
NO	0
N/A	99

M6.31 Can you describe the symptoms? _____

M6.4. Have you ever missed taking any tablets

YES	1
NO	0
N/A	99

M6.5 Are still taking the tablets?

YES	1
NO	0
N/A	99

IF NO
M6.6 WHY WAS THIS_____

M6.7 The ARV treatment requires that you have a person who is your treatment "buddy"?_____

M6.8
Is he/she helping you

YES	1
NO	0
N/A	99

IF NO
M6.9 Why is this?_____

IF YES
M6.10 How is your buddy helping you?_____

_____

M6.10 Is it a difficult to get to the clinic every month for the tablets?

YES	1
NO	0
N/A	99

IF YES
M6.11 Why is this?_____

M6.12 Other than your treatment buddy does anybody else know you are on medication?

YES	1
NO	0
N/A	99

M6.13 Have you had to disclose to more people because you are taking tablets?

YES	1
NO	0
N/A	99

IF YES
M6.14. To whom did you have to disclose _____

M6.15. Why was it necessary to disclose to these people/person? _____

M6.16. Have people asked you why you have to keep on taking tablets

YES	1
NO	0
N/A	99

IF YES
M6.17. What do you tell them? _____

Now I wish to ask you some questions about your baby

M7. Since we last saw you has the baby been ill?

IF NO go to M8

YES	1
NO	0

IF YES
M7.1. What was wrong with the baby? _____

M7.2 Was the baby admitted to hospital?

YES	1
NO	0
N/A	99

M8. Have you taken the baby to a traditional/spiritual healer

YES	1
NO	0
N/A	99

IF YES

M8.1 Why did you take the baby? _____

M8.2 What did he/she do? _____

M8.3. Do you think it helped the baby?

YES	1
NO	0
N/A	99

M9. Is the baby HIV +ve**?**

If NO go to M10

YES	1
NO	0

IF YES
M9.1 What treatment is the baby receiving?

None	0
Bactrim	1
Multivits	2
Antiretrovirals	3
Other (Specify)	4
N/A	99

(Can tick more than 1)

M9.2 Are you managing to remember to give the baby the antiretroviral medicine every time

YES	1
NO	0
N/A	99

M9.3 Has the baby been ill because of the treatment

YES	1
NO	0
NOT SURE	2
N/A	99

IF YES
M9.4 Specify_____

M9.5 Do you find it difficult to come to the clinic every month for the medication

YES	1
NO	0
N/A	99

IF YES
M9.6 Why_____

-_____

M9.7 Who is taking care of the child?_____

M9.8. With whom is the child during the day?_____

M9.9 Are they responsible for giving the child the medication?

YES	1
NO	0
N/A	99

M9.8 Do they manage to give the baby the medication

YES	1
NO	0
DON'T KNOW	2
N/A	99

M10 . What are you currently feeding the baby and how many times in a day?

FOOD	**YES (TICK)**	**TIMES PER DAY**
Breastmilk		
commercial infant formula		
commercial semi-solid infant food such as purity		
home prepared cereals/porridge/ mashed fruit/vegetables		
traditional medicine		
over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify		
Medicine prescribed by a doctor or		
water/sugar water		
juice/tea		
other food / fluid, specify		

EXAMINATION
MOTHER

OE1. Anthropometric measurements

Mother
Height……...m Mid upper arm circumference……..cm
Weight……...kg

0E2

STAGING.			YES	NO
1. Skin	1. Acne	Face		
		Back		
	2. Herpes Zoster	Current		
		Scar		
	3. Dermatitis	Non specific		
		Seborrhoeic		
	4. Kaposi Sarcoma			
	5. Nail fungal infections			
2. Mouth	1. Oral candidiasis	White		
		Red		
		hypertrophic		
		periorbital		
	2. Oral hairy leukoplakia			
	3. Oral ulceration			
	4. Gingivitis			
3. Lymph Nodes	1. Small			
	2. Large			
	3. Matted			
4. CNS	1. Appropriate			
	2. Inappropriate			
	3. Peripheral Neuropathy			
5. Chest	1. Dyspnoea			
	2. Tachypnoea			
	3. Cough	Dry		
		Productive		
	4. Crepitations			
	5. Consolidation			
	6. Effusion			
6. CVS	1. Normal			
	2. Tachycardia			
	3. Other			
7. GIT	1. HSM			
	2. Ascites			
	3. Diffusely tender			
8.	1. Oedema			
	2. Clubbing			
9.	1. Loss of weight			
	2. Cachexia			
Stage				

OE3. Any new medical problems_____
_____

OE4. Action taken_____

BABY

OB1. Baby weight_____

OB2. Baby length_____

OB3 Sex of baby

MALE	1
FEMALE	2

OB4. Any obvious illness

YES	1
NO	0

P1. Any new medical problems_____

_____

P2. Action taken_____

_____

SECTION A

I wish to ask you some questions about your personal life and how it may have changed since the last time we saw you. These questions we have asked you before and we apologise for this. The reason we want to ask them is to see how things have changed for you. This will help us with our research. This is the last time we will be asking these questions

A1 Did your marital status change in the last 6 months**?**

YES	1
NO	2

IF NO, continue with **A6**

IF YES:

A2. What is your marital status now?

SINGLE	1
MARRIED: (CIVIL OR TRADITIONAL)	2
NO CHANGE	3

A3 IF MARRIED Are you living with your partner?

YES	1
NO	2
NO CHANGE	3
N/A	99

A4 IF SINGLE:

LIVING WITH PARTNER	6
HAVE A PARTNER NOT LIVING TOGETHER	7
SINGLE WITHOUT A PARTNER	8
NO CHANGE	9
N/A	99

IF "not living together" THEN Where does your partner stay?_____
_____

A4. .Does your new husband/partner currently work?

YES	1
NO	0
NO CHANGE	2

IF YES:
A5 What is your new husband/partner's occupation?_____

A6.Within the last 6 months has your husband/partner provided money you need for food, rent, and bills?

YES	1
NO	0
NO CHANGE	5

A7. Are you still staying in the same house?

YES	1
NO	0

IF NO
A8. Where are you staying now?

_____

A9. Why did you move there?

A10. With whom do you share your home?

PERSON	**No.**	**Code**
PARTNER		1
PARENT		2
DAUGHTER		3
SON		4
PARENT-IN-LAW		5
SON-IN-LAW		6
DAUGHTER-IN-LAW		7
GRANDCHILD		8
BROTHER/SISTER		9
OTHER RELATIVES		1
NOT RELATED		11
NO CHANGE		12

A11. In the past 6 months did your work status change?

YES	1
NO	0

IF YES:
A12 What kind of work do you do now? (includes self employment)
……

(IF STILL WITH THE SAME PARTNER ASK THESE QUESTIONS)

A13. Did your partner's work situation changed the past 6 months?

YES	1
NO	0
NO PARTNER	2
NEW PARTNER	3

2

IF YES

A14. What kind of work does he do now? ……

A15. Have the other sources of income you had changed during the past 6 months?

YES	1
NO	0

IF YES:
A16. What other sources of income do you have now?

Old age pension / government	1
Pension from work/retirement benefits	2
Disability grant /.government	3
Compensation Fund (injury / illness at work)	4
State maintenance grant/r child support grant	5
Private maintenance parent/ former spouse	6
Care dependency (single care) grant	7
Foster care grant	8
Unemployment Insurance Fund	9
Remittance/financial support people not in household	10
Gratuities/other lump sum	11
Other sources (specify)	12
NO CHANGE	13

A17 About how much is the income in your household each month? R _____

A18. How many people live on this income?_____

SECTION B

In the past few interviews we have asked you about who makes decisions on certain things such as buying of food how money has spent who decides on your treatment if you are ill, if your baby is ill who makes the decision to have another child and sexual matters

B1 Do you think that any of these have changed at all?

YES	1
NO	0

B2.Who in your household decides on what food to buy?

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
OTHER, SPECIFY	4

B3. Who in your household has the final say on how money is spent?

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
OTHER, SPECIFY	4

B4. If you were sick and a decision had to be made about treatment, who in your household would have the final say in making the decision

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
OTHER, SPECIFY	4

B5. If your child were sick, who in your household would have the final say, if a decision needed to be made about treatment?

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
OTHER, SPECIFY	4

B6. Who in your household has the final say on whether to have another child

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
OTHER, SPECIFY	4
NA	5

B7. Partners do not always agree on everything, tell me between you and your partner who has the final say in decisions to do with sex?

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
NO PARTNER	4

B8. Who has the final say about whether to use contraception?

RESPONDENT	1
HUSBAND/ PARTNER	2
JOINTLY	3
NO PARTNER	4

SECTION C

We now want to ask you about the people you have disclosed to

C1. Have you ever disclosed?

YES	1
NO	2

Who was it that you told? first, second etc.	**Why was it that you wanted to disclose to this person?**	**What was this person's reaction?**	**Overall, do you consider it a good or bad thing that you disclosed to this person?** **Good**	**Bad**
1)				
2)				
3)				
4)				
5)				

PROMPT, BEFORE YOU FINISH COMPLETING DISCLOSURE SHEET: "IS THERE ANYONE ELSE YOU HAVE TOLD ABOUT THE HIV?"

SECTION D

The following is a list of statements that people with HIV have made about themselves. For each statement, please let me know the answer that comes closest to the way you feel about yourself. Let me know if you agree or disagree

D1 PERSONAL VIEW	**AGREE**	**DISAGREE**
1. When people know I have HIV I feel uncomfortable around them		
2. I feel ashamed that I have HIV		
3. I must have done something to deserve getting HIV		
4. If I drank from a tap and people knew I had HIV they would not drink from the same tap		
5. Most employers would not employ me because I am HIV+		
6. Although I have HIV I am a person who deserves as much respect as anyone else		
7. I feel that it is my fault that I got HIV		
8.People are right to be afraid of me because I have HIV		
9.Because of my HIV I feel I am less attractive to others		
10 I have a lot to teach people about life through having HIV		
11.I feel it is completely safe for me to handle other people's children		
12. I deserve a lot of praise for coping with HIV		
13 I would understand if people rejected my friendship because I am HIV+		
14. My neighbours would not like me living next door if they knew I had HIV		
15. I think less of myself because I have HIV		
16. I think my getting HIV was a matter of bad luck		
17. I feel that I am bewitched because I have HIV		
18. If I was in public or private transport and someone knew I had HIV they would not sit next to me		
19. Even though I have HIV I don't believe I am different from anyone else		
20. Getting HIV is a punishment for bad behaviour		

The general public has a wide range of beliefs about people who have AIDS or HIV. I am going to read a list of some of these beliefs and attitudes and I want you to let me know what you think <u>most people</u> in your community believe. Let me know if you agree or disagree that most people think like this.

D2 COMMUNITY VIEW	AGREE	DISAGREE
1.Most people think that getting HIV is a punishment for bad behaviour		
2. Most people think that someone with HIV is no different from anyone else		
3. Most people would not sit next to someone with HIV in public or private transport		
4. Most people feel that some people with HIV are bewitched		
5. Most people think that having HIV is just a matter of bad luck		
6. Most people think less of someone because they have HIV		
7. Most people would not like someone with HIV to be living next door.		
8. Most people would reject the friendship of someone with HIV		
9. Most people feel that a person with HIV deserves a lot of praise for the way that they cope with the disease		
10. Most people feel that it is safe for a person with HIV to look after somebody else's children		
11. Most people think that people with HIV can teach us a lot about life		
12. Most people would not be attracted to a person with HIV		
13. Most people are afraid to be around people with HIV		
14. Most people feel that if you have HIV it is your own fault		
15. Most people feel that people with HIV deserve as much respect as anyone else		
16.Most employers would not hire someone with HIV to work for them		
17. Most people would not drink from a tap if a person with HIV had just drunk from it		
18. Most people believe that if you have HIV you must have done something to deserve it		
19. Most people believe that someone with HIV should be ashamed of themselves.		
20. Most people feel uncomfortable around people with HIV		

I am now going to go through a list of things that some women have experienced because they have HIV. Please let me know whether you have experienced this and, if so, whether it was a little or a lot. (SHOW CARD)

D3 ENACTED OR EXPERIENCED COMMUNITY STIMA	**NO EXPERIENCE OF THIS**	**I HAVE EXPERIENCED THIS A LITTLE**	**I HAVE EXPERIENCED THIS A LOT.**
1. I have lost friends because I'm HIV+			
2. I have felt hurt by how people have reacted to learning about my HIV			
3. People have avoided touching me because of my HIV			
4. People don't want me around their children because of my HIV			
5. People act as though it is my fault I am HIV+			
6. People don't want me to come to their houses because I am HIV+			
7. I have been shouted at because I am HIV +			
8. I have been called bad names because I am HIV+			
9. I have been hit or physically hurt because I am HIV+			
10. People have threatened to kill me because I am HIV+			

D4.My husband/ partner left me because I am HIV +

YES	1
NO	0

D5.Have you had any other experiences than those mentioned where people have discriminated against you or treated you badly because of your HIV

YES	1
NO	0

DO NOT FILL IN D6 IF NO EXPERIENCE OF ENACTED STIGMA

D6. I know this might be difficult for you, but could you please describe these experiences for me

SECTION E

The amount of support people get from others around them can be important to people with HIV. In the next few questions we want to get an understanding of how much support you get from others.

E1.If you were ill and had to stay in bed for days, is there someone who would take care of you?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E2.If you needed money for food would there someone to help you

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E3. Is there someone you help you in an emergency even if they had to go out of their way?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E4. Is there someone you could talk to about things that have been troubling you?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E5. Is there someone who really understands you, and what your life is like?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E6. If you were going through a tough time, would you have someone to talk to?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E7. If you were feeling low about yourself, or felt that you couldn't do anything right, is there someone who has faith in you?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E8. Is there someone who accepts you as you are, both your bad points and your good points

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E9. Is there anyone who lets you know that they respect who you are and how you think and act?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E10. If you had a decision to make about the HIV, is there someone you could talk to who would give you good advice?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E11. If you had to be ospitalised for a few days because of your HIV is there someone who would care for your child(ren)?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

E12. Is there someone who knows about your HIV and who really understands what you're going through?

NO	**None**	**0**
YES	**As much as I need**	**3**
	Quite a lot	**2**
	Only a little	**1**

Now I want to ask you about some negative and unwanted support that you have been given by family and friends.

E13. Are there any people in your circle of family and friends who are domineering, who try to tell you what to do or want to run your life for you?

NO	**None**	**0**
YES	**All the time**	**3**
	Sometimes	**2**
	Occasionally	**1**

E14. Are there any people in your circle of family and friends who try to protect you too much or treat you like a child?

NO	**None**	**0**
YES	**All the time**	**3**
	Sometimes	**2**
	Occasionally	**1**

E15. Are there people in your circle of family and friends who give you too much unwanted advice?

NO	**None**	**0**
YES	**All the time**	**3**
	Sometimes	**2**
	Occasionally	**1**

E16. Are there people in your circle of family and friends who didn't offer to help or support you when you thought they should?

NO	**None**	**0**
YES	**All the time**	**3**
	Sometimes	**2**
	Occasionally	**1**

SECTION F
I am now going to ask you how you are feeling about your life and yourself

F1	**SELF ESTEEM**	**STRONGLY AGREE**	**AGREE**	**DISAGREE**	**STRONGLY DISAGREE**
1. I think I am no good at all					
2. I feel I have a number of good qualities					
3. I can do things as well as most other people					
4. I do not have much to be proud about					
5. I feel useless at times					
6. I am as good as other people					
7 I respect myself					
8. I think I am a failure					
9. I have a positive attitude toward myself					
10. In general I am satisfied with myself					

For each statement, how often have you felt of behaved this way DURING THE PAST WEEK? (SHOW CARD)

F2	DEPRESSION	RARELY OR NONE OF THE TIME (LESS THAN 1 DAY) 1	SOME OR LITTLE OF THE TIME (1-2 DAYS	OCCASIONALLY OR A MODERATE AMOUNT OF THE TIME (3-4 DAYS)	MOST OR ALL OF THE TIME (5-7 DAYS)
1. I was bothered by things that usually don't bother me					
2. I did not feel like eating; my appetite was poor					
3. I felt that I could not shake off the blues even with the help of my family					
4. I felt that I was just as good as other people					
5. I had trouble keeping my mind on what I was doing					
6. I felt depressed					
7. I felt that everything I did was an effort					
8. I felt hopeful about the future					
9. I thought my life had been a failure					
1. I felt fearful					
11. My sleep was restless					
12. I was happy					
13. I talked less than usual					
14. I felt lonely					
15. People were unfriendly					
16. I enjoyed life					
17.I had crying spells					
18.I felt sad					
19. I felt that people disliked me					
20.I could not get going					

People are very different in how they cope with things. The next few statements give us an idea of how people cope with different types of things. Please let me know whether you do these things to feel better. Now I would like you to select from the statements below the one that best describes how you try and cope with daily situations that confront you. (SHOW CARD)

F3	COPING	MOST OF THE TIME	SOME OF THE TIME	ALMOST NEVER
1. I take responsibility to protect my and other people's health				
2. I try to fight this virus by keeping fit and eating in a healthy way				
3. I learn to live with HIV				
4. I accept that I have HIV and that this cannot be changed				
5. I try to get as much information as I can about HIV				
6. I talk to someone with similar experience to find out how best to handle the situation				
7. I use my time to educate others to stay healthy				
8. I support other people with HIV				
9. I am inspired to make the most of the rest of my life				
10. I refuse to believe that it has happened to me				
11.I can cope as long as people do not know my status				
12. I talk to someone who can help me				
13. I get comfort and understanding from people				
14. I look for something good in what is happening				
15. This situation helped me to change my life for the better				
16. I seek comfort in my religion or spiritual beliefs				
17. I keep myself busy to take my mind off HIV				
18. I try not to think about the situation I am in				
19. I get upset and fight with other people				
20. I talk to let my unpleasant feelings escape				
21. I use alcohol or drugs to help me get through it				
22. I wish I could escape from this situation				
23. There is nothing I can do to make me feel better				
24 I do not feel in control of my health				
25 I put my trust in God				

F4. On a 10-point scale where 10 is very well and 1 is not well at all, how well do you rate your way of coping with your life in the past 3 months? (CIRCLE)

1 2 3 4 5 6 7 8 9. 10

Not coping at all **In between** **Very well**

S1. What effect do you think your involvement with the Serithi project has had on your life?

Detrimental	1
No effect	2
Beneficial	3

S1.1 Why?

…….

……..

S1.2 What effect has your involvement with Serithi had on your ability to disclose your HIV status?

Made it more difficult	1
Made it easier	2
No difference	3

S2. What have you liked/disliked about Serithi?

……

……

Thank you very much for answering all these questions, the new ones and all the old ones, so patiently. We really do appreciate it. Most of the old questions we will not be asking you again.

Patient address	Address of person who can contact patient	Address of person who can contact patient
Tel no	Tel no	Tel no
	Relationship to patient	Relationship to patient

SERITHI PROJECT
24 Months QUESTIONAIRE

IDENTIFICATION
CLINIC:
TOWNSHIP:
PATIENT NAME:
PATIENT REGISTRATION NUMBER:

INTERVIEW		
	INTERVIEW	RESULT CODES
DATE IN FULL:	DD /MM/YY	1. COMPLETED: ☐
		2. REFUSED: ☐
		3. PARTIALLY COMPLETED: ☐
		4. OTHER: ☐
INTERVIEWER'S NAME:		

LANGUAGE		
LANGUAGE OF INTERVIEW:		
HOME LANGUAGE OF RESPONDENT:		
LANGUAGE CODES		
1 ENGLISH	5 IsiXhosa	9 ziTSONGA
2 sePEDI	6 isiZULU	10 isiNDEBELE
3 seTSWANA	7 seSOTHO	11 seSWATI
4 AFRIKAANS	8 tshiVENDA	

SUPERVISOR	DATA CAPTURER	OFFICE EDITOR
NAME:	NAME:	KEYED BY:
DATE:	DATE: DATE:	

Thank you for being willing to talk to us again. In this interview we want to find out how you have been since the last interview, how the baby has been and if there have been any changes in your life since we last saw you. We will also examine you and the baby and take some blood from you
First we would like to ask you some medical questions

A. Since you were informed of your HIV status, did you receive any information on what foods to eat to stay healthy:

YES	1
NO	0
DO NOT KNOW	2

B. From where did you obtain the information?

Serithi Project	1
Counselling session	2
Magazine/ other printed material	3
Self	4
Radio	5
Television	6
Other (specify)	7

C. From your viewpoint what is the main message on healthy eating for persons living with HIV?
_____

D. Have you followed the advice you were given on healthy eating habits?

YES	1
NO	0
DO NOT KNOW	2

E. Have you lost a lot of weight in the past 6 months

YES	1
NO	0
DO NOT KNOW	2

IF YES
F. If you have lost a lot of weight would you say the change has been in :

One dress size	1
More than 1 dress size	2
Do not know	3

Other (specify)	4

M1. Are you sexually active?
IF NO go to M2

YES	1
NO	0

If YES
M1.1. Are you using contraception?

YES	1
NO	0
NA	5

IF YES
M1.2. What are you using?

CONDOMS	1
INJECTION	2
PILL	3
OTHERS - SPECIFY	4
N/A	99

IF YES OR NO TO M1.1

M1.2 Are you using a condom now?

ALL THE TIME	2
SOMETIMES	1
NEVER	0
N/A	99

M2. Have you been pregnant since the birth of your “Serithi baby”?

YES	1
NO	0

IF YES
M2.1 Did you plan the pregnancy?

YES	1
NO	0
N/A	99

M2.2 Are you pregnant now?

YES	1
NO	0
DON"T KNOW	2

M 3. Are you planning another child?

YES	1
NO	0

IF YES
M3.1 Whose decision is this?

RESPONDENT	1
PARTNER	2
JOINTLY	3
PRESSURE FROM FAMILY	4
OTHER (SPECIFY)	5
N/A	99

M4. Have you been ill since we last saw you?

IF NO go to M5

YES	1
NO	0

IF YES
M4.1. What was wrong_____

M4.2
WERE YOU ADMITTED TO HOSPITAL?

YES	1
NO	0
N/A	99

M5. We acknowledge the work that traditional/spiritual healers do and respect their practices and are interested in hearing about their contribution in dealing with HIV so would like to hear from you if you have ever been to a traditional/spiritual healer about your HIV?

YES	1
NO	0

M5.1 What did he/she do to try and help you? _____.

M5.2 Do you think it helped you?

YES	1
NO	0
NA	99

M6. Are you on antiretrovirals?

YES	1
NO	0

IF NO go to M7

Now I wish to ask you about the possible problems with the medication. This will possibly help us to develop methods to try and solve these problems

M6.1 When did you start the medication? _____

M6.2 Have you seen any change in your condition?

YES	1
NO	0
NOT SURE	2
N/A	99

M6.3 Have the medicines made you feel ill?

YES	1
NO	0
N/A	99

M6.31 Can you describe the symptoms?

_____

M6.4. Have you ever missed taking any tablets

YES	1
NO	0
N/A	99

M6.5 Are still taking the tablets?

YES	1
NO	0
N/A	99

IF NO

M6.6 Why was this_____

M6.7 The ARV treatment requires that you have a person who is your treatment "buddy"?_____

M6.8
Is he/she helping you?

YES	1
NO	0
N/A	99

IF NO
M6.9 Why is this?_____

IF YES
M6.10 How is your buddy helping you?_____

_____
___

M6.10 Is it a difficult to get to the clinic every month for the tablets?

YES	1
NO	0
N/A	99

IF YES
M6.11 Why is this?_____

M6.12 Other than your treatment buddy does anybody else know you are on medication?

YES	1
NO	0
N/A	99

M6.13 Have you had to disclose to more people because you are taking tablets?

YES	1
NO	0
N/A	99

IF YES
M6.14. To whom did you have to disclose
_____

M6.15. Why was it necessary to disclose to these people/person?
_____

M6.16. Have people asked you why you have to keep on taking tablets

YES	1
NO	0
N/A	99

IF YES
M6.17. What do you tell them?
_____

NOW I WISH TO ASK YOU SOME QUESTIONS ABOUT YOUR BABY

M7. Since we last saw you has the baby been ill?

IF NO GO TO M8

YES	1
NO	0

IF YES
M7.1. What was wrong with the baby?
_____

M7.2 Was the baby admitted to hospital?

YES	1
NO	0
N/A	99

M8. Have you taken the baby to a traditional/spiritual healer

YES	1
NO	0
N/A	99

IF YES
M8.1 Why did you take the baby?
_____

M8.2 What did he/she do?
_____

M8.3. Do you think it helped the baby?

YES	1
NO	0
N/A	99

M9. IS THE BABY HIV +VE**?**

IF NO GO TO M10

YES	1
NO	0

IF YES
M9.1 What treatment is the baby receiving?

None	0
Bactrim	1
Multivitamins	2
Antiretrovirals	3
Other (Specify)	4
N/A	99

(Can tick more than 1)

M9.2 Are you managing to remember to give the baby the antiretroviral medicine every time

YES	1
NO	0
N/A	99

M9.3 Has the baby been ill because of the treatment?

YES	1
NO	0
NOT SURE	2
N/A	99

IF YES
M9.4
Specify_____

M9.5 Do you find it difficult to come to the clinic every month for the medication?

YES	1
NO	0
N/A	99

IF YES
M9.6
Why_____

-
_____

M9.7 Who is taking care of the
child?_____

M9.8. With whom is the child during the
day?_____
M9.9 Are they responsible for giving the child the medication?

YES	1
NO	0
N/A	99

M9.8 Do they manage to give the baby the medication?

YES	1
NO	0
DON'T KNOW	2
N/A	99

M10 . What are you currently feeding the baby and how many times in a day?

FOOD	YES (TICK)	TIMES PER DAY
Breastmilk		
commercial infant formula		
commercial semi-solid infant food such as purity		
home prepared cereals/porridge/ mashed fruit/vegetables		
traditional medicine		
over the counter unprescribed medicine such as Umuti wenyoni or gripe water – specify		
Medicine prescribed by a doctor or		
water/sugar water		
juice/tea		
other food / fluid, specify		

Examinationm Mother:

OE1. ANTHROPOMETRIC MEASUREMENTS

Mother

Height……...m Mid upper arm circumference……..cm

Weight……...kg

0E2

STAGING.			YES	NO
1. Skin	1. Acne	Face		
		Back		
	2. Herpes Zoster	Current		
		Scar		
	3. Dermatitis	Non specific		
		Seborrhoeic		
	4. Kaposi Sarcoma			
	5. Nail fungal infections			
2. Mouth	1. Oral candidiasis	White		
		Red		
		hypertrophic		
		periorbital		
	2. Oral hairy leukoplakia			
	3. Oral ulceration			
	4. Gingivitis			
3. Lymph Nodes	1. Small			
	2. Large			
	3. Matted			
4. CNS	1. Appropriate			
	2. Inappropriate			
	3. Peripheral Neuropathy			
5. Chest	1. Dyspnoea			
	2. Tachypnoea			
	3. Cough	Dry		
		Productive		
	4. Crepitations			
	5. Consolidation			
	6. Effusion			
6. CVS	1. Normal			
	2. Tachycardia			
	3. Other			
7. GIT	1. HSM			
	2. Ascites			
	3. Diffusely tender			
8.	1. Oedema			
	2. Clubbing			
9.	1. Loss of weight			
	2. Cachexia			
Stage				

OE3. ANY NEW MEDICAL PROBLEMS_____
_____
___

OE4. ACTION TAKEN_____

BABY

OB1. Baby weight_____

OB2. Baby length_____

OB3 SEX OF BABY

MALE	1
FEMALE	2

OB4. ANY OBVIOUS ILLNESS

YES	1
NO	0

P1. ANY NEW MEDICAL PROBLEMS_____
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P2. ACTION TAKEN_____
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