

**The effect of hiv on growth of malnourished children under five years during follow-up at mulago hospital in kampala, uganda**

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## DECLARATION

I Ssenkusu John Mbaziira declare that this report is entirely my work and that it has not been presented in any University or Institution of higher learning for any degree award.

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## **DEDICATION**

Thanks to God who enables us to do all things including this piece of work.

## **ACKNOWLEDGEMENT**

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## ACRONYMS

<b>AIDS</b>	Acquired Immune Deficiency Syndrome
<b>ARV</b>	Antiretroviral drugs
<b>CSB</b>	Corn Soya Blend
<b>DNA</b>	Deoxyribonucleic acid
<b>F100</b>	Formula diet containing 100 kcal per 100 millilitres (Appendix 2)
<b>F75</b>	Formula diet containing 75 kcal per 100 millilitres (Appendix 2)
<b>FANTA</b>	Food and Nutritional Technical Assistance Project
<b>g</b>	Gramme
<b>HAART</b>	Highly Active Antiretroviral Therapy
<b>HEM</b>	High Energy Milk
<b>HIV</b>	Human Immunodeficiency Virus
<b>Kcal</b>	Kilo calories
<b>Kg</b>	Kilogramme
<b>MOH</b>	Ministry of Health
<b>NCHS</b>	National Centre of Health Statistics
<b>PCR</b>	Polymerase chain reaction
<b>RUTF</b>	Ready-to-use Therapeutic food
<b>SD</b>	Standard deviation
<b>SFC</b>	Supplementary Feeding Centre
<b>SPSS</b>	Statistical Package for Social Scientists
<b>UDHS</b>	Uganda Demographic Health Survey
<b>WHO</b>	World Health Organization



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## DEFINITION OF TERMS

<b>Baseline</b>	Is used concurrently with 'at discharge' to mean the point in the study at which the follow-up of each study participant started.
<b>Follow-up</b>	Is used concurrently with 'one month follow-up visit' to mean the point in the study at which study participants' measurements of one month after discharge were taken.
<b>Physical growth</b>	For this study, it is taken to mean an increase in the child's weight for height and/or an increase in weight over a specified period.
<b>Weight gain velocity</b>	$\frac{\text{Weight at follow-up in grams} - \text{Weight at baseline in grams}}{\text{Weight at baseline in kg} \times \text{Days between baseline \& 1 month}}$

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## **ABSTRACT**

### **Introduction**

Globally, of the 2.3 million children living with HIV/AIDS under 15 years, two thirds (63%) live in sub-Saharan Africa. In Uganda, approximately 100,000 children < 15 years are living with HIV/AIDS, which is 10% of all people living with HIV. On average, stunting (a deficit in height for age) and wasting (a deficit in weight for height) affects over 40% and 10% of under-5-year children, respectively in developing countries. Studies have shown that the HIV prevalence in malnourished children is high. However, it is not clear whether the management of malnutrition in HIV infected children should be different from that of malnourished HIV non-infected children.

### **Objective**

To determine the effect of HIV on growth of malnourished children under five years during follow-up at Mulago hospital, Kampala

### **Methods**

The study design was a retrospective cohort employing quantitative methods of data collection and was conducted at Mwanamugimu Nutrition Unit, Mulago Hospital by reviewing medical records between January 2007 and March 2008. Malnourished children under five years during follow-up were eligible for the study with HIV positive children as the exposed group and HIV negative children as the non-exposed group. All children with complete records meeting the eligibility criteria were included in the study. Baseline parameters were documented at discharge into the Supplementary Feeding Centre and follow-up parameters at one-month follow-up visit. The outcome variables were weight gain, change in weight for height, and weight gain velocity. The extraneous variables were illnesses at discharge and at one month follow-up visit, age, sex and immunization status.

## Results

One hundred and eight children treated for malnutrition were enrolled in this study. Thirty eight (35.2%) children were HIV positive and the rest were HIV negative. Fifty five (50.9%) were male while 53 (49.1%) were female. On average HIV positive children gained less mean body weight (0.58 kg) and had a less weight gain velocity (3.15 g/kg/day) compared to 0.65 kg and 3.18 g/kg/day respectively for HIV negative children. Although the difference in mean weight gain and mean weight gain velocity between malnourished HIV positive children and HIV negative children was statistically significant, the difference in change in weight for height which is a better measure of wasting (than weight gain and weight gain velocity) was not statistically significant.

## Conclusion and recommendation

HIV does not affect growth of under five malnourished children in the first one month of follow-up after discharge. The current Ministry of Health policy on nutritional management of under five malnourished children which does not provide for special management of malnourished HIV positive children during follow-up should be maintained.

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## 1.0 CHAPTER ONE: INTRODUCTION

### 1.1 Background

Globally, of the 2.3 million children living with HIV/AIDS under 15 years, two thirds (63%) live in sub-Saharan Africa [1]. Uganda has braved a severe and devastating epidemic of HIV infection and AIDS for almost a quarter of a century. It has imposed a severe and unsustainable burden on the inadequate health sector resources, as funds are diverted from other areas to HIV prevention and AIDS care and treatment services [2].

Although there has been a decline in HIV/AIDS, the trends in malnutrition have not changed. As the dry season progresses, meals consumed become less varied and families eat two meals or even one meal a day at the onset of the planting season. This aggravates the problem of recurring malnutrition [2].

According to the Uganda Demographic Health Survey (UDHS), 39% of children less than five years of age are stunted. Over 65% of children less than five years of age are anemic, while 28% are vitamin A deficient [3]. According to Bisase H et. al, malnutrition was found to be the fourth commonest reason for admission in Mulago Hospital [4]; and in 1995, it accounted for 12.6% of the overall pediatric admissions in Mulago Hospital [3]. Bachou found that the HIV prevalence in malnourished children at Mwanamugimu nutrition unit (Mulago Hospital) was 30% [5]. Though genetic factors have been associated with generally affecting growth in children [6, 7], infections such as diarrhea, fever, vomiting and pneumonia [8-11] and chronic psychosocial stress [12, 13] have been found to be associated with poor growth in HIV positive children.

Studies suggest that HIV has a negative effect on the nutrition of malnourished children [11, 14]. In spite of this, the nutritional management of HIV infected and non-infected malnourished children under five are the same. Thus, current nutritional management of HIV infected malnourished children may be inappropriate.

The aim of this study therefore was to determine the effect of HIV on the growth of HIV infected malnourished children so as to contribute to development of guidelines for the management of HIV infected malnourished children.

## **1.2 Statement of the problem**

Severe malnutrition is a common cause of morbidity and mortality in Uganda. In children under the age of 5 years, 39% of children are stunted, 4% wasted and 23% are under weight. Four percent of Ugandan children die due to illnesses related to malnutrition [3].

Bachou et. al found that the HIV prevalence in malnourished children at Mwanamugimu nutrition unit (Mulago Hospital) was 30% [5]. HIV infected children are more likely to experience growth failure and are at greater risk of death. They are more susceptible to common childhood illnesses such as diarrhea, acute respiratory infection (ARI), malaria, neurological problems and general growth retardation. They are also at increased risk of malnutrition due to poor appetite, inability to suck, swallowing difficulties, and nausea. Severely malnourished children with HIV/AIDS are about five times more likely to die than uninfected children [2].

Studies suggest that HIV has a negative effect on the nutrition of malnourished children [11, 14]. In spite of this, the nutritional management of under five HIV infected and non-infected malnourished children is the same. Thus, current nutritional management of malnourished HIV infected children may be inappropriate. Therefore the aim of this study was to determine the effect of HIV on the growth of HIV infected malnourished children during follow-up at Mulago Hospital so as to contribute to the development of guidelines for the management of malnourished HIV infected children.

### **1.3 Justification of the study**

The Ministry of Health policy on nutritional management of malnourished children under five years does not provide for special nutritional management of malnourished HIV infected children. The evidence available is not conclusive as to how the malnourished HIV-infected children should be managed. The results of this study may contribute to better understanding of the effect of HIV on growth of malnourished HIV infected children and inform the policy on the management of malnutrition in HIV infected children.

### **1.4 Research question**

Is there a difference in physical growth between malnourished HIV positive children and HIV negative children at 1 month follow-up visit?

### **1.5 Hypotheses**

$H_0$ : There is no difference in physical growth between malnourished HIV positive children and HIV negative children at 1 month follow-up visit?

$H_a$ : There is a difference in physical growth between malnourished HIV positive children and HIV negative children at 1 month follow-up visit?

### **1.6 Study objectives**

#### **1.6.1 General**

To determine the effect of HIV on growth of malnourished children under five years during follow-up at Mulago Hospital, Kampala.

#### **1.6.2 Specific**

- i. To compare the mean weight gain between malnourished HIV positive children and HIV negative children at 1 month follow-up visit?

- ii. To compare the mean weight gain velocity between malnourished HIV positive children and HIV negative children at 1-month follow-up visit
- iii. To compare the mean change in weight for height between malnourished HIV positive children and HIV negative children at 1-month follow-up visit?

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## **2.0 CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This section includes associated studies, research and information related to this area of study. It covers prevalence and causes of malnutrition, how malnutrition is managed, growth of malnourished children, measurement of nutrition status in children as well as the relationship between HIV and malnutrition.

### **2.2 Prevalence and causes of malnutrition**

The worldwide prevalence of acute malnutrition, which contributes up to 60% of the 10.9 million deaths each year among children under five in developing countries, is slowly decreasing. However, almost 30% of children under five in developing countries still suffer from stunted growth. The situation in some parts of Africa is particularly alarming because the numbers of malnourished children are increasing as a result of HIV/AIDS, ecological disasters, armed conflict, civil disturbances, and mass population movements [15].

In Mulago Hospital, Uganda's national referral hospital, the number of children suffering from severe malnutrition increased from 11 to 45 per 1000 pediatric admissions between 1995 and 2002 [16]. For optimum nutrition, one needs adequate food security. However, in Uganda, food insecurity results from poverty, intra-regional differences, internal displacement, gender imbalances in food allocation and intra-household food distribution, and lack of knowledge [2]. Protection, promotion and support of infant and young child feeding are critical to preventing malnutrition and ensuring the healthy growth and development of children.



### 2.3 Management of malnutrition

The WHO guidelines for management of severe malnutrition describes it in two phases i.e. the initial (resuscitation) and the rehabilitation phase. The initial phase lasts 2 – 7 days and here complications often caused by the severe state of malnutrition are controlled. The diet recommended in this phase is formula 75 (F75), a milk-based diet with low caloric value of 75 kcal per 100 ml and low osmolarity [17]. When children are free from complications of severe malnutrition, they are then transferred to the second phase of treatment i.e. rehabilitation. In the rehabilitation phase, children stay for an average of 2 – 6 weeks and the diet used is formula 100 (F100), which provides 100kcal per 100 ml and enables rapid weight gain. When children attain the desired weight for height and have no other infections, they are then discharged and followed up as out patients until they recover from acute malnutrition and this often takes 7 – 26 weeks [17].

In this period, relapses of severe acute malnutrition are common after discharge and without follow-up; there is increased risk of mortality. In a follow-up study of severely malnourished children in Zaire, it was found that there was increased mortality in the first year after discharge [18]. There was lack of catch-up after discharge for height and weight possibly because the children return to the home environment, which may predispose them to under nutrition. In Tanzania, a one year follow-up of severely malnourished children revealed 8% mortality, 13% relapse rate, 4% with residual signs of malnutrition and 75% recovered with good catch-up in weight (weight for age and weight for height) but not in height [19]. One third of the children discharged from the hospital died within 6 months and even in survivors, only a few had significant improvement in weight for age [20].

In Mulago Hospital, the management of severe malnutrition at Mwanamugimu nutrition unit is based on guidelines adapted from World health Organization i.e. giving malnourished children F75 in the initial phase followed by F100 in the rehabilitation phase. At follow-up Corn Soya Blend (CSB) (see appendix 3) is given. All children are given the same food formulas irrespective of their HIV status.

## **2.4 Growth of malnourished children**

Data on the prevalence of acute malnutrition in developing countries indicate that on average, stunting (a deficit in height for age) and wasting (a deficit in weight for height) affect over 40% and 10% of under-5-year children, respectively [21]. Length growth is more easily impaired during early childhood and once such a deficit has developed, complete catch-up growth in later life is hard to achieve [22, 23].

In the rehabilitation phase, severely malnourished children are given high energy and nutrient dense diets which allow rapid weight gain of 10 g/kg/day and this phase usually lasts 2 to 6 weeks [17]. However, this does not take into consideration whether the malnourished children are HIV positive or not.

F100 is given until the child achieves -1SD or 90% median NCHS/WHO reference value for weight for height and then the child will be ready for discharge [17]. The child may also be discharged if s/he attains 85% weight for height, has good appetite and a good weight gain with no oedema [17, 24, 25]. A child who does not gain at least 5 g/kg/day for 3 consecutive days is said to be failing to respond to treatment [17, 25]. In an efficacy study in Senegal, the F100 group was found to have a rapid weight gain of 10.1 g/kg/day with an average duration of rehabilitation of 17.3 days [26].

In an open label randomized clinical trial to compare the efficacy of RUTF and HEM among malnourished children at Mwanamugimu Nutrition unit, Nambuya found that on average, the mean time taken to attain

85% weight for height when admitted in both groups (HIV infected and non-infected) was 12.61 (SD 6.8) days [14]. The weight gain among inpatient malnourished HIV positive children was found to be 3.467 [11] and 4.65 g/kg/day less than in HIV negative children during the rehabilitation phase [14]. In a concurrent cohort in Rwanda, weight for height mean z score was found not to be consistently lower in HIV-infected children in comparison with uninfected ones [12]. Pitt et.al in a longitudinal study found that within the first 1–2 months of life, the weights and heights of HIV-infected children declined when compared with those for the non-infected cohort. HIV-infected children had lower weight-for-height Z-scores; much of the time these differences were not statistically significant [27].

Presence of infections like persistent diarrhea, persistent fever, vomiting and pneumonia were found by Tumbu (2005) to be important causes of poor growth in HIV positive children [11]. In addition, many studies have found diarrhea and pneumonia to be responsible for poor growth in HIV infected children [8-10]. Also, children who lack parental care suffer from chronic psychosocial stress leading to hypopituitarism and other endocrine dysfunction with reduced levels of growth hormone secretion hence poor growth [12, 13].

It is known that the parents' height has an influence on the stature of their children. However, the relationship between the height of the baby and that of the parents is not apparent at birth but becomes more evident toward the age of 2 years, and thereafter the correlation becomes greater with increasing age [7].

In the Louisville Twin Study that examined height data longitudinally from birth to maturity in twin families observed a substantial and constant correlation between the height of the children and their parents from the age of 3 years and onwards. Monozygotic twins, with identical genetic composition, had a greater difference in final height when reared apart than when reared together. The difference in height of monozygotic twins was thought to be caused by environmental factors [6].

With the development of protease inhibitor anti-retroviral therapy and highly-active anti-retroviral treatment regimens, children with HIV infection in developed countries are living longer with a chronic illness. A follow-up study of 67 children, who had been exposed on protease inhibitor therapy, before or after protease-inhibitor therapy nutritional indices showed an improvement in weight and weight-for-height Z-score while on protease-inhibitor therapy (TL Miller, C Duggan, B Mawn and SL Gorbach, unpublished results).

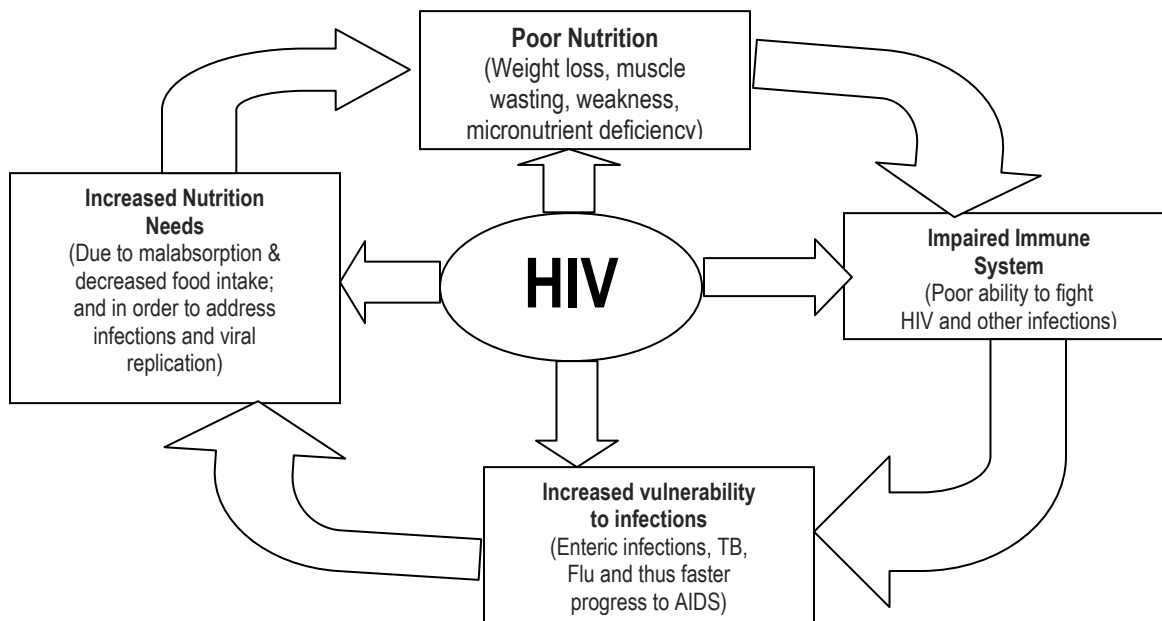
## **2.5 Measurements for nutritional status**

Indices height-for-age, weight-for-height, and weight-for-age provide different information about growth and body composition, which is used to assess nutritional status. The height-for-age index is an indicator of linear growth retardation and cumulative growth deficits. Height-for-age represents the long-term effects of malnutrition in a population and is not sensitive to recent, short-term changes in dietary intake. The weight-for-height index measures body mass in relation to body height or length and describes current nutritional status. Children whose Z-scores are below minus two standard deviations (-2 SD) are considered thin (wasted) and are acutely malnourished. Wasting represents the failure to receive adequate nutrition in the period immediately preceding the measurements and may be the result of inadequate food intake or a recent episode of illness causing loss of weight and the onset of malnutrition. Weight-for-age is a composite index of height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition [28]. Mid-upper arm circumference (MUAC) is a measure of the diameter of the upper arm, and gauges both fat reserves and muscle mass. It has been proposed as an alternative index of nutritional status, in particular situations where data on height, weight, and age are difficult to collect [29].

## 2.6 HIV and Malnutrition

The prevalence of HIV infection among severely malnourished children was found to range from 49% in Zimbabwe, 41% in Zambia to 26% in Tanzania [8, 9, 30]. A study by Bachou at Mwanamugimu nutrition unit at Mulago Hospital found the prevalence of HIV in malnourished children to be 30% [5]. In another study, children who were less than the 10th percentile for height-for-age made up 64%, 33%, and 23% of AIDS, HIV-infected and negative children; respectively. Only 36% of children diagnosed with AIDS had normal nutritional status compared to 61% and 79% of the HIV-infected and HIV non-infected, respectively [31].

HIV impairs the immune system, making the body vulnerable to various infections. These infections require an increase in the energy and nutrient needs and if these increased needs are not met malnutrition results. HIV impairs the immune system, making the body vulnerable to various infections. To handle the HIV infections and the frequent other illnesses the energy and nutrient needs are increased. If these increased needs are not met malnutrition results. Malnutrition also contributes to immune impairment, which worsens the effects of HIV and thus encourages more rapid progression to AIDS forming a vicious cycle (See figure 1 below). Malnutrition therefore can both contribute to and result from the progress of HIV [32]. Therefore, this study sought to find the extent to which HIV affects the growth of malnourished children.

**Figure 1: The cycle of malnutrition and infection in the context of HIV/AIDS**

Source: [33]

For malnourished HIV infected under 5 children, the Uganda guidelines for service providers on Nutritional Care and Support for People Living with HIV/AIDS advise to look out for and attend to complications that might lead to death. These complications include; very low body temperature (below 35° C), dehydration or diarrhea for which to give oral rehydration solution to replace lost fluids; hypoglycemia (characterized by drowsiness and stupor) to give a glucose solution (use intravenous fluids in moderation) and provide broad-spectrum antibiotics to all children with severe malnutrition. However, they do not recommend any food formula specifically for malnourished HIV positive children. As such, the same food formulae are used for all malnourished children whether HIV positive or not.

### **3.0 CHAPTER THREE: METHODS**

#### **3.1 Introduction**

This chapter includes the methodology and procedures used to carry out this research. It describes the study design, study setting, population of study, sample size estimation methods, sampling procedure and data collection methods employed during the study.

#### **3.2 Study design**

This was a retrospective cohort.

#### **3.3 Study setting**

The study was conducted in Mulago National referral Hospital at Mwanamugimu Nutrition Unit. The hospital provides various services ranging from primary to specialized care and serves urban, peri-urban and village populations from near and far districts. Most of the children diagnosed with severe malnutrition are transferred to the Mwanamugimu Nutrition Unit. It provides practical experience in the treatment and rehabilitation of children who suffer from severe acute malnutrition. This unit has two wards, a resuscitation ward with a bed capacity of 60 and a rehabilitation ward with a bed capacity of 25. After children have been stabilized on the resuscitation ward, they are transferred to the rehabilitation ward. On average, the unit admits about 80 severely malnourished children per month. The unit uses the Uganda national guidelines on management of severe malnutrition adapted from the WHO [34]. HIV testing of all children whose caretakers give informed consent is done at admission using DNA PCR for children 18 months and below and a rapid anti-body test for children above 18 months. These children are discharged to the Supplementary Feeding Centre (SFC) where they are followed up after attaining a weight for height of or above 85%. In this centre, they are given bi-weekly appointments in the first one month after which they are

given monthly appointments. The Centre operates once a week serving on average 30 – 40 children. At each visit, the children's weights and heights are taken, are examined for any illnesses, caretakers counseled in relation to their child's growth progress and are also given health education. At follow-up they are given CSB and food rations (beans and posho) and are discharged out of the out-patient clinic when they attain a weight for height of 90%.

### **3.4 Population**

#### **3.4.1 Target population**

Malnourished children 6-59 months who attended the follow-up phase out-patient clinic after their Initial and rehabilitation phase at Mulago Hospital, Kampala.

#### **3.4.2 Accessible population**

Malnourished children 6-59 months who attended the follow-up phase out-patient clinic between January 2007 and March 2008 after their Initial and rehabilitation phase at Mulago Hospital, Kampala.

#### **3.4.3 Study population**

Malnourished children 6-59 months who attended the follow-up phase out-patient clinic between January 2007 and March 2008 after their Initial and rehabilitation phase at Mulago Hospital Kampala, who fulfilled the eligibility criteria.

### **3.5 Eligibility criteria**

#### **3.5.1 Exposed group**

##### **3.5.1.1 Inclusion criteria**



Malnourished HIV positive children aged 6-59 months who attended Mwanamugimu nutritional unit follow-up phase out-patient clinic between January 2007 and March 2008. These children would have completed the initial and rehabilitation phase in management of severe malnutrition and attended their one month follow-up visit in the Supplementary Feeding Centre (SFC).

### 3.5.1.2 Exclusion criteria

Children with incomplete records were excluded.

## 3.5.2 Non-exposed group

### 3.5.2.1 Inclusion criteria

Malnourished HIV negative children aged 6-59 months who attended Mwanamugimu nutritional unit follow-up phase out-patient clinic between January 2007 and March 2008. These children would have completed the initial and rehabilitation phase in management of severe malnutrition and attended their one month follow-up visit in the Supplementary Feeding Centre (SFC).

### 3.5.2.2 Exclusion criteria

Children with incomplete records were excluded.

## 3.6 Sample size determination and sampling procedure

### 3.6.1 Sample size determination

We wanted to determine a 6.54 kg difference in mean weight gain between malnourished HIV positive children and malnourished HIV negative children during follow-up. To compare this between the two groups, the sample size was estimated with the formula below by Beth Dawson et. al (2000) [35].

$$n = 2 * \left( \frac{(Z_{\alpha/2} - Z_{\beta}) \sigma}{\mu_1 - \mu_2} \right)^2 \quad \alpha = 0.05, \quad Z_{\alpha/2} = 1.96, \quad \beta = 0.20 \quad Z_{\beta} = 0.8416$$

$$\mu_1 - \mu_2 = 6.54 \text{ kg (Nambuya, 2005),} \quad \sigma = 9.83$$

n = sample size

$\sigma$  = standard deviation of weight gain for malnourished HIV negative children [14].

$\mu_1$  = Mean weight gain of malnourished HIV negative children [14].

$\mu_2$  = Mean weight gain of malnourished HIV positive children [14].

$Z_\beta$  = Is the standard normal lower one-tailed value of Z related to  $\beta$ .

$Z_{\alpha/2}$  = Is the standard normal two-tailed value of Z related to  $\alpha$ .

n = 36 children in each group were required to answer the research question making a total sample of 72 children.

Therefore, the minimum sample that was required to answer the research question was 72 children i.e. 36 children in each group.

### 3.6.2 Sampling procedure

All the children who met the eligibility criteria between January 2007 and March 2008 were enrolled in the study.

## 3.7 Variables and Data collection

### 3.7.1 Variables

**Exposure:** HIV infection

**Outcomes:** Weight gain, weight for height and weight gain velocity.

**Extraneous variables:** Illnesses at enrollment and at one month follow-up visit, type of malnutrition treated, age, sex and immunization status.

### 3.7.2 Data collection

The patient summary discharge book at the unit together with the Supplementary Feeding Centre (SFC) attendance registry book was used to establish the eligible study participants by the Principal Investigator.

Files of identified children were then retrieved from the records and baseline parameters extracted from them. Follow-up parameters were retrieved from the SFC attendance registry book. All this data was transcribed onto a semi-structured questionnaire by a doctor and a nurse who had been trained in the research protocol.

### **3.8 Data management and analysis**

#### **3.8.1 Data Management**

All data collected was edited, coded, and cleaned to check for completeness, accuracy and consistency. It was double data entered using Epidata 3.1 and backed up. It was then exported to SPSS 12.0 and STATA 8.0 for analysis.

#### **3.8.2 Data analysis**

##### **3.8.2.1 Univariate analysis**

This was performed to describe the characteristics of the respondents. Continuous variables like age were summarized into means while categorical variables were summarized into frequencies, percentages and proportions for description.

##### **3.8.2.2 Bivariate analysis**

The student's T-test was used to determine if there is a difference in mean weight gain, change in weight for height and weight gain velocity between HIV positive and HIV negative malnourished children. A p-value of 0.05 was considered statistically significant.

### 3.8.2.3 Multivariate analysis

Multivariate analysis was carried out to determine the effect of HIV on growth while controlling for interaction and confounding.

Linear regression was used while controlling for interaction and confounding to

- i. Compare the mean weight gain between malnourished HIV positive children and HIV negative children at 1 month follow-up visit.
- ii. Compare the mean change in weight for height between malnourished HIV positive children and HIV negative children at 1 month follow-up visit.
- iii. Compare the mean weight gain velocity between malnourished HIV positive children and HIV negative children at 1 month follow-up visit.

### 3.9 Ethical considerations

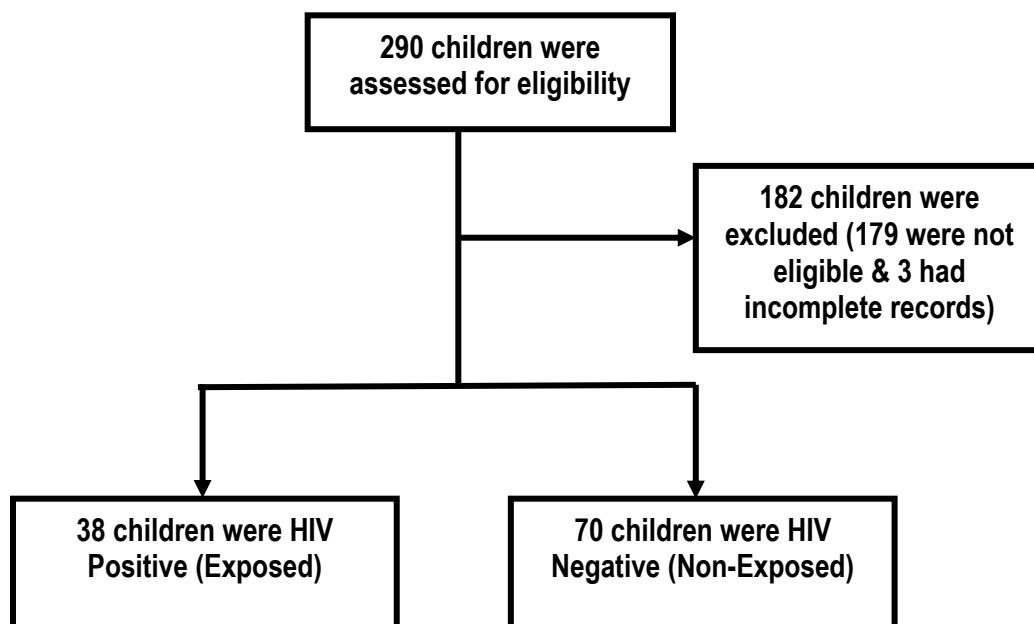
The principal investigator obtained approval to conduct the study from Makerere University Clinical Epidemiology Unit, and the Faculty of Medicine Ethics and Research Committee. Confidentiality was maintained on the information collected.

## 4.0 CHAPTER FOUR: PRESENTATION OF FINDINGS

### 4.1 Background characteristics

One hundred and eight children treated for malnutrition at Mwanamugimu were enrolled in this study between January 2007 and March 2008. Thirty eight (35.2%) children were HIV positive and seventy (64.8%) were HIV negative (Figure 2).

**Figure 2: Study profile**



Fifty five (50.9%) were male while 53 (49.1%) were female. Their age ranged from 6 – 48 months with mean age of 17.2 (SD=9.20) months. Prior to discharge from the ward, 46 (42.6%) had been treated for kwashiorkor, 40 (37.0%) for Marasmus and 22 (20.4%) for marasmic-kwashiorkor. Most of these children (82.4%, 89/108) were cared for by their mothers followed by grandmothers (9.3%, 10/108). Six children were cared for by their fathers, 2 by their aunties and 1 by his step mother (see Table 1). The care taker's ages ranged from 17 – 65 years with a mean age of 28.4 (SD=10.22) years. In the exposed group, 7

(18.4%) out of the 38 were on antiretroviral therapy, 27 (71.1%) were on cotrimoxazole prophylaxis and 6 were on both antiretroviral therapy and cotrimoxazole prophylaxis.

Baseline measurements were taken at discharge from the ward to the supplementary feeding centre. The majority of the children (95.2%, 100) were discharged with good appetite. Only 5 children were discharged with a poor appetite of which 4 were HIV negative and the other HIV positive. Only one child was discharged with moderate dehydration and was also HIV positive. Five children were discharged with oral thrush of which 3 were HIV positive. Three children had a skin rash of which one was HIV positive with a generalized skin rash and the rest were HIV negative with a localized skin rash. Only one HIV positive child was still breast feeding at the time of discharge in comparison to nine who were HIV negative. At discharge to the supplementary feeding centre, the baseline weight of the children ranged from 4.3 – 12.3 kg with a mean of 7.33 (SD=1.84) kg; their height/length ranged from 55.0 – 100.0 cm with a mean of 71.03 (SD=7.97) cm and their percentage weight for height ranged between 55.6% - 125.0% with a mean of 85.9% (SD=8.74). The majority of these children (62.0%, 67) were from Kampala district followed by 13.9% (15) from Wakiso district and the rest came from the neighboring districts of Mukono, Mpigi and Luwero.

#### **4.2 Baseline characteristics of the exposed and non-exposed groups**

From Table 1, basing on the p-values, there was no significant difference between the exposed group (HIV positive) and the non-exposed group (HIV negative) in respect to sex, type of malnutrition at admission, relationship to the child, occupation of the caretaker and having fever at discharge. However, there was a difference between the two groups with respect to whether they were discharged with cough or not ( $p=0.008$ ).

**Table 1: Baseline characteristics (categorical variables) of study participants and their caretakers**

Characteristics		HIV Positive (Exposed) n = 38 (%)	HIV Negative (Non- Exposed) n = 70 (%)	p - Value
Sex	Male	17 (44.7)	38 (54.3)	0.343
	Female	21 (55.3)	32 (45.7)	
Type of malnutrition at admission				
	Kwashiorkor	12 (31.6)	34 (48.6)	0.232
	Marasmus	17 (44.7)	23 (32.9)	
	Marasmic-kwashiorkor	9 (23.7)	13 (18.6)	
Symptoms at discharge				
	Fever	4 (5.7)	0 (0.0)	0.295
	Cough	3 (7.9)	22 (31.4)	<b>0.008*</b>
Relationship of caretaker to child				
	Mother	30 (78.9)	59 (84.3)	0.598
	Others	8 (21.1)	11 (15.7)	
Occupation of caretaker				
	Housewife	20 (52.6)	46 (65.7)	0.813
	Others	18 (47.4)	24 (34.3)	

\* = Significant p – value

At discharge, HIV positive children had a higher mean age (19 months) in comparison to those in the HIV negative children (16 months). Though their mean height was not much different, HIV positive children had a lower mean weight (7.1 kg) and weight for height (82.4%) compared to 7.5 kg and 87.7% respectively for the HIV negative children. On average, caretakers of HIV positive children had a higher mean age (30 years) than those of HIV negative children (see Table 2).

**Table 2: Baseline characteristics (continuous variables) of study participants and their caretakers**

Characteristics	HIV Positive (Exposed) Mean (C.I)	HIV Negative (Non-Exposed) Mean (C.I)	p - Value
Age of child (months)	19.11 (15.31 - 22.91)	16.44 (14.54 – 18.34)	0.082
Weight (kg)	7.13 (6.50 – 7.77)	7.52 (7.07 – 7.96)	0.542
Height (cm)	71.28 (68.45 – 74.11)	71.27 (69.37 – 73.16)	0.697
Weight for height (%)	82.36 (80.24 – 84.48)	87.70 (85.42 – 89.98)	<b>0.003*</b>
Age of caretakers (years)	30.16 (25.97 – 34.35)	27.41 (25.30 – 29.52)	0.191

\* = Significant p – value; C.I = 95% Confidence interval

However, there was no statistical difference between the HIV positive children and HIV negative children at discharge in relation to age, weight, height/length and age of caretakers at baseline. A statistical difference between the two groups was registered in weight for height ( $p=0.003$ ) which means that the weight for height for HIV positive children at baseline was significantly lower than that of the HIV negative children (Table 2).



### 4.3 Factors associated with growth in malnourished children during follow-up

#### 4.3.1 Effect of HIV and other factors on weight gain at one month visit

On average HIV positive children gained less mean body weight (0.58 kg, 95% C.I = 0.39-0.78) compared to HIV negative children (0.65, 95% C.I = 0.49 – 0.81) kg. However, this difference in mean weight gain was not statistically significant ( $p=0.621$ ).

At bivariate analysis, three factors i.e. having oral thrush at follow-up ( $p=0.006$ ), having cough at follow-up (0.001) and having diarrhea at follow-up ( $p=0.017$ ) were found to be significantly associated with weight gain at one month visit. The rest of the factors were not statistically significant (Table 3).

**Table 3: Effect of other factors on weight gain at one month visit**

Factor	N=108 n (%)	Mean weight gain difference in kg (C.I)	p - value
Alert (discharge)	90 (83.3)	0.30 (-0.02 – 0.61)	0.067
Marasmus	40 (37.0)	0.18 (-0.06 – 0.43)	0.145
Marasmic kwashiorkor	22 (20.4)	-0.21 (-0.50 – 0.09)	0.165
Multivitamins (discharge)	75 (69.4)	-0.20 (-0.46 – 0.06)	0.124
Oral thrush (follow-up)	5 (4.6)	0.78 (0.23 – 1.33)	<b>0.006*</b>
Cough (follow-up)	22 (20.4)	0.52 (0.24 – 0.80)	<b>0.001*</b>
Fever (follow-up)	12 (11.1)	0.37 (-0.01 – 0.74)	0.052
Diarrhea (follow-up)	12 (11.1)	0.45 (0.08 – 0.82)	<b>0.017*</b>

N=Overall total sample; n=Number with a factor out N; \* = Significant p – value; C.I = 95% Confidence interval

At multivariate analysis (Table 4), having oral thrush at follow-up and having cough at follow-up were the only significant independent factors affecting weight gain. Though HIV did not affect weight gain at bivariate analysis, after controlling for interaction by multivitamins (at discharge) and confounding by diarrhea (follow-up) at multivariate analysis, it became statistically significant ( $p=0.015$ ) and it negatively affected

weight again as was having an oral thrush or cough at follow-up. Being HIV positive and at the same time having received multivitamins at discharge was positively associated with weight gain ( $p=0.012$ ).

**Table 4: Linear regression model for factors affecting weight gain**

Factor	$\beta$ coefficient	$\beta$ coefficient C.I	p - value
HIV Positive	-0.528	-0.951 – -0.105	<b>0.015*</b>
Oral thrush (follow-up)	-0.651	-1.205 – -0.096	<b>0.022*</b>
Cough (follow-up)	-0.402	-0.692 – -0.113	<b>0.007*</b>
Multivitamins	-0.153	-0.461 – 0.155	0.326
HIV positive * Multivitamins	0.657	0.150 – 1.164	<b>0.012*</b>
Diarrhea (follow-up)	-0.292	-0.675 – 0.090	0.133

\* = Significant p – value; C.I = 95% Confidence interval

#### 4.3.3 Effect of HIV and other factors on weight gain velocity during one month follow-up

Since each of the children had a different weight and weight for height at discharge or enrollment into the study, weight gain velocity was computed in order to standardize the weight gained taking into consideration the time of follow-up in days as well as the weight with which each participant was enrolled into the study.

On average HIV positive children had a less mean weight gain velocity (3.15 g/kg/day, 95% C.I = 2.08 – 4.23) compared to HIV negative children (3.18 g/kg/day, 95% C.I = 2.36 – 3.40). However, this difference in mean weight gain velocity was not statistically significant ( $p=0.967$ ).

At bivariate analysis (Table 5), presenting with oral thrush ( $p=0.005$ ), cough ( $p=0.001$ ), fever (0.044) or diarrhea ( $p=0.009$ ) at one month follow-up visit were significantly associated with weight gain velocity.

**Table 5: Effect of other factors on weight gain velocity at one month visit**

Factor	N=108 n (%)	Difference in mean weight gain velocity in g/kg/day (C.I)	p - value
Multivitamins (discharge)	75 (69.4)	-1.10 (-2.48 – 0.29)	0.120
Marasmus	40 (37.0)	0.96 (-0.35 – 2.28)	0.150
Oral thrush (follow-up)	5 (4.6%)	4.24 (1.31 – 7.17)	<b>0.005*</b>
Cough (follow-up)	22 (20.4)	2.84 (1.32 – 4.36)	<b>0.001*</b>
Fever (follow-up)	12 (11.1)	2.13 (0.06 – 4.21)	<b>0.044*</b>
Diarrhea (follow-up)	12 (11.1)	2.73 (0.68 – 4.78)	<b>0.009*</b>

N=Overall total sample; n=Number with a factor out N; \* = Significant p – value; C.I = 95% Confidence interval

At multivariate analysis (Table 6), having oral thrush and having cough at follow-up were still the only significant independent factors affecting weight gain velocity. Though HIV did not affect weight gain velocity at bivariate analysis, after controlling for interaction by multivitamins (at discharge) and confounding by diarrhea (follow-up) at multivariate analysis, it became statistically significant ( $p=0.044$ ) and it negatively affected weight gain velocity as was having an oral thrush or cough at follow-up. Also, being HIV positive and at the same time having received multivitamins at discharge was still positively associated with weight gain ( $p=0.021$ ).

**Table 6: Linear regression model for factors affecting weight gain velocity**

Factor	$\beta$ coefficient	$\beta$ coefficient C.I	p - value
HIV Positive	-2.314	-4.565 – -0.062	<b>0.044*</b>
Oral thrush (follow-up)	-3.455	-6.418 – -0.493	<b>0.023*</b>
Cough (follow-up)	-2.186	-3.734 – -0.639	<b>0.006*</b>
Multivitamins (discharge)	-0.663	-2.311 – 0.984	0.426
HIV Positive * Multivitamins	3.233	0.530 – 5.936	<b>0.021*</b>
Diarrhea (follow-up)	-1.738	-3.823 – 0.347	0.101

\* = Significant p – value; C.I = 95% Confidence interval

The immunization status of the child (complete, incomplete or unknown immunization status) did not affect any of the measures of growth i.e. weight gain, change in weight for height and weight gain velocity.

#### 4.3.2 Effect of HIV and other factors on change in weight for height at one month visit

The mean change in weight for height was higher (4.13%, 95% C.I = 2.05 – 6.21) in HIV positive children by 0.07% than in HIV negative children (4.06%, 95% C.I = 2.04 – 6.08). Though there was a difference in the mean change in weight for height at 1 month follow-up visit, it was not statistically significant ( $p=0.967$ ).

From Table 7, the independent factors that were associated with the change in weight for height at bivariate analysis included; having been treated for Marasmus before discharge ( $p=0.015$ ), presenting with oral thrush at one month follow-up visit ( $p=0.030$ ), presenting with cough at follow-up ( $p=0.012$ ) and presenting with diarrhea at one month follow-up visit ( $p=0.012$ ). Though presenting with oral thrush was statistically significant, only 5 (4.6%) children presented with oral thrush.

**Table 7: Effect of other factors on change in weight for height at one month visit**

Factor	N=108 n (%)	Difference in mean change in weight for height in % (C.I)	p - value
Multivitamins (discharge)	75 (69.4)	-2.12 (-5.30 – 1.06)	0.189
Marasmus	40 (37.0)	3.72 (0.74 – 6.69)	<b>0.015*</b>
Marasmic kwashiorkor	22 (20.4)	-3.35 (-6.95 – 0.26)	0.069
Vomiting (follow-up)	6 (5.6)	5.71 (-0.65 – 12.06)	0.078
Oral thrush (follow-up)	5 (4.6)	7.61 (0.74 – 14.49)	<b>0.030*</b>
Cough (follow-up)	22 (20.4)	4.60 (1.04 – 8.16)	<b>0.012*</b>
Fever (follow-up)	12 (11.1)	4.54 (-0.07- 9.16)	0.054
Diarrhea (follow-up)	12 (11.1)	5.87 (1.31 – 10.43)	<b>0.012*</b>

N=Overall total sample; n=Number with a factor out N; \* = Significant p – value; C.I = 95% Confidence interval

At multivariate analysis (Table 8); having been treated for Marasmus and presenting with cough at follow-up were independently affecting the change in weight for height at 1 month follow-up visit. After controlling for the confounding effect of presenting with diarrhea at one month visit, HIV did not affect the change in weight for height ( $p=0.930$ ).

**Table 8: Linear regression model for factors affecting change in weight for height**

Factor	$\beta$ coefficient	$\beta$ coefficient C.I	p - value
HIV Positive	-0.136	-3.179 – 2.908	0.930
Cough (follow-up)	-3.717	-7.295 – -0.140	<b>0.042*</b>
Marasmus	-3.623	-6.520 – -0.726	<b>0.015*</b>
Diarrhea (follow-up)	-4.492	-9.251 – 0.268	0.064

\* = Significant p – value; C.I = 95% Confidence interval

#### 4.3.4 Effect of HAART on growth among malnourished HIV positive children

Within the HIV positive children, the mean weight gain velocity of children on antiretroviral therapy (7.57g/kg/day, 95% C.I = 4.87 – 10.28) was 5.42 g/kg/day higher than those not on antiretroviral therapy (2.15 g/kg/day, 95% C.I = 1.26 – 3.04) and this difference in weight gain velocity was statistically significant ( $p=0.001$ ).

HIV positive children on HAART still had a higher mean change in weight for height (12.57%, 95% C.I = 6.76 – 18.38) than those not on HAART (2.22%, 95% C.I = 0.533 – 3.91) and this difference in mean change in weight for height was statistically significant ( $p=0.001$ ). However taking or not taking cotrimoxazole prophylaxis did not affect the weight gain velocity of the children during the one month of follow-up.

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## **5.0 CHAPTER FIVE: DISCUSSION OF FINDINGS**

### **5.1 Introduction**

This study was carried out to determine the effect of HIV on growth of malnourished children 6-59 months during follow-up at Mulago Hospital, Kampala. It included children recovering from malnutrition discharged into the Supplementary Feeding Centre at Mwanamugimu between January 2007 and March 2008. The sex distribution in this study was similar to another study that was carried out in malnourished inpatient children [11].

### **5.2 Effect of HIV on weight gain of malnourished children**

This study found that being HIV positive negatively affected weight gain in malnourished children under five years within one month after discharge. Studies measuring growth in children use anthropometry measurements (weight for age, height for age, weight for height and Body Mass Index) of which weight gain is not part and this makes comparison of this finding with other studies very difficult. However the results show that HIV affects body mass weight gain among malnourished children. Basing on the fact that each child at discharge had a unique weight (some high and others low), it is possible that the baseline weight may influence the weight gain of a child during the one month of follow-up. This parameter was therefore standardized into weight gain velocity by taking into consideration the baseline weight and the duration of follow-up.

### **5.3 Effect of HIV on weight gain velocity of malnourished children**

Being HIV positive was found to negatively affect the weight gain velocity of malnourished children during the follow-up period. Tumbu found similar results that malnourished HIV positive children on average gained 3.5g/kg/day less than the HIV negative children and this was statistically significant at bi-variate analysis ( $p=0.023$ ). However, it was not significant at multivariate ( $p=0.742$ ) which he attributed to a small

sample size [11]. In our study, though HIV status affected weight gain velocity, its significance was borderline ( $p=0.044$ ). The follow-up period of one month was relatively short and close to when they were managed for acute malnutrition and thus the effect of the hospital management of malnutrition could have been still prevalent among the children resulting in similar growth. It is as well difficult to establish, in what direction this finding could have been influenced if ineligible participants were included in the study.

#### **5.4 Effect of HIV on change in weight for height of malnourished children**

In this study, we found that HIV did not affect the change in weight for height at one month follow-up visit even after controlling for confounders. The results of this study are similar to those of a concurrent cohort in Rwanda which found that the weight for height mean z score was not consistently lower in HIV-infected children in comparison with uninfected ones [12]. In a five year longitudinal study by Pitt et.al (1998), birth weights were similar between HIV infected and non-infected groups, although within the first 1–2 months of life the weights and heights of HIV-infected children declined when compared with those for the non-infected cohort. Once HIV-infected children deviated from the non-infected group these differences persisted, but did not increase over time. HIV-infected children had lower weight-for-height Z-scores, although the study found that much of the time these differences were not statistically significant [27]. Weight for height is considered the best indicator of acute under or over nutrition (thinness or wasting) among children [36, 37]. These findings thus suggest that malnourished HIV positive children gain relatively the same weight for height as malnourished HIV negative children within one month after discharge. This can assist policy makers involved in making guidelines for management of malnourished children.

#### **5.5 Association of HAART and growth of malnourished HIV positive children**

We also found that the weight gain velocity of HIV positive children on HAART was 3.52 times higher than those not on HAART and this difference was statistically significant. These results seem to differ from those

found by Newell et. al (2002) who found that growth of HIV infected children who were born before 1994, before the widespread use of antiretroviral therapy (ART) prophylaxis to reduce vertical transmission, did not substantially differ from that of children who were born after 1994 [38]. However, their results do not clearly stipulate whether the mothers took or did not take HAART to reduce vertical transmission during pregnancy or children were taking HAART during the study period or not. This study did not have enough power to make firm conclusions on this difference.

## 5.6 Study limitations

Because this study was a retrospective cohort, we were unable to document the feeding practices of the children during the study. However for each child discharged, the caretaker is given food rations which include Corn Soya Blend, beans and posho depending on availability. The caretakers receive these supplements each time they come for review in the supplementary feeding centre. Although there are many potential etiologies for inadequate energy intakes of HIV-infected children, there is little data to support this theory. In a study by Miller et. al (1997a) of over 700 food records, the total energy intake across all groups (HIV positive children, children with AIDS and HIV negative children) was similar, as were the intake of protein, carbohydrate and fat and dietary intake overtime was stable in all groups [39]. Other studies on the dietary intake of these children have similar results, with normal dietary and micronutrient intakes [40, 41]. In general, limited data show that low energy intake does not fully explain the nutritional problems of children with HIV in developed countries.

Like many other retrospective studies, we had limited control of the quality and nature of the weight and height measurements. Measurements of weight and height at Mwanamugimu nutrition unit are done routinely in the Supplementary Feeding Centre and are recorded both in the patient book and the attendance book. The HIV status is neither recorded in their book nor in the attendance book which are the



only information sources in the SFC. It is therefore unlikely that there were any differences in taking measurements between the HIV infected children and HIV non-infected children.

Maternal health, emotional and psychological status and the characteristics of the caregiver-child interaction have a strong influence on growth. Infants of depressed mothers are at greater risk for growth failure [42]. However, little research on the effect of maternal depression and anxiety on childhood have been performed in resource-constrained nations and specific to HIV-positive mothers and their infants. In our study, caretakers were given continuous health education on clinical, psychosocial and nutrition issues during their stay as inpatients. Even when they were discharged to the supplementary feeding centre, each time they came for review, health education was still given. Thus if psychosocial issues had any effect on growth, they affected the HIV infected children and HIV non-infected children equally.

We were also unable to document the education level of the caretakers in this study. In a study by Kikafunda et. al, the education level of the mother influenced the nutritional status of children and better educated mothers had less stunted children ( $p=0.045$ ) [43]. However, we do not know to what direction this could have affected the findings.

We were also unable to measure the children's CD4 counts to establish the difference in CD4 counts between the malnourished HIV positive children and HIV negative children. Tumbu (2005) found that malnourished HIV negative children had significantly ( $p=0.000$ ) higher CD4 counts than malnourished HIV positive children [11]. In our study, we recognized that 58% of the HIV positive children were in WHO stage three and four of HIV progression and the rest were in stage one and two. It is therefore possible that malnourished HIV positive children had lower CD4 counts compared to malnourished HIV negative

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children. However, even with this possibility there was no significant difference in their growth at one month visit.

Like in other cohort studies, the degree of lost to follow-up is a major potential source of selection bias. In our study, only three respondents were excluded because of incomplete records and all these were HIV negative. However, these three respondents were not different from the rest of the HIV negative children in their baseline characteristics i.e. sex and age. It is therefore unlikely that the exclusion of these respondents affected our findings. The respondents who were not eligible for inclusion in our study were either over or under age, their baseline parameters were not measured or did not come back at the one month follow-up visit or both.

## **6.0 CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS**

### **6.1 Conclusions**

- i. Malnourished HIV positive children 6-59 months had a lower weight gain during follow-up compared to malnourished HIV negative children.
- ii. There was no difference in weight gain velocity between malnourished HIV positive children and malnourished HIV negative children 6-59 months in the first one month after discharge.
- iii. There was no difference in change of weight for height between malnourished HIV positive children and malnourished HIV negative children under five years in the first one month after discharge.

In conclusion, there is no difference in growth between malnourished under five HIV positive children and malnourished under five HIV negative children in the first one month of follow-up after discharge.

### **6.2 Recommendations**

The current Ministry of Health policy on nutritional management of under five malnourished children which does not provide for special management of malnourished HIV positive children during follow-up should be maintained.

In light of the short period of follow-up in this study, a large concurrent cohort study with a longer duration of follow-up needs to be carried out to determine the effect of HIV on growth of malnourished children so as to inform policy on management of malnutrition in HIV infected children.

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## REFERENCES

1. UNAIDS. and WHO., *AIDS epidemic up-date: Special report on AIDS*. WHO library cataloguing-in-publication data, 2006.
2. MOH, U., *Nutritional Care and Support for People Living with HIV/AIDS in Uganda: Guidelines for Service Providers*. MOH Uganda, Kampala, 1999.
3. UDHS, *Uganda Demographic Health Survey*. 2000/2001, UBOS: Kampala, Uganda.
4. Bisase H., Musoke P., and Ndugwa C M. *Mortality in Ugandan children admitted in Mulago Hospital, Pediatric wards*. in *UNAPASA Conference*. 1996. Kampala, Uganda.
5. Bachou Hanifa., *Malnutrition in children admitted to Mulago Hospital Uganda: Prevalence, mortality and associated factors*. Thesis for Master of Philosophy. 2004, University of Bergen, Norway.
6. Philips K and Matheny AP, *Quantitative genetic analysis of longitudinal trends in height: preliminary results from the Louisville Twin Study*. *Acta Genet. Med. Gemellol.*, 1990. **39**: p. 143-163.
7. Smith DW, Truog W, and Rogers J. E, *Shifting linear growth during infancy: illustration of genetic factors in growth from fetal life through infancy*. *J. Pediatr*, 1976. **89**: p. 225-230.
8. Chintu C., Zumla A., and Mwansa-Salam P et. al., *Impact of Human Immunodeficiency virus type 1 on common paediatric illnesses in Zambia*. *Journal of Tropical Paediatrics*, December 1995. **41**.
9. Mgone C., Mhalu F., and Shao et. al., *Prevalence of HIV and symptomatology of AIDS in severely malnourished children in Dar es Salaam Tanzania*. *Journal of Acquired Deficiency Syndrome*, 1991. **4**: p. 910-1355.
10. Ticklay I M H., Nathoo K J., and Siziya S et. al., *HIV infection in malnourished children in Harare Zimbabwe*. *East African Medical Journal*, 1997. **74**(4).

11. Tumbu Paul., *Outcomes of severely malnourished HIV infected and uninfected children admitted at Mwanamugimu Nutrition Unit, Mulago Hospital. Thesis for Master of Medicine.* 2005, Makerere University: Kampala, Uganda.
12. Lepage P, M.P., Hitimana D.-G. ;Bazubagira A. ;Van Goethm C. ;Simonon A. ;Karita E. ;Dequae-Merchand L.;Van DE Perre P. ;Dabis F.; , *Growth of human immunodeficiency type 1-infected and uninfected children : a prospective cohort study in Kigali, Rwanda, 1988 to 1993* Paediatric Infectious Diseases Journal, 1996.
13. Tracie LM and Summet G, *Gastrointestinal and nutritional problems in Pediatric HIV disease.* In: Pizzo AP, Wilfert CM. *Pediatric AIDS*, Baltimore, Lippincott Williams & Wilkins, 1998.
14. Nambuya Harriet., *Comparison of the efficacy of a semi-solid ready to use therapeutic food with a liquid milk-based diet for rehabilitation of severely malnourished children in Mulago Hospital. Thesis for Master of Medicine (Pediatrics and Public Health).* 2005, Makerere University: Kampala,Uganda.
15. WHO., *Childhood nutrition and progress in implementing the International Code of Marketing of Breast-milk Substitutes: Report by the Secretariat: FIFTY-FIFTH WORLD HEALTH ASSEMBLY.* 2002.
16. Mulago., *Inpatient Activity Statistics. Edited by: Records office.* Kampala, Mulago Hospital Complex, 2002.
17. WHO, *Management of severe malnutrition: A manual for physicians and other senior health workers.* Geneva, 1999.
18. Hennart P., Beghin D., and Bossuyt M., *Long time follow-up of severe protein energy malnutrition in Eastern Zaire.* Journal of Tropical Paediatrics, 1987. **33**: p. 10-12.

19. Van Roosmalen-Wiebenga M W., Kusin J A., and Dewith C., *Nutritional rehabilitation in Hospital- a waste of time and money? Evaluation of nutrition rehabilitation in a rural District in Southwest Tanzania*. Journal of Tropical Paediatrics, 1987. **33**: p. 24-28.
20. Mahin S., Gonzalo D., and Habib H., *The fate of the hospitalised malnourished child in Iran*. Journal of tropical Paediatrics; Envir. Child Health, 1973: p. 28-29.
21. World-Bank, *World Development Report 1993*, in New York: Oxford University Press; 1993. 1993.
22. Martorell R., R. J., and Kaplowitz., *Consequences of stunting in early childhood for adult body size in rural Guatemala*. Ann Nestle, 1990. **48**: p. 85-92.
23. Golden M., *Is complete catch-up possible for stunted malnourished children?* Eur J Clin Nutr, 1994. **48**.
24. Golden M., *Treatment of severe malnutrition in refugee camps*. Journal of Tropical Paediatrics, 1999. **45**.
25. Maharaj KB., Bhandari N., and Bahl R., *Management of severely malnourished child: perspective from developing countries*. BMJ, 2003. **326**: p. 146-51.
26. Diop el H I., Briend A., and Samalita Wade et al., *Comparison of efficacy of a solid ready to use food and a liquid, milk-based diet for rehabilitation of severely malnourished children*. American Journal of Clinical Nutrition, 2003. **78**(2): p. 302-307.
27. Pitt J, G.J., Schluchter M, Kovacs A, Cooper E, Hodes D, MacIntosh K, Peavy H and Shearer W, *HIV vertical transmission rate determinations are subject to differing definitions and therefore different rates. The Pediatric Pulmonary and Cardiovascular Complications of Vertically Transmitted HIV Infection Study Group*. Journal of Clinic Epidemiology, 1998. **51**(159–164).
28. UDHS., *Uganda Demographic and Health Survey 2006*, Uganda Bureau of Statistics, Kampala, Uganda. 2006, Macro International Inc. Calverton, Maryland, USA.

29. INDEPTH Network, *An International Network for the Continuous Demographic Evaluation of Populations and Their Health in Developing Countries* 2008.
30. Ticklay I.M, N.K., Siziya S et. al., *HIV infection in malnourished children in Harare Zimbabwe*. East African Medical Journal, 1997. **74**(4).
31. Gaston J, Nesheim S, and Sawyer M. *Prevalence of malnutrition in children infected with HIV*. in *International Conference on AIDS*. 1996. Infectious Disease Program, Atlanta, GA.
32. Ministry of Health Uganda., *Nutritional Care and Support for People Living with HIV/AIDS in Uganda: Guidelines for Service Providers*. Kampala, Uganda, 1999.
33. RCQHC/FANTA., *Handbook: Developing and Applying National Guidelines on Nutrition and HIV/AIDS*. Regional Centre for Quality of Health Care. 2003, Kampala, Uganda.
34. WHO, *Management of severe malnutrition: A manual for physicians and other senior health workers*. 1999, Geneva.
35. Beth Dawson. and Robert G Trapp., *Basic and Clinical Biostatistics*. Lange Medical Books/McGraw. 2000: Hill Medical Publishing Division.
36. Gorstein J, S.K., Yip R, de Onis M, Trowbridge F, Fajans P, Clugston G., *Issues in the assessment of nutrition status using anthropometry*. Bull WHO 1994, 1994. **72**(2): p. 273-83.
37. WHO working group, *Use and interpretation of anthropometric indicators of nutritional status*. Bull WHO, 1986. **64**: p. 929-41.
38. Marie-Louise Newell, M.C.-B., Claire Thorne and Catherine Peckham, *Height, Weight, and Growth in Children Born to Mothers With HIV-1 Infection in Europe. The European Collaborative Study*. Paediatrics: Official journal of the American Academy of Pediatrics., 2002. **111**.
39. Miller TL, E.S., Vasquez I, Orav EJ, *Dietary intake is an important predictor of nutritional status in HIV-infected children*. Paediatric Research, 1997a. **41**.

40. Henderson RA, T.K., Hutton N, Yolken RH and Caballero B, *Serum and plasma markers of nutritional status in children infected with the human immunodeficiency virus*. Journal of the American Dietetic Association, 1997. **97**(1377–1381).
41. Zuin G, C., Fontana M, *Energy and nutrient intakes in HIV-infected children*. Pediatric AIDS and HIV Infection, 1994. **5**(159–161).
42. Stephen M Arpadi. *Growth failure in HIV-infected children. Consultation on Nutrition and HIV/AIDS in Africa: Evidence, lessons and recommendations for action*. 10–13 April 2005. Durban, South Africa.
43. Joyce K. Kikafunda, et al., *Risk Factors for Early Childhood Malnutrition in Uganda*. Pediatrics: Official Journal of the American Academy of Pediatrics, 1998.



**APPENDIX 1: STUDY QUESTIONNAIRE**

Study number \_\_\_\_\_ Research Assistant \_\_\_\_\_

Mwanamugimu Inpatient Number: \_\_\_\_\_

Date of birth of the child \_\_\_\_/\_\_\_\_/\_\_\_\_ Age in complete months \_\_\_\_\_

Date of enrollment on the study (*Date of discharge*) \_\_\_\_/\_\_\_\_/\_\_\_\_

Sex 1.Male 2.Female District of origin \_\_\_\_\_

HIV Status 1.Positive 2.Negative

**Caretaker's particulars**

Age in complete years \_\_\_\_\_

Relationship to the child 1.Mother 2.Father 3.Grandmother 4.Other (specify) \_\_\_\_\_

Highest education attained 1.None 2.Primary 3.Secondary 4.Tertiary

**Symptoms/diagnosis at discharge (enrollment)**

No	Symptoms/diagnosis	Yes	No
1	Diarrhea		
2	Fever		
3	Vomiting		
4	Cough		
5	Difficulty in breathing		
6	Fast breathing		
7	Pneumonia		
8	Convulsions		
9	Others (Specify)		

What was the type of malnutrition at admission? 1. Kwashiorkor 2. Marasmus 3.Both

**Skin rash** 1.None 2.Generalised 3.Localised**Physical examination**

Alert 1.Yes 2.No Oral thrush 1.Yes 2.No Anaemic 1.Yes 2.No

Dehydration status 1.None 2.Moderate 3.Severe

**Feeding related issues**

Was the child still breast feeding at discharge? 1.Yes 2.No

Appetite 1.Poor 2.Good

What is the immunization status of the child? 1.Complete 2.Incomplete 3.Don't know

**Drugs and nutrients given at discharge**

No	Drugs or nutrients	Yes	No
1	Micronutrients Vitamin A		
2	Folic acid		
3	Multivitamins		
4	Anti TB		
5	Anti malarials		
6	Mebendazole		
7	Others (Specify)		

**For HIV Positive children only**

If child is HIV positive, is s/he on HAART? 1.Yes 2.No

Is s/he on cotrimoxazole prophylaxis? 1.Yes 2.No

WHO Stage (Circle) I II III IV

**Anthropometry at discharge/ enrollment**

Weight measurements \_\_\_\_\_ kg Height/length measurements \_\_\_\_\_ cm

Percentage weight for height \_\_\_\_\_%

**Note: This section is filled at 1 month follow-up visit**

One month follow-up visit date \_\_\_/\_\_\_/\_\_\_\_\_

**Symptoms/diagnosis during follow-up period** (tick as applicable and if yes specify duration)

No	Symptom/diagnosis	Yes	No
1	Diarrhea		
2	Fever		
3	Vomiting		
4	Cough		
5	Difficulty in passing urine		
7	Pneumonia		
8	Oral thrush		
9	TB		
10	Others (Specify)		

**Summary at one month follow-up visit**

Weight at 1 month visit \_\_\_\_\_ kg Height/length at 1 month visit \_\_\_\_\_ cm

Percentage weight for height at 1 month visit \_\_\_\_\_%

**APPENDIX 2: COMPOSITION OF F75 AND F100****F75**

Elements	Per litre of F100	Elements	Per litre of F100
Energy	750 kcal	Ac. Pantothenique	3 mg
Proteins	9 g	Vitamin K	40 mg
Lipids	20 g	Sodium	< 150 mg
Vitamin A1	500 µg	Calcium	320 mg
Vitamin D	30 µg	Phosphorous	240 mg
Vitamin E	22 mg	Magnesium	105 mg
Vitamin C	100 mg	Zinc	20.5 mg
Vitamin B1	0.7 mg	Iodine	77 µg
Vitamin B2	2 mg	Potassium	1570 mg
Vitamin B9	350 µg	Pantothenic acid	3 mg
PP	10 mg	Selenium	47 µg
Vitamin B6	0.7 mg	Copper	2.8 mg
Vitamin B12	1 µg	Iron	< 0.1 mg
Biotine	100 µg		

**F100**

Elements	Per litre of F100	Elements	Per litre of F100
Energy	988 kcal	Ac. Pantothenique	5.8 mg
Proteins	> 10% of energy	Vitamin K	29 µg
Lipids	> 45% of energy	Sodium	< 560 mg
Vitamin A	1544 µg	Calcium	579 mg
Vitamin D	29 µg	Phosphore	579 mg
Vitamin E	38.6 mg	Magnesium	154 mg
Vitamin C	96.5 mg	Zinc	21.2 mg
Vitamin B1	0.97 mg	Iodine	135 µg
Vitamin B2	3.1 mg	Potassium	2123 mg
Niacine	9.7 mg	Cuivre	2.7 mg
Vitamin B6	1.2 mg	Selenium	38.6 mg
Ac. Folique	386 µg	Fer	< 0.4 mg
Vitamin B12	3.1 µg		
Biotine	116 µg		

**APPENDIX 3: COMPOSITION OF CSB**

<b>Weekly food basket for children under 5 years</b>				
<b>Commodity</b>	<b>Quantity in gms</b>	<b>Kcal</b>	<b>Protein (g)</b>	<b>Fats (g)</b>
CSB	1600	6080	288	96
Vegetable oil	200	1770	0	200
Sugar	200	800	0	0
<b>Total</b>		<b>8650</b>	<b>288</b>	<b>296</b>
<b>Energy (Kcal)</b>				
		8650	1152	2664
<b>Proportion of energy (%)</b>				
			13.3%	30.8%