**Factors contributing to severe acute malnutrition among the under five children in Francistown-Botswana**

Abigail Piniel

Dissertation submitted in fulfilling of the requirements for the degree

MA Child and Family Studies

In the
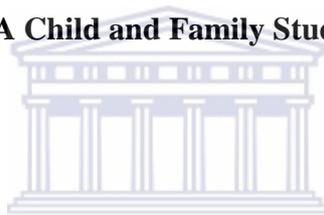
Department of Social Work

Faculty of Community Health Sciences

University of the Western Cape

Supervisor: Prof E.C. Swart

January   2016

DECLARATION OF INDEPENDENT WORK

DECLARATION WITH REGARD TO INDEPENDENT WORK

I, Abigail Piniel, passport number BN 0083181 and student number 3417752, do hereby declare that this research project submitted at the University of the Western Cape for MA Child and Family Studies (Social Work): "Factors contributing to severe acute malnutrition among the under five children in Francistown, Botswana", is my own independent work and has not been submitted to any institution before by myself or any other person in fulfilment of the attainment of any qualification. I further concede copyright of this research in favor of the University of the Western Cape.

UNIVERSITY *of the*
WESTERN CAPE

ACKNOWLEDGEMENTS

ABSTRACT

Introduction

Malnutrition is the immediate result of inadequate dietary intake, the presence of disease or the interaction between these two factors. It is a complicated problem, an outcome of several etiologies. SAM is one of the leading causes of morbidity and mortality among children under the age of five in developing countries. Although studies in Botswana show some improvement in child malnutrition since the 1980s, severe acute malnutrition still remains a cause for concern in many parts of the country. There is little information on undernourishment situation of children under the age of five years in the urban areas of the country.

Aim

The purpose of this study was to determine the risk factors to severe acute malnutrition among children under the age of five years in Francistown, Botswana. The UNICEF conceptual framework was used as a guide in assessing and analysing the causes of the nutrition problem in children and assisted in the identification of appropriate solutions.

Methods

The study was conducted on cases who had been admitted and referred at any time between March and July 2015. A quantitative research methodology was used to conduct the study. A case-control study design was utilised. Random selection of cases and controls was done on a ratio of 1:2 case per control. Cases included children under the age of five years admitted to Nyangabgwe Referral Hospital and those referred to the Nutritional Rehabilitation Centre within the hospital in Francistown-Botswana with a diagnosis of severe acute malnutrition. Controls were children of the same age, gender and attending the same Child welfare clinic as

the case and with good nutritional status. Data was collected through face-to-face standardised interviews with care-givers.

Results

Data collection was done using a combination of a review of records (child welfare clinic registers, and child welfare clinic cards) and structured questionnaires. 52 cases and 104 controls were selected with the primary or secondary care-giver as the respondent. (N=156). Data was collected using a self-developed structured questionnaire and the review of documents. Of all the cases 36.5% (n=19) were diagnosed with MAM, 46.2% (n=24) with SAM, 1.9% (n=1) with moderate PEM and 7.7% (n=4) each for PEM and Severe PEM. All the cases had presented with clinical signs and symptoms of severe acute malnutrition and/or the weight-for-height Z-score of $\leq$ -3 SD.
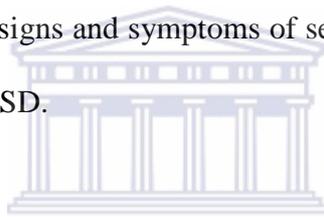
Following placement of the data in regression models, the factors that were found to be significantly associated with child malnutrition were low birth weight (AOR = 0.437; 95% CI = 0.155-1.231) , exclusive breastfeeding (AOR = 2.741; 95% CI = 0.955-7.866), child illness (AOR = 0.383; 95% CI = 0.137-1.075), growth chart status (AOR =7.680; 95% CI = 1.631-36.157), level of care-giver's education (AOR = 0.953; 95% CI = 0.277-3.280), breadwinner's work status (AOR = 1.579; 95% CI = 0.293-8.511), mother's HIV status (AOR = 0.777; 95% CI = 0.279-2.165), alcohol consumption (AOR = 0.127; 95% CI = 0.044-0.369), household having more than one child under the age of five (AOR = 0.244; 95% CI = 0.087-0.682), household food availability (AOR = 0.823; 95% CI = 0.058-11.712), living in a brick type of house (AOR = 13.649; 95% CI = 3.736-49.858), owning a tap (AOR = 1.269; 95% CI = 0.277-5.809) and refuse removed by the relevant authority (AOR= 2.095; 95% CI = 0.353-12.445) were all statistically significantly associated with severe acute malnutrition (p < 0.05).

iv

Therefore, all these variables were included in the binary stepwise regression where living in a mud house type was the most significant factor and not being breastfed for at least three months was the least significant.

Conclusion

The findings of this study suggested that immediate determinants to SAM were; child born with a low birth weight, appetite and child illness. Underlying contributing factors were; the child not exclusively breastfed for at least three months, growth chart not up to date, care-givers education level, employment status, alcohol consumption, household food availability, type of housing, owning a tap and number of children under the age of five year. Therefore, increasing household food security and strengthening educational interventions for women could contribute to a reduction in the prevalence of SAM in Francistown, Botswana.

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBEVIATIONS

<	Less than
>	Greater than
≤	Less than or equal
≥	Greater than or equal
ACSD	Accelerated Child Survival and Development
ANC	Ante Natal Care
AOR	Adjusted odds ratio
BMI	Body mass index
CMAM	Community-based Management of Malnutrition
CWC	Child Welfare Clinic
DHMT	District Health Management Team
GF-DHMT	Greater Francistown District Health Management Team
gms	Grams
HIV	Human Immunodeficiency Virus
ICM	International Conference on Malnutrition
LBW	Low Birth Weight
MAM	Moderate Acute Malnutrition
MDGs	United Nation Millennium Development Goals
NGO	Non-Government Organizations
MOH	Ministry of Health
MUAC	Mid-upper arm circumference
NRH	Nyangabgwe Referral Hospital
NRC	Nutritional Rehabilitation Centre

OR	Odds ratio
PEP	Protein-energy malnutrition
PMTCT	Prevention of mother to child treatment
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SMH	Sekgoma Memorial Hospital
SPSS	Statistical Package for the Social Sciences
STATA	Statistics and Data
UOR	Unadjusted odds ratio
UN	United Nations
UNICEF	United Nation Children's Funds
UWC	University of the Western Cape
WHO	World Health Organization
WHZ	Weight-for-height Z-score

TABLE OF CONTENTS

UNIVERSITY *of the*
WESTERN CAPE

List of Contents

1   CHAPTER 1 ORIENTATION TO THE STUDY

1.1   Introduction

This chapter provides the background information about the research problem which motivated the researcher to carry out the study. It highlights the aim of the study and its significance and also explains the foundation of the research. This chapter announces the research design and methods and discusses the validity, reliability and ethical consideration related to the study.

1.2   Background to the problem

Nutrition is a basic human need that remains unmet for vast numbers of children who are hence unable to achieve their full genetic developmental potential. An estimated 150 million children in developing countries are projected as malnourished, which is 28 % of children under the age of five (UNICEF, 2011). Globally in 2011, an estimated 2 million children aged five years and below were admitted for treatment of severe acute malnutrition (UNICEF, 2012).

Malnutrition is the immediate result of inadequate dietary intake, the presence of disease or the interaction between these two factors (WHO, 1997). Botswana is one of the most economically stable countries in Southern Africa and subscribes to initiatives such as the United Nations Millennium Development Goals, one of the aims of which is to reduce the number of people suffering from hunger by 50 % by 2015 (UNICEF, 2006). However, despite this, Botswana faces child malnutrition problems. According to the Botswana Family Health Survey (2007), 13.5 % of children aged five years and younger were under-weight, 26 % were stunted and 7.2 % wasting (UN, 2010).

Francistown is the second largest city in Botswana, with a population of about 98,961 according to figures obtained from the 2011 census. The city is home to the second largest referral hospital. Although there is little statistical information on the number of SAM cases in the city, it is perceived that the cases are increasing despite the nutritional interventions and the monthly Child welfare clinic attendance by all children under the age of five years.

Many studies have shown that nutritional problems all over the world share many similar factors in their causes (Kikafunda, Walker,Collet, & Tumwire, 1998; Griffithts, Madise, Whitworth, & Matthews, 2004; Heaton & Forste, 2003). These factors can originate and manifest at different levels of the child's environment i.e. family, household, community and nationally (Griffiths, et al., 2004) and include aspects such as educational level of the child's care-giver, household food security level, number of children under the age of five years in a household, child care practices, health care system and the national economic stability. Therefore, to plan and deliver an effective preventive intervention programme, the children at risk and the factors contributing to their malnourished condition should be identified. Otherwise efforts in eradicating malnutrition would be redundant and wasteful (Rice, Saccol, Hyder, & Black, 2000).

Tackling malnutrition is directly related to the achievement of MDG1 (eliminating hunger), MDG4 (reducing child mortality) and MDG5 (reducing maternal mortality) (El-Sayed, 2001). In fact, the achievement of many of these goals in human development pivots upon elimination of malnutrition as it impacts on health, productivity and educational achievement (El-Sayed, 2001). However, African governments have either underestimated or have an unenthusiastic attitude with respect to investing and ensuring alleviation of malnutrition (El-Sayed, 2001).The

purpose of this study was to establish the factors contributing to severe acute malnutrition among children under the age of five years.

1.3 Theoretical framework

The conceptual framework underlying this study was adapted from the United Nation Children's Funds framework for the causes of child malnutrition (UNICEF, 1998). Since 1992, a conceptual framework suggested by UNICEF has been adopted at the international level. This conceptual framework on the causes of malnutrition was developed in 1990 as part of the UNICEF nutrition strategy. The framework shows that causes of malnutrition are multi-sectorial, embracing food, health and caring practices (Smith & Haddad, 2000). They are also classified as immediate, underlying, and basic, whereby factors at one level influence other levels.
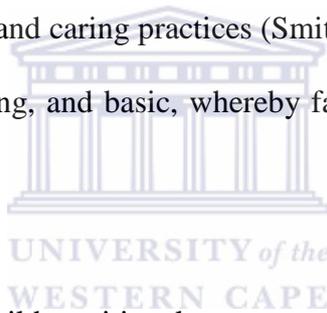
The immediate determinants of child nutritional status manifest themselves at the level of the individual human being. They are dietary intake and health status (UNICEF, 1998). These factors themselves are interdependent. The immediate determinants of child nutritional status are in turn influenced by underlying determinants manifesting themselves at household level. These are food security, adequate care for mothers and children, adequate education for mothers and a proper health environment including access to health services (Smith & Haddad, 2000). Associated with each is a set of resources necessary for their achievement.

A key factor affecting all underlying determinants is poverty. A person is considered to be in absolute poverty when the person is unable to satisfy his or her basic needs (Frankenberger, 1996). The risk factors to child malnutrition are in turn influenced by basic elements including

the potential resources available to a country or community, which are limited by the natural environment, access to technology and the quality of human resources (Smith & Haddad, 2000).

This framework was suitable for this study because it assisted the researcher to deduce whether these determinants apply to the severe acute malnutrition cases in Francistown, Botswana, despite the community in study being considered to have access to health care facilities, nutritional supplements and safe water supply.

1.4   Problem statement

Malnutrition still remains a cause of concern in developing countries. Although studies have shown that the prevalence rate of malnutrition has declined in Botswana, Francistown being the second largest city in the country, with a population of about 98,961 as per 2011 census report, still has a high rate of severely malnourished children under the age of five years admitted to the hospital, as revealed in a 2011 study by Madondo, et al., (2012).

Despite awareness about the dire impact of malnutrition on health and the availability of child health and nutritional interventions, malnutrition continues to be one of the leading causes of morbidity and mortality worldwide, particularly in developing countries (UNICEF, 2006). In Botswana, all children below the age of five years are required to attend monthly Child welfare clinics (CWC), where the weight against height is monitored, and they are given monthly food supplies and nutritional supplements. However, although there are all these health and nutritional interventions in place, there is estimated evidence of high proportions of children under the age of five years still being admitted to hospital with severe acute malnutrition. This

study will therefore determine the contributing factors to severe acute malnutrition amongst children under the age of five years in Francistown, Botswana and identify the means to affecting partnership with families and health services in order to improve child health programmes and nutritional interventions.

1.5   Research question

What are the factors contributing to severe acute malnutrition amongst the children under five years of age in Francistown, Botswana?

1.6   The aim of the study

The study aimed at identifying the contributing factors to severe acute malnutrition among the under five children in the community of Francistown, Botswana.

1.7   Objectives

Thus the objectives of the study were to;

•   Determine the risk factors for severe acute malnutrition among the children under the age of five years in Francistown, Botswana.

•   Establish the extent at which the following factors were associated with severe acute malnutrition among children under the age of five in Francistown, Botswana:

-   Demographic factors

-   Socio-economic factors

-   Health related factors

1.8 Significance of the study

The proposed study was to assist in identifying and bridging the gap between the health care providers, the community and families for effecting collaboration in early identification, management and treatment of childhood malnutrition. The study will also assist in adding new information and modification of the already existing data about the risk factors to severe acute malnutrition among children under the age of five years. The findings of the study are to be used to assist in developing new and improve available child nutritional intervention programmes in Botswana.

1.9 Definition of terms
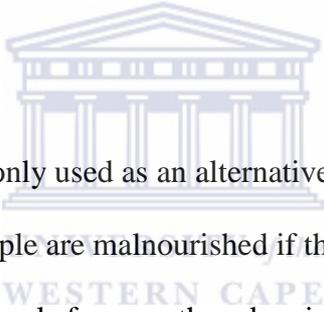
Malnutrition: Broad term commonly used as an alternative to under-nutrition but technically it also refers to over nutrition. People are malnourished if their diet does not provide adequate calories, proteins, vitamins or minerals for growth and maintenance or if they are unable to fully utilize the nutrients from the food they eat due to illness. They are also malnourished if they consume too many calories (UNICEF, 2006). In this study the term is used to refer solely to deficiency of nutrition.

Malnourished: Suffering from malnutrition. Affected by improper nutrition or insufficient diet (Stedman's Medical Dictionary, 2005).

Undernourished: It is the outcome of insufficient food intake or repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) or deficient in vitamins and minerals (UNICEF, 2006).

Severe acute malnutrition (SAM): Is defined as when a child falls under 70% of median in the index of weight for height and has oedema or three SD or more below the WHO mean reference values, or a mid-upper-arm circumference of less than 115 mm in children aged 1-5 years (Collins et al., 2006).

Nutrition: The result of interrelated causes in the area of food, health and care in the society (Swart et al., 2008).

Under five children: In this study it refers to a young person whose age ranges from 6 months to 59 months old.

Breastfeeding: Is an unequalled way of providing ideal food for the healthy growth and development of infants; it is also an integral part of the reproductive process with important implications for the health of mothers (WHO, 2013).
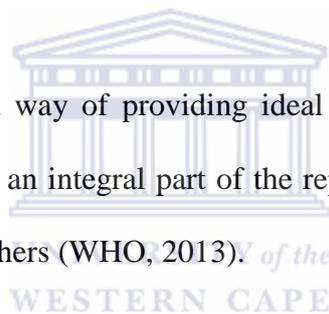
Early childhood development: Early childhood is the most rapid period of development in a human life. It is a period from birth to eight years of age. Although individual children develop at their own pace, all children progress through an identifiable sequence of physical, cognitive, and emotional growth and change (World Bank, 2011).

Childhood: Early stage in existence. Time for children to be in school and at play, to grow strong and confident with the love of their family and community (UNICEF, 2005).

Contributing factors: Forces or influences that work with other forces or influences to bring about a result (The American Heritage Dictionary of English Language, 2011).

UNICEF conceptual framework: A malnutrition theory which explains that malnutrition is not a simple problem with a single, simple solution. Multiple and interrelated determinants are involved in the development of malnutrition, and a similarly intricate series of approaches, multifaceted and multi-sectorial, are needed to deal with it (UNICEF, 1998).

1.10 Foundations of the study

This study was guided by the UNICEF conceptual framework for causes of malnutrition in children.

1.11 Research design and methods

This is a quantitative approach. In a quantitative study, the researcher uses numerical data to obtain information about the world in a formal, objective and systematic process (Burns & Groove, 2005). In other words, quantitative research is thought to produce a hard science that involves vigour, objectivity and control (Burns & Groove, 2005). Data collection was carried out using two approaches, namely a review of records and a self-developed survey.

1.12 Validity and reliability of the study

To enhance validity and reliability of this study, the following measures were taken:

- Similar conditions for data collection were ensured for each participant.

- The nature and purpose of the research were regularly communicated to the participants.

- Two weeks before the study was carried out, the study methodology was piloted in Serowe, a semi-urban region in the central district. The cases were recruited from Sekgoma Memorial Hospital in Serowe and controls were recruited from the surrounding Child welfare clinics. This area has almost similar characteristics with the proposed study setting, in terms of the socio-demographic status and it is the biggest district hospital around the central part of the country.
- Elements of the research proposal that were pre-tested included the study variables, the availability of the respondents, the acceptance of the study by the participants, the adequacy of resources, the time factor, the relevance of the questions, the sequence and comprehensibility of the questions and the accuracy of the respondents' interpretation of the questions. Pilot data were not used in the main study.

1.13 Ethical consideration
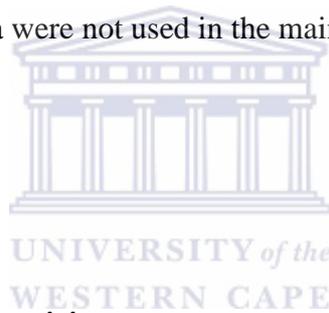
1.13.1 Protecting the rights of participants

The risks for human-beings were minimal with the methodology used in the study. Nevertheless, the following was done to protect the rights of participants:

- Care-givers of selected cases and controls were informed of the purpose of the study and were allowed to voluntarily choose whether or not to participate.
- Care-givers had the right to withdraw from the study at any time without sustaining any penalty.
- The participants were kept anonymous and the information that was collected was kept confidential.

-   The researcher obtained consent from care-givers before their enrolment in the study (Appendix G).

1.13.2 Protecting the rights of the institution

Before collecting data from the participants, permission was sought from the following institutions and individuals;

-   The Senate Higher Degree Committee of the University of the Western Cape (Appendix B).

-   The Health Research Unit in the Ministry of Health of Botswana (Appendix C).

-   The Greater Francistown Health Management team (Appendix E).

-   Health workers in charge of Nyangabgwe Referral Hospital paediatric ward, Nutrition rehabilitation centre and local Child welfare clinics.

In addition;

-   The researcher took all the necessary precautions so that the daily activities of the institution where the study was conducted were not disturbed.

-   All the information collected during the course of the study and involving the institution where the study was conducted has been kept confidential and will not be divulged under any circumstances, without prior permission from the institution concerned.

1.13.3 Scientific integrity of the study

The following measures were taken to ensure the scientific integrity of the study:

- The research proposal was submitted for institutional review to the Senate Higher Degree Committee of the University of the Western Cape and to the Health Research Unit of the Ministry of Health of Botswana.

- All the sources that have been used have been acknowledged accordingly.

- All contributors to the study have been acknowledged.

- No fabrication or distortion of data or results has been applied.

1.14 Conclusion

Child malnutrition still remains a persistent problem in Botswana, with children under the age of five years being more vulnerable to the condition than any other age group. Francistown, which is the focus of this study experiences a significant number of child admission to hospital with a diagnoses of severe acute malnutrition. This case-control study intended to bridge the gap between the health care system and the community, with regard to dealing with child malnutrition. The UNICEF conceptual framework was utilised to grow the body of knowledge concerning risk factors to child malnutrition. The following chapter presents the theoretical background which was used in the study.

1.15 Format of the study

The first chapter provides the background information about the research problem, which inspired the researcher to carry out the study. It highlights the aim of the study and its significance and also explains the foundation of the research. This chapter announces the theoretical framework, research design and methods and discusses the validity, reliability and ethical consideration related to the study. The chapter also gives an overview of the chapters.

The second chapter focuses on an extensive discussion of the theory used in the study. It discusses the relevance of the theory to the study by linking the two. The third chapter focuses on the review of relevant previous research done on malnutrition.

The fourth chapter states the research design and method used to carry out the study. It specifies the population selection criteria used, the type of sampling used, and the specific research population. It focuses on the ethical consideration process. It also reports on the data collection approach as well as the method that was used, the development and testing of the data collection instrument, data coding and analysis process.

The firth chapter presents the research findings in graphic form for each of the test items in the questionnaire.The last chapter specifies the procedures that were followed in analysing the data and the computer programs that were used. It focuses on the study findings. The research findings are discussed in relation to the theory and literature review. It reports on the conclusions that were arrived at in relation to the research problem, purpose and objective, and whether the objective of the study was achieved. It indicates the limitations of the study and presents recommendations for future action and research.

2   CHAPTER 2 THEORETICAL BACKGROUND

2.1   Introduction

This chapter provides the theoretical framework used in this study. It focuses on an extensive discussion of the UNICEF conceptual framework and how it is relevant to the study.

2.2   Conceptual framework

A conceptual framework is an analytic tool with several distinctions and contexts. It is the way ideas are organised to achieve the purpose of a research project in empirical studies (Shields. Patricia, & Rangarjan, 2013). The UNICEF conceptual framework was relevant in this study because it assisted in analysing malnutrition, which is classified as a wicked problem. A wicked problem is a problem that is difficult or impossible to solve because of incomplete contradictory and changing requirements, it is an essentially novel and unique problem and can be considered symptoms of another problem with no given alternative solution (Conklin, 2006). Malnutrition is not a simple problem with a single simple solution. Several and interconnected determinants are involved in why malnutrition develops and a similar elaborate series of multifaceted and multi-sectoral actions and attitude.

2.3   The UNICEF conceptual framework

In 1990, UNICEF deemed it necessary to develop a strategy for improved nutrition of children and women in developing countries with two key features; a method for assessment and a method of analysis of action related to nutrition.

The underlying causes of inadequate access to food, insufficient health services and unhealthy environment and inadequate care for women and children were echoed in the International Conference on Nutrition 1992 (UNICEF, 1998). This categorization of food, health and care guided analysis of nutrition relevant actions in 1990 leading to the development of the UNICEF conceptual framework for malnutrition (UNICEF, 1998). The framework was adopted at the international level in 1992 because by then, some important background such as trends in nutritional status were known in many countries; there was considerable experience of nutritional programmes through research which confirmed the proposed hypothesis and therefore the framework became a broadly accepted model of analysis (Bizouerne, 2012). The conceptual framework has been used by the nutrition community for the past 25 years (Black et al, 2008).
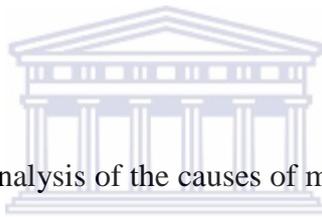
The framework is a guide to the analysis of the causes of malnutrition in a given context. It is based on collective experience of working in nutritional programmes globally (Pelletier, 2002). It is important not to interpret the framework as a predictive model. The framework accommodates possible causes, but also enables the reduction to the most essential causes in a given context (UNICEF, 1998). It further enables dialogue and cooperation among people of different professions.

In the framework, malnutrition and child death are viewed as two of the manifestations of a multi-sectoral development problem that can be analysed in terms of the immediate, underlying and basic causes (Pelletier, 2002). The conceptual framework shows that causes of malnutrition are multi-sectoral, embracing food, health and caring practices. These causes are classified in the framework as; immediate, underlying and basic (UNICEF, 1998). The conceptual framework reveals, besides feeding and health, a third underlying component of care practices.

Each of these conditions is necessary but not sufficient for child survival. The factors at one level influence the other levels. The framework is used at national, district and local level, to help plan effective actions to improve nutrition. It serves as a guide in assessing and analysing the causes of the nutrient problem and helps in identifying the appropriate mixture of actions (Engle et al, 2000).

This framework can be applied in different cultural, geographic and economic situations, and in each application, the particular causes of malnutrition will be local and specific which is where its strength lies. However, just like any other tool, it is only as useful as the user allows it to be. The more specific you are about categorising causes, the more useful it is in enlightening subsequent strategies to improve the nutritional status of the focus community (Swart et al, 2008).
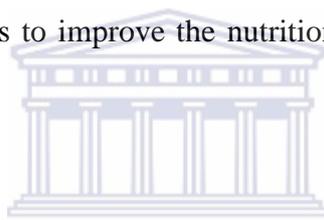
The UNICEF conceptual framework's target is child malnutrition and therefore it is greatly relevant to this particular study. Nevertheless, it may be used for all vulnerable populations. It is widely accepted as a useful tool to help understand the different levels of causes and multiple connected factors that influence nutritional status.

Figure 2.1 illustrates the causes of malnutrition according to the UNICEF conceptual framework. It identifies the three levels of causes of under-nutrition namely; immediate causes which operate at the individual level, underlying causes influencing household and communities and basic causes which are around the structure and process of the societies.
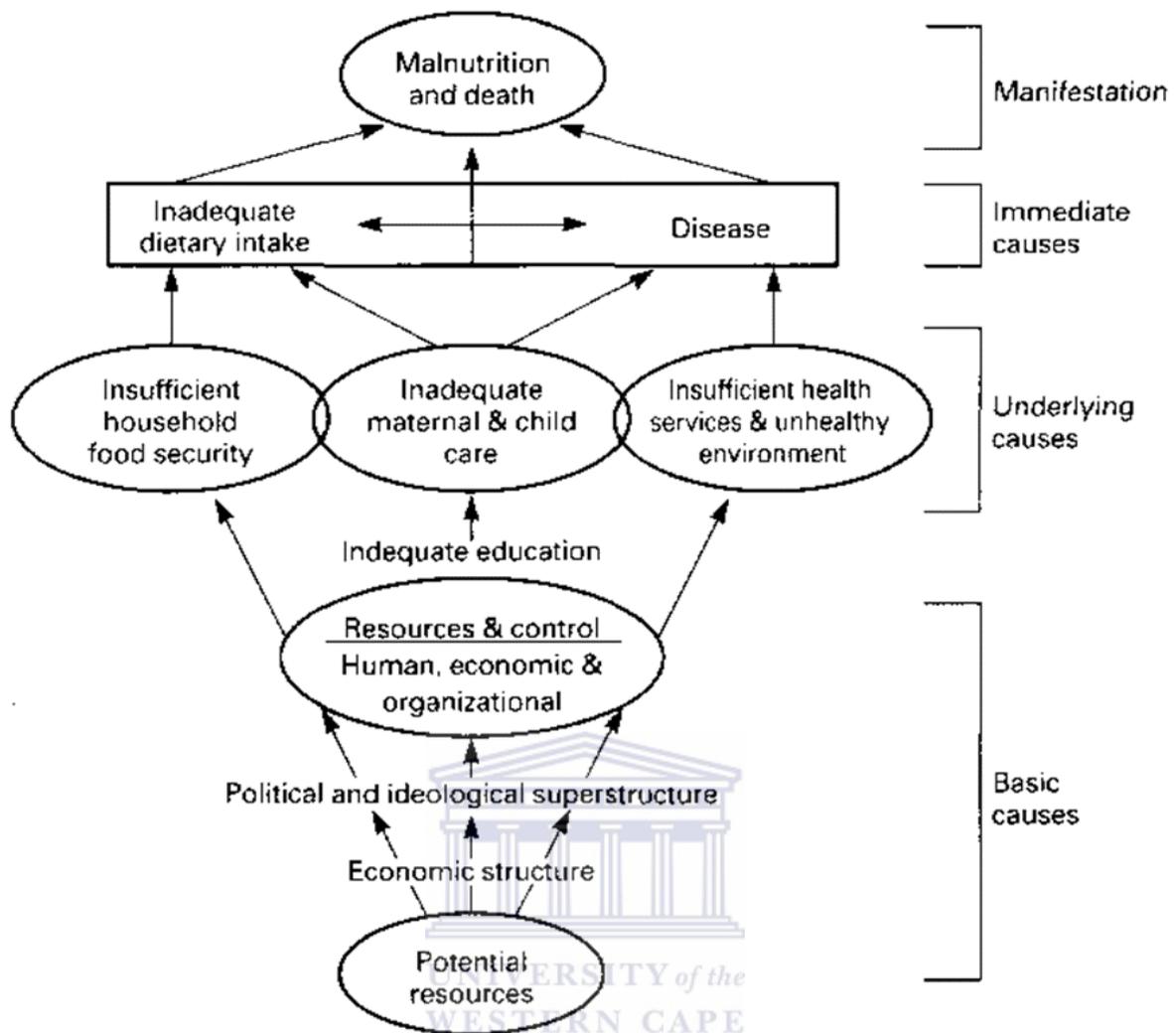
Figure 2:1: UNICEF conceptual framework for causes of malnutrition (UNICEF 2006)

2.4 Causes of malnutrition

Malnutrition is a complicated problem, an outcome of several aetiologies. A number of cross-country and case-control studies of determinants of child malnutrition have been carried out over the past years and the UNICEF conceptual framework for malnutrition has been adopted in these studies (Kinyoki, et al, 2015, Fuch et al, 2014, Shafqat et al, 2013, Kadima, 2012 and Rayhan & Khan, 2006). Root causes of hunger, undernourishment and malnutrition are complex, and diverse ranging from situational or severe poverty, extreme drought, flood, and

other weather disparities in food distribution, and absence of food security (Fontell & Vince, 2011).

These causes have been proven in some studies conducted previously (Kinyoki et al, 2015, Mizumoto et al, 2013, and Shargi et al, 2011). Some variables that might be important determinants of child nutrition, such as democracy and women status may exhibit greater variation between countries than within them (Smith & Haddad, 2000). Other variables may only be observed at national level. For example, national food supplies and income (Smith & Haddad, 2000). This therefore suggests that variable definitions may not be uniform across countries. For example, "access to safe water" may be different between Botswana and South Africa.

Children under the age of five years are more vulnerable to malnutrition, which is why this age is often used as a cut of point. They rely on nutrients to facilitate their development (UNICEF, 2009). When a child is born to an undernourished mother or they are born with a low birth weight they have a high risk of remaining undernourished (UNICEF, 2009). This was also suggested by studies carried out by; Fuchs et al, (2014), Hailemariam (2014), Kadima (2012) and Babantunde et al, (2011).

Poverty, ignorance, disordered feeding, nutritional status, repeated pregnancies, parent's separation and mother's health are established risk factors for malnutrition (Ijarotimi, 2013, Shargi et al, 2011 and Delpeuch et al, 2000). Physical environment, personal hygiene, and consumption of contaminated water and food are also important risk factors (Shafqat et al., 2013, Mizumoto et al, 2013 and Babantune et al, 2011). A number of studies suggest that factors such as lack of knowledge about recommended infant and child feeding,

unemployment, and health related factors are predictors of malnutrition among the under five children (Siddiqi, 2011, Amsalu & Tiyabu, 2006 and Rayhan & Khan, 2006).

2.5   Immediate causes of malnutrition

The immediate determinants of child nutritional status manifest themselves at the level of the individual human being. They are a result of lack of dietary intake or disease (UNICEF, 1998). This can be caused by consuming too few nutrients or nutrient imbalances or an infection which can increase the body's nutritional requirement and/or prevent the body from absorbing nutrients consumed. These factors themselves are interdependent as illustrated in figure 2.2.

Child malnutrition

Inadequate dietary intake   Disease   Immediate

Or a combination
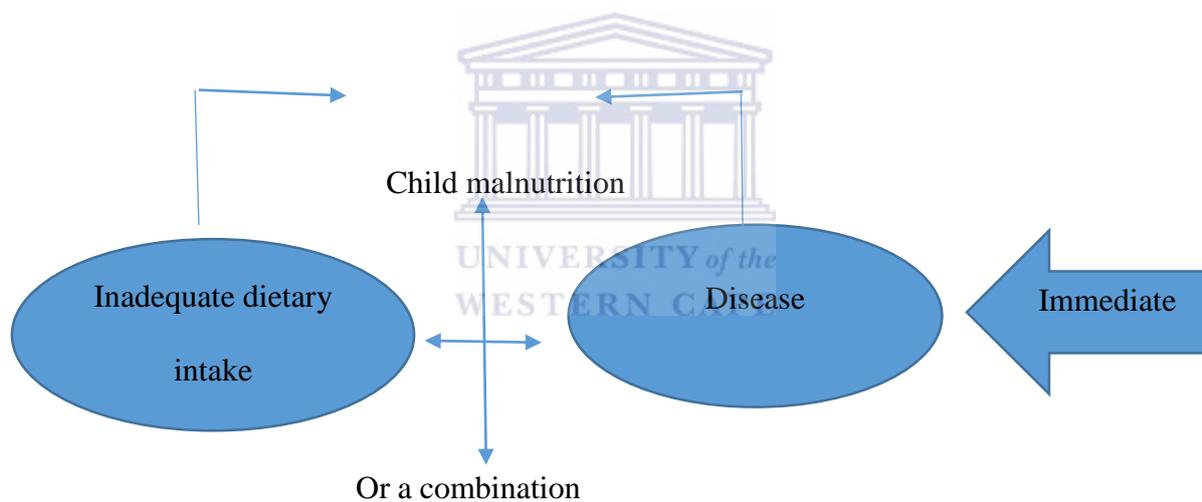
Figure 2:2: Illustration of the immediate causes of malnutrition

In practice, under-nutrition and infection often occur at the same time because one can lead to the other. Inadequate dietary intake and illness tends to create a vicious cycle. The interaction of malnutrition and infection, acknowledged as a main public health issue operates as a cycle, or perhaps is better described as a coil. Incidences of disease led to decreasing nutritional status

manifested by growth failure in children, which reduces resistance to disease, increasing vulnerability further; the way back is better nutrition (UNICEF, 1998).

In general, poor nutrition can result in reduced body ability to resist infection, by undermining the functioning of the main immune response mechanism thus leading to infection (UNICEF, 2008). This can subsequently increase the possibility of an individual getting an illness which lasts for a long time and/or severity hence resulting in loss of appetite, increased nutrient requirements and/or decreased absorption of nutrients consumed (UNICEF, 2008). This then further affects children's eating patterns and how they are cared for. This, in turn, elicits weight loss and reduces resistance to further infection. This vicious cycle needs to be broken by treatment of infection and improved dietary intake (UNICEF, 2008).

The vicious cycle of inadequate dietary intake and infection accounts for much of the morbidity and mortality of children seen in developing countries (UNICEF, 2006). In general, disease speeds up nutrient loss and suppresses appetite such that sick children tend not to eat as they should, and the cycle continues as illustrated by the conceptual framework.

2.5.1   Poor diet

Children under the age of 5 years have an increased energy requirements. If the child does not eat enough food or if the food they eat does not provide them with the nutrients they require for good health, they suffer from malnutrition (Black et al, 2008 and Brown, 2013). Poor diet may be caused by several different factors. If the patient develops dysphagia the patient can take insufficient nutrients. Having an illness or recovering from an illness may cause an inability to consume enough of the right nutrients (Black et al, 2008 and Brown, 2013). Poor

diet might also be due to not having enough food, or lack of variety of foods in meals, low concentration of energy and nutrients in meals, infrequent meals, insufficient breast milk and early weaning (Ijarotimi, 2013, Shargi et al, 2011 and Delpeuch et al, 2000).

2.5.2   Lack of breastfeeding

Breastfeeding practices and weaning foods are also related to malnutrition (Mizumoto, 2013, Amsala & Tigabu, 2006 and Mahgoub et al, 2006). Lack of breastfeeding is mostly common in developing countries and it leads to malnutrition among infants and children. The deprivation of breast milk and the commencement of nourishment with food (weaning) occurs during the high risk period of a child's life (de Onis et al, WHO database 1997). Weaning is often complicated by geographic, economy, hygiene, public health, culture and dietetics (de Onis et al, WHO database, 1997). It can be ineffective if the food introduced provide inadequate nutrients.
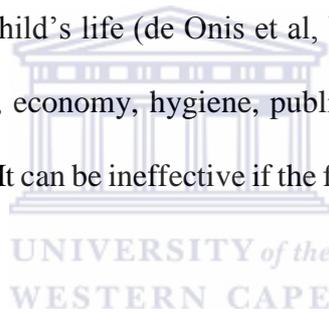
2.5.3   Disease

Children under the age of 5 years have an increased susceptibility to viral and bacterial infections. Infectious disease cause malnutrition because a sick child may not eat or absorb enough nutrients or may lose nutrients from the body due to vomiting or diarrhoea or have increased nutrients needs which are not met (Black et al, 2008; Victoria et al, 2008; Brown, 2013 and Kinyoki et al, 2015). The diseases most likely to cause malnutrition are measles, diarrhoea, AIDS, respiratory infections, malaria and intestinal-worms (Black et al, 2008; Nhampossa et al, 2013 and Kinyoki et al, 2015)

2.5.4 Digestive disorders and stomach conditions

Some children may have inadequate absorption of nutrients. Examples include patients with chron's disease or ulcerative colitis. Individuals who suffer from Celiac disease have a genetic disorder that makes them intolerant to gluten (Murray & Lopez, 1996 and Brown, 2013). People with Celiac disease have a higher risk of damage to the lining of their intestines resulting in poorer food absorption. Patients who experience serious episodes of diarrhoea and/or vomiting may lose vital nutrients and are at higher risk of suffering from malnutrition (Murray & Lopez, 1996 and Brown, 2013).

2.6 Underlying causes of malnutrition
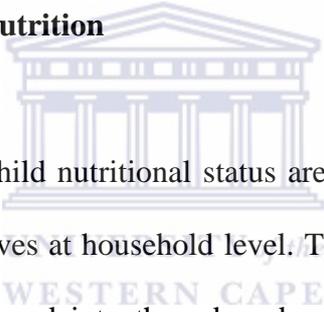
The immediate determinants of child nutritional status are in turn influenced by underlying determinants manifesting themselves at household level. The underlying factors contributing to child malnutrition can be grouped into three broad categories namely; household food insecurity, inadequate care, unhealthy household environment and lack of health services. These are often referred to as 'food', 'care' and 'health' factors (Black et al, 2008). A more refined version of the framework has since been developed adding female education just below the underlying causes (Black et al, 2008). Whether or not an individual gets enough food to eat or whether he/she is at risk of infection is mainly the result of factors operating at the household and community level (Smith & Haddad, 2000).

Health environment and services, rests on the availability of safe water, sanitation, health care and environmental safety including shelter (Golden et al., 2000). These factors where proven in studies conducted by; Larrea & Kawachi (2005), Pongou et al, (2006), and Masiye et al,

(2010). Some of the most important factors contributing to malnutrition are inadequate knowledge about the benefits of exclusive breast-feeding and complimentary feeding practices and the role of micronutrients and the lack of time women have available for appropriate infant care and practices and their own care during pregnancy and in the first two years of life (Shekar, 2006). These determinants were investigated and proven by; Shafqat et al, (2013), Ijarotimi (2013), Kadima (2012) and Hailemariam (2014). Maternal education level, maternal age, marital status, availability of pipe borne water, and latrines have been reported related to malnutrition (Mboho & Bassey, 2013, Siddiqi et al, 2011 and El-Sayed et al, 2001).

2.6.1   Food shortages

In the poorer developing nations food shortages are mainly caused by a lack of technology needed for higher yields found in modern agriculture, such as nitrogen fertilizers, pesticides and irrigation (Smith & Haddad, 2000). Food shortages are a significant cause of malnutrition in many parts of the world (Smith & Haddad, 2000).

2.6.2   Family food shortages

Most families do not have enough food to feed everyone properly throughout the year. The possible reasons for family food shortages may be that there are a large number of families in the locality, leading to over-cultivation of their lands (Siddiqi et al, 2011). Another might be the effect of low income or poor budgeting (Mahgoub et al, 2006 and Fuchs et al, 2014). Some people may spend so much on non-essential things cigarettes and beer so there is not enough money left for the family's food needs. There might also be poor distribution of food among families (Masiye et al, 2010 and Mahgoub et al, 2006).

2.6.3 Food insecurity

Food security is when people have a physical and economic access to adequate, safe and nutrition food at all the time that meet their dietary and food preferences for an active and healthy lifestyle (World Bank, 2011). Household food security is embraced by four factors: availability, access, stability and utilisation. The household should have satisfactory food availability, have adequate resources to acquire it, and be able to consume it at all times in order to have an active healthy life (Smith et al., 2000; FAO; WHO). It is fundamental for the household to be food secure. If a household is food insecure it becomes vulnerable to food shocks such as low production, failed harvest, and price fluctuation of goods, just to name a few (Turner et al, n.d).

The resources necessary for gaining access to food are food production, income for food purchases, or any kind transfer of food whether from other private citizens, national or foreign governments or international institutions (Smith & Haddad, 2000). Groups which are particularly vulnerable to food insecurity include but not limited to; women especially low income, pregnant and lactating women, victims of conflict, the ill and children aged below five years (FAO-UN, 2011). Cultural taboos play a negative role in food security such as withholding nutrition foods for the mother and the baby.

South Africa have shown that in order to cope with food insecurity some common strategies such as; care-giver changing their approaches, limiting food variety, portion size and skipping meals have been employed (Oldewage-Theron et al, 2006). All of these common strategies seriously affect nutritional status of a household. Contrary to popular perceptions undernutrition is not simply a result of food insecurity; many children in food-secure

environments and from non-poor families are under-weight or stunted because of inappropriate feeding (Shekar, 2006, Amsalu & Tigabu, 2006, and Mizumoto et al, 2013).

Other potential sources of food are by exchange, gifts from family or friends, and in some cases food aid provided by the government like it is the case for the under five children in Botswana. The Botswana government in collaboration with UNICEF and other development partners have developed an evidence based Accelerated Child Survival and Development (ACSD) strategic plan in which Vitamin A supplementation and locally produced food supplement (Tsabana, ground nuts and beans and vegetable oil) are amongst the cost-effective nutrition interventions that are used to improve the nutrition situation of children 6–59 months in Botswana (UNICEF, 2012). Household food security is dependent on access of food determined by financial, physical and social well-being.
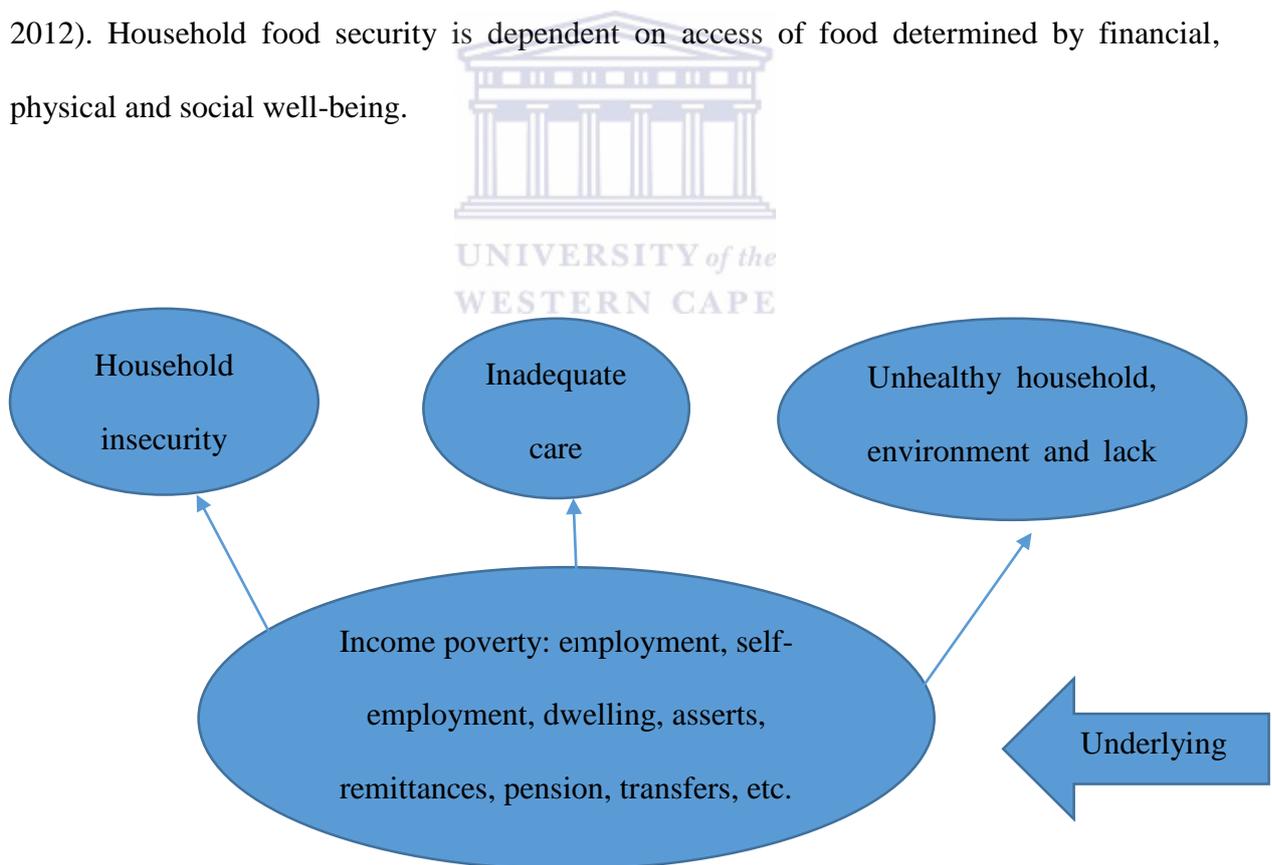
Figure 2:3: Illustration of the underlying causes of malnutrition

2.6.4 Poverty and employment

A key factor affecting most determinants of malnutrition is poverty. A person is considered to be in absolute poverty when the person is unable to satisfy his or her basic needs (Frankenberger, 1996). Income poverty and unemployment are very closely linked, and by default unemployment and hunger are correlated. In a country with high unemployment rate, often results in a large part of the population being dependent on subsistence farming (Smith & Haddad, 2000). Little extra income is generated and the rural population can become increasingly food insecure and it can thereby affect dietary intake, as well as the access to health facilities (Smith & Haddad, 2000). In a 2011 study conducted by Shargi et al, poverty was proved to be linked to child under-weight.

2.6.5 Inadequate care

Care, the second underlying determinant is the provision in households and communities of time, attention, and support to meet the physical, mental and social needs of the growing child and other household members (ICN, 1992). Care practices are defined as the behaviours and practices of care-givers (mother, fathers, siblings and child care providers) that provide the food, stimulation and emotional support necessary for the children's healthy growth and development (Engle et al, 2000). This includes for example, child feeding practices, health seeking behaviour, support and cognitive stimulation for children and care and support of mothers during pregnancy and lactation (Smith & Haddad, 2000). Not only the practices themselves but the way they are performed with affection and responsiveness to children are critical to children's survival, growth and development (Engle, 2000). It is impossible for care-givers to provide this care without enough resources such as time and energy.

Therefore, we may have a suitable environment on the health and food level but one that the child will not benefit from if care practices are inadequate (Engle, 2000). For example, if a child has diarrhoea and loses appetite, he/she will benefit from existing health services only if the people around her/him realise that he/she is not well and take her/him to the health services. On the other hand, adequate care practices may be rendered useless or ineffective when a child has diarrhoea and loses appetite and the people around her/him would like to have their child treated but there is no health services. In this case the child would not benefit from the medical treatment she/he needs. Changes to underlying factors such as humanitarian or natural emergences may disrupt these practices and lead to poor dietary intake and infection.
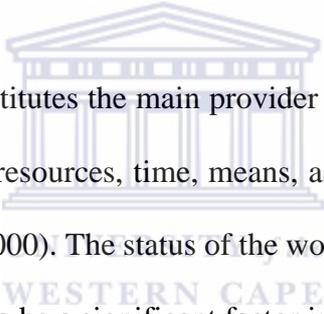
In most societies, the mother constitutes the main provider for child care and she experiences many constraints such as lack of resources, time, means, as well as spiritual, knowledge and cultural constraints (Engle et al, 2000). The status of the woman in the community is therefore fundamental. Education is found to be a significant factor in improving health status therefore the education level of women, who are the main care takers of children, has many positive effects on the quality of care (Engle et al, 2000). The quality of care practices is correlated with the child development, not only at intellectual development level but also for developing the mother and child relationship. It is also related to nutrition, growth and health (Engle et al, 2000).

Care for children is defined by Engle et al, (2000) as practices of the care-giver that affect nutrient intake, health, cognitive and psychosocial development of the child. Care is the provision in household and communities of time, attention, and support to meet the physical, mental and social needs of the growing child and other household members (ICN, 1992).

Children need to be fed appropriate foods, need to be taken to the health facility when ill or otherwise treated correctly and need to live in an environment which is disease preventive in order to avoid immediate causes of malnutrition (Turner et al, n.d).

This can only be achieved if a child has a care-giver who provides appropriate care. For the care-giver to be able to provide appropriate care, certain resources such as; knowledge, autonomy and economy, economic resource control, time, good mental health and support from the society are needed to achieve proper care practices (Turner et al, n.d). Education is found to be a significant factor in improving health status therefore the education level of women, who are main care takers of children has many positive effects on the quality of care (Mahgoub et al, 2006, Larrea & Kawachi, 2005 and Smith & Haddad, 2000).

Some examples of care practices include feeding practices, psychosocial care and cognitive stimulation for children, care and support for women before, during and after pregnancy, food preparation, hygiene and home health practices (Smith & Haddad, 2000). Child feeding practices also determines the child nutritional intake (Turner et al, n.d). Engle et al, (2000) stated that hygiene practices and the home health practices determine the child's morbidity and mortality.Displacement of the mother or the entire household or violence might lead to exhaustion impairing breast-feeding. Good hygiene at home and in food preparation reduces illness.

2.6.6   Poor public health

The third category of the underlying causes of under-nutrition refers to those related to poor public health. These include factors relating to the health environment, exposure to disease and

27

access to basic health services (UNICEF, 1998). The healthy environment is affected by access to safe clean water and sanitation, the presence of breeding sites, the quality of shelter and consequently the level of cold, stress and overcrowding. Access to basic health and sanitation services determines the extent to which infection and disease can be prevented or treated (UNICEF, 1998). An essential element of good health is access to curative and preventive health services that are affordable and of good quality (UNICEF, 1998). Families should have a health centre within a reasonable distance and centre staff should be qualified and equipped to give advice and care if needed (UNICEF, 1998).

In environmental health, the lack of ready access to a safe water supply and proper sanitation and the unhygienic conditions in and around homes, which causes most childhood diarrhoea, have significant implications for the spread of infectious diseases (UNICEF, 1998). Moreover, when food is handled under unhygienic conditions and the environment is unhealthy, littered with animal and human waste, young children are also more prone to infection which is another cause of poor growth and malnutrition.

2.6.7   Poor water and sanitation

Lack of access to safe drinking water and adequate sanitation results to the spread of infectious diseases, including childhood diarrhoea which is a major cause of malnutrition (Kinyoki et al, 2015; Kavosi et al, 2014; Shargi et al, 2011 and Babantunde et al, 2011). Clean water, adequate sanitation and better hygiene practices can prevent disease and improve nutrition as people are able to grow more crops when water is readily available.

In order to reduce the spread and control severity of infections within the household and community there is a great need to address sanitation and hygiene (Cainrncross et al, 2010). There is an obvious direct correlation between personal hygiene, sanitation, clean water and malnutrition especially in young children (Tharakan and Suchindran 1999; Golden et al., 2000; Checkley et al, 2004; Fewtrell et al, 2006). Improved hygiene lowers the percentage of children with diarrhoea and other forms of infections that impairs the consumption and utilisation of nutrients (Fewtrell et al, 2006).

According to Fewtrell et al, (2006) implementations that reduces diarrhoea significantly were hygiene education, hand washing practices (33 %), increases sanitation (22 %) and water supply improvements (22 % and 17 %). Cainrncross et al, (2010) find the same trend in their meta-analysis, 48 % decrease for hand washing with soap, 36 % for good disposure of excrements and 17 % for improved water sources. There is a direct correlation between water quality, water storage facilities and sanitation on stunting in children in Peru as proved by Chenkley et al, 2004. It has long been acknowledged that infectious disease results in insufficient nutrient intake and that insufficient nutrient intake makes a person more susceptible to infectious disease and that the two factors work in synergistic relationship creating a vicious circle (Bain et al, 2013).

2.6.8   Inadequate health services

Resources are often insufficient to support the provision of essential services. The lack of life saving equipment at the first referral level, lack of equipment and personnel and poor patient management are a contributing factor to malnutrition (UNICEF, 2011). When the primary health service functions insufficiently it may lead to child undernourishment as a result of lack

of health services (UNICEF, 2008). The primary health care services have been put in place to provide treatment to all children for simple infections such as pneumonia, malaria, and diarrhoea, as well as provide advice and education to care-givers about care practices (Turner et al, n.d). Therefore the primary health care services prevent and treat disease and secure sound child development and avoid the development of child malnutrition (Turner et al, n.d).

The primary health services must be available to all and should be offered free of charge when considering developing countries so that people can afford to seek help at any time suitable to them (Turner et al, n.d). This is very important in order cover every child with needed public health interventions such as immunization, vitamin A supplementation, and in the case of malnutrition, supplementary food and information for care-givers (UNICEF, 1998). In some previous studies conducted, poor primary health care services was linked to child malnutrition (Hailemariam, 2014, Kavosi et al, 2014 and Larrea & Kawachi, 2005).
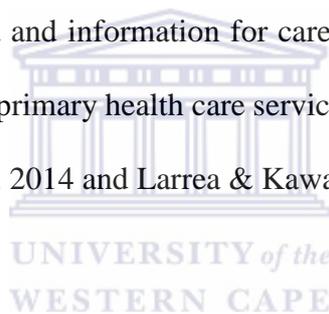
2.6.9 Inadequate education

It is said the way to a child's stomach is through the mind of the mother (Turner et al, n.d). In order to reduce malnutrition related mortality and morbidity the improvement of parents' educational status especially of mothers, on nutrition, sanitation and common disease prevention strategies (Bain et al, 2013). Quality of the food taken, choices and quantity are all at the discretion of the mother or care-giver. Poverty and education are closely related and virtually integrates into the virtual cycle of ignorance, disease and poverty (Bain et al, 2013).

Education could help reduce excessively large family sizes. A poor community of certain cultural beliefs might not actually realise that giving birth to a fewer number of children might

actually help them to match the limited resources, and also offer adequate and quality nutrition to the family (Bain et al, 2013). Lack of education was significantly associated with under-nutrition in some previous studies (Kavosi et al, 2014, Mboho & Bassey, 2013 and Siddiqi et al, 2011). In a community based study by Shafqat, Manzoor & Abbasi, (2013), it was concluded that child nutritional status is strongly associated with the literacy of mothers, their health awareness and child rearing practices.

2.6.10 Links between underlying causes of malnutrition

There is a significant overlap in the three groups of underlying causes. For example; a child who is sick is dependent on his/her care-giver to take him/her to a health facility, yet the care-giver's time is dependent on the type of work they do, which is also affected by the time required to access a health facility. The factors associated with this situation of accessing health care for the child are not only related to public health, but food security and social care as well as the environment.

2.7 Basic causes of malnutrition

The basic causes of malnutrition refers to potential resources available (human, structural and financial) and how they are utilised (the political, legal and cultural factors) (UNICEF, 1998). These can be thought of as the real reasons behind the underlying causes. Political, legal and cultural factors may defeat the best efforts of households to attain good nutrition. The political and economic system determines how income and assets are distributed and the ideologies and policies that govern social sectors (UNICEF Harmonized Training Package, n.d). Overcoming entrenched poverty and under development requires resources and inputs. If the basic causes

of malnutrition are to be addressed, greater and better-targeted resources and better collaboration are needed (Black et al, 2008).
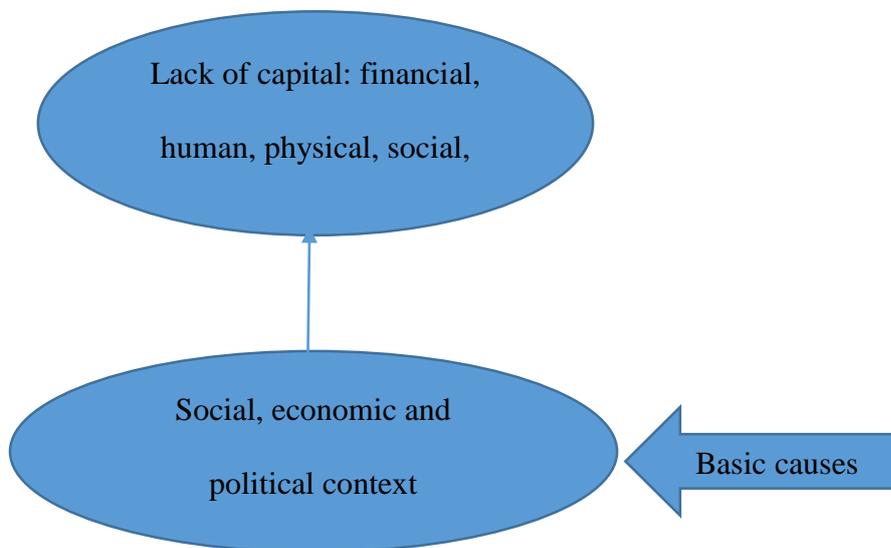
Figure 2:4: Illustration of the basic causes of malnutrition

2.8 Linking the study to the UNICEF conceptual framework

Malnutrition is a complicated problem, an outcome of several causes. A number of cross-country studies of determinants of child malnutrition have been carried out over the past years and the UNICEF conceptual framework for malnutrition has been adopted in these studies (Smith & Haddad, 2000) to fit with the context within these counties. Some variables that might be important determinants of child nutrition, such as democracy and women status may exhibit greater variation between countries than within them (Smith & Haddad, 2000). Other variables may only be observed at national level. For example, national food supplies and income (Smith & Haddad, 2000). This therefore suggests that variable definitions may not be uniform across countries or even within a country. For example, "access to safe water" may be different between Botswana and South Africa; similarly it can be different between provinces or regions within a country.

32

The UNICEF conceptual framework assisted in identifying what should be assessed and how causative relationships should be identified and analysed. It also helps to clarify the objectives of actions selection for implementation. The objectives of the study were guided by the framework because with all the immediate, underlying and basic causes of malnutrition suggested by the framework, it was necessary to determine the factors relevant to the community of Francistown. In order to determine which factors were relevant for this study, the framework was used to develop the questionnaire which had five categories of data namely; the child and anthropometric information which included factors affecting the child directly, care-giver information, house hold data and primary health care information which contribute to the basic and underlying factors.
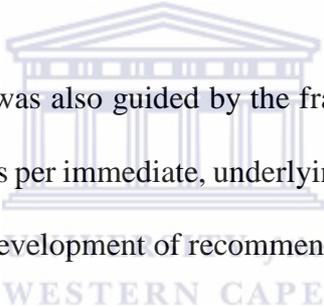
The analysis of data in the study was also guided by the framework because the contributing factors to SAM were categorised as per immediate, underlying and basic causes of malnutrition and therefore this assisted in the development of recommendations to rectify the problems.

The UNICEF conceptual framework highlighted throughout this study that childhood malnutrition is not just a food or health care issue. It promoted a broader understanding of factors influencing status and encouraged need assessment to look beyond just the food needs of the population. This is based on the assumption that a population requires care, food security, adequate health services and a healthy household environment in order to be protected from disease and malnutrition. If these are unavailable they need to be provided. This will help ensure that available resources are used effectively.

Nevertheless, the framework shows that child nutrition is an inherently individual and household-level phenomenon, which therefore calls for community based approach for determinants of childhood malnutrition in Francistown, Botswana. Although there are a

number of common variable determinants of child malnutrition as suggested by past studies, each region has its own common features which play a role.

A self-developed questionnaire which had different categories of questions that were developed through the guidance of the UNICEF conceptual framework was used as a guidance in assessment, analysis and action in a specific context. The questions that were developed in the assessment tool for this study covered the immediate, underlying and the basic contributors to child malnutrition, as suggested by the framework, nevertheless the assessment questions were developed based on relevance to the area of study. According to Pelletier (2002), the triple 'A' cycle provided by the framework can be used at all levels of society to create a process whereby people's right to good nutrition is fulfilled.
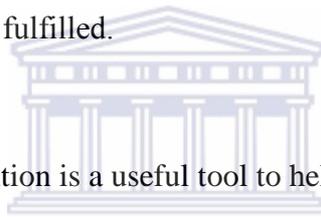
The conceptual model of malnutrition is a useful tool to help understand the many factors that impact on nutritional status therefore it was relevant to use in this study because the aim of the study was to determine the contributing factors to severe acute malnutrition amongst children under the age of five in Francistown, Botswana. The framework was useful in creating a checklist to identify and prioritise the short and long term needs of children and the general population thus providing a structure for relevant recommendations. It also assisted in providing a structure to organise and analyse data collected during the survey. Concerning each case, it is important to look for the causes that have led to malnutrition, this will assist in providing answers and appropriate advices to patients.

2.9   Conclusion

Nutrition cannot be separated from growth, survival and development of the child, stressing the point that malnutrition is only one, amongst several outcomes of the contextual factors but not the only one. There is rarely a unique cause of malnutrition, but rather a set of factors linked together in a given context. A systematic approach is more relevant to understand malnutrition than a linear causal interpretation: thus a cause may have several effects and through feedback, an effect may modify the risk factors. According to UNICEF/WHO joint committee, multiple linear determinants are involved in why malnutrition develops and a similar intricate of approaches, multifaceted and multi-sectoral are needed to deal with it. Therefore, employing the UNICEF framework in this study assisted greatly in focusing on many different determinants of child malnutrition because of the shared understanding provided by the framework. There is the potential to foster collaboration and bring organisations together to exchange information and therefore, strengthen the understanding of a situation and promote consensus on the priority of needs. The next chapter presents a review of literature that was studied regarding the research topic.

3   CHAPTER 3 LITERATURE REVIEW

3.1   Introduction

This chapter provides a review of literature that was studied on the pathophysiology of malnutrition, classification of malnutrition, views of various authors regarding malnutrition among children in Botswana, Africa and the World, and an in-depth discussion of evidence of causes in child malnutrition.

3.2   Pathophysiology of malnutrition

Malnutrition is a general term commonly used as an alternative to under-nutrition but technically it also refers to over-nutrition. A person is classified as being malnourished if his/her dietary intake does not provide adequate nutrients for growth and maintenance; or for increased requirements as a result of infections or disease; or if they are unable to fully utilize the food they eat (under-nutrition) (UNICEF, 2006; Black et al, 2008 and Brown, 2013). They are also malnourished if they consume more nutrients than needed by their body (over-nutrition) or have a nutrient imbalance (UNICEF, 2006; Black et al, 2008 and Brown, 2013). This study will focus on malnutrition in the context of under-nutrition.

According to de Onis, Monteiro, Akre, & Clugston (1997), World Health Organisation (WHO) defines malnutrition as the inability of cells to balance between the supply of nutrients and energy and the demand of the body to ensure growth, maintenance and other bodily activities. Malnutrition may be an outcome of several circumstances; first and far most, the absence of adequate and proper food may be due to insufficient agricultural processes, limitation in food

distribution, or certain social problems such as poverty (Grantham-McGregor et al, 2007). In these instances the causes of malnutrition is most often found to be diet largely inadequate in energy or protein (Grantham-McGregor et al, 2007).

Brown (2013) defines malnutrition as the shortage of one or more nutritional elements needed for health and well-being. Primary malnutrition is caused by the deficiency of vital food stuffs usually vitamins, minerals or proteins in the diet. This commonly leads to specific nutritional deficiency diseases (Brown, 2013). Poor eating habits and food preferences may lead to malnutrition through the exclusion of other foods and the habitual consumption of certain foods or eating large quantities of non-nutritious foods. In certain parts of Africa for example, the practice of weaning breastfed infants to a diet consisting mostly of one kind of starchy food, such as cassava, may lead to protein deficiency (Rabinowitz et al, 2014).
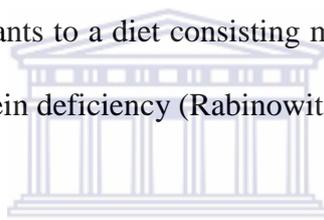
Secondary malnutrition is caused by failure of absorption or use of nutrients which may be due to acquired or inherited metabolic defects, notable those involving the digestive tract, thyroid, liver, kidney, pancreas and red blood cells (Shashidhar & Grigsby, 2009). It can also be due to increased nutritional requirements such as growth, injury, fever or excessive excretion such as diarrhoea (Shashidhar & Grigsby, 2009). These defects cause malnutrition by preventing the digestion, absorption and metabolism of food staffs by organs and tissues (Shashidhar & Grigsby, 2009 and Brown, 2013).

Malnutrition affects almost every organ system. Dietary protein is needed to provide amino acids for synthesis of body proteins and other compounds that have various functional roles (Shashidhar & Grigsby, 2009). Energy is needed in children for growth and development functions in the body because of the rapid development of their bodies and the physical

movement. Furthermore, micronutrients are essential in many metabolic functions in the body as components and cofactors in enzymatic processes (Shashidhar & Grigsby, 2009).

The pathophysiological changes in malnutrition are as a result of the imbalance between nutrient supplies and requirements resulting in loss of tissues with adverse functional consequences. The mechanisms involved account for the clinical signs and symptoms of malnutrition (Armstrong, 2002). Malnutrition leads to slow metabolic rate, abnormal lipid metabolism and immunologic deficiency which predispose a child to infections (Armstrong, 2002). The body resolves to breaking down the adipose tissue for energy and when these tissues are exhausted it uses protein for energy. Protein mass which is mainly represented by muscle and some organs (e.g. heart), can decrease as much as 30% in the most serious forms of malnutrition. The muscle fibers in turn become thin with loss of striation (Shashidhar & Grigsby, 2009). Muscle cells are atrophic, and muscle tissue is infiltrated with fat and fibrous tissue. The brain, skeleton, and kidney are preserved, whereas the liver, heart, pancreas, and digestive tract are first affected (Shashidhar & Grigsby, 2009).

Potassium is an important electrolyte studied in malnutrition. Total body potassium deficit is associated with decreased muscle mass, poor intake, and digestive losses (Rabinowitz et al, 2014 and Shashidhar & Grisby, 2009). This potassium deficit contributes to hypotonia, apathy, and impaired cardiac function. Plasma sodium concentration is generally within the reference range, but it can be low, which would be a sign of poor prognosis (Rabinowitz et al, 2014 and Shashidhar & Grigsby, 2009). A deficit in calcium, phosphorus, and magnesium stores is also observed. Iron deficiency anemia is consistently observed in malnutrition. However, in the most serious forms, iron accumulates in the liver, most likely because of the deficit in transport protein (Rabinowitz et al, 2014). Patients who have iron accumulation in the liver are at higher

risk of mortality (Rabinowitz et al, 2014). Malnutrition also manifests through the reduction of physical activity in young children which in turn will cut down on their exploration of their immediate environment impacting negatively in their development (Armstrong, 2002 and Victoria et al, 2008).

So much development occurs in the first few years of life therefore, nutrient deficiencies can have major short-term implications in young children. Malnourishment can greatly compromise a child's immune system, making them more susceptible to infectious diseases (Murray & Lopez, 1996 and Musager, Hassan, & Obeid, 2011). Particularly in households where there are poor sanitary practices, children are vulnerable to infections from other children or caregivers (Musager, Hassan, & Obeid, 2011). In particular, zinc, iron and vitamin A are commonly associated with weakened immune function. Malnutrition causes immune response changes which predispose children to severe and chronic infections (Musager, Hassan, & Obeid, 2011). It is an underlying factor in many diseases in both children and adults (Corware, 2014 and Murray & Lopez, 1996). Malnutrition is associated with infections such as measles, acute respiratory tract infection, malaria, HIV/AIDS and tuberculosis (WHO, 1999 and Musager, Hassan, & Obeid, 2011). These infections further compromise nutrition causing anorexia, decreased nutrient absorption, increased metabolic needs and direct nutrient losses (Murray & Lopez, 1996).

Nutrient deficiencies and gastrointestinal infections commonly co-occur. A child may contract an infection due in part to poor nutritional status. In turn, a gastrointestinal infection places the child at even greater risk for nutrient deficiencies because nutrients are unable to be absorbed properly (Brown, 2013). Consequently, nutrient deficiency combined with infection can cause growth retardation (Victoria et al, 2008 and Black et al, 2008). A deficiency in one nutrient

may lead to a deficiency in another nutrient. For example, deficiencies in iron, magnesium and zinc can cause anorexia and thereby result in reduced intake of other important nutrients such as protein. Low lipid intake can also affect the absorption of important fat-soluble vitamins such as vitamins A and D. Zinc and protein deficiencies can retard bone growth and development, putting a child at risk for long-term complications (Victoria et al, 2008; Black et al, 2008).

Low serum levels of zinc have been associated with the cause of skin ulceration in many patients diagnosed with malnutrition (Victoria et al, 2008). Serum levels of zinc are closely related to the presence of edema, stunting of growth, and severe wasting. Malnutrition leads to impaired glucose clearance that relates to dysfunction of pancreatic beta-cells (Spoelstra et al, 2012 and Shashidhar & Grigsby, 2009). At the early stages of malnutrition, a rise in gluconeogenesis leads to a perceived increased metabolic rate. As fasting progresses, gluconeogenesis is suppressed to minimize muscle protein breakdown, and ketones derived from fat become the main fuel for the brain (Spoelstra et al, 2012). With chronic underfeeding, the basal metabolic rate decreases. One of the main adaptations to long-standing energy deficiency is a decreased rate of linear growth, yielding permanent stunting (Shashidhar & Grigsby, 2009).

Reduced energy intake in turn leads to a decrease in physical activity followed by a progressively slower rate of growth. Weight loss initially occurs due to a decrease in fat mass, and afterwards by a decrease in muscle mass, as clinically measured by changes in arm circumference. Muscle mass loss results in a decrease of energy expenditure (Victoria et al, 2008; Black et al, 2008). Reduced energy metabolism can impair the response of patients with malnutrition to changes in environmental temperature, resulting in an increased risk of

hypothermia. Furthermore, during infection, fever is reduced compared to a well-nourished patient (Victoria et al, 2008; Musager, Hassan, & Obeid, 2011). The metabolism is redirected to vital function in case of nutrient deficiency.

In growth reduction there are three types of undernutrition namely; acute malnutrition characterised by thinness or oedema, chronic malnutrition linked with shortness and acute and/or chronic malnutrition characterised by being under-weight (Victoria, et al, 2008; Bhutta et al, 2008 and de Onis et al, 1997).

The short-term implications of malnutrition eventually give way to long-term complications, such as growth and cognitive delays (Bhutta et al, 2008 and Victoria et al, 2008). Malnutrition not only impacts growth in the short term, but can also limit total bone growth. Children classified as low height-for-age (stunted) may never be able to regain lost growth potential if they continue to live in a nutritionally deprived situation (Bhutta et al, 2008 and Victoria et al, 2008). Malnutrition negatively effects brain development causing delays in motor and cognitive development, such as; reduced social skills, reduced language development, memory deficiency and attention deficit disorder (Bhutta et al, 2008; Victoria et al, 2008 and Black et al, 2008). Children who are undernourished before age two and gain weight quickly later in childhood and in adolescence are at high risk of chronic diseases related to nutrition (Bhutta et al, 2008 and Rabinowitz et al, 2014). Undernourished girls tend to grow into short adults and are more likely to have small children (Black et al, 2008 and Victoria et al, 2008).

Malnutrition has long lasting effect on health, generally with effects on physical growth, morbidity, cognitive development, reproduction and physical work capacity (Mahgoub, Nnyepi, & Bandeke, 2006 and Grantham-McGregor, 2007). It is particularly prevalent in developing countries where it affects one out of every three pre-school-age children (UN,

2012). Adaptation to nutrient deficiency aims at establishing lasting saving conditions by promoting optimization of energy reserve utilisation while preserving protein pool (Grantham-McGregor, 2007 and Brown, 2013).

All forms of malnutrition can affect organs and the function of those organs. Dietary protein is required for synthesis of amino acids producing proteins needed for tissue repair (Shashidhar & Grigsby, 2009 and Kaneshiro & Zieve, 2011). Energy is needed for basal metabolic rate essential for biochemical and physiologic functions (Black et al, 2008 and Rabinowitz et al, 2014). Micronutrients are essential in metabolic functions as components and cofactors in enzymatic processes (Shashidhar & Grigsby, 2009 and Kaneshiro & Zieve, 2011).

3.3   Classification of malnutrition

A well-nourished child is one with access to adequate food supply, care and health. Such a child will grow well. Growth is assessed using comparison of weight and height measurements with the standard normal distribution of heights and weights of healthy children of the same age and sex (de Onis, et al, 1997 and Walker et al, 2007). Therefore, the best way to evaluate the nutritional status and overall health of a child is to compare the child's growth indices associated with adequate growth, with the set cut-off points in the standard normal distribution of well-nourished children (de Onis et al, 1997 and Walker et al, 2007).

There are three clinical forms of acute malnutrition namely; marasmus which is characterised by severe weight loss or wasting primarily caused by a deficiency in energy, whereas kwashiorkor is characterised by oedema associated with protein deficiency and marasmic-kwashiorkor which is a combination of both wasting and bilateral oedema indicates that, in

practice, separating these entities conclusively is difficult (Scrimshaw & Viteri, 2010; Spoelstra, 2012 and de Onis et al, 1997). These forms of serious PEM represent a group of pathologic conditions associated with a nutritional and energy deficit occurring mainly in young children from developing countries at the time of weaning (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012).

.

Marasmus can be considered as a progressing adaptation in a child facing an insufficient energy intake. Marasmus always results from a negative energy balance (Scrimshaw & Viteri, 2010; Spoelstra et al, 2012 and Victoria et al, 2008). The imbalance can result from an inadequate energy intake, an increased loss of ingested calories (e.g. emesis, diarrhea, and burns), an increased energy expenditure, or combinations of these factors, such as is observed in acute or chronic diseases (Rabinowitz et al, 2014). It is characterised by severe loss of fat and muscle which the body breaks down to make energy. Children adapt to an energy deficiency with a decrease in physical activity, lethargy, a decrease in basal energy metabolism, slowing of growth, and, finally, weight loss (Rabinowitz et al, 2014).

The body mass of a child with marasmus is significantly decreased in a diverse way. Fat stores can decrease to as low as 5% of the total body weight and can be macroscopically undetectable (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012). The remaining fat is usually stored in the liver, giving a puzzling appearance of a fatty liver. Although this is often observed in kwashiorkor, it also occurs to a lesser extent in marasmus (Rabinowitz et al 2014). The proportion of water content in the body increases with the increased seriousness of PEM (marasmus or kwashiorkor) and is related to the loss of fat mass (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012). The amount of extracellular water also increases, often resulting in edema. Edema is significant in kwashiorkor but can also be present in marasmus or in the

frequently encountered mixed forms of PEM (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012). The increase in extracellular water is related to the increase in the total body water (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012).

.

The overall metabolic adaptations that occur during marasmus are similar to those in starvation. The body's primary goal in cases of marasmus is to preserve adequate energy to the brain and other vital organs in the face of a compromised supply (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012). The energy saving is partially reduced by the diversion of energy from muscle to the more metabolically active organs (Scrimshaw & Viteri, 2010 and Spoelstra et al, 2012).

The body of a child who has lost their fat and muscle tries to preserve the little energy that it has as much as possible by reducing physical activity and growth, reducing internal body processes and shutting down the body's response to infection (de Onis et al, 1997 and Rabinowitz et al, 2014). This reduced activity results in limited function of the liver, kidney, heart, and gut putting the child at risk for; low blood glucose, low body temperature, fluid overload or heart failure. According to the WHO database (1997), a child who has lost body fat and muscle can be classified as either moderate or severe acute malnutrition based on body measurements. Mid-upper arm circumference (MUAC) and weight-for-height Z-score (WHZ) are used for this classification. Kwashiorkor is characterised by bilateral pitting oedema affecting both sides of the body in the lower legs and feet which as it progresses becomes more generalised to the arms, hands, and face (de Onis et al, 1997and Kaneshiro & Zieve, 2011). Oedema is the condition where there is too much fluid in the body tissues which results from severe nutrition deficiencies. All cases of kwashiorkor are classified as severe acute malnutrition (SAM) (de Onis et al, 1997 and Shashidhar & Grigsby, 2009). The WHO global

database states that kwashiorkor is classified by severity of oedema such that oedema in both feet indicates mild case of malnutrition and is denoted as +, oedema in both feet, lower legs and hands or lower arms indicates moderate acute malnutrition and is denoted as ++, and severe acute malnutrition is characterised by generalised body oedema including both feet, legs, hand, arms and face and is denoted as +++.

Kwashiorkor typically starts after the child has been weaned and breast milk being replaced with a diet low in protein, although it can occur in infants if the mother is protein-deprived (Shashidhar & Grigsby, 2009). It can also occur due to parasites and infections that can interfere with nutritional status. Low protein diets associated with dietary changes due to milk allergies in infants, fad diets, poor nutritional education, or a chaotic home life, are other causes of kwashiorkor (Kaneshiro & Zieve, 2011).
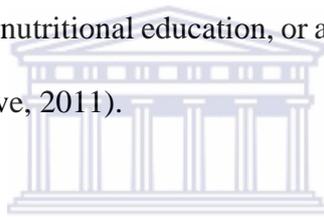
Kwashiorkor impairs physical and cognitive growth, and immune system changes (loss of delayed hypersensitivity, impaired lymphocyte response, fewer T lymphocytes, and impaired phagocytosis secondary to decreased cytokines and secretory immunoglobulin (Kaneshiro & Zieve, 2011). These immune changes can predispose a child to severe and chronic infections such as; infectious diarrhea, which leads to anorexia, decreased nutrient absorption, increased metabolic demands, and direct nutrient loss (Shashidhar & Grigsby, 2009 and Kaneshiro & Zieve, 2011). Cystic fibrosis, which not only affects the lungs, but affects the digestive system, can lead to chronic malabsorptive conditions resulting in kwashiorkor (Liu et al, 2001).

Studies of malnourished children have shown changes in developing brain, including: a slowed rate of growth of the brain; lower brain weight; cerebral atrophy; decreased number of neurons; inadequate myelinization; changes in dendritic spines (similar in cases of mental retardation);

ventricular dilation; periventricular white matter changes; widening of Sylvian fissures and sulci; prominence of the basal cisterns (Atalabi et al, 2010 and Shashidhar & Grigsby, 2009). Other systemic involvement includes fatty degeneration of the liver and heart, atrophy of small bowel, and decreased intravascular volume leading to secondary hyperaldosteronism (Shashidhar & Grigsby, 2009 and Cooper, 2009)

Marasmic-kwashiorkor is a mixed form of both marasmus and kwashiorkor and is characterised by the presence of both wasting and bilateral pitting oedema. It is also known as protein-energy malnutrition (PEM) (de Onis et al, 1997). Both kwashiorkor and marasmic-kwashiorkor are very serious conditions and are classified as forms of SAM (de Onis et al, 1997 and Lint et al, 2007).

According to de Onis et al, (1997) and Rabinowitz et al, 2014; the term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor and intermediate states of marasmus-kwashiorkor. Marasmus results from insufficient consumption of both protein and energy. Kwashiorkor refers to an insufficient consumption of proteins with reasonable intake of energy (Lin et al, 2007). Studies suggest that marasmus signifies an adaptive reaction to starvation whereas kwashiorkor signifies a maladaptive reaction to starvation. Therefore, protein-energy malnutrition includes both entities. In general marasmus is when there is inadequate energy intake to match the body's requirements. As a result, the body draws on its stores resulting in emaciation (de Onis et al, 1997 and Rabinowitz et al, 2014). In kwashiorkor, there is an acceptable energy intake and decreased protein intake which then leads to decreased production of visceral proteins (de Onis et al, 1997).

The three most common anthropometric indices used to assess child growth are; height-for-age, weight-for-age and weight-for-height (de Onis et al, 1997). Low-height-for-age is in general referred to as stunting. Stunted growth reflects a process of failure to reach linear growth potential as a result of sub-optimal health and/or nutritional condition.

Weight-for-age is influenced by both the height of the child and the weight and its composition makes interpretation complex. Low weight-for-age is referred to as underweight and reflects either long term or short term undernutrition although it is impossible to differentiate between the two. Height-for-age reflects the long term (chronic) health and nutritional experience of the individual or population. Low-weight-for-height, also known as wasting or thinness indicates in most cases a recent and severe process of weight loss (acute) which is often associated with starvation and/or severe disease (de Onis et al, 1997). However, it may also be a result of a chronic unfavourable conditions. Low-weight-for-height with a focus on recent and severe weight loss will be the emphasis of this study.
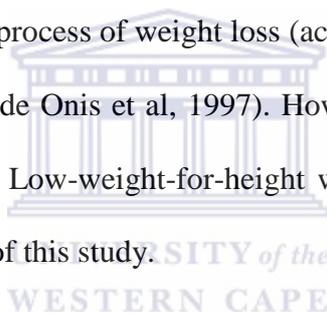
Weight-for-height is a nutritional index which is a calculation of two measurements namely weight and height into a single value so that children of different ages can be compared (de Onis et al, 1997). The Z score is used to describe how far a measurement is from the median average. A weight-for-height Z score therefore provides an indication of how an individual's weight compares to the average weight of an individual of the same height in the WHO reference population growth standard. According to the de Onis et al., (1997), a positive WFH Z-score means that the individual's measurement is higher than the median weight value of an individual of the same height in the WHO growth standard, while a negative WFH Z-score means that the individual's weight is lower than the average weight of an individual of the same height in the WHO growth standard. According to the de Onis et al., (1997) a positive

WFH Z-score means that the individual's measurement is higher than the median value of the individual of the same height in the WHO growth standard, while a negative WFH Z-score means that the individual's measurement is lower than the median value of the individual of the same height in the WHO growth standard.

The various forms of acute malnutrition are classified based on severity as weight-for-height Z score < -2 but > -3 is defined as moderate acute malnutrition (MAM) according to WHO/UNICEF. Severe acute malnutrition (SAM) is defined as weight-for-height Z score < -3 or by Mid-upper arm circumference (MUAC) < 11.5cm. Collins et al., (2006) stated that the sudden loss of weight of a child can be further classified as moderate acute malnutrition or severe acute malnutrition. Moderate Acute Malnutrition (MAM) is defined as a child falling between 70 % and 80 % of the weight for height median and may or may not be having oedema (Collins et al, 2006).
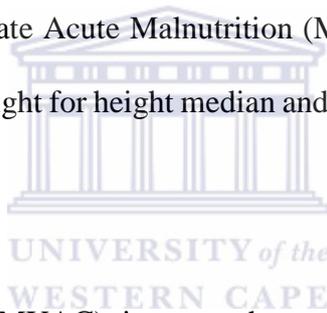
Mid-upper arm circumference (MUAC) is an anthropometric parameter for analysis of nutritional status, mainly used for detecting individuals in need of treatment rather than for measuring population trend data (WHO, 2012). It is a good indicator of muscle mass and can be used as a proxy for wasting. It is mainly measured on children aged 6-59 months. There is no agreement for the measurement and interpretation of MUAC values in children less than 6 months and in adults (WHO, 2012). MUAC is a very good predictor of the risk of death in children probably because of its relationship with the muscle mass. MUAC is measured in one arm and quoted directly, without the use of any references. MUAC < 110mm is recommended as criterion of admission to therapeutic feeding programmes (WHO, 2012 and Collins et al, 2006). It is particularly recommended for the detection of severe malnutrition among children

at community level (WHO, 2012 and Collins et al, 2006). Generally, it is not collected routinely.

Severe Acute Malnutrition (SAM) is when a child falls under 70 % of the median weight for height and have oedema (Collins et al, 2006). Severe Acute Malnutrition occurs when infants and children do not have adequate energy, protein and micronutrients in their diets combined with other health problems such as recurrent infections (WHO, 2013). Children with severe acute malnutrition are among the most vulnerable people in the world. They are very thin as most of their fat and muscles have been used by their bodies to stay alive (WHO, 2013).

3.4 Global malnutrition situation

Most governments and international communities in developing countries have been unsuccessful in dealing with malnutrition over the past decades despite the acknowledgement that malnutrition destabilises economic growth and propagates poverty, even though there are well tested approaches in place (World Bank, 2014). The results of this failure to act are now revealed in the world's inadequate progress towards the Millennium Development Goals and towards poverty reduction (World Bank, 2014).

The scarcity and deprivation of food has been a recognised problem among the poor in many nations. It is variously referred to as hunger, food poverty, food insufficiency, and household food insecurity. Food security is a broad concept which covers issues related to the nature, quality and security of food supply as well as issues of access (Barrett, 2010 and Webb et al, 2006). Food insecurity is a daily reality for hundreds of millions of people around the world (Barrett, 2010). Although its most extreme manifestations are often obvious, many other

households facing constraints in their access to food are less identifiable (Barrett, 2010). Household food insecurity is recognised as a public health problem.

Food insecurity is experienced at the household and individual levels in different ways. The household level is defined by food supply management and acquisition issues whereas at individual level it is more defined by the issues of food consumption and allocation and includes the psychological sensation of hunger (Webb et al, 2006). According to Webb et al (2006), some areas of the world have poor economy or regional conditions such as drought or over population which then causes inadequacy of certain food stuffs and thus leads to a certain portion of the population being undernourished because of lack of vital nutrients. However, even when there is more than enough food, malnutrition can occur due to poor eating habits (Webb et al, 2006).
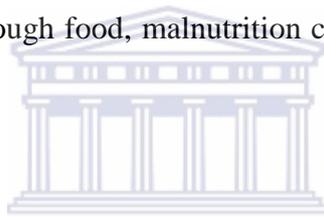
The experience of food insecurity is not stagnant but dynamic in nature, defined by a temporal sequence of events and experiences that can be considered in terms of frequency, duration and periodicity (Webb et al, 2006 and Pĕrez-Escamilla & Segall-Corrĕa, 2008). Graded levels of severity of food insecurity are defined in sequential stages ranging from compromise of quality in food selection and consumption to compromise in quantity in intake and the attendant physical sensation of hunger as resources become increasingly depleted (Webb et al, 2006 and Pĕrez-Escamilla & Segall-Corrĕa, 2008).

Within households, individual's experiences of food insecurity differ. In particular, adults appear to compromise their own intakes first in an effort to minimise the extent and nature of compromise experienced by children in the household (Haddley & Patil, 2008 and Webb et al, 2006).This suggests that food insecurity is a managed process in which the sequence of events

and severity of experience for different household members is, to some extent, controlled and predictable (Haddley & Patil, 2008 and Webb et al, 2006).

Nearly every country in the world experiences some form of malnutrition, and no country can take good nutrition for granted. Malnutrition is one of the leading causes of morbidity and mortality in children under the age of five in developing countries (WHO, 1999). In a survey focusing on low-income areas in the United States, 22-35 % of children aged 2-6 years were below the 15th percentile of weight (Lin et al, 2007). Another survey showed that 11% of children in low-income areas had height-for-age measurements below the 5th percentile. Poor growth is seen in 10 % of children in rural populations (Lin et al, 2007). In 2000, WHO estimated that malnourished children numbered 181.9 million (32 %) in developing countries. Approximately 50 % of the 10 million deaths each year in developing countries occur because of malnutrition in children younger than 5 years (Lin et al, 2007).
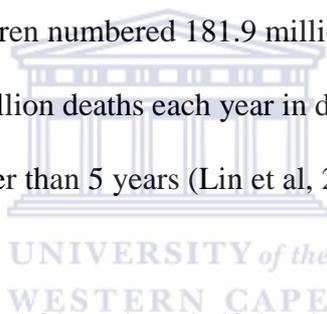
In South Central Asia and Eastern Africa, about half the children have growth retardation due to protein-energy malnutrition (WHO, 2000). Severe acute malnutrition (SAM) affects a number of children below five years of age in low and middle income countries (Fabiansen et al, 2010). The disorder is associated with 1 million to 2 million preventable child deaths each year (Fabiansen et al, 2010).

One person dies every second, 4 000 every hour, 100,000 each day, 36 million annually or 58 % of all deaths are associated with hunger, undernourishment and malnutrition. One child dies every five seconds, 700 every hour, 16 000 each day or 60 % of all child deaths occur due to malnutrition (Black et al, 2013). According to Black et al, (2013), chronic hunger, undernourishment and malnutrition are the prime global health hazards. Nutritional

deficiencies are responsible for over 50 % of years lived with disability in children aged four and below (Vos et al, 2012). According to Black et al, (2013), 45 % of under-five mortality is attributed to undernutrition.Underweight is the number-one contributor to the burden of disease in Africa south of the Sahara and number four in South Asia (Lim et al, 2012). The World Health Organization estimates that by the year 2015, the prevalence of malnutrition will have decreased to 17.6 % globally, with 113.4 million children younger than 5 years affected as measured by low weight for age. The overwhelming majority of these children, 112.8 million, will live in developing countries with 70 % of these children in Asia, particularly the south central region, and 26 % in Africa (WHO, 2013).

An additional 165 million (29 %) children will have stunted length/height secondary to poor nutrition (Shashidhar & Grigsby, 2014). Globally, we are off course to meet every one of the six World Health Assembly (WHA) nutrition targets. There is modest global progress on stunting and exclusive breastfeeding but little progress on wasting, low birth weight, and anaemia (Global nutrition report, 2014). According to the Global nutrition report, 2014, at the country level, rates of progress and regress on meeting the WHA targets vary widely among countries and indicators. Currently, it is only possible to assess country progress on meeting the WHA targets for four of the six indicators (stunting, wasting, overweight, and anaemia). Of the 99 countries that have data on the four WHA indicators, 1 country is on course for all four targets, 24 are on course for two or more t targets, 44 are on course for only one target, and 31 are not on course for any target (Global nutrition report, 2014). There is no strong regional pattern to the rates of progress.

Currently, 22 out of 109 countries with available data are on course to meet the stunting reduction target; 59 countries out of 123 are on course for wasting reduction and 5 countries

out of 185 are on course for anaemia reduction (Global nutrition report, 2014). Countries must do much more to align their reporting with WHA targets and with global nutrition efforts more generally (Global nutrition report, 2014). Primary malnutrition due to lack of food or inability to afford nutritious food has been estimated to affect as many as fourth of the world's children (Columbia Encyclopaedia, 2015). Although these estimates are tentative, it is certain that severe acute malnutrition is an extremely important health problem worldwide.

3.5 A review of related studies on child malnutrition

A cross-sectional nutritional assessment survey study conducted by Kinyoki et al, (2015) to investigate the contributing factors to malnutrition among children aged 6-59 months, using the height-for-age, weight-for height and mid-upper arm circumference classification of malnutrition; sampled on a two stage cluster methodology in Somalia using data from the 2007-2010 household cross-sectional surveys it showed that infection and climatic variations are likely to be key drivers of undernourishment in Somalia.

On the other hand, a 2010 national cross-sectional survey study conducted by Masiye et al, which examined the nutritional status among children below five years of age in Zambia using the weight-for-height, weight-for-age and height-for-age classification of malnutrition showed that household expenditure is a leading determinant of nutritional status of a child. Multivariate analysis was used to quantify the effects of several household and child-specific socioeconomic and demographic factors on nutritional status, as well as a geographic context (community level) fixed effect. The positive effect of parental education was observed. Children become more malnourished as they get older than 18 months. After controlling for other covariates, poor nutrition falls unreasonably on rural children (Masiye et al, 2010).

A cross-sectional study employed from March-April 2014 conducted by Hailemariam (2014), to study the selected factor associated with malnutrition among children under two years of age residing in a rural area of Western Ethiopia. 593 mothers of under two children were interviewed. SPSS was used for statistical analysis of data, the Kolmogorov-Smirnove test, scatter plots and histograms. Hosmer-Leme show test was performed for model fitness and multicollinearity also checked using variance inflation factor and correlation coefficients and the study showed that the important factors contributing to malnutrition were age of child, frequency of breast feeding, birth weight, health information after delivery and Vitamin A-rich fruits/vegetables (Hailemariam, 2014). Pongou et al, (2006), examined the household and community level socioeconomic and environment factors associated with child nutrition status in a cross-sectional demographic and health survey in Cameroon. Multivariate, multilevel analyses were undertaken to estimate the net effects of both household and community factors. Maternal education and maternal health seeking behaviour were associated with better child nutrition. Improved household (water, sanitation and cooking fuel) and community environment had positive effects. Both Pongou et al, (2006) and Hailemariam, (2014) characterised malnutrition using the weight-for-height and height-for-age Z score.

Nevertheless, most studies used the weight-for-height Z score standard for malnutrition characterisation as seen in a case-control study of 449 children aged 6-59 months admitted to Dhaka Hospital in Bangladesh which was conducted by Fuchs et al, (2014) to assess the risk factors to acute malnutrition during the period of June-September 2012. Logistic regression analysis revealed that the significantly associated determinants to under-five malnutrition were mother being undernourished, father with no or a low paying job, coming from a family with low monthly income and having stopped predominant breast feeding before or at four months of age (Fuchs et al, 2014).

The study is supported by Kavosi et al, 2014 who conducted a house to house survey study to estimate the prevalence of malnutrition and identify determinants of under-nutrition among children under six years of age in Fars Province, Iran. With this study, a total of 15408 children were studied for nutritional assessment. Backward stepwise logistic regression was used to relate underlying factors to the odds of under-nutrition indices. The study revealed that gender, lower family income and lower maternal education were significantly associated with low-height-for-age. Living in urban areas and poor water supply were identified as significant risk factors of malnutrition. There was also a suggestion that non access to health services were associated with wasting, and also large family size was related to malnutrition (Kavosi et al, 2014).
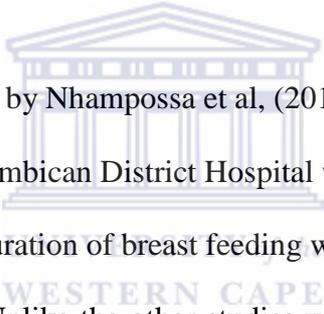
In a retrospective study conducted by Nhampossa et al, (2013) on all children under the age of five years admitted to Rural Mozambican District Hospital with severe malnutrition it showed that some childhood illness and duration of breast feeding were independently associated with a lower risk of a poor outcome. Unlike the other studies which used SPSS for data analysis, data was double entered in FoxPro-designed database and statistical analysis performed with the STATA statistical software package. On the other hand, community based cross-sectional study which was done over six months by Shafqat, Manzoor and Abbasi (2013), to assess the nutritional status and potential risk factors for malnutrition in children less than 5 years of age in a community. A total of 393 children and their mothers were included in the study. In children; nutritionally, 245 (62.3 %) were normal, 148 malnourished and 77 (19.6 %) undernourished.

When data of normal children was compared with malnourished it was found that literacy of mother, her knowledge about health including hand washing and maintaining contact with lady

health worker, boiling water and giving ORS and practice of not throwing garbage at open spaces were significant interpreters of better child nutritional status (Shafqat et al, 2013). Therefore child nutritional status was strongly associated with the mother's literacy, their health awareness and child rearing practices (Shafqat et al, 2013). A qualitative study conducted in Aileu District in South-East Asia by Mizumoto, Takahashi, Kinoshita, Michiyo, Bachroen and Silva (2013), to determine the possible risk factors associated with the high prevalence of child malnutrition. In-depth interviews were conducted to 32 guardians of children aged younger than 5 years. It was observed that early termination of exclusive breast-feeding and a short lactation period along with an unsanitary living environment were associated with the nutritional status of children in the study area.
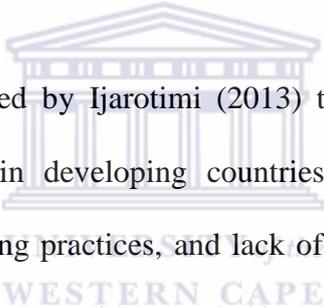
The findings in a study conducted by Ijarotimi (2013) to determine causes of childhood malnutrition and consequences in developing countries revealed that poverty, lack of nutritional knowledge, poor feeding practices, and lack of care by care-givers and infection were to blame for the lack of adequate nutrition needed in early childhood. A case-control study conducted by Kadima (2012) on factors influencing malnutrition among the under-five children in the Kweneng West district of Botswana with 36 cases of children with malnutrition and 76 controls, following logistic regression the results revealed that there was significant association between child illness and child underweight. Low birth weight was also positively associated with child malnutrition, there was also significance association of number of under-five year olds in the family and large household size and the condition of malnutrition. Under-weight was also significantly associated with small number of meals taken by a child per day, and inadequate Vitamin A supplementation. Lack of knowledge on malnutrition preventive measures by the parent, parent's unemployment status and child raised by a guardian were also some of the factors that were significantly associated with underweight (Kadima, 2012).

The evidence from Bangladesh on malnutrition of children under the age of five, a study conducted by Siddiqi, Haque and Goni (2011), in an attempt to describe the differential and associated risk factors of malnutrition. Using the SPSS, Chi-square test and Logistic Regression technique were used to find out the significant factors associated with child's nutritional status. It revealed that household economic status, mother's education, father's education, mother's antenatal visit, mother's age at birth and mother's BMI are the most significant factors associated with child malnutrition (Siddiqi et al., 2011). A study conducted by Shargi, Kamran and Faridan (2011), which included 76 cases of under-nutrition children and 76 controls in the city of Namin in Iran, it revealed that the female gender, poverty, short maternal height and the use of unhygienic latrines in the home were associated with childhood malnutrition.
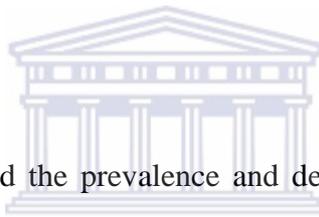
Babatunde et al, (2011) examined the prevalence and determinants of malnutrition among children aged below five years of farming households in Kwara state in Nigeria, the study revealed that gender and age of child, education and body mass of mother, calorie intake of the households, access to clean water and presence of toilet in the household were substantial factors related to malnutrition. A case-control study conducted by Amsalu and Tigabu (2006) consisted of 102 cases diagnosed with SAM and they were matched with 102 controls of children under the age of five years admitted in the same hospital with different conditions. The data was analysed using SPSS and the results showed that severe acute malnutrition in Ethiopia was independently associated with lack of exclusive breast-feeding for the first six months of life and late initiation of complementary diet. Inappropriate feeding practices such as, supplementation with prelacteal feeds, late initiation (12 months of age and beyond) of complimentary diet and bottle feeding were commonly identified in children with SAM (Amsalu & Tigabu, 2006).

Rayhan and Khan (2006), conducted a cross-sectional health survey study on factors causing malnutrition among under five children in Bangladesh. The study examined differential impact of some demographic, socioeconomic, environmental and health related factors on nutritional status among under five children in Bangladesh. Bivariate and multivariate analysis (Cox's linear logistic regression model were used to identify the determinants of under-five malnutrition. The study revealed that 45 percent of the children under the age of five years were suffering from chronic malnutrition, 10.5 percent were acutely malnourished and 48 percent had under-weight problem (Rayhan & Khan, 2006). Similar to Amasalu and Tigabu, (2006), the main contributing factors for under five malnutrition were found to be previous birth interval, size at birth, mother's body mass index at birth and parent's education (Rayhan & Khan, 2006).
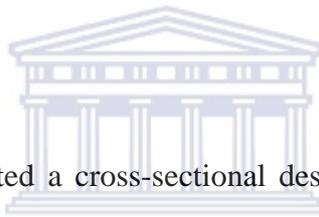
In 2006, Mahgoub et al, conducted a cross-sectional descriptive survey using a structured questionnaire and measurement of weight and height of children under the age of three years. The objective of the study was to evaluate the level of malnutrition and the impact of some socio-economic and demographic factors of households on the nutritional status of children under the age of three in Botswana. 400 households of children under the age of three participated in the study.

Although the study was focused on specific factors, it revealed that malnutrition was significantly higher among boys than girls, under-weight was less prevalent among those whose parents were involved in informal businesses, children brought up by single parents suffered from malnutrition to a significant higher level than children living with both parents, the prevalence of under-nutrition decreased significantly as family income increased, the higher the level of the mother's education the lower the level of child under-weight observed,

58

and duration of breastfeeding was found to reduce the occurrence of underweight among children (Mahgoub et al,2006).

In a 2004 prospective and case-control study conducted by Ayaya, Esamai, Rotich and Olwambula in Kenya on 66 children aged 3 to 36 months with severe PEM admitted to hospital and in the clinic were age matched with 66 controls in an effort to determine the social and economic factors that predispose children to severe PEM as seen at the Moi Teaching and Referral Hospital in Eldoret. A standard pre tested questionnaire was used to interview care-givers of severe PEM children and care-givers of the age-matched controls. SPSS was used for data analysis and the results showed that single mothers, young mothers, the child's living conditions such as living in a temporary house, the care-taker who was not married to the child's parent and the child not staying with both parents for the past six months were social risk factors for severe PEM (Ayaya et al, 2004).
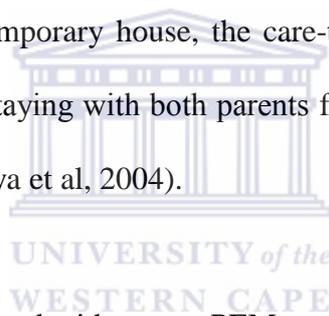
The economic risk factors associated with severe PEM among children were; father's lack of ownership of land, cattle, not growing crops and ownership of small piece of land by grandfather (Ayaya et al, 2004). Other risk factors which the study associated with severe PEM were incomplete immunization and female sex (Ayaya et al, 2004).

However, Larrea and Kawachi (2005), revealed that maternal education, basic housing conditions, access to health services, ethnicity, fertility, maternal age and diet composition were independently associated with low-height-for-age. The study was a case-control in order to determine if economic inequality affect child malnutrition. The results were analysed using multivariate and multilevel analysis.

Some studies used weight-for-age of children to assess the influence of mother's age, education and marital status on nutritional status of children under the age of five years in Nsit Ibomo Local Government Area of Akwa Ibomo State in Nigeria (Mboho & Bassey 2013). The study adopted the ex-post facto survey research design. It involved 201 mothers as respondents and 202 children's nutritional status was measured. Simple percentage, mean score analysis and independent t-test statistical analysis were adopted.The results showed that mothers' variables examined in the study have significant influence on the nutritional status of children aged below five years in the study area.

The previous studies on child malnutrition have had the strength of including representative samples and using structured questionnaires and collection of anthropometric data through measurement of child weight and height (Babantunde et al, 2010, Fuchs et al., 2014, and Hailemariam, 2014). Many studies were concentrated on children under the age of five which therefore shows that they consider the age to be a vulnerable group (Shafqat et al, 2013, Masiye et al, 2010, and Kadima, 2012).

There are also some limitations noted in the previous studies. Most of the previous studies were focused on the broad term of under-nutrition and not classifying the different forms of malnutrition (Kadima, 2012; Shargi et al, 2011 and Amsalu & Tigabu, 2006). Many studies were conducted in the rural areas and did not cover the urban areas. In some studies participants were restricted to children under three years of age (Mahgoub et al, 2006; and Hien & Hoa, 2009). Most of the studies conducted were cross-sectional studies and therefore were not able to distinguish between factors that cause the disease and factors that prolong the period with the disease (Nnyepi et al, 2010; Mahgoub et al, 2006 and Rayhan & Khan, 2006). When

compared to cohort studies and case-control studies, cross-sectional studies provide weaker evidence about the disease causation.

The studies reviewed above, eight were cross-sectional studies. Cross-sectional studies are the best way to determine prevalence. They are relatively quick and can study multiple outcomes. These studies do not differentiate between cause and effect or the sequence of events (Mann, 2003). The other seven reviewed studies were case-control. Case-control studies are retrospective, simple to organize and aim to identify predictors of an outcome (Mann, 2003). Case-control studies permit assessment of the influence of predictors on outcome via calculation of an odds ratio and useful for hypothesis generation (Mann, 2003). Although the case-control studies are much more efficient and better suited for these type of studies, their major problems are of confounding variables and bias.
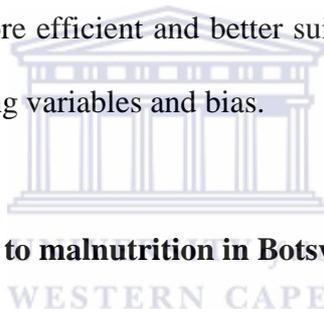
3.6 The situation with respect to malnutrition in Botswana

There has been quite a number of population-based surveys carried out in Botswana and they have revealed that child malnutrition still remains a problem in Botswana. Overall, a comparison of observation from these reports indicate that the prevalence of malnutrition in Botswana, though still a problem has declined somewhat since late 1980s (Mahgoub et al, 2006). The reports also suggest that the risk of malnutrition differs across population groups of children. Most of the studies carried out in the past in Botswana reports malnutrition in general without giving details of the three indicators (Mahgoub et al, 2006). A cross-sectional descriptive study carried out by Mahgoub et al, 2006 reported a prevalence of 5.5 % for wasting.

Table 3-1: Shows child anthropometry for the data available for Botswana

CHILD ANTHROPOMETRY		
Number of children under 5 affected (000)		
Stunting	72	2007
Wasting	17	2007
Percentage of children under 5 affected		
Wasting	7	2007
Severe wasting	3	2007
Low birth weight	13	2007
Sources: UNICEF/WHO/WB 2014; UNICEF 2014.		

With the assistance of UNICEF and other development partners, the government of Botswana has been implementing the compulsory monthly Child Welfare clinic attendance for every Botswana citizen under the age of five years. Vitamin A supplementation and Tsabana (a locally produced food supplement) are among the nutritional interventions that are used to improve the nutritional situation of children aged 6-59 months in Botswana (UNICEF, 2012).

The government of Botswana provides fortified sorghum and maize products; Tsabana, is an enriched (fortified) precooked maize meal, provided together with vegetable oil to all children aged 4-59 months at every monthly Child welfare check-up (UNICEF, 2012). Tsabana was developed as a weaning food to improve the diet quality of undernourished infants but also as a dietary intervention product for children in the 4-59 months age group to improve their nutritional status. Sorghum and soya are the two major ingredients of Tsabana which contribute to its protein and energy provision (Makepe et al., 2008). Although Tsabana provides some minerals insufficiently, it has an adequate micronutrient provision in relation to WHO

recommended nutrient intakes (Makepe et al., 2008). Tsabana remains more nutritious than other cooked porridges.

According to the Global nutrition report (2014), Botswana is among the countries which are estimated to have an increase in child wasting rate i.e. > 5 %. WHA target is to reduce the number of stunted children by 40 % by 2025, which is equivalent to the projection of about 15 % based on current population projections (Global nutrition report, 2014). Based on the 2007 data from Botswana, which is the most current data on child malnutrition data for the country, Botswana is currently off target in meeting the WHA goal of reporting > 5 % for stunting and wasting under five children (Global nutrition report, 2014). There is not much data report on the situation of malnutrition in Botswana.

3.7   The situation with respect to malnutrition in Francistown

In early 2006 cases of severe acute malnutrition were seen in Nyangabgwe Referral Hospital, Francistown, Botswana coinciding with the diarrhoea outbreak (Creek et al, 2010). There were 1276 hospital visits for diarrhoea during this period and 83 cases of severe acute malnutrition were identified among children under the age of five (Creek et al, 2010). A study carried out in Nyangabgwe Referral Hospital, Francistown-Botswana in 2011, which determined the anthropometric profile of under-five malnourished children with a sample size of 113 care-giver-child pairs with a diagnosis of malnutrition, protein-energy malnutrition and oedematous malnutrition (Madondo, MacIntyre, & Ntuli 2012). According to the study oedema was present in 49.6 % of children on admission. The presence of oedema indicates severe acute malnutrition but may mask the extent of weight loss.

Wasting was present in 93.8% of the children and severe wasting in 72.5 % (Madondo et al, 2012). A study conducted by Madondo et al., 2012 revealed that severe underweight, a measure of both chronic and acute was present in 79.6 % of children (Madondo et al, 2012). The study highlighted the severity of malnutrition of children admitted to Nyangabgwe Referral Hospital in Francistown, Botswana. Although the findings of this study cannot accurately report the extent of under-nutrition in Botswana they do provide a socio-demographic and clinical picture of severe acute malnutrition among under-five year olds. This study has shown that although a number of factors contribute to malnutrition among children, each region has its own unique features that play a role (Madondo et al, 2012).

3.8   Prevention and management of malnutrition

Most children are at greatest risk of malnutrition from the age of about six months when they are growing fast and breastmilk alone cannot cover nutrient needs until they are about 2-3 years old when growth slows and they can feed themselves. Families and health workers can find out if children are well nourished or malnourished by weighing them regularly and plotting their weights on growth charts. A child may: gain weight at the healthy rate, which means the child is almost certainly eating well and is healthy; gain weight too slowly or not gain any weight, which signals that something is wrong. The child may be sick and/or not eating enough; lose weight, which is a very dangerous sign (WHO, 2008). The child may not be eating enough and almost certainly ill; gaining weight faster than the healthy rate, which will probably mean the child is catching up weight lost during an illness but can also mean that the child has a health

problem that could lead to obesity. Care-givers and health workers need to pay attention to these changes in a child.

Health workers need to work with the family of a malnourished child to find out why the child is not growing well and discuss the feeding pattern, i.e. amount, variety and frequency of meals, appetite, behavior and illnesses (Ruel et al, 2008 and Waters et al, 2006). They should examine the child for infections or other medical conditions in order to find the underlying causes such as family food shortages; poor feeding practices; child receives insufficient care (Ruel et al, 2008 and Waters et al, 2006). The intervention plan for the child should be worked on together with the care-givers.

In order for the child's nutritional status to improve, a family will need to feed the child better. This may mean increasing breastfeeding, improving complementary feeding, feeding more frequently and/or giving more attention during meals (Ruel et al, 2008). Family beliefs on child feeding and blocks to better feeding e.g. lack of resources, such as food, cash, time or cooking facilities should be discussed and addressed. Then the decisions on improved feeding practices should be determined based on what the family is able and willing to adopt (Ruel et al, 2008).

The child should be taken for treatment if sick and care-givers should be taught how to prevent childhood infections in the future. Health workers should monitor undernourished children's weights closely (Ruel et al, 2008). If a family is unable to provide a healthy, balanced diet for a child, they may need to be assisted with provision of food by enrolling the child in a supplementary feeding programme for a while. Sometimes a family should may be referred to a social worker, agricultural field worker or other community service to help deal with underlying reasons for poor nutrition. Hospital admission is required for severe cases of

malnutrition until the child is stable to be managed as an outpatient (Ruel et al, 2008 and Waters et al, 2006).

3.9 Conclusion

Poor nutrition is implicated in more than half of all child deaths world-wide a proportion unmatched by any infectious disease. It is ultimately linked with poor health and environmental factors but planners, politicians and economists often fail to recognise these connections. Efforts in promoting better growth and health of children may be hindered by the complex causality involving political, environmental and social factors which are difficult to prevent and control by isolated vertical approaches (Black, Morris & Bryce, 2003).

Many health promotion implementers are looking at the comprehensiveness as the key element of successful child health programmes. Health workers are no longer perceived as screening and referral tools for identifying children to be referred for malnutrition rehabilitation only, but rather as partners with families in combating malnutrition (Gross & Webb 2006). Nutrition is a desperately neglected aspect of maternal, new born, and child health (Lopez et al, 2006).

According to a study by Mahgoub, Nnyepi, & Bandeke, (2006) efforts for redressing child under nutrition issues in Botswana should focus on factors associated with development outcomes such as maternal income, maternal education, and the creation of employments or engagements that do not compromise important child care practices such as breastfeeding. Child nutrition is an inherently individual and household- level phenomenon, which therefore calls for community based approach for determinants of childhood malnutrition in Francistown, Botswana. Research by Madondo et al, (2012) highlighted the severity of

malnutrition among children admitted in Francistown. Although there are a number of common variable determinants of child malnutrition as suggested by past studies each region has its own common features which play a role, therefore this suggests that community based outcomes are crucial for effective modification. Child malnutrition is a problem which not only affects the child but the whole community and if prevalence is not reduced it will ultimately have an effect on the lack of human capital (Victoria et al, 2008). There is a need to address all the significantly associated contributing factors to child malnutrition in order to reverse the situation (Bain et al., 2013).

4   CHAPTER 4 RESEARCH METHODOLOGY

4.1   Introduction

This chapter explains the research design that was used, the target population and the type of sampling followed. It also provides the data collection approach and method of data analysis used.

4.2   Rationale for study

As the main aim of the study was to determine the contributing factors to severe acute malnutrition among the children under the age of five years, the study used a quantitative method approach. The method was justified by the fact that the purpose of the study was an evaluation of a relationship between different variables. In quantitative research, variables can easily be measured using some instruments so that numbered data can be analysed using statistical procedure (Creswell, 2012). The participants were allowed to explain and/or give reasons for some of the answers.

4.3   Ethical consideration

Ethics are norms of conduct that distinguish between acceptable and unacceptable behaviour (Resnik, 2011). Ethical approval to conduct the study was obtained from the Senate Research Committee of the University of the Western Cape (14/10/54) (Appendix B). Permission was also granted by the Ministry of Health-Botswana, Nyangabgwe Referral Hospital and Great Francistown District Health Management Team respectively (Appendix C, D. and E). When

the probable participant met the inclusion criteria of the study they were recruited for the study with their care-givers (respondents). The purpose of the study was explained to the care-givers and they were given an information sheet before they completed and signed an informed consent form (Appendix G), which was written in English and there was a hospital or clinic orderly who assisted with translation to Tswana were necessary.

Care-givers had a choice to voluntarily participate in the study or not, they were free to withdraw from the study at any time without any intimidations or loss of benefits for which they would otherwise qualify. All information was explained to the care-givers before they signed the consent form. The information sheet (Appendix F) which explained the purpose of the study was given to the care-givers, and it served as a clarification of what the study was all about and with information of whom to contact in any case of further clarification or if they had any questions concerning the study.
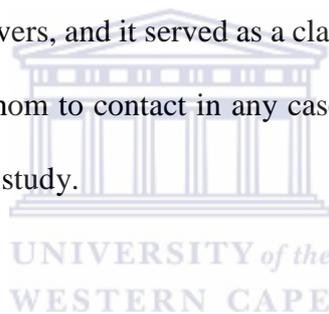
4.3.1   Confidentiality

Confidentiality was maintained to both the child and the care-giver, and their anonymity was guaranteed as no name or identification of either the participants or respondents was collected during the interview. Confidentiality is a promise that you will not be identified or presented in identifiable form (Bell, 2005).

4.3.2   Anonymity

All the collected data were anonymous. Anonymity is a promise that even the researcher will not be able to tell which responses came from which respondent (Bell, 2005). Codes were used

on forms and in data analysis. Codes are tags or labels for assigning units of meaning to information compiled during a study (Bell, 2005).

4.4 Type of research

As the aim of the study was to determine the contributing factors to severe acute malnutrition among the under five children, the study used a quantitative approach. In a quantitative study, the researcher uses numerical data to obtain information about the world in a formal, objective and systematic process (Burns & Groove, 2005). In other words, quantitative research is thought to produce a hard science that involves vigour, objectivity and control (Burns & Groove, 2005).

4.5 Study design

In order to maximise accuracy of data, a case-control study was carried out. A case-control study is a type of observational study used to identify factors that may contribute to a medical condition by comparing individuals with the condition of interest (cases) with those without the condition of interest (controls) (Lewallen & Courtright, 1998). In a case-control study, the researcher begins with an outcome then traces back to investigate the risk factors. This is achieved through identification of a population who have developed the outcome of interest and identifying the population that does not have the outcome of interest. Once cases and controls have been identified, the researcher will look back in time to learn which subject in each group had the exposure(s) comparing the frequency of the exposure between the two groups (Joubert & Ehrlich, 2007).

In this study the researcher identified cases in Nyangabgwe Referral Hospital among children aged 6-59 months who were admitted to the paediatric ward with the diagnoses of any type of malnutrition, but within the range of the WHO (2013) definition of severe acute malnutrition weight-for-height Z-score of < -3 SD at the time of admission, and the children of the same age range who had the same diagnosis and who were referred to the Nutritional Rehabilitation Centre within the hospital. The cases were children who had been admitted and referred at any time between March and July 2015.

The controls were then identified by tracing back to the local clinics attended by the cases for their monthly child welfare check-up. At the Child welfare clinic, the log book was used to identify a random child of the same age and gender who had never been diagnosed with malnutrition. If there was more than one child who met the control inclusion criteria, all the children were identified and randomly selected using the JavaScript random number generator. The two subjects were then compared according to predetermined exposure (s) variables and the frequency of the exposure was compared between the two. The case-control design was ideal for the study as it assisted in attaining the set objectives of the study, by comparing the probability of risk factors among children who had severe acute malnutrition and the probability of risk factors among well-nourished children.

4.6   Research setting

The study was carried out in the North-East district in Francistown, Botswana. Figure 4.1 shows the location of Francistown in a map of Botswana and Table 4.1 illustrates the hospital and clinics that were included in the study population.
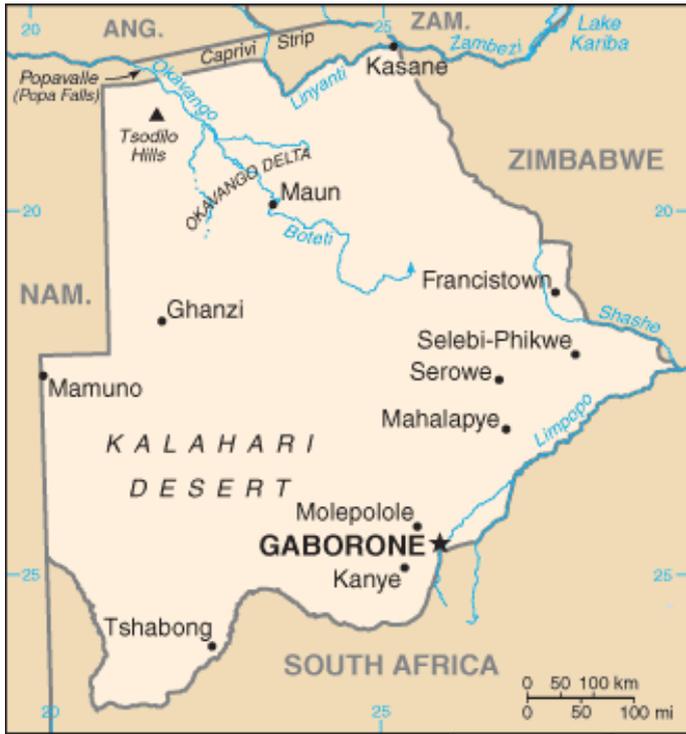
Figure 4:1: Map of Botswana by administrative districts (Botswana Central Statistics Office)
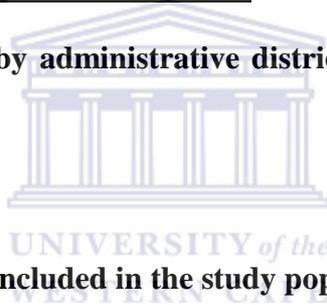
Table 4-1: Hospital and clinics included in the study population

Facility name	Location	Number of participants
Nyangabgwe Referral Hospital	Francistown	52 cases
Lapologang clinic	Extension (Game)	22 controls
Botsalano clinic	Maipaahela	18 controls
Botswelelo clinic	Extension	16 controls
Tshwaragano clinic	Monarch	16 controls
Botshelo clinic	Monarch	12 controls
Area S clinic	Area S	8 controls
Masego clinic	Block 8	6 controls
Gerald clinic	Gerald	6 controls

The study took place in Nyangabgwe Referral Hospital in Francistown and out of the seventeen clinics in the city, only eight clinics were identified as the ones attended by the recruited cases for the child welfare check up.

4.7   Study population

A population is a group of individuals who have the same characteristics. The study population included children under the age of five years and their care-givers as respondents. Within this sample frame the researcher had to select a sample for the study (Cresswell, 2012) using random sampling using the JavaScript random number generator. A list of all the cases who met the study inclusion criteria were randomly sampled on a weekly basis.

4.7.1   Inclusion criteria and Exclusion criteria

Inclusion criteria are characteristics that the potential subjects must have if they are to be included in the study, while exclusion criteria are those characteristics that disqualify potential subjects from inclusion in the study (Velasco, 2010). Inclusion criteria, along with exclusion criteria, make up the eligibility criteria used to rule in or out the target population for a research study (Velasco, 2010). Inclusion criteria should respond to the study aim and objectives because they play a crucial role in achieving the outcome (Velasco, 2010). Proper selection of inclusion criteria will enhance the external and internal validity of the study, improve its feasibility, lower its costs, and minimize ethical concerns; specifically, good selection criteria will ensure the consistency of the sample population, reduce confounding, and increase the likelihood of finding a true association between exposure and outcomes (Velasco, 2010).

4.7.2 Inclusion criteria for cases:

- The child had to have been a resident of Francistown for at least six consecutive months prior to the time of study.

- The child had to be under the age of five years and admitted to Nyangabgwe Referral Hospital or referred to the hospital Nutritional Rehabilitation Centre with a diagnosis of any type of malnutrition provided the weight-for-height SD score was < -3SD (SAM).

- The child had to have attended at least four out of six consecutive months of the required monthly Child Welfare clinic check-up in Francistown, Botswana immediately prior to admission.

4.7.3 Inclusion criteria for controls:

- The child had to have been a resident of Francistown for at least six consecutive months prior to the time of study.

- The child had to be under the age of five years and should have never been diagnosed as suffering from any type of malnutrition from their birth up to the time that the study will be conducted.

- The child had to have attended at least four out of six required monthly Child Welfare clinic check-up immediately prior to the sampling process.

- A control had to be of the same gender and age or not more than two weeks older or younger than the case and attending the same Child Welfare clinic as the one attended by the case.

4.7.4 Exclusion criteria

- The child that had been a resident of Francistown for less than six months prior to the time of the study.

- The child who was aged under five years, admitted to Nyangabgwe hospital with a diagnosis of malnutrition and a weight-for-height SD score > -3.

- The child who was same gender and same age as the case but did not attend the monthly Child welfare check-up as the one attended by the case.

4.7.5 Study sample

A sample frame is a group of individuals with some common significant features that the researcher can identify and study (Cresswell, 2012). A sample is a subgroup of the target population that the researcher plans to study for generalizing about the target population (Cresswell, 2012). The design of the study was a case-control on a ratio of 1:2 for cases to controls. According to the OpenEpi version 3, Kelsey method of sample size calculation for the cases and controls, a minimum of 64 cases and a maximum of 128 controls needed to be identified (Appendix A). Five cases (two females and three males) withdrew from participation on the day of the interview and four controls (three males and one female) said they did not have time for the interview, which then resulted in some cases being unmatched and therefore had to be excluded from the study. Only 52 cases and 104 controls were identified due to the time constraints experienced during the study.

The level of confidence required in this study was 95% which corresponds to significance testing at 5% level (P< 0.05). According to Madondo et al, (2012), 73% of the children admitted

to Nyangabgwe Referral Hospital had severe wasting, therefore the sample size of the study was derived based on this incidence rate. Cases were selected from the children admitted in Nyangabgwe Referral Hospital and children referred to the Nutritional Rehabilitation Centre within the hospital in Francistown, and the controls were randomly selected using the JavaScript random number generator from the same Child welfare clinics that were attended by the cases.

Simple random sampling was used to select cases from Nyangabgwe Referral hospital on a weekly basis among children who met the cases inclusion criteria and controls from the nutritional surveillance logbook monthly reports in the clinics among children who met the inclusion criteria. Random sampling is when a subset of individuals (a sample) is chosen from a larger set (a population). Each individual is chosen randomly and entirely by chance, such that each individual has the same probability of being chosen at any stage during the sampling process (Cresswell, 2012). The intent of simple random sampling is to choose individuals to be sampled who will be representative of the population. Any bias in the population will be equally distributed among the people chosen (Cresswell, 2012).

From the list of cases in the hospital who met the inclusion criteria, a random sample was selected using the JavaScript random number generator and matched with controls who met the inclusion criteria and randomly selected from the Child welfare clinic nutritional surveillance log book. The cases and the controls were then paired on the basis of same age, same gender and attendance of the same Child welfare clinic.

4.8 Pilot study

Two weeks before initiating the main study, a pilot study was carried-out on 15 participants (5 cases and 10 controls) in Sekgoma Memorial Hospital in Serowe, a semi-urban area located in the Central district of Botswana with a population of approximately 60 000 as per 2011 census report. During the pilot study measuring instruments were standardised. A 1:2 case-control ratio was used. A simple random selection of five cases paired with 10 controls was done using the inclusion criteria. The pilot study assisted in assessing the response rate to the study, the time required to complete each questionnaire, the adequacy of resources, the relevance of questions, the sequence and comprehensibility of the questions, and the scope at which respondents' interpret the questions. This assisted in determining any changes that needed to be made before the study started. The pilot study is important because it helps the researcher to identify challenges from the study instrument so that the respondents in the main study do not experience any difficulty in completing it (Bell, 2005). It also assists the researcher to carry out preliminary analysis to see whether the wording and format of questions will present any difficulties when the main data are analysed (Bell, 2005).

4.9 The Research Instrument

The researcher used two approaches for data collection namely i) review of records which is the process of analysing medical records based on a set of criteria, and ii) a survey which is defined by Cherry; 2014 as a data collection tool used to gather information about individuals. Sapsford (2005) stated that a survey is a detailed and quantified description of a population.

4.9.1 Review of records

In the review of records, the researcher consulted documents such as; the Child welfare clinic registers, the nutrition surveillance logbook monthly reports, and the Child welfare clinic cards. The researcher used the Child welfare clinic register and nutrition surveillance logbook to obtain information about the children (controls) who were expected to come for the monthly check-up in the months of the duration of the study, so that they can be recruited for the study if they matched the cases and the inclusion criteria. In the child's Child welfare clinic card the researcher obtained information about the growth chart status, immunization status, mother's HIV status and whether the child has been ill for the past two weeks prior to the study.

4.9.2 Survey

In the survey, a self-developed standardised questionnaire including both open and close-ended questions and consisting of six sections was utilised. Surveys involve the systematic collecting of data whether this be by interview, questionnaire or observation methods. At the heart of a survey lies the importance of standardization (Stapsford, 2005). A standardised questionnaire developed by the researcher with the assistance of an expert for the purpose of the study was used to conduct a structured interview with the respondents.

With the assistance of a graduate IT researcher who was trained and coached on completing the questionnaire, eligible care-givers were interviewed. A structured interview enables the researcher to tick or circle responses on the questionnaire that can be fairly easily recorded, summarised and analysed (Bell, 2005). Interview technique is the most expensive survey method because large amounts of interviewer time, significant proportion of which is often

spent travelling to and from interviews (Sapsford, 2005). Questionnaires on which the interviews are based can be difficult, time consuming and costly to produce. However, response rates are usually higher than for other methods (Sapsford, 2005).

4.9.3 Questionnaire construction and the questionnaire items

The variables used in the development of the questionnaire were mostly from the review of the literature of the previous studies on child malnutrition, with the help of the UNICEF conceptual framework of malnutrition. Those variables are the factors that have been investigated by other researchers in other settings. The data collection instrument was made up of both open-ended questions and closed-ended questions and consisted of the following six sections:
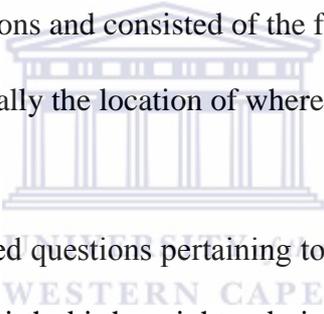
- The first section was basically the location of where the interview was taking place.

- The second section included questions pertaining to the child's health history such as; the age, gender, place of birth, birth weight, admission date for cases, breast-feeding history, any history of illnesses, number of meals taken in a day, vitamin A supplementation status and elaboration of some of the answers.

- The third section included questions about the anthropometric history such as; the state of the child's growth chart on weight and height and the number of months the child attended Child Welfare clinic. Some answers were explained as well.

- The forth section included the questions about the mother or care-giver's health and social history such as; the relation of the respondent to the child, history of antenatal care consultation while pregnant with the study participant child, the HIV status, the

age at birth of the case or control, education level, employment status, level of knowledge about issues of malnutrition, alcohol drinking and cigarette smoking status and intake of any other habitual drugs and clarification were necessary.

- The fifth section was basically about the household information such as; the number of people living in the same household with the child, household food availability, monthly money spent on food, if the child goes to bed hungry, the type of household and toilet system, how refuse is disposed and the water source for the household. There were also some concepts elaborated.

- The final section was about the primary health care services in the local Child welfare clinic such as the health workers' reception towards the respondents, provision of the monthly food supplies and availability of immunizations for children, the health education they receive and whether there are any community home visits from the primary health care providers. It also had parts where the answers were explored further.

4.10 The Research Process

4.10.1 Recruitment of Cases

Step 1

The minimum number of cases required was 64 as per the OpenEpi version 3, Kelsey method of sample size calculation (Appendix A), but due to time constraints and the withdrawal of some respondents only 52 cases were recruited. At first the researcher identified cases from the children admitted in Nyangabgwe Referral Hospital and those referred to the Nutrition Rehabilitation Centre within the hospital in Francistown. Cases were arranged in alphabetical order and numbered. The selection was done on a weekly basis from the ward admission log-book and the Nutrition Rehabilitation centre register, using the JavaScript random number generator.
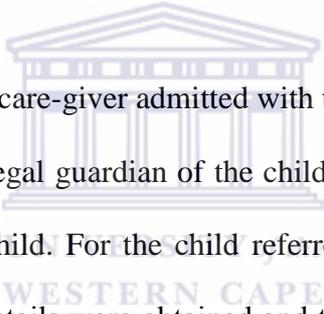
The researcher then requested the care-giver admitted with the child to participate in the study and sought permission from the legal guardian of the child in cases where they were not the one lodging in hospital for the child. For the child referred to the Nutrition Rehabilitation Centre, the care-givers' contact details were obtained and they were contacted and requested to be respondents in the study. If the primary care-giver was not available to be a respondent, the secondary care-giver was requested to participate. At the end of each week there were 15 cases selected and were categorised per Child welfare clinic attended, age and gender. If the care-giver declined from participating in the study, the next available random number was used to identify replacement cases.

Step 2

Before the interview, the researcher introduced self and explained the purpose of the study, and provided the information sheet and consent form to the respondent and sought informed

consent from the care-givers. The face-to-face interview was conducted within the hospital setting only after obtaining written consent from the caregivers. The interviews were conducted with the assistance of an IT researcher graduate who was coached and trained on how to administer the questionnaire. The child welfare cards and the in-patient cards for the case were consulted for the purpose of collecting more data about the health status of the case and to confirm any other information relevant to the study. However, no anthropometric data was collected from the participating children.

4.10.2 Recruitment of Controls

Step 3
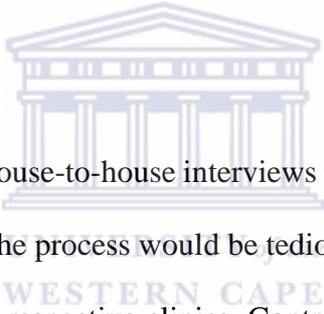
Initially, the plan was to conduct house-to-house interviews for the controls but during the pilot study the researcher realised that the process would be tedious and time consuming, therefore, interviews were carried out in the respective clinics. Controls were identified in the different clinics every two weeks. All the controls who were within the inclusion criteria and expected to come for their monthly check-up on those particular weeks were identified, and randomly selected using the JavaScript random number generator and matched with the 15 cases who were selected that week and the previous week, the care-givers were contacted telephonically and requested to participate in the study so that they come prepared for the interview on the day of their monthly check-up. Random selection from the Child welfare clinics' nutritional surveillance log-book monthly report was done using the JavaScript random number generator after sorting the names by alphabetical order per Child welfare clinic attended, age and gender. If the primary care-giver was not available to be a respondent, the secondary care-giver was

requested to participate. If the care-giver declined from participating in the study, the next available random number was used to identify replacement controls.

Step 4

Before the interview, the researcher introduced self and explained the purpose of the study, provided an information sheet and consent form to the respondent and sought informed consent from the respondents. After informed consent, the face-to-face interview was conducted with the assistance of an IT researcher graduate who was coached and trained on the administration of the questionnaire. During the interviews, the child welfare cards were consulted in order to collect more information about the health status of the child and confirm any other information relevant to the study. If the care-giver declined to participate in the study on the day of the check-up, the next available random number was used to identify replacement control. The records of those who declined and those who withdrew from the study were kept for response rate calculations.

It was intended that the interviews will take no longer than 20 minutes but some ended up taking up to 30 minutes. The researcher conducted the interviews in English, but in some instances where a communication barrier was a problem, the IT researcher graduate assisted with translation because he was fluent in English and both the local languages spoken by the residents of Francistown, namely; Tswana and Kalanga.

Step 5

Data was collected for the minimum number of 52 cases and 104 controls and the total number of respondents were 156, with 5 cases who withdrew from the study and 4 controls who declined participation. Confidentiality was maintained throughout the interview process and during data handling.

4.10.3 Handling of Data

The questionnaires were coded with numbers after the interviews. Codes are labels for assigning units of meaning to descriptive or inferential information compiled during a study (Bell, 2005). The data were filed and kept in a lock and key cabinet under the supervision of the researcher.
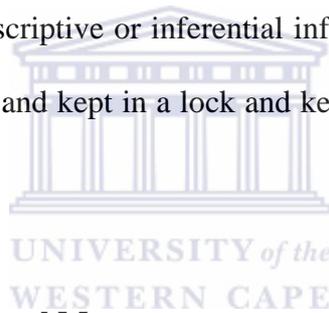
4.10.4 Sorting and Quality Control Measures

The researcher interviewed care-givers and collected the questionnaire in one setting. The researcher then performed a manual sorting of data and the following basic procedures:

- Data were coded. Codes take the view that it is not the words themselves that matter but their meaning (Bell, 2005). Codes are used to retrieve and organise the large piece of data. The organizing part will entail some system for categorising the various information, so that the researcher can quickly find, pull out and cluster the segments related to a particular question (Bell, 2005).

- Inconsistencies in data in the questionnaires were checked for, and if found were queried with the respondents.

- Any missing data were documented.

Summary tables and frequency tables, as well as visual representation of the appropriate variables were used.

4.11 Ensuring Reliability and Validity

Reliability refers to the consistency of a measure. It is the extent to which a test or procedure produces similar results under constant conditions on all occasions (Mertens, 2010). A questionnaire or test is considered reliable if the same result is obtained when the questionnaire is re-administered or test repeated (Muhammad, Muhammad, & Muhammad, 2008). A standardised questionnaire which was self-developed with the assistance of a specialised supervisor was used and questions were presented to participants in the same order, thus increasing reliability. The study reliability was also measured by administering the questionnaire in a pilot study before it was utilised in the study.

According to Twycross (2004), validity refers to the extent to which a questionnaire or test measures what it purports to measure. Validation of the questionnaire was also ensured through correcting the questions following the pilot study to ensure that it measures what was intended in the study. The study design, methodology and all questions used for the purpose of this study were considered to be a valid measure of the variables analysed and they provided credible conclusions for the study. To ensure that the results were valid, all the information in the questionnaires was directly related to the aim and objectives of the study, and the assistant was coached and trained on administering the questionnaire correctly during an interview.

4.12 Data Analysis

As the purpose of this study was to determine the contributing factors to severe acute malnutrition among the children under the age of five years, data collected was presented in both descriptive and analytic form in order to achieve the study objectives. With the assistance of a statistician, the Statistical Package for the Social Sciences (SPSS 23) for data analysis was used. The data was cleaned and checked for errors using the software. Descriptive statistics namely; frequencies and percentages for categorical data, mean and standard deviation and median were calculated as relevant. Bi-variate and step-wise logistic regression was used to investigate the contributing factors to severe acute malnutrition. Cases and controls were analysed using the 95% confidence interval for the percentage differences and for the changes within each group. Data were then presented using summary tables, frequency tables, cross-tabulations and visual representation of appropriate variables.
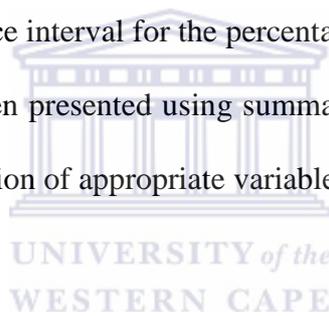
4.13 Conclusion

This chapter discussed the research paradigm, design and methodology that guided the study. The ethical consideration followed was also discussed. The method used in this study had some limitations which were also presented. The following chapter will document the findings of the data analyses.

5 CHAPTER 5 RESULTS

5.1 Introduction

This chapter provides an overview of the results of the study. The results are presented in descriptive and analytic statistics in frequencies, percentages, graphs, figures and tables. The purpose of the study was to establish the contributing factors to severe acute malnutrition among children under the age of five years in the community of Francistown, Botswana. The objective was to ascertain the extent at which the following factors were associated with the condition of SAM among under five children in Francistown, Botswana:

-**Demographic factors:** The age and gender of the child during the period of diagnosis with severe acute malnutrition and the age group of the care-givers.

-**Socio-economic factors**: The size of the household, the level of education of the care-giver, the knowledge of the care-giver about malnutrition, causes and prevention, the child's appetite on a regular day, breast feeding practices, the bread-winner's employment status, the care-giver's marital status, alcohol and drug intake by the care-giver, the number of under five children in the household and the household food security status.

-**Health related factors:** The child's birth weight, immunization status, vitamin A supplementation status, growth chart status, child illness, antenatal care attendance by mother and the mother's HIV status.
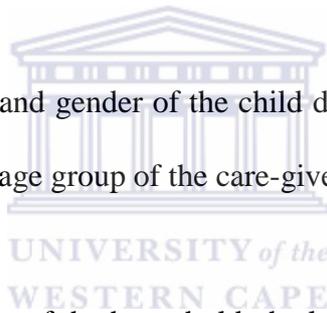
-Primary health care services: reception at the clinic, provision of the necessary monthly food supplies by the clinic, education at the clinic and home visits by health care workers.

This was a case-control study on a ratio of 1:2. Initially, it was intended to collect data on randomly selected 64 cases and 128 controls, but due to limited resources only 52 cases were randomly selected among children who were admitted in Nyangabwe Referral Hospital in Francistown, Botswana and those who were registered with the Nutritional rehabilitation centre in the same hospital and 104 controls were interviewed in corresponding clinics as per the inclusion and exclusion criteria.

All the cases had presented with clinical signs and symptoms of severe acute malnutrition and/or the weight-for-height Z-score of $\leq$ -3 SD which according to the WHO 1997 database malnutrition classification falls under severe acute malnutrition. Different malnutrition diagnosis terms were used for cases depending on the initial health care officer who diagnosed the case. All cases who were admitted and registered with the Hospital nutritional rehabilitation centre from the month of March until July 2015 and met the inclusion criteria were enrolled for the study provided they consented. Controls who met the inclusion criteria were matched to cases by age, gender and Child welfare clinic attended. The age ranges for the cases and controls were 6- 56 months old. The Child welfare clinic register and the under-five Child welfare clinic card were reviewed to obtain some more information.

5.2   Statistical analysis

Descriptive statistics is the term given to the analysis of data that helps describe, show or summarize data in a meaningful way such that, for example, patterns might emerge from the data (frequency distribution, median, maximum and minimum) and graphs like bar charts and

histograms (Frankfort-Nachmias and Leon-Guerrero, 2006). Descriptive statistics do not, however, allow us to make conclusions beyond the data we have analysed or reach conclusions regarding any hypotheses we might have made (Frankfort-Nachmias and Leon-Guerrero, 2006). They are simply a way to describe our data. Inferential statistics such as logistic regression analysis and chi-square are techniques that allow us to use samples to make generalizations about the populations from which the samples were drawn (Frankfort-Nachmias and Leon-Guerrero, 2006).

A 95 % confidence interval is a range of values within which you can be 95 % certain (i.e. 0.95 probability) that it contains the true parameter of the population (Rumsey, 2011). This is not the same as a range that contains 95 % of the values. Confidence intervals are used because a study recruits only a small sample of the overall population so by having an upper and lower confidence limit we can infer that the true population effect lies between these two points (Rumsey, 2011). If the confidence interval is relatively narrow the effect size is known more precisely. If the interval is wider the uncertainty is greater, although there may still be enough precision to make decisions about the variables (Rumsey, 2011). Intervals that are very wide indicate that we have little knowledge about the effect, and that further information is needed (Rumsey, 2011). $P < 0.05$ indicates a statistically significant difference between groups. $P > 0.05$ indicates there is no statistically significant difference between groups (Rumsey, 2011).

5.3 Descriptive findings

5.3.1 Demographic characteristics of the cases and controls

A total of 156 respondents (N=156) were recruited including 52 cases with malnutrition (n=52) and 104 controls without malnutrition (n=104). As the cases and controls were matched for gender and age, the distribution of these characters were similar in cases and controls with 50% females and a median age of 25.5 months (Table 5.1). The age of cases and controls is not normally distributed (Figure 5.1).

Table 5-1: Demographic data for the cases and controls
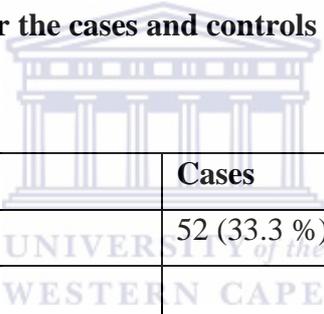
Variable	All	Cases	Controls
N,%	156	52 (33.3 %)	104 (66.7 %)
Gender (N, %)			
Female	78 (50 %)	26 (50 %)	52 (50 %)
Male	78 (50 %)	26 (50 %)	52 (50 %)
Age (Months)			
Median	25.5	25.5	25.5
Maximum	56	56	56
Minimum	6	6	6

Histogram

Mean = 29.17
Std. Dev. = 12.452
N = 156
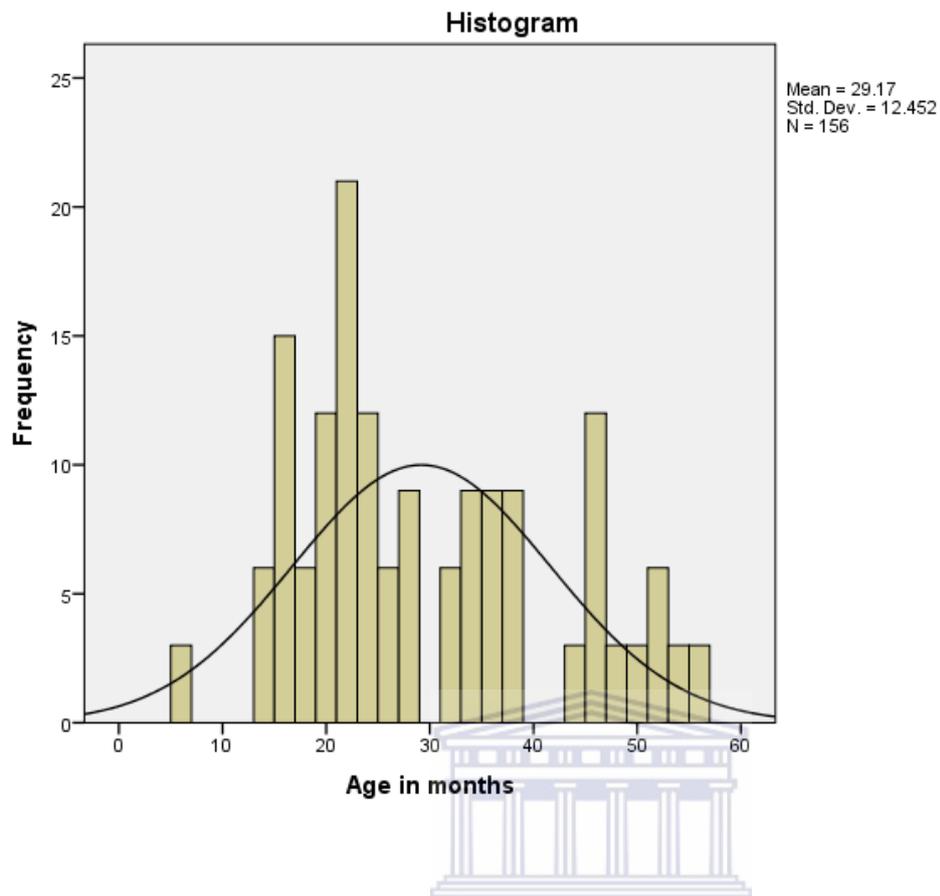
Figure 5:1: Distribution of age in months for cases and controls

5.3.2 Child characteristics investigated for possible contribution to under five malnutrition

Several child characteristics were investigated for possible contribution to child malnutrition using univariate analysis (Table 5.2).

Table 5-2: Child characteristics, with 95 %confidence intervals (n=52 cases, n=104 controls)

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
Low birth weight (< 2500 grams) Yes No	21 31	40.4 59.6	24 80	23.1 76.9	1.64-1.78
Exclusively Breastfed for at least 3 months Yes No Not sure	14 31 7	26.9 59.6 13.5	68 33 3	65.4 31.7 2.9	1.44-1.64
Immunization status up to date Yes No	51 1	98.1 1.9	101 3	97.1 2.9	1.03-1.00
Vitamin A supplement intake up to date Yes No	42 10	80.8 19.2	84 20	80.8 19.2	1.13-1.25
Child illness Yes No	40 12	76.9 23.1	58 46	55.8 44.2	1.30-1.45
Child's appetite on a regular day Satisfactory Unsatisfactory Not sure	29 21 2	55.7 40.4 3.8	95 9	91.3 8.7	1.75-1.99
Growth chart up to date Yes No	38 14	73.1 26.9	100 4	96.2 3.8	1.06-1.17
Child raised by care-giver Yes No	15 37	28.8 71.2	33 71	31.7 68.3	1.77-2.32

Significantly more cases were born at a low birth weight than the controls (23.1 % and 40.4 %) respectively [(95 % CI 1.64-1.78)]. Significantly more participants in the control group were exclusively breastfed for at least the first three months of life (65.4 %) compared to the case

group (26.9 %) (95 % CI 1.44-1.64). About 55.7 % of cases were reported to feed well and 91.3 % was recorded for the controls (95 % CI 1.75-1.99).

For both cases and controls the immunisation status (95 % CI 1.03-1.00) was up to date for almost all participants (98.1 % cases and 97.1 % controls). The vitamin A supplement intake was also up to date for the majority of cases and controls at 80.8 % (95 % CI 1.13-1.25) as recorded in the Child welfare clinic card. There were 76.9 % of cases who recorded child hood illness (95 % CI 1.30-1.45) two weeks prior to being diagnosed with SAM and only 55.8 % of controls for the corresponding period. There were 26.9% of cases who had a growth chart which was not up to date for the last six months prior to being diagnosed with under-weight. About four percent (3.8 %) of the controls had a growth chart which was not up to date for the corresponding period (95 % CI 1.06-1.17). Twenty-nine percent (28.8 %) of cases were raised by a care-giver as compared to 31.7 % of the controls (95 % CI 1.77-2.32).

In all these child characteristics, low birth weight, the child being exclusively breastfed for the first three months of life, child's appetite on a regular day, whether the child had an illness two weeks prior to diagnosis or a corresponding period for the control and the growth chart being up-to date were statistically significantly associated with being malnourished (p < 0.05).

The reasons which were given by cases and controls care-givers were almost similar and therefore they were combined. The reasons which were stated for not breastfeeding the children at birth were that the mother was HIV positive and on treatment when they had the child (48 % of care-givers), the mother was ill therefore not fit enough to breastfeed (16 % of care-givers) and that the mother had to go back to school or work leaving the child in the care of relatives which therefore resulted in the child being bottle-fed since birth (36 % of care-givers).

For the child's feeding status being unsatisfactory, the respondents stated that the child fed reluctantly (38 % of care-givers), or they took small feeds at a time especially if the child was not well (62 % of care-givers). The reasons given by the respondents for the child missing their Child welfare monthly check-up was that the care-taker was not available so there was no one present to take the child to the clinic (39 % or responses) or they missed the check-up during the time when the child was admitted to hospital (61 % of responses).
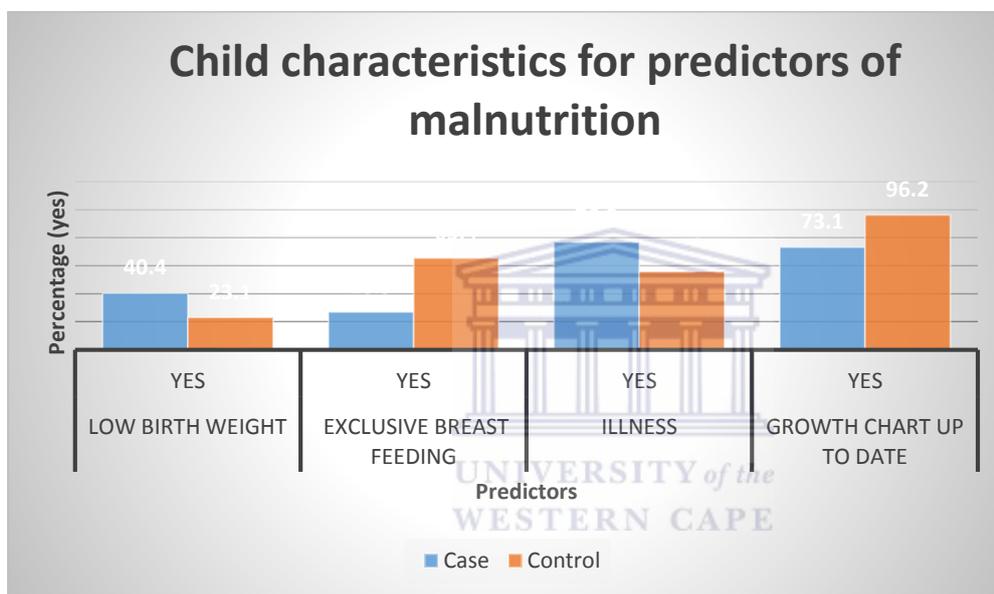
Figure 5:2: A comparison of child characteristics for selected significant predictors of underweight

5.3.3   Characteristics of care-givers

Table 5.3 presents a comparison of care-giver characteristics of child malnutrition for cases and controls.

Table 5-3: Care-giver characteristics with 95 % confidence intervals (n =52 cases, n = 104 controls)

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
Care-giver younger (≤ 21years) Yes No	4 48	7.7 92.3	6 98	5.8 94.2	1.90-1.94
Care-giver's level of education None & Primary Secondary & Tertiary	17 35	32.7 67.3	16 88	15.4 84.6	2.85-3.05
Knowledge about definition of malnutrition Yes No	38 14	73.1 26.9	71 33	68.3 31.7	1.23-1.37
Knowledge about causes of malnutrition Yes No	30 22	57.7 42.3	60 44	57.7 42.3	1.34-1.50
Knowledge about prevention of malnutrition Yes No	28 24	53.8 46.2	51 53	49 51	1.41-1.57
Marital status of care-giver (Not living with partner) Yes No	25 27	48.1 51.9	51 53	49 51	1.45-1.63

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
Bread winner working					
Yes	9	17.3	103	99	2.78-3.01
No	43	82.7	1	1	
Alcohol consumption					
Yes	22	43.2	18	17.3	1.67-1.81
No	30	57.7	86	82.7	
Cigarette smoking					
Yes	0		3	2.9	1.96-2.00
No	52	100	101	97.1	
Habitual drugs					
Yes	3	5.8	1	1	1.95-2.00
No	49	94.2	103	99	
ANC attendance by mother					
Yes	44	84.6	92	88.5	1.14-1.34
No	0		3	2.9	
Not sure	8	15.4	9	8.7	
Mother's HIV status					
Positive	28	53.8	34	32.7	1.70-1.94
Negative	13	25	47	45.2	
Unknown	11	21.2	23	22.1	

For both the groups (cases and control) only a limited number of care-givers were of the younger age (7.7 % for cases and 5.8 % for controls 95 % CI 1.90-1.94). For education level (95 % CI 2.85-3.05), most cases had secondary and tertiary education level 67.3 % and those who had primary and no education level were 32.7 %. When this data is compared with the control data there was 84.6 % with secondary and tertiary education level and 15.4 % with no formal education and primary education level. The cases who could define malnutrition correctly were (73.1 %) 95 % CI 1.23-1.37)], the cases who could state the causes of malnutrition were (57.7 %) 95 % CI 1.34-1.50)] and those who could state the prevention measures of malnutrition were (53.8%) 95 % CI 1.41-1.57)] as compared to (58.3 %, 57.7% and 49 %) for the controls on the same variables respectively. In both groups (cases and controls) there was an equal chance for care-givers living alone or with partners (95 % CI 1.45-1.63). However, the majority of the cases breadwinner was unemployed (82.7 %) as compared

to the majority of controls who were employed (99 %) (95 % CI 2.78-3.01). As seen in Table 5.3, 43.2 % of care-givers for the cases consumed alcohol and 17.3 % of the control care-givers took alcohol (95 % CI 1.67-1.81). Cigarette smoking and any other habitual drug intake was almost non-existent for both cases and controls (2.9 %) 95 % CI 1.96-2.00)] and (95 % CI 1.95-2.00) respectively. Both cases and controls equally attended the Ante natal clinic check-up during pregnancy (case; 84.6 %, control; 88.5 %) 95 % CI 1.14-1.34)]. Fifty four percent (53.8 %) of mothers for the cases were HIV positive compared to 32.7 % of controls (95 % CI 1.70-1.94).
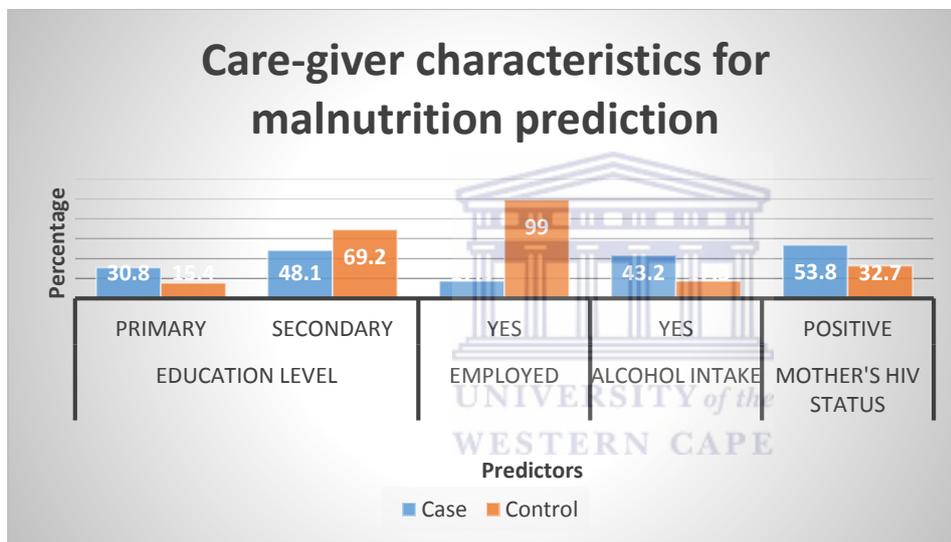
Figure 5:3: Figure 5.3: A comparison of care-giver characteristics for selected significant predictors of underweight

For the care-giver characteristics, the level of education, the breadwinner's employment status, alcohol consumption by the care-giver and the mother's HIV status were statistically significantly associated with the child being malnourished ($p < 0.05$). Care-givers who reported to have an unemployed head of the family stated that they had no one to look after the child while they work (48 % of responses) and that they did not have any child support from their partners or any other family members (22 % of responses). For the care-givers who had said

they drink alcohol they stated that they only take alcohol occasionally just to pass time. The reasons given by care-givers were combined for both cases and controls because they were almost the same.

5.3.4 Household information for cases and controls

Table 5.4 shows household information for cases and controls who had more than one child under the age of five years and more than four family members. It also shows the household food security status.

Table 5-4: Household information with 95 %confidence intervals (case n =52, control n = 104)

Variable	Case		Control		95 % CI for percentage difference
	n	**%**	**n**	**%**	
Many children under the age of five (> 1)					
Yes	33	63.5	27	26	5.96-6.72
No	19	36.5	77	74	
More than 4 family members					
Yes	50	96.2	98	94.2	1.37-1.58
No	2	3.8	6	5.8	
Household food availability					
Satisfactory	43	82.7	102	98.1	1.85-2.00
Unsatisfactory	9	17.3	2	1.9	
Brick house					
Yes	37	71.2	101	97.1	1.06-1.71
No	15	28.8	3	2.9	
Own tap					
Yes	29	55.8	87	83.7	1.22-1.45
No	23	44.2	17	16.3	

98

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
Flush toilet type					
Yes	27	51.9	62	59.6	1.35-1.51
No	25	48.1	42	40.4	
Refuse removed by authorities					
Yes	31	59.6	92	88.5	1.15-1.28
No	21	40.4	12	11.5	

The majority of cases had more than one child under the age of five years in the household (63.5 %) as compared to 26 % of controls (95 % CI 5.96-6.72). Nevertheless, both cases and controls had a high number of families with more than four family members (96.2 % cases and 94.2 % controls) 95 % CI 1.37-1.58)]. The household food availability (95 % CI 1.85-2.00) was satisfactory for both groups (82.7 % cases and 92.1 % controls).

In both groups (cases and controls) the majority of the care-givers lived in a brick house structure (71.2 % for cases and 97.1 % for controls) 95 % CI 1.06-1.71)]. Most of these households had a tap (95 % CI 1.22-1.45) and access to a flush toilet (95 % CI 1.35-1.51)] (55.8 %, 51.9% cases and 83.7%, 59.6 % controls) respectively. Only 59.6 % of cases had their refuse bin collected by relevant authorities as compared to 88.5% of controls (95 % CI 1.15-1.28).

The household characteristics which remained significantly associated with under five malnutrition ($p < 0.05$) were having more than one child under the age of five (Fisher's Exact Test), household food availability (Fisher's Exact Test), living in a brick house, having own tap and refuse waste collected by relevant authorities. The respondents who stated that food availability was unsatisfactory related this to the reason that there was no one in the family who

was employed therefore it made it difficult to acquire enough food for the household, which then resulted in some days going by without food.
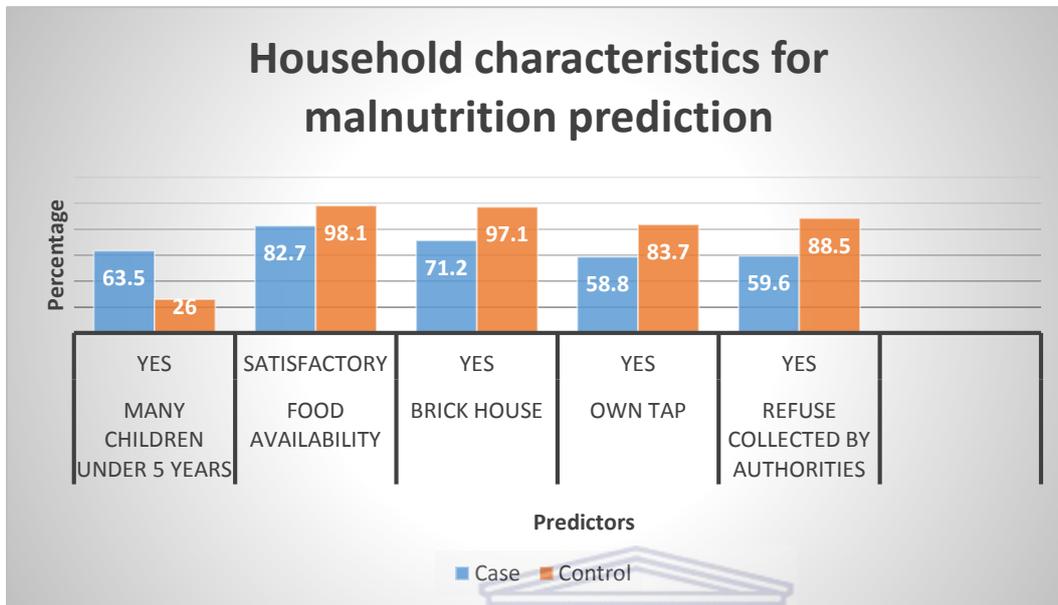
Figure 5:4: A comparison of household characteristics for selected significant predictors of underweight

5.3.5 Primary health care services

Table 5.5 reflects on the child welfare clinic reception for both cases and controls and the availability of the monthly food supplies in the clinics.

Table 5-5: Primary health care services with 95%confidence intervals (cases n =52, control n = 104)

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
CWC reception Satisfactory Unsatisfactory	52 0	100	104 0	100	1.25-1.39

Variable	Case		Control		95 % CI for percentage difference
	n	%	n	%	
CWC food supplies availability					
Yes	17	32.7	11	10.6	3.68-3.98
No	35	67.3	93	89.4	

Both cases and controls were satisfied with the reception they got from the Child welfare clinics they attended (95 % CI 1.25-1.39). For the monthly food supplies (95 % CI 3.68-3.98), 67.3 % of the cases did not receive any and 89.4% of the controls did not get any food supplies.

As for the food supplies availability in the Child welfare clinics, the care-givers reported that they sometimes go for months without getting any supplies (34 %), other months they received less supplies than what they are supposed to get (45 %), and some respondents stated that they got supplies every month (21 %). Both the cases and controls respondents stated that the reasons they were usually told by the health workers for shortage of food supplies are that the main supplier has not supplied the government and therefore there are no supplies country wide, some respondents said that they were told that the clinic had run out of supplies because the government contract with the main supplier had come to an end, and some respondents were not given a reason at all. There was a copy of the saving gram (Appendix J) placed on the notice boards with regard to food supplies in clinics. As for the feedback pertaining to the home visits, respondents said it did not take place any more or it rarely happens if at all it still exists.

5.4 Logistic regression

In statistics, logistic regression is a regression model where the dependent variable is categorical (David, 2009). Logistic regression measures the relationship between the

categorical dependent variable and one or more independent variables by estimating probabilities using a logistic function (David, 2009). Binary logistic regression is when dependent variables can take only two values, such as yes/no (David, 2009). The binary logistic regression was used to analyse the child characteristics namely; low birth weight, exclusive breastfeeding for at least 3 months, childhood illness two weeks prior to diagnosis and the growth chart status which were statistically significantly associated with severe acute malnutrition ($p < 0.05$). The child's feeding status, although statistically significantly associated with child under-nutrition ($p < 0.05$), was excluded from logistic regression analysis because a child can have a poor appetite due to an illness therefore the child might have been suffering from malnutrition which might have led to poor feeding habits.
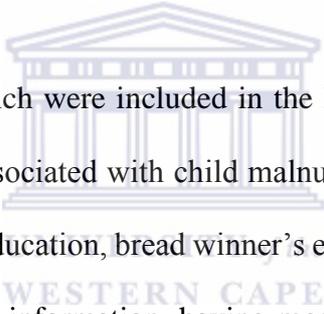
The care-giver characteristics which were included in the logistic regression analysis due to being statistically significantly associated with child malnutrition ($p < 0.005$) were, mother's HIV status, care-giver's level of education, bread winner's employment status and care-giver's alcohol intake. For the household information, having more than one child under the age of five, household food availability status, living in a brick house, having own tap and refuse collected by relevant authorities was also statistically significantly associated with child under-nutrition ($p < 0.05$), therefore included in the logistic regression analysis. The Child welfare food supplies status was statistically significantly associated with child malnutrition but because the period during which the data was collected there was shortage of food supplies in the whole country due to the end of contract with the suppliers (Appendix J) it was not included.

5.4.1 Odds ratio (OR)

According to Szumilas (2010) an odds ratio (OR) is a measure of association between an exposure and an outcome. The odds ratio represents the chances that an effect will occur given a particular exposure, compared to the chances of the effect occurring in the absence of that exposure.

Table 5.6 reflects an unadjusted odds ratio (UOR) i.e. an odds ratio without controlling the effects of other variables, and table 5.7 reflects an adjusted odds ratio (AOR) i.e. an odds ratio after controlling the effects of the other variables.

Table 5-6: Binary logistic regression (Unadjusted Odds ratio (UOR)) of variables which have a p-value < 0.05

Variables	B	S.E.	Wald	Df	Sig.	UOR	95 % C.I.for OR	
							Lower	Upper
Weight at birth								
Low birth weight (<2500grams)	1							
Normal birth weight (>2500grams)	-0.815	0.366	4.949	1	0.026	0.443	0.216	0.908
Exclusive Breastfeeding at least 3 months								
Yes	1							
No	-1.365	0.374	19.052	1	0.000	0.195	0.094	0.406
Child had Illness								
Yes	1.000							
No and not sure	-0.972	0.384	6.416	1	0.011	0.378	0.178	0.803

Variable	B	S.E.	Wald	Df	Sig	UOR	95 % C.I. for OR	
							Lower	Upper
Growth chart								
Up to date	1.000							
Not up to date and not sure	2.220	0.598	13.781	1	0.000	9.211	2.852	29.744
Mother HIV status								
Positive	1.000							
Negative and unknown	-0.876	0.348	6.342	1	0.012	0.416	0.210	0.823
Education Level								
None and Primary	1.000							
Secondary and Tertiary	-0.983	0.402	5.987	1	0.014	0.374	0.170	0.822
Work status								
Unemployed and Part-time	1.000							
Full-time and Self-employed	-1.315	0.426	9.519	1	0.002	0.269	0.116	0.619
Alcohol intake								
Yes	1.000							
No	-1.254	0.382	10.770	1	0.001	0.285	0.135	0.604
Household Food Availability								
Satisfactory	1.000							
Poor	2.368	0.803	8.704	1	0.003	10.674	2.214	51.466
House type								
Brick	1.000							
Mud	2.614	0.661	15.634	1	0.000	13.649	3.736	49.858
Water system								
Own tap	1.000							
Communal and other	1.401	0.385	13.235	1	0.000	4.059	1.908	8.633
Refuse type								
Local Authority	1.000							
Refuse dump	1.647	0.417	15.590	1	0.000	5.194	2.293	11.765

Variable	B	S.E.	Wald	Df	Sig.	UOR	95 % C.I. for OR	
							Lower	Upper
Under_5 more than 1								
Yes	1.000							
No	-1.600	0.365	19.255	1	0.000	0.202	0.099	0.413

The contributing factors which remained statistically significantly associated with severe acute malnutrition among children under the age of five (p = 0.05) in the outcome of the binary logistic regression for the unadjusted odds ratio were; birth weight, exclusive breastfeeding for at least three months, child illness, growth chart status, mother's HIV status, care-giver's educational level, care-giver's employment status, alcohol consumption, household food availability, house type owning a tap, refuse collected by relevant authorities and having more than one child under the age of five.
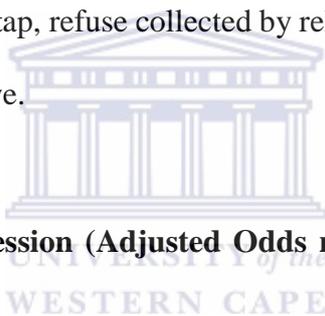
Table 5-7: Binary logistic regression (Adjusted Odds ratio (AOR)) of variables which have a p-value < 0.05

Variables	B	S.E.	Wald	Df	Sig.	AOR	95% C.I.for OR	
							Lower	Upper
Weight at birth								
Low birth weight (<2500grams)	1							
Normal birth weight (>2500grams)	-0.827	0.528	2.453	1	0.117	0.437	0.155	1.231
Exclusive Breast feeding at least 3 months								
Yes	1							
No	1.008	0.538	3.512	1	0.061	2.741	0.955	7.866
Child had Illness								
Yes	1.000							
No and not sure	-0.959	0.526	3.321	1	0.068	0.383	0.137	1.075

Variable	B	S.E.	Wald	Df	Sig.	AOR	95 % C.I. for OR	
							Lower	Upper
Growth chart								
Up to date	1.000							
Not up to date and not sure	2.039	0.790	6.653	1	0.010	7.680	1.631	36.157
Mother HIV status								
Positive	1.000							
Negative and unknown	-0.252	0.523	0.232	1	0.630	0.777	0.279	2.165
Education Level								
None and Primary	1.000							
Secondary and Tertiary	-0.048	0.630	0.006	1	0.940	0.953	.0277	3.280
Work status								
Unemployed and Part-time	1.000							
Full-time and Self-employed	0.457	0.859	0.283	1	0.595	1.579	0.293	8.511
Alcohol intake								
Yes	1.000							
No	-2.064	0.544	14.374	1	0.000	0.127	0.044	0.369
Household Food Availability								
Satisfactory	1.000							
Poor	-0.195	1.355	0.021	1	0.885	0.823	0.058	11.712
House type								
Brick	1.000							
Mud	2.614	0.661	15.634	1	0.000	13.649	3.736	49.858
Water system								
Own tap	1.000							
Communal and other	0.238	0.776	0.094	1	0.759	1.269	0.277	5.809
Refuse type								
Local Authority	1.000							
Refuse dump	0.740	0.909	0.662	1	0.416	2.095	0.353	12.445
Under_5 more than 1								
Yes	1.000							
No	-1.412	0.525	7.235	1	0.007	0.244	0.087	0.682
Constant	2.511	1.556	2.604	1	0.107	12.322		
Nagelkerke R Square = 0.534								

The adjusted odds ratio indicates that 53 % of cases ($r^2 = 0.534$) could be explained by these factors after controlling the effect of other variables. For the binary logistic regression analysis after controlling the effect of other variables (adjusted odds ratio) the factors which remained statistically significantly associated with severe acute malnutrition (p = 0.05) were growth chart status, alcohol consumption and the type of house. Some variables lost their statistical significance to SAM after controlling the effect.

5.4.2 Confounding variables

A confounding variable is a variable, other than the independent variable that one is interested in that may affect the dependent and independent variable. This can lead to erroneous conclusions about the relationship between the independent variables (McDonald, 2014). Confounding variables are dealt with by controlling them, matching, randomising, or by statistical control (McDonald, 2014).
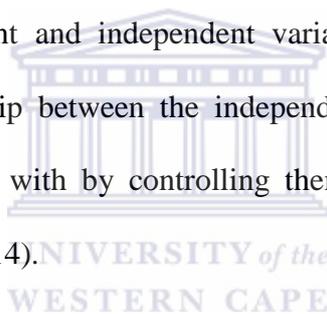
5.4.3 5.4.3 Stepwise binary logistic regression

Stepwise binary regression includes regression models in which the choice of predictive variables is carried out by an automatic procedure (Hosmer and Lemeshow, 2000). It involves a one-by-one automatic selection of variables which are associated with severe acute malnutrition in children aged below five years. These variables are added one after the other at every step starting with the variable which is statistically highly significantly associated with under-weight. In this case, low birth weight, exclusive breastfeeding, child illness, growth chart status, level of care-giver's education, breadwinner's work status, mother's HIV status, alcohol consumption, household having more than one child under the age of five, household food

availability, living in a brick type of house, owning a tap and refuse removed by the relevant

authority were all statistically significantly associated with severe acute malnutrition ($p < 0.05$).

Therefore, all these variables were included in the stepwise regression.

Table 5-8: Stepwise binary regression Nagelkerke R Square

Steps 1-3

		B	S.E.	Wald	df	Sig.	Exp(B)	95 % C.I. for EXP(B) Lower	Upper	Nagelkerke R Square
Step 1[a]	**House type**									0.18
	Brick	1								
	Mud	2.614	0.661	15.634	1	0.000	13.649	3.736	49.858	
	Constant	-3.618	0.740	23.897	1	0.000	0.027			
Step 2[b]	**House type**									0.28
	Brick	1.000								
	Mud	2.878	0.683	17.757	1	0.000	17.778	4.662	67.801	
	Alcohol Intake									
	Yes	1.000								
	No	-1.511	0.413	13.362	1	0.000	0.221	0.098	0.496	
	Constant	-1.344	0.940	2.045	1	0.153	0.261			
Step 3[c]	**House type**									0.37
	Brick	1.000								
	Mud	2.132	0.724	8.676	1	0.003	8.428	2.041	34.811	
	Alcohol intake									
	Yes	1								
	No	-1.900	0.471	16.296	1	0.000	0.150	0.059	0.376	
	Under 5 more than 1									
	Yes	1.000								
	No	-1.584	0.456	12.055	1	0.001	0.205	0.084	0.502	
	Constant	1.046	1.205	0.753	1	0.386	2.845			

Step 4

		B	S.E.	Wald	df	Sig.	Exp(B)	95 % C.I. for EXP(B)		Nagelkerke R Square
								Lower	Upper	
Step 4[d]	**House_type**									0.44
	Brick	1.000								
	Mud	1.975	0.757	6.809	1	0.009	7.206	1.635	31.761	
	Alcohol intake									
	Yes	1.000								
	No	-1.919	0.481	15.910	1	0.000	0.147	0.057	0.377	
	Under 5 more than 1									
	Yes	1.000								
	No	-1.541	0.468	10.852	1	0.001	0.214	0.086	0.536	
	Growth_chart									
	Up to date	1.000								
	Not up to date and Not sure	2.009	0.678	8.769	1	0.003	7.457	1.972	28.187	
	Constant	-1.037	1.408	0.542	1	0.461	0.355			

The results of the five step regression showed that 18 % of cases ($r^2 = 0.18$) could be explained by living in a brick house type. When alcohol intake is added in step 2, 28 % of cases ($r^2 = 0.28$) could be explained by living in a brick house type and alcohol intake by care-giver. In step 3 having more than on child under the age of five was automatically added which then showed that 37 % of cases ($r^2 = 0.37$) could be explained by these variables. In step 4, 44 % of cases (($r^2 = 0.44$) could be explained by living in a brick house type, alcohol intake by the care-giver, having more than one child under the age of five years in the household and the child's growth chart being up-to-date.

Step 5

		B	S.E.	Wald	df	Sig.	Exp(B)	95 % C.I. for EXP(B) Lower	Upper	Nagelkerke R Square
Step 5[e]	**House_type**									0.49
	Brick	1.000								
	Mud	1.586	0.773	4.212	1	0.040	4.883	1.074	22.200	
	Alcohol intake									
	Yes	1.000								
	No	-2.005	0.515	15.159	1	0.000	0.135	0.049	0.370	
	Under 5 more than 1									
	Yes	1.000								
	No	-1.346	0.485	7.691	1	0.006	0.260	0.101	0.674	
	Growth_chart									
	Up to date	1.000								
	Not up to date and Not sure	2.158	0.722	8.942	1	0.003	8.654	2.103	35.606	
	Exclusive Breastfeeding at least 3 months									
	Yes	1.000								
	No	1.366	0.465	8.627	1	0.003	3.919	1.575	9.751	
	Constant	-1.450	1.476	0.966	1	0.326	0.234			

a. Variable(s) entered on step 1: House_type
b. Variable(s) entered on step 2: Alcohol.
c. Variable(s) entered on step 3: Under_5recode
d. Variable(s) entered on step 4: Growth_chart.
e. Variable(s) entered on step 5: Breast_fed.

In the final step 49% of the cases ($r^2 = 0.49$) could be explained by living in a brick house type, alcohol intake by the care-giver, having more than one child under the age of five years in the household, the child's growth chart being up-to-date and the child being exclusively breastfed for at least three months. The Nagelkerke R Square (r^2) shows that living in a brick house was the most important variable and exclusive breast feeding for at least three months was the least important.

6 CHAPTER 6 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter seeks to interpret findings and explore the implications of these findings. The variables which were investigated for causes of SAM among children under the age of five years in Francistown, Botswana were;

-Child characteristics: birth weight, exclusive breastfeeding for at least three months, childhood illness, immunization status, vitamin A supplementation status, growth chart status, child's appetite on a basic day and child raised by a care-giver.

-Care-giver characteristics: age range, level of education, knowledge about defining malnutrition, stating the causes and preventive measures of malnutrition, marital status, employment status, alcohol consumption, cigarette smoking, habitual drug intake, ante natal care attendance and mother's HIV status.

-Household characteristics: more than one child under the age of five, more than four family members, food availability, type of housing, owning a tap, type of toilet and refuse removal from the household.

-Primary health care services: Child welfare clinic reception and Child welfare clinic food availability.

The cross tabulation statistical analysis revealed significant association (p = 0.05) with SAM on a number of variables after controlling the effect of other variables (adjusted odds ratio). In logistic regression a greater proportion of cases could be explained by house type and the least proportion by exclusive breastfeeding for at least three months.

6.2   Discussion

6.2.1   Child characteristics

In this study logistic regression analysis showed that the child characteristics factors which were significantly associated with SAM among children under the age of five years were; child being born with a low birth weight, not being exclusively breastfed for at least the first three months of life, having an illness two weeks prior to being diagnosed with SAM, reluctant to feed and the growth chart not being up to date.
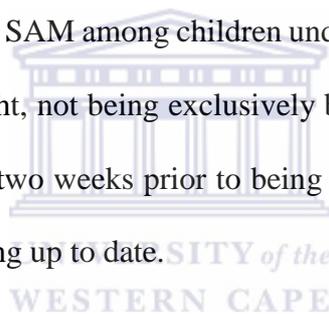
The findings showed that a child with low birth weight (LBW) < 2500mg was likely to be diagnosed with severe acute malnutrition as compared to a child born with a normal birth weight ≥ 2500mg (AOR = 0.437; 95 % CI = 0.155-1.231). Cross-sectional studies conducted by Hailemariam (2014) in western Ethiopia and Rayhan & Khan (2006) in Bangladash showed that low birth weight children were more likely to be under weight as compared to high birth weight children. However, Rayhan & Khan stated that babies who were lager in size at birth were at lower risk for malnutrition but did not mention the weight they considered as large.

A case-control study conducted by Kadima (2012) in Kweneng west (Botswana) revealed that low birth weight had a greater risk of malnutrition. Kadima's study was carried out in the rural

area while the previous study was conducted in the urban area. Nevertheless, the present and previous studies did not establish whether children who had a low birth weight were born at pre-term or not and whether they were born to undernourished mothers or not which might have led to a child born small for gestation age.

Children who were exclusively breastfed for at least the first three months of life were at low risk of SAM as compared to those who were not breastfed or who were breastfed for a shorter period (AOR = 2.741; 95 % CI = 0.955-7.866). This is consistent with results conducted by (Hailemariam 2014; Fuchs et al., 2013; Nhampossa et al, 2013; Mizumoto et al, 2013 and Amasalu & Tigabu 2006) in Bangladash, southern Mozambique, East Timor and Ethiopia respectively. However, Hailemariam (2014) investigated the effects of frequency of breastfeeding in 24 hours as opposed to duration which was in all the other studies including the present one. In Francistown, mothers who did not breastfeed their new born babies either had to go back to work or school immediately after birth and/or were HIV positive. However, Kadima 2012's case-control study discovered that breastfeeding exposure did not influence the risk of malnutrition.

The present study showed that child illness two weeks prior to being diagnosed with SAM was significantly associated with severe acute malnutrition (AOR = 0.383; 95 % CI = 0.137-1.075). The childhood illness which were assessed for were cough, diarrhea, vomiting, fever, ear problem or any disability. This factor was consistent to Kinyoki et al., 2015's cross-sectional study carried out in Somalia and a case-control study conducted by Kadima (2012) in Kweneng west in Botswana who also discovered significant association between infection and illness on child malnutrition. Kinyoki et al, (2015) associated diarrhea and respiratory infections with

malnutrition while Kadima (2012) on the other hand did not specify the type of illness assessed for.

The child being reluctant to feed on a regular day or having a poor appetite was significantly associated with severe acute malnutrition. This factor was not included in the stepwise logistic regression analysis because under-nutrition and infection often occur at the same time because one can lead to the other. Inadequate dietary intake and illness tend to create a vicious cycle. In general, poor nutrition can result in reducing the body's ability to resist infection by undermining the functioning of the main immune response mechanism thus leads to infection (UNICEF Harmonized Training Package, n.d). This can then increase the possibility of an individual getting an illness increased in duration and/or severity hence resulting in loss of appetite, increased nutrient requirements and/or decreased absorption of nutrients consumed (UNICEF Harmonized Training Package, n.d). This then further affects children's eating patterns and how they are cared for. These, in turn, elicits weight loss and reduces resistance to further infection.

The growth chart not being up to date was likely contributing to severe acute malnutrition (AOR = 7.680; 95 % CI = 1.631-36.157). Most of the care-givers had stated that the growth chart was not updated during the period they were admitted in the hospital which then indicates that technically they did not miss the child's monthly check-up but the health services missed an opportunity for monitoring.

6.2.2   Care-giver characteristics

The care-giver characteristics which were significantly associated with the risk of developing severe acute malnutrition in children below five years after binary logistic regression analysis of data were; mother's HIV status being positive, none and primary level of education, being unemployed, and alcohol consumption.

The present study showed that a mother who was HIV positive or whose HIV status was unknown had a likely chance of the child being diagnosed with severe acute malnutrition (AOR = 0.777; 95 % CI = 0.279-2.165). This could be related to lack of breastfeeding to prevent transmission of HIV from mother to child which leads to the child not receiving the disease fighting substances contained in the breast milk that protect the baby from illness. The child then becomes susceptible to infection due to compromised development of immunity which might cause the child to have recurrent illness leading to loss of appetite and ultimately severe acute malnutrition.

Turner, et al, n.d stated that "the way to a child's stomach is through the mind of the mother", this statement is supported by the findings of this study which indicated that the care-giver with none and primary level of education was likely to have a chance of child developing severe acute malnutrition as compared to the one with secondary and tertiary education (AOR = 0.953; 95 % CI = 0.277-3.280). (Kavosi et al, 2014; Shafqat et al, 2013; Mboho & Bassey 2013; Shiddigi et al, 2011; Masiye et al, 2010 and Mahgoub et al, 2006) indicated a reduced risk rate for malnutrition with increased or higher education and being literate. However, in all these studies Siddiqi et al, (2011)'s study was the only case-control study and the other studies were cross-sectional. Maternal education is known to have a profound beneficial effects on child

care practices like child feeding practices which is especially important for the child nutritional status.

Unemployment was significantly associated with malnutrition in previous case-control studies (Fuchs, et al, 2014 and Kadima 2012). This study is consistent with these findings as it revealed that the care-giver being unemployed had a probability of the child being diagnosed with severe acute malnutrition (AOR = 1.579; 95 % CI = 0.293-8.511). This factor might also explain the high percentage of controls cared for by other relatives because it is highly likely that the mother is employed, versus the cases who are cared for by their mothers which might be due to unemployment. Unemployment might also affect house hold food availability depending on the income rate and thus ultimately leads to SAM.

The present study indicated that alcohol consumption by the care-giver was more likely contribute to the child being diagnosed with severe acute malnutrition (AOR = 0.127; 95 % CI = 0.044-0.369). Alcohol intake can impair a person's judgement level which might lead to lack of hygienic child feeding practices which then results in the child developing an infection and ultimately leading to severe acute malnutrition due to poor feeding.

6.2.3 Household characteristics

Unsatisfactory house hold food availability, mud house type, having more than one child under the age of five years, not owning a tap and refuse not collected by relevant authorities was significantly associated with severe acute malnutrition in the logistic regression analysis of data.

The household having unsatisfactory food availability was significantly associated with severe acute malnutrition (AOR = 0.823; 95 % CI = 0.058-11.712). This factor might be influenced by lack of employment and lack of education depending on the type of job and the income. Living in a brick house type (AOR = 13.649; 95 % CI = 3.736-49.858), owning a tap (AOR = 1.269; 95 % CI = 0.277-5.809) and refuse collected by the relevant authority (AOR = 2.095; 95 % CI = 0.353-12.445) was significantly associated with low risk of SAM. This might prove that there is direct correlation between sanitation, clean water and severe acute malnutrition.

Consistent with results from a study conducted by Kadima (2012) which showed a significant association between the number of children under the age of five years in the household with malnutrition. This study revealed that the households which had more than one child under the age of five was a risk factor for SAM. The family might have more children under the age of five years due to the communities certain cultural beliefs or lack of education which is related to ignorance (Bain et al, 2013). This therefore might lead to the family not realising that giving birth to a fewer number of children might actually help them to match the limited resources, and also offer adequate and quality nutrition to the family (Bain et al, 2013).

6.2.4   Health care services

Availability of food supplies in Child welfare clinics was affected by the end of the government contract with the country's main supplier (Appendix J), therefore, Child welfare clinics provided the available food supplies to care-givers according to needs priority which therefore created biasness for this factor.

117

6.2.5 Different in association from previous studies

Contrary the findings of the cross-sectional studies conducted by (Mahgoub, et al, 2006; and Mboho & Bassey 2013) and Ayaya, et al, 2014 case-control study which indicated that malnutrition was significantly associated with the single parent status. This study also has different association in findings of the study conducted by Kadima (2012), to determine factors influencing malnutrition among children under 5 years of age in the Kweneng west district of Botswana which showed a significant association between large household size (Kavosi, et al, 2014), inadequate vitamin A supplement (Hailemariam, 2014), lack of knowledge about the preventive measures of malnutrition (Ijarotimi, 2013) and the child being raised by a guardian and malnutrition (Kadima, 2012).
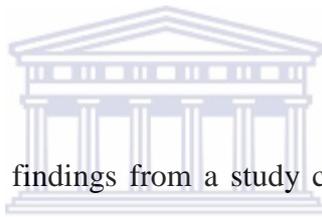
The study also revealed different findings from a study conducted by Kawachi (2005) and Ayaya, et al, (2004) which showed a significant association between younger age of care-giver and malnutrition. Siddiqi, et al., 2011 also revealed an association between mother's ante natal care attendances with child malnutrition which is contradictory to this study. The current study did not show a significant association between SAM and these factors.

A case-control study conducted by Shargi, et al, (2011) to determine the risk factors for protein-energy malnutrition in children under the age of 6 years in Iran, a study conducted by Siddiqi, (2011) to describe the associated risk factors among children under the age of five showed that malnutrition and a study Ayaya, et al, (2004) to determine the social and economic factors that predisposed children under three years to severe PEM in Kenya was significantly associated with the female gender. However, (Kavosi, et al, 2014 and Mahgoub, et al, 2006) studies conducted in Iran and Botswana respectively indicated that the male gender was significantly

associated with malnutrition. This observation is not confirmed by the findings of this study. The differences observed across studies in regard to the relationship between gender and the child's nutritional status may indicate that gender is not a biological factor in malnutrition, but that there may be other gender-related social or cultural factors that affect a child's growth.

6.2.6   UNICEF conceptual framework analysis

For all the contributing factors to severe acute malnutrition among children aged below five years in Francistown, Botswana; child born with a low birth weight, appetite and child illness among the child characteristics can be classified according to the framework as immediate determinants because these factor are manifested at the level of the individual human-being. Being small for age might affect nutritional absorption by the body leading to inadequate nutrient supply in the body and child illness might cause reduced appetite leading to inadequate dietary intake and thus the cycle goes on.
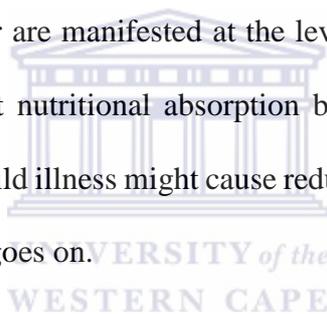
The underlying determinants in this study among the child characteristics were; the child not exclusively breastfed for at least three months and growth chart not up to date. The underlying determinants among care-giver characteristics are; education level, employment status and alcohol consumption. The underlying determinants among house hold characteristics were; food availability, type of housing, owning a tap and number of children under the age of five years. For the primary health care characteristics the availability of food supplies was an underlying factor. These are often referred to as 'food', 'care' and 'health' factors (Black et al, 2008) and education has been added among these factors. These factors manifest themselves at household level i.e. food insecurity, inadequate care, lack of education, unhealthy household environment and lack of health services (UNICEF, 1998).

The basic causes of malnutrition refers to potential resources available (human, structural and financial) and how they are utilised (the political, legal and cultural factors) (UNICEF, 1998). These factors ultimately affect all the other determinants in this study.

7   Conclusion

It is well known that cases of severe acute malnutrition are high in developing countries. Although the prevalence of SAM among children under the age of five years in the study area was lower than some reported elsewhere, binary logistic regression analysis confirmed that child characteristics such as being born with a low birth weight, not being breastfed for at least the first three months of life, child illness and growth chart not up to date were contributing factors. Care-giver characteristics which were identified as determinants included mother being HIV positive, unemployment, none and primary education level and alcohol consumption. Household characteristics which were associated with SAM were food availability, mud house type, not owning a tap, refuse not collected by the relevant authority and having more than one child below the age of five years. These contributing factors make up the immediate causes which operate at the individual level, underlying causes influencing household and communities and the basic causes which are around the structure and processes of the society.

According to the stepwise binary logistic regression analysis, house type, alcohol consumption, having more than one under five children, growth chart status and exclusive breastfeeding for at least three months were the most significant determinants of SAM in this study. The analysis concluded that staying in a mud house type was the most crucial factor and not being exclusively breastfed was the least important of these five factors. However, these findings might be due to the effect of other variables (confounding) because staying in a mud house and

alcohol consumption are not directly linked to child nutrition and not being exclusively breastfed for at least three months is a direct link to child care practices and child nutrition.

Despite the decreased trend of severe acute malnutrition in the last years, still malnutrition must be considered as a public problem because of its major effect on morbidity and mortality of children and impairment of intellectual and physical development in long term.

The above findings are expected to update knowledge of health practitioners about possible causes of severe acute malnutrition among children under five years and help policy planners to design and implement nutritional and health promotion policies in Francistown, Botswana to improve child nutritional status.

8 Limitations

Although the study has provide important information on the factors that could influence severe acute malnutrition among children aged below five years in Francistown, Botswana, this study has a number of limitations.

This was a case-control study which means it could not establish the correct temporal relationship between exposure and disease. The study did not assess all the potential factors that could explain the differences between this study and those of other studies conducted on the same topic but in different settings. A large sample of participants could not be obtained due to time constraints. This could explain the wide confidence intervals observed for some of the variables such as growth chart status (AOR = 7.680; 95 % CI = 1.631-36.157). Some

variables affected the outcome of other variables which might have led to variables appearing to be significantly associated with SAM (confounding).

The study relied on care-givers self-reported data which is prone to recall bias and social desirable bias whereby care-givers provide non-true statements to some questions. In a case-control study, recall bias is a common form of information bias and social desirable bias occurs when participants respond to particular questions by providing answers that they consider to be the most desirable or least stigmatizing rather than answering with complete honesty (Joubert & Ehrlich, 2007).

9   Recommendations
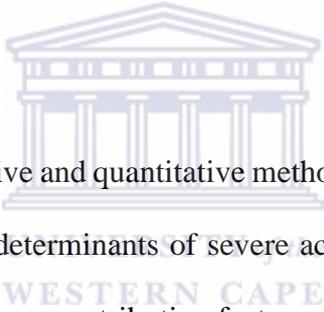
-Another study using both qualitative and quantitative methods should be conducted to identify the confounding variables to the determinants of severe acute malnutrition and establish the correct temporal relationship between contributing factors and SAM.

Measures to improve severe acute malnutrition recognition by health care workers responsible for the first evaluation of children at the Child welfare clinic level is urgently needed so as to improve early identification, management and treatment of childhood malnutrition. In view of this study, there is a need to plan current, efficient and equitable strategies and preventive public policies based on the public regional specific risk factors to alleviate severe acute malnutrition. Certain factors and possible causes of SAM are complex and involve societal and broad based preventive programs.

-A healthy mother can give birth to healthy children therefore the intervention programs for improving the nutritional status of children must focus not only on children but also on their mothers. Efforts should therefore be made to improve maternal education and women empowerment, through provision of child care information at the clinics and during home visits.

-Involvement of the community, NGO's and use of media mass communication with coverage of necessary health care information may prove to be useful in improving nutritional status.

-The associated factors identified for SAM in this study can be incorporated into the design and targeting of preventive interventions. Factors such as breastfeeding practices are potentially modifiable by delivering interventions that motivate behaviors more consistently with recommended feeding practices, with emphasis on the importance of proper infant and young child feeding practices. This would be expected to have a positive impact.
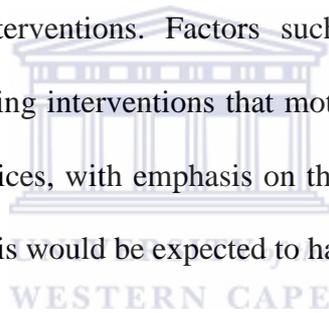
-Health education should be reinforced at Child welfare clinics, health facilities and community level to improve care-givers' knowledge of the recommended infant and child feeding practices. Education enhances knowledge and equips with decision-making power.

-There is a need for national and international organizations and public health officials to continue embarking on women empowerment programs to eradicate poverty among women, which would have a positive impact on the nutritional and health well-being of children.

-The government of Botswana and Francistown local authorities should provide more job opportunities for women to reduce unemployment rate, which leads to families staying in house

types which may not be suitable for the health of children and ultimately drives to child malnutrition.

-The Botswana government should ensure continuous provision of supplementary food supplies to all children under five years of age by ensuring that the supplying companies' contracts are renewed well in time before they end.

All in all, combined efforts by government, non-governmental organizations and the community is essential to improve the nutritional status of children.

10 REFERENCES

Amsalu, S., & Tigabu, Z. (2006). Risk factors for severe acute malnutrition in children under the age of five: A case control study. *Ethiopian Journal of Health Development, 22*(1), 21-25.

Armstrong, J., & Reilly, J. J. (2002). Breastfeeding and lowering the risk of childhood obesity. *The Lancet*, *359*(9322), 2003-2004.

Ayaya, S. O., Esamai, F. O., Rotich, J., & Olwambulwa, O. R. (2004). Socioeconomic factors predisposing under five-year-old children to severe protein energy malnutrition at the Moi Teaching and Referral Hospital, Eldoret, Kenya. *East African Medical Journal,* 81(8), 414-421.

Babantunde, R. O., Olagunju, F. I., Fakayodi, S. B., & Sola-ojo, F. E. (2011). Prevalence and determinants of malnutrition among under-five children of farming households in Kwara State, Nigeria. *Journal of Agricultural Science*, 3(3), 173-181.

Bain, L. E., Awah, P. K., Geraldine, N., Kindong, N. P., Sigal, Y., Bernard, N., & Tanjeko, A.T. (2013). Malnutrition in Sub–Saharan Africa: burden, causes and prospects. *The Pan African Medical Journal*, 15:120.

Barrett, C. B. (2010). Measuring food insecurity. *Science,* 327(5967), 825-828.

Bell, J. (2005). Doing your research project: A guide for first-time researchers in education, health and social sciences (*4th Ed*.). Mc Graw-Hill house: Open press University.

Bizouerne, C. (2012). Conceptual models of child malnutrition: The ACF approach in mental health and care practices.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., ... & Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *The lancet*, *371*(9608), 243-260.

Black, R. E., Morris, S. S., & Bryce, J. (2003). Where and why are 10 million children dying every year? *The Lancet*, *361*(9376), 2226-2234.

Botswana Central Statistics Office. 2009. *2007 Botswana Family Health Survey IV Report*. Gaborone: CSO & UNICEF.

Brown, I. (2013). The pathology of malnutrition and malabsorption, in Morson and Dawson's gastrointestinal pathology *(5ᵗʰ E.d.)*. Shepherd, N. A., Warren, B. F., Williams, G. T., Greenson, J. K., Lauwers, G. Y., & Novelli, M. R. (Eds). Wiley-Blackwell, Oxford, UK.

Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., Fun, I. CH., & Schmidt, W-P. (2010). Water, Sanitation and Hygiene for the Prevention of Diarrhea. International Journal of Epidemiology, 39, i193–i205.

Checkley, W., Gilman, R. H., Black, R. E., Epstein, L. D., Cabrera, L., Sterling, C. R., & Moulton, L. H. (2004). Effect of water and sanitation on childhood health in a poor Peruvian Peri-Urban community. *The Lancet;* 9403(363), 112-118.

Cherry, K. (2014). Available (Online *psychology.about.com*). Accessed (06/06/2014).

Collins, S., Dent, N., Binns, P., Bahwere, P., Sandler, K., & Hallam, A. (2006). Management of severe acute malnutrition in children. *Lancet, 368*, 1992-2000.

Conklin, J. (2006). Dialogue mapping: building shared understanding of wicked problems. Chichester, England: Wiley Publishing.

Corware, K., Yardley, V., Mack, C., Schuster, S., Al-Hassi, H., Herath, S., … et al. (2014). Protein energy malnutrition increases arginase activity in monocytes and macrophages. Nutrition & Metabolism. 11(1). [Medline].

Creek, T. L., Kim, A., Lu, L., Bowen, A., Masunge, J., Arvelo, W., Smith, M., Mach, O., Legwaila, K., Motswere, C., Zaks, L., Finkbeiner, T., Povinelli, L., Maruping, M., Ngwaru, G., Tebele, G., Bopp, C., Puhr, N., Johnston, S., Dasilva, A., Bern, C., Beard, R. S., & Davis, M. K. (2010). Hospitalization and mortality among primarily nonbreastfed children during a large

outbreak of diarrhea and malnutrition in Botswana, 2006. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *53*(1), 14-19.

Creswell, J. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research (4th Ed.).* Upper Saddle River, NJ: Pearson Education.

David, A. (2009). Statistical Models: Theory and Practice. Freedman. Cambridge University Press.

Delpeuch, F., Traissac, P., Martin-Prével, Y., Massamba, J. P., & Maire, B. (2000). Economic crisis and malnutrition: socioeconomic determinants of anthropometric status of preschool children and their mothers in an African urban area. *Public health nutrition*, 3(01), 39-47.

De Onis, M., & Blössner, M. (1997). WHO global database on child growth and malnutrition. WHO/NUT/97.4. World Health Organization, Geneva.

El-Sayed, N., Mohamed, A. G., Nofal, L., Mahfouz, A., & Zeid, H. A. (2001). Malnutrition among Pre-school Children in Alexandria, Egypt. *Journal of Public Health Nutrition,* 19(4), 275-280.

Engle, P. L., Menon, P., & Haddad, L. (2000). Care and Nutrition: Concepts and Measurements. *World Development*, 27(8), 1309-1337.

Fabiansen, C., Christensen, V. B., Eklund, M., Michaelsen, K. F. & Friis, H. (2010). Sever acute malnutrition in children. Ugeskrift for laeger, 39(173), 2671-2674.

FAO Food security: http://www.fao.org/organicag/ofs/index_en.htm Accessed 31 May 2015.

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, l., & Colford Jr, J. M. (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: A systematic review and meta-analysis. *Lancet Infectious Disease*, *5, 42-52.*

Fontell, J., & Vince L. (2011). "Sustainable Efforts to Eradicate Global Hunger, Undernourishment and Malnutrition." *Journal of Global Business Issues*. Retrieved August 03, 2015 from High-Beam Research: http://www.highbeam.com/doc/1P3-2610095461.html

Frankfort-Nachmias, C., & Leon-Guerrero, A. (2006). Social Statistics for a Diverse Society. Thousand Oaks, CA: Pine Forge Press.

Frankenberger, T. R. (1996). *Measuring household livelihood security: An approach for reducing absolute poverty*. Food forum, No. 34. November- December 1996. Washington, D.C. Food Aid Management.

Fuchs, C., Sultana, T., Ahmed, T., & Hossain, I. (2014). Factors associated with acute malnutrition among children admitted to a Diarrhoea Treatment Facility in Bangladesh. *International Journal of Paediatrics*, 1-5.

Golden, B. E. Corbet, M., Mc Burney, R., & Golden, M. H. (2000). Current issues in tropical paediatric infectious diseases, malnutrition: trials and triumphs. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 94, 12-23.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., & International Child Development Steering Group. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet,* 369(9555), 60-70.

Griffiths, P., Madise, N., Whitworth, A., & Matthews, Z. (2004). A tale of two continents: A multilevel comparison of the determinants of child nutritional status from selected African and Indian regions. *Health and Place*, 10, 183-199.

Gross, R., & Webb, P. (2006). Wasting time for wasted children: Severe child undernutrition must be resolved in non-emergency settings. *The Lancet*, 367, 1209-1211.

Hadley, C., & Patil, C. L. (2008). Seasonal changes in household food insecurity and symptoms of anxiety and depression. *American Journal of Physical Anthropology*, 135(2), 225-232.

Hailemariam, T. W. (2014). Prevalence of underweight and its determinant factors of under two children in a rural area of Western Ethiopia. Food Science and Quality Management, (31), 59-69. www.iiste.org

Harmonized training package: Resource material for training on nutrition in emergencies. Understanding malnutrition; module 3 and 5. (n.d). http://www.unicef.org/nutrition/training/ Accessed 20 June 2015.

Heaton, T. B., & Forste, R. (2003). Rural/urban differences in child growth and survival in Bolivia. *Rural Sociology*, 68(3), 410.

Hein, N. N., & Hoa, N. N. (2009). Nutritional status and determinants of malnutrition in children under three years of age in Nghean, Vietnam. *Pakistan Journal of Nutrition, 8*, 958-964.

Hosmer, D. W., & Lemeshow, S. (2000). Applied Logistic Regression *(2nd E.d.)*. New York, NY: John Wiley & Sons.

Ijarotimi, O. S. (2013). Determinants of childhood malnutrition and consequences in developing countries. Department of Food Science and Technology. *Current Nutrition Report*, 2: 129-133.

International Food Policy Research Institute. (2014). *Global Nutrition Report 2014: Actions and Accountability to Accelerate the World's Progress on Nutrition*. Washington, DC.

Joubert, G., & Ehrlich, R (Eds.). (2007). *Epidemiology: A research manual for South Africa (2ⁿᵈ Ed.)*. Cape Town: Oxford University Press.

Kadima, Y. E. (2012). Factors influencing malnutrition among children under five years of age in Kweneng West District of Botswana. Available (Online unisa.ac.za). Accessed (10/06/2014).

Kaneshiro NK, Zieve D. Kwashiorkor. (2010). *Public Medical Health*. Available at http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0002571. Accessed (20/11/15).

Kavosi, E., Rostami, Z. H., Kavosi, Z., Nasihatkon, A., Moghadami, M., & Heidari, M. (2014). Prevalence and determinants of under-nutrition among children under six: A cross-sectional survey in Fars province, Iran. *International Journal of Health Policy and Management*, 3(2), 71-76.

Kikafunda, J. K., Walker, A. F., Collett, D., & Tumwire, J. K. (1998). Risk factors for early childhood malnutrition in Uganda. *Pediatrics, 102*(4), 45.

Kinyoki, D. K., Berkley, J. A., Moloney, G., Kandala, N-B., & Noor, A. M. (2015). Predictors of the risk of malnutrition among children under the age of five years in Somalia. *Public Health Nutrition*, 1-9.

Kwashiorkor (Pathology). Britannica Online Encyclopaedia. Available at http://www.britannica.com/EBcheck/topic/325852/kwashiorkor. Accessed (18/11/15).

Larrea, C., & Kawachi, I. (2005). Does economic inequality affect child malnutrition? The case of Ecuador. *Social Science & Medicine*, 60, 165-178.

Kwashiorkor. Columbia Electronic Encyclopaedia. 6th ed. 2010. Available at http://web.ebscohost.com.libproxy.bellarmine.edu.ehost. Accessed (18/11/15).

Last, J. M (Ed.). (2000). A dictionary of epidemiology. Oxford University Press.

Lewallen, S., & Courtright, P. (1998). Epidemiology in practice: Case-control studies. *Community Eye Health*, *28*(11), 57-58.

Lim, S. S., T. Vos, A. D. Flaxman, G. Danaei, K. Shibuya, H. Adair-Rohani, M. Amann, …et al. (2012). "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet,* 380 (9859): 2224–2260.

Lin, C. A., Boslaugh, S., Ciliberto, H. M., Maleta, K., Ashorn, P., Briend, A., & Manary, M. J. (2007). A prospective aspect of food intake in a population of Malawian children at risk of kwashiorkor. *Journal of Paediatric Gastroenterology and Nutrition*, 44, 487-493.

Liu, T., Howard, R. M., Mancini, A. J., Weston, W. L., Paller, A. S., Drolet, B. A., ... & Frieden, I. J. (2001). Kwashiorkor in the United States: fad diets, perceived and true milk allergy, and nutritional ignorance. Archives of dermatology, 137(5), 630-636.

Lopez, A. D., Mathers, C. D., Ezzati, M., Jamison, D. T., & Murray, C. J. (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *The Lancet*, *367*(9524), 1747-1757.

Madondo, A., MacIntyre, U. E., & Ntuli, B. (2012).The clinical and anthropometric profile of undernourished children aged five admitted to Nyangabgwe Referral Hospital in Botswana. South African Journal of Child Health, 6(4), 123-127.

Mahgoub, S. E. O., Nnyepi, M. S., & Bandeke, T. (2006). Factors affecting prevalence of malnutrition among children under three years of age in Botswana. *African Journal of Food Agriculture Nutrition and Development, 6*(1), 1-16.

Makepe, M. P., Kebakile, P. I. N. K. I. E., Batsetswe, L. E. T. S. O. G. I. L. E., Mmopelwa, D. A. V. I. D., Mbaiwa, K. E. L. E. S. W. E. T. S. E., & Jackson, J. O. S. E. (2008). The feasibility of mandatory fortification of cereals in Botswana. LightBooks. (Accessed 18/09/2015).

Mann, C. J. (2003). Observational research methods. Research design II: cohort, cross-sectional, and case-control studies. *Emergency Medical Journal*, 20, 54-60.

Masiye, F., Chama, C., Chita B., & Jonsson, D. (2010). Determinants of child nutritional status in Zambia: An analysis of a national survey. *Zambia Social Science Journal*, 4(1), 29-42.

Mboho, M., & Bassey, R. (2013). Mothers' variables as determinants of nutritional status of children 0-5 years in Nsit Ibom local government area of Akwa Ibom State, Nigeria. *Academic Research International*, 5(4), 187-198.

McDonald, J. H. (2014). Handbook of biological statistics *(3rd E.d).* Sparky House Publishing, Baltimore, Maryland.

Mertens, D. M. (2010). Research and evaluation in research and psychology: Integrating diversity with quantitative, qualitative and mixed methods (3rd Ed.). United States of America. SAGE publications, Inc.

Mizumoto, K., Takahashi, T., Kinoshita, Y., Higuchi, M., Bachroen, C., & Da Silva, V. (2015). A qualitative study of risk factors related to child malnutrition in Aileu district, Timor-Leste. *Asia-Pacific Journal of Public Health*, *27*(2).

Muhammad, B., Muhammad, T. A., & Muhammad, A. (2008). Reliability and validity of Quantitative and operational research paradigm. *Pakistan Journal of Statistics and Operational Research, 4*(1), 35-45.

Murray, C. J., & Lopez, A. D. (1996). Evidence-Based Health Policy---Lessons from the Global Burden of Disease Study. *Science*, *274*(5288), 740-743.

Nhampossa, T., Sagaŭque, B., Machevo, S., Macete, E., Alonso, P., Bassat, Q., Manėndez, C., & Fomadŏ, B. (2013). Severe malnutrition among the children under the age of five years admitted to a rural district hospital in southern Mozambique. *Public Health Nutrition,* 16(9), 1565-1574.

Oldewage-Theron, W. H., Dicks, E. G., & Napier, C. E. (2006). Poverty, household food insecurity and nutrition: Coping strategies in an informal settlement in the Vaal Triangle, South Africa', *Public Health* 120, 795–804.

Pelletier, D. L. (2002). Towards a common understanding of malnutrition: Assessing the contribution of the UNICEF framework. World Bank/UNICEF.

Pérez-Escamilla, R., & Segall-Corrêa, A. M. (2008). Food insecurity measurement and indicators. *Revista de Nutriçao*, 21, 15s-26s.

Pongou, R., Ezzati, M., & Salomon, J. A. (2006). Household and community socioeconomic and environmental determinants of child nutritional status in Cameroon. *BioMed Central Public Health*, 98(6).

Rabinowitz, S. S., Gehri, M., Di Paolo, E. R., & Wetterer, N. M. (2014).Marasmus: background, pathophysiology, body composition. [Medscape]. Retrieved at http://emedicine.medscape.com/article/984496-overview#a7 (Accessed on 18/11/15).

Rayhan, M. I., & Khan, M. S. H. (2006). Factors causing malnutrition among under five children in Bangladesh. *Pakistan Journal of Nutrition, 6*(5), 558-562.

Rice, A. L., Sacco, L., Hyder, A., & Black, R. E. (2000). Malnutrition as an underlying cause of childhood deaths associated with infectious disease in developing countries. *Bulletin of WHO, 78*(10), 1207-1221.
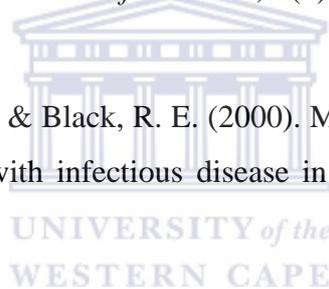
Resnik, D. B. (2010). What is ethics in research and why is it important? NIEHS. http://www.niehs.nih.gov/research/resources/bioethics/whatis.cfm

Ruel, M. T., Menon, P., Habicht, J. P., Loechl, C., Bergeron, G., Pelto, G., ... & Hankebo, B. (2008). Age-based preventive targeting of food assistance and behaviour change and communication for reduction of childhood undernutrition in Haiti: a cluster randomised trial. *The Lancet,* 371(9612), 588-595.

Rumsey, D. J. (2011).Statistics for dummies *(2ⁿᵈ E.d.).* John Wiley & Sons.

Sapsford, R. (2005). Survey research. London. SAGE publications, Inc.

Scrimshaw, N. S., & Viteri, F. E. (2010). INCAP studies of kwashiorkor and marasmus. *Food and Nutrition Bulletin*. 31(1):34-41. [Medline].

Shafqati, N., Manzoor, S., & Abbasi, S. (2013). Relationship of sociodemographic factors with malnutrition in preschool children: A community based study. *Pakistan Journal of Medical Research,* 52(4), 120-125.

Shargi, A., Kamran, A., & Faridan, M. (2011). Evaluating risk factors for protein- energy malnutrition in children under the age of six years. *International Journal of General Medicine, 4*, 607-611.

Shashidhar, H. R., & Grigsby, D. G. (2009). Malnutrition. Accessed 30 March 2015, from http://emedicine.medscape.com/article/985140-overview#aw2aab6b2b2

Shekar, M. (2006). World Bank Publications. Repositioning nutrition as central to development: A strategy for large-scale action.

Shields, P., & Rangarjan, N. 2013. A Playbook for Research Methods: Integrating Conceptual Frameworks and Project Management. Stillwater, OK: New Forums Press.

Siddiqi, N. A., Haque, N., & Goni, A. (2011). Malnutrition of under-five children: Evidence from Bangladesh. *Asian Journal of Medical Sciences*, (2), 113-119.

Smith, L. C., & Haddad, L. (2000). Explaining child malnutrition in developing countries: A cross-country analysis. International Food Policy Research Institute: Food consumption and nutrition division. FCND. Paper NO. 60.

Smith, L. C., El Obeid, A. E., & Jensen, H. H. (2000). The Geography and Causes of Food Insecurity in Developing Countries. Agricultural Economics, 22, 199-215.

Spoelstra, M. N., Mari, A., Mendel, M., Senga, E., van Rheenen, P., van Dijk, T. H.… et al. (2012). Kwashiorkor and marasmus are both associated with impaired glucose clearance related to pancreatic ß-cell dysfunction. Metabolism. [Medline].

Statistics Botswana. (2011). Preliminary results of the 2011 population and housing census.

Stedman's Medical Dictionary. (2005). *Illustrated in colour (28th Ed.).*

Swart, R., Sanders, D., & McLachlan, M. (2008). Nutrition: a Primary Health Care perspective: Primary Health Care: programme areas. *South African health review*, 129-147.

Szumilas, M. (2010). Explaining Odds Ratios. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *19*(3), 227–229.

Tharakan, C., & Suchindran, C. (1999); Determinants of Child Malnutrition- an Intervention Model for Botswana. *Nutrition Research,* 19 (6), 843-860.

The American Heritage Dictionary of English language *(5th Ed.).* (2011).

The Food and Agriculture Organization of the United Nations. (2011). The State of Food Insecurity in the World: How does international price volatility affect domestic economies and food security. FAO. Canada.

The International Conference on Nutrition (ICN). (1992). http://www.fao.org/docrep/v7700t/v7700t02.htm Accessed 28/09/14.

The International Bank for Reconstruction and Development /World Bank. (2008). World development report: Agriculture for development.

The International Bank for Reconstruction and Development /World Bank. (2012). Global monitoring report: Food Prices, Nutrition, and the Millennium Development Goals.

The International Conference on Nutrition (ICN). (1992). http://www.fao.org/docrep/v7700t/v7700t02.htm Accessed 28/09/14.

Turner, K. G (20050821)., Nielsen, M. K (20040923)., & Madsen, og E. L (20002455). (n.d). Causes of Undernutrition in Children under five in the Case of Sierra Leone.

Twycross, A. (2004). Validity and reliability: What's it all about? Part 1 validity in quantitative studies. *Pediatric Nursing, 16*(9), 28.

UNICEF. (1998). *The state of the world's children*. Focus on Nutrition. Oxford University Press, Oxford.

UNICEF. (2006). *Tracking the progress of child malnutrition.* Available http://www.unicef.org/progressforchildren/2006n4/malnutritiondefinition.html. Accessed 17/06/2014.

UNICEF. (2008). http://www.unicef.org/infobycountry/sierraleone.html Accessed 05 May 2015.

UNICEF. (2009). *Tracking Progress on child and maternal nutrition*: A survival and development priority. http://www.unicef.org/publications/index_51656.html Accessed 30 June 2015.

UNICEF. (2011). *Botswana annual report*. Child nutrition situation in Botswana: Observations from 2000-2007 household survey.

UNICEF-Botswana. (2012). *Indicators of child well-being in Botswana between 2001 and 2008.*Thari ya bana: Ref1. Gaborone. UNICEF.

UNICEF. (2014). Measuring the burden of severe acute malnutrition: Current challenges. http://globalnutritionreport.org/the-report/ Accessed 25/03/15.

United Nations (UN). *Botswana Millennium development goals (2010): Status report*. UN house. UN office. Gaborone, Botswana

United Nations Children's Fund, World Health Organization, World Bank. UNICEFWHO-World Bank Joint Child Malnutrition Estimates. (2012). UNICEF, New York; WHO, Geneva; World Bank, Washington, DC.

Velasco, E. (2010). Encyclopaedia of research design. SAGE publications, Inc.

Victoria, C. G., Adair, L., Fall, C., Hallal, P. C., Martorell, R., Richter, L., … for the Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: consequences for adult health and human capital. *Lancet*, *371*(9609), 340–357. http://doi.org/10.1016/S0140-6736(07)61692-4

Vos, T., Flaxman, A. D., Naghavi, M., Lozano, R., Michaud, C., Ezzati, M., Shibuya, K., …et al. (2012). "Years Lived with Disability (YLDs) for 1160 Sequelae of 289 Diseases and Injuries 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010."

Walker, S. P., Wachs, T. D., Gardner, J. M., Lozoff, B., Wasserman, G. A., Pollitt, E., Carter, J. A., & The international child development steering group. (2007). Child development in developing countries. *Lancet,* 369: 145-57.

Waters, H. R., Penny, M. E., Creed-Kanashiro, H. M., Robert, R. C., Narro, R., Willis, J., ... & Black, R. E. (2006). The cost-effectiveness of a child nutrition education programme in Peru. *Health Policy and Planning*, 21(4), 257-264.

Webb, P., Coates, J., Frongillo, E. A., Rogers, B. L., Swindale, A., & Bilinsky, P. (2006). Measuring household food insecurity: why it's so important and yet so difficult to do. *The journal of nutrition*, 136(5), 1404S-1408S.

World Bank. (2011). *Early childhood development.* Available (Online http://go.worldbank.org/BJA2BPVW91). Accessed 31/05/2014.

World Bank. (2014). Nutrition country profile. http://www.worldbank.org/en/topic/health/publication/nutrition-country-profiles Accessed 14 July 2015.

1. WFP. World Food Summit in Rome. 1996. WFP. Rome. PubMed | Google Scholar.

WHO. Child growth standards. Arm circumference for age. Available at: http://www.who.int/childgrowth/standards/ac_ for_age/en/index.html.

WHO Food security. Available at: http://www.who.int/trade/glossary/story028/en/ Accessed 12 June 2015.

World Health Organization (WHO). (1997). *WHO global database on child growth and malnutrition: Programme of nutrition.* WHO document No. WHO/NUT/97.4. Geneva.

World Health Organization (WHO). (1999). *Management of severe malnutrition: A guide for physicians and other senior health workers*. Geneva.

World Health Organization (WHO). (2013). *Global database on child growth and malnutrition.*

11 APPENDICES

APPENDIX A: OpenEpi sample size calculation

OpenEpi sample size calculation for cases and controls

NB: This study refers to the sample calculated using method of Kelsey.

Sample Size for Unmatched Case-Control Study

For:

Two-sided confidence level(1-alpha)	95
Power(% chance of detecting)	80
Ratio of Controls to Cases	2
Hypothetical proportion of controls with exposure	40
Hypothetical proportion of cases with exposure:	61.54
Least extreme Odds Ratio to be detected:	2.40

	Kelsey	Fleiss	Fleiss with CC
Sample Size - Cases	64	63	70
Sample Size – Controls	127	125	139
Total sample size:	191	188	209

References

Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15

Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19

CC = continuity correction

Results are rounded up to the nearest integer.

Print from the browser menu or select, copy, and paste to other programs.

Results from OpenEpi, Version 3, open source calculator—SSCC.

APPENDIX B: UWC-Ethical clearance letter

OFFICE OF THE DEAN
DEPARTMENT OF RESEARCH DEVELOPMENT

UNIVERSITY *of the*
WESTERN CAPE

07 April 2015

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape approved the methodology and ethics of the following research project by:
Ms A Piniel (Social Work)

Research Project:	Factors contributing to severe acute malnutrition among the under five children in Francistown, Botswana.
Registration no:	14/10/54

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

APPENDIX C: MOH-Botswana permission granting letter

TELEPHONE: 363 2766
FAX: 391 0647
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

MINISTRY OF HEALTH
PRIVATE BAG 0038
GABORONE

Republic of Botswana

REFERENCE NO: PPME 13/18/1 PS V (350)   20 May 2015

Health Research and Development Division

Notification of IRB Review: New application

Abigail Piniel
Private Bag X17
Bellville 7535
South Africa

Protocol Title: **FACTORS CONTRIBUTING TO SEVERE
                                          MALNUTRITION AMONG THE UNDER
                                          FIVE CHILDREN IN FRANCISTOWN,
                                          BOTSWANA REGISTRATION NUMBER**

HRU Approval Date: 19 May 2015
HRU Expiration Date: 18 May 2016
HRU Review Type: HRU reviewed
HRU Review Determination: Approved
Risk Determination: Minimal risk

Dear Sir/Madam

Thank you for submitting new application for the above referenced protocol. The permission is granted to conduct the study.

This permit does not however give you authority to collect data from the selected sites without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health within 3 months of completion of the study.

1

Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

Continuing Review
In order to continue work on this study (including data analysis) beyond the expiry date, submit a Continuing Review Form for Approval at least three (3) months prior to the protocol's expiration date. The Continuing Review Form can be obtained from the Health Research Division Office (HRDD), Office No. 7A.7 or Ministry of Health website: www.moh.gov.bw or can be requested via e-mail from Mr. Kgomotso Motlhanka, e-mail address: kgmmotlhanka@gov.bw As a courtesy, the HRDD will send you a reminder email about eight (8) weeks before the lapse date, but failure to receive it does not affect your responsibility to submit a timely Continuing Report form

Amendments
During the approval period, if you propose any change to the protocol such as its funding source, recruiting materials, or consent documents, you must seek HRDC approval before implementing it. Please summarize the proposed change and the rationale for it in the amendment form available from the Health Research Division Office (HRDD), Office No. 7A 7 or Ministry of Health website: www.moh.gov.bw or can be requested via e- mail from Mr. Kgomotso Motlhanka, e-mail address: kgmotlhanka@gov.bw . In addition submit three copies of an updated version of your original protocol application showing all proposed changes in bold or "track changes".

Reporting
Other events which must be reported promptly in writing to the HRDC include:
• Suspension or termination of the protocol by you or the grantor
• Unexpected problems involving risk to subjects or others
• Adverse events, including unanticipated or anticipated but severe physical harm to subjects.

If you have any questions please do not hesitate to contact Mr. P. Khulumani at pkhulumani@gov.bw, Tel +267-3914467 or Lemphi Moremi at lamoremi@gov.bw or Tel: +267-3632754. Thank you for your cooperation and your commitment to the protection of human subjects in research.

Yours faithfully

P. Khulumani
For Permanent Secretary

MINISTRY of HEALTH **Vision**: *Model of Excellence in Quality Health Services*
Values: *Botho, Equity, Timeliness, Customer Focus, Teamwork, Accountability*

BOTSWANA

2

143

APPENDIX D: NRH-permission granting letter

Telephone : +2672411000
Fax : +2672416706

Republic of Botswana

Nyangabgwe Hospital
Private Bag 127
Francistown

Ethical Review of Proposed Study: Factors Contributing To Severe Malnutrition among The Under Five Children In Francistown, Botswana

Name of Applicant: Abigail Pintel
Private Bag X17
Bellville 7535
South Africa

Name of Site: Nyangabgwe Referral Hospital
Decision: **Approved**
Date of Decision: 08 June 2015
Expiry Date: 18 May 2016
Risk Determination: Minimal risk

The Institutional Review Board (Research and Ethics Committee) For Human Subjects Research of Nyangabgwe Hospital is pleased to inform you that the research protocol was approved.

The study involves collection of data at Nyangabgwe Hospital; no more than minimal risk. It is a non therapeutic research and doesn't involve the use of devices for which there is limited knowledge.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Hospital Research and Ethics Committee. In addition you are expected to submit at least one hard copy and an electronic copy of the report to the committee within three months of completion of the study.

Signed: ...

Dr. M. Katengua
Chairperson
Research and Ethics Committee)

144

Appendix E: GF-DHMT-permission granting letter

GREATER FRANCISTOWN DHMT

ALL CORRESPONDENCE TO
BE ADDRESSED TO DHMT
COORDINATOR

PRIVATE BAG F372
FRANCISTOWN BOTSWANA
TELEPHONE: 2413808
FAX: 2406178

Republic of Botswana

REF: GFHMT 1/14 III   DATE: 28th May 2015

TO: Abigail Piniel

Dear Sir/Madam

PERMISSION TO CONDUCT RESEARCH STUDY WITH CARE TAKERS OF CHILDREN UNDER THE AGE OF FIVE IN CLINIC AROUND FRANCISTOWN

Reference is made to your request letter on the above mentioned subject.

This letter serves to inform you that your request to conduct the above mentioned research in the Greater Francistown health facilities has been acceded to.

Thank you.

Yours faithfully

Dr A.T.Kalonji
For Greater Francistown DHMT Coordinator

APPENDIX F: Information sheet

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959, Fax: 27 21-959

Email: rswart@uwc.ac.za

<u>**INFORMATION SHEET**</u>

Project Title: <u>Factors contributing to severe acute malnutrition among under-five children in Francistown, Botswana.</u>

What is this study about?

This is a research project being conducted by Ms. Abigail Piniel at the University of the Western Cape. We are inviting you to participate in this research project because you meet the inclusion criteria for this study. The purpose of this research project is to establish the contributing factors to severe acute malnutrition among the under five children in the community of Francistown, Botswana.

What will I be asked to do if I agree to participate?

You will be asked to participate in a face-to-face structured interview which will be conducted in the hospital for the cases and at home for the controls. The interview will take about 20 minutes. The interview questions will try to obtain information on the circumstances of the child.

Would my participation in this study be kept confidential?

Your personal information will be kept private and confidential. To help protect your confidentiality, your name will not be included on the questionnaires and other collected data.

146

A coding system will be used on the questionnaires and other collected data. The researcher will be able to link your survey to your identity through the use of codes known by the researcher only. The information collected from you will be kept under lock and key cabinet and only be accessible to the researcher. A password protected computer will be used to enter your data. If we write a report or article about this research project, your identity will be protected to the maximum extent possible.

What are the risks of this research?

You may experience minimal risks such as the interview taking longer than anticipated and/or experience some discomfort from some of the questions during the interview process. Should you experience any discomfort please feel free to inform the researcher who will arrange for a referral to the counselling department or a relevant clinic.
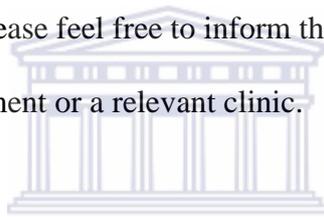
What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about the possible risk factors to severe acute malnutrition in children under the age of five in Francistown, Botswana. We hope that, in the future, other people might benefit from this study through improved understanding of identification of malnutrition in children and improved child nutritional interventions and policies.

Do I have to be in this research and may I stop at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

If you are negatively affected by participating in this study counselling will be provided to you at no cost.

What if I have questions?

This research is being conducted by Ms. Abigail Piniel in the Faculty of Community Health Sciences, department of Social Work at the University of the Western Cape. If you have any questions about the research study itself, please contact the researcher:

Ms. Abigail Piniel

University of the Western Cape

Private Bag X17

Bellville 7535, South Africa.

Cell number: + 27 732051430

Email: piniel_a@yahoo.com.

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Head of Programme: Professor Nicky Roman

University of the Western Cape

Department of Social Work

Private Bag X17

Bellville 7535, South Africa

Tel: +27219592970/2277

Cell: +27828776691

Email: nicoletteroman@gmail.com

Dean of the Faculty of Community Health Sciences: Professor Josẻ Frantz

University of the Western Cape

Private Bag X17

Bellville 7535, South Africa

Tel: +27219592631

Email: chs-deansoffice@uwc.ac.za

This research has been approved by the University of the Western Cape's Senate Research

Committee and Ethics Committee.

APPENDIX G: Consent form

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959, Fax: 27 21-959

Email: rswart@uwc.ac.za

Consent form

Research topic: Factors contributing to severe acute malnutrition among the under five children in Francistown, Botswana.

Name of researcher: Abigail Piniel

Student number: 3417752

Position: Masters Student in Child and Family Studies, University of the Western Cape

	Tick
I confirm that I fully understand the explanation that the researcher gave me about the above study, and have had a chance to ask questions. I have read and understood the information sheet.	
I understand that the aim of the study is to investigate the factors contributing to malnutrition among the under five children in Francistown.	
I understand that the findings from this study could contribute to the development and improvement of children's nutritional interventions.	
The researcher regards the proposed study to have minimal risk to the participants and described the level of risk as low. The researcher also explained that I may receive counselling at no cost to myself, if I may experience any discomfort as a result of questions asked.	
I am fully aware that the information I will provide will remain confidential and that my personal details will not be made known.	
I understand that my participation is voluntary.	
I agree to take part in the above study.	
I disagree to take part in the above study.	

_____   _____   _____

Name of participant   Signature   Date

_____   _____   _____

Name of Researcher   Signature   Date

APPENDIX H: Study questionnaire

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27 21-959, Fax: 27 21-959

Email: rswart@uwc.ac.za

QUESTIONNAIRE

UNIVERSITY OF THE WESTERN CAPE

FACTORS CONTRIBUTING TO MALNUTRITION AMONG THE UNDER FIVE

CHILDREN IN FRANCISTOWN, BOTSWANA

Subject Identification *(circle appropriate subject):* **Case 1**　　　　**Control 2**

I.　　　**HEALTH FACILITY NAME**_____

II.　　　**CHILD INFORMATION**

1. Birth registration number _____

2. Child Welfare clinic attended_____

3. Child Welfare clinic card number_____

4. Date of birth_____

5. Age (in months)_____

6. Place of birth_____

7. Place of residence_____

8. Period of residing in the place_____

9. Gender _____

- Male =1

- Female = 2

10. Weight at birth_____

- Low birth weight (<2500grams) =1
- Normal birth weight (> or = 2500grams) =2

11. Date of admission _____

12. Diagnosis at admission _____

- Moderate malnutrition = 1
- Severe malnutrition = 2
- Control = 3

13. Has the child ever been breast-fed after birth? _____

- Yes (Breast-fed) = 1
- No (Never breast-fed) = 2
- Not sure =3

➢ Elaborate more if the answer is 2 or 3._____

_____

_____

14. How long has the child been breastfed after birth? _____

- Still currently breastfeeding =1
- 0 to 3 months = 2
- 3 to 6 months =3
- 6 months to 1year = 4
- Over 1 year = 5
- Never breastfed = 6
- Not sure = 7

➢ Elaborate if the answer is 6 or 7._____

153

_____

_____

15. Was it exclusive breastfeeding or mixed feeding? _____

- Exclusive = 1
- Mixed = 2
- Exclusive for some time then mixed = 3
- Not sure = 4

16. If exclusive for some time then mixed, how long in months was the child exclusively breastfed? _____

17. How is the child's appetite on a regular basic day? _____

- Good =1
- Satisfactory = 2
- Unsatisfactory = 3
- Not sure = 4
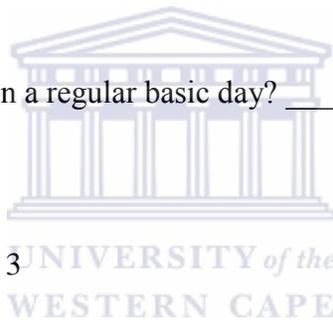
➢ Explain your answer._____

_____

_____

18. How was the immunization status by the time of admission for malnutrition for the case or the corresponding date for the control? _____

- Up to date = 1
- Not up to date = 2
- Not sure = 3

19. Did the child ever had one of the following conditions within the 2 weeks before admission for malnutrition for the case or corresponding date for the control: (cough, diarrhoea, vomiting, fever, ear problem, or any disability)? _____

- Yes = 1
- No = 2
- Not sure = 3

20. How was the vitamin A supplementation at the time of admission for malnutrition for the case or the corresponding date for the control? _____

- Up to date = 1
- Not up to date = 2
- Not sure = 3

III. ANTHROPOMETRIC INFORMATION

1. How is the child growth chart? _____

- Up to date = 1
- Not up to date = 2
- Not sure = 3
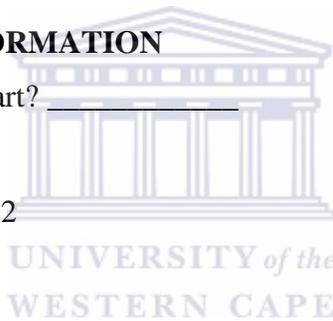
2. How many months did the case attend the Child Welfare clinic in the last six months prior to admission or the corresponding date for the control? _____

➤ If the case has missed attendance in any month state the reason(s). _____

_____

_____

_____

3. How was the weight-for height measurement for the case in at least three months prior to admission or corresponding date for the control?

- $\geq +2SD = 1$
- $\leq +2SD - 0SD = 2$
- $< 0SD - \geq 2SD = 3$
- $\leq -2SD - \geq -3SD = 4$

- $\leq$ -3SD = 5
- Not sure = 5

IV.MOTHER OR CARE-GIVER INFORMATION

1. Who is the respondent to the child? _____

   - Mother = 1
   - Care-giver = 2

2. If the care-giver, what is your relationship to the child? _____

   - Father = 1
   - Stepparent = 2
   - Grandparent = 3
   - Sibling = 4
   - Uncle / Aunt = 5
   - Cousin = 6
   - Other relative = 7
   - Not related = 8

3. If care-giver, for how long have you been taking care of the child (in months)? _____

4. If care-giver, where is the mother? _____

   - Alive and is at work = 1
   - Deceased = 2
   - Unknown = 3

5. If the mother is deceased, what was the cause of death?

   - Disease = 1

- Accident = 2
- Unknown = 3
- Non applicable = 4

6. Did the mother attend at least 3 antenatal care consultations while she was pregnant with the study participant child? _____

- Yes (attended 3 or more antenatal care consultations) = 1
- No (did not attend or attended less than 3 antenatal care consultations) = 2
- Not sure = 3

7. If yes to item 6, what was the HIV status of the mother while she was pregnant with the study participant child? _____

- Positive = 1
- Negative = 2
- Unknown = 3

8. What is your age in years at last birthday? _____

- Young age (< 21 years) = 1
- Old age (> 21 years) = 2
- Unknown = 3

9. What is your current marital status? _____

- Living alone (single or married) = 1
- Living together (married or cohabiting) =2
- Separated or divorced = 3
- Widowed = 4

10. What is your education level? _____

- None (never been at school) = 1

- Primary (at least 1 year) = 2

- Secondary (at least 1 year) = 3

- Tertiary (at least 1 year) = 4

11. What is malnutrition? _____

- Knowledgeable (able to define) = 1

- Not knowledgeable (fails to define) = 2

12. What causes malnutrition in children? _____

- Knowledgeable (gives at least one cause) = 1

- Not knowledgeable (fails to give at least one cause) = 2

13. How can you prevent malnutrition in children? _____

- Knowledgeable (give at least one preventive measure) = 1

- Not knowledgeable (fails to give at least on preventive measure) = 2

14. Which of the following is the most appropriate about the current employment of the head of your household? _____

- Unemployed =1

- Sometimes gets temporary jobs = 2

- Regular job = 3

- Self- employed = 4

- Refused employment = 5

➢ Explain your answer._____

_____

_____

15. Do you drink alcohol? _____

- Yes = 1

- No = 2

16. If yes to item 15, how often do you have a drink? _____

- Once or less in a month = 1

- 2-4 times in a month = 2

- 2-3 times per week = 3

- 4 or more times per week = 4

- Daily or almost daily = 5

17. If yes to item 15, how many drinks do you take on a typical occasion you drink? ____

- 1 or 2 = 1

- 3 or 4 = 2

- 5 or more = 3

➤ Elaborate on your answer._____

_____

_____

18. Do you smoke? _____

- Yes = 1

- No = 2

19. If yes to item 18, how many cigarettes do you smoke in a typical day?

- 3 or 5 = 1

- 6 or 10 = 2

- More than 10 = 3

- Not sure = 4

20. Do you take any other habitual drugs?

- Yes = 1

- No = 2

21. If yes to item 20, specify which habitual drug you take. _____

V. HOUSEHOLD INFORMATION

1. How many people currently live in your household? _____

2. How many children under the age of five years of age are currently living in your household? _____

3. How would you describe your household food availability? _____
    - Readily available = 1
    - Satisfactory = 2
    - Poor = 3
  ➢ Explain your answer._____
  _____
  _____

4. How much money is spent on food on monthly basis? _____
    - P 1 – P 500 = 1
    - P 501 – P 1000 = 2
    - P 1001 – P 2500 = 3
    - Over P2500 = 4
    - Not sure = 5
    - Response not given = 6

5. Did the child go to bed hungry in the month prior today?

- Yes = 1
- No = 2

6. If yes, on how many days in that month did the child go hungry?
    - < 5 = 1
    - > 5 = 2
    - Not sure = 3

7. What type of a house do you dwell in? _____
    - Brick, concrete = 1
    - Traditional mud = 2
    - Plank wood = 3
    - Other, specify = 4 _____

8. Where do you get drinking water most of the time? _____
    - Own tap = 1
    - Communal tap = 2
    - River, Dam = 3
    - Borehole, Well = 4
    - Other, specify = 5 _____

9. What type of toilet does the household have? _____
    - Flush = 1
    - Pit latrine = 2
    - Bucket/ Pot = 3
    - None = 4
    - Other, specify = 5 _____

10. How do you dispose refuse? _____

- Removed by local authorities = 1
- Refuse dump (own/ communal) = 2
- No refuse disposal = 3
- Other, specify = 4 _____

VI.PRIMARY HEALTH CARE SERVICES

1. How would you describe the reception you get from the Child Welfare clinic attended by the child? _____
   - Good = 1
   - Satisfactory = 2
   - Bad = 3
   - Not sure = 3
   ➢ Explain your answer._____
   _____
   _____

2. How often has the Child Welfare clinic attended by the child, been able to provide the necessary monthly food supplies? _____
   - Always (provide every month) = 1
   - Often (provide almost every month) = 2
   - Not too often (provide at least once every two months) = 3
   - Rarely (provide every 4 months or more) = 4
   - Never (nothing provided) = 5
   - Not sure = 6

3. If your answer for question 2 above is bullet 3, 4 or 5, what is the likely reason you are given for not getting regular monthly food supplies?
   - The clinic has run out of food supplies = 1
   - There are no supplies in all clinics across the country = 2

- Never get a reason = 3

- Not sure = 4

➢ Elaborate on your answer._____

_____

_____

4. Is the child given immunizations on time as stipulated in the Child Welfare card? ___

- Yes (as per card) = 1

- No (sometimes later) = 2

- Not sure = 3

➢ When immunized later than scheduled time, are you given a reason for the delay? (Explain). _____

_____

_____

5. Does the clinic educate you on child care and child illness? _____

- Yes (every visit there is education) = 1

- No (never been educated) = 2

- Sometimes (educated on some visits) = 3

- Not sure = 4

6. Do you know of any existing home visits that are done by the primary health care providers in the Child Welfare clinic attendant by the child? _____

- Yes (I have heard about it) = 1

- No (it does not exist) = 2

- Not sure = 3

➢ Elaborate on your answer._____

_____

_____

Thank you for your time.

DATE OF INTERVIEW _____

TIME OF INTERVIEW _____

INTERVIEWER'S NAME AND SURNAME _____

APPENDIX I: SMH-Serowe permission letter (pilot study)

MINISTRY of HEALTH

SEKGOMA MEMORIAL HOSPITAL

10th June 2015

Sekgoma Memorial Hospital Institutional Review Board

Notification of IRB Review: New application

Ms Abigail Piniel

Protocol title: FACTORS CONTRIBUTING TO SEVERE ACUTE MALNUTRITION AMONG THE UNDER FIVE CHILDREN IN FRANCISTOWN, BOTSWANA.

Thank you for submitting your study protocol for review by Sekgoma Institutional Review Board.

Having met on the 10th June 2015, and after considering all the documents submitted being; the research proposal, letter of approval from Ministry of health headquarters, Sekgoma Memorial Hospital Institutional Review Board **approved** your request to undertake a **pilot study** of your research **with the above stated title** in the institution.

This approval is only valid for the period of your pilot study. In the event that you make changes to this proposal before the end of the pilot study you are advised to submit the proposed changes for consideration by the board.

Thank you

Dr George Nkweto Simuanza

Chairperson- the Institutional Review Board-Sekgoma Memorial Hospital

Hospital Superintendant- Sekgoma Memorial Hospital.

Appendix J: Shortage of food commodities notification-Francistown Health Facilities

FROM: Food Relief Services
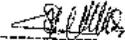
TEL: 2412704

FAX: 2412044

C.O. Moshabi/D.M.

TO: All Health Facilities

Francistown

North East

REF: FRS/D3 I (150)

10th June 2015

RE: SHORTAGE OF FOOD COMMODITIES: HEALTH FACILITIES

This serves to notify you that the Department has experienced shortage of food commodities, tsabana, malutu and sunflower oil since March 2015 due to elapse of contract.

We were informed about three months interim for tsabana and malutu to rescue the situation but since then we did not receive anything.

We only received the update from Local Government Finance and Procurement after the follow ups that the tenders for Tsabana, Malutu and sunflower oil were submitted for adjudication to Ministry Tender Committee.

Thank you.

cc. District Commissioner-Francistown

Masunga