FACTORS ASSOCIATED WITH MALNUTRITION AMONG UNDER 5-YEAR-OLD CHILDREN HOSPITALISED IN SEDIBENG DISTRICT, GAUTENG PROVINCE

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Declaration

I, Dr M.B. ITAKA, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in Family Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this or any other University.

Signed ………………………….

Date:

Dedication

I dedicate this work to my wife, Sandy Mbombo Kayembe, and my two sons, Providence and Aaron Itaka, who supported me during this challenging time.

Abstract

Background

Globally, malnutrition accounts for about 60% of all deaths among children younger than five years with socio-economic deprivation underlying most cases. Although Sedibeng district is more socio-economically challenged than other districts in Gauteng Province, no local study has explored the factors that influence malnutrition among children admitted in hospitals in this district.

Aim

To explore the factors associated with malnutrition among hospitalised children aged less than five years in hospitals in the Sedibeng District.

Objectives

1) To determine the proportion of children admitted with malnutrition to hospitals in the Sedibeng District.

2) To describe participants' characteristics (any of socio-demographic, clinical, dietary and anthropometric).

3) To compare children admitted with and without malnutrition in terms of socio-economic, dietary and clinical characteristics.

Method

A cross-sectional study was done that involved 306 consecutively sampled under-five-year-old children and their carers during admission to the children's wards of the three hospitals in the Sedibeng district. A researcher-administered questionnaire was used to collect information from the carers on socio-demography and the child's diet. Information on anthropometry, immunisation and other clinical measures were extracted from the medical records.

Analysis included descriptive statistics, chi square tests and logistic regression. Main outcome measures were factors significantly associated with admission for malnutrition.

Results

Of 306 children admitted to hospital, 59.8% (183) were male and 9.47% (29) had acute malnutrition associated with other illnesses. Of those with acute malnutrition, moderate acute malnutrition accounted for 17.2% (5) while severe acute malnutrition accounted for 82.8% (24). The majority of children (43.14%, n=132) had a maximum of three meals per day at home and 194 (63.4%) had at least one additional snack per day. On tests of association, a family income of more than R 2,000.00 per month, fathers' and mothers' employment status, lack of breast feeding, and concurrent diarrheal diseases were all significantly associated with

admission for malnutrition. In the adjusted logistic regression, only a history of never having being breast fed and admission for diarrhoeal diseases predicted admission for malnutrition: Compared to children who were breastfed, those never breastfed were significantly more likely to be admitted for malnutrition (OR=3.9; 95% CI: 1.23 – 12.29; p =0.021). Compared to those with pneumonia or any other concurrent illnesses, children who had diarrhoea were significantly more likely to have malnutrition (OR=23.3; 95% CI: 6.85 – 79.43; p=<0.000).

Conclusion

This study found a high prevalence of acute malnutrition in under-fives admitted to hospitals in Sedibeng district. This finding highlights huge missed opportunities for regular anthropometric screening in this district.

While the protective effects of breast feeding in early childhood was reiterated by this study, the strong association of diarrhoea with admission for malnutrition signify the importance of screening any child who presents with diarrhoea for malnutrition.

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List of Acronyms and Abbreviations

HIV	:	Human Immunodeficiency Virus
MAM	:	Moderate Acute Malnutrition
NCHS	:	National Centre for Health Statistics
NDH	:	National Department of Health
PEM	:	Protein-Energy Malnutrition
PMTCT	:	Prevention Mother-To-Child Transmission
RTHC	:	Road to Health Chart
SAM	:	Severe Acute Malnutrition
SSA	:	Sub-Saharan Africa
UNICEF	:	United Nations Children's Fund
WHO	:	World Health Organisation

Chapter 1: INTRODUCTION

According to a report by the World Health Organisation (WHO) in 2018, substantial progress has been made globally in reducing the number of under-five deaths. The 12.6 million deaths in 1990 decreased to 5.4 million in 2017, with the global under-five mortality rate dropping by 56%, from 93 deaths per 1000 live births in 1990 to 39 per 1000 live births in 2017.[1] Deaths from malnutrition account for a significant proportion of these.[2]

Although research has shown some gains in reducing the rate of malnutrition among children, a large number of them still suffer from malnutrition, especially in developing countries. In sub-Saharan Africa (SSA), one out of every 13 children die before their fifth birthday - 14 times higher than in high-income countries.[2,3] Malnourished children, particularly those with severe acute malnutrition, have a high risk of death from common childhood illnesses such as diarrhoea, pneumonia and malaria. Nutrition-related factors also contribute to about 45% of deaths in children under five years of age.[2,3] In South Africa, the prevalence of malnutrition among under-five-year-old children is about 6% to 9%, with 27% being stunted and 12% and 5% being underweight and wasted, respectively.[4] Malnutrition continues to be a major health problem and constitutes an important risk factor for illnesses and death among young children.[5] Factors such as insufficient diet, frequent infections, sociocultural taboos that lead to the exclusion of certain food elements, poor psychosocial care, neglect, abnormal mealtimes and financial problems have been found to be immediate causes of childhood malnutrition. Increased nutritional needs, indispensable for the growth of infants and young children, make them more vulnerable to suffering from malnutrition.[5] For this reason, the WHO refers to childhood malnutrition as the most lethal form of malnutrition,[6] since malnutrition makes under-fives more vulnerable to serious health problems.

In South Africa, several studies have illustrated the impact of malnutrition, with most concentrating their efforts on determining the prevalence and risk factors associated with malnutrition among children aged less than five years.[4, 7] Sedibeng District, where this study was conducted, experiences more socio-economic challenges than other districts in Gauteng Province, South Africa.[8] Despite this socioeconomic deprivation and therefore an increased risk for endemic malnutrition, no study has been conducted to determine the prevalence and factors contributing to malnutrition in this area. While local data suggests that the prevalence of malnutrition among hospitalised children aged less than five years may not be particularly higher than in other districts in Gauteng province, local data indicate a very high case fatality rate.[9] This raises serious clinical and public health concerns. A good understanding of the factors contributing to the development of malnutrition is therefore important for an effective response, especially because the clinical benefit of intervention is likely to be greater for those who are moderately and severely malnourished. The current study therefore aims to determine the factors contributing to malnutrition among hospitalised under-five-year-old children. It is hoped that the findings of this research will enable role players to understand those factors and trigger an effective clinical and community response to reducing the fatalities from acute malnutrition in Sedibeng District and in similar settings.

Chapter 2: LITERATURE REVIEW

2.1 Introduction

This chapter will attempt to present current knowledge on malnutrition and factors that influence admission to hospital. In doing so, it aims to situate the current study within the body of current knowledge.

The following search engines were used for literature search and retrieval: Google Scholar, PubMed and PubMed Clinical Queries, Cochrane database and Up-to-date. Search words used included "malnutrition" and "factors". The yield of the initial search was enormous, with some articles dating back more than ten years. The search was therefore restricted only to recent studies conducted within the past ten years, and articles from South Africa were prioritised for inclusion.

The chapter starts with a description and classification of malnutrition followed by a review of literature on the epidemiology and factors associated with this disease, and ends with a summary and conclusion.

2.2 Definition and classification of malnutrition

Malnutrition is defined as a status of nutrition in which deficiency or excess of energy, protein, and other nutrients cause measurable adverse effects on tissue and body form and function, and clinical outcome.[10] This is the most relevant definition of malnutrition because it includes elements impacting on the nutritional status but does not provide ranking about the importance of those elements or reflect on both acute and moderate malnutrition.[11] Alternatively, malnutrition can also be defined as a nutritional disorder causing reduced nutrient intake or impaired metabolism.[10]

Health care workers often refer to malnutrition as protein-energy malnutrition (PEM) in all its forms as described by the WHO classification.[1] The National Centre for Health Statistics (NCHS) [11] classifies malnutrition as a status of nutrition in which all indices (weight-to-age, height-to-age and weight-to-height) are below a -2 z-score.[12] This is the current most commonly used definition as it gives the opportunity to differentiate between underweight, stunting and wasting, and therefore reflects both acute and moderate malnutrition.

However, as children's baseline body composition has to be taken into consideration, a serial measurement is needed to obtain the growth curve by using well-maintained equipment and standardised measurement techniques.[11] Unfortunately, the majority of the cut-off points are arbitrary and often do not represent a prognostic significance for any given individual child.[13] Also ,most of the cut-off points are arbitrarily admitted, which cannot be applied to all individuals with a significant prognosis.[11]

Despite enormous expansion on malnutrition screening, there is no gold standard for the optimal definition and operationalisation of malnutrition. This lack of a universally accepted gold standard definition, taking into consideration the pathophysiology of malnutrition and its consequences, limits adequate interventions because an adequate diagnosis of malnutrition may not always be made.[14]

Two different approaches have been used to classify malnutrition, namely the Welcome and Waterlow classifications, with the former basing malnutrition on weight-for-age and the latter using height-for-age and weight-for-height. Different sets of reference data are used for each classification and different cut-off points are used to determine the nutritional status.[1]

However, these classifications have weaknesses in the way their cut-off points are presented, usually as a percentile of the population they refer to. Therefore, a z-score or standard deviation system to classify malnutrition is highly recommended by the WHO, because it measures all the indices (weight-for-age, height-for-age, weight-for-height), and results are presented using statistical methods such as a z-score or standard deviation units.[15] This classification will be used for the purpose of this study

As recommended by the WHO, a z-score cut-off point of less than a -2 standard deviation and a mid-upper-arm circumference between 11.5 and 12.5 cm define moderate malnutrition. This is classified as underweight for low weight-for-age, stunting for low height-for-age and wasting for low weight-for-height. A z-score cut-off point of less than a -3 standard deviation weight-for-height and a mid-upper-arm circumference of less than 11.5 cm, with or without oedema, define severe malnutrition.[15]

2.3 Epidemiology of malnutrition

Globally about 20 million children are severely and acutely malnourished with most of them living in developing countries, especially in sub-Saharan Africa and Asia.[14] For instance, a Bangladesh study by Huda *et al*. has indicated the following breakdown of malnutrition: underweight (35%), stunting (42.7%) and wasting (9.2%). In 2011, about 165 million under-fives children were found to be stunted worldwide but considering the current attention to the problem and planned interventions, by 2020 about 127 million children aged less than five years are estimated to be stunted in Asia and Africa, and 132 million globally.[18]

According to a United Nations report in 2015, malnutrition accounts for 3.1 million deaths among under-five-year-old children annually, representing approximately 45% of all deaths in this group.[19]

In studies conducted in the USA and Europe to determine the prevalence of malnutrition among hospitalised children over a period of 10 years (2000-2010), the malnutrition prevalence was found to vary from 6 to 14%.[19] On the contrary, in developing countries such as those in sub-Saharan Africa, malnutrition prevalence was found to be high, with up to one out of four children suffering from malnutrition.[2]

By way of example, a Nigerian study on prevalence and factors associated with malnutrition among 616 children aged from one to five years found that 9.7% were globally malnourished, 4.4% were severely acutely malnourished, and 9.9% were stunted.[5]

In another study conducted in Cape Town to determine the prevalence of malnutrition among 227 hospitalised children, it was found that 35% were moderately malnourished. Factors that were associated with malnutrition in this study included lower socio-economic conditions, nutritional factors such as not breastfeeding, inadequate food intake and health problems such as Human Immunodeficiency Virus (HIV) and diarrhoeal diseases. The highest malnutrition prevalence is found in those provinces with relatively poor resources, especially the Eastern Cape and Northern Cape.[20]

It is important to note that Nigeria and South Africa are the leading economies in Africa and that the prevalence figures elsewhere on the continent may be worse.[5]

2.4 Contributory factors to malnutrition

According to UNICEF's conceptual framework of 2013, risk factors of malnutrition are multi-sectorial. Such factors include food, health and care practices and are linked to political, economic, social and cultural environments.[20] They are also classified as immediate, underlying and basic factors, and studies have shown a strong link between all of them. Therefore, a good understanding and evaluation of those risk elements will be indispensable in the prevention and treatment of malnutrition.

It is noted that factors vary according to the socio-economic, cultural, medical and environmental characteristics of different regions of the world. In Europe, for example, the highest prevalence of chronic malnutrition is found in children with a chronic underlying disease, especially in children with a chronic cardiac or renal disease.[15] Comparatively, in sub-Saharan Africa, there are multiple factors which contribute to the development of childhood malnutrition such as the quality of breastfeeding, lack of food, family and socio-economic variables, poor environmental conditions, maternal level of education, and clinical illnesses such as gastroenteritis, HIV/AIDS and lower respiratory tract infections.[2]

2.4.1 Core factors

Dietary and clinical factors constitute immediate factors that contribute to malnutrition. In addition to dietary practices such as breastfeeding (exclusive or partial) and other feeding practices and adherence to food-based dietary guidelines, a child's medical background with reference to concurrent acute illness or any current treatments also impacts on his or her nutritional status.[22]

2.4.1.1 Inadequate diet

Inadequate diet and poor nutritional status go together. The following factors have been found to impact negatively on the quality of diet: cultural and social practices with regard to feeding, and especially the quality and adherence to breastfeeding (exclusive or partial). [6] Parents' nutritional ignorance is highly linked to dietary choices when determining the quality of food necessary to achieve good nutritional status in children.[23]

A study by Livingston *et al (*2013) in the Free State, South Africa showed that neglected children easily develop malnutrition. In addition, abnormal mealtimes, insufficient quantities of food and food restrictions were found to be associated with malnutrition.[23] This is usually due to a low income that is inadequate to provide food for the family, as decreased income goes hand in hand with poor quality and quantity of food. Malnutrition is a consequence of factors such as unemployment and low wages, which lead to the family eating cheaper and less nutritious food.[24]

Exclusive breastfeeding refers to an infant receiving only breast milk and no other liquids or solids, with the exception of medicines and supplements. Partial breastfeeding refers to an infant receiving breast milk sometimes mixed with artificial feeds such as milk or cereal.[25] Although breast milk is known to be rich in protein, Livingstone *et al.* found that a delay in starting complementary food due to prolonged breastfeeding can lead to micronutrient deficiencies as breast milk contains relatively little iron and zinc.[2,25] Conversely, the early introduction of complementary food for reasons such as maternal death and HIV status (to prevent mother-to-child transmission or PMTCT) may also lead to malnutrition as the child may not benefit from proteins and other micronutrients found in breast milk .[6,23]

A study done in Eastern Ghana to evaluate risk factors of malnutrition among children five years of age and younger reported that children who were exclusively breastfed for a period of six months had a lower incidence of malnutrition compared to those who were given mixed feeding.[26]

2.4.1.2 Health status of the child

Diarrhoeal diseases are considered an important cause of malnutrition among children under five years, as diarrhoea can lead to malnutrition and malnutrition also can predispose to diarrhoeal disease with each episode of diarrhoea impacting on the child's nutritional status.[27]

A 2018 report by the WHO revealed that malnourished children, particularly those with the severe acute form, have a risk of death from common illnesses such as diarrhoea, pneumonia and malaria. This aligns with the current situation in South Africa where diarrhoea and pneumonia are common diseases among children and gives an indication of what is happening in other countries with different disease profiles. [1]

Deaths related to diarrhoeal disease are estimated to be about 30-50% of deaths in developing countries.[29] Children of weaning age are more vulnerable to gastrointestinal infections that usually present as episodes of diarrhoea, and there is a strong link between persistent diarrhoea and malnutrition, lack of breastfeeding and systemic infections among children. Moreover, persistent diarrhoea is also linked to certain factors such as poverty, the environmental situation, inappropriate feeding practices and early weaning, which negatively impact on children's growth and intellectual functions.[30]

Exclusive breastfeeding, especially during the first six months of life can be protective against diarrhoeal disease (acute and persistent) and this is an important prevention strategy.[32]

Malnutrition is commonly linked to the HIV status of a child. For instance, in sub-Saharan Africa a study reported that HIV-infected children are more prone to a severe form of malnutrition as compared to uninfected children.[32] This study highlights the impact of HIV in children's nutritional research. In South Africa the high rate of children with HIV and with HIV being a risk factor for malnutrition necessitates knowing the child's HIV status. This is crucial as it enhances the competence of caregivers in providing helpful advice that can improve hygiene and care, health-seeking behaviour, feeding practices, initiating early treatment and survival.[32]

Infections in general are known to be a major contributing cause of malnutrition due to their metabolic and physiological disruptions.[35] Infection increases the risk of morbidity and mortality in light of the fact that malnourished children recover from infections and repeated illnesses with difficulty.[35] Studies have found that malnutrition increases the mortality and morbidity of children suffering from diarrhoea and respiratory infections. Tuberculosis (TB) also as a common cause, increases energy and protein requirements, significantly contributing to childhood malnutrition.[6]

2.4.2 Other factors

Other known factors contributing to malnutrition are the level of maternal and child care as determined by regularity of clinic attendance during and after pregnancy for maternal and child care purposes, adequate nutritional information received in regard to healthy eating, diarrhoea, breastfeeding, food fortification, complementary feeding, the growth chart and hygiene, the vocational or career education level, the socio-economic status of the household, and the safety of the environment in which the family lives.[35]

2.4.2.1 Maternal and child care status

In 2011, Kiran and Banapurmath showed that the nutritional status of a child can be improved by good implementation of Reproductive Child Health.[36] This implies that the mother should be familiar with important health issues during pregnancy and early childhood development as recommended in the Road to Health booklet, such as vaccination, feeding, growing, screening for common disease and their managements.

Maternal and child care status can be determined by the frequency of clinic attendance during pregnancy for antenatal care (monthly), and by the comprehensive monitoring of the child's growth and health promotion as recommended in the Road to Health Chart (RTHC).[31]

Generally, the caring capabilities of carers have a strong influence on the child's nutritional status. It was found that factors such as poverty or food insecurity can badly affect the caring capabilities of the caregiver, possibly resulting in poor nutritional status of the child.[35]

Protecting mothers against malnutrition is essential to raising healthy children. Women may try to earn extra wages when household income decreases resulting in insufficient time for child care and inability to ensure healthy eating for the child.[37]

In South Africa, poor maternal health and nutritional status as well as smoking during pregnancy were found to be factors contributing to childhood malnutrition. Maternal death increases the risk of malnutrition among children as they are most likely to be underfed after the death of the mother. The same applies if she is ill with HIV or has twins.[38] The height-for-age of children in Cambodia, Namibia and Nepal has been found to be negatively affected by maternal smoking and maternal smoking together with biofuel smoke can lead to growth deficiencies.[39] During pregnancy, maternal smoking practices need to be discouraged because it can have a negative effect on the infant during pregnancy and after birth such as low birth weight and respiratory illnesses, and can lead to a congenital immunodeficiency which can cause malnutrition.[39]

2.4.2.2 Information with regard to nutrition and education level of the carer

This information constitutes any counselling on diarrhoea, feeding, the growth chart, hygiene and other relevant topics received by the caregiver referred to the health facilities, and the person's level of education.[38]

2.4.2.2.1 Level of Education

A 2009 UNICEF report showed a strong link between maternal levels of education and poor nutritional status among children aged three to 23 months.[1] Even though Neervoort *et al* did not find any association between maternal levels of education and malnutrition in their study conducted in Kenya,[40] several studies have shown that the more educated mothers are, the less likely the risk of their children to develop malnutrition.[41, 42]

2.4.2.2.2 Nutrition

In South Africa, data from the National Department of Health (NDOH) showed that adequate knowledge of children's growth as well as quality and quantity of food is mandatory for a family to have a good nutritional status, because it helps the family member or caregiver to understand the nutritional needs of children and provide the necessary nutrients, thereby preventing the children from developing malnutrition.[43]

For instance, an Indian study found that young children's feeding practices and the mother's diet during pregnancy were the major contributing factors to malnutrition among children. Furthermore, a history of poor breastfeeding and being unable to breastfeed for at least 6 months were associated with children suffering more communicable infections and presenting with more signs and symptoms of malnutrition.[44]

2.4.2.3 Household background, environmental factors and quality of health services

This will be expressed as the household factors and socio-economic status of the household such as number of persons in the house, parent employment status, sanitary conditions, and household income. The safety of the child and quality of health services will be expressed as the access to quality health care services.[45]

These factors are strongly associated with the level of personal development. For example, the Kenyan study by Neervoort *et al*. showed that malnutrition was strongly associated with the marital status of the mother as children of single and younger mothers were most likely to suffer from malnutrition.[46] In comparison, a study conducted in Europe found that important social factors associated with malnutrition were child abuse and maternal deprivation.[47]

2.4.2.4 Family size

Several studies showed that living in a big family predisposes children to malnutrition.[48,49] The chances of children suffering from severe malnutrition increased significantly in families with 7–12 children whereas living in a smaller family (5-7 children) was associated with improved nutritional status in children.[50,51]

2.4.2.5 Parents' employment status

Parent's employment status is also linked to malnutrition. Although research has revealed that a father's occupation is considered as the best indication of income, there is an indication in other research that a mother's employment was found to be more beneficial to the household and therefore protective against malnutrition.[52] In 2017, a study conducted by Santhakumaran *et al.* found that a father's employment does not protect against malnutrition.[49] Conversely, studies have revealed that women's empowerment is associated with the improvement of children's nutritional status because women are more likely than men to use economic resources for the basic family needs by allocating resources towards food, nutrition, health and education[6,53]

Nevertheless, two studies showed that women's employment is not necessarily a mechanism for empowerment and wellbeing.[55, 56] For instance, it has been found that the more a mother is employed outside the home, the more likely her children's nutritional status will deteriorate due to the fact that she has less time to spend with them, thus affecting the quality of child care.

Furthermore, a study conducted in developing countries found that not all jobs protect against malnutrition. Employment in the agricultural sector is associated with increased malnutrition, while manual labour and service work do not have an effect on malnutrition, compared to unemployment.[57, 59]

2.4.2.6 Quality of health services

The lack of access to quality health care in developing countries has been reported to contribute to high rates of malnutrition.[56] As mentioned previously, multiple factors have been linked to malnutrition among children; however, those factors are subject to the level of economic and industrial development and availability of resources in the different regions of the world.[57]

Despite the fact that there are enough health facilities in South Africa, knowledge of health care workers and parents on caring for children is still problematic. For instance, it was found that some health care workers and parents are not knowledgeable with regard to the RTHC.[51] This could be to the shortage of health staff members in South Africa, leading to a higher workload that strongly influences the quality and quantity of health services rendered.

2.4.2.7 Resources (income)

The availability of resources in the family is a factor that has been associated with malnutrition; the poorer the family, the more vulnerable the children and the greater the risk of developing malnutrition. Household income is considered an indicator of socio-economic status and has been consistently shown to influence the nutritional status of children, especially higher income, which is associated with a better nutritional status. [57] Researchers found that socio-economic status impacts more on nutritional status than other factors[56, 57] and that low family income is highly associated with the occurrence of undernutrition.[58] This includes poor availability and control of resources.[57] All the studies listed above were conducted in developing and developed countries and had found a link socio-economic status and malnutrition, especially between low income and malnutrition.

2.5 Summary and conclusion

In conclusion, this literature review found that the prevalence of malnutrition is high in developing countries. Of note however, is the lack of agreement on the definition of malnutrition, which may affect a proper diagnosis.

Multiple factors contribute to the high prevalence of malnutrition and these vary across different regions of the world. Addressing these factors has potential to favourably impact on the fight against malnutrition. Considering that there are no local studies in Sedibeng district that can inform interventions, the current study aims to determine the prevalence and factors associated with malnutrition among under-five-year-old children admitted to hospital in the Sedibeng District.

Chapter 3: METHODS

3.1 Aim and Objectives

Aim: To explore the factors associated with malnutrition among hospitalised children aged less than five years in hospitals in the Sedibeng District.

Objectives:

1. To determine the proportion of children admitted with malnutrition to hospitals in the Sedibeng District.
2. To describe participants' characteristics (socio-demographic, clinical, dietary and anthropometric).
3. To compare children admitted with and without malnutrition in terms of socio-economic, dietary and clinical characteristics.

3.2 Study design

This is a cross-sectional descriptive study. It was deemed an appropriate study design because it is the design of choice for estimating prevalence and as an observational study, involves the analysis of data collected from a population, or a representative subset, at one specific point in time.[60]

3.3 Study setting

This study was conducted at the paediatric wards of the following three hospitals in the Sedibeng District: Heidelberg, Kopanong and Sebokeng.

The Sedibeng District is located in the southern part of Gauteng Province. It is divided into three subdistricts namely Lesedi, Emfuleni and Midvaal, with populations of 75,975; 721,663 and 76,513, respectively.[9]

The Heidelberg Hospital is a level one hospital in the Lesedi subdistrict, with 126 approved and useable beds. It has a catchment population of about 83,000 plus 38,500 from the adjoining township of Balfour in the Mpumalanga Province. The Heidelberg Hospital refers patients to the Natalspruit and Chris Hani Baragwanath hospitals and is surrounded by 8 clinics, 3 mobile clinics, a satellite clinic and a community health centre (CHC) in Balfour (Siyathemba CHC).

The paediatric ward in Heidelberg Hospital comprises 18 beds run by two doctors, 15 nurses in total (five professional, five enrolled and five auxiliary), a dietitian, a social worker, an administrative clerk, and an operational manager, who is also a paediatric specialist nurse. During 2015, about 375 children under the age of five were admitted in total, and 21 of them were malnourished. [9]

The Kopanong Hospital is also a level one hospital, situated in the Emfuleni subdistrict in the Sedibeng District, and is capacitated with 248 beds. Its patient headcount is estimated at about 52 000 per annum and it is surrounded by 31 clinics and four CHCs. The paediatric ward consists of 32 beds and is run by four doctors, nine nurses in total (five professional and four enrolled), a dietitian, a social worker and an administrative clerk. An estimated 391 admissions of children under the age of five were reported in 2014/15, among which 49 were malnourished.[9]

The Sebokeng Hospital, one of the largest level two hospitals in the Gauteng Province, is located in the Sebokeng Township about 20 km south of Vereeniging. It covers a catchment population of about 402,980, with 800 approved beds. The paediatric ward consists of 34 beds and is run by four doctors, ten nurses in total (five professional and five enrolled), a dietitian, a social worker and an administrative clerk. The Sedibeng District Clinical Specialist Team (DCST) data revealed that about 697 children under the age of five were admitted during 2014/15, among which 82 were reported to be malnourished.[9]

3.4 Study population

Considering that the majority of children with mild malnutrition are likely to be seen as outpatients at the community-based clinics, this study targets hospitalised children, who are more likely to have the more severe forms of malnutrition. Children aged one to 59 months and admitted to the paediatric wards at the Sebokeng, Kopanong or Heidelberg hospitals for any reason were eligible for the study. Children under one month old were excluded because malnutrition is uncommon in this category and if present, is likely to be due to maternal and intrauterine factors.

3.5 Sample size and sampling

Previous data from the records departments at the three hospitals showed that a total of 3 138 children were admitted across the board during 2014/15, of whom 1 463 children were aged one to 60 months (Heidelberg Hospital, 374; Kopanong Hospital, 390; and Sebokeng Hospital, 699). Among these children, 153 were diagnosed with malnutrition, representing about 10.48%. Assuming a confidence interval of 95%, a sampling error of 5% and a response distribution of 50%, the minimum sample required for this study was calculated as 306 children, using the Raosoft sample size calculator.[61]

Participants were consecutively selected during admission from 1 March to 31 May 2017. Upon admission, all caregivers were consecutively approached and briefed by the ward clerk on the purpose of the research, then invited to participate after the study information sheet (Appendix I) had been read and explained to them and the consent form (Appendix II) signed by the caregiver. In the event that a caregiver refused to consent to the study, the child was excluded and the next caregiver was approached for consent. Those who consented to the study constituted the sample of the study and were interviewed by the researcher or his assistant.

The sample size was proportionally divided among the three different hospitals based on the proportion contributed to the district admission for children younger than five years as stated above. This was to ensure equitable distribution of participants across hospitals; at Heidelberg Hospital (25.6% / 78 participants); Kopanong Hospital (26.7% / 81 participants) and Sebokeng Hospital (48.4% / 148 participants).

3.5.1 Inclusion and exclusion criteria

3.5.1.1 Inclusion criteria

For participation in this study:

- The child caregiver had to sign an informed consent form
- The child had to be admitted during the study
- The child had to be aged between one and 59 months

3.5.1.2 Exclusion criteria

- Children who were too sick to participate, such as those admitted to the intensive care unit (ICU).

3.6 Data collection tools

A researcher-administered questionnaire for the collection of data was adapted from a questionnaire (Appendix III) used in an Indonesian study on factors contributing to malnutrition among children aged 0 to 60 months admitted to hospital, to collect data.[21] Permission to use the questionnaire was requested from the author (Appendix IV). The following sections of the questionnaire were adapted to address the aim and objectives of this study: the question on religion listed under caregiver's characteristics was withdrawn; and the questions relating to the source and quality of water, dietary practices, diarrhoea, health characteristics and immunisation were also adapted to local conditions.

The caregiver provided information on the participant's demographic profile, household, socio-economic status and medical information.

Moreover, information collected on the questionnaire in respect of the anthropometric parameters (weight, height/length, and mid-upper arm circumference [MUAC]), was measured by the researcher. The socio-economic, clinical, environmental, hygienic, breastfeeding and dietary practices were partially extracted from the medical record and also collected by questionnaires administered to the caregiver. Other information such as serious perinatal events, immunisation and deworming status, and previous episodes of clinic attendance for illness were collected from the RTHC.

3.7 Data collection process

Prior to proceeding with data collection, training was organised to discuss the aim and objectives of the study, and to train the research assistant / ward clerk on how to administer the questionnaire in the absence of the primary researcher. The research assistant / ward clerk also acted as interpreter for participants who could not speak English.

Each prospective caregiver was approached by the ward clerk as part of his normal function of obtaining information from patients and capturing this electronically. After the consent form was signed, the questionnaire was administered by the research assistant alone or in the presence of the researcher. Within two days of admission, the researcher or research assistant conducted the interview. This assisted in avoiding a delay in the collection of anthropometric parameters, which may have changed within days after admission. All information given by the caregiver was immediately captured onto the questionnaire. Each interview lasted a maximum of 30 minutes.

The background information and previous anthropometric parameters were captured by health care professionals as part of routine care processes on admission.

Each participant had a unique code consisting of his or her study number, and this number was written on all the questionnaire pages. At the end of each business day, the researcher collected all the completed questionnaires and the data were captured into a secured computerised file. Only the researcher and his supervisor had access to this information.

3.8 Data analysis

Each patient's data were first captured onto an MS Excel sheet and then transferred to STATA-14.0 software for analysis and coding. Data analysis was performed by the researcher, assisted by a statistician. The analysis focused on the key objectives of the study.

The proportions of children with different categories of malnutrition were determined based on the WHO classification. Moderate acute malnutrition (MAM) was defined as a standard deviation of less than -2 for height-for-age (stunting) or for weight-for-age (underweight). Severe acute malnutrition (SAM) was defined as a standard deviation of less than -3 for weight-for-height.

The participants' characteristics (socio-demographic, clinical, dietary and anthropometric) were summarised as appropriate. Categorical variables were reported as frequency and proportions/percentages. Continuous variables were reported as means with standard deviations. Where data was not deemed normally distributed, medians and interquartile ranges were reported.

The sample was divided into two groups: those who were well-nourished and those who were malnourished (MAM or SAM). These were compared using Pearson's Chi-square test and logistic regression in terms of socio-economic, dietary and clinical characteristics. Where statistically significant associations were detected, further analyses were carried out using multivariate logistic regression to determine factors independently associated with malnutrition. Statistical significance was taken as $p<0.05$.

3.9 Ethics

Informed consent was obtained from the caregiver for participation in this study and participants were able to withdraw unconditionally from the study. Participants' information was kept confidential by not writing their identifying features on the questionnaire. Instead, they were represented by a unique link code kept in a secured file which could only be accessed by the researcher and the supervisor. Raw data will be kept for the duration of five years, after which they may be discarded. The interviews were conducted in a private setting.

Prior to conducting this study, ethics clearance was obtained from the Human Research Ethics Committee of the University of the Witwatersrand, Johannesburg (Appendix V) and permission was obtained from the Sedibeng District Research Committee (Appendix VI) - Sebokeng Hospital (Appendix VII), Kopanong Hospital (Appendix VIII) and the Heidelberg Hospital (Appendix IX). Regarding the use of the questionnaire, permission was granted by the author (Appendix X).

Chapter 4: RESULTS

4.1 Introduction

This chapter presents the findings of the study as follows: firstly, the participants' socio-demographic characteristics; secondly, the prevalence of malnutrition; thirdly, the results of the comparison between malnourished and well-nourished children; and lastly, those of the logistic regression analysis.

4.2 Participants

Three hundred and six (306) participants were interviewed. Participants' hospital of origin is shown in Table 4.1. The number of participants was almost equally distributed between provincial (48.36%, n=148) and district hospitals (51.62%, n=158).

Table 4.1 Participants' hospital of origin

Hospitals	**Number** (n=306)
REGIONAL HOSPITAL	
Sebokeng Hospital	148 (48.36%)
DISTRICT HOSPITALS	
Kopanong Hospital	85 (27.78%)
Heidelberg Hospital	73 (23.86%)

4.3 Participants' characteristics

4.3.1 Socio-demographic characteristics of the parents/guardian

The demographic characteristics of the parents/guardians are illustrated in Table 4.2, showing that the majority of the mothers were single (66.01%, n=202) and unemployed (71.24%, n=218). In contrast, most of the fathers were employed (60.13%, n=184). Almost half of the participants 154 (50.33%) had a total household income of less than R 2,000.00 per month.

Table 4. 2 Socio-demographic characteristics of the guardians

Characteristics	N (%)
Mother's age median (IQR)	29 (9)
Less than 18 years	4 (1.31%)
18 to 35 years	257 (83.98%)
More than 35 years	45 (14.71%)
Mother's marital status	
Single	202 (66.01%)
Married or living together	100 (32.68%)
Others (Divorced, widowed)	4 (1.31%)
Mother's employment status: Employed?	
No	218 (71.24%)
Yes	88 (28.76%)
Father's employment status Employed?	
No	122 (39.87%)
Yes	184 (60.13%)
Income median (IQR) (in Rands)	R2000 (1000-4000)
Household income category	
Less or equal to R 2,000.00	154 (50.33%)
More than R 2,000.00	152 (49.67%)
Number of dependants median (IQR)	3 (2-4)
Four or less dependants	237 (77.45%)
More than four dependants	69 (22.55%)
Source of water	
Public tap	50 (16.34%)
Private	214 (69.93%)
Open in the yard	42 (13.73%)
Number of children under five median (IQR)	1 (1-1)
Guardian relationship with the child	
Mother	283 (92.48%)
Grandmother	6 (1.96%)
Caregiver	7 (2.29%)
Father	10 (3.27%)

4.3.2 Socio-demographic characteristics of the children

The socio-demographic characteristics of the children are presented in Table 4.3. Most were males (59.80%, n= 183), older than 6 months (52.94%, n=162), and had a normal birth weight (80.72%, n=247).

Table 4.3 Socio-demographic characteristics of the children

Characteristics	N (%)	Median (IQR)
Age (months)		14 (IQR: 6 - 29)
<6	74 (24.18%)	
6 – 12	70 (22.88%)	
>12 months	162 (52.94%)	
Gender		
Male	183 (59.80%)	
Female	123 (40.20%)	
Birth weight (gram)		2905 (IQR 2600-3200)
Birth weight 2500g or more	247 (80.72%)	
Low birth weight < 2500 g	43 (14.05%)	
Very low birth weight < 1500 g	15 (4.90%)	
Extremely low birth weight < 1000 g	1 (0.33%)	

4.3.3 Nutritional data of the children

The nutritional data of the children are described in Table 4.4 and show that most children (69.93%, n=207) had been breastfed. The median duration of breastfeeding was 6 months (IQR 3-12) with most (57.4%) of these having been breastfed for more than 6 months. The median age of starting other food beside breast milk was 6 months (IQR 6-6). The median number of meals per day was 4 (IQR 3-5) with most (43.14%) having three meals per day. The median of number of snacks per day was one (IQR 0-2) with most (34.97%) not having snacks at all.

Table 4.4 Nutritional data of the children

Characteristics	N (%)	Median (IQR)
Children been breastfed		
No	88 (29.83%)	
Yes	207 (70.17%)	
Duration of breastfeeding median (IQR) in months	6 (9)	
Less than 6 months	89 (42.58%)	
6 months or more	120 (57.42%)	
Mothers currently breastfeeding		
No	220 (74.58%)	
Yes	75 (25.42%)	
Reasons for stopping breastfeed		
Old mother??	34 (15.38%)	
Baby Refused (be specific!)	31 (14.03%)	
Breast problem	58 (26.24%)	
Sick who baby or mother?	71 (32.13%)	
School or work	27 (12.22%)	
Children who started other food beside breastfeeding		
No	76 (24.84%)	
Yes	230 (75.16%)	
Age of starting other food		6 (6-6)
Less than 6 months	44 (19.05%)	
6-9 months	170 (73.59%)	
More than 9 months	17 (7.36%)	
Number of meals per day		4 (3-5)
Two meals per day	6 (1.96)	
Three meals per day	132 (43.14)	
Four meals per day	72 (23.59)	
Five meals per day	29 (9.48)	
Six meals per day	38 (12.42)	
Seven meals per day	5 (1.63)	
Eight meals per day	19 (6.21)	
More than eight	5 (1.63)	
Number of snacks per day median		1 (0-2)
None	107 (34.97)	
One snack per day	87 (28.43)	
Two snacks per day	67 (21.90)	
Three snacks per day	32 (10.46)	
Four snacks per day	12 (3.92)	
Five snacks per day	1 (0.33)	

4.3.4 Children's concurrent illness and immunisation status

The health characteristics of the children described in Table 4.5 show that pneumonia was the leading cause of admission (52.29%) followed by diarrhoea (20.91%), and that the majority (298, 97.39%). of children's vaccinations were up to date.

Table 4.5 Children's concurrent illness and immunisation status

Characteristics	N (%)
Concurrent illness during admission	
Diarrhoea	64 (20.91%)
Pneumonia	160 (52.29%)
Others	82 (26.80%)
Frequency of the diarrhoea	
Rarely	30 (27.62%)
Sometimes	25 (39.68%)
Very often	8 (12.70%)
Children immunisation's status up to date	
No	8 (2.61%)
Yes	298 (97.39%)
Missed immunisation	**n = 6**
Vitamin A	1 (16.67%)
Deworming and vitamin A	1 (16.67%)
Oral polio vaccine 1	3 (50.00%)
Measles	1 (16.67%)

4.3.5 Anthropometric characteristics of children

The anthropometric characteristics of the participants are described in Table 4.6. The median weight was 9.15 kg, and the median height and MUAC were 75 cm and 14 cm, respectively.

Table 4.6 Current anthropometric characteristics of children

Characteristics	N (%)
Child's current weight in kg median (IQR)	9.15 (6.4-11.8)
Child's current height in cm median (IQR)	75 (61-88)
MUAC current in cm median (IQR)	14 (12.3-15)

4.4 Prevalence of malnutrition

The prevalence of malnutrition in general and in the three respective hospitals is presented in Table 4.7. Severe acute malnutrition (SAM) was mostly found in the provincial hospital (Sebokeng) and the number of participants with acute malnutrition was almost equally distributed between the provincial hospital 4.57% (14) and district hospitals (Kopanong and Heidelberg) 4.89% (15).

Table 4.7 Prevalence of malnutrition according to hospital using WHO classification

Hospital	MAM			Total MAM	SAM	TOTAL MAM & SAM
	Stunted	Wasted	Underweight			
Sebokeng	1	1	2	4	10	14
Kopanong	0	1	0	1	7	8
Heidelberg	0	0	0	0	7	7
Total				5 (17.25%)	24 (82.75%)	29 (100%)

4.5 Comparison of children with malnutrition to those without malnutrition

Comparison of participants without malnutrition to those with malnutrition in terms of their socio-economic characteristics

There were no statistically significant differences between the two groups with regards to socio-demographic characteristics, as shown in Table 4.8.

Table 4.8 Comparison of children with and without malnutrition in terms of sex, age and weight

	Malnutrition (MAM & SAM)			MAM			SAM		
	No (n)	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**
Sex									
Female	108 (39.13%)	14 (48.28%)	0.426	108 (39.13%)	2 (40%)	1.000	108 (39.13%)	12 (50%)	0.385
Male	168 (60.87%)	15 (51.72%)		168 (60.87%)	3 (60%)		168 (60.87%)	12 (50%)	
Age in months									
<6 months	69 (24.91%)	5 (17.24%)		69 (24.91%)	1 (20%)		69 (24.91%)	4 (16.67%)	
6 to 12 months	61 (22.02%)	9 (31.03%)	0.454	61 (22.02%)	2 (40%)	0.717	61 (22.02%)	7 (29.17%)	0.582
>12 months	147 (53.07%)	15 (51.72%)		147 (53.07%)	2 (40%)		147 (53.07%)	13 (54.16%)	
Birth weight (g)									
Birth weight 2500g or more	1 (0.36%)	0 (0%)		1 (0.36%)	0 (0%)		1 (0.36%)	0	
Low birth weight < 2500 g	14 (5.05%)	1 (3.45%)	0.929	14 (5.05%)	0 (0%)	1.000	14 (5.05%)	1 (4.17%)	1.000
Very low birth weight <1500g	40 (14.44%)	3 (10.34%)		40 (14.44%)	0 (0%)		40 (14.44%)	3 (12.50%)	
Extremely low birth weight < 1000g	222 (80.14%)	25 (86.21%)		222 (80.14%)	5 (100%)		222 (80.14%)	20 (83.33%)	

Comparison of children with malnutrition and those without malnutrition in terms of the socio-demographic characteristics of their parent or guardian

The comparison between children without malnutrition and those with malnutrition in terms of the socio-demographic characteristics of their parent/guardian is shown in Table 4.9. Children of mothers and fathers who are employed were less likely to be admitted for SAM. In addition, children of families with a household income of less than R 2,000.00 per month were significantly more likely to be admitted to hospital for SAM.

Table 4.9 Comparison of participants without malnutrition to those with malnutrition in terms of socio-demographic characteristics of parent/guardian

	Malnutrition (MAM & SAM)			MAM			SAM		
	No (n)	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**
Mother's age									
Less than 18 years	4 (1.44%)	0	0.727	4 (1.44%)	0 (0%)	0.601	4 (1.44%)	0 (0%)	0.677
18 to 35 years	231 (83.39%)	26 (89.66%)		231 (83.39%)	4 (80%)		231 (83.39%)	22 (91.67%)	
More than 35 years	42 (15.17%)	3 (10.34%)		42 (15.17%)	1(20%)		42 (15.17%)	2 (8.33%)	
Mother's marital status									
Single	183 (66.06%)	19 (65.52%)	0.953	183 (66.06%)	4 (80%)	0.666	183 (66.06%)	15 (62.5%)	0.823
Married or living together	0 (0%)	0 (0%)			0 (0%)		0 (0%)	0 (0%)	
Divorced	0 (0%)	0 (0%)			0 (0%)		0 (0%)	0 (0%)	
Widowed	94 (33.94%)	10 (34.48%)		94 (33.94%)	1(20%)		94 (33.94%)	9 (37.5%)	
Mother's educational status									
Never	22 (7.94%)	3 (10.34%)	0.691	22 (7.94%)	1 (20%)	0.520	22 (7.94%)	2 (8.33%)	0.850
Primary	28 (10.11%)	3 (10.34%)		28 (10.11%)	0 (0%)		28 (10.11%)	3 (12.5%)	
Secondary	186 (67.15%)	21 (72.41%)		186 (67.15%)	4 (80%)		186 (67.15%)	17 (70.83%)	
Tertiary	41 (14.80%)	2 (6.90%)		41 (14.8%)	0 (0%)		41 (14.80%)	2 (8.33%)	
Father's educational status									
Never	87 (31.41%)	8 (27.59%)	0.401	87 (31.41%)	2 (40%)	1.000	87 (31.41%)	6 (25%)	0.602
Primary	0 (0%)	0 (0%)		0 (0%)	0 (0%)		0 (0%)	0 (0%)	
Secondary	150 (54.15%)	19 (65.52%)		150 (54.15%)	3 (60%)		150 (54.15%)	16 (66.67%)	
Tertiary	40 (14.44%)	2 (6.9%)		40 (14.44%)	0 (0%)		40 (14.44%)	2 (8.33%)	
Mother's employment status									
No	190 (68.59%)	28 (96.55%)	0.002	190 (68.59%)	5 (100%)	0.328	190 (68.59%)	23 (95.83%)	0.004
Yes	87 (31.41%)	1 (3.45%)		87 (31.41%)	0 (0%)		87 (31.41%)	1 (4.17%)	
Father's employment status									
No	100 (36.1%)	22 (75.86%)	0.000	100 (36.10%)	5 (100%)	0.007	100 (36.1%)	17 (70.83%)	0.002
Yes	177 (63.9%)	7 (24.14%)		177 (63.90%)	0 (0%)		177 (63.9%)	7 (29.17%)	
Household income category									
Less or equal to R 2,000.00	127 (45.85%)	27 (93.1%)	0.000	127 (45.85%)	5 (100%)	0.022	127 (45.85%)	22 (91.67%)	0.000
More than R 2,000.00	150 (54.15%)	2 (6.9%)		150 (54.15%)	0 (0%)		150 (54.15%)	2 (8.33%)	
Number of dependants									
Four or less dependants	211 (76.17%)	26 (89.66%)	0.098	211 (76.17%)	5 (100%)	0.594	211 (76.17%)	21 (87.5%)	0.310
More than four dependants	66 (23.83%)	3 (10.34%)		66 (33.83%)	0 (0%)		66 (23.83%)	3 (12.5%)	
Source of water									
Public tap	43 (15.52%)	7 (24.14%)	0.190	36 (13%)	2 (40.00%)	0.295	43 (15.52%)	5 (20.83%)	0.164
Private	198 (71.48%)	16 (55.17%)		198 (71.48%)	3 (60.00%)		198 (71.48%)	13 (54.17%)	
Open in the yard	36 (13%)	6 (20.69%)		43 (15.52%)	0 (0%)		36 (13%)	6 (25%)	
Guardian relationship with the child									
Mother	256 (92.42%)	27 (93.1%)	0.660	256 (92.42%)	4 (80%)	0.206	256 (92.42%)	23	0.710
Grandmother	5 (1.41%)	1 (3.45%)		5 (1.41%)	1 (20%)		5 (1.41%)	0	
Caregiver	6 (2.17%)	1 (3.45%)		6 (2.17%)	0 (0%)		6 (2.17%)	1	
Father	10 (3.61%)	0 (0%)		10 (3.61%)	0 (0%)		10 (3.61%)	0	

Comparison of participants with malnutrition to those without malnutrition in terms of health characteristics of children

The comparison of health characteristics of children with malnutrition to those without malnutrition is described in Table 4.10. There was a strong association between diarrhoea and hospital admission for any severity of malnutrition.

Table 4.10 Comparison of participants with malnutrition to those without malnutrition in terms of health characteristics of children

	Malnutrition (MAM & SAM)			**MAM**			**SAM**		
	No (n)	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**
Concurrent illness									
Diarrhoea	42 (15.16%)	22 (75.86%)			3 (60%)		42 (15.16%)	19 (79.17%)	
Pneumonia	155 (55.96%)	2 (6.9%)	0.000		2 (40%)	0.030	155 (55.96%)	3 (12.5%)	0.000
Other	80 (28.88%)	5 (17.24%)			0 (0%)		80 (28.88%)	2 (8.33%)	
Frequency of the diarrhoea									
Rarely	20 (44.44%)	10 (55.56%)			1 (33.33%)		20 (44.44%)	9 (60%)	
Sometimes	19 (42.22%)	6 (33.33%)	0.796		2 (66.67%)	0.739	19 (42.22%)	4 (26.67%)	0.501
Very often	6 (13.33%)	2 (11.11%)			0 (0%)		6 (13.33%)	2 (13.33%)	
Children's immunisation status up to date									
No	6 (2.17%)	2 (6.9%)	0.170		0 (0%)	0.739	6 (2.17%)	2 (8.33%)	0.127
Yes	271 (97.83%)	27 (93.1%)			5 (100%)		271 (97.83%)	22 (91.67%)	
Missed immunisation									
Vitamin A	1 (20%)	0 (0%)			0 (0%)		1 (20%)	0 (0%)	
Deworming and vitamin A	1 (20%)	0 (0%)	1.000		0 (0%)		1 (20%)	0 (0%)	1.000
Oral polio vaccine 1	2 (40%)	1 (100%)			0 (0%)		2 (40%)	1 (100%)	
Measles	1 (20%)	0 (0%)			0 (0%)		1 (20%)	0 (0%)	

Comparison of participants without malnutrition to those with malnutrition in terms of dietary characteristics of children

The comparison of dietary characteristics of children without malnutrition to those with malnutrition is presented in Table 4.11 and shows that there is a significant association between children with malnutrition and breastfeeding practices, with children who were breastfed being less likely to suffer from acute severe malnutrition.

Table 4.11 Comparison of participants without malnutrition to those with malnutrition in terms of Nutritional / dietary characteristics of children

	Malnutrition (MAM & SAM)			MAM			SAM		
	No (n)	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**	**No (n)**	**Yes (n)**	**p-value**
Children ever been breastfed									
No	70 (26.12%)	18 (66.67%)	0.000	70 (26.12%)	2 (50%)	0.286	70 (26.12%)	16 (69.57%)	0.000
Yes	198 (73.88%)	9 (33.33%)		198 (73.88%)	2 (50%)		198 (73.88%)	7 (30.43%)	
Duration of breastfeeding									
Less than 6 months	86 (43.43%)	3 (27.27%)	0.309	86 (43.43%)	0 (0%)	0.585	86 (43.43%)	3 (33.33%)	0.583
6 months	18 (9.09%)	0 (0%)		18 (9.09%)	0 (0%)		18 (9.09%)	0 (0%)	
6 months or more	94 (47.48%)	8 (72.73%)		94 (47.48%)	2 (100%)		94 (47.48%)	6 (66.67%)	
Mothers currently breastfeeding									
No	196 (73.13%)	24 (88.89%)	0.102	196 (73.13%)	3 (75%)	1.000	196 (73.13%)	21 (91.3%)	0.078
Yes	72 (26.87%)	3 (11.11%)		72 (26.87%)	1 (25%)		72 (26.87%)	2 (8.7%)	
Reasons for stopping breastfeed									
Old	51 (25.63%)	7 (31.82%)	0.725	51 (25.63%)	1 (33.33%)	0.247	51 (25.63%)	6 (31.58%)	0.966
Refused	32 (16.08%)	2 (9.09%)		32 (16.08%)	0 (0%)		32 (16.08%)	2 (10.53%)	
Breast problem	28 (14.07%)	3 (13.64%)		28 (14.07%)	1 (33.33%)		28 (14.07%)	2 (10.53%)	
Sick	24 (12.06%)	3 (13.64%)		24 (12.06%)	1 (33.33%)		24 (12.06%)	2 (10.53%)	
School or work	64 (32.16%)	7 (31.82%)		64 (32.16%)	0 (0%)		64 (32.16%)	7 (36.84%)	
Children who started other food beside breastfeeding									
No	69 (24.91%)	7 (24.14%)	1.000	69 (24.91%)	1 (20%)	1.000	69 (24.91%)	6 (25%)	1.000
Yes	208 (75.09%)	22 (75.86%)		208 (75.09%)	4 (80%)		208 (75.09%)	18 (75%)	
Age of starting other food									
Less than 6 months	41 (19.62%)	3 (13.64%)	0.733	41 (19.62%)	1 (25%)	1.000	41 (19.62%)	2 (11.11%)	0.480
6-9 months	153 (73.21%)	17 (77.27%)		153 (73.21%)	3 (75%)		153 (73.21%)	14 (77.78%)	
More than 9 months	15 (7.18%)	2 (9.09%)		15 (7.18%)	0 (0%)		15 (7.18%)	2 (11.11%)	
Number of meals per day									
Two meals per day	5 (1.8%)	1 (3.45%)	0.770	5 (1.8%)	0 (0%)	1.000	5 (1.8%)	1 (4.17%)	
Three meals per day	118 (42.6%)	14 (48.28%)		118 (42.6%)	3 (60%)		118 (42.6%)	11 (45.83%)	0.569
Four meals per day	66 (23.83%)	6 (20.69%)		66 (23.83%)	1 (20%)		66 (23.83%)	5 (20.83%)	
Five meals per day	25 (9.03%)	4 (13.8%)		25 (9.03%)	0 (0%)		25 (9.03%)	4 (16.67%)	
Six meals per day	36 (13%)	2 (6.9%)		36 (13%)	1 (20%)		36 (13%)	1 (4.17%)	
Seven meals per day	4 (1.44%)	1 (3.45%)		4 (1.44%)	0 (0%)		4 (1.44%)	1 (4.17%)	
Eight meals per day	18 (6.5%)	1 (3.45%)		18 (6.5%)	0 (0%)		18 (6.5%)	1 (4.17%)	
More than eight	5 (1.8%)	0 (0%)		5 (1.8%)	0 (0%)		5 (1.8%)	0 (0%)	
Number of snacks per day									
None	94 (33.94%)	13 (44.83%)	0.607	94 (33.94%)	4 (80%)	0.522	94 (33.94%)	9 (37.5%)	0.672
One snack per day	81 (29.24%)	6 (20.69%)		81 (29.24%)	1 (20%)		81 (29.24%)	5 (20.83%)	
Two snacks per day	59 (21.3%)	8 (27.59%)		59 (21.3%)	0 (0%)		59 (21.3%)	8 (33.33%)	
Three snacks per day	30 (10.83%)	2 (6.9%)		30 (10.83%)	0 (0%)		30 (10.83%)	2 (8.33%)	
Four snacks per day	12 (4.33%)	0 (0%)		12 (4.33%)	0 (0%)		12 (4.33%)	0 (0%)	
Five snacks per day	1 (0.36%)	0 (0%)		1 (0.36%)	0 (0%)		1 (0.36%)	0 (0%)	

4.6 Logistic regression analysis

4.6.1 Univariate analysis with MAM as dependent variable

The following characteristics of the father's lack of employment, poor household income and concurrent illness showed a statistically significant association with MAM, as shown in Table 4.12. However, only the father's unemployment remained statistically significant in the logistic regression analysis.

Table 4.12 Univariate analysis with MAM as dependent variable

	Odd ratio	p-value	95% Confidence interval
Father's employment status			
Father employed	1	0.045	
Father unemployed	19.42786		1.063249 - 354.989
Household income			
More than R 2,000.00	1	0.084	
Less or equal to R 2,000.00	12.98431		0.7110549 - 237.1018
Concurrent illness			
Pneumonia	1		
Diarrhoea	5.122354	0.053	0.9758295 - 26.88842
Other	0.3863353	0.541	0.0183282 - 8.143471

Children whose fathers were unemployed were more than 19 times likely to develop MAM compared to children whose fathers were employed.

4.6.2. Univariate analysis with SAM as dependent variable

Mother's employment, father's employment, household income, breastfeeding practices and concurrent illness demonstrated statistically significant associations with SAM, as shown in Table 4.13.

Table 4.13 Univariate analysis with SAM as dependent variable

	Odd ratio	p-value	95% Confidence interval
Mother's employment			
Mother employed	1	0.022	
Mother unemployed	10.53158		1.399685 - 79.2422
Father's employment			
Father employed	1	0.002	
Father unemployed	4.298571		1.723872 - 10.71873
Household income			
More than R 2,000.00	1	0.001	
Less or equal to R 2,000.00	12.99213		2.997105 - 56.31945
Breastfeeding practice			
Breastfed	1	0.000	
Never breastfed	6.465306		0.0166369 - 0.0751267
Concurrent illness			
Diarrhoea	1		
Pneumonia	0.0427844	0.000	0.0120817 - 0.1515106
Other	0.0552632	0.000	0.0122801 - 0.2486961

Children whose mothers were unemployed were 10.5 times more likely to develop SAM compared to children whose mothers were employed. Children whose fathers were unemployed were 4.3 times more likely to develop SAM compared to children whose fathers were employed. Children from households with an income of R 2,000.00 per month or less were 13 times more likely to develop SAM compared with households earning R 2,000.00 or more per month. Children who were never breastfed were 6.5 times more likely to have SAM compared to children who had ever been breastfed. With regard to the presence of concurrent illness, children who had diarrhoea were 23.4 times more likely to have SAM compared to children with pneumonia.

4.6.3 Test of association between characteristics of the participants and malnutrition (MAM & SAM combined)

4.5.3.1. Univariable analysis

The following socio-demographic characteristics as shown in Table 4.14 demonstrated a statistically significant association with malnutrition: the father or guardian father's employment status, mother's employment status, household income, child's breastfeeding status and concurrent illness.

Table 4.14 Univariable analysis with MAM & SAM (combined) as dependent variable

	Odd ratio	p-value	95% Confidence interval
Father's employment			
Father employed	1	0.000	
Father unemployed	5.3		2.159788 – 12.79779
Mother's employment			
Mother employed	1	0.015	
Mother unemployed	12.3		1.644616 – 91.9676
Household income			
More than R 2,000.00	1	0.000	
Less than or equal to R 2,000.00	15.2		3.547083 – 65.43016
Breastfeeding practice			
Breastfed	1	0.000	
Never breastfed	6.465306		0.0166369 - 0.0751267
Concurrent illness			
Pneumonia	1	0.000	
Diarrhoea	23.37302		6.6002 - 82.76989
Other	1.291667	0.782	0.2115083 - 7.888121

Children whose fathers were unemployed were 5.25 times more likely to develop malnutrition compared to children whose fathers were employed. Children whose mothers were unemployed were 12.3 times more likely to develop malnutrition compared to children whose mothers were employed. Children from households with an income of R 2,000.00 or less were 15.2 times more likely to develop malnutrition compared to households earning R 2,000.00 or more. Children who had never been breastfed were 4.7 times more likely to have malnutrition compared to children who had been breastfed. With regard to the presence of concurrent illness, children who had diarrhoea were 16.2 times more likely to be malnourished compared to children with pneumonia.

4.6.4 Multivariable Analysis

4.6.4.1 Adjusted predictors of SAM

The adjusted predicting factors associated with SAM are presented in Table 4.15 and show that the likelihood of having SAM was statistically significantly higher for children who had never been breastfed compared to children who had been breastfed. Children who had diarrhoea were 35 times more likely to have SAM with a statistically significant difference (p=<0.001) compared to children with pneumonia.

Table 4.15 Adjusted predicting factors associated with SAM

	Odd ratio	p-value	95% Confidence interval
Mother's employment status			
Employed	1	0.135	
Unemployed	5.279067		0.5960482 - 46.75552
Father's employment status			
Employed	1	0.401	
Unemployed	1.709167		0.4892154 - 5.971304
Household Income			
More than R 2,000.00	1	0.082	
Less or equal to R 2,000.00	4.459115		0.827839 - 24.01881
Breastfed			
Breastfed	1	0.003	
Never breastfed	6.797103		1.934194 – 23.88624
Concurrent illness			
Pneumonia	1		
Diarrhoea	35.24167	0.000	8.104376 – 153.2475
Other	1.5383785	0.633	0.2396899 – 10.46508

4.6.4.2 Adjusted predicting factors associated with malnutrition (MAM & SAM) combined

The adjusted predicting factors associated with malnutrition (MAM & SAM) combined are presented in Table 4.16 and show that never having been breastfed and concurrent illness were statistically significantly associated with malnutrition. The odds of having malnutrition were 23.3 more for children who had never been breastfed compared to children who had been breastfed. Children who had diarrhoea were 23.3 times more likely to have malnutrition with a statistically significant difference (p=<0.001) compared to those with pneumonia.

Table 4.16 Adjusted predicting factors associated with combined malnutrition (MAM & SAM)

	Odd ratio	p-value	95% Confidence interval
Household Income			
More than R 2,000.00	1	0.58	
Less than or equal to R 2,000.00	5.0		0.95 – 26.6
Mother's employment status			
Employed	1	0.76	
Unemployed	7.1		0.82 – 61.5
Father's employment status			
Employed	1	0.167	
Unemployed	2.3		0.70 – 7.8
Breastfed			
Breastfed	1	0.021	
Never breastfed	3.9		1.23 – 12.29
Concurrent illness			
Pneumonia	1		
Diarrhoea	23.3	0.000	6.85 – 79.43
Other	0.46	0.50	0.05 – 4.28

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter discusses the findings of this study by comparing them to the literature and highlighting the implications for health care, policy formation and further research.

5.2 Participants' characteristics

Participants were proportionally recruited from one provincial hospital (Sebokeng) and two district hospitals (Kopanong and Heidelberg) with an almost equal number from each of the two levels of care.

A vast majority of the children had a normal birth weight (2 500 g or more) and there was no association between children's birth weight and malnutrition, contrary to previous studies where prematurity or low birth weight was strongly associated with malnutrition.[46,51] The lack of association in this study was possibly because although preterm and low birth weight children are known to have health challenges and are most likely to be sick during the first few days of their lives,[47] they were excluded from this study. Nevertheless, this may imply that the older children become in Sedibeng district, the more vulnerable they are to malnutrition. This may possibly be due to their increasing physical dependence in a context of food insecurity.

The majority of mothers (83.98%) were aged between 18 and 35 years and should be able to care for their children with minimal risk of malnutrition. There was no association between the mother's age and acute malnutrition in this study, contradicting a previous study where a younger age of the mother was associated with a higher risk of malnutrition in her baby.[47] It thus appears that factors other than maternal age play a more important role in the study setting and need to be recognised as such.

Most of the mothers (66.01%) were single. Although this study found that 65.12% of mothers with malnourished children were single, there was no significant association between the mother's marital status and malnutrition. This finding is contrary to that of another study conducted in Botswana where being married and residence with the child's father were protective against malnutrition.[46] It suggests that the mediator in the above relationship may be the improved financial/economic and/or social support from the father. It may therefore be important to empower single mothers to secure a means of additional income or support from the partner to reduce the risk of having children with malnutrition.

A vast majority of those mothers interviewed (68.59%) were unemployed. In contrast, most fathers (63.9%) were employed, and these findings are aligned with previous studies that looked at the employment status of parents.[52] Therefore, empowering mothers through employment will assist in the fight against malnutrition.

This study showed that most participants (93.1%) had a monthly income of less than or equal to R2,000.00. There was a significant association between low income and malnutrition, especially SAM, as 50.33% of household with a monthly income of less than or equal to R2,000.00 has a child with malnutrition. This finding agrees with previous studies conducted in similar settings in South Africa where lower household income was found to be a predictor of acute malnutrition.[57] Improving household income will obviously protect against malnutrition and underscore the need for more poverty alleviation initiatives from government. These should be created amongst other general measures to improve households 'quality of life, therefore protecting children against malnutrition.

The results of this study indicated that the 70.17% of participants who were breastfed were less likely to have malnutrition compared to those who were not breastfed. This aligns with studies that showed that breastfeeding protects against malnutrition.[24] Most of the children (73.79%) were breastfed for at least six months but this study did not show any association between the duration of breastfeeding and acute malnutrition, contrary to other studies that found that children who were breastfed for short durations were more likely to develop malnutrition.[25] Adversely, participants that had ever in their lives been breastfed were significantly less likely to be admitted for malnutrition ($p=0.00$), suggesting that any length of breastfeeding is protective against malnutrition, noting that antibody transfers via the breast milk reduces malnutrition-aggravating illnesses such as diarrhoea.

Most of the children in this study had about three meals and no snack per day, which is below the recommended 6 to 8 meals per day.[25] Therefore, efforts have to be made to educate parents and carers about feeding practices necessary to meeting the nutritional needs of the children. In addition, socioeconomically vulnerable families need to be identified for support by community-based meal programs in the fight against malnutrition.

Although diarrhoea accounted for only 20.9% of admissions, there was a significant association with acute malnutrition. This relationship underpins why previous studies have found diarrhoea to be an important predictor of acute malnutrition.[25] Diarrhoea limits the digestion and absorption of nutrients and, when persistent, predisposes towards the development of malnutrition.[25] Therefore, good hygiene and nutritional practices together with adequate early management of children suffering from diarrhoeal disease are indispensable in the prevention of malnutrition.

5.3 Prevalence of malnutrition

Of the 306 children included in this study, using the WHO classification, the prevalence of acute malnutrition was 9.4% (29). Moreover, of those with acute malnutrition, participants with moderate acute malnutrition accounted for 17, 2% (5); with one child (3.45%) being stunted and two (6.89%) being respectively underweight and wasted. The children suffering from severe acute malnutrition accounted for 82.8% (24). A point-prevalence of 9.4% may be regarded as low compared to a similar study conducted in Cape Town that reported the prevalence of malnutrition at 26% among under-five-year-old children. These children were classified as follows: stunted (27%), underweight (12%), and wasted (5%).[43] Nonetheless, the finding of the current study aligns with data from the Sedibeng district information system that showed a low prevalence of acute malnutrition but a high fatality rate from malnutrition.[9] Almost half of malnourished children in this study were aged more than 12 months, which concurs with previous studies showing older children were at a higher risk of developing malnutrition.[47]

It was also noted that severe acute malnutrition was mainly found at the provincial hospital (Sebokeng). This could be expected because children with this type of condition are more likely to be taken care of in such institutions due to their severity, as shown in similar studies.[8] The prevalence of moderate acute malnutrition was lower in both district hospitals combined, compared to the provincial hospital; secondly, the quality of care especially with regard to the preventive measures taken (such as the mother's health education and management of moderate acute malnutrition) to avert malnutrition may be questionable at the district level, resulting in complications that require admission at the provincial hospital. Thirdly, an attempt to describe the characteristics of participants according to the hospital of origin to ascertain if there was a specific factor for each group of participants that could justify their admission to Level 1 or 2 hospitals should also have given some clarification.

5.4 Factors associated with malnutrition

5.4.1 Predictors of MAM

On test of association, the father's employment status, household income and concurrent illness demonstrated statistically significant associations with MAM. However, only the father's employment remained statistically significant in multivariate logistic regression analysis.

5.4.1.1 Father's employment status

An attempt was made to specify the exact take-home income of each parent of children suffering from MAM, to understand to what extent each parent was contributing to the family budget and to ascertain the impact of each contribution in protecting against MAM. This was, however, not feasible because caregivers were reluctant to volunteer this information. The estimated total household income data were collected by combining all sources of income (parents' income and grants) together.

The results of this study showed that the majority of fathers (63.9%) were employed compared with mothers (28.76%). Similarly, in a previous study conducted in the Free State Province, the rate of employment for fathers was relatively higher compared to that of mothers.[38]

It is important to acknowledge that this study did not show any association between the mother's employment status and acute malnutrition. This can be explained by the fact that most mothers included in this study were single, the heads of the households, and working. Therefore, the father's employment was considered only as an additional support for those who could obtain it. This could provide some protection against moderate forms of malnutrition but not SAM. In addition, this study showed that children whose fathers were unemployed were 19.4 times more likely to suffer from MAM compared with children whose fathers were employed. This aligns with a previous study that showed that the father's employment status linked to the household income was found to be the most significant factor associated with acute malnutrition, as empowering fathers by providing employment improves the quality of life and provides necessary nutritional needs to protect against malnutrition.[53]

Keeping in mind that mothers are more likely to direct resources toward the family needs, we expected the mother's employment to also be protective again malnutrition as in other studies.[6,54] However, this was not the case and may be due to the fact that most mothers were single, unemployed or had a relatively low income. The finding of our study showed that the father's employment status was the minimum requirement as protection against malnutrition in our setting and efforts have to be made to encourage fathers to direct resources toward family's nutritional needs to fight moderate malnutrition.

5.4.2 Predictors of SAM

All the following characteristics namely the parent's employment status, household income, breastfeeding status and concurrent illness remained statistically significant in logistic regression analysis. However, when adjusted with other factors, only breastfeeding practice and concurrent illness were statistically significantly associated with malnutrition.

5.4.2.1 Mother's and father's employment status

This study found a significant association between both the father's and mother's employment status and SAM. In a previous study, it had been shown that parent's unemployment linked to household income was considered as an underlying factor contributing to malnutrition.[54] In our study, children whose mothers were unemployed were 10.5 times more likely to suffer from SAM compared with children whose mothers were employed. Children whose fathers were unemployed were 4.3 times more likely to suffer from SAM compared to children whose fathers were employed. Even though this study found that both parents being employed protected against malnutrition and that mothers' employment did so to a greater extent than fathers, there is still controversy about the impact of each parent's employment.

Some researchers have revealed that the father's employment is considered as the best indication of income and hence more protective against malnutrition, whereas other researchers consider the mother's employment as the more beneficial to the household and therefore protective against malnutrition.[53]

Women's empowerment is associated with improving children's nutritional status because the former are more likely than men to use economic resources on basic family needs by allocating resources toward food, nutrition, health, and education.[6,55] However, women's employment could also impact negatively on the family.[56,57] For instance, it has been found that the more the mother was employed outside the home, the more the children's nutritional status deteriorated due to the fact that the mothers spent less time with their children and that this affected the quality of child care.[34] Regardless of this controversy, each parent's employment was found to be beneficial against malnutrition; by empowering both parents, the chances of children suffering from malnutrition will decrease, but it is the mother's empowerment that will provide more protection against malnutrition. However, both mother's and father's employment were not statistically significant in multivariate logistic regression analysis.

5.4.2.2 Household income

Previous studies conducted in Sedibeng District Health Services showed that this district is socio-economically disadvantaged compared with other districts in Gauteng.[8] In this study, the median household income was R2,000.00 (R3,000 - R4,000) and on univariate regression analysis there was a significant association between household income and SAM. Children from households with an income of R2,000 per month or less were 13 times more likely to develop SAM compared with households earning R2,000 or more per month. This aligns with findings of a similar study conducted in South Africa that found household income to be an underlying factor contributing to malnutrition, and that low income could translate into lack of resources to buy food resulting in insufficient meals and failure to gain weight.[59]

However, households with a lower income are also more likely to live under poor socio-economic conditions that increase the risks of food insecurity and limit access to food, which could lead to illness and weight loss.[57] Therefore, improving family socio-economic status by increasing household income will dramatically decrease the rate of SAM amongst children. However, household income status did not show any significant relationship with malnutrition in multivariate logistic regression analysis, signifying that the protective effect of household income may not be a direct effect but may be confounded by other risk factors such as concurrent illnesses (e.g. diarrhoea and pneumonia), since these tend to occur more among children from low socioeconomic status.[57]

5.4.2.3 Breastfeeding practice

The majority of children (70.17%) included in this study were breastfed at some stage of their lives. Breastfeeding is a strong protective factor for SAM in this study; children who were never breastfed were four times more likely to have malnutrition compared to children who were breastfed. Breast milk is known to be rich in protein and is therefore protective of malnutrition.[24] However, a study showed that delay in starting complementary food due to prolonged breastfeeding can lead to micronutrient deficiencies, as breast milk contains less zinc and iron. [25] It was noted that about a third of children were not breastfed either for medical or other reasons. This included HIV-infected children whose mothers opted not to breastfeed, seriously ill children or ill mothers or for other reasons related to work or school. In this study, mothers were not asked about whether they did exclusive breast feeding or not but rather were asked about the duration. Most of them had breastfed for at least 6 months and supplementary food was then introduced, which is the minimum requirement as per WHO recommendations.[24]

Breastfeeding practice as part of dietary intake, with its protective and alimentary advantages, has been considered as one of the principal factors providing protection against severe forms of malnutrition, and poor breastfeeding practice has also previously been listed as among the immediate causes of malnutrition.[25] Therefore, this should be taken into consideration, especially in this research setting where breastfeeding practices are subjected to many polices that have been changing during the last decades with regard to the HIV endemic. Also of importance are the different factors that influence breastfeeding practices in the community such as breastfeeding problems, work, school or any diseases that do not make breastfeeding possible. [26]

When adjusted by other factors in this study, the likelihood of having SAM remained statistically significantly higher for children who were never breastfed compared to children who were breastfed (Table 4.15 and Table 4.16). Therefore, policies have to be directed toward promoting sound breastfeeding practices such as exclusive breastfeeding for at least 6 months, by giving instructions and information about breastfeeding to mothers as early as possible during antenatal care to prevent children from suffering from malnutrition. This can be done using facility or community-based breastfeeding supporters. In addition, health education on breast feeding needs to be integrated into the MOM Connect program to promote optimal uptake in the perinatal period.

5.4.2.4 Concurrent illnesses

The results from this study indicated that diarrhoeal disease was strongly associated with SAM. Children who had diarrhoeal disease were more likely to be malnourished compared to children with pneumonia or other illnesses. Moreover, this aligns with findings of previous studies that found a strong association between diarrhoeal disease and malnutrition, compared with other diseases. Diarrhoea accounted for about 60,7% of young children suffering from malnutrition as compared to other causes such as malaria (57.3%), pneumonia (52.3%) and measles (44.8%).[28]

Even though the frequency of diarrhoeal disease did not show any association with malnutrition, feeding practice during diarrhoeal disease and the management of diarrhoea episodes in children are keys points that should be considered while trying to explain this strong association between diarrhoea and malnutrition. It would have been of great importance if the HIV status of malnourished children was explored to find out whether any association between HIV status and malnutrition exists. This wasn't done in this study because it was not part of the objectives. Diarrhoeal diseases inadequately managed, i.e. without adequate fluid and electrolyte replacement and good feeding practice, lead to severe disease that may result in malnutrition or even death.[29] Even though this study did not find any association between the frequencies of diarrhoeal disease and malnutrition, diarrhoeal disease should be adequately managed to protect children from severe forms of malnutrition.

When adjusted with other factors in this study, it was shown that children who had diarrhoea were 23.3 times more likely to have malnutrition with a statistically significant difference ($p=<0.001$) compared to those with pneumonia. Therefore, good hygiene and nutritional practices together with adequate management of children suffering from diarrhoeal disease are indispensable in the prevention of malnutrition.

5.4.3 Predictors of malnutrition (MAM & SAM)

All of the following characteristics - parent's employment status, household income, breastfeeding status and concurrent illness remained statistically significant in univariable logistic regression analysis. However, when adjusted with other factors, only breastfeeding practice and concurrent illness were statistically significantly associated with malnutrition.

This study showed that children whose mother or father was employed or whose parents earned less or equal to R2,000.00 per month were more likely to develop any form of malnutrition (MAM & SAM) compared to children whose mother or father was employed and earned more than R 2,000.00 respectively. Conversely, children who had never been breastfed were 4.7 times more likely to have malnutrition compared to children who had been breastfed. With regard to the presence of concurrent illness, children who had diarrhoea were 16.2 times more likely to be malnourished compared to children with pneumonia.

It should be noted that all the factors associated with SAM were also associated with malnutrition (MAM & SAM combined). In addition to this, a father's employment status was the only characteristic significantly associated with MAM, and also found to be associated with SAM and automatically with malnutrition in general. Due to the fact that a majority of children suffered from a severe form of malnutrition (SAM) and this study included hospitalised children who were more likely to have SAM, factors that were significantly associated with SAM were automatically associated with malnutrition in general.

After multivariable analysis, only lack of breast-feeding and concurrent illnesses remained statistically significantly associated with malnutrition. The odds of having malnutrition was 23.3 more for children who had never been breastfed compared to children who had been breastfed, and children who had diarrhoea were 23.3 times more likely to have malnutrition with a statistically significant difference (p=<0.001) compared to those with pneumonia. Therefore, among all the factors contributing to malnutrition in the research setting, breastfeeding and concurrent illnesses are the most important in the fight against malnutrition. The incidence of diarrhoea may be brought down by the fact that there was a high immunisation rate in this study and that Rota virus immunisation had been given for the previous 10 years.

5.5 Limitations and sources of bias

1. Participants were not selected randomly, and this might predispose the study to selection bias. However, the researcher had no influence on who presented for admission and recruitment was done days after the children were admitted. The fact that there was no standardisation could also lead to bias as individuals differ much.

2. Although the results of this study may be generalised to the hospitals in the Sedibeng District Health Services, caution needs to be applied in transferring these findings to other hospitals in different socio-economic contexts.

3. Information on the income of each parent was not considered separately. Therefore, the researcher was unable to comment on each parent's income. This may have facilitated more information on how only the father's employment status, not the mother's, was significantly associated with MAM.

4. The questionnaire used in this study excluded detailed information on exclusive breastfeeding questions. Although an association was found between breastfeeding and malnutrition, it would have been better to know the quality of breastfeeding practice.

5. Anthropometric measurements were made by the researcher and could have been subject to a margin of human error.

6. Recall and information bias could have affected the accuracy of the responses as the parent or guardian may have found it difficult to remember all the details about their children.

7. Also, response bias should be considered as participants were asked questions about sensitive aspects of their life such as their income, which is usually difficult to disclose, their reason(s) for not breastfeeding, for example, as it is attached to HIV status in some contexts, and for some of them an interpreter was used to collect information.

Nonetheless, there was a high rate of participation and response in this study and almost all the parents or guardians agreed to partake in the study and were able to answer most of the questions they were asked.

Chapter 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study found that a significant proportion of under-five year old children admitted to hospitals in Sedibeng district had acute malnutrition. This reiterates the need for regular anthropometric screening for early detection and management of malnutrition.

The significant correlates of malnutrition in this study reaffirm the importance of promoting interventions such as exclusive breastfeeding, immunisation, oral rehydration therapy and strict implementation of IMCI protocol as key pillars of childhood survival strategies. To the end that diarrhoea is the most predictive factor, presentation with diarrhoea in a child must trigger anthropometric screening for malnutrition.

6.2 Recommendations

The findings of this study should be considered in the implementation of critical interventions with regard to the prevention and management of malnutrition:

1. Health care providers should at every clinic visit provide adequate health education and promotion to parents and guardians of children with regard to the prevention of malnutrition.

2. Health providers should consider any clinical encounter as an opportunity for anthropometric screening. Where there is a gap, adequate management intervention(s) should be instituted.

3. Except if there is an absolute contraindication, health care providers should promote breastfeeding practice unhindered.

4. Health care providers should be trained on the management of diarrhoeal disease to assure provision of quality care and minimise the risk of malnutrition. This could integral to promotion of the implementation of IMCI as a core strategy to strengthen healthcare providers' clinical assessments and management interventions.

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APPENDICES

Appendix I Information Sheet

‘Factors associated with malnutrition among
under 5-year-old children hospitalised in
Sedibeng District, Gauteng Province’

Dear Sir / Madam,

My name is Dr M.B. ITAKA, Medical Doctor and Registrar at Wits University, Department of Family Medicine, based in the Sedibeng District. I am conducting research titled, ‘Factors associated with malnutrition among under 5-year-old children hospitalised at Sedibeng District Health Services in Sedibeng District, Gauteng Province.’ Research is just the process to learn the answer to a question.

The purpose of this research survey is to assess nutritional status (anthropometric and dietary intake) and household information, in an attempt to identify specific factors that play a role in the development of malnutrition. The information collected will be used to resolve problems and investigate solutions to these problems.

I am requesting that you and the child in your care participate in this research study. In order for this information to be collected, you will be asked a number of questions with regard to background information such as education level, household income, types and amounts of food given to the child in your care and how often he or she eats these foods, breastfeeding or other feeding practices, counselling received at the clinic, weight, height and mid-upper arm circumference, measurements of you and the child in your care, hospital background, ante-natal risks and practices, medical treatment of you and the child in your care, prevalence of disease (TB & HIV/ AIDS), and clinic attendance and participation in the PEM scheme.

The questionnaire will be completed while the child is in hospital, so therefore only one visit is required to collect all the necessary information. The entire interview will take about one hour to complete. The measurements to be taken are not harmful in any way to you or the child in your care and will only be done once. These measurements include height, weight, and mid-upper arm circumference. Measurements will be taken with the child and carer wearing a minimum amount of clothing.

No special tests will be done and only available blood results will be used. The blood results refer to any and all tests results or related tests and results regarding HIV/AIDS and other diseases.

This information is collected from malnourished children aged one to sixty months in the Kopanong, Sebokeng and Heidelberg hospitals in the Sedibeng District Health Services, South Africa. The number of children who will take part in the study depends on the number of children admitted to these hospitals over a period of 12 months. There are no risks involved in taking part in this research study.

The benefits of partaking in this research survey will be that you can make a difference to improving health care services in the country. Furthermore, should the child in your care be suffering from any other disease, he or she will receive treatment.

You will be given pertinent information on the study while participating in the project and after the results are available.

Participation is voluntary, and there is no penalty should you decide not to participate. You may discontinue participation at any time and it will not be held against you in any way.

Efforts will be made to keep personal information confidential. However, absolute confidentiality cannot be guaranteed but persons will not be identified when analysing and presenting findings to various stakeholders or when publishing the results in scientific journals.

The Ethics Committee of the Faculty of Health Sciences of the University of the Witwatersrand, Johannesburg and the Ethics Committee of Sedibeng District Health Services have approved the study.

For further information, contact the researcher, Dr M.B. Itaka, on 0738457024 or his supervisor, Dr O.B. Omole, on 016 950 6192.

Appendix II Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to partake as a participant in this research on 'Factors associated with malnutrition among under 5-year-old children hospitalised in Sedibeng District, Gauteng Province.'

Print Name of Participant ____

AND

Thumb print of participant

Signature of Participant ____

Date (dd/mm/yyyy) ____

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness (1) ____

Signature of witness ____

Date (dd/mm/yyyy) ____

Print name of witness (2) ____

Signature of witness ____

Date (dd/mm/yyyy) ____

Appendix III Questionnaire

QUESTIONNAIRE IDENTIFICATION		
ID01	**Serial number of questionnaire**	
ID02	**Date of interview** *dd-mm-yy*	

CHARACTERISTICS OF CARER			
CR01	**How old are you?**	□__ □__ □ years	
CR02	**What is your civil status?**	Single Married/living together Divorced Widowed	1 2 3 4
CR03	**What is your highest level of completed education?**	Not finished Primary school Secondary school Graduate studies/University Technical education/Vocational training	1 2 3 4 5
CR04	**What is the father of the child's highest level of completed education?**	Not finished Primary school Secondary school Graduate studies/University Technical education/ Vocational training	1 2 3 4 5
CR05	**What is your occupation?**	Housewife Garbage collector Seamstress Government employee Private sector employee Farmer Other (Please specify) ……………………………………………	1 2 3 4 5 6 7
CR06	**What is the father of the child's occupation?**	Driver (taxi, bus) Garbage collector Governmental employee Private sector employee. Farmer Other (Please specify) ……………………………………………	1 2 3 4 5 6

SOCIO-ECONOMIC FACTORS		
SE01	**What was the household's total income last month?**	____________________Rand
SE02	**How many people are supported by the total household income?**	____________________People
SE03	**What was the household's total expenditure last month?**	____________________Rand

EC01	**What is the main source of drinking water for the household?** *Circle only one category*	Public tap Private tap Protected well Open well in yard Spring River/stream Lake Purchased bottle water Other ………………………………………	1 2 3 4 5 6 7 8 9

THE CHILD			
CC01	**How many children below 5 years live in this household?** |□ children *If the answer is more than one, **randomly** select one child aged between 0-59 months*		|□ |□
CC02	**What is your relation to the child?**	Mother Grandmother Carer Father	1 2 3 4
CC03	**Is the child a boy or a girl?**	Boy Girl	1 2
CC04	**How old is the child?** *In completed years and months*	Years: months DK	|□_|□_|□:|□ |□_|□ 98
CC05	**What was the child's birth weight?**	DK	|□_|□_|□_|□ |□ grams 98

BREASTFEEDING (If respondent is not the child's mother, skip module after marking n/a)				
BF01	**Did you ever breastfeed the child?**	Yes No N/A	1 2 97	 → END MODULE
BF02	**How old was the child when you stopped breastfeeding?**	|□__|□__|□months		
BF03	**Why did you stop breastfeeding?**	Child was too old to continue breastfeeding Child did not want breast milk anymore Breastfeeding was inconvenient I had problems with the breastfeeding Other (Please specify) ……………………………………………	1 2 3 4 5	

Can you tell me if you agree or disagree with the following statements? 1 Agree; 2 Disagree		
BF04	A child needs other food and drink besides breast milk during the first 6 months of life	1 2
BF5	Formula milk is better than breast milk	1 2
BF6	Breastfeeding protects the child against infections	1 2
BF7	After 6 months of age, a child should breastfeed on demand until 2 years or beyond in addition to complementary food	1 2

DIETARY PRACTICES			
DP01	**How old was the child when you started to give food in addition to breast milk?**	*Answer in <u>completed</u> months* DK N/A	|□__|□ |□months 98 97

Can you tell me if you agree or disagree with the following statements about child and infant feeding? 1 Agree; 2 Disagree		
DP02	Children should not eat meat until they are 2-3 years old	1 2
DP03	Children have small stomachs and therefore need small servings with food rich in energy	1 2
DP04	Children should not start with food in addition to breast milk before the age of 6 months	1 2
DP05	By 12 months most children can eat the same types of food as consumed by the rest of the family	1 2
DP06	How many meals per day does this child eat?	|□__|□__|□ times/day
DP07	How many snacks per day does this child eat?	|□__|□__|□ times/day

Concurrent illnesses				
OZ01	**Any concurrent illnesses?**	Yes No DK	1 2 3	If yes, specify

OZ02	**Have you ever treated this child for diarrhoea?**	No	If yes, how often?	1 2 3	Rarely Sometimes Very often

IM Immunization status (information from medical records)	
IM01 Up to date?	YES / NO
IM02 Not up to date?	YES / NO
IM03 If not up to date, what is missing?	

ANTHROPOMETRIC MEASUREMENTS CHILD			
Age in completed months ____________months.	Weight (kg) ________kg.	Height/length (cm) MUAC cm __________cm.	
MC01	Stunting	Normal height for age Stunted (z-score < 2 SD from median value) Severely stunted (z-score <3 SD from median value)	1 2 3
MC02	Wasting	Normal weight for height/length Wasted (z-score < 2 SD from median value) Severely wasted (z-score < 2 SD from median value)	1 2 3
MC03	Underweight	Normal weight for age Underweight (z-score < 2 SD from median value) Severely underweight (z-score < 3 SD from median value)	1 2 3

Appendix IV Letter requesting permission to use survey/questionnaire tool

Dr Makanda Bob Itaka
Registrar: Family Medicine
Wits Student N◦ 778822

Private Bag X 535
TAUNG
Republic of South Africa
✆ 0027738457024
💻 bobmakanda@yahoo.fr

Professor Akhar Hussain
University of Oslo
NORWAY
PB 1130 BLINDERN

Ref.: *Permission to use survey/questionnaire tool of your student study Mr M.Kolbrek:_Malnutrition and associated factors in children aged 0-60 monthsin urban Indonesia*

Dear Professor Hussain,

I am a registrar in the Department of Family Medicine, Wits University conducting my research titled, 'Factors associated with malnutrition among under five years old children hospitalised in the Sedibeng District, Gauteng Province, Republic of South Africa' under the supervision of Dr OB Omole (Head of clinical Sedibeng District /senior lecturer wits), who can be reached at phone/email: 0027764721289 /alagbaomole@gmail.com.

I would like your permission to use an adapted questionnaire instrument form your student's survey or questionnaire tool of the above mentioned survey for my research. I would like to use your survey under the following conditions:

- I will use the surveys only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will include the copyright statement on all copies of the instrument.

If these are acceptable terms and conditions, please confirm your response via my e-mail address: bobmakanda@yahoo.fr

Please find enclosed a copy of the adapted questionnaire.

Sincerely,

---------------------- ------------------------

Dr M.B. ITAKA Date

Registrar

/Encl.1

Cc: Prof M Kolbrek
Mr Kari Kvein Lie

Appendix V Ethics Clearance Certificate (M161041)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Makanda Bob Itaka

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M161041

NAME: (Principal Investigator)	Dr Makanda Bob Itaka
DEPARTMENT:	School of Clinical Medicine Family Medicine Sedibeng District - Heidelberg, Kopanong and Sebokeng Hospitals
PROJECT TITLE:	Factors Associated with Malnutrition among under of 5-Year-Old Children Hospitilised in Sedibeng District, Gauteng Province
DATE CONSIDERED:	28/10/2016
DECISION: CONDITIONS:	Approved unconditionally
SUPERVISOR:	Dr OB Omole
APPROVED BY:	Prof C Feldman, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	20/12/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in October and will therefore be due in the month of October each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date 02/02/2017

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix VI Permission to perform a study at Sedibeng District

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Dr. V. Figueroa
Directorate: Family Medicine
Tel: 016 428 7184
Fax: 016 950 6034

TO	:	**CEOs and Clinical Managers – (Kopanong, Sebokeng and Heildelberg Hospital)**
CC	:	**Dr. O.B Omole -**
FROM	:	**Dr. Victor Figueroa – Research Coordinator – Sedibeng DHS**
DATE	:	**21 July 2016**
SUBJECT	:	**Dr. M. B Itaka's Research**

This is to certify that Dr. M.B Itaka, is currently a Registrar in family Medicine in Sedibeng District and will be conducting research as part of the requirement of the Faculty in pursuing Master Degree in Family Medicine.

The title of the study is: Factors associated with malnutrition among children 0 to 60 months hospitalised at Hospitals in Sedibeng District.

Please kindly assist him with his need.

Regards,

DR. Victor Figueroa
Research Coordinator
SEDIBENG DISTRICT HEALTH SERVICES

DATE: 2016/07/21

1

Appendix VII Permission to perform a study at Sebokeng Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Dr Z Ngcwabe
Directorate: Sebokeng Hospital
Tel: +27 (0)16 930 3300
Fax: +27 (0)16 988 1964
Fax2mail: 086 570 7442
E-mail: ZolelaN@gpg.gov.za / Helena. Lewis@gauteng.gov.za
Ref: 1/6/2

TO	:	**Dr. M.B. Itaka**
		Registrar: Family Medicine
CC	:	**Dr. V. Figueroa**
		Research Coordinator–Sedibeng DHS
FROM	:	**Dr. Z. Ngcwabe, Chief Executive Officer**
DATE	:	**29 November 2016**
RE	:	**Request to perform a study at Sebokeng Hospital**

Permission is hereby granted for your request to perform the following study at Sebokeng Hospital.

Study title
Factors associated with malnutrition among children 0 to 60 months hospitalized at Hospitals in the Sedibeng District.

Kind regard

Dr. Z. Ngcwabe
Chief Executive Officer

Appendix VIII Permission to perform a study at Kopanong Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

KOPANONG HOSPITAL
Private Bag X031, Vereeniging, 1930

OFFICE OF THE CHIEF EXECUTIVE OFFICER

Enquiries : Dr. P. Mabena
Tel. No. : 016-4287160
Fax no: : 016-4281148

22 February 2017

TO WHOM IT MAY CONCERN

Approval to conduct research by Dr. M.B. Itaka Paediatric department is subject to the following conditions:

1. Study should not disrupt the services of the unit.
2. The data colletion form/sheet for record reviews being submitted should specify exact information extracted from patient's records.
3. Hard copy of the final report of the study and recommendations should be submitted to the CEO of Kopanong Hospital.
4. May need Provincial Research Office approval.

DR. P. MABENA
ACTING CLINICAL MANAGER

DATE: 22/02/2017

Appendix IX Permission to perform a study at Heidelberg Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

TO: DR. M.B. ITAKA
RESEARCHER (FAMILY MEDICINE IN SEDIBENG DISTRICT)

FROM: DR. E.R. MASILELA
CHIEF EXECUTIVE OFFICER
HEIDELBERG HOSPITAL

SUBJECT: MASTER DEGREE IN FAMILY MEDICINE

The above subject bears reference.

Your application to conduct family medicine research is herein acknowledged and approved

You are further requested to furnish my office with your project plan / proposal to enable us to monitor compliance and provide you with necessary support you may require.

Kindly ensure that you provide us with the report once your project has been completed

Regards,

DR. E.R. MASILELA
CHIEF EXECUTIVE OFFICER

DATE: 29/11/2016

Appendix X Permission to use questionnaire

Imprimer

Objet : RE:Permission to use research questionnaire

De : Malfrid kolbrek (malfkolberk@gmail.com)

À : bobmakanda@yahoo.fr;

Cc : duo-hjep@ub.uio.no;

Date : Dimanche 26 août 2016 21h01

Bob
Yes, you have my permission to use the research questionnaire under the conditions you indicated . I would also be very interested in the results of you dissertation when it is available. Could you share it?
Cheers

--
Prof Malfrid Kolbrek
MD,PHD
Tel :0047 452 98 992

UiO
University of Oslo