KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

KUMASI, GHANA

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH

KNUST

AN ASSESSMENT OF THE EFFECT OF HIV/AIDS ON THE TREATMENT OUTCOME OF SEVERE ACUTE MALNUTRITION IN CHILDREN UNDER 5 YEARS AT THE KOMFO ANOKYE TEACHING HOSPITAL, KUMASI, GHANA

BY

MRS PRISCILLA AITPILLAH (BSc NURSING)

APRIL 2015

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DECLARATION

I, Mrs Priscilla Aitpillah, duly declare that this study was done by me. No portion of the work referred to in this dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institution of learning.

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ABSTRACT

Few studies have reported on nutritional recovery, survival and growth among severely malnourished children with HIV combining both inpatient and community-based nutrition rehabilitations. This study explores treatment outcome in HIV-infected and HIV-uninfected children at the paediatric ward of the Komfo Anokye Teaching Hospital. This is a retrospective case-control study done on the paediatric ward at the Komfo Anokye Teaching Hospital. The main outcome measures were nutritional recovery/death, duration of nutritional recovery and mortality, and anthropometrics.

In the sample of 141 children with severe acute malnutrition (SAM), 36% (n=51) of children were HIV-infected; 64% (90) of children were not HIV-infected. 92.1% (47/51) of HIVinfected children recovered compared with 90.9% (80/88) in HIV-uninfected children (p=1).

Thus children with HIV recovered as frequent as those without HIV (1% point difference, 95% CI, 0.6 to 1.3). Among the HIV-infected children, 8% (4/51) died, compared with 9% (8/88) in HIV-uninfected children (P=1). Children with HIV infection spent an average of 24 ± 7.5 days before discharge from the hospital compared with 20 ± 6.1days in HIV-uninfected children (P<0.005). Children with HIV infection therefore stayed longer before discharge from the hospital than children without HIV infection. HIV-infected children however, had similar weight gain to HIV-uninfected children (5.5 ± 2 vs. 4.8 ± 1.6 respectively, not statistically significant). The conclusion is that HIV infected children with SAM have similar mortality rates compared to HIV-uninfected children with SAM. Among those who survive, however, nutritional recovery is similar in HIV-infected and HIV-uninfected children. It is necessary to integrate HIV services into programmes for nutritional rehabilitation.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS Acquired Immunodeficiency Syndrome

ART Anti-retroviral Treatment

BMI Body Mass Index

CD4 Main targets cells for HIV. It decreases during HIV infection. A measure of the strength of the immune system.

CDC Centres for Disease Control and Prevention

CTC Community-Based Therapeutic Care

DTC Diagnostic HIV Testing and Counselling

HAZ Height- or length-for-age Z -score

HIV Human immunodeficiency virus

KATH Komfo Anokye Teaching Hospital

MDG Millennium Development Goals

MOH/GHS Ministry Of Health/Ghana Health Service

MTCT Mother-To-Child Transmission of HIV

MUAC Mid Upper Arm Circumference

NRU Nutrition Rehabilitation Unit (inpatient)

PCR Polymerase chain reaction

PEM Protein Energy Malnutrition

PiTC Provider-Initiated Testing and Counselling

PLWHA People living with HIV/AIDS

PMTCT Prevention of Mother-To-Child Transmission of HIV

SAM Severe Acute Malnutrition

SD Standard deviation

UNAIDS The Joint United Nations Programme on HIV/AIDS

UNICEF United Nations Children's Fund

VCT Voluntary HIV Counselling and Testing

WFP World Food Programme

WHO World Health Organization

WHZ Weight-for-age Z –score

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CHAPTER ONE
GENERAL INTRODUCTION

1.1. Background to the Study

The necessity of adequate nutrition for early childhood development cannot be overemphasized. This is because the provisions of ample nutrition for infants facilitate healthy growth, proper organ formation and function, a strong immune system, as well as neurological and cognitive development (Black *et al*., 2010). Lui *et al* (2012) opine that economic growth and human development require well- nourished populations who can learn new skills, think critically and contribute to their communities. The cognition of children is therefore shaped extensively one way or the other by the extent to which they are fed or have received adequate nutrition for subsequent development. Rice *et al* (2000) estimated that more than one-third of under-five deaths are attributable to under-nutrition.

Nutrition has increasingly been recognized as a basic pillar for social and economic development. The reduction of infant and young child malnutrition is essential to the achievement of the Millennium Development Goals (MDGs) — particularly those related to the eradication of extreme poverty and hunger (MDG 1). The seriousness of the global community towards addressing child developmental challenges is further articulated in efforts in ensuring child survival as well as reducing child mortality (MDG 4).

The relationship between early child nutrition and almost all the millennium development goals is explicit. UNICEF (2008) reports that, severe acute malnutrition leads among the causes of morbidity and mortality in children under-five years' of age group in developing countries. The report posits that malnutrition contributes over 50% of the 10 - 11 million deaths from preventable causes, which occur annually in this age group.

In developing countries with Ghana as an example, an estimated 230 million (39%) children under the age of five are chronically malnourished and about 54% of deaths among children

younger than five are associated with malnutrition. This development puts younger children in a very vulnerable situation. The death rate for malnourished children under-five years in many developing countries is alarming. These deaths often happen at home without care, and even when hospital care is provided, the death toll for malnourished children is very high, ranging between 30-50% (WHO Fact sheet report (2012). According to the WHO Fact sheet report (2012), globally about a third of all child deaths are linked to malnutrition. In subSaharan Africa alone, there are 137 million children under the age of five, of which 12.3 million are wasted.

Malnutrition is indeed widespread in developing countries like Ghana with a prevalence of 21.2%. This high prevalence rate notwithstanding, most malnourished children miss the opportunity for being diagnosed in clinical settings (Antwi, 2008). There has however been a shift in the trend in sub-Saharan Africa in terms of the epidemiology of severe malnutrition.

The shift is now towards the point where an increasing percentage of children requiring hospitalization comprise those who are HIV-infected or HIV-exposed with high case-fatality rates. This shift emanates from the high percentages of HIV infected children, which is still as high as 20–50% ((Heikens *et al*., 2008). In addition to this, the management of severe wasting disease and malnutrition in children— particularly in those infected with HIV remains poorly addressed. A vast difference exists between the population of HIV-infected malnourished children and the uninfected population for which international malnutrition guidelines were originally developed (WHO 1999). The reduction of infant and young child malnutrition is essential to the achievement of the Millennium Development Goals (MDGs 1 & 4). In terms of country specific efforts to the achievement of the millennium development goals in Ghana in the last decade, despite increasing investments in health, the country has not achieved envisaged health outcomes. The 1993, 1998 and 2003 Ghana Demographic Health Survey

(DHS) surveys provide substantial evidence that the mortality decline in Ghana has stagnated at very high levels of mortality.

In the last couple of years, under-five mortality is slightly increasing. Malnutrition in Ghana is most prevalent in the form of Protein Energy Malnutrition (PEM), which results in growth retardation and underweight. About 54% of all deaths beyond early infancy are associated with PEM, making this the single greatest cause of child mortality in Ghana (WHO, 2007a). The difficulty as a country has been how to manage children with HIV as against those without HIV, on malnutrition treatment interventions. Currently as of early 2013, there are very few evidence-based recommendations for managing children with severe acute malnutrition with HIV infection as compared to children with SAM without HIV infection (Bahwere *et al* 2008). However, drug toxicity, antimicrobial use, fungal infections and persistent diarrhoea are likely to require extra consideration amongst HIV-infected children with SAM. This development calls for further attention and examination of the differentials in terms of the treatment outcomes for severe acute malnourished HIV and non-HIV malnourished children.

1.2. Problem Statement

There exists ample evidence to show high mortality rates among children with severe acute malnutrition. Becquet *et al* (2007) indicated that, there are potential interventions to reduce mortality among children with SAM in HIV-endemic settings. The impact on children with SAM in terms of nutritional recovery is scanty despite the ample literature on the prevalence of HIV among children with SAM. Information pertaining to the association between risk factors for increased fatality among severely malnourished children during periods of HIV pandemic remains sketchy in the sub- Saharan Africa with little research on nutritional recovery.

The United Nations (2004), Brown (2003) and Blossner (2003) report that Under-nutrition is associated with >50% of all childhood mortality in developing countries with the risk of mortality being 5–8 fold among severely malnourished children compared to moderately malnourished children. This finding depicts the seriousness of the relationship that exists between acute malnutrition and child survival. Because of the high risk of death, most severely malnourished children are managed in hospital. Several factors contribute to the high case fatality in children hospitalized with severe malnutrition.

These factors range from acute bacterial infections, electrolyte imbalance to micronutrient deficiencies. Although prompt and appropriate treatment of severely malnourished children should reduce case fatality, empirical evidence to demonstrate a reduction of the case fatalities in any hospital in sub-Saharan Africa is absent to meet the acceptable international level of <5%. The difference observed might be in the prevalence of HIV/AIDS. Information on the effect of the added burden of HIV infection on the clinical features and cellular immunity of severely malnourished children is very limited. More to the problem is the fact that few studies, have reported on nutritional recovery, survival and growth among severely malnourished children with HIV. Though Sandige *et al* (2004) and Ndekha *et al* (2005) in studies of children with SAM treated as outpatients with ready-to-use therapeutic food in Malawi, reported nutritional recovery, but that of differentials in SAM HIV children is yet to be established. In the first study in Malawi, nutritional recovery, as defined by achieving a weight for height Z score (WHZ) > −0.5, was 78% (202/260) among the children overall and 59% (46/78) among HIV-infected children (Ndekha *et al*., 2005). In the second study, 56% (52/93) of HIV-infected children achieved nutritional recovery, defined as 100% weight for height index (W/H). However, Sandige *et al* (2004) reported a significantly slower weight gain in HIV-infected children compared with HIV-uninfected children (mean (SD) 3.6 (4.7) g/kg/d vs. 5.6 (4.0)

g/kg/d, p<0.001). These two studies however, do not give a complete picture of nutritional recovery in HIV.

The defect with these findings is that children were recruited after a period of hospital stabilization. In addition, mortality was not described during this period. In Ghana, paediatric anti-retroviral drugs (ARV) are becoming increasingly available. This calls for the need to develop a greater understanding of the impact of HIV on nutritional rehabilitation of SAM. Ghana's effort in meeting the Millennium Development Goals 4 and 6 (Combatting HIV infection and other diseases) is greatly affected by the success of malnourished treatment interventions. Any mediating factor like HIV that has a potential for influencing the outcome of the malnourished treatment interventions should be identified through research. In the quest to respond to the additional challenge of severe malnutrition in the context of HIV infection, the researcher seeks to find answers to the following research questions:

1. What is the incidence level of HIV/AIDS in children with severe acute malnutrition at KATH?
2. How long does it take the treatment of children with severe acute malnutrition to recover or die on admission?
3. Are there any differences in the treatment outcomes of severe acute malnutrition in HIV/AIDS children from non- HIV/AIDS children?

1.3. Research Objective

The study is informed by its general and specific objective.

1.3.1. General Objective

Generally the study sought to:

Determine the treatment outcome of severe acute malnutrition in children with HIV/AIDS at the Komfo Anokye Hospital.

1.3.2. Specific Objectives

The specific objectives of the study were:

1. To determine the incidence of HIV/AIDS in children with severe acute malnutrition.
2. To identify the time to recovery or time to death in the treatment of children with severe acute malnutrition.
3. To compare the treatment outcomes of severe acute malnutrition in HIV/AIDS children with non- HIV/AIDS children at Komfo Anokye Hospital.

1.4. Hypothesis

This study is underpinned by the following hypothesis:

Ho: There is no difference between the treatment outcome for SAM children with HIV and those without HIV

Ha: There is a significant difference between the treatment outcome for SAM children with HIV and SAM children without HIV.

1.5. Rationale of Study/Justification

The epidemiology of severe malnutrition in sub-Saharan Africa, including Ghana has shifted to one where a growing percentage of children requiring hospitalization are composed of those who are HIV infected. This new development has necessitated that extra attention is given to children particularly those with HIV infection since management of severe wasting disease and malnutrition in children have received less attention.

The international malnutrition guideline was originally developed for children without HIV. This research is justified on the basis that it will offer an empirical basis for ascertaining the variations in nutritional outcome with respect to HIV SAM and non- HIV SAM children. The study will offer clinicians and nutritional health promoters the opportunity in identifying the special needs that is required for the different groups. This research constitutes an area that is dearth of empirical knowledge and has not received much attention from researchers. The findings of the study will therefore provide a reference point around which future national research could be conducted.

1.6. Scope of the Study

The study examined the effect HIV has on the nutritional outcome of children with severe acute malnutrition. Geographically, the study was limited to the Paediatric department of the Komfo Anokye Teaching Hospital in Kumasi and specifically Ward B4 where cases of SAM are admitted and managed. The contextual scope of the study was to detail the incidence of HIV/AIDS in children with severe acute malnutrition. In addition, the time to recovery in the treatment of children with severe acute malnutrition and the time to death in the treatment of children with severe acute malnutrition were examined. The researcher looked into the treatment outcomes of severe acute malnutrition in children with HIV/AIDS compared with children without HIV/AIDS.

1.7. Organization of the Study

Chapter one provides an overview of the entire research work. The chapter introduces the background of the study, the problem statement, leading research questions, objectives of the study, Research hypothesis, justification, contextual and geographical scope and the organization of the study.

Chapter two reviews literature on the incidence and prevalence of HIV/AIDS in children with severe acute malnutrition, international and local context as well as related causal factors. In this part the related literature was reviewed, theoretical framework and conceptual issues are discussed to establish the linkages between HIV/AIDS and SAM.

Chapter three considers the methodology, which discusses the methodological foundation and data analysis techniques that were be used to analyse the problems stated to achieve the objective. This includes sampling, the methods used for data collection, and procedure for data analysis. The study area is also introduced in this chapter.

Chapter four is devoted to presentation of results. Summary statistics of the variables used in the study are presented and discussed. The chapter five presents the discussion of the results of the study.

The chapter six of the study covers the summary of key findings, conclusions and recommendations for policy implications.

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CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

Severe Acute Malnourishment (SAM) has become an issue of much concern over the past one decade especially with those who are malnourished and have been crippled with HIV/AIDS around the globe. HIV and malnutrition overlap and interact, thus, are multirelated (Koethe and Heimburger, 2010). There is high HIV prevalence among children with severe malnutrition, and mortality in these children is approximately three-fold higher than in HIV-uninfected children with severe malnutrition(Chinkhumba *et al*., 2008).

2.2. HIV and Opportunistic Infection

Three million children have HIV and AIDS; with 800 000 children becoming newly infected yearly and 500 000 dying from AIDS related illnesses each year. The epidemic is the greatest in Sub-Saharan Africa (Tomkins 2005). Complications of paediatric HIV infection are usually seen in growth failure and finally more serious malnutrition. Half of the children presenting with severe malnutrition are HIV infected. Globally, all countries are trying to achieve Millennium Development Goals four and six (MDGs 4 and 6) that are to promote child health and to combat HIV and AIDS respectively. Anti-retroviral drugs (ARVs) are becoming more available and therefore severe malnutrition in the context of HIV is becoming increasingly important.

The need for malnourished HIV infected children to be treated in facilities is increasing by the day (Heikens *et al*., 2008). Evidence in sub-Saharan countries shows that HIV infected children can recover their nutritional status when given the correct treatment for severe acute malnutrition (SAM) without ARVs but their recovery is slower than that of uninfected children (Collins *et al*., 2006). Globally, malnutrition contributes to more than one third of all childhood deaths- Neonatal 37%, acute respiratory infections 17%, HIV/AIDS 2%, Measles 4%, Malaria

7%, Diarrhoea 16%, injuries 4% and other 13% World Health Organization (WHO), 2007b). In developing countries, the severity of malnutrition in HIV infected children is greater and more severe than in uninfected children.

The role of anti-retroviral therapy (ART) in achieving better nutritional status is vital (Heikens *et al*., 2008). Opportunistic infections or malnutrition is the cause of 75% of the deaths among HIV infected children before the age of five years. In Sub-Saharan Africa, the mortality rate of malnourished HIV infected children is three times higher than in uninfected children. HIV has changed the epidemiology, clinical presentation, pathophysiology, case management and survival of malnourished children. Even with the WHO guidelines, case fatality rates are at 20-50%. More and more HIV infected children are being admitted to the hospital (Heikens *et al*., 2008).

A study done by Bachou *et al*., (2006) showed that within a group of 315 malnourished children, 119 (38%) were female with a median age of 17 months while only 3% were below the age of six months. They also showed a high prevalence of infections (26%) and bacteraemia (18%). The HIV infected children were more likely to have persistent diarrhoea than the HIV uninfected malnourished children. Children aged three to five years stretching over to six years old are often admitted for persistent diarrhoea with a high case fatality rate and poor prognosis even with management according to guidelines (Heikens *et al*., 2008). HIV infected malnourished children are either perinatally infected, underfed or both (Heikens *et al*., 2008; Winter, 1996). HIV infected children are usually present in families that are poor and with food insecurity (Heikens *et al*., 2008).

Infants of HIV infected mothers have a low weight gain in the first four months of life and then a decrease in height is also observed. Even uninfected children are also affected in situations

where mothers and caretakers are experiencing chronic diseases and high mortality (Heikens *et al*., 2008). During breastfeeding, babies may be exposed to the HIV virus from

HIV infected mothers for prolonged periods (Kalanda *et al*., 2005) and Mother To Child Transmission (MTCT) rates are further influenced by nutritional status and dietary intake (Tomkins, 2005, p.486). It has been suggested that mothers should be tested to know their HIV status. This requires an Opt-out testing despite the challenges associated with it. According to Asante (2007), the difficulty with mother opting out for testing is due to the risks of stigma and discrimination. As a result, though parents may allow their children to undergo voluntary testing, Thurstans, *et al*. (2008), reports in a study exploring HIV and SAM at national level in Malawi that while 523 (91.7%) of parents consented for their malnourished children to be tested, a minimum 368 (70.6%) offered themselves to be personally tested for HIV.

The lower weight gain in HIV infected children can often be ascribed to the presence of infectious diseases in such children (WHO, 2007a). Infections can be viral, bacterial, parasitic, fungal and other opportunistic infections (Fenton and Silverman, 2008). The infections also include TB, pneumonia, skin infections and oral thrush. All of these contribute to the development of malnutrition (Torún, 2006; Collins *et al*., 2006; Heikens *et al*., 2008).

When children have lower respiratory tract infections, TB is 22 times more prevalent in HIV infected children than uninfected children (Heikens *et al*., 2008). Since nutrition and HIV are closely linked, weight loss and wasting are problems associated with inadequate intake due to anorexia, mal-absorption, digestion, metabolic irregularities, and increased excretion of nutrients through vomiting and decreased absorption. Adding to how nutrition affects weight loss Bahwere *et al* (2008) identified that the MUAC level among children with HIV infection was low. In addition, catabolic processes, abnormal energy utilization, increased requirements,

uncontrolled opportunistic infections and/or a lack of physical activity are also involved in weight loss and wasting (Torún, 2006, p.883; Fenton and Silverman, 2008, p.1008).

Decreased oral intake can also occur due to medications, depression, infection, nausea, vomiting, diarrhoea, dyspnoea, fatigue, neurological disease, fever, pain, dementia and despair. Low oral intake is also caused by problems in the mouth and oesophagus, such as thrush and oral herpes and dyspepsia due to zinc deficiency. The reduced intake causes a deficiency of energy needed for resting energy expenditure. Other deficiencies due to low food intake in asymptomatic HIV infected children include reduced plasma levels of retinol, beta-carotene, folate and iron, which becomes more severe when clinical AIDS develops
(Tomkins, 2005, p.486). In HIV infected children there is low serum levels of Vitamin A, C, B6, B12 and E, beta-carotene, selenium, zinc, copper and iron. Vitamin A deficiency is associated with a higher risk of HIV infection and higher risk of MTCT. Deficiencies of copper, zinc, iron, selenium, magnesium, folic acid, vitamin A, C. B6, B12, beta-carotene and vitamin E lead to a higher risk for opportunistic infections and progression of AIDS, which can lead to death (Drain *et al*., 2007; Tang *et al*., 2005).

The gastrointestinal (GI) tract is one of the most important organs in the acquisition of HIV. When children become sick due to HIV infection, it leads to mal-absorption resulting from epithelial cell dysfunction and bacterial overgrowth, diarrhoea, and infections. Malabsorption causes loose stools, diarrhoea or vomiting, which can be caused by medications, a developed intolerance to lactose, fat or gluten (Fenton and Silverman, 2008, p.1008) and small intestinal damage. The immune changes seen in AIDS and PEM are similar. Deficiencies of protein, calcium, copper, zinc, selenium, and iron, essential fatty acids, pyridoxine, folate and Vitamins A, C, E all interfere with immune function. Direct and indirect mechanisms are responsible for the impact of nutrition on HIV.

Nutrition plays a direct role in immune-cell triggering, interaction and expression. Indirectly nutrition also plays a role in deoxyribonucleic acid and protein synthesis as well as the physiologic integrity of cell tissues, organ systems and lymphoid tissues (Fenton and Silverman, 2008).

HIV can lead to food insecurity through the loss of labour, increased need for health care and funerals, low household agricultural production due to sick household members not able to work, diminished ability to care for young children and vulnerable individuals and the loss of wealth. Therefore, there is a relationship between food insecurity and an increase in the HIV epidemic (Tang *et al*., 2005).

2.2.1. Incidence and Prevalence Of HIV /Aids In Children With Severe Acute Malnutrition

HIV is a virus that attacks and impairs the body's natural defence system against disease and infection. An HIV-infected person's defence system thus becomes vulnerable over time to other viruses that further weaken the body and cause symptoms and illnesses like diarrhoea, fever, vomiting, thrush, or anaemia (Seumo-Fosso *et al*., 2004). These kinds of ailments give rise to depletion of individual nutrients that are implicated in malnutrition, including vitamins A, E, C, B6 and B12, as well as zinc (Zn), Selenium (Se) and iron (Fe) (Chandra, 1999; Semba *et al*., 2010).

Fergusson *et al* (2009) in a Prospective cohort study of the Lilongwe district in Malawi identified in a sample study of 454 children with severe acute malnutrition (SAM), that 17.4% (n = 79) of children were HIV infected and that out of the total HIV-infected children, 35.4% (28/79) died, compared with 10.4% (39/375) in HIV-uninfected children (p, 0.001). This proves that in terms of mortality among children with SAM, those with HIV infection died earlier than those without. The relationship between HIV and malnutrition results in a deleterious cycle for the immune system.

Nutrient depletion leading to generalized malnutrition causes widespread atrophy of lymphoid tissues, the greatest of which is in the T-lymphocyte areas. In the opinion of Isanaka (2009) such atrophy results in immunosuppressive effects including a decrease in the number and function of T-helper (CD4) cells, an inverted T-helper/T-suppressor (CD4:CD8) ratio, and loss of the ability of killer lymphocytes to recognize and destroy foreign tissues.
(Heikens *et al*., 2008; WHO 2006).

In other words, the bodies of those with malnutrition have fewer and less active Tlymphocytes that are needed to enhance the immune response to infection. Malnutrition is also associated with the presence of many of other types of lymphocytes (T-suppressor cells) that normally suppress the immune system to keep it in balance. Decreased immunity may lead to increased susceptibility to infections, which lead to increased nutrient requirements. If such requirements are not sufficiently met, the result is even more malnutrition, and increased potential for secondary infections by opportunistic agents (Seumo-Fosso *et al*., 2004).

Rapid diagnostic tests for HIV, however, can give false positive results in children <18 months due to the presence of maternal HIV antibodies taking some time to clear. Alternatives are however needed for definitive diagnosis.

Currently, PCR (Polymerase chain reaction) detection of HIV is the recommended method for children <18 months. Studies in which majority of HIV-infected children have severe immune suppression and poor nutritional status at presentation, consistently report 5–10% early mortality among HIV-infected children starting anti-retroviral therapy (ART). (Puthanakit *et al*., 2007; Sutcliffe *et al*., 2008). Global statistics for 2007 on HIV/AIDS shows that approximately 2.5 million people were newly infected and over 2.1 million people died of the disease.

The number of newly infected continues to increase daily (up to 1500). Africa has the highest HIV prevalence rates in the world ranging from < 0.1%-28% with the sub-Saharan Africa being the worst hit region with AIDS as the leading cause of death in the region (UNAIDS, 2008). Malnutrition and HIV/AIDS are multi-related with malnourished children being prone to HIV infection as compared to their counterparts who are well nourished (Fergusson and Tomkins, 2009). An estimated 19 million children are severely wasted in developing countries—malnutrition is responsible for 11% of the total global disease burden and 35% of child deaths worldwide (Thurstans *et al*., 2008). In some regions, notably sub-Saharan Africa, human immunodeficiency virus (HIV) infection poses an added challenge to the care of malnourished children. While the clinical context and interventions for many common causes of childhood mortality worldwide have been addressed over the last decade, the management of severe wasting disease and malnutrition in children—particularly in those infected with HIV — remains poorly addressed (Hesseling *et al*., 2005). This population of HIV infected malnourished children are in many ways very different from the uninfected population for which international malnutrition guidelines (WHO 2005) were originally developed.

In sub-Saharan Africa, the epidemiology of severe malnutrition has shifted to one where an increasing percentage of children requiring hospitalization is composed of those who are HIV infected or HIV exposed with case-fatality rates still as high as 20–50% (Heikens *et al*., 2008). Researches of diverse kinds reveal that individuals who are severely malnourished [body mass index (BMI)<16.0 kg/ square meter] have been found to have six times higher risks of dying in the first 3 months than those with a normal nutritional status (Zachariah *et al*., 2006).

2.3. Malnutrition and HIV: A Vicious Cycle

Nutrition and HIV are strongly related to each other since any immune impairment as a result of HIV/AIDS leads to malnutrition and malnutrition leads to immune impairment. This worsens the effect of HIV and contributes to more rapid progression to AIDS (Cambodia, 2013; Colecraft, 2008; Mehta and Fawzi, 2007; Oguntibeju *et al*., 2007; Suttajit, 2007). Micro nutrient deficiencies as associated with HIV vary across populations and according to disease stage; are associated with an accelerated progression of HIV infection to AIDS; and are predictive of AIDS -related mortality. Malnutrition contributes to about 5.6 million out of 10 million child deaths per year, with severe malnutrition contributing to about 1.5 million of these deaths (Heikens *et al*., 2008). The nutritional status of children is the best indicator of the wellbeing of children. The different causes of malnutrition are interlinked and these include immediate causes, underlying causes and basic causes (UNICEF, 2004). All these factors operate together and not independently (Williams, 2005).

The AIDS virus acts by replicating inside the white blood cells from the point of infection, window period, through sero-conversion to asymptomatic and symptomatic phases. However preventing severe infection, the immune system plays vital role in this respect. The CD4 cells are seen as critical to the immune system. Both the immune system and the levels of nutrients correlate with the progression of the disease. This implies that malnutrition results in increased replication of HIV and the former is a result of HIV itself. Bachou H. *et al* (2006) report in a study in Uganda that CD4% was low in HIV-infected children with SAM. Adding to that Chinkhumba J. *et al* (2008) identified that low CD4% is linked with increased risk of mortality. To Hughes *et al* (2009) in a study in Zambia, CD4 count examined remained low in all HIV-infected children with SAM, even with apparent nutritional recovery. Due to increased basal metabolic rate, which attacks the HIV viral infection in acute cases, the body mobilizes fats

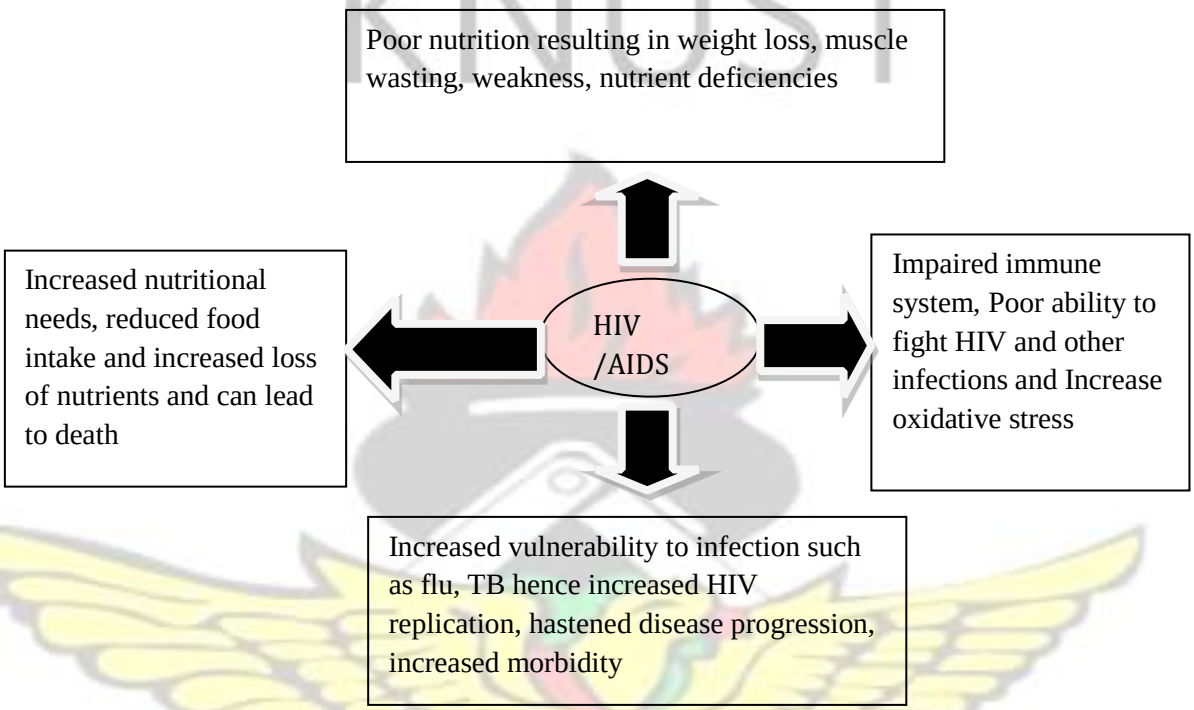
and proteins later on resulting in weight loss, muscle wasting, weakness and nutrient deficiencies. In advanced stages, opportunistic infections that interfere with ingestion, digestion and absorption (i.e. mouth sores) and necrosis of the gastro intestinal tract set in.

Poor nutrient absorption prevents the body from using the nutrients provided by foods and contributes to energy and nutrient losses, which will increasingly hamper the capacity of people living with HIV/AIDS to meet their increased nutritional needs. If mal-absorption of nutrients is not properly addressed, the deficit in energy and nutrients will increase and further weaken the person and their immune system and speed up the progression of the disease. According to Mukhopadhyay C. *et al* (2007) studies in Zambia, Uganda, Thailand and Nepal report HIV infection as being associated with pathogens that are not easily treated as accompanied with prolonged diarrhoea.

The relationship between HIV/AIDS and malnutrition is a classic example of the vicious cycle of immune dysfunction and infectious diseases. There exist variations in terms of HIV prevalence and SAM. Studies conducted by Akenami *et al* (1997) and Fergusson (2009) all demonstrate high rates of HIV among children with SAM.

On the contrary research conducted by Bahwere (2008) at the community level depicts a low rate of HIV among children with SAM. This poses the difficult challenge of generalizing the relationship between HIV and SAM. In all these studies the relationship between HIV status and nutritional recovery is not detailed extensively. As illustrated in figure 1 below, malnutrition can weaken the immune system and increase vulnerability to infections and may speed up the progression of HIV disease.

Figure 1 The Vicious Cycle of Malnutrition and HIV



Source: Author's Construct, (2013) as adapted from FANTA (2004).

2.3.1. Severe Acute Malnourishment and HIV/AIDS.

Koethe, *et al* (2010) asserts that HIV contributes to malnutrition in diverse ways. This infection can indirectly or directly lead to decreased caloric intake, increased loss of nutrients, and increased use of energy. Factors that contribute to malnutrition in HIV infected individuals include but not limited to the following: metabolic alterations, infections, fever, gastrointestinal changes and illness, developmental/neurological problems, and economic and psychological issues.

In the opinion of Magadi (2011) HIV infected children in sub-Saharan Africa are significantly more likely to be stunted, wasted, and underweight. HIV also affects the lean body or muscle

mass more aggressively than some other infections, resulting in a disproportionate loss of muscle as compared with the development of malnutrition. Since an increased production of cytokines in HIV, infection may also contribute to wasting in HIV infection.

Sauvageot *et al* (2010) reiterate the commonness of malnutrition in HIV-infected children for which reason their treatment have to be done jointly. Any infection, and HIV infection in particular, alters the metabolism of energy, carbohydrates, fats, proteins, vitamins, and minerals, increasing the body's need for these nutrients. Fever may increase protein utilization and increases calorie needs by 12% for each degree Celsius above normal and 7% for each degree Fahrenheit above normal. Though there is some controversy, it is thought that HIV infection may increase resting energy expenditure (the amount of energy that the body uses to run basic cell and tissue functions at rest), which could lead to wasting. (Maitland *et al*., 2006).

Akech, *et al* (2010) reporting on their study of Phase II trial of isotonic fluid resuscitation in Kenyan children with severe malnutrition and hypervolemia, found that in such instance where resting energy is expended leading to severe wasting, there could be difficulty in treating children with SAM.

The interaction of HIV with the GI tract can profoundly affect nutritional status. Diarrhoea increases caloric needs by 25% and often leads to a decreased oral intake. Mal-absorption, the inability of the body to absorb nutrients from the GI tract, may be associated with diarrhoea or occur without diarrhoea because of metabolic changes associated with HIV (Mor and Tzipori, 2008). It can lead to vitamin, mineral, protein, fat, and carbohydrate losses as well as a decrease in oral intake.

Dehydration from diarrhoea may result in an acute loss of weight from water loss and can be a life-threatening complication of diarrhoea, which calls for recommendation of the treatment of dehydration. Severe oral candidiasis (yeast), oesophageal candidiasis, herpes

gingivostomatitis, viral esophagitis, and gastritis can make eating difficult and painful, leading to decreased oral intake or feeding refusal, nausea and vomiting caused by drugs, infection, and/or illness can result in poor oral intake, dehydration, and loss of nutrients.

Children and adults with HIV/AIDS can develop feeding problems, often due to neurological deterioration related to HIV infection, leading to inadequate intake of nutrients. Infants with HIV can have a weak suckling reflex, resulting in inadequate intake of breast milk or formula. Older children may develop poor chewing and feeding skills. Difficulty in swallowing can as well lead to poor oral intake or refusal to eat. The unfortunate aspect of this development is that the metabolic and nutritional needs of HIV-infected children are not well known as reported by Mody *et al*.; and Musoke and Fergusson (2014; 2011).

Again, the risk of aspiration and pneumonia, which is usually common in infants, can also bring about swallowing problems leading to FTT (failure To Thrive). Economic issues resulting in inadequate nutritional intake as required by the body are frequent contributors to malnutrition in many settings. These issues include a limited food supply, loss of household income or livelihood (such as farming) due to illness, and limited cooking and storage facilities. HIV-infected adults may be too ill or uninterested to care for themselves and their children. Depression in an adult or child can also lead to decreased appetite and poor nutrient intake. (Trehan *et al*., 2012). Malnutrition can be caused either by its immediate, underlying or basic causes.

2.3.2. Immediate Causes of Malnutrition

The immediate causes of malnutrition especially in children according to the UNICEF (2004) are insufficient diet as well as stress, trauma, disease (severe or frequent infections) and poor psychosocial care. Insufficient dietary intake may refer to poor breastfeeding practices, early weaning, delayed introduction of complementary foods and insufficient protein in the diet.

The inadequate intake can also be linked to neglect and abuse (UNICEF, 2004; Williams, 2005).

2.3.2.1. Insufficient Diet

Inadequate dietary intake and poor nutritional status go hand in hand. It is uncommon for well-nourished children to die from diarrhoea, therefore maintaining a good nutritional status can help with the improvement of child survival (Jackson *et al*., 2006). Some factors contributing to the development of protein-energy-malnutrition (PEM) include socio-cultural practices that lead to the exclusion of rich sources of protein, minerals and vitamins from certain foods due to food taboos, food and dietary fads and migration from rural areas to urban slums (Piercecchi-Marti *et al*., 2006). Dietary choices are also influenced by parents' nutritional ignorance, preference for alternative foods and true or perceived food allergies (Katz *et al*., 2005).

Malnutrition can also develop due to neglect, abnormal mealtimes with a caregiver or parent or insufficient quantities of food (because of insufficient parental knowledge, poor appetite in the child or neglect, physical or emotional abuse") (Duggan and Golden, 2005). In certain instances, some mother's may restrict their ward's food intake. This is either because the mother did not want the child or because a second child is born and there isn't sufficient money to buy food for the expanding family (Piercecchi-Marti *et al*., 2006).

In the normal circumstances when income decreases, the quality and quantity of food is also likely to be affected. Evidence shows that, families who are challenged with the issue of unemployment and low income-earning end up enjoying cheaper food, which is less nutritious, leading to weight loss and malnutrition (UNICEF, 2009b).

As animal source of protein are usually more expensive, children's intake of proteins and nutrients from these groups decreases with poverty (Christiaensen and Alderman, 2004).

Malnutrition again, develops when the food ingested does not meet the high protein and energy needs of the child (Piercecchi-Marti *et al*., 2006).

Globally, the practice of exclusive breastfeeding is declining and this contributes to the high prevalence of malnutrition worldwide (Davies-Adetugbo, 1997; Faruque *et al*., 2008; Onah *et al*., 2014). Again, nutrient deficiencies and low energy and protein intake seen in children are due to the increased use of diluted cow's milk and vegetable foods and a delay in giving children family foods (Kapur *et al*., 2005; Torún 2006). Even though breast milk is rich in high quality protein (Torún, 2006), prolonged breastfeeding causes a delay in the introduction of complementary foods and can result in micronutrient deficiencies, as human milk is low in iron and zinc (Kalanda *et al*., 2005).

On the other hand, babies are sometimes weaned too early because of another birth, causing the mother to cease breastfeeding of the first baby. Babies are then often weaned on a thin cereal with low quality protein, causing the older child to become ill when the new baby arrives.

In developing countries, malnutrition may develop after breastfeeding is ceased because of low milk production, death of the mother or because the mother decided to bottle-feed her infant. The mother might have decided to bottle-feed because of her Human Immunodeficiency Virus (HIV) status, work commitments or because the baby is not living with her (Davies-Adetugbo, 1997; Onah *et al*., 2014). Breast milk substitutes may be unsuitable because of a high renal solute load (cow milk) or low energy density (diluted cow's milk or incorrect formula) (Duggan and Golden, 2005).

The early introduction of complementary food is associated with an increased risk of respiratory infections, eye infection, high incidence of malaria and other morbidities. When complimentary foods are started, there is a reduction in breast milk consumption, which can lead to a loss of protective immunity. This causes a higher morbidity when unhygienic foods

are introduced, and diarrhoea usually develops. According to a study done by Kapur *et al*. (2005) in India, growth curves falter by the fourth month of life due to the early introduction of weaning foods. In Prevention of Mother To Child Transmission (PMTCT), mothers that opted for exclusive breastfeeding had a mean duration of exclusive breastfeeding of less than one month (UNICEF, 2007).

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2.3.2.2. Diseases

Most deaths of children from 6-59 months old are related to malnutrition and infection (Mahgoub and Adam, 2012; Vygen *et al*., 2013). Caulfield *et al*. (2004) found that, the principal causes of deaths in young children globally in 2004 were: diarrhoea (60,7%), pneumonia (52,3%), measles (44,8%) and malaria (57,3%). All of these can also worsen malnutrition. Some additional causes associated with child mortality were found by Muller and Krawinkel (2005) and UNICEF (2009) and these include perinatal causes, acute respiratory infections and others. Infections play a major role in the aetiology of PEM because they result in increased needs and a high energy expenditure, lower appetite, nutrient losses due to vomiting, diarrhoea, poor digestion, mal-absorption and the utilization of nutrients and disruption of metabolic equilibrium (Ambrus and Ambrus, 2004; Schaible and Kaufmann, 2007; Schneider *et al*., 2004). It takes time for a malnourished child to recover from respiratory and diarrhoea diseases and therefore the risk of morbidity and mortality is higher. Repeated illnesses contribute to ill health and compromised nutritional status.

2.3.3. Underlying Causes of Malnutrition.

The underlying causes of malnutrition include inadequate care of children, low educational levels and information, insufficient health service, an unhealthy environment (availability of sanitation and safe water) and inadequate levels of household food security (UNICEF, 2004;

Müller and Krawinkel, 2005). For malnutrition to improve there should be specific emphasis on social norms, gender equity and maternal access to education (UNICEF, 2009c).

2.3.3.1. Inadequate Care of Children

Ignorance is directly associated with poor infant and child upbringing practices, misconceptions about food, inadequate feeding during illness (especially infectious diseases and diarrhoea), improper food distribution among family members, poor maternal care and high birth rates (Bain *et al*., 2013; Ijarotimi, 2013). Childcare practices also include protecting the children's food and drinks from contamination to reduce the risk of infections. In Southern Africa there is a decrease in caring capabilities of caregivers the moment poverty and food insecurity increases (Shoo, 2007).

Poverty can indirectly cause poor caring practices, for instance when a parent becomes ill and dies; and issues related to feeding and hygiene are exacerbated by emotional instability (Mason *et al*., 2005). When the household income decreases, it is usually the women who try earning extra wages. This causes the mother to have less time for childcare and ensuring the children eat healthy food. If the female children are also sent out to look for work, this results in poor school attendance, which influences education, leading to poor knowledge and caring practices for their family (UNICEF, 2009b).

2.3.3.2. Insufficient Health Services

Malnutrition rates in the developing world are still high because of the lack of access to health services (Oyelami and Ogunlesi, 2007). Even though patients have little or no access to formal health services, there is still the problem that patients do not make use of the services available (Müller and Krawinkel, 2005). Families that are food insecure and reliant on inadequate health services develop a reduced resistance to infections, which causes malnutrition.

The health services are influenced by a loss of health staff, which leads to a higher workload for those that stay behind. This has a serious effect on the quality and quantity of health services rendered. The staffs that are available at the facilities lose their skills because of a lack of supplies and equipment, lack of incentives and low morale. Shortages of staff can also lead to remote areas not being covered by health services.

2.3.3.3. Low Educational Level And Information

Malnutrition is worsened by a lack of nutritional information and knowledge, especially maternal nutrition education (Abuya *et al*., 2012; Gupta *et al*., 1991), which leads to unhealthy dietary habits, poor nutrition related practices and attitudes, perceptions and sociocultural influences. All of these issues can negatively influence nutritional status. For families to be healthy with a good nutritional status, they need knowledge regarding growth, purchasing, processing, and preparation and feeding a variety of food, in the right quantities and combinations (Gupta *et al*., 1991; Owoaje *et al*., 2014; Silveira *et al*., 2010a). A lack of nutritional knowledge can also lead to misconceptions about food and negative food traditions that are passed on from generation to generation (Owoaje *et al*., 2014; Silveira *et al*., 2010a).

Previous studies conducted in the Philippines show that maternal education is one of the most important key elements in addressing child malnutrition. The association between maternal schooling and child health still needs to be investigated further. There are three ways how school education and knowledge can influence the child's health and nutritional status: (1) formal education leads directly to a higher knowledge of mothers; (2) literacy acquired in school ensures that mothers are more capable of identifying health problems in children; and (3) when mothers have attended school they are more aware of modern diseases and where to get help and information. Even though nutrition knowledge is not gained in the classroom, the

school education that mothers receive can help with caring for children and the household. Both female and male education can have a positive effect on the child's

nutritional status.

Knowledge can lead to a higher household income and better nutritional status when the education is linked with strategies to improve both. Maternal nutrition knowledge matters even more when the child falls within the high-risk group of younger than three years, as there is an association between low maternal literacy and poor nutritional status of children three to 23 months (UNICEF, 2009c).

2.3.4. Basic Causes of Malnutrition

Basic causes, also called national or root causes, of malnutrition include poor availability and control of resources (political, social, ideological and economic), environmental degradation, poor agriculture, war, political instability, urbanization, population growth, size and distribution, conflicts, trade agreements and natural disasters, religious and cultural factors (UNICEF, 2004a; Torún, 2006). In addition, landlessness and migrant labour are also considered to be basic causes of malnutrition.

Other basic causes include market failures due to economic decline, conflict and political upheavals that can lead to a reduction in food yields and price increases (Mason *et al*., 2005). Loss of food after a harvest can also occur when storage conditions are poor and food is inadequately distributed (Torún, 2006). If issues related to the economic position of the family are affected negatively, it can influence the chances of a child being stunted and underweight (UNICEF, 2004a).

2.4. The Time To Recovery And Death In The Treatment Of Children With Severe Acute Malnourishment

Diet and nutrition are critical issues for children living with HIV/AIDS. Malnutrition is a common complication associated with this chronic disease process, both early on and throughout disease course progression. The majority of children affected by the disease may be at risk for compromised nutritional status resulting from a depressed immune system. Further, nutritional deficiency has become a greater concern as HIV-infected people increasingly survive previously life-threatening complications. HIV-related malnutrition is caused by changes in metabolism due to primary HIV infection or secondary infection with a variety of opportunistic infections as well as by inflammation of the oral cavity or intestinal dysfunction and weight loss (ASSAF Report, 2007).

Metabolic disorders affect the chemical and physical processes involving proteins, carbohydrates, and fats. Inflammation of the oral cavity limits food intake, and intestinal dysfunction results in mal-absorption. Ultimately, metabolic disorders and related complications lead to a wasting complex in which energy depletion and deficiencies in protein and micronutrients negatively affect bodily functions and the immune system. The resulting loss of muscle mass and body weight directly affects health and mortality. Increased incidence of opportunistic infections, on-going destruction of the immune system, and declining nutritional status are all closely associated with loss of lean body mass. Thus, nutritional status and disease trajectory appear to be directly related. (WHO, 2009) and the general functioning of the body becomes very pitiable and thus their rate of recovery to diseases is very slow.

Malnutrition itself results in decreased immune function and greater susceptibility to infections and accelerating disease progression (WHO, 2009). Mor *et al* (2009) identify that diarrhoea is even persistent within children who are malnourished and are HIV positive.

Infections are very common- with viral and bacterial infections co-existing, as well as recurrent respiratory infections. Bacterial infections frequently relapses and Dendritic cell maturation fails, thus, anergic DC cells stop working to support T cell proliferation in the body (Hughes *et al*., 2009), consequently making the rate of recovery in the treatment of HIV/AIDs children with severe acute malnourishment very stumpy.

Malnourished individuals who are not HIV positive are only prone to associated problems regarding poor nutritional support. Diarrhoea in such individuals is not very recurrent as compared to those who have the virus within them thus their immune system is comparatively stronger to withstand infections and diseases.

In such individuals, anergic DC cells do not fail in their functions, but support the T Cell Proliferation in the body, resultantly, making the immune system much stronger than HIV positive victims (Hughes *et al*., 2009).

Though studies have showed that malnutrition itself results in decreased immune function and greater susceptibility to infections and accelerating disease progression (WHO, 2009) and that the increasing rate of malnourished individuals falling prey to diseases are not uncommon, the rate of recovery from diseases in these individuals is relatively faster and more active than those with the AIDS virus. Of greatest concern, Fergusson *et al* (2009) argues that there is a level of resistance of SAM complicated by HIV with standard care. Their study further reveals that mortality among HIV-infected malnourished children is consistently and significantly higher than in those with SAM alone (30.4 vs. 8.4%, RR = 2.81, 95% CI 2.04—3.87).

The time to recovery is much slower in HIV positive victims; thus, they die off earlier with the absence of proper nutritional support. The loss of weight, muscle and weak body system, increased opportunistic infections, increased incidence of morbidity influence mortality rate among these people (WHO, 2009).

The persistence of diarrhoea and other multiple infections, the continuous weakening of the immune system (Hughes *et al*., 2009) increase transience among severe malnourished people who are HIV positive. The time to death in the treatment of these individuals is very high, but can be reduced when there is good nutritional support and proper medical care.

HIV negative victims who are malnourished also face the threat of early death, as their immune system does not get the required diet needed to fight against diseases and infections.
They are likely to face loss of weight and other multiple and opportunistic infections (WHO, 2009). Interestingly, despite these individuals being at risk of death, they stand a better chance of living long relative to their counterparts who have the AIDS virus within their immune system.

Again, with proper nutritional support, they stand the chance of living for very long period of time, consequently, making their rate to death in their treatment lower and their rate to recovery in the treatment process very optimistic. CD4% is low in HIV-infected children with SAM and low CD4% is linked with increased risk of mortality. Furthermore, CD4 count examined by one study in Zambia remained low in all HIV-infected children with SAM, even with apparent nutritional recovery (Hughes *et al*., 2009).

2.5. The Treatment Outcomes/Nutritional Recovery Of Severe Acute Malnutrition In HIV Infected Children And Non-HIV Infected Children

Knowing the treatment outcomes of malnourished HIV children is very important. Interestingly, the use of ART in HIV-infected children with complication of malnutrition must always be guided with regards to its optimal timing, regimen and dosing (WHO, 2005/2009). One treatment outcome of the use of the ART among malnourished HIV AIDS (those suffering from marasmus) is that there is a higher rate of mortality in those with severe marasmus (Callens *et al*., 2009), but no trial evidence exists to suggest that waiting until a child's nutritional status improves correlates with improved outcomes. In fact, an important

recent retrospective study suggests that malnourished children who start promptly have higher rates of nutritional recovery and weight gain than those in whom ART is delayed (Kim *et al*., 2012).

A study in Zambia has shown that simply improving the nutritional status of severely malnourished HIV-infected children is insufficient to improve their immunological status without ART (Hughes *et al*., 2009). Another study by Fergusson *et al*. (2009) agrees with Hughes. In the study by Fergusson, the findings confirmed that HIV-positive and HIVnegative SAM children achieved nutritional recovery (85% weight for height and no oedema), regardless of HIV status. Those with HIV- infection had similar weight gain compared to HIV-uninfected children (8.9 vs. 8.0g/kg/d). This did not prove significant. Moreover, there were mean increase in Z scores for both subscapular (2.72vs 2.69, NS) and triceps (1.26 vs. 1.48); skinfolds were similar between HIV- infected and HIV- uninfected children, respectively during nutritional rehabilitation. Mean weight for z score was similar in HIV-infected and HIV- uninfected children (20.85 vs. 20.64, NS). This study concludes that nutritional recovery is similar in HIV-infected and HIV-uninfected children.

In fact, excellent responses in CD4 count and viral load have been demonstrated among those with severe malnutrition who do receive ART, just as in those with better baseline nutritional status (Naidoo *et al*., 2010). It is clear that severely malnourished children are indeed able to respond suitably to ART and nutritional supplementation in terms of both nutritional and immunological recovery. Therefore, the use of ART medications should not be delayed, and child health systems should embrace this in a programmatic manner, even though, optimal timing for starting ART remains controversial due to concerns over immune reconstitution inflammatory syndrome (IRIS) or to the adverse metabolic effects of ART (Sharma and Soneja, 2011). The treatment of non-HIV/AIDS children who are severely malnourished is different

from HIV/ AIDS positive children. The treatment does not involve the use of the ART medications. In fact, an important study suggests that malnourished children with proper medications and feeding have higher rates of diseases and nutritional resurgence (Kim *et al*., 2012).

Medical experts are always optimistic with the treatment outcome of malnourished children without HIV/AIDs than those with the AIDs virus in their immune system.

Indeed severe malnourishment is only a lack of nutritional knowledge which lead to misconceptions about food and negative food traditions that are passed on from generation to generation (Owoaje *et al*., 2014; Silveira *et al*., 2010b). Accordingly with proper nutritional knowledge and reduced poverty, malnutrition among children could reduce drastically. Diseases and infections in children with severe acute malnourishment can easily be addressed with proper nutrition; hence treatment outcomes among such children do not necessarily pose challenges to medical specialists compared to children who are malnourished and crippled with the AIDs virus within their immune system.

2.6. Conclusion

The review of the literature on HIV/AIDS and Severe malnutrition demonstrates an increasing concern and contrast in findings in terms of whether nutritional recovery varies in HIV infected SAM children and HIV uninfected children. In addition, there is a growing debate in the existing literature about the increasing rate of HIV among children with SAM. This study will therefore contribute to the growing quest for establishing the relationship between HIV status and SAM in children.

CHAPTER THREE RESEARCH METHODOLOGY

3.1. Introduction

This chapter provides a description of the methods that were employed in conducting this study. It details the specific research methods and techniques used for the study. It also looks at the appropriate data collection procedures and the tools used for the data analysis.

3.2. Profile Of Study Area

The study was conducted at the Komfo Anokye Teaching Hospital (KATH) located in the city of Kumasi, which is the second largest city in Ghana. Kumasi is the capital of the Ashanti region and the centre of the Kumasi Metropolitan District in Ghana. The Komfo Anokye Teaching Hospital (KATH) is the second-largest hospital in Ghana and the only tertiary health institution in the Ashanti Region. The hospital was built in 1954 as the Kumasi Central Hospital. It was later named Komfo Anokye Hospital after Okomfo Anokye, a legendary fetish priest of the Ashanti. It was converted into a teaching hospital in 1975 to train nurses, doctors, medical technologist, and paramedics. It is affiliated to the School of Medical Sciences of the Kwame Nkrumah University of Science and Technology. The hospital currently has 1000 beds, up from the initial 500 when it was first built.

The Ashanti Region lies between longitude 0.15^0- 2.25^0 West and latitude 5.5^0 –7.40^0 north. It shares boundaries with Brong Ahafo to the north, Eastern Region to the east, Central Region to the south and Western Region to the west. Its size of 24,390sq km represents 10.2% of the total landmass of Ghana. The geographical location of KATH, the road network of the country and the commercial and metropolitan nature of Kumasi make the hospital accessible to all the areas that share boundaries with Ashanti Region and others that are further away. As such, referrals are received from all the northern regions (namely, Northern, Upper East and Upper West Regions), Brong Ahafo, Central, Western, Eastern and parts of the Volta Regions. An

increasing number of patients also come in from the neighbouring countries (Burkina Faso and La Cote d' Ivoire).

In addition to health care services provided, the hospital offers facilities for teaching/training of all health professionals (nurses, undergraduate medical students, postgraduate resident medical practitioners, pharmacists, laboratory technologists) and research. The hospital has as its vision: To become a medical Centre of excellence offering Clinical and Non-Clinical services of the highest quality standards comparable to any international standards', within 5 years with a mission to provide quality services to meet the needs and expectations of all its clients.

3.3. Research Design

A retrospective case-control study design was used in the study. The cases were Severely Acute Malnourished (SAM) children with and without HIV/AIDS between the ages six months and 59 months. In case control design, the emphasis is on the identification of individuals with ('cases') and without ('controls') of a particular disease or condition. In a case–control study, subjects are identified on the basis of presence or absence of the disease
(or any other outcome) under study as past exposure to putative risk factors is determined (Lilienfeld and Lilienfeld, 1979). This study design was selected because it often constitute one of the foremost approaches to studying the aetiology of a disease or condition and has an ability to look at a wide range of exposures whiles aiming at identifying factors responsible for disease development. It can be conducted relatively cheaply and quickly.

3.4. Study Population

Severely malnourished children to the Paediatric Ward B4 during the period of January to July 2013 constituted the population for the study.

3.5. Sampling

Non-probability sampling was applied in selecting the research participants. The purposive non-probability sampling was used in selecting only children who were diagnosed to be with severe acute malnutrition with or without HIV infection.

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3.5.1. Inclusion Criteria

I. Children with Severe Acute Malnutrition who are aged between 6 months and 59 months.

II. Children with Severe Acute Malnutrition on admission at the Paediatric Ward B4.

III. Children with Severe Acute Malnutrition whose HIV/AIDS status was knownpositive or negative

3.5.2. Exclusion Criteria

I. Children who have a chronic debilitating illness other than HIV.

II. Severely malnourished children with generalized oedema.

III. Severely malnourished children whose HIV/AIDS status cannot be determined.

3.6. Study Variables

Demographic Characteristics	Operational Definition	Scale Of Measurement	Type Of Variable
Sex	Gender of participant	Nominal Male or Female	Binary
Age	Number of complete years one had lived as at the time he/she was admitted	Ratio Range of years	Continuous
Mother as primary caretaker	Whether it is the child's mother taking care of the child	Nominal Yes or No	Binary
Mother alive	Whether the child's mother is living or dead	 Nominal Yes or No	Binary
Father alive	Whether the child's father is living or dead	Nominal Yes or No	Binary
Father at Home	Whether the child's father lives with them at home	Nominal Yes or No	Binary
Number of children under 5 at home	The number of children less than 5 years old who lives with the child's caretaker at home	 Interval Discrete numbers	Discrete
Currently breastfeeding	Whether the child is breastfeeding or not	Nominal Yes or No	Binary
Age stopped breastfeeding	Number of years one had lived as at the time he/she stopped breastfeeding	Interval Range of numbers	Continuous
Clinical Characteristics			
Type of SAM	Whether the child has Kwashiorkor, Marasmuskwashiorkor, or Marasmus	Ordinal Kwashiorkor, MarasmusKwashiorkor, or Marasmus	Ordinal
Mid-upper arm circumference	The circumference of the upper arm at its midpoint, measured with a nonstretchable tape measure	 Interval Range of numbers	Continuous
Weight/kg	How heavy the child is	 Interval Range of numbers	Continuous
Height or length /m	How tall the child is (standing) or how long the child is (lying down)	Interval Range of numbers	Continuous
Axillary temperature/^{o}C	How hot or cold the body is as measured from the armpit	Interval Range of numbers	Continuous

Study Variables (Continued)

Medical History	Operational Definition	Scale Of Measurement	Type Of Variable
Ever been hospitalized for any reason	Whether the child has been admitted to the hospital before	Nominal Yes or No	Binary
Ever been hospitalized for malnutrition	Whether the child has been admitted to the hospital before for malnutrition	Yes or No	Binary
Child's HIV Status	Whether the child has tested HIV positive or not	Yes or No	Binary
If Child is HIV Positive, is he/she on ART	Whether the child is on anti-retroviral therapy or not	Yes or No	Binary
Mother has had HIV test done	Whether the child's mother has tested for HIV	Yes or No	Binary
Mother's HIV test positive	Whether the child's mother has tested HIV positive or not	Yes or No	Binary
HIV-positive mother on ART	Whether the child's mother is on antretroviral therapy	Yes or No	Binary
At least one infectious symptom in prior two weeks	Whether the child has shown any symptoms indicative of an infection in the two weeks period before admission to the hospital	Yes or No	Binary
Fever in prior two weeks	Whether the child has had raised body temperature in the two weeks period before admission to the hospital	Yes or No	Binary
Cough in prior two weeks	Whether the child has been coughing in the two weeks period before admission to the hospital	Yes or No	Binary
Diarrhoea in prior two weeks	Whether the child has been passing frequent loose watery stools in the two weeks period before admission to the hospital	Yes or No	Binary
Vomiting in prior two weeks	Whether the child has been vomiting in the two weeks period before admission to the hospital	Yes or No	Binary
Rash in prior two weeks	Whether the child has had rashes in the two weeks period before admission to the hospital	Yes or No	Binary
Reported to have a good appetite	Whether the child has good appetite at admission	Yes or No	Binary

Outcome	Whether participant was discharged, died, or remained acutely malnourished	Discharged, died, or remained acutely malnourished	Nominal
Time to Outcome	Number of days spent on admission before discharge or death	Range of numbers	Continuous

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3.7. Sample Size Determination

To estimate the sample size, the following formula is used:

$N= P (1-P) (1.96)^2/d^2$

N= sample size, P=Prevalence of severe acute malnutrition at KATH

Assuming a P to be 10% (since the prevalence of severe acute malnutrition at KATH is not known), and d=0.05 (allowable error of unknown prevalence),

N = 0.1 x 0.9 x 1.96 x 1.96 / 0.05 x 0.05 = 138.3

Design effect = 1.8%, 1.8% of 138.3 = 2.5

Hence sample size is 138.3 + 2.5 = 140.8 ≈ 141

A sample size of 141 was selected as appropriate for the study.

3.8. Data Collection Techniques And Tools

The study used secondary data of children at the Komfo Anokye Ward B4. The study used the clinical records of children in the Ward B4 from January 2013 to July 2013. A case record form (CRF) or a questionnaire (Appendix B) was used to gather the data as outlined in the study variable chart on each study participant. The Principal researcher designed the study.

Severe acute malnutrition (SAM) or severe wasting is defined by very low weight-for-height (below -3 z-scores of the median (WHO child growth standards), a mid-upper arm circumference < 115 mm, or by the presence of nutritional oedema. The folders of the children were used in eliciting the necessary data for subsequent analysis. The presence of severe acute malnutrition was sourced from the records/medical history of the children.

According to WHO voluntary counselling and testing should be available for children with severe acute malnutrition and for their mothers (A Joint Statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children's Fund, Community-Based Management of Severe Acute Malnutrition (2007). The researcher elicited information on the HIV status of the mother from the records of the child, as it was available. This was used in ascertaining whether the child had exclusive breastfeeding from the mother or otherwise. Severely malnourished children admitted at B4 of the Paediatric ward of the Komfo Anokye Teaching Hospital during the period January 2013 to July 2013, were followed up from the time of admission to outcome (death or discharge or persisting severe acute malnutrition) using their clinical records

The following parameters were recorded for all the children at admission: demographic characteristics (age, sex, caretaker, and breastfeeding status), clinical features (weight, height/length, Mid-upper-arm circumference, presence of oedema, appetite, and the presence of the infectious symptoms fever, cough and diarrheal in previous 2 weeks). The Mid-upper arm circumference (MUAC) measurement and weight-for-height (WFH) index were used to assess wasting, a clinical manifestation of acute malnutrition, reflecting the child's current nutritional status.

The children were categorized into Non-HIV/AIDS and HIV/AIDS SAM groups, and the clinical definition of malnourishment was used to sub-classify them into the following

categories: Kwashiorkor, Marasmus-Kwashiorkor, and Marasmus. Indicators and clinical signs of Severe Acute Malnutrition with cut-offs were MUAC < 11.5 cm, WFH z-score < -3, and the presence of bilateral pitting oedema.

The following were additionally collected: time to outcome (continued to have severe acute malnutrition, recovery/death), gains in weight (g/kg/day), length (mm/day), and mid-upperarm circumference (mm/day). The weight-for-height standard deviation (SD) score (Z-score) was computed using the United States National Centre for Health Statistics (NCHS)/World Health Organization (WHO) reference chart (or World Health Organization [WHO] Child Growth Standards/ reference).

3.9. Pre-Testing

During the feasibility phase of the study (pilot study), which lasted approximately one week, the researcher extensively tested all procedures outlined for the study. The goal during this pilot was to recruit at least 10 subjects at the study site—a minimum of 5 each of SAM with HIV/AIDS and SAM without HIV/AIDS. During the pilot, the interest was to determine the number of SAM who had undergone voluntary counselling and testing for HIV, and the proportion of SAM who were HIV positive. The assessment was also to ensure clarity, consistency, and correctness in the completion of the case record forms in documenting the data in order to meet the stated objectives of the study.

3.10. Plan for Data Handling

Data collected on participants was given maximum confidentiality. The completed CRFs were kept in envelopes and separated from each other with labels. These envelopes were kept in a safe under lock and key and only the researcher had access to the data. Names of patients did not form part of the data that was collected.

3.11. Ethical Consideration

This study was reviewed and certified by the Committee on Human Research Publication and Ethics, Kwame Nkrumah University of Science and Technology College of Health SciencesSchool of Medical Sciences, and the Research and Development Unit, Komfo Anokye Teaching Hospital (KATH) in Kumasi. All data gathered from the records were strictly used solely for this academic purpose.

3.12. Limitations of Study

The study was limited by the incompleteness of data in the children's clinical records/folders that gave the researcher a difficult time in getting the required sample size for the study. However with the assistance of the in-charge of records at the B4 unit this difficulty was overcome.

3.13. Assumptions

The researcher assumes that information gathered from the folders of the children with SAM was accurate.

3.14. Data Analysis Plan

The author did data input. This was done on a weekly basis. A codebook for each variable was prepared beforehand. The data was analysed both descriptively and inferentially with the aid of the SPSS version 20.

3.15. Statistical Methods

All calculated anthropometric indices were determined by using the clinical records of the children. The two primary end points were determined as nutritional recovery and mortality. A sample size of at 141 children was estimated to be necessary for the study to have 95% power at a two-sided alpha level of 0.05.

One pre-specified subgroup analysis was conducted – evaluating the interaction between type of SAM (kwashiorkor, marasmus-kwashiorkor, or marasmus) and HIV/AIDS status, again using nutritional recovery and mortality as the primary endpoints of interest.

Secondary outcomes of interest included weight gain, length gain, and time to admission and recovery or default.

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Some of the p-values were derived from risk ratios and while others were derived from t-test for differences.

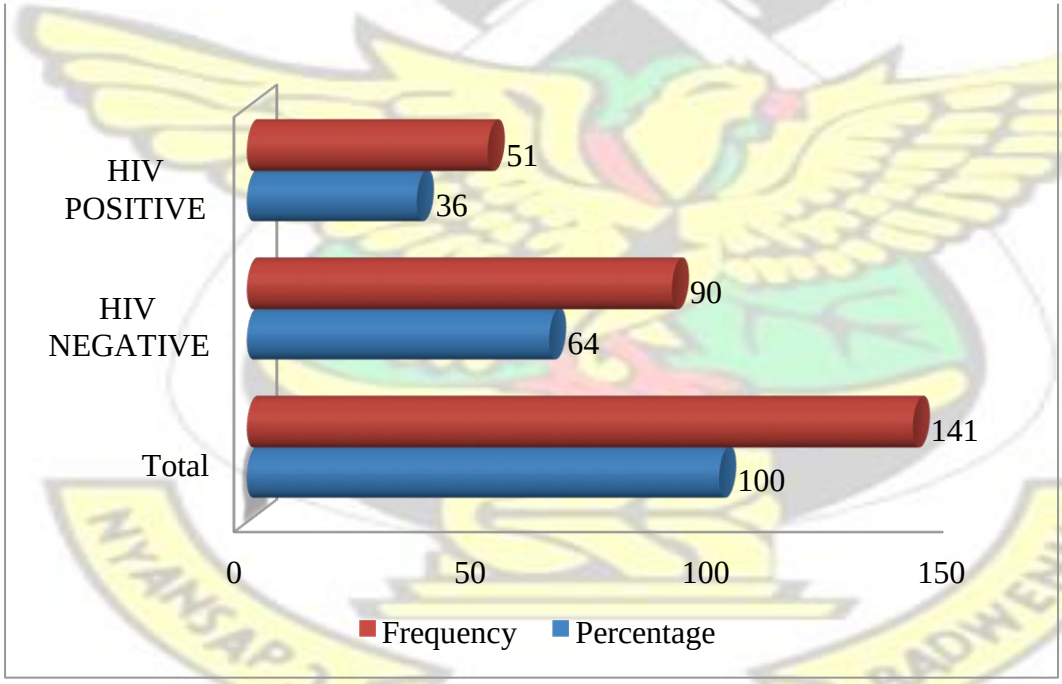
CHAPTER FOUR RESULTS

4.1. Introduction

This part of the study presents the results of the data that was gathered from the clinical records of the children under study. The results are presented and analysed based on the variables and in reference to the specific objectives of the study.

A total number of 156 children were admitted to ward B4 of the Komfo Anokye Teaching Hospital for Severe Acute Malnutrition from the period of January 2013 through July 2013. 141 children were enrolled into the study after the exclusion of 15 ineligible children. 51(36%) of the children were HIV positive, with the remaining 90(64%) being HIV negative (Figure 2).

Figure 2 HIV Status of Enrolled Children



4.2. Demographic Characteristics Of The Children

As shown in Table 4, 139 of the children had their mothers alive; 49 of these children had HIV infection whereas the remaining 90 did not have the HIV infection. All these children had their mothers as their primary caretaker except 4 of the children who were not infected with HIV. It was not stated who the primary caretakers of these 4 children were.

It was also found that 127 of the children had their fathers alive; 49 of these children had the HIV infection and the remaining 78 did not have the infection. 53 of the children without HIV infection and 29 of the children with the HIV infection had their fathers living at home with them. The researcher in detailing the additional number of children under five years old living at home with the SAM children found out that, out of the total sample of 141, 9 (6.4%) of the parents of the children studied did not have any additional child, 97 (68.8%) of mothers had 1 additional child, 34 (24.1%) of the mothers had 2 children and 1 (0.7%) of the mothers indicated having 3 children under five at home. This indicates that most of the mothers of the children studied had at least one child under five years old at home. The average numbers of children under five years at home for the HIV negative and HIV positive groups were 1.1 ± 0.5 and 1.3 ± 0.6 respectively (Table 1).

The mean age in months at which those children not currently breastfeeding stopped breastfeeding were 19.1 ± 7.2 and 19.3 ± 6.2 for the HIV negative and HIV positive children respectively. The mean age is higher in the HIV infected group but the difference is not statistically significant (Table 1).

Table 1 Selected Baseline Characteristics of Enrolled Children (Demographic Characteristics)

Variables	HIV -ve SAM (N=90)	HIV +ve SAM (N=51)	P-Value
Demographic Characteristics			
Male - no. (%)	51 (57)	22 (43)	0.4476
Age – months	15.4 ± 9.8	20.4 ± 11.8	0.0071
Mother as primary caretaker – no/total. (%)	86 (96)	49 (96)	1

Mother alive – no (%)	90 (100)	49 (96)	0.9012
Father alive – no (%)	80 (89)	47 (92)	0.8996
Father at Home – no (%)	53/80 (66)	29 (57)	0.6636
Number of children under 5 in home	1.1 ± 0.5	1.3 ± 0.6	0.1477
Currently breastfeeding	49 (54)	22 (43)	0.5405
Age stopped breastfeeding - months	19.1 ± 7.2	19.3 ± 5.9	0.8609

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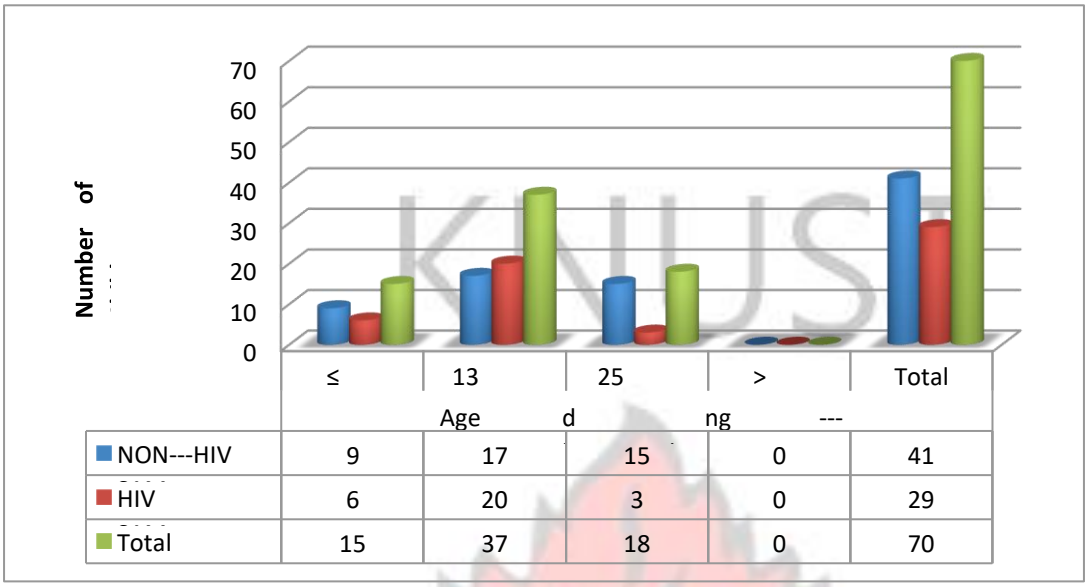
As depicted in Table 2 below, 71 (50.4%) of children were currently breastfeeding while 70(49.6%) of the children were not. 43% of the HIV infected group were currently breastfeeding as compared to 54% of the group without HIV infection. Therefore, half of the children in the study were currently breastfeeding although a greater proportion of the children without HIV infection were currently breastfeeding as compared to the children with HIV infection.

Table 2 Current Breast-Feeding Status of Child

Is the Child Currently Breast-feeding?			
	Yes	**No**	**Total**
HIV-positive Child	22	29	51
HIV-negative Child	49	41	90
Total	71 (50.4%)	70 (49.6%)	141

The data gathered shows that 37(53%) of the children not currently breast-feeding received continuous breast-feeding until the age of (2) two years. In the case of 15 (21%) children, breast-feeding ended by the end of the twelfth month and 18 (26%) of them continued breastfeeding till end of the thirtieth month. None of the children were breast-fed beyond thirty months (Figure 3).

Figure 3 Age at Which the Children Stopped Breastfeeding

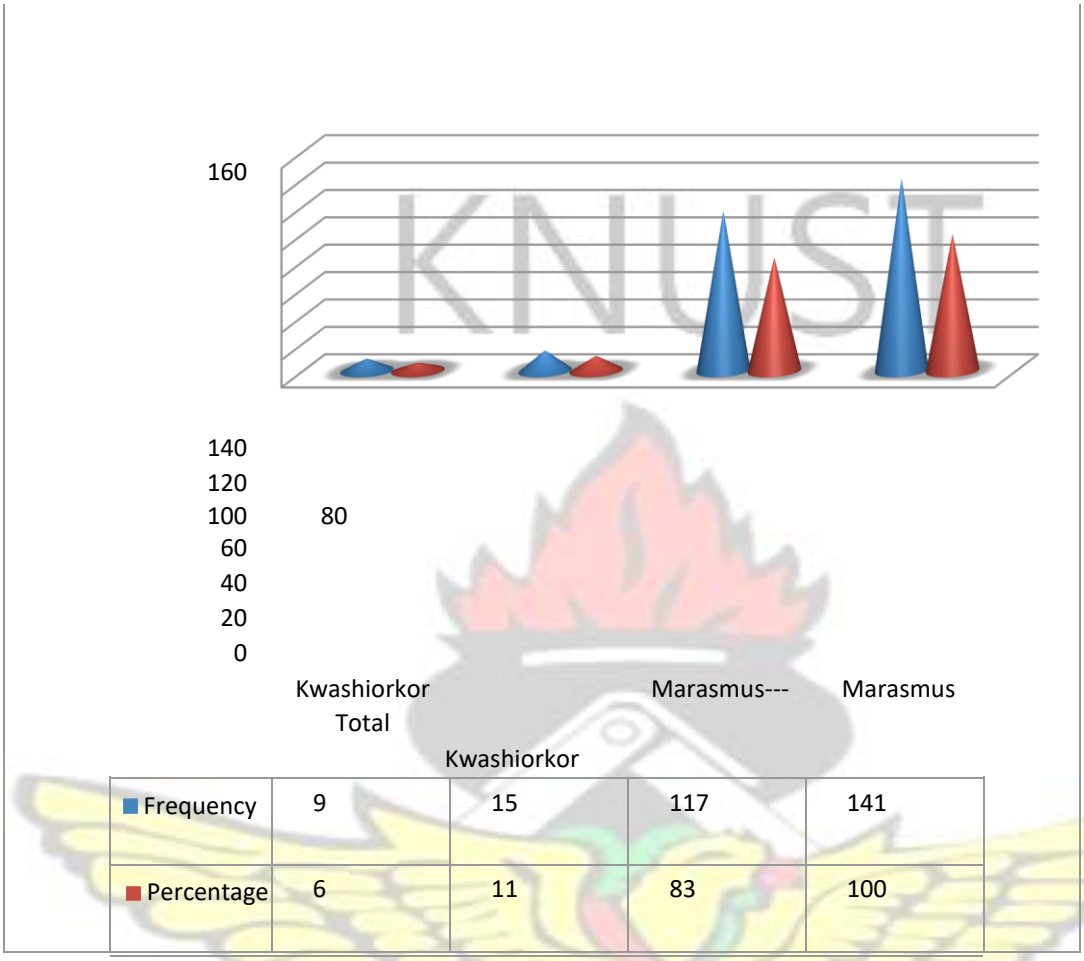


	≤ 13	25	>	Total
NON---HIV	9	17	15	0	41
HIV	6	20	3	0	29
Total	15	37	18	0	70

4.3. Incidence of Severe Acute Malnutrition In Children

From the study, data on the type of SAM showed that 9 (6%) of the children had Kwashiorkor, 15 (11%) had Marasmus-Kwashiorkor and 117 (83%) of the children had Marasmus. This indicates that marasmus was the dominant type of SAM in children admitted to the hospital for SAM (Figure 4).

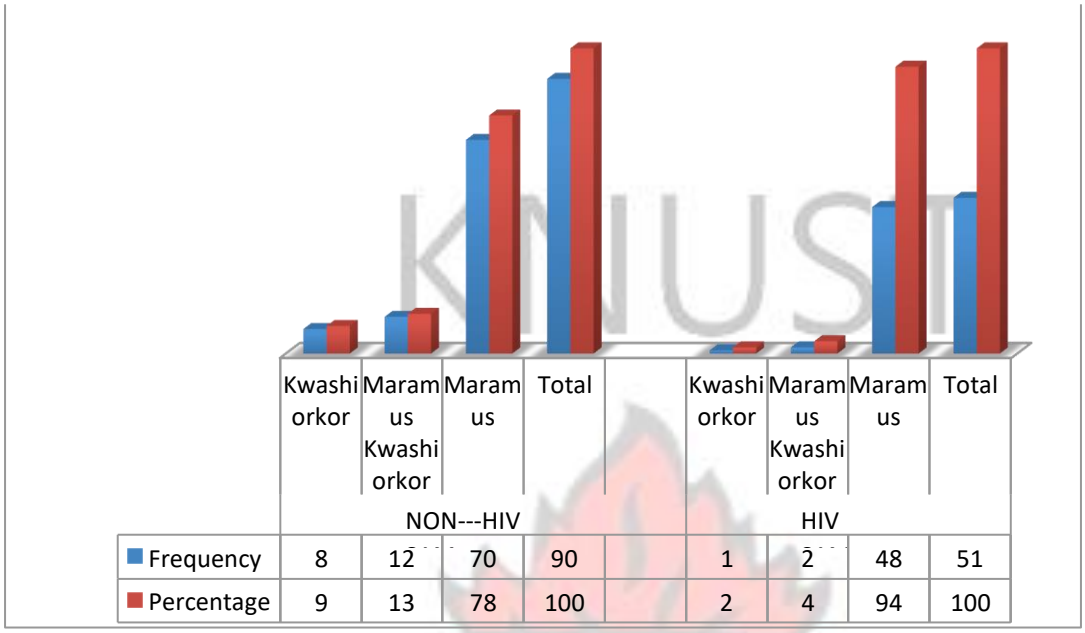
Figure 4 Type of SAM of Enrolled Children



Frequency	9	15	117	141
Percentage	6	11	83	100

Figure 5 below presents the findings on the type of severe acute malnutrition in the children with and without the HIV infection. 8 (9%) out of the 90 Non-HIV children had Kwashiorkor, 12 (13%) and 70 (78%) were Marasmus-Kwashiorkor and Marasmus respectively. Out of the 51 HIV SAM children, 1 (2%), 2 (4%), and 48 (94%) had Kwashiorkor, Marasmus-Kwashiorkor and Marasmus respectively.

Figure 5 Type of Acute Severe Malnutrition (SAM) and HIV Status



	Kwashiorkor	Marasmus Kwashiorkor	Marasmus	Total		Kwashiorkor	Marasmus Kwashiorkor	Marasmus	Total
	NON---HIV					HIV			
Frequency	8	12	70	90		1	2	48	51
Percentage	9	13	78	100		2	4	94	100

4.3.1. Clinical Characteristics of Children With Severe Acute Malnutrition (SAM) on Admission

The data as presented in Table 6 indicates that 42 of the children, representing 30% were moderately stunted, ≤ -2 x > -3 SD, and 72 of them, representing 51% were severely stunted, x ≤ -3 SD. The mean length-for-age Z-score were -3.23 ± 1.64 and -3.21 ± 1.47 for the SAM children without HIV and SAM children with HIV respectively. This finding indicates that most of the children had severe stunting. The responses show that the mean weight-for-length Z-score (wasting assessment) was -3.46 ± 0.56 for all the SAM children (except kwashiorkor children), -3.47 ± 0.56 and -3.44 ± 0.55 for the SAM children without HIV and SAM children with HIV respectively (Table 3).

The mid-upper arm circumference and weight based measurements were not used to monitor the children with Kwashiorkor because of the influence of the oedema on these. The researcher found out about the children's mid-upper arm circumference (MUAC)/cm of Marasmus-Kwashiorkor and Marasmus children at and periodically during admission till recovery or death. The study revealed that the MUAC for the marasmus-kwashiorkor children, marasmus children, and both groups combined the ranges were between 9.6cm and 11.8, 9.4cm and

11.9cm, 9.4cm and 11.9cm respectively. The mean MUAC (±SD) for the three groups were 10.7 ± 0.9, 10.9 ± 0.9, and 10.9 ± 0.9 respectively (Table 3).

For the children with marasmus-kwashiorkor the mean MUAC (±SD) for the HIV negative and HIV positive groups were 10.7 ± 0.9 and 10.6 ± 0.8. The mean MUAC (±SD) for the HIV negative and HIV positive children with marasmus were the 10.9 ± 0.9 for each group (Table 3). The mean MUAC (±SD) for the HIV negative Marasmus-kwashiorkor children was higher than that of the HIV positive marasmus-kwashiorkor children. The difference though is not statistically significant.

Table 3 Selected Baseline Characteristics Of Enrolled Children

(Clinical Characteristics)

Clinical Characteristics	**HIV -ve SAM (N=90)**	**HIV +ve SAM (N=51)**	**P-Value**
Kwashiorkor – no (%)	8 (9)	1 (2)	0.1636
Marasmus-Kwashiorkor			
Mean score weight-for-length Z-score	-3.74 ± 0.62		
No. Of Children (%)	12 (14)	3 (4)	0.1409
Mid-upper arm circumference - cm	10.7 ± 0.9	10.6 ± 0.8	0.4627
Weight-for- length Z-score	-3.75 ± 0.64	-3.73 ± 0.55	0.4724
Marasmus			
Mean weight-for- length Z-score	-3.42 ± 0.55		
No. Of Children (%)	70 (78)	47 (92)	0.5212
Mid-upper arm circumference - cm	10.9 ± 0.9	10.9 ± 0.9	0.9642
Weight-for- length Z-score	-3.42 ± 0.55	-3.42 ± 0.55	0.8764
Length-for-age Z-score			
Mean score	-3.23 ± 1.64	-3.21 ± 1.47	0.8861
Length-for-age Z-score ≤ -2 - no./total no. (%)	71/90 (79)	43/51 (84)	0.8964
Length-for-age Z-score ≤ -3 - no./total no. (%)	45/90(50)	27/51 (53)	0.8811
Axillary temperature - ^{o}C	37.5 ± 0.6	38.2 ± 0.6	< 0.0001

4.4. Medical History of Children In Relation To Severe Acute Malnutrition (SAM) The results presented in table 7 show that 25 (28%) of the 90 SAM children without HIV had dermatosis on admission, whereas 31 (61%) of the 51 SAM children with HIV had it (Table 4). This implies a greater proportion of SAM children with HIV had dermatosis on admission than SAM children without HIV. This difference is statistically significant, meaning SAM children with HIV are more likely to have dermatosis than SAM children without HIV.

The results above further show that 80 representing 56.7% of the children had been admitted to the hospital before. This included 45 (50%) of the 90 SAM children without HIV and 35 (69%) of the SAM children with HIV. A greater proportion of SAM children with HIV had already been admitted before in the hospital but the difference is not statistically significant. Malnutrition was the reason for 17 (12%) of all the 80 previous admissions, 9 (10%) of previous admission of SAM children without HIV, and 8 (16%) of previous admission of SAM children with HIV. There is therefore no significant difference between the tendencies for the two study groups to be admitted before for malnutrition.

On admission, Children's' axillary temperatures were taken. The mean (±SD) axillary temperatures at admission of all SAM children, SAM children without HIV, and SAM children with HIV were 37.8 ^{o}C ± 0.6, 37.5 ^{o}C ± 0.6, and 38.2 ^{o}C ± 0.6 (Table 4) respectively. The minimum and maximum temperatures were 36.6 ^{o}C and 39.2 ^{o}C, 36.6 ^{o}C and 38.3 ^{o}C, 37.2 ^{o}C and 39.2 ^{o}C respectively. The axillary temperature at admission of SAM children with HIV was higher than that of SAM children without HIV and this difference is statistically significant. This means that SAM children with HIV are more likely to be admitted to the hospital with fever than SAM children without HIV.

Forty-seven of the mothers of the children enrolled into the study were tested for HIV infection or had their HIV status known. Sixteen (18%) and 31 (61%) of these were mothers of SAM

children without HIV and SAM children with HIV respectively (Table 4). This means not all the SAM children with HIV had their mothers' HIV status know. Twenty (39%) of them did not have their HIV status known.

None of the 16 mothers of SAM children without HIV tested for HIV had the infection whereas 31 (61) of the mothers of SAM children with HIV tested for HIV had the infection (Table 4). This is a significant difference, meaning mothers of SAM children with HIV are more likely to test positive for HIV infection than mothers of SAM children without HIV.

The data shows that 18(35%) of the children were on anti-retroviral therapy as against 33 representing 65% of the children not being on anti-retroviral therapy. This demonstrates that 2/3 of the HIV positive children were not on anti-retroviral therapy.

Additionally, for the thirty-one mothers who were HIV positive, only 12(39%) were on antiretroviral therapy with the majority 19 (61%) not being on anti-retroviral therapy. The reasons for this happening were difficult to ascertain from the records of the children.

The results from the table 4 also show that 127 of the 141 children, representing 90% showed at least one symptom of infection in the two weeks period before admission to the hospital. Among these were 78 (87%) SAM children without HIV and 49 (96%) SAM children who had HIV infection. Eighty (57%) of the children who showed at least one symptom of infection in the two weeks period before admission had fever. Thirty-nine (43%) and Forty one (80%) of these were SAM children without HIV and SAM children with HIV respectively.

More than two thirds of the children were therefore ill with some sort of infection in the two weeks period before admission to the hospital; and SAM children with HIV infection are more likely to suffer a febrile illness prior to admission for SAM.

The data on whether children were coughing on admission showed that almost half 68 (48%) of the children were coughing on admission, 73 of them were not coughing on admission. Out of the 68 children, 37 (41%) were from the 90 children without HIV infection and 31 (61%) were from the 51 children with HIV infection.

An additional finding was that 81 of children, representing 57% were having diarrheal in the two weeks prior to admission, as against 60 of the children who did not have diarrheal in the two weeks prior to admission. Those who had the diarrheal consisted of 57 (63%) of the 90 children without HIV infection and 24 (47%) of the 51 children with HIV infection.

With regards to whether the children were vomiting on admission or not, the study identified that whilst 46 children representing 33% were vomiting on admission, 95(67%) of the children were not. 26 (29%) and 20 (39%) of these were mothers of SAM children without HIV and SAM children with HIV respectively (Table 4). Vomiting therefore is not a common affliction of SAM children prior to their admission for SAM.

The records as shown in the Table 4 found only 14 of children representing 10% had good appetite on admission in sharp contrast to 127 (90%) children with loss of appetite on admission. Only 8 (9%) of the 90 children without HIV and 6 (12%) of the children with HIV had good appetite on admission. From the data above, most of the children (83.1%) had lost appetite on admission.

The study found out that 58 of the children representing 41% were irritable and redrawn at the time of admission, 29 (32%) of the 90 children without HIV and 29(57%) of the 51 children without HIV.

Table 4 Selected Baseline Characteristics Of Enrolled Children (Medical History)

Medical History	HIV -ve SAM (N=90)	HIV +ve SAM (N=51)	P-Value
Ever been hospitalized for any reason no./total no. (%)	45 (50)	35 (69)	0.3152
Ever been hospitalized for malnutrition no./total no. (%)	9 (10)	8 (16)	0.4309
Child HIV Positive on ART - no./total no. (%)		33 (65)	
Mother has had HIV test done - no./total no. (%)	16 (18)	31 (61)	0.0006
Mother's HIV test positive - no./total no. (%)	0 (0)	31 (61)	< 0.0001
HIV-positive mother on ART - no./total no(31). (%)		12/ (39)	
At least one infectious symptom in prior two weeks - no. (%)	78 (87)	49 (96)	0.7058
Fever in prior two weeks - no./total no. (%)	39 (43)	41 (80)	0.0336
Cough in prior two weeks - no./total no. (%)	37 (41)	31 (61)	0.2268
Diarrhoea in prior two weeks - no./total no. (%)	57 (63)	24 (47)	0.4476
Vomiting in prior two weeks - no./total no. (%)	26 (29)	20 (39)	0.3789
Rash in prior two weeks - no./total no. (%)	25 (28)	31 (61)	0.0164
Reported to have a good appetite - no./total no. (%)	8 (9)	6 (12)	0.7723
Reported to be irritable and withdrawn	29 (32)	29 (57)	0.0811

4.5. Comparing Baseline Characteristics of the Enrolled Children among the Study Sub-Populations

The baseline characteristics of the enrolled children were similar among the two study groups except that the HIV group was more likely to be older, have a higher axillary temperature on admission, have an HIV positive mother, and have had fever and/or rash in the two weeks prior to admission (Tables 1,3,4).

Of the various baseline demographic characteristics the age of the child, and the number of children under 5 at home had an effect on the treatment outcome. Increasing age and decreasing number of children under 5 at home were associated with increasing nutritional recovery rates (Tables 5).

Table 5 Enrolment Characteristics Of Children Who Recovered From SAM, Or Died During Therapy For SAM (Demographic Characteristics)

Variables	Recovered (N =127)	Died (N = 12)	Recovered vs. Died P value
Demographic Characteristics			
Male - no. (%)	67 (53)	4 (33)	0.5858
Age – months	18.2 ± 10.8	7.6 ± 1.5	0.0009
Mother as primary caretaker–no/total. (%)	125 (98)	8 (67)	0.4891
Mother alive – no (%)	125 (98)	12 (100)	1
Father alive – no (%)	113 (89)	12 (100)	0.8325
Father at Home – no (%)	73 (57)	8 (67)	0.8098
Number of children under 5 in home	1 ± 0.5	2 ± 0.8	< 0.0001
Currently breastfeeding	67 (53)	4 (33)	0.5858
Age stopped breastfeeding - months	19.2 ± 6.8	18.5 ± 7.4	0.7399

Of the various baseline clinical characteristics the MUAC of the marasmus child, and the axillary temperature on admission had an effect on the treatment outcome. Increasing MUAC of the marasmus child and decreasing axillary temperature on admission were associated with increasing nutritional recovery rates (Tables 6).

Table 6 Enrolment Characteristics Of Children Who Recovered From SAM, Or Died During Therapy For SAM (Clinical Characteristics)

Variables	Recovered (N =127)	Died (N = 12)	Recovered vs. Died P value
Marasmus-Kwashiorkor – (%)	8 (6)	7 (58)	0.0005
Mid-upper arm circumference - cm	10.7 ± 0.8	10.0 ± 0.8	0.0038
Weight-for-length Z-score	-3.53±0.52	-3.97 ± 0.74	< 0.001
Marasmus	110 (87)	5 (42)	0.2123
Mid-upper arm circumference - cm	11 ± 0.84	9.9 ± 0.5	< 0.0001
Weight-for-length Z-score	-3.38±0.53	-3.84 ± 0.73	< 0.001
Length-for-age Z-score	3.13± 1.59	3.78 ± 1.38	< 0.005
Length -for-age Z-score ≤ -2 - no./total no. (%)	91 (72)	10 (83)	0.8219
Length -for-age Z-score ≤ -3 - no./total no. (%)	56 (44)	8 (67)	0.4489

Axillary temperature - ^{o}C	37.7 ± 0.6	38.5 ± 0.4	< 0.0001

From Table 7 below starting a HIV SAM child on ART had a significant positive impact on the nutritional recovery as none of the children on ART died during treatment on admission. It was also found that a recent history of an infection did not have a significant effect on the nutritional recovery.

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Table 7 Enrolment Characteristics Of Children Who Recovered From SAM, Or Died During Therapy For SAM (Medical History)

Variables	**Recovered (N =127)**	**Died (N = 12)**	**Recovered vs. Died P value**
Ever been hospitalized for any reason no./total no. (%)	77 (61)	2 (17)	0.0905
Ever been hospitalized for malnutrition no./total no. (%)	18 (14)	0 (0)	0.3626
Child has had HIV test done - no./total no. (%)	127 (100)	12 (100)	1
Child's HIV test positive - no./total no. (%)	47 (37)	4 (33)	1
Child HIV Positive on ART - no./total no. (%)	33/51 (65)	0 (0)	< 0.0001
Mother has had HIV test done - no./total no. (%)	43 (34)	4 (33)	1
Mother's HIV test positive - no./total no. (%)	26/44 (59)	4/4 (100)	0.4758
HIV-positive mother on ART - no./total no. (%)	10/26 (38)	2/4 (50)	1
At least one infectious symptom in prior two weeks - no. (%)	115 (91)	12 (100)	0.8337
Recent symptoms			

Fever in prior two weeks - no./total no. (%)	73 (57)	7 (58)	1
Cough in prior two weeks - no./total no. (%)	66 (52)	2 (17)	0.153
Diarrhoea in prior two weeks - no./total no. (%)	73 (57)	8 (67)	0.8098
Vomiting in prior two weeks - no./total no. (%)	42 (33)	4 (33)	1
Rash in prior two weeks - no./total no. (%)	50 (39)	6 (50)	0.7848
Reported to have a good appetite - no./total no. (%)	14 (11)	0 (0)	0.6037
Reported to be irritable and withdrawn	50 (39)	8 (67)	0.3042

4.6. Baseline Characteristics Related To Recovery

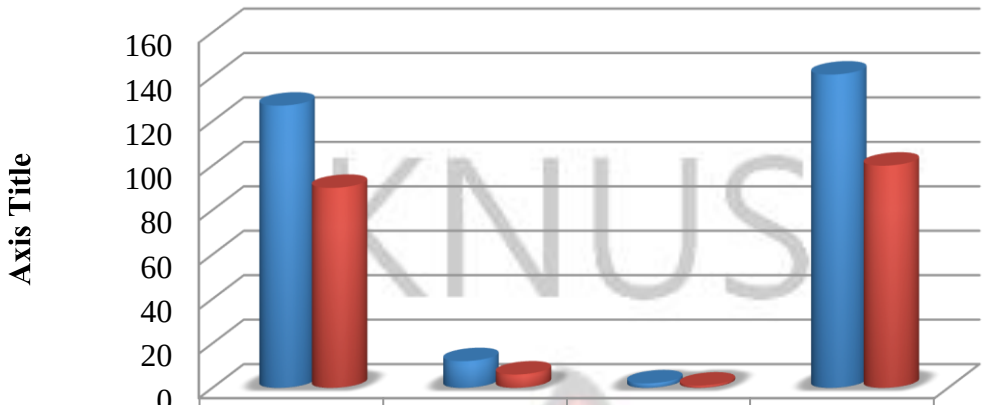
Children who recovered were significantly older as compared with children who did not recover, and were more likely to have more than one sibling less than 5 years living at home (Table 5). Among children with marasmus or marasmus-kwashiorkor, those with the lowest mid-upper-arm circumference and the lowest weight-for-length z-score on admission were most likely to die. Children with the lowest length-for-age z-score were least likely to recover (Table 6). Acute infectious symptoms and poor appetite both on admission (Table 7) were not associated with an increased risk of treatment failure.

4.7. The Treatment Outcome of Children with SAM

The researcher was also interested in finding out whether children who were admitted to the hospital were discharged, died, remained acutely malnourished, or discharged against medical advice. The following data was gathered.

The data showed that 127 of the children, representing 90% were discharged, 12 (9%) of them died, none of the children studied remained acutely malnourished and 2 (1%) were discharged against medical advice or defaulted (Figures 6).

Figure 6 Treatment Outcome of Enrolled Children



	Discharged	Died	Defaulted	Total
Frequency	127	12	2	141
Percentage	90	6	1	100

4.7.1. Length of Time to Treatment Outcome

The results of the study further show that, the minimum number of days spent by a child on admission before death and recovery for discharge were 14 days and 8 days respectively with the maximum number of days spent on admission before death and recovery for discharge being 26 days and 48 days respectively. SAM children without HIV spent 22 and 8 minimum days respectively before death and recovery for discharge, and 26 and 32 maximum days respectively before death and recovery for discharge. On the other hand, SAM children with HIV spent 14 minimum days each before death and recovery for discharge, and 16 and 48 maximum days respectively before death and recovery for discharge.

On the average 20 ± 6.1 and 24 ± 7.5 days were spent before recovery by the HIV negative and HIV positive SAM children respectively, and 24 ± 1.4 and 15 ± 1.0 days were spent before death by the HIV negative and HIV positive SAM children respectively (Table 6).

Overall, HIV positive SAM children spent an average 23 ± 8.0 days on admission before death or nutritional recovery whereas HIV negative SAM children spent on the average 20 ±

6.0 days on admission before death or nutritional recovery (Table 8).

Table 8 Relationship Between HIV Status Of SAM Children And Time To Their Therapy To For Nutrition Outcome

HIV Status of Children	Mean time to their therapy for nutrition outcome			
	Recovered	**Died**	**Total**	**P values**
Positive	24 ± 7.5	15 ± 1	23 ± 8	0.095
Negative	20 ± 6.1	24 ± 1.4	20 ± 6	0.001
Total	21 ± 7.0	21 ± 4.9	21 ± 7	0.002
P values	.001	.002	.005	

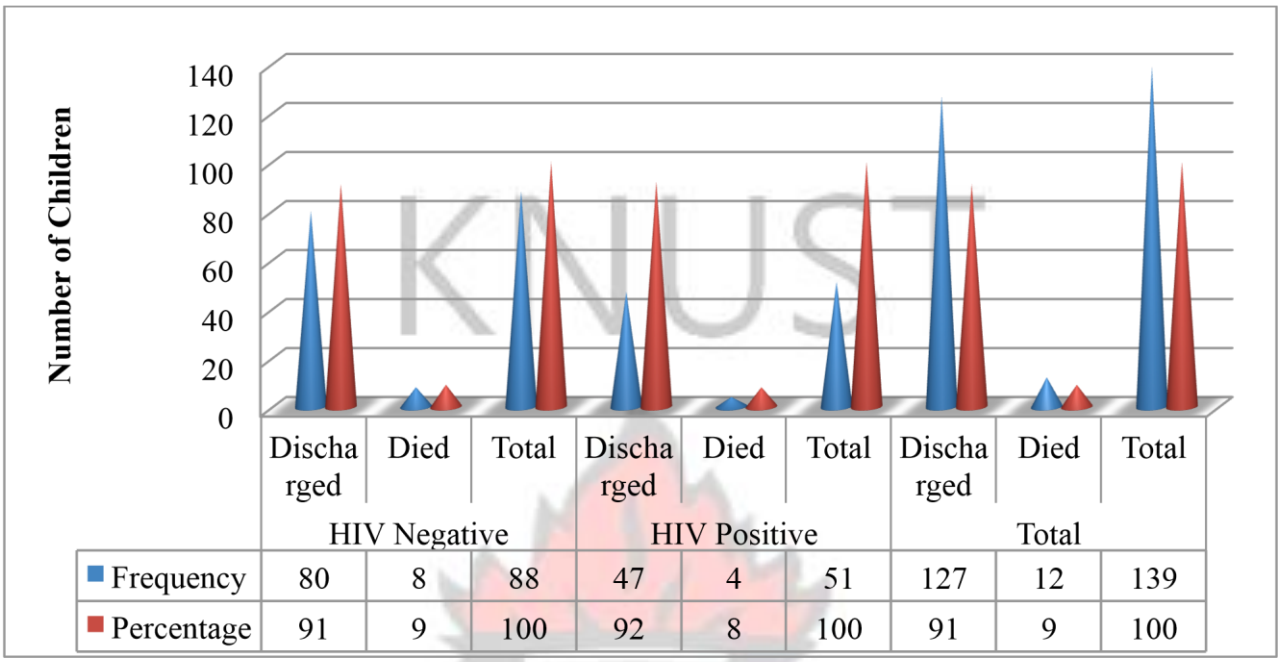
4.7.2. Treatment Outcome According To HIV Status

Hypothesis: There is a significant difference between the treatment outcome for SAM children with HIV and SAM children without HIV.

Out of the 90 children without HIV, 80 (91%) recovered from their SAM and 8(9%) died and out of the 51 children with HIV, 47(92%) recovered from their SAM and 4 (8%) died. The data showed that many of the children (90.1%) were discharged. The 2 who defaulted were not included in the final analysis of the treatment outcomes (Figure 7).

Figure 7 The Relationship between HIV Status of SAM Children and Their Therapy for

Nutrition Outcome



4.8. Nutritional Recovery and Mortality Rates

90% (127/141) of all the enrolled children recovered from severe acute malnutrition. SAM children with HIV recovered as frequent as those without HIV (1% points difference, 95% CI, 0.6 to 1.3) (Table 9). Children with marasmus-kwashiorkor recovered less frequently and were more likely to die than children with either kwashiorkor or marasmus. Except for 2 SAM children without HIV who defaulted, death was responsible for all the children who did not recover in each of the two study groups. The overall mortality rate was 9% and the rate was not significantly different between the two groups in the study (relative risk 1.044, 95%CI, 0.7 to 1.6).

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Table 9 Recovery And Growth Outcomes According To HIV Status And Type Of SAM

Outcome	Non-HIV/AIDS SAM	HIV/AIDS SAM	Non-HIV/AIDS SAM vs. HIV/AIDS SAM	
			Relative risk 95% CI	P value
Overall				
Number of Children	90	51		
Recovered – no. (%)	80 (91)	47(92)	0.8819 (0.6170 to 1.261)	0.7704
Did not recover - no. (%)	10 (11)	4 (8)	1.119	0.7714
Died	8 (9)	4 (8)	1.044	1
Incomplete data	2 (2)	0 (0)	1.567	0.5379
Continued to have SAM	0 (0)	0 (0)		
Kwashiorkor				
No. of children	8	1		

Recovered – no. (%)	8 (100)	1 (100)		1.0
Did not recover - no. (%)	0 (0)	0 (0)		
Died	0 (0)	0 (0)		
Incomplete data	0 (0)	0 (0)		
Continued to have SAM	0 (0)	0 (0)		
Marasmus-Kwashiorkor				
No. of children	12	3		
Recovered – no. (%)	6 (50)	2 (67)	0.8750 (0.5298 to 1.445)	1.0
Did not recover - no. (%)	6 (50)	1 (33)	1.071	1
Died	6 (50)	1 (33)	1.071	1
Incomplete data	0 (0)	0		
Continued to have SAM	0 (0)	0		
Marasmus				
No. of children	70	47		
Recovered – no. (%)	66 (94)	44 (94)	1.050 (0.5429 to 2.031)	1.0
Did not recover - no. (%)	4 (6)	3 (6)	0.9551	1
Died	2 (3)	3 (6)	0.6686	0.3994
Incomplete data	2 (3)	0 (0)	1.671	0.518
Continued to have SAM	0 (0)	0 (0)		

Septicaemia (in patients with oedematous dermatosis) and anaemia were the significant causes of death among SAM children without HIV as against pneumonia among SAM children with HIV (Table 10).

Table 10 Causes of Death According To Doctors' Stated Cause Of Death.

Reported Cause Of Death	HIV (N=4)	NON-HIV (N=8)	TOTAL
Oedematous dermatosis (With septicaemia)	0(0)	3(37.5)	3
Diarrhoea	1(25)	2(25)	3
Anaemia	0(0)	3(37.5)	3
Pneumonia	3(75)	0(0)	3

Recovery rates were higher and mortality rates were lower among SAM children without HIV than among those who had HIV, across a number of baseline characteristics (Figures 8 and 9 Forest Plots).

Figure 8 Forest Plot for Recovery

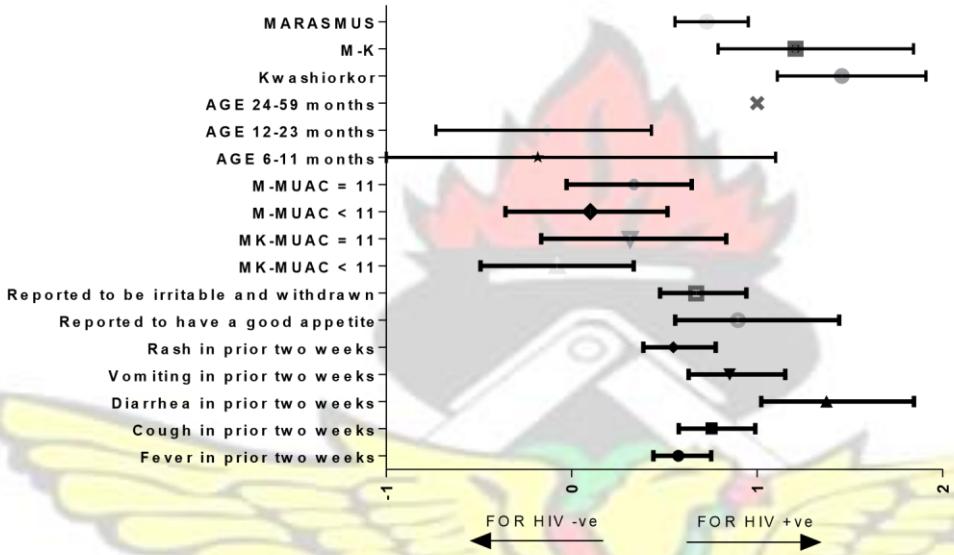
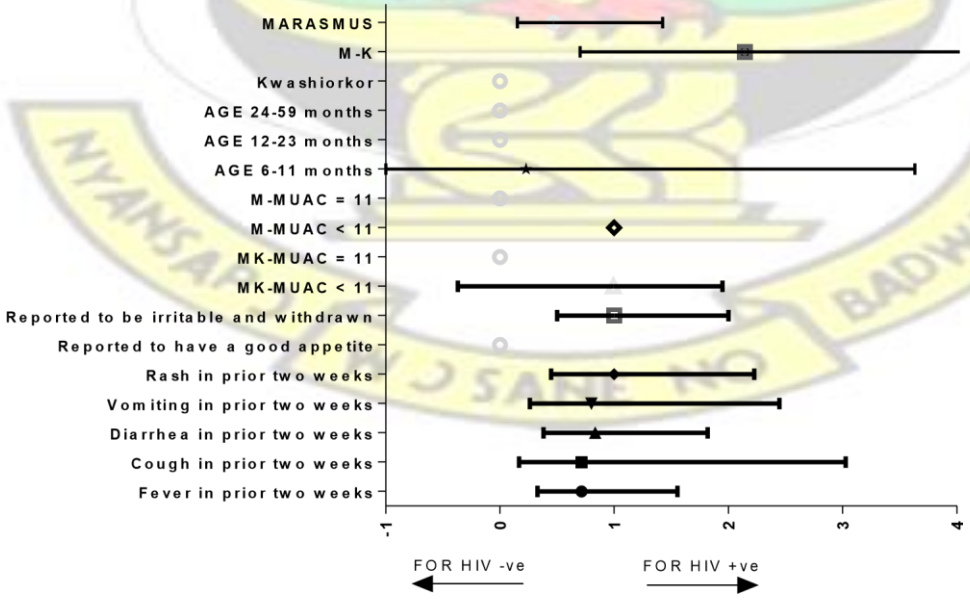


Figure 9 Forest Plot for Mortality



4.9. Secondary Outcomes

The time to recovery was shorter in the Non HIV group than in the HIV group (Figure 11). Weight gains and gain in length from admission until discharge were significantly higher among SAM children with HIV than among those who did not have HIV. SAM children with HIV also had greater increases in mid-upper-arm circumference than did those who did not have HIV (Table 11).

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Table 11 Secondary Outcomes, HIV Status And Type Of SAM (Overall)

Secondary Outcome	Non-HIV/AIDS SAM	HIV/AIDS SAM	Total
Overall	90	51	141
Time to Recovery			
Number of Children	88	51	139
Number of days	20 ± 6	23 ± 8	21 ± 7
Weight			
No. of children	88	51	139
Gain (g/kg/day)	4.8 ± 1.6	5.5 ± 2.0	5.3 ± 1.7
Length			
No. of children	88	51	139
Gain (mm/day)	0.18±0.44	0.22±0.44	0.20±0.44

Mid-upper-arm circumference			
No. of children	88	51	139
Gain (mm/day)	0.27 ± 0.12Ⅲ	0.34 ± 0.13Ⅲ	0.31 ± 0.13

Children with marasmus-kwashiorkor recovered significantly more slowly than children with either kwashiorkor or marasmus (Tables 14-16). Weight gain from admission until discharge was highest among Marasmus children and least among the children with Kwashiorkor.

Table 12 Secondary Outcomes, HIV Status And Type Of SAM (Kwashiorkor)

Secondary Outcome	Non-HIV/AIDS SAM	HIV/AIDS SAM	Total
Time to recovery			
No. Of children	8	1	9
No. Of days	13 ± 4	14	13 ± 4
Weight			
No. of children	8	1	9
Gain (g/kg/day)	2.5	3.2 ± 0.8	3.2 ± 0.8
Length			
No. of children	8	1	9
Gain (mm/day)	0.20±0.48	0.24±0.47	0.22 ± 0.48
MUAC			
No. of children	8	1	9
Gain (mm/day)	0.21	0.26 ± 0.18	0.26 ± 0.17

Table 13 Secondary Outcomes, HIV Status And Type Of SAM (Marasmus-Kwashiorkor)

Secondary Outcome	Non-HIV/AIDS SAM	HIV/AIDS SAM	Total
Time to recovery			
No. of children	12	3	15
No. of days	24 ± 5	29 ± 3	25 ± 5
Weight			
No. of children	12	3	15
Gain (g/kg/day)	3.6 ± 2.0	4.1 ± 0.9	4.0 ± 0.80
Length			

No. of children	12	3	15
Gain (mm/day)	0.13±0.30	0.17±0.38	0.15±0.32
Mid-upper-arm circumference			
No. of children	12	3	15
Gain (mm/day)	0.19 ± 0.2	0.34 ± 0.12	0.31 ± 0.12

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Table 14 Secondary Outcomes, HIV Status And Type Of SAM (Marasmus)

Secondary Outcome	Non-HIV/AIDS SAM	HIV/AIDS SAM	Total
Time to recovery			
No. of children	68	47	115
No. of days	20 ± 6	23 ± 8	21 ± 7
Weight			
No. of children	68	47	115
Gain (g/kg/day)	4.9 ± 1.6	6.0 ± 1.9	5.6 ± 1.9
Length			
No. of children	68	47	115
Gain (mm/day)	0.16±0.32	0.21±0.35	0.17±0.34
Mid-upper-arm circumference			
No. of children	68	47	115
Gain (mm/day)	0.28 ± 0.13	0.34 ± 0.13	0.32 ± 0.13

CHAPTER FIVE DISCUSSION

5.1. Introduction

Malnutrition is a significant public health problem in developing countries; more than 50% of the 10 million deaths each year are attributed either directly or indirectly to malnutrition in children younger than 5 years; (WHO, Global database on child growth and malnutrition. Geneva 2011). There are 137 million children under the age of 5 in sub-Saharan Africa, of who 12.3 million are wasted while some 2.3 million children aged 0–14 in the region have HIV (UNICEF, "The state of the world's children 2011). There is undoubtedly a significant overlap and interaction in these two populations in resource-limited settings (Koethe and Heimburger,

2010). Severe acute malnutrition (SAM) is associated with increased severity of common infectious diseases, and death amongst children with SAM is almost always as a result of infection (Black *et al*., 2008). The HIV pandemic ravaging sub-Saharan Africa has changed the face of childhood malnutrition. In high HIV prevalence settings, HIV is a major contributor to the burden of child malnutrition (De Maayer and Saloojee, 2011; Thurstans *et al*., 2008).

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5.2. The Prevalence and Types of Severe Acute Malnutrition KATH

The findings of this study shows a total of 141 children with SAM were admitted to the Komfo Anokye Teaching Hospital over a period of six months. This means about 24 cases of SAM were admitted per month at KATH. 9(6.4%) of these children had Kwashiorkor and 15 (10.6%) had Marasmus-Kwashiorkor. The greater majority forming 83.0% had Marasmus. As has been described previously, the children were more likely to suffer from marasmus than kwashiorkor (oedematous malnutrition) (Bachou *et al*., 2006; Chinkhumba *et al*., 2008).

The presence of marasmus as the main severe acute malnutrition in this study is in agreement with findings by Antwi (2008). All the 9 children with Kwashiorkor had severe wasting with generalized oedema whereas the Marasmus or the Marasmus-Kwashiorkor children all had severe wasting with or without severe stunting.

The findings of this study supports the assertion by the WHO (2009), and ASSAF Report, 2008, that severe acute malnutrition opens doors for opportunistic infections as the results of the study show that 127 (90.1%) of the children had at least one infectious symptom in prior two weeks before admission, and that the average axillary temperature of the children at admission was 37.8 ± 0.6 ^{o}C. These findings also support earlier research works conducted Williams 2005, p.405, Torun, 2006, p.882 and Seumo-Fosso *et al*., 2005 on how opportunistic infections take root in HIV+ and severe acute malnourished children.

For malnutrition to improve according to UNICEF there should be specific emphasis on social norms, gender equity and maternal access to education (UNICEF, 2009c). This makes women's role as primary care takers of children indispensable. This study found out that 135 of the children representing 95.7% wee under the primary care of their mothers. This finding on its face value is at variance with what UNICEF has said to the effect that women's role as primary care takers of children is indispensable in the prevention of malnutrition in children. However this finding depicts the fact that other factors such as mother's educational background, economic earning power, work load, decision making power and access to health care, all play a role in the final outcome of a child's nutritional status.

Out of the total sample of 141, 131(92.9%) homes had at least 1 additional child, 35 (24.8%) had at least 2 additional children and 1 (0.7%) had 3 additional children less than five years in their homes. This could be a contributory factor to the levels of malnutrition among the children in this study as affirmed by many studies: Piercecchi-Marti et. al.2006; UNICEF 2004, Müller & Krawinkel 2005; Hendricks *et al*., 2006 and Shoo, 2007. These attest to the fact that an additional child born into a family with children under five years has the potential of creating economic hardship and in the wake of insufficient money to buy food for the expanding family the children get malnourished due to family food insecurity.

5.3. The Incidence of HIV/AIDS among Children with Severe Acute Malnutrition (SAM)

The data shows that out of the total of 141 SAM children studied, 51 (36.2%) of them were HIV positive and 90 (63.8%) of them were HIV negative. The HIV prevalence in severely malnourished children was high (36.2%) but it is in consonance with previous African studies which have reported figures between 17% and 54% (Bachou *et al*., 2006; Chinkhumba *et al*., 2008; De Maayer and Saloojee, 2011). This finding also shows that there is a significant overlap and interaction between HIV and malnutrition in resource-limited settings as supported

by Hughes *et al*. and Koethe J. *et al.*, (2009; 2010). The finding however, contradicts the work by, Bahwere (2008) that reports of a low rate of HIV among children with SAM despite the study being at the community level. This difference could be as a result of a number of factors such as chronic food insecurity, frequent common childhood illnesses, poor access to modern health care and suboptimal complementary feeding practices that cause SAM in the absence of HIV in Malawi and were likely to have contributed to the low prevalence of HIV amongst severely malnourished children in the Bahwere (2008) study.

The study found out that 47(33.8%) of mothers were tested for HIV, whereas 92 (66.2%) of them were not tested for HIV. 74 (82.2%) of mothers of HIV negative SAM children and 18 (36.7%) of mothers of HIV positive SAM children were not tested for HIV. Most of the parents especially those of HIV negative SAM children were thus not tested for HIV. As many of the mothers of HIV negative SAM children were not tested for HIV it is therefore not known how many of the SAM children were HIV affected. According to Shapiro and Lockman (2010), the number of children categorised as being HIV affected (i.e., HIV exposed but not infected) is expanding exponentially around the world, through improvements in prevention of mother-to-child transmission of HIV programmes, and their health is raising concern. It is therefore important that the HIV status of the parents of SAM children should be known so that SAM children who are HIV affected (i.e., HIV exposed but not infected) will be identified; especially as children who are HIV exposed but uninfected are at a higher risk of morbidity and mortality compared with non-exposed children (Brahmbhatt *et al*., 2006; Kuhn *et al*., 2010; Roger L. Shapiro and Lockman, 2010). While all the 139 (100%) mothers (alive) consented for their malnourished child to be tested; only 47 (33.8%) offered to be personally tested for HIV. This supports Thurstans, *et al*. (2008) finding that suggests that though parents may allow their children to undergo voluntary testing they may not allow themselves to be tested.

The data shows that 33 (64.7%) of the HIV positive SAM children were on anti-retroviral therapy as against 18 representing 35.3% of the children not being on anti-retroviral therapy. All the 33 children on ART had nutritional recovery in the acute setting (Phases I, Transitional phase and phase II), and none of these died in the acute setting. This finding contradicts earlier findings that HIV-infected children started on ART with more severe wasting have higher rates of mortality than those with less wasting, (Callens *et al*., 2009; Naidoo *et al*., 2010; Taye *et al*., 2010): but supports an important recent retrospective study that suggests that malnourished children who start ART promptly have higher rates of nutritional recovery and weight gain than those in whom ART is delayed(Kim *et al*., 2012). In the earlier findings with the contradictions it was not stated exactly when the ART was started. Children with SAM at admission may by suffering from or be at risk of hypoglycaemia, hypothermia, dehydration and septic shock (WHO, 2007a). The phase I and transitional phase are used to stabilize the child and the introduction of ART at this point may increase morbidity and/or mortality. It also supports other findings that overall, amongst infants (SAM and non-SAM), early ART initiation is associated with a 4-fold reduction in mortality(Prendergast *et al*., 2012; Violari *et al*., 2008).

5.4. The Time to Recovery and Time to Death in the Treatment of Children with SAM

Overall, for the SAM children who recovered, the average number of days spent on admission was 21 ± 7.0 (8-48 days). SAM children without HIV infection spent an average of 20 ± 6.1days (8-32 days), whereas SAM children with HIV infection spent an average of 24 ± 7.5 days (14-48 days) before discharge from the hospital. SAM children with HIV infection therefore stayed longer before discharge from the hospital than SAM children without HIV infection. However nutritional recovery was similar in HIV-infected and HIV-uninfected SAM children supporting earlier evidence in sub-Saharan countries that shows that HIV infected

children can recover their nutritional status when given the correct treatment for severe acute malnutrition (SAM) without ARVs but their recovery is slower than that of uninfected children (Collins *et al*., 2006: WHO, 2007B). Although HIV-infected children had a longer stay on admission before discharge (24 ± 7.5 days vs. 20 ± 6.1 days; p=0.001), their rate of weight gain was slightly higher (5.5 ± 2.0 g/kg/d vs. 4.8 ± 1.6 g/kg/d).

For the SAM children who died while on admission, the average number of days spent on admission before death was 21 ± 4.9 (14-26 days). SAM children without HIV infection spent an average of 24 ± 1.4 days (22-26 days), whereas SAM children with HIV infection spent an average of 15 ± 1 day (14-16 days) on admission before death. Thus HIV-infected SAM children were likely to die earlier on admission than HIV-uninfected SAM children.

5.5. The Treatment Outcomes of SAM in HIV/AIDS Children Compared With Non-HIV/AIDS Children

This study reports nutritional recovery in 91.4% (127/139) of severely acute malnourished children overall, meeting international minimum standards (>75%) for recovery from nutritional rehabilitation (Anti-retroviral Therapy for HIV Infection in Infants and Children,

2010). All children who survived achieved nutritional recovery, regardless of HIV status. Among the HIV-infected children, 92.1% (47/51) recovered in the acute setting compared with 90.9% (80/88) in HIV-uninfected children (p=1). Thus SAM children with HIV recovered as frequently as those without HIV (1% point difference, 95% CI, 0.6 to 1.3). Except for 2 SAM children without HIV who defaulted (were discharged against medical advice), death was responsible for all the children who did not recover in each of the two study groups. This study reports that 8.6% (12/139) of all the SAM children studied died.

This figure was on a rather low side compared with the reported case fatality rate (CFR) of 21% (30 - 50%) without effective treatment (WHO Fact sheet report, 2012). This improvement

is due to the effective in-patient management of SAM in accordance with the WHO guidelines. There was no statistical significant relationship between HIV status in this study and the treatment outcome of the children ($\chi 2 = 0.095$, p-value =0.05). Among the HIV-infected children, 7.8% (4/51) died in the acute setting compared with 9.1% (8/88) in HIV-uninfected children (p=1). Thus the overall mortality rate was 8.6% and the rate was not statistically significantly different between the two groups in the study (relative risk 1.044, 95%CI, 0.7 to 1.6). Mortality level in HIV-infected children in this study does meet international minimum standards for nutrition rehabilitation, which state that mortality should be below 10%, (WHO, 2007a). However the findings contradict those of early studies that HIV-infected children with SAM have higher mortality rates than HIV-uninfected children, (Brahmbhatt *et al*., 2006; Chinkhumba *et al*., 2008; De Maayer and Saloojee, 2011; Fergusson *et al*., 2009; Fergusson and Tomkins, 2009; Kuhn *et al*., 2010; Schofield and Ashworth, 1996; Shapiro, R. L. and Lockman, S. 2010). These studies consisted of an initial in-patient phase, based on WHO guidelines, and an out-patient recovery phase using readyto-use therapeutic food; and were conducted over longer periods whereas the present study involved only the initial in-patient phase, based on WHO guidelines and was conducted over a far shorter period. These could explain the difference since according to Pamela Fergusson, and Andrew Tomkins(2009), HIV-negative children treated within community-based therapeutic care (CTC) programmes had lower mortality than those treated within an inpatient nutrition rehabilitation unit (NRU) but there is no significant difference in mortality for HIV-infected children with SAM treated in the NRU (an initial inpatient phase, based on WHO guidelines) or CTC (an outpatient recovery phase using ready-to-use therapeutic food) settings. Most, 33 (64.7%), of the HIV-infected children were on ART. This could have contributed to the reduced mortality in the HIV-infected children to a level similar to that of the HIV-uninfected group.

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CHAPTER SIX SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

6.1. Introduction

The growing levels of severe acute malnutrition and its interrelationship with HIV among children globally and specifically in Ghana necessitates this study. The objectives of this study are:

1. To determine the incidence of HIV/AIDS in children with severe acute malnutrition.
2. To identify the time to recovery and time to death in the treatment of children with severe acute malnutrition.
3. To compare the treatment outcomes of severe acute malnutrition in HIV/AIDS children with non- HIV/AIDS children at Komfo Anokye Hospital.

The following key findings were made on the specific objectives of the study:

6.2. The Incidence of HIV/Aids among Children with Severe Acute Malnutrition (SAM).

The study identified that 156 children were admitted for severe acute malnutrition over a six months period. Out of the141 of these children enrolled in the study 51(36%) had HIV infection whereas 90(64%) were HIV negative. It could not be determined how many of these children were HIV affected since 74 (82.2%) of the mothers of children without HIV infection were not tested for HIV infection. The selected baseline characteristics of the children were similar among the HIV-infected and the HIV-uninfected children except for the children's age, axillary temperature at time of admission, fever in the two weeks preceding hospital admission, and rash in the two weeks preceding hospital admission. HIV-infected children were older, and more likely to have a higher axillary temperature at admission, and likely to have fever and/or a rash in the two weeks preceding hospital admission. Most, 33 (64.7%), of the HIV-infected children were on ART. This could have contributed to the reduced mortality in the HIV-infected children to a level similar to that if the HIV-uninfected group.

6.3. The Time to Recovery and Time to Death in the Treatment of Children with Severe Acute Malnutrition

On the average 20 ± 6.1 and 24 ± 7.5 days were spent before recovery by the HIV negative and HIV positive SAM children respectively, and 24 ± 1.4 and 15 ± 1.0 days were spent before death by the HIV negative and HIV positive SAM children respectively.

Overall, HIV positive SAM children spent on the average 23 ± 8.0 days on admission before death or nutritional recovery whereas HIV negative SAM children spent on the average 20 ± 6.0 days on admission before death or nutritional recovery.

6.4. The Treatment Outcomes of Severe Acute Malnutrition in HIV/AIDS Children with Non- HIV/AIDS Children.

Out of the 90 children without HIV, 80 (91%) recovered from their SAM and 8(9%) died and out of the 51 children with HIV, 47(92%) recovered from their SAM and 4 (8%) died. A majority of the children (90.1%) were discharged.

There was no significant effect of the HIV status of the children in this study on their treatment outcomes.

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6.5. Conclusions

HIV-infected children with SAM have similar mortality rates as HIV-uninfected children but take a longer time to recover. Among those who survive, however, nutritional recovery is similar in HIV-infected and HIV-uninfected children.

Our findings show that HIV-infected children can achieve and maintain nutritional recovery. Routine testing and treatment for HIV among all malnourished children is necessary to improve quality of care and reduce mortality among children with SAM.

Nutrition rehabilitation programmes are an important entry point for HIV care, and in order to achieve further gains in child growth and survival among HIV-infected severely malnourished children, it is essential to integrate HIV services into programmes for nutritional rehabilitation.

6.6. Recommendations

The study makes the following recommendations to be implemented by the various authorities to improve child health and treat SAM/HIV children effectively:

6.6.1: Hospital Policy Makers:

This study recommends ART should be started promptly (7 to 10 days after transition to the rehabilitation phase of SAM treatment) in HIV-infected SAM children. Mothers who are tested positive, as a matter of policy should be placed on the ART according to standard protocols.

All mothers of SAM children should be encouraged to undergo voluntary HIV counselling and testing (VCT) so as to identify the HIV-affected children. This could then help in the study of the effect of HIV exposure in the treatment outcome of SAM children. HIV status of SAM children should be by provider-initiated testing and counselling (PiTC) or diagnostic HIV testing and counselling (DTC) which provides an immediate benefit for a child's care. ('TC' refers specifically to the approach of testing then counselling for direct clinical care, rather than 'CT', which refers to counselling and testing in other contexts). Also this study should be extended to cover a longer period of at least one and also to cover at least four months of an outpatient recovery phase using ready-to-use therapeutic food.

It is anticipated that an intervention study be conducted on the children with an increase in the sample of the children to monitor the progress in nutritional recovery and the variations in HIV-infected children and HIV-uninfected children. It is also anticipated that a prospective study be conducted on the optimal timing, regimen, and dosing of ART in SAM children.

6.6.2: Care Managers/ In-Patient Caretakers of Children with Severe Acute Malnutrition It is recommended that every child who is diagnosed of SAM be tested for HIV/AIDs as the preliminary stage of the study demonstrated that that a number of the SAM children HIV status could not be ascertained causing their ineligibility for this study. The testing could either be done through rapid testing when child is over eighteen months of age or through
PCR testing at less than eighteen months of age after which children should be placed on ART. This can be supported with by testing for the CD4 percentage to help in placing child on ART with optimal timing, regimen, and dosing.

It is further recommended that in the absence of the CD4 percentage in children with moderate to severe unexplained wasting/malnutrition not responding to standard therapy, children should

begin ART because the WHO (2009) staging criteria for children infected with HIV places these children under stages III and IV.

6.6.3: Ministry Of Health /Ghana Health Service

The findings of this study is only limited to the hospital setting for which it will be difficult in knowing HIV and SAM prevalence and mortality variations at the community level. Nutrition rehabilitation programmes run at hospital due to systemic barriers in health care utilization, travel distances to access care, demands an alternative approach to addressing nutritional concerns of children with mothers being focal persons. This study recommends to the MOH/GHS that within the Kumasi metropolis, there are still urban poor and that multi–purpose health education campaign be designed to increase coverage and service provision for SAM at the community level. This will aid in identifying and treating children with SAM at community level, as it will aid in identifying HIV-infected children earlier in their disease, and referring them for appropriate treatment.

6.7. Limitations and Future Research

Due to the fact that the study had to be conducted in hospital setting in a resource-limited setting, and also the fact that it was retrospective, the study had some challenges relating to data collection. Some data for specific variables were missing, or of poor quality. Some data on morbidity were collected but these were incomplete and inconclusive and difficult to interpret. Future research should explore an interventional study where children will be put on a nutritional recovery treatment to examine the outcome variable for HIV-positive and HIV-negative cases.

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APPENDIX A: ETHICAL CLEARANCE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/144/14

25th April, 2014.

Mrs. Priscilla Atipillah
Child Health Department
Maternal and Child Health Hospital
Post Office Box 1934
KUMASI.

Dear Madam,

LETTER OF APPROVAL

Protocol Title *"The Effect of HIV/AIDS on the Treatment Outcome of Severe Acute Malnourished Children".*

Proposed Site: *Child Health Directorate, Komfo Anokye Teaching Hospital.*

Sponsor: *Principal Investigator.*

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 24th July, 2013 from the Komfo Anokye Teaching Hospital (study site) indicating approval for the conduct of the study in the Hospital.
- A completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Proposal.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, renewable annually thereafter. The Committee may however, suspend or withdraw ethical approval at anytime if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you Madam, for your application.

Yours faithfully,

Osomfuor Prof. Sir J. W. Acheampong MD, FWACP
Chairman

Room 7 Block J, School of Medical Sciences, KNUST, University Post Office, Kumasi, Ghana
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APPENDIX B: QUESTIONAIRE / CASE RECORD FORM (CRF)

The Impact of HIV/AIDS on the Treatment Outcome of Severe Malnutrition in Children Under 5 Years at the Komfo Anokye Teaching Hospital

KNUST

Data Entry Form

DATE OF INTERVIEW: / /

__ __ __ __ __ __ __ __ __ __

DAY MONTH YEAR

(Record month in 3-letter abbreviations like JAN, FEB, MAR, DEC)

INTERVIEWER'S NAME: _____

Please print name clearly

SUPERVISOR'S NAME: _____

Please print name clearly

STUDY SITE: __ __

INTERVIEW START TIME: __ __:__ __ AM / PM (circle one)

INTERVIEW OUTCOME CODE: __ __ 01 completed

02 partially completed

A. Demographic Characteristics

A1. Sex

Male……. 1

Female……. 2

A2. Age: _____ _____ months

A3. Is the mother alive?

Yes _____1 **Go to A3.1**

No _____2

Don't know _____9

A3.1 Is the mother the primary caretaker?

Yes _____1

No _____2

Don't know _____9

A4. Is the father alive?

KNUST

Yes _____1 **Go to A4.1**

No _____2

Don't know _____9

KNUST

A4.1 Does the father live with them at home?

Yes _____1

No _____2

Don't know _____9

A5. How many children under 5years old live at home? _____ _____

A6. How many minutes does it take to reach the nearest health centre from the child's home?

_____ _____ minutes

A7. Is the child currently breastfeeding?

Yes _____1

No _____2

Don't know_____9

A8. At what age did the child stop breastfeeding? _____ _____ months

B. Clinical Characteristics

B1. What type of Severe Acute Malnutrition did the child have?

Kwashiorkor……1

Marasmic kwashiorkor…….2

Marasmus……..3

KNUST

B2. What was the child's Mid-upper arm circumference/cm?

B2.1 Period 1 _____ _____ cm

B2.2 Period 2 _____ _____ cm

B2.3 Period 3 _____ _____ cm

B2.4 Period 4 _____ _____ cm

B3. What was the child's weight/kg?

B3.1 Period 1 _____ _____ kg

B3.2 Period 2 _____ _____ kg

B3.3 Period 3 _____ _____ kg

B3.4 Period 4 _____ _____ kg

B4. What was the child's length or height/cm?

B4.1 Period 1 _____ _____ cm

B4.2 Period 2 _____ _____ cm

B4.3 Period 3 _____ _____ cm

B4.4 Period 4 _____ _____ cm

B5. What was the child's axillary temperature/^{0}C?

B5.1 Period 1 _____ _____ ^{0}C

B5.2 Period 2 _____ _____ ^{0}C

B5.3 Period 3 _____ _____ ^{0}C **B5.3**

Period 4 _____ _____ ^{0}C

KNUST

A. Medical History

C1. Has the child been admitted to the hospital before?

Yes _____1

No _____2

Don't know _____9

C2. Has the child been admitted to the hospital before for malnutrition?

Yes _____1

No _____2

Don't know _____9

C3. Has the child been tested for HIV?

Yes _____1 **Go to C3.1**

No _____2

Don't know _____9

KNUST

C3.1 Has child tested HIV positive?

Yes _____1 **Go to C3.2**

No _____2

Don't know _____9

C3.2 Is the child on anti-retroviral therapy?

Yes _____1

No _____2

Don't know _____9

C4. Has the child's mother tested for HIV?

Yes _____1 **Go to C4.1**

No _____2

Don't know _____9

C4.1 Has the child's mother tested HIV positive?

Yes _____1 **Go to C4.2**

No _____2

Don't know _____9

C4.2 Is the child's mother on anti-retroviral therapy?

Yes _____1

No _____2

Don't know _____9

C5. Has the child shown any symptoms indicative of an infection in the two weeks period before admission to the hospital?

Yes _____1

No _____2

Don't know _____9

KNUST

C6. Has the child had fever in the two weeks period before admission to the hospital?

Yes _____1

No _____2

Don't know _____9

C7. Has the child been coughing in the two weeks period before admission to the hospital?

Yes _____1

No _____2

Don't know _____9

C8. Has the child been passing frequent loose watery stools in the two weeks period before admission to the hospital?

Yes _____1

No _____2

Don't know _____9

C9. Has the child been vomiting in the two weeks period before admission to the

hospital?

Yes _____1

No _____2

Don't know _____9

KNUST

C10. Has the child had rashes in the two weeks period before admission to the hospital?

Yes _____1

No _____2

Don't know _____9

C11. Has the child good appetite at admission?

Yes _____1

No _____2

Don't know _____9

B. Treatment Outcome

D1. Was participant discharged, died, or remained acutely malnourished?

Discharged _____ 1 **Go to D2**

Died _____ 2 **Go to D2-D3**
Remained acutely malnourished _____ 3

D2. What was the number of days spent on admission before discharge or death?

_____ _____

D3. What was the cause of death as stated by the attending physician?

_____ _____

PLEASE REVIEW THIS QUESTIONNAIRE AFTER COMPLETION.

THANK YOU.

KNUST