MORTALITY AND MORBIDITY TRENDS IN UNDER-FIVE CHILDREN WITH SEVERE ACUTE MALNUTRITION AT UNIVERSITY TEACHING HOSPITAL (UTH), LUSAKA ZAMBIA

Dissertation

By

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Declaration

I declare that the work presented in this thesis entitled MORTALITY AND MORBIDITY TRENDS IN UNDER-FIVE CHILDREN WITH SEVERE ACUTE MALNUTRITION AT THE UNIVERSITY TEACHING HOSPITAL (UTH) is to the best of my knowledge and belief my own work and that it is original. The dissertation has never been presented anywhere in whole or in part for the award of a degree in any university and all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Dated October 2014

DEDICATION

To God who is my source of strength. To my mother Martha Hakuna Munthali and in loving memory of my father William Weston Munthali and my loving husband Kelvin Sepete and our daughters Chiweme and Tasheni.

APPROVAL

The University of Zambia has approved this dissertation of Tendai Munthali as fulfilling the partial requirement for the award of the degree of Masters of Science in Epidemiology.

SUPERVISORS

I, the undersigned have read this dissertation and approved it for examination

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Abbreviations

ACC/SCN	-	Administrative Committee on Coordination/ Subcommittee on Nutrition
CSO	-	Central Statisticals Office
HIV	-	Human immune-deficiency virus
IQR	-	Inter quartile range
MDG	-	Millennium Development Goals
MOH	-	Ministry of Health
NFNC	-	National Food and Nutrition Commission
RUTF	-	Ready to use therapeutic foods
RVD	-	Retro Viral Disease
SAM	-	Severe Acute Malnutrition
WHO	-	World Health Organization
UNICEF	-	United Nations Children's Fund
UTH	-	University Teaching Hospital
FANTA	-	Food and Nutrition Technical Assistance

Abstract

Introduction: Severe acute malnutrition has continued to cause high disease burden in Zambia. Mortality rates at the University Teaching Hospital (UTH) were as high as up to 50% in 2008. There is paucity of published data on mortality and morbidity trends in under-five children with SAM at UTH. This study aimed to determine mortality and morbidity trends in under-five children with severe acute malnutrition at UTH.

Methods: A retrospective cross-sectional study, of all children admitted to ward A07 from January 2009 to December 2013. The study was done to assess trends in mortality, and how they are affected by morbidity, co-morbidity, and length of stay. A total of 9540 under-five children were analysed. The median and inter quartile ranges (IQR) were used to summarize and describe the data, as the data was not normally distributed. The Chi-square test was used to test the difference between the samples of the categorical variables sex, morbidity, co-morbidity and residence. In addition Kruskal Wallis was used to compare if means of the numerical variables length of stay on the ward and age for the different mortality, morbidity, and co-morbidity groups were different. Logistic regression was used to predict the odds of death in the independent variables and to control for confounding since the dependent variable mortality was categorical. Cuzick a non parametric test for trends was used to test mortality and morbidity trends. Furthermore survival analysis was done using Wilcoxon and Cox proportion hazard regression to test of difference of survival for the different groups and illustrated using Kaplan-Meier curves.

Results: Overall, 45.9% (4,386) were females and 53.9% males, median age was 17 months (IQR 12 to 22 months), and median length of stay was 8 days, (IQR of 3 to 14). The overall mortality rate was 46.7% with overall prevalence of HIV at 32.2% (2,589). About 62% (5,609) had Kwashiorkor 21.6% had Marasmus and 16.4% had marasmic-Kwashiorkor. Children with Marasmus had the highest prevalence of HIV infection at 40.1% (703). Kwashiorkor was associated with high prevalence of Anaemia 13.2% (121) while, Marasmic-Kwashiorkor had the highest prevalence of Diarrhoea (33.6%). Children with TB had the longest length of stay on the ward (14 days) and those with Septicaemia the shortest stay (4 days). Children who had co-morbidity were 50% more likely to die than those without co-morbidity. Of the children that

died, those who were HIV infected were 4 times more likely to die and children with Septicaemia were 3.8 times more likely to die than those with Anaemia respectively. Kaplan Meier survival curves showed also that children with Marasmus, Diarrhoea, Septicaemia, tuberculosis, and those who were HIV infected had reduced survival rates. Mortality and morbidity trends decreased with admissions (from 2009 to 2013) and both trends were significant at p=0.000.

Conclusion: Declining mortality and morbidity in children with acute malnutrition at UTH may suggest improved management practices. Nonetheless, limitations to totally prevent malnutrition may be an indicator of complex structural challenges that may be existent in this population thereby needing matching and complex intervention.

CHAPTER ONE: BACKGROUND

1.1 Introduction

Severe acute malnutrition is a major public health challenge globally and highly prevalent in developing countries. It affects about 19 million children, giving them a 10-fold higher risk of death compared to children without severe acute malnutrition (WHO, 2013 and UNICEF-WHO-The World Bank, 2012). The term malnutrition is usually used to explain imbalances in nutrition such as over-nutrition to under-nutrition seen in many developing countries. In this study, malnutrition will be synonymous with protein energy malnutrition, which signifies an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and function (De Onis and Blossner 1997).

The level of malnutrition can be measured using anthropometric measures such as weight and length (height) in combination with age and sex. These measurements are used to construct indices and indicators used to describe nutritional status of individuals or populations. The three basic indices used in childhood are weight for age Z-score (underweight), length or height for age Z-score (stunting) and weight for length or height Z-score (wasting). Other commonly used measures include various body circumferences (mid upper arm, head, chest, and abdomen) and skin folds (biceps, triceps, and sub-scapular, among others) (Maleta, 2006). The three indices are either expressed as either a Z-score or a percentage relative to the median of the reference population (ibid). In this study, only severe acute malnutrition (wasting) which is weight for height (De Onis & Blossner 1997) will be the focus. It is defined by WHO as weight for height measurement of 70% or less or weight for height measurements of below –3Standard deviations and/or the presence of oedema (WHO, 2003). Severe malnutrition, is characterized by wasting (Marasmus), oedema (Kwashiorkor), or both (Marasmic Kwashiorkor), and occurs mostly in children. Marasmus is diagnosed when subcutaneous fat and muscle are lost because of the body's process of mobilizing energy and nutrients. Clinical features usually include a triangular face extended abdomen (from muscular hypotonia) and anal or rectal prolapse (from loss of perianal fat). Features such as oedema, changes to hair and skin colour, Anaemia, hepatomegaly, lethargy, severe immune deficiency and early death, characterize Kwashiorkor (Bhan, et al. 2003).

1.2 Public health significance of under-five malnutrition

Under-five severe acute malnutrition is the result of closely linked factors such as insufficient food intake, and repeated severe infections usually associated with meeting basic needs and access to food, housing, and health care. Furthermore, severe malnutrition has serious immediate consequences such as high susceptibility to contracting illnesses (morbidity), and death (mortality). In the long term, impaired psychological and intellectual development may result, while in adulthood reduced body size, poor work and reproductive performance combined with increased risk of chronic diseases are common complications (De Onis & Blossner, 1997).

Globally about 52 million under five children are affected by moderate and severe acute malnutrition (Lenters et al., 2013). It is also estimated that over 19 million children worldwide are severely acutely malnourished at any one time (Lancet, 2008). In addition, Heikens, (2007) revealed that 53% to 60% of global child deaths are attributed to malnutrition (determined by weight for- height z-scores of less than minus 1). This represents 5.7–6.4 million malnutrition-related deaths each year associated with Pneumonia, Diarrhoea, measles, and malaria. Moreover, the prevalence of malnutrition has remained static at 30% in eastern and southern Africa from as far back as 1990, underlying about 57% of the almost 2 million deaths in the region every year (UNICEF, 2008). In Zambia, the prevalence of malnutrition is very high and malnutrition underlies up to 52% of all under five deaths (MOH, 2011). Currently 5% of under five children are acutely malnourished (wasted) and 15% are underweight (CSO, 2009). Under-five stunting rates are at 45% and have been this high for the past decade (UNICEF, 2008a).

1.3 Strategies to manage and prevent severe acute malnutrition

The Ministry of Health has implemented since 2005, the Integrated Management of Acute Malnutrition program which looks at community and health centre level management of uncomplicated severe acute malnutrition and training of health workers (FANTA, 2008). The program is a community-based approach for the management of uncomplicated severe acute malnutrition (SAM), where Ready to Use Therapeutic Foods (RUTF) is made available to families of children with SAM through either health facility or a community health worker. Community health workers are trained to identify children with SAM and to recognize those children who need urgent treatment or have complications and need referral (UNICEF & Valid International 2011). At hospital level training of health workers in World Health Organization (WHO) treatment guidelines is part of the policy in place to manage complicated SAM in the in-

patient setting. The WHO treatment guidelines are a ten-step protocol with three phases of treatment, which include stabilization, rehabilitation, discharge and follow up used in inpatient settings in the country (Amadi, 2009).

Recently the National Food and Nutrition Commission (NFNC) together with cooperating partners launched the First Most 1000 Critical Days Program. It is aimed at promoting good nutrition, infection prevention, and ultimately prevention of stunting (NFNC, 2012). Despite this program being in place, malnutrition fatality rate remains unacceptably high at 20 to 40% in hospitals across the country (MOH, 2011). An increase in the levels of admissions was noticed in 2008 despite the promotion of community therapeutic care for treatment of uncomplicated severe malnutrition and introduction of early identification of malnutrition and reduces congestion in hospitals (NFNC, 2008).

1.4 Mortality and co-morbidity in severe acute malnutrition

According to Annan and Turyashemererwa (2011), severe acute malnourished children have nine times risk of death compared with normal or moderately malnourished children. This high risk of mortality is evident in many nutrition rehabilitation units where peak mortality rates are within 48 to 72 hours of admission. A cross sectional study was conducted by the National Food and Nutrition Commission (2008) to analyze trends and patterns of malnutrition admissions in first and second level hospitals in all the provinces of Zambia. Mortality rate for the study period 2005 to 2008 was up to 24.2% but Solwezi and Zimba in 2006 had mortality levels of up to 92%. UTH in the last quota of 2008 recorded up to 50% mortality rates. Mortality rate were highest in the 24 -59 months age group (43%) and lowest in the less than 6 months age group (13%) (ibid). In contrast studies conducted in some nutrition rehabilitation units have reported lower mortality rates. For example a study in Kenya by Maitland et al., (2006) examined the major risk factors associated with early and late in-hospital death in children with severe malnutrition involving 920 children with severe acute malnutrition. It was found that 19% of children died during hospital stay with mortality greatest in children presenting with Marasmus. Mortality rates were highest (41%) among children who died within 72 hours compared to 33% within 48 hours of admission. In both studies however, severe acute malnutrition had several co-morbidities. These co-morbidities included gastroenteritis, malaria, Anaemia, Pneumonia, laboratory-confirmed bacteraemia; other invasive bacterial diseases (meningitis and osteomyelitis), tuberculosis,

known HIV infection, renal failure, and neurological impairment were documented as contributory. In the Maitland et al., (2006) study, bacteraemia and known HIV infection were seen to be associated with the highest mortality rates of 30% and 16% respectively. However in the NFNC study, malnutrition in several instances was recorded as either a primary or secondary diagnosis implying that severe acute malnutrition could be considered as morbidity or as co-morbidity.

Severe acute malnutrition co-morbidity with HIV and diarrhoea has also been associated with long recovery periods and high mortality rates. After a review of various studies done in Africa Trehan, et al., (2012) revealed that in Zambia more than half of patients admitted for malnutrition therapy treatment these days are HIV positive, with case fatality rates of about 40%. Irena et al., (2009) conducted a cohort study involving children 6-59 months old with Severe Acute Malnutrition (SAM) admitted to the UTH. They investigated the prevalence and effect of diarrhoea and HIV infection on inpatient treatment outcome of children with complicated SAM unit in 2009 on 430 children. It was revealed that 40.5% died while 67.1% had diarrhoea on admission 38.6% were HIV infected and only six children had tuberculosis. The study further revealed that overall mortality rate was at 40% while at 48 hour of admission it was 30.6% and 65% at 1 week of admission. Overall recovery period was 9 days, those with diarrhoea having the shortest duration at 9.6 days and those without diarrhoea recovering in 11.8 days. HIV infected children had the longest recovery period at 11.9 days compared to HIV uninfected children with duration of 9.4 days.

HIV-infected children present with either Kwashiorkor or Marasmus, just as those without HIV, though a considerable larger number of children with HIV present with Marasmus. Children with HIV tend to be more stunted and underweight than HIV-uninfected children because they usually present with severe oral and oesophageal candidiasis, which complicates attempts at therapeutic feeding. Since HIV-infected children are more susceptible to a variety of infections, such as cutaneous infections on the skin observed in Kwashiorkor, aggressive antimicrobial therapy, wound care, and a higher caloric requirements are needed compared to HIV -uninfected children (Trehan, et al., 2012).

As response to malnutrition therapy is less predictable and is not well understood in HIV-infected children a diagnosis of HIV should be strongly suspected in unusually young malnourished children (those under 6 months of age), in unusually older children (those over 5 years of age), and in those who do not respond appropriately to nutritional interventions. This is because decreased food intake will lead to wasting; causing a reduction in organ system function and an increased susceptibility to environmental alarms and stress (Jackson, et al., 1987). Since most of the metabolic responses described in severe malnutrition are based on children without HIV, the responses in HIV-infected malnourished children remain largely unknown (Heikens, 2007). Though Bhan, et al., (2003) argued that recovery from severe malnutrition can take longer and treatment failures are more common.

From the reviewed literature it is evident that severe acute malnutrition is associated with high mortality rates and co-morbidity. Due to limited literature on the subject matter, there is need, therefore, to generate information on the extent of mortality and morbidity in Zambia's highest-level hospital, hence this study.

CHAPTER TWO: RESEARCH FOCUS

2.1 Problem statement

In order to adjust and sharpen interventions, there is need to understand the dynamics and determinants of mortality among under five children with SAM at UTH. The core drivers of mortality are poorly understood largely due to limited structured monitoring and evalutation sytems. Moreover, there is paucity of data on mortality and morbidity trends in under-five children with SAM at UTH. The threshold figures are above the national trigger levels (5%) for the basis of considering a problem for public health decisions (Ministry of Health, 2011). The University Teaching Hospital Ward AO7 had in 2008 mortality rates as high as 50% among children with SAM in ward A07 (NFNC, 2008). Such high level of mortality among admitted children makes this study very relevant.

2.2 Justification

An understanding of mortality and morbidity trends in children with SAM will contribute to achieving Millennium Development Goal (MDGs) on reducing child mortality in Zambia. Furthermore the findings from this study will be critical for three things, namely: Intervention response, identifying information gaps therby dictating research focus and Policy in the area of under five SAM.

2.3 A Conceptual Framework

In order to examine the dynamics and determinants of mortality among under five children with SAM, it is important to be guided by conceptual framework so as to critically examine factor dynamics and interplays that may be important in this regard. The following framework adapted from Andrew Tomkins and Fiona Watson (1989) was used to examine these factors.

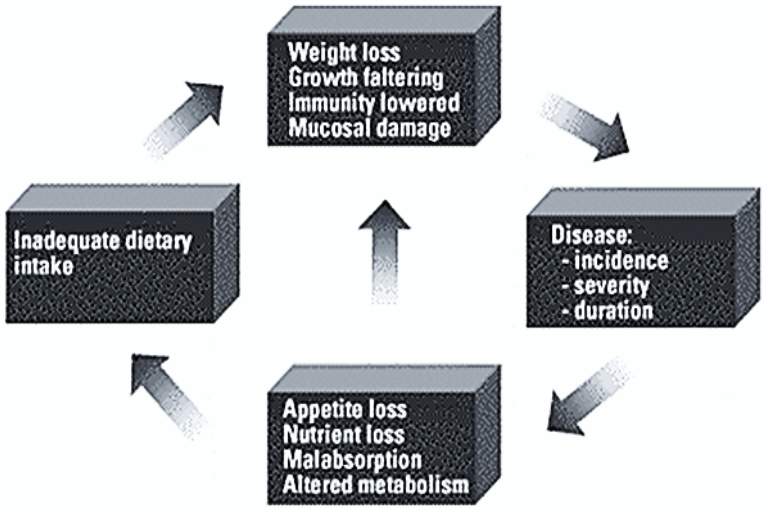


Figure 1; Inadequate dietary intake and morbidity cycle (Adapted from Andrew Tomkins and Fiona Watson, malnutrition and infection), ACC/SCN, Geneva (1989)

Childhood malnutrition is closely linked to insufficient food intake, and repeated severe infections. It follows then that malnutrition can be a result of repeated severe infections or can lead to severe repeated infection and high mortality. The vicious cycle between inadequate dietary intake and infection accounts for much of the high morbidity and mortality seen in Zambia and other developing countries. The immune system defences are lowered when children do not eat enough. This results in greater disease incidence, duration, severity, and progression into severe acute co-morbidities such as Diarrhoea and Pneumonia. Suppressed appetite in the presence of disease speeds nutrient loss and further weakens the immune system that facilitates severe acute malnutrition. Suppressed appetite in already existing severe acute malnutrition further perpetuates low immunity and incidence of diseases causing the cycle to continue, leading to mortality rates (UNICEF, 1998).

2.4 Research Questions

The research question for this study was:

What are mortality, morbidity and co-morbidity patterns and trends in children with SAM attending the UTH?

2.5 Research Objectives

General objective

To assess trends in mortality, morbidity, co-morbidity and length of stay on the ward in under five children with SAM at UTH

Specific objectives

1. To determine mortality trends among severely malnourished under-five children admitted at UTH.
2. To compare and determine length of stay on the ward in the different morbidity and co-morbidity groups of severely malnourished under five children at UTH.
3. To determine morbidity and co-morbidity patterns in under-five children with SAM at UTH.

CHAPTER THREE: METHODOLOGY

3.1 Study context

The study was conducted at the University Teaching Hospital (UTH) in Lusaka, which is a third level hospital in Zambia. The under-five malnutrition ward has a bed capacity of 59 and admits patients all year round. According to data collected during the study, up to 2108 children with SAM are admitted to the unit annually. Owing to high numbers of severe cases of complicated SAM than the unit can accommodated cot sharing is a common practice.

The ward is managed by three rotating resident physicians, two junior resident medical officers, a senior registrar, a consultant paediatrician and three to five nurses. All admissions are examined by the attending physician and the children are managed using WHO standard guidelines for the management of severe acute malnutrition. In the first phase F75 therapeutic milk (prepared using fresh or fermented milk on the ward) are used to nutritionally rehabilitate the children. After the nutritional rehabilitation F100 therapeutic milk or a peanut based ready to use therapeutic food (RUTF) is used to stabilize the children. Once the child is stabilized, they are discharged and referred to one of the 25 outpatient therapeutic programs (OTP) for full recovery.

3.2 Study population

All under five children admitted to ward A07 from January 2009 to December 2013 were eligible for this study. Admission to the unit was based on the presence of bilateral pitting oedema and /or weight for height Z-scores (WHZ) < -3 standard deviations (SD). The NCHS/WHO normalised charts are used to calculate weight for height Z- scores.

3.3 Study design and Sampling

The study was a retrospective cross-sectional study of all children admitted to ward A07 from January 2009 to December 2013, to assess trends in mortality, and how they are affected by morbidity, co-morbidity, and length of stay. This study was conducted from July 2013 to March 2014. Total sampling method was used, where all under-five children admitted to ward A07 from January 2009 to June 2013 were considered for analysis. A sample size of about 9540 children was included in the study.

The inclusion criteria for the study was

All under five children in the patient registers with variables of interest

The exclusion criteria was

1. Those children with unreadable data in the registers;
2. All children above five years (>60 months);
3. Those children who are not diagnosed as having severe acute malnutrition.

3.4 Data collection and analysis

Data on variables of interest was extracted from ward A07 patient death and discharge registers and files, using a predesigned data collection form. Data for ward A07 was also sourced from the Paediatric centre of excellence. The data collection forms were completed legibly in ballpoint pen by trained data collectors. The data collectors were trained by the investigator on the requirements of the protocol and data to be collected. Completeness and legibility of each data collection form was audited at the end of each day by the investigator to ensure accuracy. Data collected from the registers and files was entered into Microsoft Excel. Data verification and validation was conducted until the database corresponded with the data collected on the collection forms. At the end of the validation process, the data was declared and documented as clean.

In this study, the dependent variable was mortality (dead or alive) while the independent variables included length of stay (in admission), morbidity (Marasmus, Kwashiorkor, and marasmic Kwashiorkor), sex, HIV status, residence and co-morbidity. Numerical (ratio scale) variables in the study were, age and length of stay. Categorical (nominal scale) variables

included morbidity (Marasmus, Kwashiorkor, and Marasmic Kwashiorkor), sex, HIV status, mortality (dead or alive), residence and co-morbidity.

Descriptive statistics such as the median and inter quartile ranges (IQR) were used to summarize and describe the data because the data was not normally distributed. Since the dependent variable mortality is categorical, logistic regression was used to predict the odds of death in the independent variables while adjusting for other variables and to estimate the effect size of the independent variables on mortality. Kruskal Wallis was used to compare if means of the numerical variables length of stay on the ward and age for the different mortality, morbidity, and co-morbidity groups were different.

To test if the categorical variables were associated, the chi-square test of independence was used. The Chi-square test was used to test the difference between the samples of the categorical variables. Cochran Armitage Chi-square test could not be used for mortality trends in the different morbidity and co-morbidity groups because the data did not fulfil the normal distribution assumptions. Cuzick a non-parametric test for trends was used instead. Survival analysis event was used to analyse the time it takes before a child dies in the different morbidity and co-morbidity groups. The variable length of stay was used in survival analysis as it provides an estimate of how long a child stays on the ward before they die or are discharged. Kaplan-Meier curves were also used to estimate survival probability of different morbidity and co-morbidity groups. The Hazard function which is the instantaneous risk of death given survival to a certain point was used to predict the risk of death given that the child is admitted with a specific morbidity or co-morbidity. The test of difference of survival for the different groups was calculated using Wilcoxon and Cox proportion hazard regression. A Sensitivity Analysis was conducted to check the effect of incomplete data from patient registers and files. All this was done using STATA version 11. P values were set at 0.05. A summary of data analysis is presented in the table 1 below.

Table 1; Summary of data analysis

TYPE OF VARIABLE	ESTIMATION FOCUS	STATISTICAL TESTS
CONTINUOUS (Independent) Age, Length of stay	Means	Kruskal Wallis ~ Wilcoxon
CATEGORICAL (Dependent) Mortality (Independent) Morbidity, residence sex, co-morbidity, HIV status	Proportions	Chi-square test and logistic regression Cuzick trends test was used to test the trends
Length of stay	Survival analysis comparing groups	Kaplan Meier survival curves and tests of difference by Wilcoxon and Cox proportion hazard function

3.5 Ethical issues/ Considerations

This study was a desk review of patient ward registers, which contained personal and private information. Personal identifiers were collected on completed forms during the data collection process, and as such confidentiality was a priority. This was done by ensuring that all data collectors were informed on the importance of confidentiality and advised not to collect full names during the process. In addition only the principle investigator had access to collection forms after data collection. In the database each patient was given a 12-digit number to maintain privacy. The data collection forms were locked away in a safe and lockable cabinet for safekeeping until the time when all collected data were verified and entered in to the computer. The dataset was then locked and the collection forms with patient's identifiers were destroyed. This was done to maximize anonymity of the dataset. As the study used total sampling method all children with readable data in the registers of interest were included in the study. Using this sampling method justice was upheld as each child had a chance of being selected. Beneficence and non-maleficence were also upheld in this study as all the information collected was only for research purposes. Safety of the study participants in this research was assured as the protocol

was forwarded for ethical approval to Excellence in Research Ethics and Science (ERES). Permission to conduct the study was solicited from UTH authorities and Ministry of Health.

CHAPTER FOUR: RESULTS

4.1 Demographic characteristics of children with SAM attending UTH from 2009-2013

During the period under study, a total of 9540 under-five children were recorded. Of these 4,386 (45.9%) were female and 5,148 (53.9%) were male. The median age was 17 months, with an inter quartile range (IQR) of 12 to 22 months. The data also revealed that 93.3% were from within Lusaka while seven per cent were from out of Lusaka. Overall, the prevalence of HIV in the period under review was 32.2% while 67.2% were negative. The median length of stay was eight days, with an IQR of 3 to 14 (as shown in Table 2 below).

Table 2: Background characteristics of the study population of under five children with SAM attending UTH in Lusaka Zambia

Characteristic	Population	
		%
Sex (n=9534)		
Male	5,148	53.9
Female	4,386	45.9
HIV status (n=8,589)		
Negative	5,827	67.8
Positive	2,589	32.2
Morbidity (n= 9,076)		
Marasmic-Kwashiorkor	1,511	16.4
Marasmus	1,957	21.6
Kwashiorkor	5,609	62.0
Co-morbidity (n= 2,037)		
Anaemia	218	11.6
Diarrhoea	723	29.8
Pneumonia	544	25.3
Septicaemia	146	5.3
Tuberculosis	113	6.8
Other	293	21.2
No co-morbidity	7503	100
Residence (n= 5,141)		
Lusaka	4,791	93.0
Out of Lusaka	358	7.0

NOTE: **n=9540** sample size was dictated by responses for age. Median age in months was 17 months IQR (11-22); median length of stay in days was 8 days IQR (3-14); overall mortality 46.7% (2,804)

4.2 Patterns of morbidity and co-morbidity

Kwashiorkor was the most frequently recorded morbidity accounting for 62.0%, followed by Marasmus, which accounted for 21.6%, while Marasmic Kwashiorkor had 16.4% (see figure 2 below). Various co- morbidities were evident from the number of recorded children. Of those whose co-morbidity was recorded (n=2,037), 11.6% had Anaemia, 29.8% had Diarrhoea, 25.3% had Pneumonia, 5.3% had tuberculosis and 6.8% had Septicaemia, while 21.2 % had other co-mobidities (see figure 3 below). Chi square test revealed that there was no association between a child's sex or residence and type of morbidity (p=0.337 and p=0.200 respectively). HIV was associated with the various morbidities (p=0.000). It was revealed that prevalence of HIV was highest among children with Marasmus at 40% while for children with Kwashiorkor and

Marasmic Kwashiorkor it stood at 30.4% and 30.5% respectively. For those whose data was present, Diarrhoea was significantly the most common co-morbidity across all morbidity groups (30.4%, 27.6% and 33.6% in the Marasmus, Kwashiorkor and Marasmic-Kwashiorkor group respectively). On the other hand Septicaemia had the lowest prevalence across the co-morbidity groups, accounting for 5.2% in the Marasmus group, 5.4% in the Kwashiorkor group and 5.1% in the Marasmic-Kwashiorkor group ($p=0.009$) (see table 3 below).

Table 3: Morbidity by HIV status and demographic factors among under five children with SAM attending UTH in Lusaka Zambia

Characteristic	Morbidity			P value*
	Marasmus (%)	Kwashiorkor (%)	Marasmic–Kwashiorkor (%)	
Sex				0.337
Male	1,023 (52.4)	3,037 (54.1)	824 (54.6)	
Female	929 (47.6)	2,572 (45.9)	685 (45.6)	
HIV status				0.000
Negative	1,050 (59.9)	3,521 (69.6)	942 (69.5)	
Positive	703 (40.1)	1,537 (30.4)	414 (30.5)	
Co-morbidity				0.009
Anaemia	33 (7.4)	121 (13.2)	50 (13.4)	
Diarrhoea	140 (31.4)	253 (27.6)	125 (33.6)	
Pneumonia	115 (25.8)	210 (22.9)	87 (23.4)	
Septicaemia	23 (5.2)	50 (5.4)	19 (5.1)	
Tuberculosis	35 (7.8)	56 (6.1)	28 (7.5)	
Other	99 (22.2)	225 (24.6)	62 (16.7)	
Residence				0.200
Out of Lusaka	1,003 (91.9)	2,656 (93.5)	866 (93.0)	
From Lusaka	88 (8.1)	183 (6.5)	65 (7.0)	

NOTE: (overall n=9,076 was dictated by the variable morbidity)

*Tested using Chi square

****Median age in months (IQR) for Marasmus 15(11-20) Kwashiorkor 18(12-23) Marasmic-Kwashiorkor 17 (12-22) was **P=0.0001**- Tested using Kruskal –Wallis

There were various co-morbidities that were recorded in the data. These co-morbidities included respiratory tract conditions such TB, Pneumonia, bronchitis, cough, flu ; skin conditions such as burns, dermatitis, abscesses, chicken pox and measles; birth defects like cerebral palsy, cleft lip pallet; blood conditions such as anaemia, septicaemia, sickle cell disease, malaria, cardiac conditions, meningitis and neoplasm among other conditions. The co-morbidities were then analysed based on frequencies and then the co-morbidities with the lowest frequencies (n<20) were grouped together and labelled "Other". Five co-morbidity groups' namely Anaemia, Septicaemia, Tuberculosis, Diarrhoea and Other were finally analysed as a single variable labelled co-morbidity. HIV was analysed as a separate co-morbidity. Patterns of co-morbidity differed significantly across age, mortality rate and HIV infection as shown in table 4 below

Table 4: Co-morbidity groups by HIV status, and demographic factors among under five children with SAM attending UTH in Lusaka Zambia

Characteristic	Co-morbidity						
	Anaemia (%)	**Diarrhoea** (%)	**Pneumonia** (%)	**Septicaemia** (%)	**TB** (%)	**Other** (%)	P value*
Sex							0.245
Male	139 (58.4)	**325 (53.6)**	258 (50.2)	**64 (59.8)**	78 (56.5)	**233 (54.1)**	
Female	99 (41.6)	**281 (46.4)**	256 (49.8)	**43 (40.2)**	60 (43.5)	**198 (45.9)**	
HIV status							
Negative	160 (76.6)	**399 (74.7)**	311 (69.7)	**61 (65.6)**	70 (53.4)	**242 (67.2)**	0.000
Positive	49 (23.4)	**135 (25.3)**	135 (30.3)	**32 (34.4)**	61 (46.6)	**118 (32.8)**	
Residence							0.245
From lusaka	180 (92.3)	**509 (93.1)**	412 (94.1)	**76 (96.2)**	110 (94.8)	**260 (90.9)**	
Outside lusaka	15 (9.67)	**38 (6.9)**	26 (5.9)	**3 (3.8)**	6 (5.2)	**26 (9.1)**	

NOTE: overall n = 2037 dictated by the variable co-morbidity
*Tested using Chi square
Median age in months (IQR) for Anaemia 17(12-23) Diarrhoea 16(11-20) Pneumonia 15(11-20) Septicaemia 15(11-19) TB 16(11-24) Other 17(12-24) **P=0.0003 -Tested using Kruskal –Wallis

The median age was highest for Anaemia and 'Other' at 17 months (IQR 12-24), for Diarrhoea and TB it was at 16 months (IQR 11-20), and 15 months (IQR11-20) for Pneumonia and Septicaemia. These associations were significant at (p=0.0003). The prevalence of HIV was significantly highest in children with TB at 46.6% and was lowest in the children who had Anaemia at 23.4% (p=0.000). Sex and residence had insignificant associations (p=0.245) (see table 4 above).

Patterns of HIV infection differed significantly by age, and sex (p=0.001 and 0.002 respectively) while residence was not associated with HIV as shown in table 5 below. The median age for the HIV infected children was 16 months (IQR 11-22) and for the HIV uninfected was 17 months

(IQR 12-22) (p=0.0001). Furthermore, the HIV prevalence for boys was higher at 52.2% than that of the girls, which stood at 47.8% (p=0.02).

Table 5: Patterns of HIV infection status by sex and residence among under five children with SAM attending UTH in Lusaka Zambia

Characteristic	HIV uninfected (%)		HIV infected (%)		P value*
Sex					0.002
Male	3,246	(55.7)	1,440	(52.2)	
Female	2,576	(44.3)	1,321	(47.8)	
Residence					0.268
From Lusaka	3,161	(92.7)	1,158	(93.6)	
From outside Lusaka	250	(7.3)	79	(6.4)	
Overall HIV prevalence	5,827	(67.8)	2,762	(32.1)	

NOTE: overall n=8,589 dictated by the variable HIV status
*Tested using Chi square

4.3 Length of stay in the different morbidity and co-morbidity groups

The length of stay on the ward in the different morbidity groups and HIV groups did not differ significantly (p=0.03662 and 0.1526 respectively). However, there were significant differences among the co-morbidities, with p=0.0001. Children with TB had the longest length of stay of 14 days (IQR 7-21). On the other hand those with Septicaemia, Diarrhoea and other diseases had the shortest length of stay on the ward (See table 6 below).

Table 6: Comparison of length of stay in the morbidity and co-morbidity groups among under five children with SAM attending UTH in Lusaka Zambia

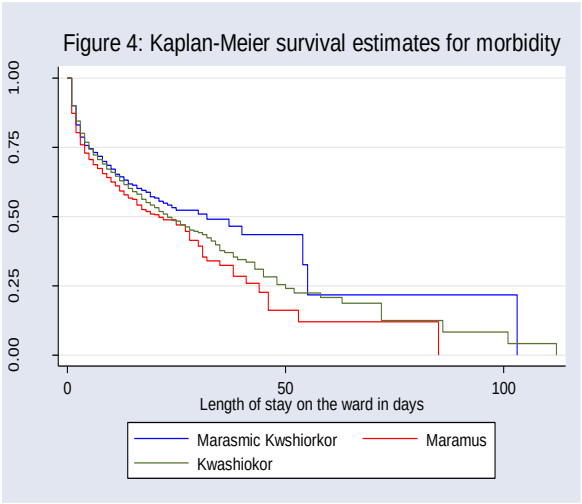
Characteristic	Population	Median Length of stay in days	Inter quartile range (25-75) in days	P value *
Morbidity				0.3662
Marasmus	1,957	8	2-14	
Kwashiorkor	5,609	8	3-14	
Marasmic-Kwashiorkor	1,510	9	3-14	
Co-morbidity				0.0001
Anaemia	277	6	1-12	
Diarrhoea	761	5	1-11	
Pneumonia	602	6	2-12	
Septicaemia	137	4	1-10	
Tuberculosis	151	14	7-21	
Other	447	4	1-10	
HIV status				0.1526
Uninfected	5,827	9	4-14	
Infected	2,762	9	3-15	

*Tested using Kruskal-Wallis

NOTE: Overall n= 5684 dictated by the variable Length of stay in days

To ensure that length of stay was compared conclusively, survival analysis was utilized. The variable length of stay was transformed into survival data and mortality was set as failure variable. There are 5300 subjects with a median survival time of 13 days. The lower quartile survival time was 3 days and upper quartile time is 19 days. Total person time at risk is 55078 days. The incidence rate was estimated at 0.056 per day or 20.4 per year. In person years this would be 20,418 per 100 person years per year. The different survival times are depicted using Kaplan Meier survival curves below. They compare the chances of survival in the different

morbidity and co-morbidity groups given that the child was admitted to ward AO7 for a specified number of days. Figures 4 and 5 below show that children with Marasmus and those who were HIV infected had reduced survival rates.



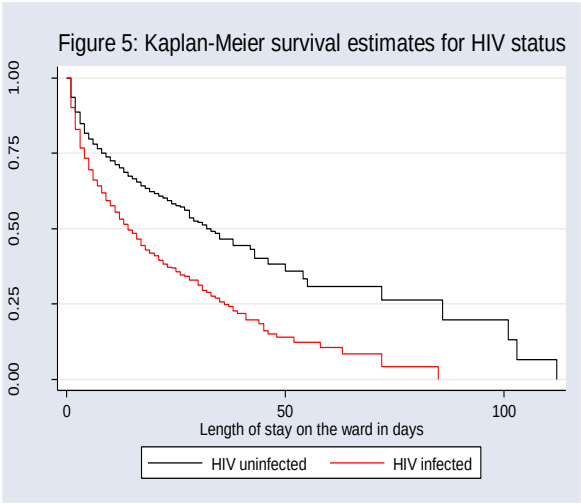
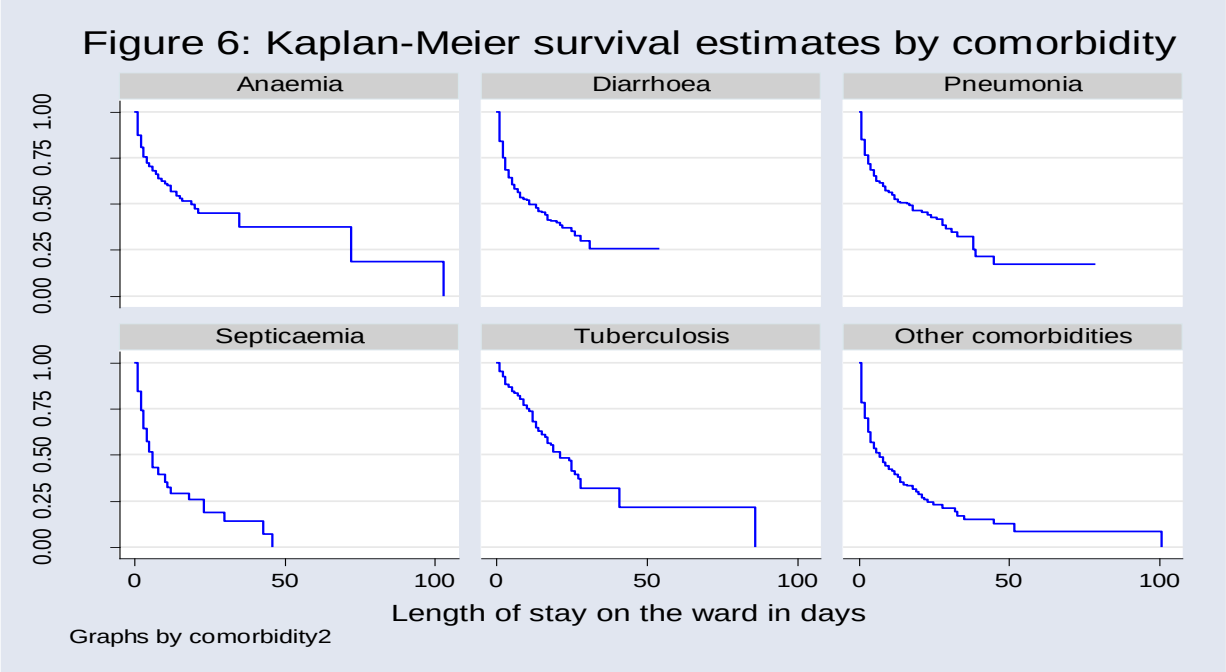


Figure 6 shows that children with Septicaemia and Diarrhoea had the lowest survival rates. While those with Pneumonia and TB also had reduced survival rates.



Cox hazard regression was also used to show the instantaneous risk if death given that the child was admitted to ward AO7. This is shown in table 7 below. It revealed that Kwashiorkor, HIV, Diarrhoea, Septicaemia, and 'Other' in the variable co-morbidity were significant ($p<0.05$). Children with Kwashiorkor were 30% less likely to die when admitted to the ward compared to those with Marasmic-Kwashiorkor while children with Diarrhoea, Septicaemia and Other co-morbidities were more likely to die than children with Anaemia given that the child was admitted to ward AO7.

Table 7: Probability of dying in morbidity and co morbidity groups among under five children with SAM attending UTH in Lusaka Zambia

Characteristics	Hazards ratio (CI)		P value *
Morbidity			
Marasmic - Kwashiorkor	1		
Marasmus	0.9	(0.7 - 1.0)	0.311
Kwashiorkor	0.7	(0.5 - 0.8)	0.002
HIV			
Uninfected	1		
Infected	1.9	(1.6 - 2.2)	0.000
Co-morbidity			
Anaemia	1		
Diarrhoea	1.4	(1.0 -1.8)	0.037
Pneumonia	1.2	(0.8 -1.6)	0.218
Septicaemia	2.1	(1.4 -3.0)	0.000
Tuberculosis	0.9	(0.5- 1.2)	0.464
Other	1.8	(1.3 -2.4)	0.000
*Tested using Cox regression – Breslow method for ties			

4.4 Mortality trends

Generally, mortality trends decreased with admissions. Cuzick a non-parametric test for trends was used to show the significance of the trends. The trends for mortality and morbidity were both significant at $p=0.000$. The trends are illustrated in the figure 7 and 8 below.

Admissions and mortality and morbidity rates seem to be showing a steady decline over the years being investigated.

Multivariate Logistic regression was carried out to determine the odds of death in the various morbidity and co-morbidity groups while controlling for other variables. The multivariate analysis revealed that children who were HIV infected were four times more likely to die than those who were HIV uninfected (95% CI 2.9– 5.6, P=0.00). While those with Septicaemia were 3.8 times more likely to die compared to those with Anaemia (95% CI 0.8 -7.9 p=0.000). The children who were diagnosed with TB were three times more at risk of dying compared to those who had Anaemia (95% CI 1.5 - 5.9, P=0.001). Furthermore children with Other co-morbidities were 2.3 times chances of dying compared to those children with anaemia. Children who had co-morbidity were 1.5 more times at risk of dying compared to those who did not have co-morbidity. The results are seen in table 8 below.

Table 8: Multivariate analysis showing factors associated with mortality among under five children with SAM attending UTH in Lusaka Zambia

Characteristic	Mortality	
	Adjusted OR(CI)	P value*
Sex		
Male	1	
Female	1.0 (0.7 - 1.3)	0.844
HIV status		
Negative	1	
Positive	4.0 (2.9– 5.6)	0.000
Morbidity		
Marasmic-Kwashiorkor	1	
Marasmus	1.2 (0.8 -1.8)	0.415
Kwashiorkor	1.9 (1.3- 2.6)	0.000
co morbidity		
Anaemia	1	
Diarrhoea	1.3 (0.8- 2.0)	0.336
Pneumonia	1.2 (0.7 -1.9)	0.561
Septicaemia	3.8 (1.8 -7.9)	0.000
Tuberculosis	3.0 (1.5 - 5.9)	0.001
Other	2.3 (1.3 - 3.8)	0.002
Co-morbidity status		
No co-morbidity	1	
Co-morbidity	1.5(1.3-1.4)	0.000
Residence		
Lusaka	1	
Out of Lusaka	0.7 (0.4 – 1.2)	0.191

*Tested using Logistic regression and all variables were adjusted for age and length of stay as continuous variables

4.5 Sensitivity Analysis

The data used in this study was abstracted from ward death and discharge registers as well as from patient files. Some registers and files were missing from the ward, which led to missing data for most of the variables like morbidity, mortality co-morbidity and HIV. Given that a complete case analysis method was used to analyse the data in this study a sensitivity analysis was done to ascertain whether the findings of this study would have been different if the missing data had been included in the analysis.

A dichotomous variable was then created using the total number of missing and present data in the dependant variable mortality. The variable was the cross tabulated in chi square to compare

Table 9: Sensitivity analysis of missing data of under five children with SAM attending UTH in Lusaka Zambia

	Mortality		
Characteristics	**Unknown (%)**	**Known (%)**	**P value**
Sex			**0.934**
Male	1,908 (37.1)	3,240 (62.9)	
Female	1,622 (37.0)	2,764 (63.0)	
Age in months	3,530 17 (IQR 12-22)	6,010 17 (IQR 12-22)	**0.5406****
Length of stay in days	3,530 8 (IQR 3.5-12.5)	6,010 8 (IQR 3-14)	**0.7767****
HIV			**0.000**
Uninfected	2,059 (35.3)	3,768 (64.7)	
Infected	1,207 (43.7)	1,555 (56.3)	
Morbidity			**0.000**
Marasmus	462 (30.6)	1,048 (69.4)	
Marasmic-Kwashiorkor	672 (34.3)	1,285 (65.7)	
Kwashiorkor	2,234 (39.8)	3,375 (60.2)	
Co-morbidity			**0.000**
Anaemia	5 (2.1)	233 (97.9)	
Diarrhoea	10 (1.7)	597 (98.3)	
Pneumonia	17 (3.3)	499 (96.7)	
Septicaemia	8 (7.5)	99 (92.5)	
Tuberculosis	1 (0.7)	137 (99.3)	
Other	28 (6.5)	403 (93.5)	
No co-morbidity	3,461 (46.1)	4,042(53.9)	**0.000**
Residence			
Lusaka	26 (0.5)	4,757 (99.5)	**0.970**
Out of lusaka	2 (0.6)	356 (99.4)	

*Tested using chi square ** Tested using Kruskal Wallis

whether there were more missing values in the independent variables as compared to the known values. Table 9 above shows that generally the known data was more than the missing. Consequently it can be inferred that the results could not have changed significantly if all the missing data were added to the analysis.

CHAPTER FIVE: DISCUSSION

Overall mortality among under five children with SAM was found to be higher in this study (46.7%) compared to other studies (Trehan et al (2012); Irena et al (2011); NFNC (2008); and Ubesie et al (2012) in a study in a Nigerian hospital). The mortality rate for this study has been found to be about 3.3% lower than that reported by NFNC in 2008. Mortality and morbidity trends are declining. This could be explained by the interventions that have been put at community level to combat malnutrition such as provision of RUTF at health centres. Heikens et al (2008) argued in similar lines that RUTF aids in effective home-based management of uncomplicated SAM leading to recovery rates of 90% and five per cent mortality rate. Further still these trends could be related to reports by De Onis et al., (2004) who reported reducing prevalence of malnutrition in developing countries of about 38% to 25% from as far back as 1980 to the year 2000. While WHO, UNICEF and The World Bank, (2012) reported an 11% decline in severe acute malnutrition from 1990. HIV was found to be one of the main drivers of mortality in this study. Children who were HIV infected were four times more likely to die than those who were HIV uninfected (95% CI 2.9– 5.6, P=0.000). This is comparable to reports by Chintu et al., (1995) who also found higher mortality rates among HIV infected children compared to HIV uninfected children at UTH. Heikens et al (2008) also revealed that in sub Saharan Africa mortality is three times higher in HIV infected children than in HIV uninfected children. This because HIV infected and uninfected children with SAM have different pathophysiology, case management and referral pathways that make therapeutic and palliative care very difficult (Ibid). They further argued that there is urgent need for therapeutic guidelines based on evidence from high HIV burden regions. In this study this could be due to co-mobidities such as TB and septicaemia as reported by Asafo-Agyei et al., (2013). It is also evident in this study that HIV influenced most of the mortality recorded. This could be associated with high numbers of mother - to - child transmission of HIV during the prenatal and breastfeeding stages making HIV testing and commencement of ART in all HIV positive pregnant and breastfeeding mothers (Option B+) very important.

The data used in this study was collected amidst several strengths and limitations which could have biased the results. Firstly, there were some missing files and registers which made it

difficult to collect the data. In view of the missing data a sensitivity analysis was conducted which revealed that the results could not have changed significantly if all the missing data were added to the analysis. Despite this, data quality was also a limitation because it is recorded from setting where there are high levels of staff turnover and fatigue, ward congestion, and limited diagnostic capabilities. Nonetheless, the sample size in this study is sufficient and data collected covers five years which is representative of the UTH as a study setting and thus reduces the likelihood of any results derived from analysis being due to chance or situational variations. Moreover, since the data was sourced from UTH which receives referrals from hospitals in every province in the country, the findings could be a representation of morbidity and mortality in referring hospitals in the country. However mortality could be slightly higher at UTH as only very severe cases are referred. Furthermore, the findings of this study are descriptive in nature, it is therefore important to consider explorative studies to be carried out to ascertain why trends and pattern of mortality, morbidity and co-morbidity are they way they are in ward AO7.

The study also showed statistical significant evidence that children who were diagnosed with TB were three times more at risk of dying compared to those who had anaemia. The reason for the risk could be because of the high HIV prevalence figures among children found with TB. Moreover it could also be related to the high odds of death in the HIV infected children. Asafo-Agyei et al., (2013) reported that the presence of TB in a child with SAM is a strong indication of HIV infection. Moreover, children with Septicaemia were 3.8 times more likely to die compared to those with Anaemia. This could be because of co-infections with HIV. Bachou et al (2006); Asafo-Agyei et al (2013) and Ashworth et al (2004) in two hospitals in South Africa also found an association between Septicaemia and high mortality especially in the HIV infected children. Kwashiorkor was found to be the most common morbidity in the current study (62%). This finding was similar with studies done by Irena et al (2011) at UTH; Maitland K et al (2006) at a hospital in Kenya and Bachou (2006) at a hospital in Uganda. However, the prevalence was higher (69.9%) in the Irena et al (2011) study. The differences in prevalence for kwashiorkor could be because of the recent and more intensified interventions such as training of community health workers to identify and treat moderately malnourished children with RUFT; and only refer children with SAM for in patient management. The intervention supports a reduction in the number of children admitted with SAM because very few children will develop severe forms of

malnutrition if they are identified at the moderate stages. Even though there is a reduction there is need to provide social cash transfer to families with malnourished children that have financial constraints to alleviating extreme poverty and insufficient food intake. These children who had Kwashiorkor also had the lowest prevalence of HIV infection (30.4%) and the highest median age of occurrence at 18 months. The low prevalence of HIV observed in this study, could be explained by a study at UTH by Amadi et al (2001), which reported that Kwashiorkor was more associated with HIV uninfected children. The mean age of 18 months in children with Kwashiorkor could be attributed to the weaning period commonly practiced around the age of 18 months as reported in a study by NFNC, (2012). The incidence of SAM at this age could be attributed to insufficient food intake during the weaning period probably due to poverty.

The study showed statistical significant evidence that children who were diagnosed as having Marasmus were found to have the highest prevalence of HIV infection, Pneumonia and TB. In line with findings of this study, Asafo-Agyei et al., (2013) in Ghanaian hospital and Trehan et al., (2012) on sub-Saharan Africa, also revealed that Marasmus was the predominant form of malnutrition amongst HIV infected children. Marasmus presents as severe wasting which could be due to the body's physiologic mechanisms of adapting to lower food intake, become pronounced in children with severe acute malnutrition (Musoke and Fergusson, 2014). This reduction in food intake perpetuates low immunity in HIV infected children leaving them at risk of opportunistic infections such as TB and Pneumonia as shown in this study. Trehan et al (2012), reported similar findings in a study in sub Saharan Africa, where high HIV infection was associated with high TB prevalence. Asafo-Agyei et al (2013) also found similar associations but had lower prevalence of TB. To the contrary, Amadi et al (2001) did not find a significant difference in the prevalence of TB in the HIV infected and uninfected groups. The reason for these results was not explained.

Children who had Marasmic-Kwashiorkor were associated with the lowest prevalence of other diseases (16.7%), and Septicaemia (5.1%). On the other hand, children with Marasmic-Kwashiorkor were associated with the highest prevalence of Diarrhoea (33.6%) and Anaemia (13.4%). The prevalence of anaemia in children with Marasmic-Kwashiorkor in this study could be associated with the low prevalence of HIV in these children. Asafo-Agyei et al (2013) also found that Anaemia was more prevalent among the HIV uninfected children. On the other hand,

Chinkhumba et al (2008) in a study in Malawi reported that HIV infected children were more associated with Anaemia. The reason for this variation in anaemia prevalence could be related to micronutrient intake and absorption in HIV infected and uninfected groups.

Generally, length of stay on the ward did not differ in the morbidity groups and among the HIV infected and uninfected. The overall median length of stay for this study was 7.4 days. This was lower than those reported by Irena et al (2011) (9 days) and De Maayer (2010) (11 days). Furthermore De Maayer (2010) did not find significant difference in length of stay in HIV infected and uninfected children. However Irena et al., (2011) reported a significant difference in length of stay in HIV infected and HIV uninfected children and attributed the difference to the increased risk of death in HIV infected children. Children with TB had the longest length of stay on the ward (14 days) as opposed to children with Septicaemia that had the shortest stay on the ward (4 days). This is consistent with results from Cox regression which showed that children with Septicaemia had two times greater chances of dying than those with Anaemia, thereby reducing their length of stay on the ward. Mwambazi-Mweene et al., (2010), also found increased chances of mortality in children with bacteraemia and SAM at UTH Moreover, children with TB had 10% reduced chance of mortality even though this association was insignificant (p=0.464).

Kaplan Meier curves also revealed similar findings in children with Diarrhoea and Septicaemia having the lowest chances of survival with length of stay of 50 days and below. Irena et al (2011) also reported similar findings where children with Diarrhoea had reduced survival rates with length of stay of 50 days and below. TB and Pneumonia had moderate chances of survival with length of stay of 50 days or more. This reduction in survival among children with TB could be due to co-infection with HIV which is associated with high mortality rates consistent with findings by Marias et al., (2007) making TB screening in HIV positive children with SAM a priority. Children with Anaemia and Other Co-morbidities had the highest chances of survival with length of stay on the ward of up to 100 days.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Mortality and morbidity trends in under-five children with severe acute malnutrition at UTH are declining significantly. The decline in mortality and morbidity is associated with declining admissions. Despite the decline, mortality rates at UTH remain very high. Children with Kwashiorkor, Diarrhoea, Septicaemia and Other co-morbidities were more likely to die than children with Anaemia when admitted to ward AO7. Furthermore, children with Septicaemia, TB, Diarrhoea, Pneumonia and HIV infected children were associated with reduced chances of survival. Of all the co-morbidities HIV seemed to have been the core driver of mortality owing to opportunistic infections associated with a positive HIV status. Kwashiorkor was the most common morbidity while Diarrhoea and Pneumonia were the most common co-morbidities. Kwashiorkor and Anaemia were common among HIV uninfected children where as Marasmus and TB was more common among HIV infected children. Declining mortality and morbidity in children with acute malnutrition at UTH may suggest improved management practices. Nonetheless, limitations to totally prevent malnutrition may be an indicator of complex structural challenges that may be existent in this population thereby needing matching and complex intervention.

6.2 Recommendations

The following are some recommendations that can aid in further reducing mortality rates among under five children with SAM:

1. UTH through Ministry of Community Development Mother and Child Health should continue implementing Option B+ so that mother to child HIV transmission can be reduced. This will further reduce HIV related mortality among children with SAM
2. UTH ward AO7 should ensure PITC is implemented on all children to ensure that all HIV infected are treated using appropriate treatment regimes from admission and to facilitate early screening for opportunistic infections.
3. UTH ward AO7 health workers should intensify screening of opportunistic infections (OI) such as TB in all children found to be HIV infected to reduce mortality due to HIV/OI co-infections in children with SAM

4. In addition there is need to enhance growth monitoring interventions at community level to detect malnutrition early and to reduce incidence of severe cases and mortality. This should be coupled with intensified sensitization among mothers with under-five children on proper child feeding practices.
5. The Ministry of Community Development Mother and Child Health should ensure continuity and sustainability of the RUFT in the health facilities to reduce incidence of severe acute cases of malnutrition.
6. The Ministry of Community Development Mother and Child Health should consider spreading the social cash transfer scheme to parents of malnourished under-five children to reduce the chances of children developing SAM.

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APPENDICES

CHILD'S RECORD DATA COLLECTION FORM

<table>
<tr><td colspan="2">Child's initials

Child's Database ID code</td><td>File Number _ _ _ _ __ year of admission _ _ _ _ month

of admission_ _ _ _ date of admission_ _ _ _</td></tr>
<tr><td colspan="3">Outcome (died or discharged)</td></tr>
<tr><td colspan="2">Age</td><td>Residence</td></tr>
<tr><td colspan="3">Sex</td></tr>
<tr><td colspan="3">Diagnosis</td></tr>
<tr><td colspan="3">Comorbidity</td></tr>
<tr><td colspan="3">HIV status</td></tr>
<tr><td>Date admitted</td><td>Date discharged or died</td><td>(length of stay= date discharged or died – date admitted)</td></tr>
</table>

Name of data collector:

Date:

Sign:

Investigator's signature: