

CONTRIBUTING FACTORS TO MALNUTRITION AMONG CHILDREN 0-60 MONTHS IN DORA NGINZA HOSPITAL, EASTERN CAPE

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Declaration

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Abstract

Introduction: South Africa has a high prevalence of malnutrition, presenting as undernutrition and overnutrition in its various forms and affecting children and adults alike. Children within Nelson Mandela Bay (NMB) are affected by malnutrition, especially stunting, while wasting and overweight is also prevalent. A poor nutritional status has long-term consequences on an individual in terms of cognitive development as well as increasing the risk of chronic disease later on. On a larger scale, nutritional deficiencies can influence school performance, increase the cost of medical expenses and therefore affect the economy as a whole. In order to implement interventions within a community, it is necessary to understand what the contributing factors are. More specific and comprehensive data regarding contributing factors to malnutrition is needed in the NMB area.

Aim: The aim of the study is to determine the contributing factors to malnutrition in children 0-60 months in Dora Nginza Hospital (DNH) in the Eastern Cape Province in South Africa.

Methods: The study followed a cross-sectional design using a quantitative approach. A convenience sample (n=184) of children 0-60 months were included from the DNH Paediatric Outpatient Department (POPD) and collected between May and July 2018 (Ethics approval: S17/10/192). Primary caregivers provided informed consent for themselves and their child for participation. The researcher and a trained research assistant completed a structured questionnaire which included socio-economic factors, health status, dietary patterns, -diversity and household food security as possible contributing factors to malnutrition and anthropometric measurements were performed for both the child and the caregiver according to standardised methods. The anthropometric data of the child was analysed using a World Health Organisation (WHO) anthropometry software programme to obtain z-scores. Relationships were explored between anthropometric measures and possible contributing factors to malnutrition. The questionnaire was developed in such a way to aim to include questions that are related to contributing factors of malnutrition found throughout literature. These include questions regarding socio-economic factors, health factors, dietary patterns, dietary diversity and household food security and the anthropometry of the caregiver was used to explore relationships between the anthropometry of the child.

Results: Most caregivers were female and more than half completed high school, yet almost 75% were unemployed. Half of households had an income of less than R2000, which is insufficient to ensure livelihood. A total of 25.6% of children were stunted, 19.8% were underweight for age, 6.4% were either Moderate Acute Malnutrition (MAM) or Severe Acute Malnutrition (SAM) and 7.2% were overweight or obese. Most of the caregivers (58.2%) were either overweight or obese. The Food Frequency Questionnaire (FFQ) showed a poor consumption of meat, dairy, fruit and vegetables and the most consumed foods being soft porridge, margarine, potatoes, white bread and chips. The most consumed dairy product was yoghurt and the most consumed meat was chicken and processed meat (polony). More than half (54%) of participants had an excellent Dietary Diversity Score (DDS) and 21.9% had an adequate DDS and 91% of children met the minimum dietary diversity score. The FFQ has shown that the frequency of consumption is relatively low for a variety of foods. When measuring household hunger,

the results showed that only 33.2% of households were food secure, with 66.8% being either at risk of hunger or food insecure.

A significant slightly positive correlation was found between the Body Mass Index (BMI) of the caregiver and the size of the child, showing the impact of genes or being exposed to a similar environment; other than the expectation, the double burden of malnutrition was not prevalent within one household. Child Dietary Diversity Score (CDDS) also showed a significant slightly positive relationship between a number of anthropometric indicators, showing nutritional status to improve when a more varied diet is eaten. DDS also showed a slightly positive correlation with the Household Food Insecurity Access Scale (HFIAS), showing that dietary diversity improves with an increase in food security. The Child Dietary Diversity Score (CDDS) also showed a strong positive correlation to the age of the child, meaning that a variety of food intake to increases as the child ages.

Conclusion and recommendations: The prevalence of stunting among children at DNH, NMB was high together with higher underweight and wasting than expected in the area. The majority of caregivers were overweight or obese, which showed a slightly positive correlation with WHZ of the child; heavier caregivers showed to have heavier children, which could indicate the influence of genes or residing in a similar environment. As expected, a lack of dietary diversity was correlated with a poorer nutritional status while food insecurity was correlated with a poor diversity of the diet. Poverty was identified as a possible underlying contributing factor to malnutrition; contributing to food insecurity and therefore poor dietary intake. Carbohydrate-rich food was most consumed while the intake of protein, fruit, vegetables and dairy products were poor among most children, this can be explained due to affordability of carbohydrates compared to other food groups. Dietary intake showed to become more diverse with an increase in the age of the child. This can be expected as a child is gradually introduced to new foods, but also emphasizes the importance of teaching caregivers to introduce a variety of food from complementary-feeding age.

Even though some nutrition education programs are currently implemented in the Eastern Cape, it is recommended that further education programs are implemented within Dora Nginza Hospital as well as surrounding areas. Dietitians and Nutritionists play a crucial role in terms of nutrition education and it may be necessary to create more jobs in these areas. Other programs to continue and strengthen include the training of selected community members to act as “mentor mothers” in order to provide support and accurate nutrition education information to families. Nutrition education should focus on breastfeeding support in order to improve continuation of breastfeeding, teaching households to grow their own food in order to improve food security as well as suitable complementary feeding practices and optimal nutrition on a limited budget. Social grants should be evaluated regarding the sufficiency of these amounts and possibly be combined with food parcels for the family to improve dietary intake. Further research in a non-hospital environment within the municipalities in order to compare the data to a healthy population is recommended. A National study regarding food consumption in children is also necessary to be repeated for comparison and to plan suitable National nutrition programs according to these results.

Opsomming (Afrikaans)

Inleiding: Suid-Afrika het 'n groot hoeveelheid wanvoeding wat veral voorkom as ondervoeding en oorvoeding in verskillende vorme en dit affekteer grootmense en kinders terselfdertyd. Kinders in die Nelson Mandela Baai (NMB) area word geaffekteer deur wanvoeding, veral dwerggroei, terwyl ondergewig en oorgewig ook voorkom. 'n Swak voedingstatus het langtermyn gevolge vir 'n individu in terme van breinontwikkeling en 'n verhoogde risiko vir kroniese siektes later in hul lewe. Op die langtermyn, kan nutrisionele tekorte skool prestasie beïnvloed, die koste van mediese uitgawes verhoog en op 'n groot skaal, die ekonomie van die land negatief beïnvloed. Vir die doel om intervensies in 'n gemeenskap te beplan, is dit nodig om te verstaan wat die bydraende faktore tot wanvoeding is. Spesifieke en gedetailleerde data rakend die bydraende faktore tot wanvoeding is nodig binne die NMB area.

Doelwit: Die doel van die studie is om vas te stel wat die bydraende faktore is tot wanvoeding in kinders 0-60 maande oud in Dora Nginza Hospitaal in die Oos-Kaap Provinsie in Suid-Afrika.

Metode: Die studie het 'n deursnee-studie ontwerp gevolg deur gebruik te maak van 'n kwantitatiewe benadering. 'n Geriefliksheid monster van die populasie (N=184) van kinders tussen 0-6 maande was ingesluit vanaf die DNH pediatrie buite-pasient department. Die data was ingesamel tussen Mei en Julie 2018 (Etiese goedkeuring nommer: S17/10/192). Primêre versorgers het ingeligte toestemming verskaf vir deelname aan die studie vir hulself en hul kind. Die navorser en opgeleide navorsings assistent het 'n gestruktureerde vraelys saam met die versorger voltooi en antropometriese metings was op die versorger en die kind gedoen volgens gestandaardiseerde metodes. Antropometriese data van die kind was geanaliseer deur gebruik te maak van 'n WHO antropometriese sagteware program om die Z-tellings te bekom. Verhoudings tussen antropometriese metings en moontlike bydraende faktore tot wanvoeding was verder ondersoek.

Resultate: Die meerderheid van die versorgers was vroulik en meer as die helfte het hoërskool voltooi, tog was meer as 75% werkloos. Die helfte van die huishoudings het 'n inkomste van minder as R2000 per maand gehad. 'n Totaal van 25.6% van kinders het dwerggroei gehad, 19.8% was ondergewig vir ouderdom, 6.4% was middelmatig tot erg wangevoed en 7.2% was oorgewig of vetsugtig. Die meerderheid (58.2%) van versorgers was oorgewig of vetsugtig. Die voedsel frekwensie vraelys (FFQ) het gedui op 'n swak inname van vleis, suiwel produkte, vrugte en groente en die kossoorte wat die meeste geëet was, is sagte pap, magarien, aartappels, witbrood en skyfies. Die suiwelprodukt wat die meeste geëet was, is jogurt en die vleis wat die meeste geëet was, is hoender en polonie. Meer as helfte (54%) van die kinders het 'n uitstekende diverse dieet telling (DDS) gehad en 21.9% het 'n voldoende DDS gehad. Die voedsel frekwensie vraelys (FFQ) het gedui daarop dat alhoewel 'n redelike groot verskeidenheid kos geëet word, dit nie gereeld geëet word nie. Die Huishoudelike voedselsekureit is gemeet (deur die HFIAS) en die resultate het daarop gedui dat slegs 33.2% van huishoudings voedselsekureit gehad het.

'n Beduidende effens positiewe verwantskap was teenwoordig tussen die BMI van die versorger en die grootte van die kind, wat daarop kan dui dat gene sowel as 'n soortgelyke omgewing 'n invloed mag hê op die grootte van die kind, hoewel 'n dubbele las van wanvoeding in een huishouding verwag is.

Die kinder dieet diversiteit telling (CDDS) het 'n beduidende effens positiewe verhouding gewys teenoor 'n aantal antropometriese indikatore, wat daarop dui dat voedingstatus kan verbeter wanneer 'n meer diverse dieet geëet word. Die DDS het ook 'n effens positiewe beduidende verwantskap gewys met HFIAS, wat daarop dui dat die dieet diversiteit verbeter met 'n verbetering in voedselsekureit. Die CDDS het ook op 'n sterk positiewe korrelasie tussen die ouderdom van die kind, wat beteken dat die variasie in kos inname toeneem met 'n toename in ouderdom van die kind.

Samevatting en aanbevelings: Die teenwoordigheid van dwerggroei was redelik hoog in kinders by Dora Nginza Hospitaal in Nelson Mandela Baai sowel as 'n hoër teenwoordigheid van ondergewig en uittering as wat verwag is in die area. Die meeste versorgers was oorgewig of vetsugtig en het 'n effens positiewe beduidende verwantskap gewys teenoor die gewig-vir-lengte z-telling (WHZ) van die kind, wat kan dui op die invloed van die ouer se gene of die invloed van dieselfde omgewing op die groei van die kind. 'n Tekort aan 'n diverse dieet, het gelei tot 'n swakker nutrisionele status en 'n tekort aan voedselsekureit het ook gelei tot 'n minder diverse dieet. Armoede was geïdentifiseer as 'n moontlike onderliggende bydraende faktor tot wanvoeding wat kan bydra tot voedselonsekerheid en daarom ook 'n suboptimale diet. Koolhidraatryke kossoorte was die meeste geëet, terwyl die inname van proteïen, vrugte, groente en suiwel swak was in kinders; dit kan bygedra word tot die bekostigbaarheid van koolhidrate in vergelyking met ander voedselgroepe. Die dieetinname van kinders het meer divers geraak soos 'n kind ouer word, dit kan verwag word, aangesien 'n kind geleidelik aan nuwe kossoorte voorgestel word, maar dui ook op die belang daarvan om vir versorgers te leer om 'n verskeidenheid kossoorte aan die kind voor te stel.

Alhoewel daar reeds sommige voedingsopvoedings programme in die Oos-Kaap geïmplementeer is, word dit aanbeveel dat daar nog voedingsprogramme in Dora Nginza Hospitaal sowel as omliggende gebiede geïmplementeer word. Dit mag nodig wees om nog poste te skep vir Dieetkundiges en Voedingkundiges om 'n groter area te dek en die kapasiteit te hê om meer ondersteuning en inligting aan families te verskaf. Huidige suksesvolle programme soos die "mentor moeder" program waar sekere gemeenskapslede opgelei word om voedingsinligting en- ondersteuning aan families te verskaf, moet uitgebrei en versterk word. Voedingsopvoeding moet fokus op borsvoeding ondersteuning om die voortdoring van borsvoeding te verbeter, huishoudings moet geleer word om hul eie groente te kweek en sodoende voedselsekureit te verbeter en inligting moet verskaf word oor gepaste komplimentêre voedingspraktyke en optimale voeding met 'n klein begroting. Maatskaplike toelae moet ook geëvalueer word op 'n Nasionale vlak om vas te stel of die bedrag voldoende is en of dit moontlik eerder met 'n voedselpakkie gekombineer kan word om dieetinname te verbeter. Verdere navorsing in die maatskaplike gebiede buite die hospitaal kan gedoen word om die navorsing resultate te vergelyk met 'n gesonde populasie. 'n Nasionale studie moet herhaal word rakende voedselinname in kinders. Die resultate van die studie kan gebruik word om resultate in kleiner gebiede mee te vergelyk en ook om Nasionale voedingsprogramme te beplan volgens die resultate.

Acknowledgements (and dedication)

I would like to dedicate this Master dissertation to my Heavenly Father, who gave me strength, motivation and endurance to complete this project. I would also like to acknowledge my parents, Desiré and Patrick Clarke, as well as my fiancé, Jesse Qiao, for continuous support and encouragement with the completion of my Master degree. I also want to dedicate this work to the late Ilse de Villiers. A great Dietitian, and a great friend who tirelessly encouraged me to not give up on working on this thesis. May her soul rest in peace.

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List of abbreviations

ABBREVIATION	MEANING
AIDS	Acquired Immunodeficiency Syndrome
ARI	Acute respiratory infection
BMI	Body mass index
BW	Body weight
CCHIP	County children's health initiative programme
CDDS	Child dietary diversity score
CHW	Community healthcare worker
DAFF	Department of Agriculture, Fisheries and Forestry
DALY	Disability adjusted life years
DDS	Dietary diversity score
EBF	Exclusive Breastfeeding
FAO	Food and agriculture organisation
FFQ	Food frequency questionnaire
GHI	Global health index
GIT	Gastrointestinal tract
HAZ	Height-for-age z-score
HCW	Healthcare worker
HFIAS	Household Food Insecurity Access Scale
HHS	Household hunger scale
HIV	Human immunodeficiency virus
IDDS	Individual Dietary Diversity Score
IFAD	International Fund for Agricultural Development
IUGR	Intrauterine growth restriction
IYCF	Infant and Young Child Feeding
KZN	KwaZulu-Natal
LBW	Low birth weight
LMIC	Low and middle-income country
LRTI	Lower respiratory tract infection
MAM	Moderate Acute Malnutrition
MBFI	Mother-Baby Friendly initiative
MDD	Minimum Dietary Diversity
MDG	Millennium Development Goal
MUAC	Mid-Upper Arm Circumference
NCD	Non-communicable disease
NFCS	National Food Consumption Survey
NMB	Nelson Mandela Bay
PEM	Protein energy malnutrition
PFBGDG	Paediatric Food Based Dietary Guidelines
PHC	Primary Health Care
POPD	Paediatric Outpatient Department
R991	The Regulations Relating To Foodstuffs for Infants and Young Children
PUFA	Polyunsaturated fatty acids
RDP	Reconstruction and Development Programme
RTHB	Road to Health Booklet

RVD	Retroviral disease
SA	South Africa
SR	Systematic review
SADHS	South African Demographic and Health Survey
SAM	Severe Acute Malnutrition
SANHANES	South African National Health and Nutrition Examination Survey
SASSA	South African Social Security Agency
SDG	Sustainable Development Goal
SGA	Small for Gestational Age
SR	Systematic Review
TB	Tuberculosis
UN	United Nations
UNICEF	United Nations Children's Fund
VAD	Vitamin A Deficiency
WASH	Water, Sanitation and Hygiene
WAZ	Weight-for-age z-score
WFP	World Food Programme
WHO	World Health Organisation
WHZ	Weight-for-height z-score

Contributions by principal researcher and fellow researchers

I developed the research concept, then wrote the protocol and obtained permission necessary from HREC, the hospital and the Eastern Cape Province. I also captured the data and wrote the thesis.

Prof Xikombiso Mbhenyane advised regarding the research topic, assisted in improving the protocol, assisted in submitting the protocol to HREC for approval, organised an assistant to capture anthropometry into WHO software and provided advice and guidance regarding thesis writing. She also assisted with a nomination for NRF funding on her project.

Dr Liana Steenkamp provided additional advice regarding the protocol and thesis writing throughout.

Tonya Esterhuizen performed the majority of statistics for the research project.

Dr Tambe Ayuk further assisted with thesis writing, focusing on the discipline of statistics and interpretation.

CHAPTER 1: INTRODUCTION

1.1 Background information

The double burden of malnutrition is a global phenomenon that is prevalent, worsening and is affecting adults and children alike (WHO, 2017). It is also prevalent in South Africa, where under- and overnutrition co-exists within one city, community and even within one household (UNICEF, 2012; Shisana et al., 2013). The Eastern Cape, including NMB, is an area where the double burden of malnutrition has a widespread presence (StatsSA, 2012; Jordaan and Mbambisa, 2015). The generality of malnutrition, presenting as under- and overnutrition as well as micronutrient deficiencies are clearly seen in South Africa as well as in the Eastern Cape (UNICEF, 2012, StatsSA, 2012, Shisana et al., 2013).

The double burden of malnutrition is characterised by the coexistence of undernutrition together with overweight, obesity or nutrition-related non-communicable disease (NCD) within individuals, households and populations across the life course (WHO, 2017).

According to WHO statistics, one in every three people globally has at least one form of malnutrition; these include wasting, stunting, micronutrient deficiencies, overweight or obesity and diet-related NCDs (WHO, 2017). The same set of data also revealed that 462 million adults are underweight globally and 1.9 billion are overweight or obese (WHO, 2017). Also, 41 million children under the age of five are overweight or obese while 155 million are chronically undernourished (WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). According to recent studies, low- and middle income countries (LMICs) are experiencing a rise in childhood overweight and obesity (WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). Furthermore, micronutrient deficiencies are also a global health problem in children which can contribute to weakened immunity, poor growth and can even influence cognitive development (UNICEF, 2007). Forty seven percent of children globally are anaemic and 33% have Vitamin A deficiency (VAD) (Tzioumis and Adair, 2014).

In South Africa, malnutrition is characterised by both underweight (which includes stunting and wasting) and overweight (UNICEF, 2007). Three studies were compared; UNICEF (2007), SANHANES-1 (2013) and SADHS (2016). Older statistics from UNICEF were included for reference. When comparing the three studies, the prevalence of stunting ranged from 15.4% to 27%, wasting ranged from 3% to 6% and overweight ranged from 7.7% to 13% (UNICEF, 2007; Shisana et al., 2013; SADHS, 2016). These studies included data from different periods of time and even included different age groups, but consistently throughout all three surveys the rising trend in stunting and overweight is noted, while wasting was decreasing (UNICEF, 2007; Shisana et al., 2013; SADHS, 2016).

Household hunger is decreasing in South Africa, but it is still a reality that faces many households and increases the risk of undernutrition as well as nutritional deficiencies. SANHANES-1 data showed that only 45.6% of the population were food secure, 28.3% were at risk of hunger and 26% were food insecure (experienced hunger) (Shisana et al., 2013). The Eastern Cape was one of two provinces within which the prevalence of food insecurity was more than 30% (Shisana et al., 2013).

It is clear that a call to action is needed in South Africa. Nationally, food security is improving in South Africa, however, food security on an individual level is still lacking (Devereux and Waidler, 2017). Objectively measured anthropometric indicators have only shown a small improvement in the nutritional status of children since the early 1990s (Devereux and Waidler, 2017). Different interventions have been implemented since 1998 to alleviate food insecurity. These include the child support grant (which is received by over 11 million children, younger than 18 years, monthly), pension- and disability grants, strengthened agricultural support and development (especially initiatives by the DAFF), directed feeding programs (especially within schools) and training and support with food gardens (Devereux and Waidler, 2017; Misselhorn & Hendricks, 2017; Chakona & Shackleton, 2019). Food consumption and dietary diversity in impoverished households were found to improve after the introduction of the child support grant, yet the nutritional status of children have shown minimal improvement (Devereux and Waidler, 2017). Although social grants have shown success in reducing food insecurity, the effect on severe malnutrition is insufficient (Devereux and Waidler, 2017).

In the Eastern Cape, the prevalence of stunting was 33.7% in children, while SAM (severe acute malnutrition) and MAM (moderate acute malnutrition) were relatively low at 0.4% and 1.5% respectively (Shisana et al., 2013). Overnutrition, however, has increased with 20% of children being overweight. According to these statistics, it is clear that stunting and overweight are also increasing rapidly in the Eastern Cape (Shisana et al., 2013).

1.2 Problem statement

Children within NMB are affected by malnutrition and the prevalence of stunting and overweight is increasing rapidly. Although specific statistics regarding the prevalence of malnutrition within DNH could not be accessed, it can be expected to be similar or even more prevalent than in the NMB area. The effects of stunting and overweight or obesity can especially influence the long-term health of these children and carry on into the next generation if no successful interventions are implemented. The contributing factors to this nutritional problem need to be investigated in order to motivate on a larger scale for programmes that could be implemented to reduce the prevalence of stunting and overweight in children. Thus the purpose of the study is to determine contributing factors to malnutrition in children 0-60 months in Dora Nginza Hospital in Ibhayi. Dora Nginza was selected to collect data from since it includes patients (children) from all over the region, providing information about the region without the necessity of implementing a more expensive regional study. Dora Nginza was selected to collect data from since it includes patients (children) from all over the NMB and Ibhayi region, providing information about the region without the necessity of implementing a more expensive regional study.

1.3 Research question

What are the contributing factors to malnutrition of children 0- 60 months in Dora Nginza Hospital, Eastern Cape?

1.4 Aim and objectives

The aim of the study is to determine the contributing factors to malnutrition in children 0-60 months in Dora Nginza Hospital, in the Eastern Cape Province in South Africa.

Objectives:

1. To determine socio-economic characteristics and health status of the participants
2. To determine the dietary patterns of the child using a Food Frequency Questionnaire
3. To determine the dietary diversity score using a 24-hour recall
4. To determine the household food security using the Household Food Insecurity Access Scale
5. To determine the nutritional status of the child using anthropometric measurements and observe trends in the Road to Health Booklet
6. To explore relationships between socio-economic and household factors, health status, dietary patterns, dietary diversity, food security and anthropometry

1.5 Significance and motivation

The consequences of malnutrition can affect children in both the short- and long term. Undernutrition in its various forms (wasting, stunting, and micronutrient deficiencies) has shown to increase the children's risk for disease and death (UNICEF, 2012; WHO, 2017). Overnutrition increases the risk for diet-related NCD's later in life, which include cardiovascular disease, certain cancers and diabetes (UNICEF, 2012, WHO, 2017). It is of utmost importance to decrease the prevalence of malnutrition in order to improve the health of children. Some contributing factors have been identified as well as some of the interventions that have been implemented to alleviate the problem at management or national level. It is, however, still necessary to find specific contributing factors to malnutrition within a community in order to address the problems contextually.

More research is needed to identify contextual contributing factors to the prevalence of malnutrition in its different forms (overnutrition, underweight and stunting) in order to target intervention programmes more specifically, in local areas. This study aims to highlight what the main contributing factors to malnutrition amongst children and the area that will be focused on in this study is the NMB or Ibhayi area. The information obtained can provide some insight into these factors to be used when planning training programmes as well as motivating for further, more comprehensive research to be done.

1.6 Proposed thesis layout

The proposed thesis layout (as seen below) will consist of the introduction followed by the literature review. The methodology will be explained followed by the results of the study, the discussion and finally the conclusion and recommendations.

Chapter 1: Introduction

Chapter 2: Literature review

Chapter 3: Methodology

Chapter 4: Results

Chapter 5: Discussion

Chapter 6: Conclusion and recommendations

CHAPTER 2: LITERATURE REVIEW

The purpose of this chapter is to examine and explore more about what is already known about malnutrition in order to compare and to build on currently known knowledge. The chapter includes an overview of malnutrition, the causes and risk factors of malnutrition, the consequences of malnutrition, possible interventions to prevent and combat malnutrition and tools that were used in the study.

2.1 Overview of malnutrition

Malnutrition refers to deficiencies, imbalances or excessive intake of energy, protein or other nutrients and includes both over- and undernutrition (Blössner and de Onis, 2018). Undernutrition manifests as underweight, wasting and stunting while overnutrition manifests as overweight and obesity (Blössner and de Onis, 2018). WHO defines malnutrition as the coexistence of undernutrition and overweight, obesity or NCD and is prevalent in adults and children alike (WHO, 2017).

Malnutrition in all its forms affects people globally and individuals of all socio-economic circumstances. This is evident in different forms of malnutrition co-existing within the same country, region, community or household (Shisana et al, 2013; Branca and Lartey, 2016). Malnutrition has many contributing factors including poor diet and infectious diseases (Blössner and de Onis, 2018). These factors are closely related to the standard of living, the environment and whether a population is able to meet its socio-economic needs including food, housing and healthcare (Blössner and de Onis, 2018).

Primary malnutrition is considered a deficiency of essential nutrients including macro- and micronutrients and is usually precipitated by poor eating habits (Piniel, 2016). It can be multifactorial including low birth weight (LBW), the lack of adequate food intake, frequent infections and environmental factors (Piniel, 2016). Secondary malnutrition results from an underlying disease that directly compromises growth by either influencing appetite or absorption of nutrients. Secondary malnutrition also does not resolve without treatment of the underlying cause. Secondary malnutrition occurs due to malabsorption of nutrients which could include acquired or inherited metabolic defects especially in the gastrointestinal tract (GIT), thyroid, liver, kidney, pancreas and red blood cells (Shahrin, Chisti and Ahmed, 2015). Nutritional requirements increase during growth, injury, fever and excessive secretions which can also contribute to malnutrition (Piniel, 2016).

Children are at particular risk of malnutrition due to increased nutritional requirements needed for growth and development, which means they require more energy and protein for their body mass than adults (Kleinman, 2009). Paediatric patients have lower muscle and fat percentages but higher resting energy requirements compared to adults, placing them at an increased risk of primary and secondary malnutrition (Wischmeyer and Skillman, 2008).

The main contributing factors to the double burden of malnutrition are thought to be the nutrition transition, epidemiological transition and the demographic transition (Oenema, Campeau and Delmuè, 2017). The nutrition transition can be explained as a change in dietary intake patterns and energy expenditure, characterised by a change of diets from traditional diets; high in fibre and low in fat to more “Westernised diets” which are low in fibre but high in saturated fat, sugar and refined foods (Defo, 2014; Oenema, Campeau

and Delmuè; 2017). The epidemiologic transition refers to a change in population distribution regarding mortality- and fertility patterns, life expectancy and causes of death which leads to a change in demographic patterns (McKeown, 2009). The demographic transition is characterized by very rapid demographic change, characterized by an era of rapid population growth (Bongaarts, 2009; McKeown, 2009; Defo; 2014).

Rapid demographic changes are experienced worldwide; some of these include an expansion of population size, change of population age groups, urbanisation and structural family changes. The large expansion of human numbers and changes in age structure is thought to have multiple consequences for the economy, society and the environment (Bongaarts, 2009). When considering the nutrition transition, it is important not just to understand the dietary and health changes that occur but to focus on implementing policies and programmes to redirect the nutrition transition (Defo, 2014).

The Millennium Development Goals (MDGs) had only one nutritional goal, aiming for a 50% reduction in the prevalence of underweight in children under five years of age between 1990 and 2015 (Osgood-Zimmerman et al., 2018). In 2012, WHO member states, (countries who are members of the WHO), put more focus on nutrition and endorsed a broader agenda to improve nutrition by 2025 (WHO, 2012). A resolution was adopted by the United Nations (UN) where a decade of action on nutrition from 2016 to 2025 was proclaimed (Branca and Lartey, 2016; Oenema, Campeau and Delmuè, 2017).

The goal of the action on nutrition is to encourage intensified action to end hunger and eradicate malnutrition as well as ensuring universal access to healthier and more sustainable diets (Oenema, Campeau and Delmuè, 2017). The policy further encourages the use of more cost-effective interventions and policies, especially to address the double burden of malnutrition. The suggested intervention also aims to contribute to achieving Sustainable Development Goals (SDGs). The SDGs were built on the success of the MDGs and also aim to end all forms of poverty (Oenema, Campeau and Delmuè, 2017). The SDGs will succeed the MDGs as reference for the goals of international community development for 2015-2030 (Le Blanc, 2015).

The SDGs can be described as an integrated system with multiple goals (Le Blanc, 2015). Some parts of the SDGs are well connected while others have weaker connections with the rest. The benefit is that SDGs are seen as a more integrated system compared to the MDGs. (Le Blanc, 2015).

At least 12 of the 17 SDGs contain indicators which are relevant to nutrition, which shows the important role of nutrition in sustainable development (Arthur et al., 2015). UNICEF stated that nutrition is the platform for progress in health, education, employment, female empowerment and poverty as well as inequality reduction (UNICEF, 2017). Poverty, inequality, water, sanitation, hygiene, education, food systems, climate change, social protection and agriculture have an important outcome on nutrition (UNICEF, 2017).

The SDG related to nutrition, namely *end hunger, achieve food security and improved nutrition and promote sustainable agriculture* (SDG 2) calls for an end to all forms of malnutrition by 2030 (Branca and Lartey, 2016; Oenema, Campeau and Delmuè, 2017). This goal is ambitious, but it brings no clear direction on how to achieve this. It is suggested to rather have more clearly defined targets, formulated in terms of absolute rather than relative change (Osgood-Zimmerman et al., 2018). A call of action was issued to all countries, urging all countries to build economic growth and to address social needs including health, social and job opportunities (WHO, 2017). The SDGs are not legally binding, but governments are expected to take ownership and establish national frameworks to achieve the goals (Oenema, Campeau and Delmuè, 2017). It is suggested that countries adopt evidence-based public health programmes to track and improve progress (Osgood-Zimmerman et al., 2018).

Many role players would need to be involved for a lasting impact on the nutritional status of adults and children. The FAO (Food and Agriculture Organization) and the WHO are leading the effort of change in collaboration with WFP (World Food Program), IFAD (International Fund for Agricultural Development) and UNICEF (United Nations Children's Fund). Efforts for lasting change would need to be driven by the country seeking change. It is recommended that programmes should be built on existing national plans and policies and should be implemented to transform the food- and health systems (Branca and Lartey, 2016). South Africa has done so in the 2030 National Development Plan (NDP, 2012).

Malnutrition was explored on a global scale together with the current policies and programmes in place to improve malnutrition on a larger scale. Next the risk factors for individuals will be explored.

2.2 Causes and risk factors of malnutrition

UNICEF stated that childhood undernutrition is not only caused by a lack of adequate, nutritious food but also by frequent illness, poor care practices and lack of access to health and other social services (UNICEF, 2015). The UNICEF conceptual framework is a structure suggested to depict the causes of malnutrition (Tette, Sifah and Nartey, 2015). It is a guide to the analysis of the causes of malnutrition in a given context and demonstrates that the causes of malnutrition are multi-sectorial and includes food, health and care practices (Tette, Sifah and Nartey, 2015). It serves as a guide in assessing and analysing the causes of nutritional problems and helps to identify appropriate actions to be taken (Piniel, 2016).

UNICEF described the conceptual framework (figure 1) of contributing factors to undernutrition over 20 years ago which includes immediate, underlying and basic causes of malnutrition (UNICEF, 2015). The framework was since then improved by including more recent knowledge and evidence regarding the causes, contributing factors and impact of malnutrition (UNICEF, 2015). The framework may be applied in different settings including different cultures, locations and economic situations. The causes in each setting will be specific to that setting (Tette, Sifah and Nartey, 2015). The more specific causes can be identified, the more useful it can be in finding strategies to improve the nutritional status of the community at hand (Piniel, 2016).

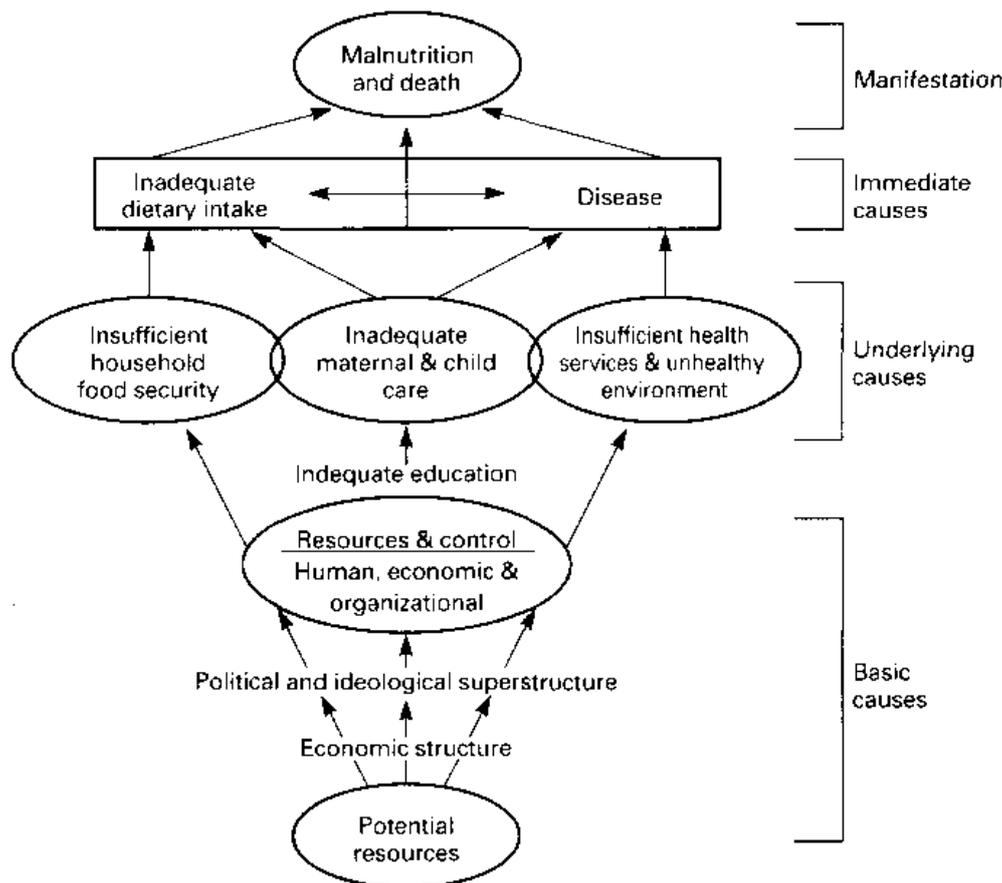


Figure 1: Conceptual Framework of the Causes of Malnutrition (UNICEF, 1990)

The immediate causes of malnutrition manifest at the individual level and include a lack of dietary intake, either from consuming too little nutrients or having increased nutritional requirements due to disease (UNICEF, 2015, Piniel, 2016). Exposure to disease is affected by household food insecurity, inadequate care and feeding practices for children, unhealthy household and surrounding environments, and inaccessible health care (UNICEF, 2015). Basic causes of poor nutrition occur at country level and include neglecting human rights, leading to a lack of essential resources and poverty (UNICEF, 2015). Undernutrition can lead to poverty and poverty leads to undernutrition, all of this creates a vicious cycle (UNICEF, 2015).

The causes of undernutrition and overnutrition are in many ways similar (UNICEF, 2015). Stunted growth in early life increases the risk of overweight later in life and factors including poverty, lack of knowledge and access to nutritious and adequate diets, poor infant and young child feeding practices, and marketing and sales of foods and drinks can lead to undernutrition as well as to overweight and obesity (UNICEF, 2015).

2.2.1 Basic causes of malnutrition

Malnutrition is described as a multi-dimensional problem, which is linked to social, economic and demographic conditions (Rahman and Hakim, 2016). South Africa has adequate food supply on a national level, but on a household level there is still an unequal distribution of resources (Shisana et al., 2013).

South Africa is known to have a history of inequality and unequal distribution of resources causing it to be one of the countries with the most unequal income distribution worldwide.

The Gini index is a standard to measure income inequality ranging from 0% (perfect equality) to 100% (perfect inequality). In South Africa it was measured to be 63.6% in 2011 without much improvement since then (World Bank, 2014). Some measurements have been put in place to help alleviate extreme poverty including the fiscal policy to increase the amount of tax paid by those who have a higher income while those with a lower income would pay less tax (World Bank, 2014). Other policies and programmes that have been implemented include different types of social grants, school feeding schemes, social security programmes, food support programmes and the provision of homes (RDP housing).

Although the current policies and programmes used to alleviate extreme poverty have shown some success, the longevity of these are questioned. In order to have sustainable programmes and improvement noted in these area, a change in infrastructure and broadened structural reforms are necessary to generate more jobs and lead to further economic growth (World Bank, 2014). In South Africa, the management of potential resources are of crucial importance to alleviate poverty and improve the livelihood of its people. Malnutrition has shown to have strong socio-economic roots and therefore will only show improvement if the underlying socio-economic causes are managed. The immediate- and underlying determinants of malnutrition are to some extent clear and measurable and mostly amenable to response, they in turn are rooted in the wider structural causes of poverty and unequal access to resources (Nisbett et al., 2014; Baker et al., 2018). Economic growth and political conflict are known for its impact on undernutrition which could be positive and negative. For example, economic growth is likely to have a larger impact on undernutrition rates if political choices are made to reduce income inequality (Nisbett et al., 2014).

Political commitment to nutrition on national and subnational levels are multifactorial, dynamic, strongly context-dependant and is something that is strengthened over time through strategic action (Nisbett et al., 2014). On a global level, strong commitment is noted towards nutrition as displayed by the *United Nations Decade of Action of Nutrition* (2016- 2025), but requires more commitment on a national level. Without political commitment and commitment on county-level, policies and programs are unlikely to be adopted or sustained. In order to achieve political commitment, the mobilisation of political systems and institutions are required including, adopting policies, allocating resources and coordinating responses for the duration necessary to produce results (Baker et al., 2018). In order to produce sustained commitment, they should generate commitment among implementation partners on all levels in order to mobilise financial resources (Nisbett et al., 2014).

Nutrition is often not well promoted on a higher national level and it is hard to track exactly how much is spent globally on nutrition, but a recent estimate spending on direct nutrition intervention accounted for only 0.4% of Official Development Assistance (ODA) (Nisbett et al., 2014). Some improvement was noted and further commitments by governments to nutrition spending has improved, but over the past 30 years, the wider political causes and consequences of childhood undernutrition have been neglected (Nisbett et al., 2014).

The links between nutrition and wider health and poverty are so strong that the nutrition community cannot afford to be excluded from the debate on the delivery of wider health services (Nisbett et al., 2014).

A policy brief review was published by the Department of Planning, Monitoring and Evaluation. The review intended to provide insight into poverty, especially the consequences of poverty on early childhood development, exposure to violence and the effect on the child (Barnes et al., 2017). Poverty was identified as a contributing factor to malnutrition and a large share of children in South Africa continue to live in conditions of extreme deprivation (Barnes et al., 2017). The review found that close to 12 million children are considered poor when using the upper bound poverty line in South Africa as reference (Barnes et al., 2017). The upper bound poverty line equates to a total of R779 per person per month, which allows minimal nutritional and basic essentials according to 2011 standard reference (Barnes et al., 2017).

The effect of poverty on children presents as physical hunger in various forms and also influences emotional wellbeing (Barnes et al., 2017). Homeless children were found to be at particular high risk of childhood malnutrition due to physical, mental, social and health challenges and they have also an increased risk of violence and abuse (Rahman and Hakim, 2016). Homeless children were included as an example of children at particular risk of malnutrition, but children who live in primitive dwellings may be exposed to some of the same conditions including an increased vulnerability to crime, natural disaster (e.g. fire), poor social circumstances and increased health risk (due to insufficient space for the amount of people as well as oftentimes poor sanitation).

Although poverty does not always cause hunger, many research articles have shown that the primary cause of food insecurity is low income (Gundersen, Kreider and Pepper, 2011; Wight et al., 2014). Poverty has also shown an effect on physical and emotional wellbeing. Some of the negative health outcomes were caused more by the insidious feelings related to food insecurity at home. Poverty is often accompanied with social factors which further effects emotional wellbeing including feelings of a lack of control in life, injustice, self-worth and stress regarding food access (Pickett, Michaelson and Davison, 2015). The inability to afford nutrient-rich food also predisposes individuals to undernutrition as well as overweight and obesity (Oenema, Campeau and Delmuè, 2017; WHO, 2017; Anon, 2018).

A lack of education was also reported to further enhance the vicious cycle of poverty and malnutrition (Arthur et al., 2015). Inadequate education is considered to be one of the causes of malnutrition as also indicated on the conceptual framework (Figure 1). A large study in Iran which investigated the causes of malnutrition showed that a higher family income and maternal education showed protective effects in stunting (Kavosi et al., 2014). Children were also less likely to be stunted if the mother has secondary education (UNICEF, 2016). A number of studies highlighted the importance of educating women and also training and equipping them to make better nutrition decisions for their families (Arthur et al., 2015; Branca and Lartey, 2016; Rahman and Hakim, 2016).

Lower education levels and a low income was found to increase the risk of obesity, explained by less access to healthy foods and making poorer dietary choices (Kolčić, 2012). Vorster et al. described that one of the difficulties in escaping the vicious cycle of poverty and malnutrition is explained by low levels of education of parents which can hinder their ability to promote optimal nutrition, development and health in children (Vorster et al, 2010). This can have a two-fold component; the parents could lack sufficient knowledge regarding optimal child care and by a lack of resources to provide an optimal environment for child health and development. This in change can limit education,

cognitive development and even the economic development of the country (Vorster, 2010).

2.2.2 Underlying causes of malnutrition

In this section, maternal and child care, WASH, and food security are discussed.

2.2.2.1 Inadequate maternal and child care

Women, in particular mothers, have an important role in the eradication of malnutrition (UNICEF, 2016). Gender inequality; presenting in a variety of ways including smaller wages, more work, a lack of maternity leave, a lack of access to healthcare and even eating after the men in some cultures have been present for decades and is still present today. Inequality have shown to increase the risk of a caregiver to have undernourished children (Marphatia et al., 2016). Many caregivers are single mothers, which can further place them under stress to provide for the family and at risk of food insecurity and malnutrition.

Undernourished mothers have an increased risk of giving birth to a baby with low birth weight (LBW) and the same baby would have an increased risk of predisposition to obesity (McDonald et al., 2010; Jornayvaz et al., 2016). This notion was emphasised by a study where maternal undernutrition of a mother has also shown to have an influence on the nutritional status of her child; especially putting them at risk of LBW, stunting and obesity (Branca and Lartey, 2016). When a child is born with LBW, the child has a higher risk of remaining undernourished (Piniel, 2016). The same pattern was found in a study in South Africa, where children with LBW were shown to be at an increased risk of malnutrition from birth to five years of age compared to those with a normal birth weight (Rahman et al., 2016).

Children born to undernourished mothers also have an increased risk of infectious diseases including diarrhoeal disease, lower respiratory tract infections (LRTIs), anaemia, lung disorders and other diseases which further enhances their risk of undernutrition (Rahman et al., 2016). Another risk of maternal undernutrition, is IUGR in the child, contributing to poor growth, cognitive effects and an increased risk of obesity later on in life (WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). Although not all premature infants are a result of IUGR, poor maternal nutrition and undernourished mothers increase the risk of prematurity. Premature births also have an increased risk of stunting and 20% of stunting is thought to originate in-utero (Prendergast and Humphrey, 2014).

A cohort study was performed in LMICs and found that infants with LBW were associated with 2.5-3.5 times higher risk of wasting, stunting and underweight (Christian et al., 2013). The risk for a population with small-for-gestational age (SGA) children to be stunted or wasted was 20% and 30% respectively (Christian et al., 2013). The analysis suggested that childhood undernutrition may have its origins in the foetal period, which suggests the need to intervene as early as possible, ideally during pregnancy (Christian et al., 2013). Interestingly, obese or overweight mothers also have an increased risk of LBW babies (Prendergast and Humphrey, 2014).

Many other studies also identified a less than optimal intrauterine environment as one of the leading causes of stunting (Khan et al., 2011, WHO, 2017, Oenema, Campeau and Delmuè, 2017, Anon, 2018). The exact pathogenesis of stunting is, however, poorly understood which provides challenges in terms of effective interventions (Khan et al., 2011). The intrauterine environment has shown consistently throughout literature to be one of the main causes of stunting showing to be directly related to the size of the infant (Khan et al., 2011). The prevalence of LBW babies were found to be far more prevalent in developed countries than in developing countries, which could be explained by less resources available for the mother in developing countries (Khan et al., 2011).

The intrauterine environment has long-term consequences on the nutritional outcome of a child. UNICEF describes the first 1000 days as the time period between conception and a child's second birthday (UNICEF, 2017, Cusick and Georgieff, n.d; Schwarzenberg and Georgieff, 2018). It is explained as a unique period within which time foundations of health, growth and neurodevelopment are established (UNICEF, 2017, Cusick and Georgieff, n.d.). Some studies have also found that insufficient nutrition during the first 1000 days of life, can have negative effects on mental health as well as increasing the risk of obesity, hypertension and diabetes (Schwarzenberg and Georgieff, 2018).

Foetal and neonatal programming is one of the mechanisms to explain poor growth patterns of infants postnatal (Shahrin, Chisti and Ahmed, 2015; WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). This tendency is usually seen with infants in a poor intrauterine environment, including a malnourished mother. These children usually have poor growth patterns initially, increased risk of stunting and a high risk of the metabolic syndrome and reduced quality of life later on (Shahrin, Chisti and Ahmed, 2015; WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). One theory suggested for poor growth in children subject to a suboptimal intrauterine environment, is The Barker hypothesis. This hypothesis states that foetal undernutrition in middle to late gestation leads to disproportionate foetal growth and increase the risk for later coronary heart disease (Kolčić, 2012). Different programming mechanisms were suggested, including changes in cellular signalling pathways, metabolic and hormonal responses and epigenetic modifications which can cause permanent changes leading to an increased risk for obesity, diabetes, hypertension and certain cancers into adulthood (Kolčić, 2012).

The thrifty phenotype hypothesis proposes that if a foetus is exposed to a suboptimal early environment in utero, for example if the mother is malnourished or consuming insufficient amounts of nutrients during pregnancy, the foetus makes metabolic adaptations to maximise chances of surviving postnatally (WHO, 2017). Furthermore, while the adaptations will be beneficial if the poor conditions continue postnatally, if the postnatal environment provides excessive nutrition, these individuals will be at an increased risk for obesity and diabetes due to changes in the glucose- insulin metabolism (WHO, 2017).

Both the Barker hypothesis and the thrifty phenotype hypothesis emphasises the crucial role of providing optimal nutrition to the pregnant mother as well as the infant after birth, a phenomenon now known as the first 1000 days of life. The intergenerational effect also indicated that early insults during periods of critical brain development (pre-and postnatal) can lead to epigenetic changes which could impact health and behavioural changes over the life span (Bowers et al., 2018).

Maternal age can also influence malnutrition since mothers under the age of 18 years are more likely to have stunted children (UNICEF, 2016). Teenage pregnancies and closely spaced births also increase the risk of stunting. Furthermore, pregnancies in older women are also considered higher risk pregnancies. Maternal height is also related to offspring height at all ages and maternal height is also inversely associated with mortality, underweight and stunting during infancy and childhood (Khan et al., 2011, WHO, 2017).

The main social determinants of malnutrition included low family income, unmarried status and type of child care (Tette et al., 2016). Poor maternal care practices showed to have a relationship with malnutrition although care practices have many components. Financial constraints can influence optimal care practices by causing insufficient food availability, insufficient funds for healthcare and sanitation and can also cause a lack of school attendance. A caregiver may also lack the knowledge regarding how to best care for a child. Furthermore social issues or even mental health issues can hinder optimal child care practices (Tette et al., 2016).

Mental health is another area that can contribute to the nutritional status of children. A study performed in Botswana found an association between depression of caregivers and malnutrition (Motlathledi et al., 2017). Malnourished children were significantly more likely to have depressed primary caregivers than non-malnourished children. The studies did not elaborate on the cause of depression. Other studies also found similar results indicating a relationship between the mental state (depression) of the caregiver leading to an increased prevalence of malnutrition (Santos et al., 2010; Ashaba et al., 2015 Motlathledi et al., 2017). The rationale behind the increased risk of malnutrition in depressed mother, is thought to be related to a depressed mother often being unable to respond to the needs of her child at all times due to the mental state she may be in.

Although no specific studies regarding this topic could be found in South Africa, a systematic review (SR) which includes 17 studies from across the world (including Africa) was conducted (Surkan et al., 2011). The SR reported on an association between maternal depression and impaired child growth in developing countries. The SR showed that children of depressed mothers had an increased risk of both underweight and stunting (Surkan et al., 2011). The studies included a range of depression; from mild depressive symptoms to severe depression. The overall results of the studies found that the more depressed the caregiver, the more growth faltering was found in the child (Surkan et al., 2011). It is, however, not clear whether the caregivers became depressed due to poor socio-economic conditions or whether it was a chemical imbalance.

Disease can also further aggravate socio-economic problems, since caregivers who have chronic- or infectious disease, may not live for long and have a healthy life, increasing the risk of child-headed households or more economical strain on another household (Vorster, 2010).

Children, who were not vaccinated, had an increased risk of malnutrition due to an increased risk of obtaining disease (Belaynew, 2014). Immunisation of children is essential in order to prevent infant- and child mortality. In South Africa, routine vaccinations protect against TB, diphtheria, tetanus, pertussis, polio, hepatitis B, pneumonia and measles (Kolčić, 2012). Information was collected by SADHS on the coverage of these vaccines among children 0-3 years of age. On average for all provinces, 61% of children aged 12-23 months received all basic vaccines, 53% received

all age-appropriate vaccines and coverage was lower for girls than for boys and also lower in urban than in non-urban areas (SADHS, 2016). Within the Eastern Cape, 57.3% of children 12-23 months were up to date with immunisations and 44.7% of children 24-35 months received all age-appropriate immunisations (SADHS, 2016). The statistics in NMB was a bit higher than the average at 78% immunisation achieved for children less than one year of age (EC Dept. of Health, 2019). Children who are not immunised are at risk of infectious diseases as described, which could also influence dietary intake and nutritional status.

2.2.2.2 Insufficient water, sanitation and hygiene (WASH)

Insufficient access to clean water and sufficient sanitation are underlying contributing factors to malnutrition, which would be classified as an “unhealthy environment” on the conceptual framework. Poor water and -sanitation can result in the spread of infectious diseases including diarrhoea which further increases the risk for malnutrition (Piniel, 2016). Undernutrition and illness often co-exist simultaneously since one can lead to the other, causing a vicious cycle. Illness often leads to a decreased nutritional status manifesting as growth failure, which further reduces immunity to disease and increasing vulnerability to disease (Piniel, 2016).

The influence of unsafe drinking water as well as unhygienic practices, including poor hand washing procedures, were also identified by other sources as a risk of disease and malnutrition (Belaynew, 2014; Arthur et al., 2015). A South African study from 2015 also concluded the role of insanitary conditions as contributing factors to infectious disease and therefore malnutrition (Tette, Sifah and Narthey, 2015). Primary healthcare (PHC) plays an important role in reducing the risk of malnutrition due to unhygienic practices. Primary healthcare activities include educating societies about hygienic practices and boiling drinking water if the water is unsafe for consumption. In NMB, however, the drinking water is confirmed to be safe to drink, yet not all residents of NMB may have access to clean and safe water (NMBM, 2018).

2.2.2.3 Inadequate food security

The Food and Agriculture Organisation (FAO) defines food security as follows: *Food and nutrition security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food and they are able to adequately utilize and absorb the nutrients in the food in order to be able to live a healthy and active life* (FAO, 2008). In order for a household to be food secure, food needs to be available, accessible, consumed and there should be a stable food supply (Piniel, 2016).

Food shortages are a major cause of malnutrition in many parts of the world. One cause of food shortages is a lack of technology needed to yield higher crops. Food shortages cause an increase in the price of food, causing insufficient money available to buy food for the whole family (Tette, Sifah and Narthey, 2015; Piniel 2016).

The GHI (Global Hunger Index) is one measure that is used to determine the level of hunger in a country and is based on insufficient energy intake, child morbidity and child underweight. In South Africa, the GHI is described as moderate (Shisana et al., 2013). Even though food insecurity is a reality in South Africa, the level of hunger is substantially lower than in other African countries. With that being said, inequality is present while there

is adequate food supply at national level but not on household level, showing an unequal distribution of resources (Shisana et al., 2013).

The Community Childhood Hunger Identification Project Hunger (CCHIP) index was used as an indicator to measure food security within South Africa in 2013. It was shown that 45.6% of the population were food secure, 28.3% were at risk of hunger and 26% experienced hunger (also known as being food insecure) (Shisana et al., 2013). The most hunger was experienced in rural formal and urban informal locations while the lowest hunger was experienced in urban formal areas (Shisana et al., 2013). Food insecurity was also far more prevalent in the black African race and the coloured population than in the white population (Shisana et al., 2013).

It is essential to reduce poverty as a key element in reducing food insecurity since people in impoverished situations spend a large portion of their income on food, which leads them vulnerable to elevated food prices (Shisana et al., 2013). In the Eastern Cape, poverty was shown to decrease from 14.4% in 2011 to 12.7% in 2016 with the lowest poverty headcount in NMB at only 3% (StatsSA, 2011). Even though NMB has the lowest poverty headcount, there are still households that experience hunger. The statistics showed that 464 838 of households in the Eastern Cape reported to run out of money within the past year of the survey while 17.6% of households reported that they have skipped at least one meal due to a lack of resources (StatsSA, 2011).

When hunger is experienced within a household, it has a two-fold influence; firstly, it increases the risk of malnutrition due to the consumption of insufficient calories and nutrients, and it also increases the risk of eating unhealthy, non-age-appropriate or foods that are not suitable for consumption anymore. This may further lead to disease which can increase the risk of malnutrition (Shisana et al., 2013).

The common strategies that are often applied in South Africa during times of food insecurity on a household level include limited food variety, skipping meals and limiting portion sizes (Piniel, 2016). Poor feeding strategies within food secure households can still lead to malnutrition (Piniel, 2016). More affordable foods were consumed more often, yet these are mostly high in energy and low in nutritional value, which can contribute to overweight and obesity along with stunting (Misselhorn and Hendriks, 2017).

Financial constraints were shown as one of the major causes of malnutrition and individuals within households with a low income or no income were at high risk of undernutrition (Arthur et al., 2015). Social grants are thought to be effective in reducing childhood poverty and hunger and that they are invaluable to impoverished communities, yet the amount appears to be too low to bring households out of poverty and food insecurity (Barnes et al., 2017). Unaffordable diets were described to be one of the root causes of food insecurity (Barnes et al., 2017; Misselhorn and Hendriks, 2017).

Food gardens were found to be an intervention that has the potential to enhance household food security status by increasing the household food supply, consumption and income generated. The Homestead Food Garden Program (HFG) programme which partners with NGOs to help households establish food gardens, was found to be particularly successful in LMICs, and has shown positive results in South Africa. (Tsefamariam et al., 2018). The success of the program and ability to expand the reach,

depends on the community involvement and continued support and training with local NGOs.

Nutrition education is another intervention that showed some success in reducing food insecurity. One particular successful strategy is to train *mentor mothers* who are paraprofessionals from a particular community, who does home visits and provides caregivers with knowledge and support (le Roux et al., 2010). This initiative should be continued and expanded in order to have a bigger impact in communities.

2.2.3 Immediate causes of malnutrition

These occur at an individual level.

2.2.3.1 Disease

Infectious diseases contribute to 60.7% of childhood deaths and the most malnourished children have the highest risk of mortality and morbidity due to infectious disease (Ibrahim et al., 2017). It was also found that nearly 50% of global child mortality occurs due to four infectious diseases including acute respiratory infections (ARI), diarrhoea, neonatal sepsis and malaria (Kolčič, 2012). Infectious diseases can be difficult to control especially in children since the available diagnostic tools don't always reach these children (Kolčič, 2012).

Human Immunodeficiency Virus (HIV) and Tuberculosis (TB) form a part of the vicious cycle of malnutrition since underlying chronic disease conditions including HIV, weakens the immune system, placing children at higher risk of infectious disease (Vorster, 2010; Chola et al, 2015; Massyn et al., 2016; Shashidhar and Grigsby, 2017). The increased risk for disease and death was attributed to the changes that occur to the immune system when undernutrition is present, some of which include impaired gut-barrier function, reduced exocrine secretion of protective substances and reduced antibodies produced after vaccination (Rytter et al., 2014). Undernutrition, including a deficiency of macro- and micronutrients, is an important risk factor for infectious diseases since undernutrition is known to weaken the immune system (Kolčič, 2012; Chola et al, 2015, Shashidhar and Grigsby, 2017). Malnutrition also changes the intestinal microbiota and in turn, this contributes to growth faltering and unregulated inflammation- and immune function (Ibrahim et al., 2017).

When considering malnutrition, it is important to realize the implication of disease on the nutritional status of a child. A lack of immunisation, increasing the risk of disease, can have a severe impact on the nutritional status of a child.

2.2.3.2 Dietary intake

Another immediate cause of malnutrition is insufficient dietary intake. SADHS assessed the dietary intake of children 6-23 months of age. It was measured against the Infant and Young Child Feeding (IYCF) acceptable dietary practices which include: breastfeeding or receiving two or more servings of commercial infant formula, receiving food from at least four food groups including dairy, grains, vitamin A-rich fruits and vegetables and other fruits or vegetables, eggs, meat, poultry, legumes and nuts (SADHS, 2016). The food frequency was also used according to age (SADHS, 2016). Infants should receive food

at least twice a day from 6- 9 months and three to four times a day between 9-23 months of age. From the children included in the survey, only 23% of children 6-23 months met the criteria of a minimum acceptable diet (SADHS, 2016). This confirms the fact that most children in South Africa have an insufficient intake of nutrients once complementary food is started due to providing too little food and/ or food that contains few nutrients.

Suboptimal breastfeeding- and complementary feeding practices were found to be important determinants of undernutrition (Prendergast and Humphrey, 2014). One of the barriers noted in terms of breastfeeding, was the early initiation of complementary food and a lack of dietary diversity of these foods (Siziba et al., 2015). Starting complementary feeding prematurely contributed to mothers either decreasing frequency of feeds or complete cessation of breastfeeding (Siziba et al., 2015).

Colostrum, which is the first milk produced by the mammary glands and rich in antibodies, was shown to be protective against disease and malnutrition (Belaynew, 2014). Children who did not receive colostrum after birth were found to be at an increased risk for malnutrition. This tendency was explained by the fact that colostrum is rich in Vitamin A and contributes to help prevent infections and disease (Belaynew, 2014).

Even though the benefits of breastfeeding are well known, breastfeeding practices were found and continue to be suboptimal in South Africa. According to WHO (2018), breastfeeding reduces child mortality since it provides a baby with all nutrients needed for the first six months of life and provides around half of a child's nutritional needs during the second part of the first year of life and a third during the second year of life. Breastfeeding protects the child against both chronic and infectious diseases and further also promotes sensory and cognitive development (Arthur et al., 2015; WHO, 2018). Exclusive breastfeeding is recommended for the first six months of a child's life and continued breastfeeding with appropriate complementary food from the age of six months until two years and beyond (WHO, 2018). Even though breastfeeding showed a multitude of benefits, an increased risk of malnutrition was found if exclusive breastfeeding is extended beyond six months (Arthur et al., 2015). It was also found that even if a caregiver is breastfeeding, but poor complementary feeding is provided at the appropriate time, the child still faces a risk of malnutrition (Piniel, 2016).

Even with all of the mentioned benefits, South Africa has the lowest rate of exclusive breastfeeding worldwide at only 8% as reported by UNICEF (UNICEF, 2012). SADHS results of 2016 have shown that initiation of breastfeeding increased with approximately 67% of infants who were breastfed within one hour of birth (SADHS, 2016). The exact figures of exclusive breastfeeding could not be determined by SADHS, but is estimated to be less than 50%. Additional liquids including formula milk, water and complementary foods were frequently added before six months of age and the mean duration of exclusive breastfeeding was determined at 2.9 months (SADHS, 2016). Another study performed in four South African provinces, demonstrated a high breastfeeding initiation rate at almost 50%, but a very low six-month EBF rate of only 12% (Siziba et al., 2015). These statistics reported by Siziba et al., were higher than UNICEF statistics, but it is far lower than the goal of 50% set by the 2015 post-development agenda target (Siziba et al., 2015).

Some of the reasons used to explain poor breastfeeding practices, include a lack of understanding of the benefits of breastfeeding and fears of HIV transmission (UNICEF,

2012). Some other reasons provided for mothers not breastfeeding, was having to return to work or studies, poor maternal health, the mother's HIV status and the unethical marketing of infant formula (Siziba et al., 2015). There is currently still a lack of data available regarding how socio-cultural practices impact on exclusive breastfeeding. As displayed through this section, underlying causes (for example inadequate maternal care) can lead to immediate causes (inadequate dietary intake for her child).

Although breastfeeding is considered to be the best nutrition for babies, continued breastfeeding rates are still significantly low in South Africa. Breastfeeding has the potential to save millions of lives each year, yet this resource is not utilized fully, contributing to malnutrition and childhood deaths (UNICEF, 2012). In addition, complementary feeding practices are suboptimal in terms of timing, diversity and hygiene; all of this further contributing to malnutrition in children.

2.2.4 Contributing factors to overnutrition

Urbanisation is considered a risk factor to malnutrition, specifically overweight and obesity. As early as 2002, WHO had already ranked overweight as the fifth most serious risk factor underlying the disease burden (Arthur et al., 2015). Modernisation is thought to play a large role in a lifestyle change of people, therefore, as a country develops economically, the risk of obesity may increase (Arthur et al., 2015). Urbanisation shows a protective effect against undernutrition, but puts individuals at risk for obesity (Arthur et al., 2015). Rapid economic development, globalization and urbanization have contributed to many changes in dietary patterns and activity levels and have been considered some of the main reasons for and the driving force behind the nutrition transition; a shift from undernutrition in childhood to overnutrition in adulthood (Kolčić, 2012). The FAO recognised the shift from under- to overnutrition as the double burden of malnutrition in six LMICs namely China, Egypt, India, Mexico, Philippines and South Africa (Kolčić, 2012). The simultaneous occurrence of under- and overnutrition were noted in more affluent countries, but was more pronounced in LMICs (Kolčić, 2012).

Obesity was shown to be most related to dietary patterns that are energy-dense, high in fat and low in fibre (Ambrosini, 2013). Obesity is considered to be multi-factorial. Although the neuro-pathways may have some role in the development of obesity, dietary patterns and intake was found to be the most consistent cause of obesity (Ambrosini, 2013). An alteration in protein-energy ratio during infancy, for example by introducing complimentary food before six months, can also increase the prevalence of obesity (Schwarz, 2017). Children also often develop and practice similar patterns as their parents, which can include poor food choices and inactivity (Schwarz, 2017). A similar finding was noted in a study in Indonesia which found that some of the highest risk factors for obesity are having overweight or obese parents (Rachmi et al., 2016). Several other studies have also shown that stunted children are more likely to be obese later in life (Bove et al., 2012; Tiwari, Ausman and Agho, 2014; Symington et al., 2015; Rachmi et al., 2016). A study conducted in twelve States in the USA found that adults who were food insecure had a 32% increased risk of obesity than those who were food secure (Pan et al., 2012).

2.3 Consequences of malnutrition

Malnutrition has multiple devastating effects, influencing almost every bodily system (Piniel, 2016). Some of the consequences of malnutrition consistently seen throughout literature are discussed in the sections below.

2.3.1. Weakened immunity, disease and death

Almost half (45%) of childhood deaths have nutrition related contributing factors, with undernutrition being the main cause (WHO, 2017). The risk of malnutrition to infection, disease and death was concluded by many other resources (Arthur et al., 2015; Tette, Sifah and Nartey, 2015; Oenema, Campeau and Delmuè, 2017; Anon, 2018). Another South African study also found a relationship between childhood malnutrition and mortality in both infants and neonates (Osgood-Zimmerman et al., 2018).

One of the ways that malnutrition contributes to childhood mortality is by weakening the immunity of the child which makes a child more susceptible to disease, including severe and chronic infections (Tette, Sifah and Nartey, 2015; Piniel, 2016). Protein and micronutrient deficiencies impact hematopoietic and lymphoid organs and compromise immune functions (Ibrahim et al., 2017). Malnutrition also changes the intestinal microbiota and in turn, this contributes to growth faltering and unregulated inflammation- and immune function (Ibrahim et al., 2017). With malnutrition, the integrity of the GIT mucosa is often impaired and gastric acid secretion is reduced (Piniel, 2016). This leads to an increased susceptibility to some pathogens (Ibrahim et al., 2017). Secondary infections further compromise nutrition causing anorexia, decreased nutrient absorption, increased metabolic needs and direct nutrient losses (Piniel, 2016).

2.3.2. Cognitive development and effect on socio- economic consequences

Slower brain development is another consequence of malnutrition, causing delays in motor and cognitive development (Piniel, 2016). Some of the consequences of slower brain development include reduced social skills, reduced language development, memory deficiency and attention deficit disorder (Piniel, 2016). The effect of malnutrition on brain development have found to influence school achievement, which can ultimately influence employability and the economy (Mehta et al., 2013).

Delayed cognitive development secondary to undernutrition, leading to suboptimal school performance in children who were underweight, was supported by other studies (Kar, Rao and Chandramouli, 2008; Prendergast and Humphrey, 2014; FAO, 2014; Tette, Sifah and Nartey, 2015; Arthur et al., 2015; Shashidhar and Grigsby, 2017). Most of these studies also explained the socio-economic effect that delayed cognitive development has on society as a whole. Poor school performance was noted with delayed cognitive development which then decreased the likelihood of further education and therefore fewer job opportunities (Prendergast and Humphrey, 2014; Tette, Sifah and Nartey, 2015). Malnutrition can lead to a vicious cycle of mothers giving birth to underweight children who would in turn have a higher risk of physical and cognitive impairment, all leading to poverty and economic stagnation (Mehta et al., 2013; FAO, 2014).

2.3.3. Stunting and obesity

Stunting is a global health problem and is currently the most prevalent form of malnutrition (Piniel, 2016). Stunting has also shown to be a contributing factor to childhood- and adult overweight and obesity. Maternal undernutrition increases the risk of IUGR, LBW and rapid weight gain in children later on, leading to an increased risk of obesity and NCD (Tette, Sifah and Nartey, 2015; Piniel, 2016; WHO, 2017).

Another example of how undernutrition can affect future generations, is that undernourished girls tend to grow into short adults which also increases their risk of having children with a LBW (Mehta et al., 2013). Stunting, low weight and LBW have also shown effects on mortality and socio-economic status by increasing the risk of disease (in both short- and longterm) and by influencing cognitive development (Branca and Lartey, 2016). These factors are thought to be responsible for over two million deaths annually in children under five years of age worldwide and 21% of disability- adjusted life years (DALYs) (Mehta et al, 2013).

A study conducted in Brazil among adolescents 9-19 years of age found that those who were stunted had a higher fat percentage compared to their non-stunted peers (Clemente et al., 2011). Fat depositions were found to mostly be in the upper body, which in turn increases the risk of NCD (Clemente et al., 2011). Another consequence of stunting is an increase in arterial hypertension that was more prevalent in stunted children, adolescents and adults than those who were not stunted (Clemente et al., 2011). Glucose metabolism seemed to also change in children who were undernourished. Some studies found that undernutrition during the first year of life, independent of birth weight, was associated with hyperinsulinemia and reduced insulin sensitivity, which further worsened if the adult were to become overweight (Piniel., 2016).

Other health consequences occurring with overweight and obesity include cardiovascular disease, diabetes, musculoskeletal disorders and an increased risk for certain cancers (Piniel, 2016). The risk of adverse effects increases with the degree of obesity (Kolčić, 2012). Besides the health problems which also influence the quality of life of an individual, obesity can also cause social isolation and stigmatising which can contribute to depression (Kolčić, 2012). The life expectancy of obese individuals is shorter and health problems can also influence the quality of life (Kolčić, 2012).

2.4 Possible interventions to prevent and combat malnutrition

It has been established that there may be different contributing factors to malnutrition in different areas with a different population, which is why it is important to understand the causes of malnutrition in a specific region, in this case the NMB area. The Lancet interventions (Hawkes et al., 2020) together with UNICEF conceptual framework (UNICEF, 2015) was used when considering interventions that could be applicable to the study population. (UNICEF, 2015).

It has been established that malnutrition is presents in the study region with undernutrition being prevalent and an increase in overnutrition emerging. It is therefore necessary to focus on interventions that simultaneously address more than one dimension of malnutrition.

Double duty actions have been recommended as a way to address the double burden of malnutrition. Double duty actions include interventions, programmes and policies that have the potential to reduce the risk of burden of undernutrition and overnutrition concurrently (Oenema, Campeau and Delmuè, 2017; Hawkes, Demaio and Branca, 2017). These include policies to ensure access to optimal maternal- and antenatal nutrition, care, protection, promotion and support of breastfeeding and appropriate complementary feeding (Oenema, Campeau and Delmuè, 2017). Another example of a

double duty programme is the implementation of governmental school feeding programmes (Branca and Lartey, 2016).

When implementing double duty actions, it is important not to address one form of malnutrition and in turn increasing the risk for another; for example providing a meal as part of a school feeding scheme, but providing a high fat high energy meal which could increase the risk of obesity. (Hawkes, Demaio and Branca, 2017). UNICEF also promotes double duty actions when addressing malnutrition; ensuring that programmes designed to address one type of malnutrition will not raise the longer-term risks of other forms of malnutrition (UNICEF, 2017). Hawkes et al. stated that addressing the double burden of malnutrition through double-duty actions is of critical importance in achieving the goals of the United Nations Decade of Action on Nutrition and the SDGs (Hawkes, Demaio and Branca, 2017).

2.4.1 Scale up new WHO antenatal care recommendations

Antenatal care should be upscaled with specific focus on healthy eating and physical activity during pregnancy to avoid excessive weight gain, while undernourished caregivers should increase daily energy and protein intake to reduce the risk of a LBW infant. Currently, the Nutrition Therapeutic Programme (NTP) is implemented to supply antenatal caregivers with energy- and protein supplementation. It should be ensured that the supplements provided are balanced in nutrients to supply adequate nutrients while avoiding overfeeding (van Deventer, 2016).

2.4.2. Scale up programmes to protect, promote, and support breastfeeding

One of the major interventions that is already being promoted worldwide is breastfeeding. South Africa also has many interventions regarding breastfeeding in place namely the MBFI, which was developed in response to the Innocenti declaration on the protection, promotion and support of breastfeeding which urges healthcare institutions to put steps in place regarding the protection and promotion of breastfeeding, the R991 is a regulation that was instilled regarding the unethical marketing of breastmilk substitutes in order to protect breastfeeding practices and the Tshwane declaration was also issued in support of breastfeeding in South Africa (UNICEF, 2015). The RthB has been updated to promote breastfeeding through the health promotion messages and updated breastfeeding-friendly growth charts (Department of Health, 2018). Furthermore, the PFBDGs are in the process of being tested and also promotes breastfeeding. (Siziba et al., 2015). Breastfeeding is the recommended feed for the majority of infants, because of the multitude of health benefits as well as being available, hygienic and free, which can improve household food security by not having to purchase infant formula (Siziba et al., 2015).

A cohort longitudinal qualitative study was performed in KwaZulu-Natal (KZN) in South Africa to identify hindrances to exclusive breastfeeding (Agunbiade and Ogunleye, 2012). The results showed a strong reliance on the support and advice of Health Care Workers (HCWs). Some of the major challenges to breastfeeding included inappropriate advice from HCWs, maternal-baby issues, family pressures and returning to school and work (Agunbiade and Ogunleye, 2012). A study performed in Nigeria also investigated some of the challenges faced in terms of breastfeeding. The major constraints to breastfeeding were the perception that babies continued to be hungry after breastfeeding, maternal

health problems, family pressures, breast pain and the need to return to work (Jama et al., 2017). The role of HCWs to provide accurate information and support to mothers was emphasised in order to build confidence and self-efficacy of mothers (Jama et al., 2017).

Another factor highlighted, which was echoed by previous studies, was that many mothers stopped breastfeeding upon returning to work or school (Agunbiade and Ogunleye, 2012, Kimani-Murage et al., 2014, Jama et al., 2017). This is a situation that requires multi-sectorial support. In other words, policies and programmes should be in place to ensure facilities enable mothers to continue expressing breastmilk at the workplace and school together with education that needs to be provided to the mother to equip her for continued lactation (Kimani-Murage et al., 2014).

The level of support a new mother requires in terms of commencing and continuing to breastfeed, is not emphasised enough. Breastfeeding mothers face a multitude of challenges that hinder them from breastfeeding, which includes their fears, influences from family and society and even having to face separation from their partners in some cultural settings while breastfeeding (BHF, 2013). The crucial role of HCWs to provide support and encouragement is often not placed high enough on the agenda. HCWs need to provide accurate information, correct misconceptions and provide the mother with support and encouragement (BHF, 2013). Simultaneously, HCWs are often overworked and are unable to provide these mothers with the support and help they require (BHF, 2013). A lack of ongoing training of HCWs negatively influences their knowledge and ability to provide up-to-date information to caregivers. The new RtHB contains many health promotion messages and can be an effective tool to use to refer mothers to for accurate information.

The MBFI initiative should be strengthened in healthcare facilities, following the 10 steps to successful breastfeeding. This initiative requires training of HCWs together with empowering caregivers to breastfeed their infants. The 10th step requires establishing breastfeeding support groups.

2.4.3. Redesign guidance for complementary feeding practices and related indicators

A new training curriculum needs to be developed for PHC workers in order to provide double-duty nutrition counselling. Guidelines regarding energy density for weight gain should be revisited in order to avoid overnutrition, especially when energy intake is not limited. A healthy and diverse diet should be encouraged which includes the daily intake of fruit and vegetables and avoiding snacks and beverages high in sugar, salt, fat and energy.

2.4.4. Redesign existing growth monitoring (GMP) programmes

The new RtHB should be used routinely for growth monitoring. Height or length monitoring should be done routinely and weight-for-height should be used to diagnose overweight and obesity. Appropriate referrals and counselling regarding all types of malnutrition should be done routinely, especially in ongoing growth monitoring programmes.

2.4.5. Prevent undue harm from energy-dense and micronutrient-fortified foods and ready to use supplements

Healthy diets should be encouraged as the default measure to prevent undernutrition and energy-dense fortified foods should only be given to extremely undernourished adults and children and carefully managed to avoid overfeeding. Weight gain should be carefully monitored to avoid rapid weight gain beyond what is needed for recovery.

2.4.6. Redesign cash and food transfers, subsidies, and vouchers

Education and behaviour change counselling should be included with any food transfers provided. Healthy diets and physical activity should be encouraged and food parcels (including for example donations from social services should exclude snack foods high in sugar, fat and salt.

2.4.7. Redesign school feeding programmes and devise new nutritional guidelines for food in and around educational institutions

Ensure that guidelines for school feeding programmes meet energy and nutrient needs while restricting foods, snacks and beverages high in sugar, salt, fat and energy. The promotion and sale of high energy snack foods should be avoided. Further, knowledge should be built in schools by providing education on healthy diets and building skills to eat nutritious food and creating school food gardens. For the included population, some of the children could be attending crèches or pre-schools at which a meal is often received and effects daily dietary intake.

2.4.8 Supplementation, fortification and dietary diversification

Interventions that were implemented to decrease VAD include Vitamin A supplementation and food fortification. Since these interventions were implemented, it was shown that the prevalence of VAD in SA decreased by 20% among children younger than five years of age (Shisana et al., 2013).

Micronutrient supplementation of the mother and the child has the potential to improve the immune system and reduce the risk of infectious disease (Prendergast and Humphrey, 2014). Micronutrient supplementation during pregnancy can reduce the risk of a SGA baby and improve the birth weight of the infant. Prenatal interventions can therefore have an impact on postnatal growth (Khan et al., 2011; WHO, 2017; Oenema, Campeau and Delmuè, 2017; Anon, 2018). Another study showed a reduced risk of 9% by provision of prenatal micronutrients (Prendergast and Humphrey, 2014).

Although these initiatives could have very favourable results for both the caregiver and the child, compliance or a lack thereof could also prevent this initiative from being successful. A study in North Nigeria reported that some caregivers had a negative perception about the use of micronutrient supplementation (Adejgbagbe et al., 2019). The perception was often based on the caregiver's level of education. The study emphasised the need to counsel caregivers to improve knowledge and perception regarding micronutrient supplementation in order to improve adherence (Adejgbagbe et al., 2019). In NMB, micronutrient supplementation is provided at healthcare facilities, yet children who do not attend these facilities routinely, can be at risk of deficiencies.

Dietary diversification may be another way to enhance micronutrient intake instead of using supplementation. The intake of a diet balanced in terms of energy, protein and

micronutrients by pregnant mothers can reduce the risk of an SGA infant by 31% (Prendergast and Humphrey, 2014). Although this may be beneficial, socio-economic challenges have proven to be a stumbling block in ensuring sufficient, nutritionally balanced meals on a consistent basis (Prendergast and Humphrey, 2014; Chola et al, 2015; Adejugbagbe et al., 2019). Low-cost interventions for example vegetable gardens are one way to ensure an improved dietary diversification and has shown successful results globally (Tesfamariam et al., 2018).

2.4.9 Education programmes

Education and employment are considered some of the most important strategies to address poverty and malnutrition (Barnes et al., 2017). Besides the importance of education in order to improve chances of employment, it is also of utmost importance to educate caregivers regarding appropriate feeding practices.

Many caregivers are not educated regarding appropriate feeding practices for their child. One nutritional problem that was noted in South Africa is that complementary food is often introduced prematurely, with approximately 17% of parents introducing food during the first month of a child's life (Siziba et al., 2015). Early introduction of complementary food can increase the risk of choking and also increase the risk of nutritional deficiencies (Kleinman, 2009). Complementary food in South Africa is also often lacking in diversity, putting children at further risk of malnutrition (Siziba et al., 2015). It is necessary that consistent and evidence-based messages and guidelines be given to caregivers regarding the complementary feeding of their children (du Plessis, 2013).

Nutrition education can include teaching regarding food gardens, appropriate enriching of food and focusing on food variety as some strategies to improve complementary feeding practices (Siziba et al., 2015). Strategies to educate families within the communities with regards to appropriate infant feeding practices may be an intervention to improve nutritional practices and reduce infant- and child malnutrition (Siziba et al., 2015). It is necessary to find strategies to address the gap in terms of breastfeeding and child feeding knowledge and awareness with a focus on community involvement and participation (Siziba et al., 2015).

Educating women as an initiative has shown to be successful in India, which is home to 40% of the world's malnourished women and children (WHO, 2015). WHO reported on a new programme called Indian Academy of Paediatrics (IAP) Healthphone, which has the goal of sending millions of text messages to the phones of women which will include links to short educational videos. Some of the topics covered include: how to improve the status of women, care of pregnant women and children, breastfeeding and eating nutritionally balanced diets. The initiative is the largest of its kind globally and has already shown some improvement in health. It is thought to help reach the SDGs, especially to end malnutrition and prevent childhood deaths by 2030 (WHO, 2015).

Education regarding spending money wisely was an area identified as a need. It was reported that oftentimes, most of the money from social grants are not spent on nutritious food for the child and it is therefore necessary to educate the caregiver with regards to suitable food to buy for a child (Langendorf et al., 2014). The nutritional value of the diet of children does depend on the availability of locally available food. In a food insecure area, even when the household purchasing power improves (having more money to buy

food as well as knowledge about which foods to buy), food is not always available which can be a challenge in terms of improving nutritional status of children (Langendorf et al., 2014). The intake of foods from an animal source or fortified foods is often not eaten frequently which provides a challenge to meet nutrient needs of children (Langendorf et al., 2014). Education regarding eating protein and balanced meals even when resources are few is another area that requires attention. In some settings, providing nutritious supplementary foods may be the only feasible strategy to prevent malnutrition in young children (Langendorf et al., 2014).

Interventions with pre-tested educational messages regarding complementary feeding and when animal-source foods and food supplements were provided, showed to be more successful (Daelmans et al., 2009). Education approaches including counselling and behaviour change communication are essential to improve infant and young child nutritional practices (Daelmans et al., 2009). Food safety, cultural beliefs and intra-family food distribution should also be a focus of counselling sessions (Daelmans et al., 2009).

2.4.10 Hygiene, immunisation and growth monitoring

Besides the appropriate and timely introduction of complementary food, appropriate supplementation, deworming and immunisation programmes may also play a significant role in improving malnutrition (Tette, Sifah and Nartey, 2015).

Immunisation is one way to combat or prevent some disease conditions that may influence children's growth and development. A study conducted in urban- and rural India investigated the effect of vaccination on nutritional status of children 0-5 years of age, found a significant association with the immunisation status of the child and an increased risk for undernutrition (Kanjilal, Mazumdar, Mukherjee, 2010). Immunisation status of children in South Africa has improved, but the coverage in 2017 was reported to be 78.6% in the Eastern Cape, which was below the South African average of 82.3% (Aung and Dlamini, 2017). The prevalence reported to be lower in rural areas in a recent study done in rural Eastern Cape where only 48.6% were up to date at three months of age and 72.3% were up to date at 24 months of age (Naidu, 2017). Education on hygienic practices, especially good hand washing procedures, may be another way to reduce risk for disease (Tette, Sifah and Nartey, 2015). Insufficient access to WASH has shown to influence children's nutritional status by increasing the risk of diarrhoeal disease, intestinal parasite infections and environmental enteropathy (UNICEF, 2015).

In an effort to identify malnutrition as soon as possible, regular growth monitoring is recommended since disturbances in health and nutritional status of a child, will affect child growth (WHO, 2015). Growth monitoring should be done regularly and practical advice given to mothers to improve the nutritional status of their children (Mehta et al, 2013).

2.4.11 Current large- scale interventions and challenges faced

One strategy that was successfully implemented in Italy is to invest in a centre for the treatment of undernourished children with an outpatient care and a day hospital (Mehta et al, 2013). The focus was on providing correct treatment for nutritional recovery. In the specified centre, the average time period of treatment was 16.4 months and was associated with a greater gain in weight-for-age and height-for-age (Mehta et al., 2013).

In South Africa in the province of KZN, an initiative started in 2013 towards establishing child community diagnostic centres throughout the province titled the “Phila Mntwana” centres (KZN health, 2013). These serve as health promotion and disease prevention centres for children in the community. The goal is to ensure provision of immediate interventions and referral of more complex cases to public health facilities (KZN health, 2013). The services rendered includes growth monitoring, screening for malnutrition, supply of supplements, intervention for diarrhoeal disease, promotion of breastfeeding, TB screening, tracing of defaulters of immunisation and other services, support for HIV and AIDS and referral for further management (KZN health, 2013). Although this seems like a positive initiative, there is so far no data available regarding the success of these centres.

Another initiative that has been set in motion since 2010 was done by the department of health, with the goal of re-engineering PHC (Barron, 2011). The goal of re-engineering PHC is to reduce the huge burden of disease in the country, to increase the access of health services to the general public and improve the quality of health services. There are three main target areas included namely strengthening the school health services and district based clinical specialist teams with an initial focus on improving maternal and child health (Barron, 2011). At this stage, all nine provinces have received some training, specifically regarding maternal- and child health, with a total of 8900 CHWs who were trained. The motion is still in process to continue with training. The success of this initiative will likely only be known once it has been fully implemented.

An intervention found in a rural area in the Eastern Cape, has shown success by integrating CHWs into PHC clinics, hospitals and health teams (le Roux et al., 2015). The reported success was considered to be attributed to building relationships with health teams at different levels of the healthcare system as well as having shared goals, supportive clinics and hospital leadership (le Roux et al., 2015). In this setting, the CHWs were called “Mentor Mothers” who were carefully selected to build relationships with the families in their care and to ensure that everyone is reached. The mentor mothers also received continuous training, supervision and support, all of which were essential factors to keep them motivated and providing the best service possible (le Roux et al., 2015).

Another fairly recent initiative that was successfully implemented within NMB is the *Sakha esethu* initiative which was started in 2018. The initiative trained mentor mothers regarding child health and development. The idea was developed by local volunteers who realised the value of sharing messages regarding relevant health messages to mothers (Sakha esethu, 2018).

2.5 Tools to measure dietary intake and socio- economic conditions

The tools reviewed are those that will be used in this study.

2.5.1 The 24-hour dietary recall questionnaire

The 24-hour dietary recall method has many advantages including easy administration, being able to be completed quickly (within 20 minutes) as well as being applicable to the South African population (Steyn and Labadarios, n.d.). Another advantage of the 24-hour recall questionnaire is that the respondent does not need to be literate since the interviewer can complete the responses with the recipient merely answering short

questions, ensuring that the questionnaire can be used across a range of populations (Steyn and Labadarios, n.d.). Since the recall happens after the food was consumed, it also does not interfere with dietary behaviour. One limitation from this questionnaire is that one day's 24-hour recall can't provide the average dietary intake of an individual, but it can measure the current dietary intake of an individual or a group (Steyn and Labadarios, n.d.). To improve reliability, it is often done three times (two weekdays and one weekend day).

2.5.2 The Food Frequency Questionnaire (FFQ)

A FFQ provides useful information regarding dietary intake patterns of the child. It is a simple data collection tool which can either be self- or researcher administered and the data is relatively easy to capture and can be done so inexpensively (Pérez Rodrigo et al., 2015). Due to the easy of completion, the respondent burden is low compared to other methods. This data collection tool allows the capture of habitual consumption over an extended period of time. When the data collection is done research-administered, more complete data may be collected although if the questionnaire is self-administered, less bias may be introduced (Pérez Rodrigo et al., 2015).

The FFQ design can be adjusted to either focus on a particular food group or to assess the whole diet and portion sizes. One limitation of the FFQ, is the amount of measurement error that often occurs which can result from an incomplete listing of all possible foods and from errors in frequency and actual serving size estimations (Pérez Rodrigo et al., 2015). The accuracy of the results is also reliant on respondent's memory. Certain foods may also be either over- or underestimated. Determining usual portion sizes may be a challenge since portion sizes may differ according to the occasion (Pérez Rodrigo et al., 2015).

A SR was compiled, including five studies that assessed the validity of the FFQ in children. All of the studies included children from the age of one to eleven years. All the studies used the adult version of the FFQ and adjusted it for the age-group and ethnic group (Pérez Rodrigo et al., 2015). The findings revealed that the FFQ has good reliability and is satisfactory for assessing dietary intake of children between the ages of one and three years. One of the studies showed that although the FFQ is a valid dietary assessment tool, intake was slightly overestimated. One of the included studies compared dietary intake between the FFQ and 24-hour recall. The study revealed moderate correlation between the FFQ and the 24-hour recall for protein, carbohydrate and fat. There was, however poor correlation noticed between the FFQ and the 24-hour recall for total energy. All of the included studies confirmed the validity of the FFQ in terms of validity to measure dietary intake of children up until the age of 11 years of age (Pérez Rodrigo et al., 2015).

2.5.3 Household Food Insecurity

The Household Food Insecurity Access Scale (HFIAS) is a simple tool for measuring household food insecurity. It contains nine questions, used in several countries and distinguishes food secure and food insecure households across different cultural contexts. It can be used to assess prevalence as well as changes over time.

The HFIAS has been used in many studies including *Malnutrition and Enteric Disease Study (MAL-ED): Consequences for Child Health and Development Network cohort study*, which assessed relationships between food security and child growth (Psaki et al., 2012). The MAL-ED study included many countries, including South Africa. Similar to all scales regarding food insecurity, the HFIAS, does not measure food consumption or diet quality.

One strength of the HFIAS is that it is able to detect aspects of food insecurity, especially decreased access to sufficient quantity or quality of food as well as anxiety and uncertainty around food access (Ballard et al., 2013). It is also relatively short and can easily be added as a module to other household surveys.

One of the weaknesses is that the questionnaire can't be used to make comparisons across diverse socio-cultural countries and contexts (Deitchler et al., 2010). The HFIAS is more comprehensive than the Household Hunger Scale (HHS). It is recommended to adapt the HFIAS according to the context for improved performance (Deitchler et al., 2010; Deitchler et al., 2011; Maxwell, Vaitla and Coates, 2014).

The HFIAS consists of nine occurrence questions and nine frequency-of-occurrence questions. When only occurrence and not frequency is measured, a score out of 9 is obtained. A score of 0- 2 indicates food security, a score 3- 5 indicated moderate or at risk of food insecurity and a score of 6- 9 is equal to food insecurity or hunger as adjusted according to guidelines (Deitchler et al., 2011).

2.5.4 The individual dietary diversity score (IDDS)

The IDDS is calculated by the number of food groups consumed over a period of time (Swindale and Blinsky, 2016). The dietary diversity score (DDS) can be calculated on household or on individual level, which means that it can either be used to identify the dietary diversity of a household or for individuals within the household. Another benefit is that the questionnaire is relatively easy to use and understand. Instead of using individual food items, food is classified within a food group. The following food groups are included: cereals, fish and seafood, root and tubers, pulses and legumes or nuts, vegetables, milk and milk products, fruits, fats and oil, meat and poultry or offal, sugar or honey, eggs and miscellaneous. The IDDS can be adjusted when obtaining information regarding a child's diet. Less food groups may be used for children, but more detail can be added per food group. It is for example useful to add information regarding food types high in Vitamin A or the amount of food eaten that is high in iron (Swindale and Blinsky, 2016).

A score out of 17 was determined with a score of 14-17 being classified as excellent, a score of 12-13 being calculated as adequate, a score of 8-11 being classified as medium, a score of 4-7 was classified as low and a score of less than three was classified as poor (Kennedy, Dop and Ballard, 2011). The DDS was also reworked to a score out of seven which was identified by the WHO as being the minimum dietary diversity for children (also known as the CDDS). A score of less than four out of seven was considered low dietary diversity while a score of more than four out of seven was considered adequate dietary diversity (Rakotonirainy et al., 2018). The food groups included were a smaller variety to make it more applicable to children and can be used for children 6- 59 months. The food groups included in the CDDS is grains, roots and tubers, legumes and nuts, dairy

products, flesh foods, eggs, vitamin A rich fruit and vegetables and other fruit and vegetables diversity (Rakotonirainy et al., 2018).

2.5.5 The Road to Health Booklet (RtHB)

The RtHB is considered to be a growth monitoring tool and it replaced the Road to Health Card (RtHC) in 2011. It has been updated four times since it was initially launched, with the latest RtHB issued by the end of 2018 (called the nRtHB), but since the data was collected before this time however, the older version of the RtHB was used. The need for change was seen to improve the growth monitoring and early intervention of child health and therefore the RtHB was launched as a monitoring tool for children (Du Plessis et al., 2018). It is currently the only readily available tool to be used for monitoring child growth, providing key child health and nutrition messages and is used for the tracking and uptake of child health care services in South Africa (Ramraj et al., 2018). The RtHB is considered a comprehensive tool and includes records of many important health interventions including immunisation, developmental screening, oral health, health promotion, and growth monitoring, infectious diseases including HIV and TB, Vitamin A supplementation and deworming (Du Plessis et al., 2018; Department of Health, 2018). Age-specific health promotion messages are also included as part of a prevention strategy (Du Plessis et al., 2018). The RtHB is used across the world by healthcare personnel to accurately record children's health and development and to identify children at risk. The RtHB has the potential to be a powerful tool in primary healthcare if it is utilised optimally. The RtHB consists of different books for boys and girls (as different growth curves would be expected) and the growth pattern is according to a breastfed child (as the golden standard). The RtHB is shared into z-scores and has growth charts for WAZ, HAZ and WHZ.

2.5.6 Conclusion

Throughout the literature, malnutrition was discussed globally, nationally and locally. The basic, underlying and immediate causes of malnutrition were discussed using the UNICEF conceptual framework. Possible intervention strategies were discussed as well as briefly looking into what is being done on a larger scale to address malnutrition. Programmes and policies are recommended to be implemented to prevent undernutrition with a focus on maternal health and education (Mehta et al, 2013). A SR regarding the contributing factors of malnutrition showed that the causes of malnutrition are multifactorial, which is similar to what is described in the conceptual framework of malnutrition as well as the literature included thus far (Akombi et al., 2017). Some of the contributing factors found include a lack of maternal education, poor socio-economic status, LBW of infants and maternal malnutrition (Akombi et al., 2017). Predisposition to malnutrition is therefore shown to be multisectoral and would require a multisectoral intervention approach (Akombi et al., 2017). UNICEF emphasised this statement in 2015, stating malnutrition rarely has a single cause, but is rather the contribution of a set of basic, underlying and immediate causes, which are all inter-related (UNICEF, 2015). Malnutrition is a far-reaching problem, affecting many children within South Africa and in the Eastern Cape and oftentimes, there are too few HCWs to appropriately manage malnourished children. Therefore, it is once again necessary to involve other role players to put malnutrition on the country's agenda of action, focusing on prevention rather than on management of malnutrition.

With all of this in mind, each location is different and the contributing factors may be different. All interventions should be focused on the specific community involved, which is why further research should be done in Ibhayi, Eastern Cape. It is necessary to explore specific contributing factors to malnutrition in this area in order to contextualise appropriate intervention programmes.

CHAPTER 3: METHODOLOGY

The purpose of this chapter is to provide elaboration into the study methodology, methods of data collection and data analysis.

3.1 Research design

The design is a descriptive cross-sectional study with an analytical component utilising a quantitative approach. Descriptive research is aimed at highlighting current issues or problems through a process of data collection, which enables a description of the situation in more detail than was known before (Leedy, Ormrod, 2014). The prevalence of malnutrition as well as a description of the population will be elaborated on, which can classify the study as a descriptive study. An analytical study compares different exposures and the result thereof (Ehrlich and Joubert, 2014). In this study, different contributing factors were compared with their potential effect on malnutrition, which means the study can also be described as an analytical study. The study assesses and compares the prevalence of disease (malnutrition) and exposure (risk factors) in children under the age of five years.

In descriptive research, the researcher has no control over variables and can be explained as an attempt to determine, describe or identify what is, while analytical research attempts to establish why it is that way or how it came to be (Leedy, Ormrod, 2014).

3.2 Study location

Nelson Mandela Bay is one of the municipalities in the Eastern Cape and includes the city of Port Elizabeth as well as nearby towns; Uitenhage and Despatch as well as the surrounding rural areas (including Ibhayi and Motherwell) and is approximately 1950km² in size (StatsSA, 2012). The population size of this area is 1 195 603 with 384 794 children under the age of five years (StatsSA, 2012). The district health barometer (DHB) indicated that 4% of childhood deaths in NMB were due to protein energy malnutrition (PEM), 12% was due to diarrhoeal disease and 9.3% due to HIV and TB. SAM had fatal consequences in 10.1% of cases (StatsSA, 2012). Overweight and obesity of children in the NMB district is at least 6% and may be increasing, which increases the risk of lifestyle diseases including diabetes, hypertension and heart disease later in life (StatsSA, 2012).

The unemployment rate of the NMB area was described at 36.6% (Jordaan and Mbambisa, 2015). Most recent available statistics described the population distribution as 60.13% Black African, 23.56% Coloured, 1.11% Indian or Asian, 14.36% Caucasian and 0.84% had another race (Jordaan and Mbambisa, 2015). An estimated 25.4% were 14 years old or younger (Jordaan and Mbambisa, 2015). In terms of socio-economic information in NMB; 3% of residents had no schooling, 13% had grade 7 or less and 75% had grade 12 or less (Jordaan and Mbambisa, 2015). Only 36.48% of the working-age population had some form of income (Jordaan and Mbambisa, 2015). The number of households has increased from 265 109 to 324 292 between 2001 and 2011, with many reported as being female headed households, which is an indicator of inadequate maternal and child care on the UNICEF conceptual framework. Approximately 44.3% of households reported having no income (Jordaan and Mbambisa, 2015). The Eastern

Cape is the third largest province in South Africa, yet it is also one of the poorest provinces (StatsSA, 2011; Shisana et al., 2013).

Ibhayi is a large township in Port Elizabeth with a total surface area of about 36km² and a population size of 237 799, which consisted of 63 474 households (StatsSA, 2018). The subsections of Ibhayi are: KwaDwesi, KwaFord, KwaMagxaki, KwaZakele, Masibulele, New Brighton, New KwaDwesi, Soweto on Sea, Struandale and Zwide (StatsSA, 2018). Approximately 5% (12 889) of the population size included children 0-5 years of age. Seventy out of 12 889 children in this age category, visit the hospital for services daily.

The study setting is Dora Nginza hospital which is a provincial government hospital located in Zwide within the Ibhayi township in Port Elizabeth in the Eastern Cape (TravelGround, 2015). Paediatrics is one of the specialty services offered at DNH. There is also a POPD which offers medical services on every week day (TravelGround, 2015). The patient population and disease conditions within the outpatient department vary greatly. Children up to the age of twelve years can visit the clinic and most are accompanied by a primary caregiver. Approximately 40-70 children are seen at the POPD department on a daily basis of which approximately six outpatients are seen per day by the Dietician (DNH statistics from ward). From the patients seen by the Dietitians, an average of 16 patients seen at the DNH outpatient department per month are classified MAM and five (5) are classified as SAM (Dietitian statistics, DNH).

3.3 Sampling

3.3.1 Sample size

The estimated sample size was 140 mother-child pairs using the Cochran equation [$n = Z^2 \times p(1-p) / e^2$] with stunting prevalence of 9% in NMB health district of the Eastern Cape (McLaren et al., 2018), a 95% confidence level and 5% of precision. In addition, 13 mother-child pairs were added to compensate for 10% non-response rate. The final sample was then 153 children 0-60 months.

3.3.2 Sampling strategy

The study sample was obtained through convenient sampling, still ensuring that a representative group of children with different forms of malnutrition was included. Data collection occurred between the 7th of May and the 15th of June 2018 on weekdays between 7am and 4pm. Children who met the inclusion criteria, and had an accompanying caregiver who gave consent for their child and themselves to participate, were recruited. All caregivers were informed about the study on a daily basis before data collection commenced.

Inclusion criteria

- The child is 0- 60 months old and has at least one primary caregiver
- The caregiver is over the age of 18 years and able to communicate in Afrikaans, English or IsiXhosa
- The child and caregiver are residing in Ibhayi or Motherwell
- The caregiver is mentally and physically able to answer questions and to be weighed and measured

- The child is mentally and physically able to participate in the study and to be weighed and measured
- Consent is obtained by caregiver to participate

Exclusion criteria

- The child is older than 60 months
- The child is comatose or too ill to participate
- The child has any health condition that may prevent him/ her from being able to be weighed or measured
- The caregiver is not available or unable to participate in the study
- Consent is not obtained from caregiver
- The participant does not reside in Ibhayi or Motherwell

3.4 Variables measured

The variables that were measured are outlined in Table 1 below, including the techniques used and the type of the instrument.

Measurement	Technique	Instrument	Appendix
1. Socio-economic and health status	Quantitative, interview	Researcher administered Questionnaire	A, Section A, B
2. Dietary patterns	Quantitative, interview	Selected food frequency questionnaire	A, Section F
3. Dietary diversity	Quantitative, interview	24 hour Recall and Dietary diversity questionnaire	A, Section E
4. Household food security	Quantitative, interview	Household food insecurity questionnaire	A, Section D
5. Anthropometry (weight, height, MUAC)	Quantitative, measurement	Scales Record Form Measuring tape	A, Section G
6. Growth Monitoring	Quantitative document review	Observation of RthB and recording	A, Section G

3.4.1 Socio-economic, general household factors and health status

The questionnaire (Appendix A, section A, B) included questions regarding: age, gender and race of the caregiver and the child. For the caregiver, further information was obtained regarding education level, employment and the number of children the caregiver was taking care of. The number of people working per household, household income as well as information regarding the social grant was also collected. The type of dwelling as well as the availability of water and electricity was also included. The health status as well as

the breastfeeding history of the child was also obtained in order to determine whether this may have an influence on nutritional status.

These were determined to obtain a sample profile of participants and to explore possible relationships between these and nutritional status of the child participants.

3.4.2 Dietary patterns

The selected FFQ (Appendix A, section F) was used to obtain dietary patterns of the child's nutritional intake.

This information was determined in order to describe the dietary patterns of the sample as well as to find possible relationships between these and the nutritional status of the child as well as the caregiver.

3.4.3. Dietary diversity

Dietary diversity was determined using the 24-hour recall and the DDS scoring sheet. (Appendix B, section E). The information gathered from the DDS provides more information regarding unique food groups consumed by the child. The relationship between the DDS and the nutritional status of the child was also investigated.

A score out of 17 was determined with a score of 14-17 being classified as excellent, a score of 12-13 being calculated as adequate, a score of 8-11 being classified as medium, a score of 4-7 was classified as low and a score of less than three was classified as poor (Kennedy, Dop and Ballard, 2011).

The DDS was also reworked to a score out of seven which was identified by the WHO as being the minimum dietary diversity for children. A score of less than four out of seven was considered low dietary diversity while a score of more than four out of seven was considered adequate dietary diversity (Rakotonirainy et al., 2018).

3.4.4 Household food security

Household food security was determined using the HFIAS (Appendix A, section D). This tool provided a way to determine the level of household food security to provide descriptive data and also to analyse the relationship between HFIAS score and other factors including the nutritional status of the child, the caregiver and the DDS.

A score of 0-2 indicates food security, a score 3-5 indicated moderate or at risk of food insecurity and a score of 6-9 is equal to food insecurity or hunger as adjusted according to guidelines (Deitchler et al., 2011).

3.4.5 Anthropometry (weight, height, MUAC)

Anthropometric measurements were obtained (Appendix A, section G) as per standardised practice described in Appendix E (ADSA, 2009; Stewart & Marfell-Jones, 2011; Cashin & Oot, 2018). The weight and height of the caregiver were measured and the weight, length (for children younger than two years of age) and height (for children older than two years of age) and MUAC (for children older than six months) were

obtained. The anthropometric information was obtained in order to provide descriptive data regarding the nutritional status of participants and also to be able to investigate a variety of possible contributing factors to the nutritional status of the child and caregiver (determined by anthropometric measurements). Z-scores describe how far and in what direction an individual's measurements is from the reference population's median value (Cashin and Oot, 2018). The WHO growth standards compare children of the same sex and age; z-scores outside of the normal range indicate a nutritional problem which could be under- or overweight. The further away from the normal range, the more severe the nutritional problem may be. Z-scores therefore provide information on current nutritional status and can also be used to follow up on individual's growth over time (Cashin and Oot, 2018).

3.4.5.1 Weight

An electronic pan-type beam scale (Seca, model 354) was used to weigh infants younger than two years of age. This has shown to be accurate to 0.01kg. For children older than two years and for adults, a levelled platform electronic scale was used. This has shown accuracy to 0.1kg. The infant and adult scales were zero-calibrated before use and the accuracy of the scales were checked before the start of the study and weekly thereafter by placing a known weight from 5 to 500g (infants) and from 100-500g (older children and adults).

For infants, the weights were taken to the nearest gram and for adults, to the nearest 100g. The weight measurement was repeated and the mean was obtained. If the weights differed more than 0.001kg (infants) and 0.1kg (older children and adults), the weights were re-taken (ADSA, 2009; Stewart & Marfell-Jones, 2011; Cashin & Oot, 2018).

3.4.5.2 Height/ length

For infants younger than two years, a perspex length board with a solid headboard and a movable footboard, with 1mm increments, was used to measure to the nearest 0.1cm twice and the mean taken.

In children older than two years of age and adults, a Seca stadiometer (model 217) was used. Two people were required to do the measurements (a nurse or the research assistant would assist) and the measurements were taken to the nearest 0.1cm (ADSA, 2009; Stewart & Marfell-Jones, 2011; Cashin & Oot, 2018).

3.4.5.3 MUAC (Mid-Upper Arm Circumference)

MUAC is a simple low-cost measure to assess nutritional status and is recommended by WHO in children 6- 59 months (WHO, 2008). A decrease in MUAC can reflect a decrease in fat- and/ or muscle mass which provides a useful tool especially when WHZ is unavailable (WHO, 2008). The measurements were taken as described in Appendix E and to the nearest 0.1cm and repeated once.

3.4.5.4 Information from the RtHB

The RtHB is considered a comprehensive tool and includes records of many important health interventions including, but not limited to immunisation and growth monitoring (Du

Plessis et al., 2018). The RtHB was utilised to observe the growth trend of the child. The RtHB was used to obtain the gestational age and the position of the birth weight of the child (on the growth chart) as well as immunisation status. The information regarding these could be used to determine if birth weight, gestational age and immunisation status could have an influence on the growth of the child.

3.5 Procedures of data collection

3.5.1 Institutional approval procedure

Prior to the start of data collection, permission was obtained from the Health Research and Ethics Committee of the University of Stellenbosch (S17/10/192) (see Appendix B). Permission had to be obtained from the manager of medical services at DNH as well as the National Department of Health and the Eastern Cape Department of Health research committee, all of which were obtained before data collection commenced (see Appendix C). The head of the paediatric department was also notified before the start of data collection. The hospital sister in charge of the POPD at DNH was notified timeously of the research that was going to take place. This ensured that all nursing staff was aware of the research as well as being able to secure a separate room for data collection.

3.5.2 Training of the research assistant

One trained research assistant was appointed to help with data collection. The research assistant was fluent in isiXhosa, which meant that participants who were Xhosa speaking could request to answer in their home language. The assistant was trained on the questionnaire; taking anthropometric measurements and how to interpret growth charts and obtain information in the RtHB prior to the commencement of data collection (see Appendix E). She was also trained on interviewing skills. Further guidance and training was provided throughout the data collection period.

3.5.3 Pilot study

Before data collection started, a pilot study was conducted at DNH on a similar population group than those included in the study. The pilot study included 20 participants who were not included in the research study. During the pilot study, the researcher was able to identify possible changes to be made to the questionnaire in order to ensure that it is easily understandable and user-friendly.

The changes made were as follows: The questions were changed from being open-ended, to being mostly categorised for ease of data capturing and analysis, some errors were found with numbering and were adjusted. For question 13 and 14, more options were added as the pilot study showed that this question had a wider range of answers and were irrelevant information. One question (question 28) was removed as it seemed it was not well understood. For question 54 (the 24-hour recall), the goal was to use the data for the dietary diversity score sheet, therefore the quantities and preparation method were removed. Also, some of the wording changed to make it easier to understand. Regarding question 55-70; the “why do you say so” was removed from the knowledge question, since it was unnecessary information and difficult to explain why an answer was selected.

3.5.4 Recruitment for the research study

A notification was displayed in the outpatient department prior to data collection to notify patients of the research study and every morning before data collection commenced, an announcement was made in the patient waiting area to inform all patients of the reason for the research study and also to encourage participation in the study. Caregivers with their children were also approached individually regarding whether they would like to participate in the research study. If the potential participants met the inclusion criteria, informed consent was obtained once all information regarding the study was disclosed. The nursing staff working at the POPD was aware of the study and were supportive and helped to recruit participants for participation. One of the nurses on duty served as gatekeeper for inclusion into the project.

3.5.5 Consent process

Each of the caregivers that indicated an interest in participating in the research study, were included if they met the inclusion criteria. The purpose of the study, the risks, the lack of direct benefits and the right to withdraw at any time was explained to the caregiver in a language that is understandable to her (Afrikaans, English or IsiXhosa) before she was asked to sign consent. Once it was established that the caregiver and the child meets the inclusion criteria, written consent for participation was obtained (see Appendix D). The caregiver was also allowed to have a copy of the consent form which provided a descriptive summary of the research study (Appendix D). After consent was obtained, the questionnaire was completed and anthropometric measurements recorded (see Appendix B).

3.5.6 Obtaining the data

Once participants were recruited and consent was obtained, the research-administered questionnaire was used to obtain the answers from the caregiver. The researcher and the research assistant collected data from different caregivers simultaneously, but were also available to assist one another with anthropometric measurements as needed. Separate rooms were available in order to ensure patient confidentiality, although some preferred answering the questions within the waiting room.

3.6 Data quality control

3.6.1 Validity

3.6.1.1 Face validity

The anthropometric measurements included are part of routine growth monitoring performed at DNH as well as recorded in the RtHB and recommended by the WHO. The questionnaire is thorough and includes a variety of aspects regarding malnutrition.

3.6.1.2 Construct validity

The questionnaire used was carefully designed to include standardised, validated research tools that were adjusted for the study. One of the ways this was assured, is by using a variety of research instruments (as described in chapter 2), which were merged

into the questionnaire (Appendix B). The instruments used include the selected FFQ, the 24-hour recall, the DDS and the HFIAS. The 24-hour recall questionnaire was not used for dietary intake, but rather to obtain information regarding the diet history for the completion of the DDS. The questions included in the questionnaire were carefully selected to answer the aims of the research study.

3.6.1.3 Content validity

Anthropometric measurements were obtained using standard measuring equipment appropriate to the age of the child. Infant scales were used to obtain weight and a length board to obtain the height of infants. For children older than two years of age as well as their caregivers, a stadiometer was used as recommended by the WHO (2006). The HFIAS, 24-hour recall questionnaire, FFQ and the DDS were tools that were included in the study and have been used and described in the literature many times before. The questions were phrased in a way to avoid influencing the answer of the respondent. Information regarding the gestational age and immunisation status was obtained from the RtHB which is an official document and further minimises the risk of error through communication or misunderstanding.

3.6.1.4 Criterion based validity

The results of this study were compared to results from SADHS (2016) and SANHANES (2013). Although the compared studies are National studies, and the results were not exactly similar, the same trend was noted, which indicates high criterion based validity.

3.6.2 Reliability

The anthropometric measurements were repeated to ensure reliability and were also re-done when the 2nd measurement was significantly different from the first (pre-determined criteria was described in the training guide for the research assistant which was compiled from known literature. The same equipment was used throughout data collection to ensure consistency and was calibrated before the study commenced and weekly thereafter. The questionnaire and measurement techniques were pilot tested before data collection commenced. The participants were classified according to weight-for-age-z-score (WAZ), height-for-age-z-score (HAZ), and weight-for-height-z-score (WHZ). The weight and height of the caregivers were converted to BMI for interpretation. WHO Anthro Plus software enabled the programme to generate z-scores. Data cleaning was applied according to WHO 2006 in which individuals whose anthropometric indicators were outside specifications (above or below +5 or -5 respectively), were removed. Outliers, which are likely due to measurement or coding errors, are removed so that they would not influence the data.

3.6.2.1 Internal reliability

The research assistant was selected based on her track record of reliability and being a graduate student. She was trained one week before the pilot study commenced and assisted throughout when any questions or concerns were raised. The same assistant was present throughout to avoid different ways of asking the questions or techniques. The same measuring equipment was used throughout the research study to assess

nutritional status and all children and adults were weighed and measured in the same way as previously described.

The reliability, validity and quality of data collection were assured throughout data collection. One of the ways this was assured, is by using a variety of research instruments (as described in chapter 2), which were merged into the questionnaire (Appendix A). The instruments used include the selected FFQ, the 24-hour recall, the DDS and the HFIAS. The 24-hour recall questionnaire was not used for dietary intake, but rather to obtain information regarding the diet history for the completion of the DDS.

Anthropometric measurements were repeated to ensure accuracy and were captured onto the WHO Anthro Plus software which enabled the program to generate z-scores.

3.7 Ethical consideration

The study was submitted and ethics approval obtained from the Health Research and Ethics Committee at the Stellenbosch University (HREC Reference # S17/10/192). Approval was also obtained from the Provincial Health Research as well as from the hospital management as specified [Appendix B; Appendix C].

During data collection, all aspects of the study were explained to participants including the purpose and procedure of the study. Participants were informed that participation is voluntary and that they can withdraw at any time from the study without any consequences. Participants were informed that there will be no financial reward for participation, and incentives will not be given since all of the participants recruited were already at the hospital for healthcare and therefore will not be reimbursed for transport or other expenses.

Written consent was obtained from the participants once they understood what the study entails and if they wanted to participate (Appendix, D). Privacy of participants was ensured by keeping the questionnaires anonymous and participants had the option of answering the questions in a separate room.

Completed questionnaires were only accessible to the researcher, the study leader and the statistician. Data capturing sheets were locked away in a safe place at the University of Stellenbosch.

3.8 Data analysis

Microsoft Excel was used to capture the quantitative data that was collected. Data cleaning was performed prior to analysis of data to ensure that all outliers could be identified and removed from the data set. Data cleaning criteria was used to exclude extremely high or low values from the data collected. Data cleaning according to WHO (2006) was applied which excluded indicators above or below +5 or -5 respectively. Both data was entered in Microsoft excel and WHO Anthro Plus software were exported to SPSS version 25 for further analysis. The anthropometric measurements were entered onto the WHO anthropometry software to calculate z-scores to be used for analysis. The children were classified according to WAZ, HAZ, and WHZ. Weight-for-age describes a body weight compared to chronological age. WAZ<-2 is described as underweight-for-age. Height-for-age describes linear growth and a HAZ<-2 is described as stunting.

Weight-for-height describes the weight in relation to the height/ length of the child and is considered acute malnutrition. $WHZ < -2$ is described as MAM and $WHZ < -3$ is described as SAM (WHO, 2009) (See Table 2).

Z- scores	Height/ length for age	Weight for age	Weight for height
Above 3	Normal	Possibly overweight (confirm with W/H)	Obese
Above 2	Normal		Overweight
Above 1	Normal		Normal
0 (Median)	Normal	Normal	Normal
Below -1	Normal	Normal	Normal
Below -2	Stunted	Underweight for age	Moderate acute malnutrition
Below -3	Severely stunted	Severely underweight for age	Severe acute malnutrition

MUAC was taken on children >6months of age as advised by the WHO and also used to determine if any relationship could be found with other nutritional factors. MUAC classification is categorised as follows:

SAM: <11.5cm

MAM: ≥ 11.5 cm to <12.5cm

Normal: >12.5cm

It is advised not to use MUAC in isolation to make a diagnosis of malnutrition, but to confirm with weight-for-height (Tadesse et al., 2017; Wieringa et al., 2018; Cashin and Oot, 2018).

The BMI of the caregiver was obtained from weight and height and classified for comparison. (See Table 3)

BMI (kg/m ²)	Interpretation
<18, 5	Underweight
18, 5- 24, 9	Normal
25- 29, 9	Overweight
30- 34, 9	Obese
35- 39, 9	Severely obese
>40	Morbidly obese

Descriptive statistics were used to report the distribution of variable within the different categories investigated. The nutritional status of the caregivers and the children were categorised by using appropriate cut-offs for classification. Bivariate analysis was done to determine the correlations between the variables. Variables were considered to be significant if the p-value was <0.05. The participants were classified according to WAZ, HAZ, and WHZ. The weight and height of the caregivers were converted to BMI for interpretation (see Table 3).

CHAPTER 4: RESULTS AND ANALYSES

Chapter 4 reports on the results obtained from data collected. A description of the study population will be followed by a description of dietary practices, anthropometry and lastly correlations will be explored. A total of 184 mother- child pairs were included in the final sample which exceeded the calculated sample of 153.

4.1 Description of study population

As displayed in Table 4, the majority of caregivers were female (96.7%, n= 178), African (58.2%, n= 107) and 74.5%, n= 137) was between the ages of 16-35 years which is child bearing age. Most of the caregivers completed grade 12 (52.7%, n= 97) yet the majority were unemployed (70.1%, n= 129). The majority of the caregivers had only one or two children (70.6%, n= 130).

Table 4: Characteristics of caregivers surveyed (n=184)

Characteristics of caregivers	Frequency (n)	Percentage (%)
Gender		
Female	178	96.7
Male	6	3.3
Ethnicity		
African	107	58.2
Coloured	69	37.5
Caucasian	6	3.3
Indian	1	0.5
Other	1	0.5
Age categories (years)		
<16 years	0	0
16- 25	52	28.3
26- 35	85	46.2
36- 40	18	9.8
>40	29	15.7
Level of school completed		
Grade 3 or less	3	1.6
Grade 6	9	4.9
Grade 9	51	27.8
Grade 12	97	52.7
Any tertiary education	24	13
Employment		
Unemployed	129	70.1
Employed (part- or full time)	48	26.1
Studying	7	3.8
Number of children		
1- 2	130	70.6
3- 4	51	27.8
5- 6	3	1.6

When participants were divided into 6 months age categories, the birth to 6 months category had the highest number of participants (28.4%, n= 52) as displayed in Table 5. Slightly more males (52.7%, n= 97) than females were included. The mean age of the children included was 20.21 months (SD=17.1). Most were of African ethnicity (58.7%, n= 108). This distribution is typical of NMB which has a population distribution of 60% black African.

Table 5: Characteristics of children surveyed (n=184)

Characteristics of children	Frequency (n)	Percentage (%)
Gender		
Male	97	52.7
Female	87	46.3
Ethnicity		
African	108	58.7
Coloured	68	37
Caucasian	6	3.3
Indian	1	0.5
Other	1	0.5
Age distribution (months)		
0- 6	52	28.4
6- 12	23	12.6
12- 24	35	19
24- 36	36	19.7
36- 48	24	13
48- 60	14	7.3

The majority of households had two or less adults (46.7%, n= 86) and two or less children (52.7%, n= 97) per house as displayed in Table 6. The household size in NMB is reported to be an average of 3.4 people per household, showing it to be comparable to the sample. Almost a third (27.7%, n= 51) had no one within the household who was working. Most children included in the study (63.6%, n= 117), received a child support grant monthly and the majority (72%, n= 98) of caregivers received the grant for one or two children. A total of 137 (74%) of caregivers received a grant for one or more of their children while fewer caregivers (63.6%, n= 117) received a grant for the child in the study. Other sources of household income included income from a spouse or boyfriend (28.8%, n= 53), income from parents or grandparents (28.3%, n= 52), a child support grant (25%, n= 46), income from family and friends (9.2%, n= 17) and income from other grants (8.7%, n= 16). The majority of participants (55.5%, n= 102) had a household income of over R2000 per month.

Table 6: Household characteristics (n=184)

Household characteristics: Residents	Frequency (n)	Percentage (%)
Adults per household		
1- 2	86	46.7
3- 4	65	35.3
5- 6	27	14.7
7+	6	3.3
Children per household		
1- 2	97	52.7
3- 4	70	38
5- 6	14	7.7
7+	3	1.6
Caregiver receiving child support grant for participating child		
Receiving grant	117	63.6
Not receiving grant	67	36.4
Number of children for whom the caregiver is receiving child support grant (N= 137)*		
1- 2	98	72
3- 4	32	23
5- 6	5	4
7+	2	1
Working individuals per household		
0	51	27.7
1	66	35.9
2	49	26.6
3	11	6
4+	7	3.8
Household income		
<R600	12	6.5
R601- R1200	40	21.7
R1201- R2000	22	12
>R2000	102	55.5
Unknown	8	4.3
Sources of household income		
Spouse or boyfriend	53	28.8
Parents or grandparents	52	28.3
Child support grant only	46	25
Family & friends	17	9.2
Other grants	16	8.7

*Some participants did not receive a grant for included child participant, but may receive a grant for children at home, therefore the difference N=117 and N=137

Most caregivers (44.5%, n= 82) reported to live in a RDP house and only 10.9% (n= 20) lived in informal housing (also known as a shack which is described as a primitive shelter or dwelling) as displayed in Table 7. The majority (82.6%, n= 152) of caregivers had a tap with running water inside their house, used a flush toilet and had municipal sewerage.

Most of the caregivers (96.2%, n= 177) had electricity at home. The majority used electricity as an energy source for cooking (90.8%, n= 167) although some used gas and paraffin. A total of 25.2% (n= 37) of caregivers reported to have a vegetable garden at their house.

Table 7: Household characteristics regarding structure (n= 184)

Household characteristics: Structure	Frequency (n)	Percentage (%)
Type of house		
RDP house	82	44.5
Free- standing house	59	32.1
Informal dwelling/ <i>shack</i>	20	10.9
Flat	20	10.9
Other	3	1.6
Water sources		
Tap with running water inside house	152	82.6
Tap with running water outside the house	20	10.9
Communal tap	10	5.4
No water source	2	1.1
Type of sanitation used		
Flush toilet inside the house	138	75
Flush toilet outside the house	34	18.5
Pit latrine	1	0.5
Bucket system	11	6
Type of sewerage system at home		
Municipal	182	98.9
Own sewerage	2	1.1
Number of households with electricity available		
Electricity source	177	96.2
No electricity source	7	3.8
Energy sources for cooking		
Electricity	167	90.8
Gas	10	5.4
Paraffin	7	3.8
Vegetable garden at the household		
Vegetable garden	37	25.2
No vegetable garden	147	74.8

4.2 Dietary information

4.2.1 Breastfeeding

Since this study included a wide age range of children (0-60 months), the children who are currently breastfeeding (n= 79) as well as those who were breastfed previously (n= 81) were included as those who have a breastfeeding history. Displayed in Table 8, a large number of the participants (87%, n= 160) were breastfed at some point or were still breastfeeding at the time of the study. There was no distinction made as to whether the child was exclusively breastfed or receiving mixed feeding. The duration of breastfeeding was less than six months for more than half (54.3%, n= 44). It was shown that 60.3% (n= 111) of children received formula milk. From these 111, most (45.9%, n= 51) received formula milk when younger than one month of age and were therefore mixed feeding. Most of the caregivers (93.7%, n= 104) used a bottle as a feeding method.

Table 8: Breastfeeding & formula feeding practices (n=183)

Breastfeeding & formula feeding practices	Frequency (n)	Percentage (%)
Breastfeeding (currently or previously, including mixed feeding)		
Breastfeeding	160	87
Not breastfeeding	23	13
Duration of breastfeeding of caregivers who stopped breastfeeding (n=81)		
0- 6 months	44	54.3
6- 12 months	19	23.5
12- 24 months	13	16
24 + months	5	6.2
Formula milk given to child (including as full feeds or top ups) (N=183)*		
Formula given	111	60.3
No formula given	72	39.1
Age when formula milk was first introduced to the child (n= 111)		
<1 months	51	45.9
1- 3 months	25	22.5
4- 5 months	9	8.2
6 months	20	18.1
> 6months	6	5.3
Feeding method of formula milk (n=111)		
Bottle	104	93.7
Cup	7	6.3

*One participant did not complete this question, therefore N=183

4.2.2 Feeding practices

As displayed in Table 9, 73.9% (n= 184) of caregivers thought that their child had a good appetite and 65.2% (n=120) reported no appetite changes from usual intake compared to appetite on the day of data collection. Of those who had appetite changes (34.8%, n= 64), the most frequent reason provided for appetite changes by the caregiver, was the health status of the child (67.1%, n= 43). Most children (95.4%, n= 131) ate breakfast daily. From the 138 children who have been introduced to complimentary food, 42.8% (n= 59) introduced complimentary food after six months of age, while 57.2% (n= 79) introduced complimentary food before six months of age. The food given most frequently to children was infant cereal (55%, n= 76). More than half (54.3%, n= 100) of participants gave the child tea or coffee to drink and 92% (n= 92) of those who drink tea or coffee, added sugar to the beverage.

Table 9: Dietary patterns of children surveyed (n=184)

Dietary intake of child	Frequency (n)	Percentage (%)
Appetite of child (as reported)		
Good appetite	136	73.9
Poor appetite	48	26.1
Appetite changes reported		
Same appetite (no change)	120	65.2
Increased appetite	18	9.8
Decreased appetite	46	25
Frequency of breakfast consumption (n=138)		
Daily	131	95.4
1-5 times/ week	7	4.6
Age of introduction of solid food (n=138)		
0- 3 months	14	10.1
3-5 months	34	24.6
5-6 months	31	22.5
>6 months	59	42.8
Type of solid food first introduced to child (n= 138)		
Maize meal porridge	17	12.3
Infant cereal	76	55
Ready to eat bottled baby food	6	4.3
Vegetables	38	27.5
Other: rice & liver	1	0.9
Tea or coffee given to child		
Tea or coffee given	100	54.3
No tea or coffee given	84	45.7
Sugar added to tea or coffee (n=100)		
Sugar added	92	92
No sugar added	8	8

*A total of 46 participants were not yet introduced to complimentary food, therefore N= 138

4.3 Dietary patterns

Described below in Table 10, are the dietary patterns of children collected using the food frequency questionnaire. The typical daily intake of children will further be described according to food group. Only children older than six months were included as this is the recommended age to introduce complimentary food, therefore n=132.

4.3.1 Cereals and starches

The most frequently consumed cereal was soft porridge which was eaten by 75% (n= 99) of children followed by potatoes and white bread which was each eaten by more than half of children (54.5%, n= 72). Daily *samp* intake was poor with only 2.3% (n= 3) children who consumed it.

4.3.2 Dairy

Dairy was not as well consumed as cereals, and only half of children consumed a dairy product daily with yoghurt being the predominant item (50.1%, n= 67) while sour milk (*amas*) (9.8%, n= 13) and cheese (9.1%, n= 12) were least consumed. Only 38.6% (n= 51) of children drank milk daily.

4.3.3 Animal protein

Animal protein consumption was poor for most children. The most consumed animal product was chicken, which was eaten by 24.2% (n= 32) of children followed by eggs (22.7%, n=30). Processed meat (*polony and viennas*) was also consumed regularly by over a quarter of the children. Pork (2.3%, n= 3) and lamb (1.5%, n=2) were least consumed.

4.3.4 Plant protein

Daily plant protein intake was fairly poor with peanut butter being most consumed on a daily basis (55%, n= 41.7). Soya was eaten daily by only 9.1% of children (n= 12) and 6.8% (n= 9) of children ate beans or lentils.

Table 10: Frequency of intake of starches, grain and protein sources (n=132)

Food items	Daily (4+/week) n (%)	Weekly (1-3/ week) n (%)	Seldom n (%)	Never n (%)
Grains				
Soft porridge	99 (75)	16 (12.1)	3 (2.3)	13 (9.8)
White bread	72 (54.5)	40 (30.3)	5 (3.8)	14 (10.6)
Breakfast cereal	60 (45.5)	38 (28.8)	7 (5.3)	26 (19.7)
Rice	57 (43.2)	48 (36.4)	9 (6.8)	17 (12.9)
Brown bread	51 (38.6)	30 (22.7)	17 (12.9)	33 (25)
Pasta	33 (25)	69 (52.3)	9 (6.8)	20 (15.2)
Stiff porridge	14 (10.6)	42 (31.8)	23 (17.4)	53 (40.1)
Samp	3 (2.3)	36 (27.3)	27 (20.5)	65 (49.2)
Starches				
Potatoes	72 (54.5)	40 (30.3)	5 (3.8)	14 (10.6)
Dairy products				
Yoghurt	67 (50.1)	40 (30.3)	9 (6.8)	15 (11.4)
Fresh milk	51 (38.6)	21 (15.9)	8 (6.1)	44 (33.3)
Fresh milk powder	21 (15.9)	6 (4.5)	5 (3.8)	99 (75)
Amasi	13 (9.8)	50 (37.9)	14 (10.6)	54 (40.9)
Cheese	12 (9.1)	32 (24.2)	22 (16.7)	65 (49.2)
Animal foods				
Chicken	32 (24.2)	71 (53.8)	5 (3.8)	23 (17.4)
Eggs	30 (22.7)	57 (43.2)	17 (12.9)	26 (19.7)
Processed sliced meat (<i>Polony</i>)	31 (23.5)	42 (31.8)	14 (10.6)	43 (32.6)
Processed sausages (<i>Viennas</i>)	16 (12.1)	38 (28.8)	25 (18.9)	52 (39.4)
Chicken livers	9 (6.8)	66 (50)	14 (10.6)	42 (31.8)
Beef	4 (3)	25 (18.9)	37 (28)	65 (49.2)
Fish	4 (3)	48 (36.4)	30 (22.7)	49 (37.1)
Chicken feet & heads	4 (3)	16 (12.1)	13 (9.8)	98 (74.2)
Chicken offal	3 (2.3)	10 (7.6)	16 (12.1)	101 (76.5)
Pork	3 (2.3)	34 (25.8)	22 (16.7)	72 (54.5)
Lamb	2 (1.5)	20 (15.2)	31 (23.5)	77 (58.3)
Plant protein				
Peanut butter	55 (41.7)	35 (26.5)	12 (9.1)	29 (21.7)
Soya	12 (9.1)	21 (15.9)	26 (19.7)	72 (54.5)
Beans	9 (6.8)	44 (33.3)	22 (16.7)	56 (42.2)
Lentils	9 (6.8)	33 (25)	16 (12.1)	73 (55.3)
Peanuts	3 (2.3)	11 (8.3)	8 (6)	109 (82.6)

*Only 132 children had yet started with complimentary feeding at the time of data collection

Table 11 describes more of the dietary patterns of children and daily intake is further described.

4.3.5 Fruit

Daily fruit intake of children is relatively low compared with the PFBDG with just over a third who consumed fruit daily. Banana and fruit juice were most consumed with 38.6% (n= 51) of children who consumed either of these daily. An apple was eaten daily by almost a third of children (38%, n= 38). Guava (2.3%, n= 3) and paw- paw (1.5%, n= 2) were least consumed.

4.3.6 Vegetables

Vegetable intake showed to be even poorer than fruit intake with less than a quarter of children who consumed vegetables daily (24.2%, n= 32). The orange vegetables (pumpkin and carrot) were most consumed and in the same measure at 24.2% (n= 32) for each of them. Green leafy vegetable (spinach) consumption was also low with only 11.4% (n= 15) of children who ate spinach daily. Beetroot was least consumed and eaten by only 6% (n= 8) of participants.

4.3.7 Miscellaneous

Margarine was eaten daily by almost two- thirds of children (59.1%, n= 78). Chips was the most frequently consumed snack food which was eaten by 53% (n= 70) of children. Biscuits (41.7%, n= 55) and sweets (37.1%, n= 49) were also eaten daily by over a third of children. Jam was also a popular condiment which was used daily by 19.7% (n= 26) of participants and ice cream was eaten least frequently by 3.8% (n= 5) of participants daily.

Table 11: Food frequency questionnaire of children (fruit, vegetables, miscellaneous) (n= 132)

Food items	Daily (4+/week) n (%)	Weekly (1 -3/ week) n (%)	Seldom n (%)	Never n (%)
Fruit				
Banana	51 (38.6)	49 (37.1)	14 (10.6)	17(12.9)
Fruit juice	51 (38.6)	40 (30.4)	9 (6.8)	31 (23.5)
Apple	38 (28.8)	45 (34.1)	8 (6.1)	40(30.3)
Orange	27 (20.5)	32 (24.2)	13 (9.8)	59 (44.7)
Pear	27 (20.5)	35 (26.5)	20 (15.2)	49 (37.1)
Naartjie	24 (18.2)	27 (20.5)	13 (9.8)	67 (50.1)
Grapes	14 (10.6)	16 (12.1)	31 (23.5)	70 (53)
Mango	7 (5.3)	6 (4.5)	17 (12.8)	100 (75.8)
Avocado	4 (3)	17 (12.9)	23 (17.4)	87 (65.9)
Guava	3 (2.3)	5 (3.8)	13 (9.9)	110 (83.3)
Paw-paw	2 (1.5)	4 (3)	12 (9.1)	113 (85.6)
Vegetables				
Pumpkin	32 (24.2)	67 (50.1)	14 (10.6)	20 (15.2)
Carrot	32 (24.2)	63 (47.7)	11 (8.3)	27 (20.5)
Sweet potato	23 (17.4)	40 (30.3)	18 (13.6)	49 (37.1)
Tomatoes	16 (12.1)	45 (34.1)	10 (7.6)	60 (45.5)
Spinach	15 (11.4)	38 (28.8)	17 (12.8)	61 (46.2)
Cabbage	13 (9.8)	41 (31.1)	17 (12.8)	60 (45.5)
Beetroot	8 (6)	23 (17.4)	25 (19)	75 (56.8)
Miscellaneous				
Margarine	78 (59.1)	17 (12.8)	3 (2.3)	33 (25)
Chips	70 (53)	34 (25.8)	8 (6.1)	19 (14.4)
Biscuits	55 (41.7)	31 (23.5)	19 (14.4)	26 (19.7)
Sweets	49 (37.1)	29 (22)	22 (16.7)	31(23.5)
Jam	26 (19.7)	22 (16.7)	9 (6.8)	74 (56.1)
Cold drinks	25 (18.9)	40 (30.3)	18 (13.6)	48 (36.4)
Fat cakes	11 (8.3)	50 (37.9)	34 (25.8)	36 (27.3)
Ice cream	5 (3.8)	11 (8.3)	37 (28)	78 (59.1)

*Only n= 132 ate food at the time of the study

As displayed in Table 12, some of the results of the FFQ, showing daily intake were stratified according to age and compared to recommendations by the PFBGDs in order to determine if the diet of children meet the recommendations (Scott, Marais and Bourne, 2009). The interpretation of the results are limited in the sense that it only indicates the number of portions consumed per day according to the age groups, yet it can't differentiate if a participant consumed more than one food type within a food group. For the purpose of this project, it was not done. The PFBGD guidelines are set to inform consumers how to choose food and beverage combinations that will lead to an adequate diet, which meets nutrients and reduces the risk of lifestyle diseases (Scott, Marais and Bourne, 2009).

The recommendations included are applicable to children 6-36 months after which the recommendations are slightly changed for children older than three years of age. The 3-5 year old age group was included for reference. The first guideline states that Animal protein (*meat, chicken, fish or egg*) *should be eaten every day or as often as possible*. The results showed that only about a fifth of children 6-12 months of age (21.7%, n= 5) ate a meat portion daily while about half of children 12-36 months of age (52.1%, n= 37) consumed a source of animal protein daily and about 63% (n= 24) of children over 3 years consumed an animal protein daily.

The second guideline stating that *children should consume dark green leafy vegetables and orange fruit and vegetables daily* showed a low intake of orange fruit, with only 8.7% (n= 2) of children 6-12 months who had daily consumption of orange fruit, 12.7% (n= 9) of children 12-36 months and 44.7% (n= 17) of children 3-5 years. Vegetable consumption was better with almost half (47.8%, n= 11) who ate orange or green leafy vegetables daily with 25.4% (n= 18) and 28.9% (n= 11) who ate orange or green leafy vegetables daily.

The fourth guideline states that *children older than one year should receive milk, maas or yoghurt every day*. The total portions are fairly high, but it is unclear whether the same children may be eating a portion of milk, yoghurt and *amas* daily or whether most children are truly receiving a portion of dairy daily. Yoghurt was most consumed with 47.9% (n= 34) of children between 12-36 months and 50% (n= 19) of children older than three years who consumed yoghurt on a daily basis. It should also be considered that 79 of the participants were still breastfeeding at the time of the study, therefore it would be expected that lower dairy intake would be noted in breastfeeding children.

Table 12: Comparison of daily consumption with PFBDG

Guidelines from PFBDG according to age	6- 12 months (n= 23)	12- 36 months (n= 71)	3- 5 years (n= 38)
Guideline 3: Give your child meat, chicken, fish or egg every day, or as often as possible			
Daily consumption of meat, chicken, fish or egg	21.7% (n= 5)	52.1% (n= 37)	63% (n= 24)
Guideline 4: Give your child dark-green leafy vegetables and orange-coloured vegetables and fruit every day			
Daily consumption of green leafy vegetables (spinach) and orange vegetables (carrots, pumpkin, sweet potato)	47.8% (n=11)	25.4% (n= 18)	28.9% (n= 11)
Daily consumption of orange fruit (Orange, naartjies, mango, peaches)	8.7% (n= 2)	12.7% (n= 9)	44.7% (n= 17)
Guideline 10: Give your child milk, maas or yoghurt every day (only >1 year)			
Milk	N/A	40.8% (n= 29)	55.3% (n= 21)
Maas	N/A	8.5% (n= 6)	5.2% (n= 2)
Yoghurt	N/A	47.9% (n= 34)	50% (n= 19)
Total		97.2% (n= 69)	110% (n= 42)

4.4 Household food insecurity

4.4.1 Food availability and accessibility was assessed.

As displayed in Table 13, more than half (61.4%, n= 113) of the caregivers or household residents had to eat a smaller variety of food due to a lack of money to buy food. Some caregivers (15.8%, n= 29) reported that they or any household resident had no food to eat at times and 12.5% (n= 23) of caregivers or household residents reported having had at least one member in the house sleep hungry at night due to a lack of food. A few caregivers or household residents (10.3%, n=19) went a whole day and night without food due to a lack of resources.

Table 13: Household food insecurity scale results breakdown per question (N=184)

Household food insecurity questions	Frequency (n) ("yes" answers)	Percentage (%)
During the past 30 days:		
Did you worry that your household would not have enough food	113	61.4
Were you or a household member unable to eat the types of food you like more	86	46.7
Did you or a household member have to eat a small variety of food	90	48.9
Did you or a household member have to eat foods that you really did not want to eat	76	41.3
Did you or a household member have to eat a smaller meal than you needed	77	41.8
Did you or a household member have to eat less meals in a day	67	36.4
Was there ever no food to eat due to lack of resources	29	15.8
Did you or a household member sleep hungry because of a lack of food	23	12.5
Did you or a household member go a whole day and night without eating anything because there was no food	19	10.3

Household hunger was also determined. As displayed in figure 2, 33.2% of households included in the study were classified as food secure, 29.3% were at risk of hunger and 37.5% experienced hunger. From the HFIAS questionnaire, participants received a score out of 9 according to how many “yes” answers were provided. A score of 0-2 indicated food security, a score 3-5 indicated moderate or a risk of food insecurity and a score of 6- 9 was equal to food insecurity or hunger being prevalent in the household.

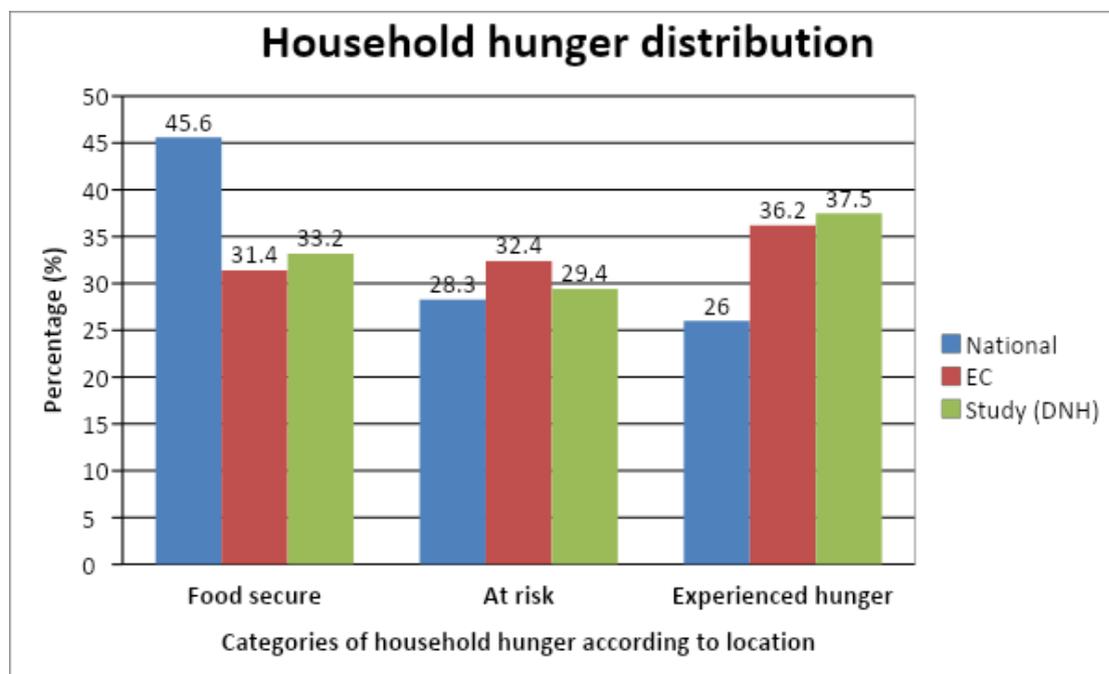


Figure 2: Household hunger distribution categories described and compared to SANHANES- 1

4.4.2 Dietary diversity

Dietary diversity of children was obtained using all 17 food groups from the DDS. The results were later reworked to the 7 food group DDS recommended for children as the minimum dietary intake in order to allow for more comparability with studies. The DDS mentioned according to food groups, describes the original 17 food group questionnaire, the CDDS was only later calculated for comparison.

As displayed in figure 3, a relatively high intake of starches which included cereals (69.9%, n= 95) and white tubers (67.2%, n= 91) were consumed by children as well as a high intake of sweets (61.7%, n= 84). Vitamin A rich food was well consumed (67.2%, n= 91) but a lower intake of dark green leafy vegetables was noted (42.1%, n= 57). Only 45.4% (n= 62) ate vitamin A rich fruits and 58.5% (n= 80) ate other fruits. A fairly small amount of children (65.6%, n= 89) consumed milk or dairy products. Protein intake was in general fairly low, with an intake of between 53% (n= 72) to 63.4% (n= 86) for the different types of meat. A total of 136 participants were included, 47 were excluded due to not yet being introduced to complimentary food at the time of data collection and one participant did not provide a response to this question.

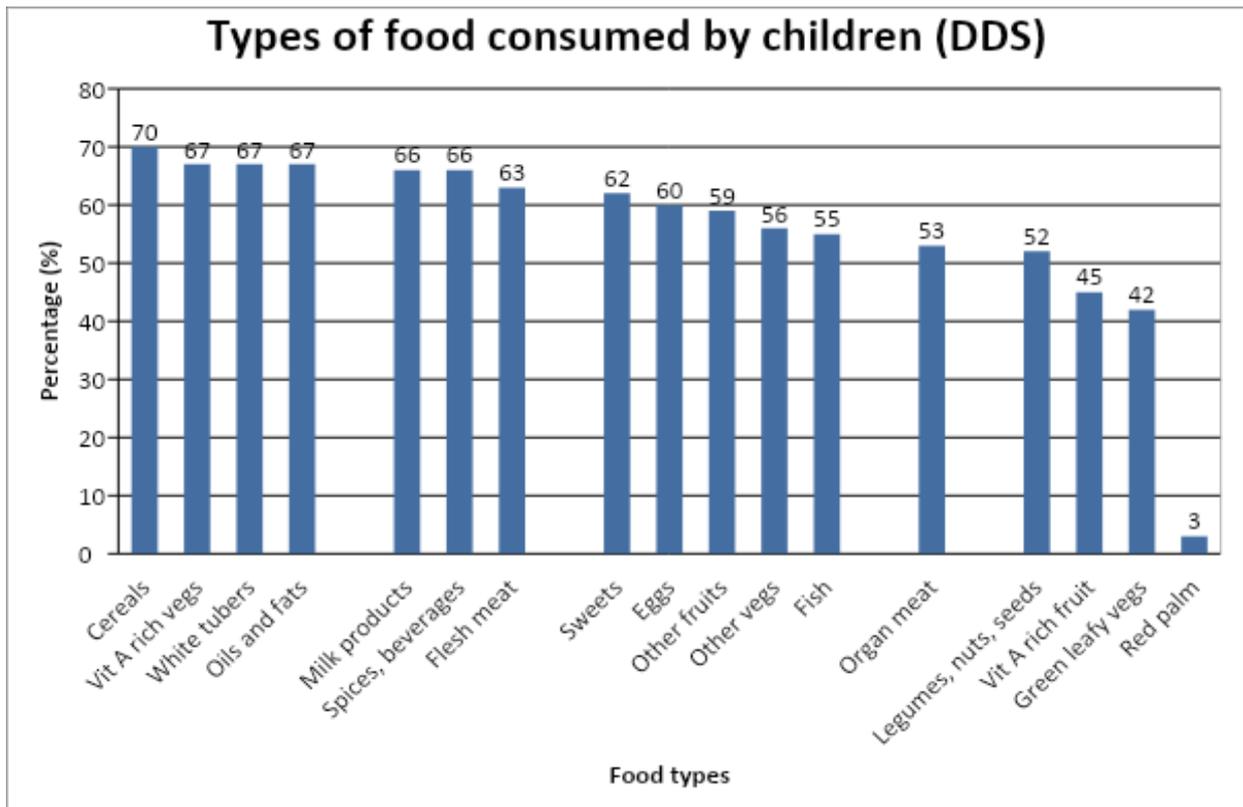


Figure 3: Food types consumed derived from the dietary diversity questionnaire (n=136)

As displayed in figure 4, only 52.9% (n= 72) of participants had an excellent DDS (score of 14- 17) while 22% (n= 30) had an adequate score (score of 12-13), 14.7% (n= 20) had a medium score (a score of 8-11), 3.7% (n= 5) had a low score (a score of 4-7) and 6.7% (n= 9) had a poor DDS (score of less than 3). Therefore a total of 75.9% (n= 76) had a DDS of adequate or more. The sample for the DDS was only 136 since 47 children were excluded as they were younger than six months of age.

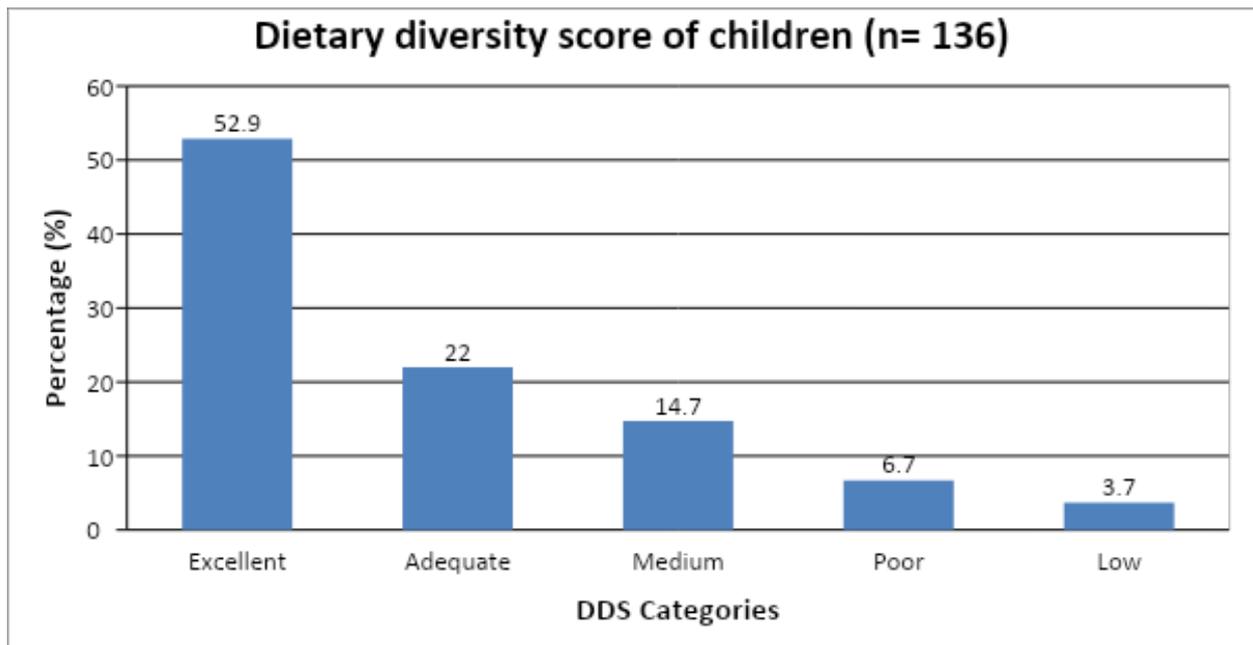


Figure 4: Classification of DDS of child participants

Table 14 and 15 displays the CDDS which was out of a score of 7. A score of four or more out of seven displays adequate dietary diversity while a score of below four displays a low dietary diversity. The majority of children (91.8%, n= 125) had an adequate CDDS (minimum dietary diversity score as per WHO).

Table 14: Child DDS (n= 136)

CDDS total score	Frequency (n)	Percentage (%)
0	1	0.8
2	1	0.8
3	3	2.2
4	6	4.4
5	9	6.6
6	35	25.7
7	81	59.5

Table 15: DDS of children (n= 136)

CDDS categories	Frequency (n)	Percentage (%)
Low dietary diversity (<4)	11	8.1
Adequate dietary diversity (>4)	125	91.9

When using the 17 scale DDS, 10.4% had poor to low dietary diversity compared to 8.1% when using the 7 scale CDDS, thus showing that data is more or less a good estimate.

4.5 Caregivers' nutrition knowledge

As displayed in Table 16, most (87.8%, n= 159) of the caregivers correctly identified breastmilk as the best food for a baby younger than six months and 32% (n= 58) also correctly thought that the ideal duration of breastfeeding is 24 months and beyond. Only 24.3% (n= 44) correctly identified rice or bread as a suitable alternative to porridge, only 9.2% (n=17) identified legumes as a suitable meat alternative and only 27.7% (n= 50) correctly identified cheese as a suitable alternative to milk. Peanut butter was selected as a suitable milk alternative by 51.9% (n= 94). . Most caregivers (68.5%, n= 124) correctly indicated that a child aged 2-5 years needs at least 1.5 cups of milk per day. A total of 91.7% (n= 166) of caregivers knew the child would need to eat at least three times per day. From the three questions that were expected for all caregivers to know the answer (breastfeeding as the best food, duration and how often to feed their child), the average score was 70.5% (n= 128).

The clinic or community health centre was most used for nutrition information (47.5%, n= 86). Other places where nutrition knowledge was obtained from friends and family (28.7%, n= 52), the media (TV, radio, newspaper) (23.2%, n= 42), own experience (16%, n= 29) or the internet (5%, n= 9). Three participants did not complete this question.

Table 16: Knowledge of caregiver regarding nutrition (n=181)

Nutrition knowledge of caregiver	Frequency (n)	Percentage (%)
Which food is the best for a baby younger than 6 months		
Breastmilk (Correct answer)	159	87.8
Infant formula	3	1.7
Breast- & formula milk	12	6.6
Soft porridge	6	3.3
Don't know	1	0.6
Ideal duration of breastfeeding		
24 months + (Correct answer)	58	32
<6 months	21	11.7
6- 12 months	34	18.8
12- 18 months	33	18.2
19- 23 months	31	17.1
Don't know	4	2.2
Suitable substitute for porridge		
Rice or bread (Correct answer)	44	24.3
Meat or milk	17	9.4
Banana or mango	30	16.6
Cabbage or pumpkin	85	47
Don't know	5	2.7
Suitable meat alternative		
Legumes (Correct answer)	17	9.2
Spinach	60	32.6
Potatoes	101	54.9
Don't know	3	1.6
Amount of dairy needed/ day for children 2- 5 years		
1.5- >2.5 cups (Correct answer)	124	68.5
0.5- 1 cup	29	16
Don't know	28	15.5
Suitable milk alternative		
Cheese (Correct answer)	50	27.7
Coffee creamer	18	9.9
Peanut butter	94	51.9
Don't know	19	10.5
Number of times a child of 2- 5 years old should eat per day		
Three or more (Correct answer)	166	91.7
Once	1	0.6
Twice	10	5.5
Don't know	4	2.2
Sources of nutrition information (more than 1 option was allowed)		
Clinic/ community health centre	86	47.5
Friends/ family	52	28.7
TV, radio, newspaper, magazine	42	23.2
Own experience	29	16
Internet	9	5

*Three participants did not complete this question

4.6 Anthropometry

As shown in Table 17, 25.1% (n= 39) of children had a birth weight below the -2SD line and 23.4% (n= 43) were born prematurely. Most children's (98%, n= 150) immunisations were up to date, with only 2% who were not immunised. Many caregivers did not bring the RtHB with to the hospital and some of the data in the booklets were incomplete.

Table 17: Information obtained from the RtHB of child

Information from RtHB	Frequency (n)	Percentage (%)
Birth weight of child (n= 155) (29 booklets were incomplete or unavailable)		
<-3 SD line	18	11.6
<-2 SD line	21	13.5
<-1 SD line	25	16.1
<Median	48	31
<+1 SD line	40	25.8
<+2 SD line	3	2
Gestational age of participants (n= 154) (24 booklets were incomplete or unavailable)		
Full term	117	63.6
Premature	43	23.4
Immunisations up to date (n= 153) (31 booklets were incomplete or unavailable)		
Yes	150	98
No	3	2

Table 18 indicates the anthropometric classification of children surveyed. An interpretation of the results indicated that, 2.8% (n= 5) of children were classified as SAM, 3.9% (n= 7) were MAM and 13.3% (n= 24) of children were at risk of wasting. A few children (7.2%, n= 13) were overweight or obese. According to the WAZ, 13.6%, (n= 25) of children were underweight for age. A quarter of children surveyed (25.6%, n= 47) were stunted. A total of 12.5% (n= 23) were severely stunted. Even though 43 children were premature, adjusted age was not used in this study since most of the caregivers did not know the gestational age of their child. This is this a limitation in the results.

Table 18: Anthropometric classification of children surveyed (n=184)

Anthropometry as per z-scores	Frequency (n)	Percentage (%)
Weight-for-age (WAZ)		
Severely underweight for age <-3	13	7.1
Moderate underweight for age -3 to <-2	12	6.5
Normal ≥ -2	159	86.4
Height-for-age (HAZ)		
Severely stunted <-3	23	12.5
Moderately stunted -3 to <-2	24	13.1
Normal ≥ -2	137	74.4
Weight-for-height (WHZ) *3 values missing values due to child too small to determine WHZ (n=181)		
SAM <-3	5	2.8
MAM -3 to <-2	7	3.9
At risk of wasting -2 to <-1	24	13.3
Normal -1 to < 1	104	57.4
At risk of overweight 1 to < 2	28	15.4
Overweight 2 to <3	10	5.5
Obese >3	3	1.7
MUAC (n= 106)		
MAM (11- 12.5cm)	4	4
At risk of malnutrition (12.5- 13.5cm)	11	10
Normal (>13.5cm)	91	86

As displayed in Figure 5, the majority (86%, n= 89) of children above six months had a normal MUAC, while a total of 14% (n= 17) were either classified as MAM or at risk of wasting.

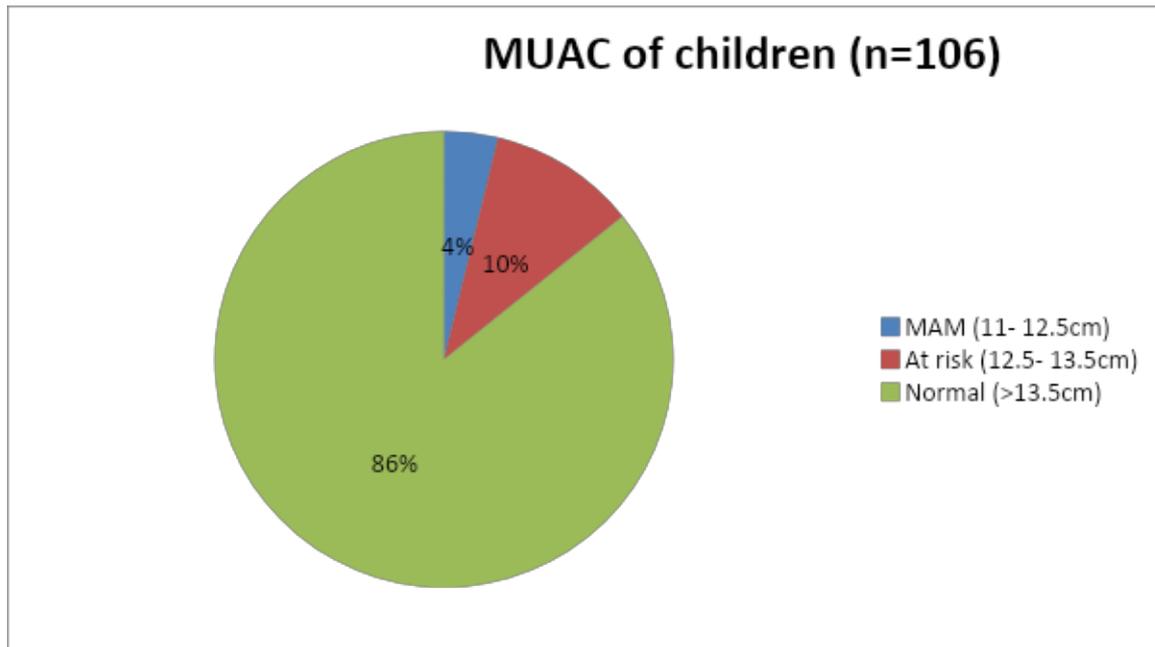


Figure 5: MUAC of children surveyed

As displayed in Figure 6, the analysis revealed that the majority of caregivers (58.2%, n= 107) were either overweight or obese. Less than two fifths had a normal BMI (38%, n= 70) and a few (3.8%, n= 7) participants were classified as wasted.

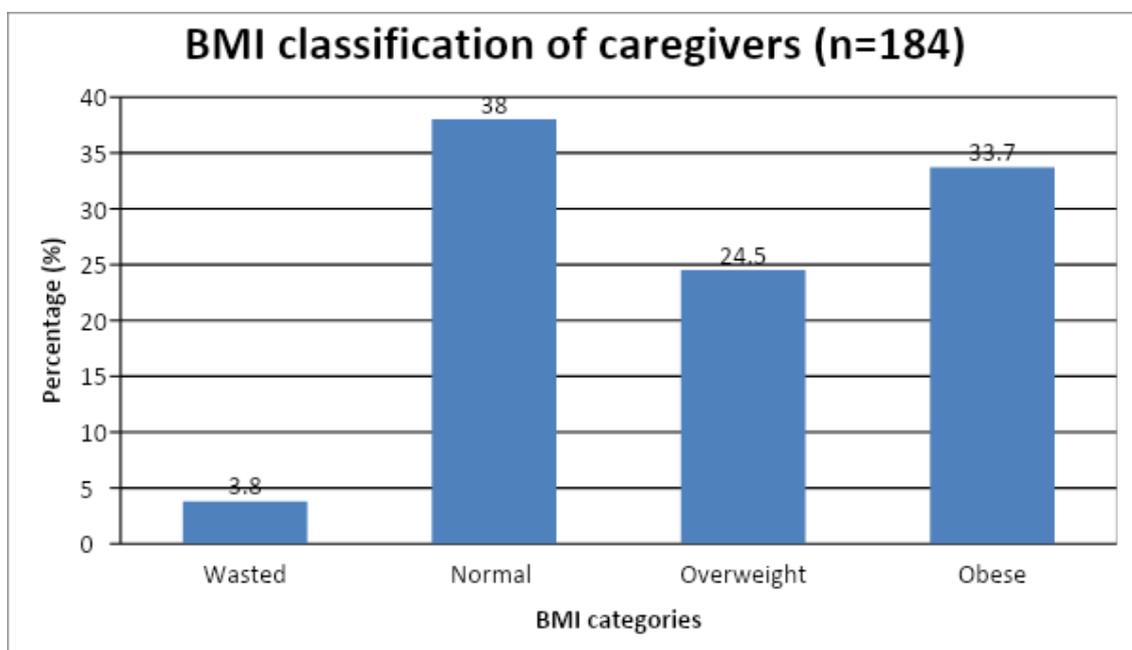


Figure 6: BMI classifications of caregivers

4.7 Relationship between socio-demographic, dietary patterns, food insecurity and anthropometry

Table 19 illustrates correlations between selected variables. Variables which have shown a significance with a p-value of <0.05 have been reported. The selected variables include anthropometry of children and caregiver, socio-economic factors and dietary patterns. All of the investigated correlations were only slightly positive, meaning that a causal relationship could not be determined, but that value X and value Y would agree in terms of being low, moderate or high. There may be a causal relationship between the variables which needs to be confirmed with further research. In general, larger caregivers were often seen with larger children, a higher household income was seen with an improved nutritional status in children and a more varied diet and MUAC increased or decreased according to the size of the child.

4.7.1 Height-for-age (HAZ)

Height for age showed a weak positive correlation between MUAC ($p= 0.0001$) and BMI of caregivers ($p= 0.009$). This would indicate that taller children would likely have a larger MUAC or children with a larger MUAC, is generally taller. This could also indicate the opposite, that children, who are shorter, generally have a smaller MUAC. Caregivers with a higher BMI tend to have children who are taller and caregivers with a lower BMI may in general have shorter children.

4.7.2 Weight-for- height (WHZ)

Similar to findings above, WHZ showed a weak positive correlation between MUAC ($p= 0.000$) and the BMI of caregivers ($p= 0.0001$). Therefore, caregivers with a higher BMI, tend to have larger children (with a higher WHZ), and caregivers with a lower BMI, tend to have thinner children (children with a lower WHZ). WHZ also showed a correlation between MUAC (0.000), meaning an increase in WHZ is associated with an increase in MUAC. This is to be expected, since MUAC is another indicator, besides WHZ for acute malnutrition and can also be used to identify obesity.

4.7.3 Weight-for-age (WAZ)

WAZ also showed a weak positive correlation between MUAC ($p= 0.0001$) as well as gestational age (0.038). An increase in WAZ, is usually associated with a larger MUAC and a lower WAZ, is associated with a smaller MUAC. An increase in gestational age is associated with an increase in WAZ and a lower gestational age is associated with a lower WAZ. This would be expected, since a lower gestational age would often result in a lower birth weight and hence a smaller child.

4.7.4 Mid-upper arm circumference (MUAC)

MUAC showed a weak positive and significant correlation with the child's appetite ($p= 0.000$), whether the caregiver receives a grant ($p=0.000$) and the household income ($p=0.000$). An increase in appetite would mostly be seen with children with a larger MUAC, and a decrease in appetite would often be seen in children with a smaller MUAC. The presence of a social grant would increase the household income. A higher household

income showed a larger MUAC in children and a lower household income showed a lower MUAC in children.

4.7.5 Household Food Insecurity Access Scale (HFIAS)

A higher HFIAS score was often seen with a higher DDS score ($p=0.000$) and a lower HFIAS score is seen with a lower DDS. This tendency can be explained by more food security within the house, would give access to a more varied diet.

4.7.6 Child Dietary Diversity Score (CDDS)

A weak positive and significant correlation was seen between CDDS and WHZ ($p= 0.001$), CDDS and WAZ ($p= 0.014$) and CDDS and MUAC of the child ($p= 0.035$). An increase in the diversity of the child's diet, showed an increased WAZ, WHZ and WHZ which could indicate that eating a more varied diet, could improve nutritional markers. A lack of diversity would likely be associated with a lower WAZ, HAZ and WHZ. There is a strong positive and significant correlation between DDS and the child age ($p= 0.0014$), showing that older children had higher diversity scores.

Table 19: Correlations between socio-demographic, dietary patterns, food insecurity and anthropometry

Variables		Pearson-r	P-value
CDDS	Age of the child	0.7436	0.0014***
HAZ	MUAC	0.14	0.0001***
	BMI of caregivers	0.018	0.009**
WHZ	MUAC	0.23	0.000***
	BMI of caregivers	0.08	0.0001***
	CDDS Score	0.289	0.001**
WAZ	MUAC	0.30	0.0001***
	Gestational age	0.02	0.038*
	CDDS Score	0.211	0.014*
MUAC	Child's appetite	0.01	0.000***
	Receiving grant	0.01	0.000***
	Household income	0.004	0.000***
	CDDS Score	0.182	0.035*
HFIAS	DDS Score	0.01	0.000***
CDDS	Age of the child	0.7436	0.0014***

Level of significance *=0.01, **=0.001, ***=0.0001

As displayed in Figure 7, the WHZ of the child, showed a weak positive correlation to the BMI of the caregiver. This could indicate that a heavier caregiver would often have a heavier child.

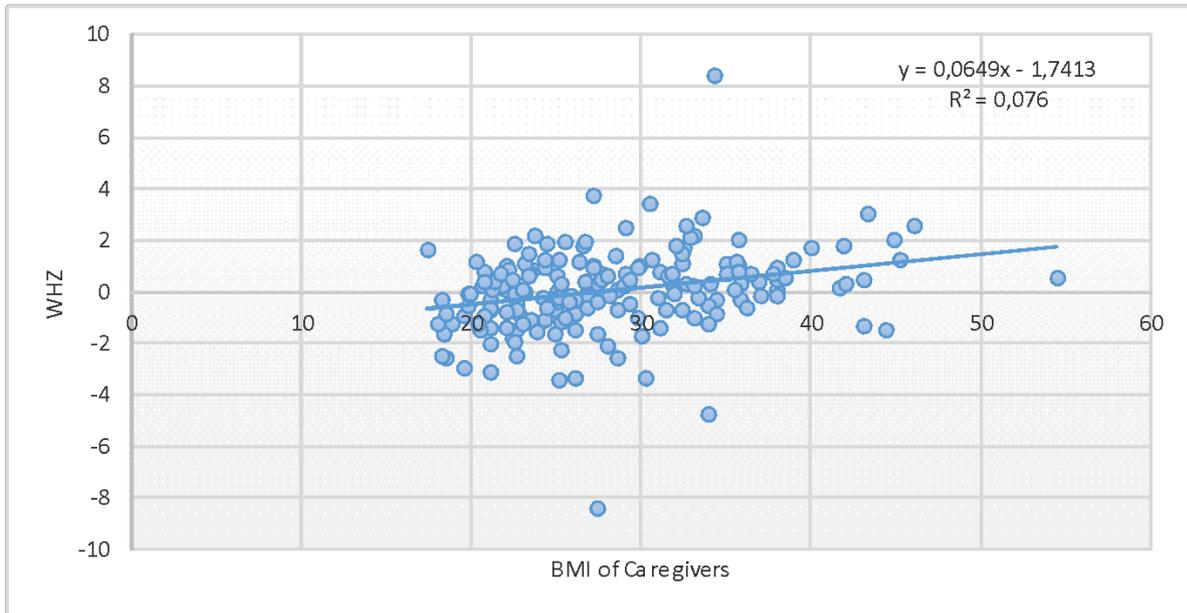


Figure 7: Scatter plot of the WHZ and BMI of caregivers

A weak positive linear correlation was seen between HAZ and BMI of the caregivers as displayed in Figure 8. Instead of the double burden of malnutrition, which is often present within one household, heavier caregivers were seen to have heavier and taller children, while caregivers who were smaller showed to have shorter and smaller children.

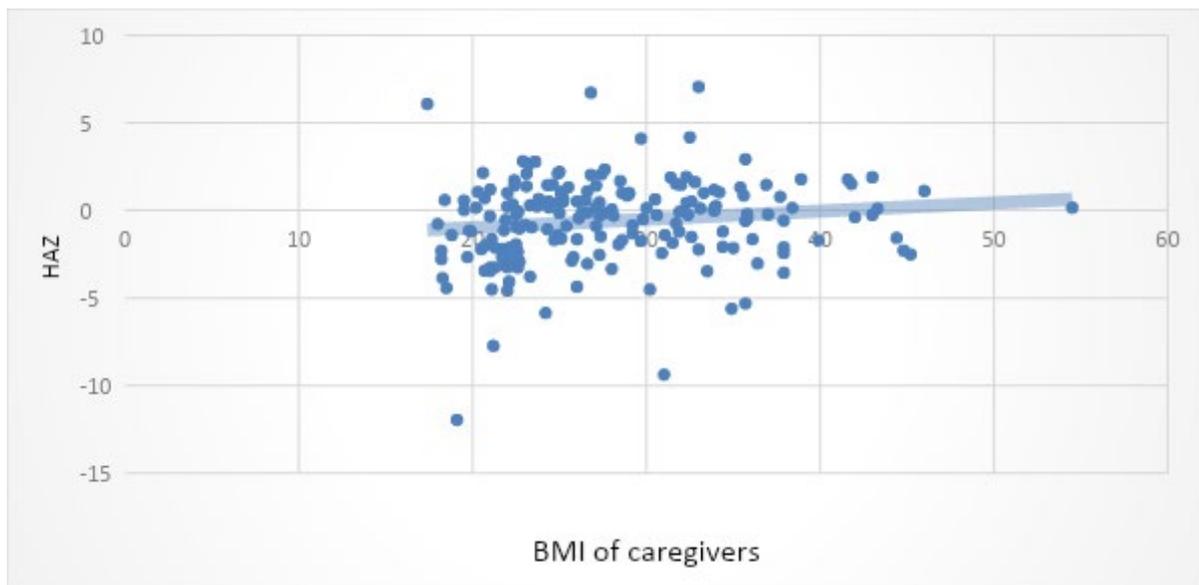


Figure 8: Scatter plot of HAZ and BMI of caregivers

As displayed in Figure 9, there was a weak, mild and significant correlation between WHZ

and MUAC of the child. This is to be expected since MUAC can also be used as an indicator of malnutrition. Increase in WHZ should be noted with an increase in MUAC and a decrease in WHZ should be seen with a lower WHZ. MUAC was significantly associated with HAZ and WHZ. The relationship between MUAC and weight-for-height z-score is to be expected since both are indicators of acute malnutrition (WHO, 2017).

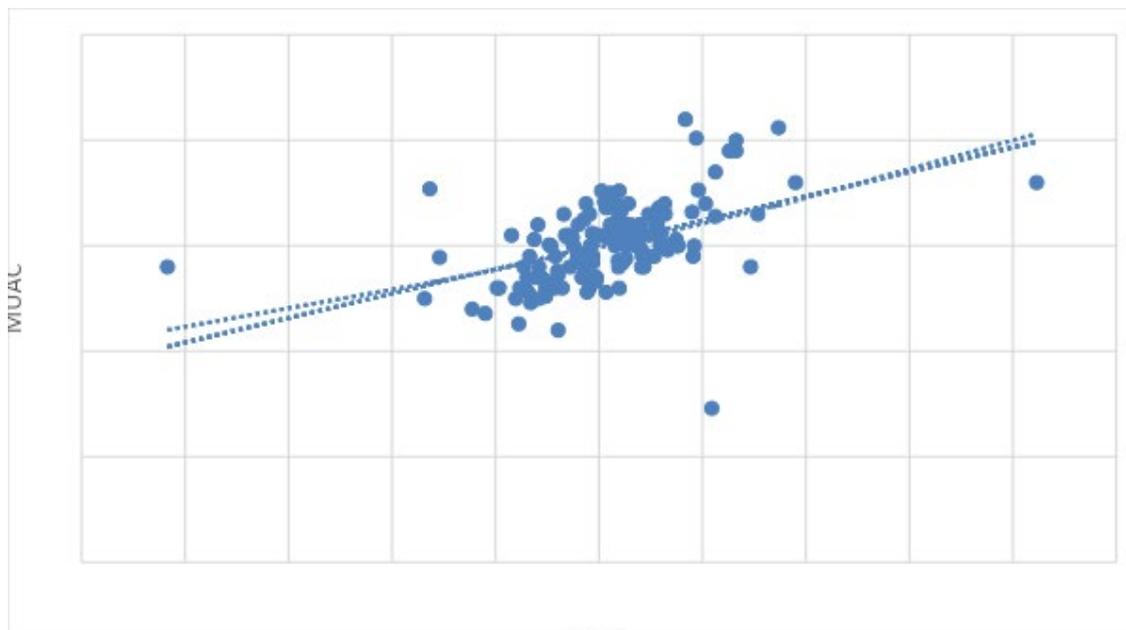


Figure 9: Scatter plot of MUAC and WHZ of children

4.8 Conclusion of results

The results showed that the sample consisted of a majority of African ethnicity families, with moderate household sizes and low incomes. Levels of education were fairly good with two-thirds of caregivers who finished high school, yet unemployment was very high (over 70%) and a strong reliance was shown on income from social grants.

Breastfeeding initiation rate was high but poor continuation of breastfeeding was seen with mix-feeding commencing from as young as one month of age. The FFQ and the DDS showed a high intake of starchy food and a low intake of sources of protein, fruit and vegetables. A high intake of high salt and sugar snack foods were also noted and tea was frequently given to children from a young age. When compared to recommendations from the PFBDG, less than half of children aged 6-36 months consumed orange and green leafy vegetables and fruit, dairy (milk, yoghurt and *amas*) and protein sources (chicken, meat, eggs or fish) daily as per the guidelines.

The HFIAS found that 33.2% were food secure, 29.5% were at risk of hunger and 37.5% were food insecure or experienced hunger. Overall the DDS was good with 91.9% of children who met the minimum dietary diversity as per WHO and 75.9% had an adequate dietary diversity on the 17-point scale. Only 10.4% on the 17-scale questionnaire and 8.1% on the CDDS (7 scale questionnaire) of children have shown to have poor dietary diversity.

One quarter of children were stunted (25.6%), 2.8% were SAM, 3.9% were MAM and 13.3% were at risk of wasting, 13.6% of children were underweight for age and 7.2% of children were overweight or obese. A total of 58.2% of caregivers were overweight or obese.

A number of correlations found showed that heavier caregivers were often seen with heavier children, a higher household income was seen with an improved nutritional status in children and a more varied diet and MUAC increased according to the size of the child. A strong correlation was also found between the dietary diversity of the child and the age of the child.

CHAPTER 5: DISCUSSION

5.1 Introduction

Malnutrition, presenting as under- and overnutrition is prevalent in NMB and affects a particularly vulnerable group, children under five years of age. Children have an increased risk of malnutrition due to additional energy required for growth and development (Kleinman, 2009). Some children have, however, a higher risk of malnutrition due to external factors. This study aimed to answer the research question, namely, what are the contributing factors to malnutrition of patients attending DNH. The study described the prevalence of malnutrition in outpatients who attended DNH and revealed the presence of malnutrition in the study setting. Socio-economic factors, dietary diversity of children, household food security and growth patterns of the child were described and the relationship between socio-economic factors, health status, dietary patterns, dietary diversity, food security and anthropometry were explored.

5.2 Socio-economic factors, general household factors and health status of participants

The results showed that the majority of primary caregivers were female (mostly either the mother or grandmother). Over two-thirds of the primary caregivers were unemployed and more than half reported that their boyfriend or spouse were a source of household income, showing that men may more frequently be the breadwinner within the households. The current findings revealed that more than half of caregivers had 1-2 children per household indicating that most households were of moderate size. Less than 10% had more than five children per household. Previous studies have reported that large households are a risk factor for malnutrition (UNICEF, 2012; Owoaje, Onifade and Desmennu, 2014). In this study, less than 10% would be considered to be at risk of malnutrition due to large household size.

The primary caregivers were fairly well educated with just over half of caregivers who completed grade 12, 13% who had a higher education and just over 5% did not complete primary school. Other studies have shown that the level of education of the caregiver was considered a risk factor for malnutrition, increasing the risk of underweight and stunting when parents are illiterate (Daelmans et al., 2009; Vorster et al., 2010; Arthur et al., 2015; Piniel, 2016; Barnes et al., 2017). In this study, just over 5% would be at risk of malnutrition due to illiterate parents. Yet, a lack of further education of parents, could lead to a lower chance of employment. Recent studies have found that education plays an important role in the labour market with only about half the number of non-graduates who were employed in the formal sector compared to graduates (StatsSA, 2013). The current study found that less than a third of caregivers were employed, showing that a lack of higher education could hinder employment, further risking household food security and possibly increase risk of undernutrition in children. In this study, however, there was no direct correlation found between malnutrition and level of education of caregivers. The correlation could further be explored in follow-up studies with potentially including more participants per group.

In the current study, 45.5% of households had a total income of less than R2000, which might not be enough to ensure livelihood. A correlation was found between MUAC of the child and household income, showing that children were often more undernourished when household income was lower. It also showed a correlation to an improved nutritional

status (measurable with MUAC) with a higher household income. Similarly, many studies have shown that low household income is considered a contributing factor to malnutrition (Arthur et al., 2015; Misselhorn & Hendricks, 2017; Barnes et al., 2017). The national poverty line was set in 2018 at R547, which is the minimum amount needed to buy just enough food per person to meet nutritional requirements (StatsSA, 2018). Most households have four or more people which show that more than half of participants would not have enough money to buy enough food to meet nutritional requirements in a month.

Insufficient WASH in children is known to increase the risk of undernutrition due to an increased risk of diarrhoeal disease, intestinal parasite infections and environmental enteropathy (UNICEF, 2015). Previous study findings within South Africa reported that insufficient access to clean and safe water and insufficient sanitation are contributing factors to malnutrition (Belaynew, 2014; Tete, Sifah & Nartey, 2015; Piniel, 2016). Within a household, poor sanitation and disease can also rapidly spread among household residents, leading to a vicious cycle of disease and undernutrition (Tete, Sifah & Nartey, 2015). This statement was further strengthened by the UNICEF conceptual framework, which describes insufficient access to clean water and sufficient sanitation as an underlying contributing factor to malnutrition (Piniel, 2016). In this study, no direct correlation was found between a lack of WASH and undernutrition. The majority of the study population (82%) had a tap with running water inside their home and 75% had a flush toilet inside their home. This indicated that few participants were exposed to poor sanitation. Even though no correlation was found in this study, the relationship should be explored further in large study populations as literature has shown to describe a relationship between a lack of WASH and undernutrition.

The study results found that caregivers received a social grant for almost two-thirds of participating children and more than two-thirds reported receiving the grant for at least one child. A relationship was also found between receiving a social grant and MUAC of the child, showing that a presence of the social grant, leads to lower undernutrition (MUAC). Social grants were first introduced 21 years ago and have shown to alleviate some poverty (UNICEF, 2012). Improvement in food consumption, dietary diversity, and food insecurity were noted since 1998, with an improvement in acute malnutrition but a decline in chronic malnutrition (UNICEF, 2012). The improvements was thought to be partly attributed as a result of child support grants, yet the amount is still considered insufficient to cover even the basic food needs of members within a family (Devereux & Wadler, 2017).

Household income and the presence of receiving a social grant has shown a slightly positive correlation to the MUAC of the child. This indicates that socio-economic factors (household income) contributes to the nutritional status of the child (measured by MUAC).

5.3 Dietary patterns of the child

Exclusive breastfeeding for the first six months of life and continued breastfeeding for two years and beyond is recommended by WHO as it protects against disease, morbidity and mortality (WHO, 2018). Initiation of breastfeeding is fairly high in this study with 87% reported to having breastfed their babies initially (this includes mixed feeding). However, just over half of caregivers breastfed for less than six months and only 6% breastfed for

two years and beyond. This indicates a high frequency of initiation of breastfeeding but poor continuation thereof. Formula milk was introduced as early as one month.

A study performed in four South African provinces demonstrated a high breastfeeding initiation rate (50%) but a low six month EBF rate (12%) (Siziba et al., 2015). Recent statistics from SADHS have shown the breastfeeding initiation rate to be moderate at 44% while exclusive breastfeeding until six months was only 4.9% (SADHS, 2016). A recent review which included 34 studies regarding feeding practices in South Africa, confirmed these findings with a trend noted of breastfeeding initiation rates ranging from 75% to 100%, a lack of exclusive breastfeeding up to six months and a varied number of continued breastfeeding after six months, with mostly low numbers of continued breastfeeding (Sayed and Schönfeldt, 2018). SADHS showed that continued breastfeeding was moderate; less than a quarter was exclusively breastfeeding until six months although almost 70% were breastfeeding (mixed feeding) at six months with just less than half (46.7%) who breastfed up to a year and about 18% who breastfeed until two years (SADHS, 2016). SADHS also reported a total of 14.9% of caregivers who started giving formula milk while still breastfeeding at less than one month of age (SADHS, 2016).

The results obtained is comparable regarding high initiation of breastfeeding but with poor continuation thereof. In South Africa, many policies and programmes have been implemented to protect, support and promote breastfeeding as discussed before, including MBFI, RtHB, Tshwane declaration and the R991. Yet, the continuation of breastfeeding is still suboptimal.

The results of this study showed that almost four-fifths of children ate breakfast daily which is consistent with results of a National study, indicating that 81.9% of children ate breakfast daily in the Eastern Cape (SADHS, 2016). This is a good dietary practices, contributing to over a quarter of some children's daily intake (SADHS, 2016). Other benefits of daily breakfast consumption, shows an overall improved diet quality, the intake of more micronutrients including calcium and B-vitamins as well as fibre. It has also shown to improve cognitive functioning, which could improve school performance. Another important benefit of daily breakfast consumption, is that it has shown to improve weight management; this can in turn help to prevent obesity (Kimbrow, 2014).

In the present study, more than half of children who were already eating were introduced to complimentary food before six months of age. Research has shown that premature introduction to complimentary food can contribute to feeding difficulties and malnutrition (Kleinman, 2009; Hollis, 2016). Late introduction of complementary foods may, however, also predispose a child to nutritional deficiencies and even obesity later on (Sayed and Schönfeldt, 2018). A review including 14 South African studies, consistently found the early introduction of food and drinks other than breastmilk (Sayed and Schönfeldt, 2018). Between one-third and over three-quarters of caregivers introduced food and other liquids prematurely, most before the age of three months (Sayed and Schönfeldt, 2018). Earlier introduction of food was also seen to be slightly higher in rural than in urban areas (Sayed and Schönfeldt, 2018).

The results of this study showed that infant cereal was most frequently given as the first solid food given as complimentary food. The FFQ from the study showed that over a three-quarter of participants consumed soft porridge more than four times per week. A

review including 14 studies also identified maize meal porridge as well as commercial infant cereal as the most popular type of complementary food (Sayed and Schönfeldt, 2018). A recent South African cohort study regarding complementary feeding in children 6-12 months found that the most frequently consumed food groups in children were grain, root and tubers (Budree et al., 2016). Grain, specifically porridge, is a suitable staple for children as it is affordable, available and nutrient-dense, especially when it is fortified (Sayed and Schönfeldt, 2018). However, when grains are consumed with a diet lacking in protein-rich foods, a deficiency in energy, iron and zinc could be present (Mutie et al., 2010).

The results of this study showed that more than half of caregivers gave their child tea or coffee to drink and the majority added sugar. The intake of tea was found to inhibit iron absorption which can further contribute to iron deficiency and is not recommended in young children (Kleinman, 2009). A study performed in a school in Kenya found that tea and cocoa were consumed by most of the included children and found that it contributed to more than a fifth of these children's daily nutritional intake (Mwaniki and Makokha, 2013). A review of studies including 14 different South African studies, found that water was often given to infants before six months of age. Other liquids frequently given include tea, sugar water, traditional herb mixtures, gripe water, antacid preparations and a sorghum beer (ijuba) food (Sayed and Schönfeldt, 2018). The practice of introduction of non-milk drinks, especially before six months, increased the risk of growth faltering.

The FFQ results of this study found that the intake of animal products were suboptimal. Chicken (24.2%) and processed meat (23.5%) were eaten most frequently, yet less than a quarter ate these four or more times a week. Just over half of children ate chicken and almost a third ate processed meat up to three times a week. The PFBDG recommends the daily intake chicken, fish, egg or meat for optimal growth and development of children from 6 months of age. In this study, only a fifth of children 6-12 months of age had a daily meat or egg portion and only half of the children 12-36 months ate a daily portion of meat or an egg. Meat intake has shown improvement in growth of children, micronutrient status and cognitive performance (Dror and Allen, 2011; Jackson, Margetts and Vorster, 2015). A recent South African cohort study showed a low meat intake at six months which increased by twelve months (Budree et al., 2016). Over 70% of children had daily intake of some protein by one year of age (Budree et al., 2016). In this study, processed meat was the most consumed meat, with over 50% eating processed meat at one year of age, while red meat was consumed by over a third of participants at one year (Budree et al., 2016). Although the Budree et al. study showed a higher intake of meat, especially after one year of age than the current study results, the current study is still comparable with both studies showing processed meat being most consumed. Processed meat is high in fat and sodium, which could have long-term consequences including an increased risk of hypertension and coronary artery disease during adulthood (Budree et al., 2016). Therefore, although protein intake should be encouraged, processed meat is not recommended for daily consumption.

Meat alternatives may provide more affordable alternative protein sources which include eggs, dairy and legumes, but these were also not consumed frequently according to the results from the FFQ used in the study. Eggs were eaten more than four times a week by just over a fifth of participants while less than half ate eggs up to three times a week. Less than two-fifths drank milk more than four times a week, with yoghurt being the most consumed dairy product with just over half consuming dairy more than four times a week

which is not surprising as yoghurt is a popular food with children in South Africa. Beans and lentils were not consumed frequently, with beans being most consumed with just over a third eating beans up to three times a week. Peanut butter was eaten more often with just over four-fifths eating peanut butter more than four times a week. This is not surprising since milk is more expensive while peanut butter is affordable. Furthermore, the knowledge test revealed that more than half of caregivers considered peanut butter to be a suitable alternative for milk. When comparing the FFQ to the recommendation of the PFBDG for children 12-36 months to consume yoghurt, milk or *amasi* daily, two-fifths consumed a daily portion of milk and almost half had a daily portion of yoghurt daily.

A cohort study in South Africa reported on the intake of eggs which was as low as 10% in children six months of age but intake increased to two-thirds eating eggs at one year of age (Budree et al., 2016). The Budree et al. study showed low dairy intake which increased to almost four-fifths consuming dairy daily at one year of age while legumes and peanut butter were poorly consumed throughout the study (Budree et al., 2016).

The current study also showed that fruit intake was poor with only about a third of participants who ate fruit frequently and bananas and apples were the most consumed fruit in this study. Vegetable intake was also poor with only a quarter of participants who ate vegetables frequently and carrots and pumpkin was the most consumed vegetables. The DDS showed a far higher intake of fruit and vegetables (42%-67% according to the different categories of fruits and vegetables). One of the possible contributing factors to the high DDS reported compared to the FFQ and socio-economic status, is that data may have been collected after a social grant was received which could have increased the diversity of the diet reported at the time.

The PFBDG recommend the daily intake of green- or orange fruit and vegetables for children from six months of age. The results showed that less than 10% of children consumed vitamin A rich fruit and almost half consumed vitamin A rich vegetables daily at 6-12 months. Vegetable consumption decreased to just over a quarter who consumed vegetables and just over a tenth who consumed Vitamin A rich fruits or vegetables at 12-36 months. Seasonal variety of fruits and vegetables could also influence the affordability and availability of these during certain times. The daily intake of orange fruit and vegetables and green leafy vegetables did not meet the recommended amount as described in the PFBDGs. This could be secondary to insufficient household food security leading to insufficient funding available to buy a slightly more expensive food (than for example a staple food). Since fruit and vegetables are perishable, when a fridge is not available, this can decrease motivation even more to buy these items.

Green leafy vegetables are especially valuable due to the higher composition of iron compared to other vegetables and orange fruits and vegetables are higher in Vitamin A than other fruits and vegetables. Vitamin A and iron are especially significant in South African children due the high prevalence of iron and vitamin A deficiencies with 8.1% of children who are iron deficient and 43.6% who have a Vitamin A deficiency (SANHANES, 2012).

A recent cohort study showed that fruit and vegetable intake was also poor, especially before one year of age (Budree et al., 2016). The findings are also in line with the National Food Consumption Survey (NFCS) findings which also reported very low fruit and vegetable intake among children in South Africa (Steyn, Eksteen and Senekal, 2016).

The NFCS showed that one in two children had insufficient intake of micronutrients and for most, the intake of iron, zinc, selenium, vitamin C, vitamin D, vitamin E, riboflavin, niacin, folic acid and vitamin B was less than 67% of the RDA. Children between the ages of 1-7 years should consume 4–6 servings (320-480g of fruit and vegetables per day (Kleinman, 2009), however according to the NFCS of 1999, the average fruit and vegetable intake of 1–3 year old South African children was 180.2g per day and only 55.3% within this age category, consumed fruit and vegetables (Steyn, Eksteen and Senekal, 2016). The NFCS was conducted in 1999 and no other National Survey on nutrient intakes has been done since. Therefore, whether an improvement was shown since 1999, is inconclusive and another National survey is needed for updated information (Steyn, Eksteen and Senekal, 2016).

A study in conducted in KZN by Faber et al. found that the consumption of dark green leafy vegetables in children aged 2-5 years of age, contributed between a fifth to over three fifths of their total daily requirements of iron and Vitamin A. Food gardens showed to be especially effective in improving consumption and ultimately reduce deficiencies of vitamin A and iron (Faber et al., 2007).

Fruit and vegetable intake could possibly be hindered by affordability since it is more expensive than most staple foods, yet it is far richer in micronutrients and fibre. Increasing fruit and vegetable consumption has the potential to reduce the risk of nutrition-related diseases, both improving micronutrient status as well as reducing the risk of NCD's (WHO, 2019).

The current research showed inappropriate food consumption, specifically snack foods high in fat and sugar, were eaten frequently. The most frequently consumed were potato chips which were eaten more than four times a week by more than half of the children. Sweets, biscuits, cooldrinks and fat cakes were consumed regularly by most children. These findings are in line with similar research in South Africa. A study by Huffman et al. (2014) found that the intake of sugary snack foods was also found to be consumed by many children 6-23 months in South Africa. A recent National study also reported that snack foods high in sugar and fat were some of the most consumed food types (SADHS, 2016). Another recent cohort study also reported on high intakes of crisps (one third of participants), sugary cooldrinks (half of participants), daily consumption of refined sugary food (half of participants) and fried foods (a third of participants) (Budree et al., 2016). The frequent intake of high sugar or high fat foods were found to increase the risk of growth faltering, obesity and type 2 diabetes into adulthood (Shisana & Labodarios, 2013; Budree et al., 2016).

Overall, the results of this study showed that the most consumed foods were soft porridge, potatoes, white bread, yoghurt and chips. Dairy intake was poor with only a third who drank milk regularly. The NFCS also showed that the five most commonly eaten foods were maize, sugar, tea, whole milk and brown bread (Steyn, Eksteen and Senekal, 2016). The results obtained in this study showed that maize and bread were both included in the five most eaten foods, tea was not on the option list, but more than half of child participants were given tea or coffee which means that it would likely be considered a food type frequently consumed. (Steyn, Eksteen and Senekal, 2016). Daily consumption of Vitamin A rich fruits and vegetables, protein and dairy as recommended by the PFBGD is met by less than half of the children, which could increase their risk of micronutrient deficiencies and growth faltering.

Despite the benefits of frequent protein consumption and the intake of a variety of nutrients including meat, fruit and vegetables; consumption of these food groups on a regular basis is poor. Starchy foods are eaten more regularly, most likely because of availability and affordability that it offers. The frequent intake of sugary snacks are also concerning, as they are given regularly to children from as young as six months of age.

5.4 Dietary diversity of the child

A diverse diet increases the chance of having nutrient adequacy; meeting the requirements of energy, protein, fat and micronutrients, with a lower risk of nutritional deficiencies (Mwaniki and Makokha, 2013). Dietary diversity therefore assesses dietary quality and nutritional adequacy. A poor dietary diversity score can increase the risk of growth faltering, especially stunting (Mwaniki and Makokha, 2013). A higher DDS is associated with a higher energy intake and better health. After six months of age, a child is required to start eating complementary foods and is at risk of deficiencies if the diet lacks variety (Thornton, 2016).

The results of this study showed that starches were eaten most frequently, especially cereals and white roots (white tubers). Dark green leafy vegetables were eaten by only two-fifths of children while over half ate other vegetables and fruit. Meat was eaten by just over half of participants and less than three-quarters ate dairy products. The DDS data supports FFQ findings. The implication of this variety is that the diet will be energy dense, low in high quality protein and essential micronutrients.

The results of this study also showed that just over half of children had an excellent DDS while one in five children had an adequate score. A similar South African study aimed to investigate dietary diversity of households and found that two-fifths of participants had a poor DDS (Thornton, 2016). Further results of the Thornton study revealed that dietary intake was characterised by a high intake of tubers and bread and a poorer intake of vegetables, fruit, dairy and meat (Thornton, 2016). This was consistent with the dietary intake patterns seen in the current study, especially low consumption of milk, fruit and vegetables.

The results of this study were also reworked to produce a minimum dietary diversity score and showed that 91.9% consumed at least four different food groups (showing adequate dietary diversity). When using 17 scale DDS, 10.4% had poor to low dietary diversity compared to 8.1% when using the 7 scale CDDS, thus showing that data is more or less a good estimate. The high DDS is, however, surprising especially considering the high prevalence of stunting and underweight in children, the FFQ and the socio-economic status of the sample.

A South African study done in KZN by Faber et al. investigated dietary intake of children 6-18 months old and found that less than 25% consumed more than four food groups (Faber, Laubscher and Berti, 2014). A longitudinal South African study found that the MDD requires the consumption of at least four different food groups. Another study showed that only 5% of children consumed more than four groups daily at six months, 24% at nine months and 75% at one year (Budree et al., 2016). SADHS also found that only 23% of children 6-23 months met a MDD score (SADHS, 2016).

A study which included slightly older children from Kenya, found that less than half of children met the MDD score. That study further reported on the increased risk of stunting and underweight when a DDS lower than four is present (Mwaniki and Makokha, 2013).

The current results indicated that the majority (91.9%) of the participants had adequate dietary diversity (MDD>4) which is far higher than other results found. The current study results did, however, include a large variety of age groups (6 months-5 years of age) which is a significantly wider range than some other studies mentioned and for future research it would be beneficial to stratify MDD results according to age or include a smaller age group. The dietary diversity could also have been influenced by the time of the month the data was collected. If it was for example collected after the caregiver received a salary or social grant, the dietary diversity may be higher for a few days. The caregiver may have also felt like reporting on what she thinks is the right thing to say rather than what was really consumed.

5.5 Household food security

Household food security is present when food is available, accessible and consumable as well as having a stable food supply in the household (Piniel, 2016). Household hunger is present when there is insufficient food available for the number of people within the house. Household hunger increases the risk of malnutrition due to the consumption of insufficient calories and nutrients, and it also increases the risk of eating unhealthy, non-age-appropriate or foods that are not suitable for consumption anymore. This may further lead to disease which can increase the risk of malnutrition (Shisana et al., 2013). National statistics of 2011 have shown that almost half a million households in the Eastern Cape have run out of money for food within the past year and almost a fifth of households reported skipping at least one meal (StatsSA, 2011).

The HFIAS questionnaire was used to identify household hunger in the present study and showed that only 33.2% of households included in the study were classified as food secure, 29.3% were at risk of hunger and 37.5% experienced hunger. The study results were compared to the results of the province as well as the National household hunger score. Food security showed to be higher on a National level (45.6%) while the results of the Eastern Cape (31.4%) and the study results (33.2%) were more similar. Household hunger was also far lower on a National level (26%) while the results in the Eastern Cape (36.2%) and the study (37.5%) were similar.

The CCHIP index was used to identify childhood hunger for a National study. The results showed that 45.6% of the population were food secure, 28.3% were at risk of hunger and 26% experienced hunger (Shisana et al., 2013). The most hunger was experienced in rural formal and urban informal locations (Shisana et al., 2013).

A review which included three National surveys and one local survey regarding food insecurity were compared and individual-, household- and child hunger were examined. Although different tools were used for measuring household food security, two questions from the HFIAS namely “household runs out of money to buy food” and “a limited number of foods are available” were two of the same questions included in the HFIAS as used in the current research study (Labadarios et al., 2011).

The first question, namely “household runs out of money to buy food” showed an improvement between 1999 and 2008, with the latest percentage being 46%. The second question, namely “a limited number of foods are available” also improved with the latest score being 39% (Labadarios et al., 2011). The current research study had a lower score for the first question at 15.8% and higher for the second question at 48.9%.

The same review compared food security and risk of hunger from the NFCS (1999) until the SASAS (2008). The results showed food security improved from 25% to 48%. The current study reported that 33.2% were food secure. Hunger also decreased from 52.3% to 25.9% while the current research study reported 37.5% to be food insecure, which is a higher score. The risk of hunger increased from 23% to 25% which is slightly lower than current study results at 29.3%. (Labadarios et al., 2011).

The current results showed lower food security and higher food insecurity scores than the Labodarios review and Shisana et al. study. The risk of hunger is also slightly higher than the Labodarios and Shisana studies. For the “household runs out of money” question, the current research showed a lower score while the “a limited number of foods are available” showed a higher score. This may also indicate that although food may be available, the diversity of the food may be lacking. The DDS score did however show that a three-quarter of children had a sufficient variety of food and 91.5% met the MDD. This may indicate that when insufficient food is available, children are often prioritised in terms of receiving food. The participants in the National studies were sampled from a normal population while in this study, it was a hospital population of children presenting with other illnesses.

Other significant results from the HFIAS showed that almost two-thirds of caregivers worried about not having enough food, almost half ate a small variety of food and were unable to eat the food they like more. Over two-fifths reported having to eat food they did not want to eat, eating a smaller meal than what they felt they needed or eating fewer meals a day due to a lack of food.

Household income showed to be poor, with almost half that had a household income of less than R2000, which may not be enough to ensure livelihood since the National poverty line was set in 2018 at R547, which is the minimum amount needed to buy just enough food per person to meet nutritional requirements (StatsSA, 2018). Most households have four or more people which show that more than half of participants would not have enough money to buy enough food to meet nutritional requirements in a month. Almost a three-quarter of caregivers were unemployed and almost a third had no one within the household who was working. Most caregivers were dependant on a monthly SASSA grant. Many studies have shown that low household income is considered a contributing factor to malnutrition (Arthur et al., 2015; Misselhorn & Hendricks, 2017; Barnes et al., 2017). When insufficient resources are available within a household, accessibility to a diverse, sufficient and suitable diet becomes limited. When food insecurity is present, the coping mechanisms of families differ, but are mostly present in terms of financial and food compromise strategies (Farzana et al., 2017). The HFIAS lists a number of coping mechanisms that caregivers may apply when resources are limited, including eating a smaller variety of food, eating less food than they felt they needed or eating fewer meals a day.

Interventions to improve malnutrition would therefore have to start with one of the root causes, namely a lack of resources. Intervention programs would therefore need to be mindful of a lack of resources as well as finding ways to address it in order to improve accessibility to food and therefore food security.

5.6 Nutritional status of the child

The study results showed that almost a fifth of the RtHB's were either not completed or not brought to the hospital. A study by Blaauw et al. in South Africa reported on the completion of RtHB's and found that although in most cases, the weight was taken and completed in booklets (94.7%) height was often not taken or recorded in the RtHB (Blaauw et al., 2017). A large nationally representative study also gave an overview of the use of the RtHB and reported that completeness of the RtHB was insufficient with only half of booklets being completed, although nearly all caregivers brought their RtHB's to healthcare facilities (Ramraj et al., 2018). Incomplete booklets can cause a lack of recorded data which makes growth monitoring more challenging among other consequences.

The results of the current study showed a prevalence of underweight for age at 13.6% which is higher than the national average of 5.2% (Shisana et al., 2013) and 7% (SADHS, 2016). One of the possible reasons for the difference can be due to the different patient population presented. The current study included patients from within the outpatient department at a hospital, thereby representing a population with possible underlying disease conditions, increasing the risk of undernutrition while the Shisana et al. results included a regular population group. Literature has confirmed the influence of underlying disease on the nutritional status of a child, especially HIV and TB (Vorster, 2010; Chola et al, 2015; Massyn et al., 2016; Shashidhar and Grigsby, 2017). Disease conditions form a part of the vicious cycle of malnutrition since underlying disease weakens the immune system, placing children at higher risk of infectious disease and under nutrition (Vorster, 2010; Chola et al, 2015; Massyn et al., 2016; Shashidhar and Grigsby, 2017).

Stunting was prevalent in one in four children in this study which is slightly higher but similar to the national average of one in five children in 2013 (Shisana et al., 2013) and lower than the 2016 results of one in three children in 2016 (SADHS, 2016). A review of articles regarding stunting confirmed that the prevalence of stunting has decreased during the past decade and that the use of the WHO growth standards has increased the prevalence of identifying stunting in SA (Said-Mohamed et al., 2015).

With this in mind, the results obtained in this study did show a decrease from the 2013 results, which was also found by other studies to be decreasing, but it is still higher than the 2016 results. These results, higher than the 2016 results, could also be a result of the included population, of which participants who may have an underlying disease condition.

Wasting was prevalent with 5.7% of children classifying either as MAM or SAM. The results are higher than the 2013 and 2016 results at 2.6 % and 3% respectively (Shisana et al., 2013; SADHS, 2016). The results obtained, are most likely influenced by the included patient population since the results were collected at a hospital. The National studies used as reference included the general public and data was collected from households.

Furthermore, overweight was also prevalent with 7.2% of children who were either overweight or obese. This was lower than the National average of 2016 at 13% and even lower than the 2013 results at 22.9% (Shisana et al., 2013; SADHS, 2016). The results obtained could once again be different from the general public since participants included were from a hospital and may have an underlying disease condition which puts them at higher risk of undernutrition. Rural areas were also one of the areas found to have an increased risk of undernutrition and the lowest obesity in children (Shisana et al., 2013). The area of data collection was at a hospital in the township, on the outskirts of NMB. These factors may also influence the anthropometry of children; therefore, the results obtained may not be representative of the whole of NMB, but more specifically to patients at Dora Nginza Hospital in Zwide.

The BMI of the caregivers revealed that one in four was overweight and one in three were obese which is in line with National data which reported that more than a third of South African women are obese (Shisana et al., 2013).

5.7 Correlations between socio-demographic, dietary patterns, food insecurity and anthropometry

Most of the investigated correlations were only slightly positive, meaning that a causal relationship could not be determined, but that the two values would agree in terms of being low, moderate or high. There may be a causal relationship between the variables which needs to be confirmed with further research.

5.7.1 BMI of the caregiver and HAZ & WHZ of the child

A slightly positive significant correlation was found between the BMI of caregivers and the WHZ and HAZ of the child. This shows that larger caregivers usually have larger children and smaller caregivers may have smaller and shorter children. The relationship noted could indicate the possible influence of genetics on the size of a child but could also be an indicator of socio-economic factors, since a household may not be food secure, increasing the risk of undernutrition in the caregiver and child. A correlation was found between household food security and the dietary diversity, indicating that the dietary diversity would be poorer in food insecure households, which in turn increases the risk of undernutrition.

WHO also reported that children have an increased risk of obesity when they have an obese caregiver, yet simultaneously adult obesity and childhood undernutrition is common in the same community and household (WHO, 2017). In this study, over- and undernutrition was noted in caregivers and in children. It was however seen that instead of the double burden of malnutrition noted within households, the caregiver and the child had a similar nutritional status (as in overnutrition or undernutrition). No local studies could be found regarding the impact of genetics of caregivers on the nutritional status of children and overall limited information is available, possible due to the long duration of cohort studies. However, a study by Dubois et al., which included data from four countries and included over 24 000 children and included children from birth to 19 years, showed that the BMI of mothers were significantly and highly correlated with HAZ and BMIZ of children, showing a strong genetic component (Dubois et al., 2012).

Genetics play an important role in the variation of weight, height and BMI of children although environmental factors also plays a large role (Dubois et al., 2012). These findings also emphasize the importance of interventions in the family and social environment as well as to identify children who may be predisposed to obesity due to genetics (Dubois et al., 2012). Childhood obesity is characterized by the susceptibility to obesity together with poor dietary intake and a sedentary lifestyle (Dubois et al., 2012). Together with the risk of obesity for a child with a larger caregiver, a child may also be predisposed to undernutrition due to malnourished caregivers. The mother's prenatal nutritional status, infections and intestinal inflammation were also thought to contribute to malnutrition risk, showing genetics to influence many biological pathways which increases the risk of malnutrition (Duggal & Petri Jr., 2018). By understanding the risk of malnutrition due to genetics, early intervention can start to reduce the risk (Duggal & Petri Jr., 2018). The first 1000 days of life have been used to explain the crucial role of nutrition from pregnancy until a child's second birthday as a unique window of opportunity that could determine future nutritional status, health status and cognitive development.

5.7.2 Dietary diversity score and anthropometry of the child

The study results found a weak but significant positive correlation between the CDDS and WAZ, WHZ and the MUAC of the child. This indicates that children with a more varied diet showed to have improved anthropometric indicators. Literature has confirmed these findings with a study in India and Iran, showing a higher weight and height with an increased DDS in children (Hooshmand, 2013). Stunting and wasting was also associated with a lower DDS (Hooshmand, 2013). A study in Ghana among children under five years of age showed a consistent positive relationship with WAZ, HAZ and WHZ; these indicators improved with an increase in DDS (Frempong and Annim, 2017). A study in Nigeria among children younger than five, showed a significant positive relationship between DDS and HAZ and children with a low DDS were more likely to be stunted (Ogechi & Chilezi, 2017).

5.7.3 Household food security and DDS

A significant slightly positive correlation was found between HFIAS and the DDS, indicating that a higher food security score was often seen with a higher level of dietary diversity in children. This also indicated that lower dietary diversity would be present in a household with lower food security. This relationship is to be expected since a higher availability of resources would equate to more finances available to purchase food. One of the questions of HFIAS include a question regarding dietary diversity, namely "*Did you or a household member have to eat a small variety of food?*" A number of other questions of the HFIAS also indirectly included questions regarding dietary diversity.

When food insecurity is present, the coping mechanisms of families differ, but are mostly present in terms of financial and food compromise strategies (Farzana et al., 2017). Food compromise strategies usually include a smaller variety of food, less food than needed or prioritising some members of the family (Farzana et al., 2017). It is therefore expected that with a lower HFIAS, a lower DDS of children would be present.

Household income and whether the caregiver received a grant for the child also showed a significant slightly positive relationship with the MUAC of the child, showing that the child may have an improved nutritional status when more resources are available.

Other studies have also found a relationship between household food security and dietary diversity of the child's diet. A study in Nigeria found a significant positive correlation

between family income and the DDS of the child, showing that an increase in family income led to a larger variety of food being given to the child (Ogechi & Chilezi, 2017).

A number of studies have reported on HFIAS and the nutritional status of children with mixed results. HAZ was positively associated with HFIAS in some studies (Psaki et al., 2012; Gooding et al., 2012; Hackett et al., 2009) although some studies did not find a significant relationship (Roba et al., 2019). One of the studies conducted in Ethiopia showed that HFIAS was not associated with stunting and suggested that when households face severe food insecurity, the available resources are often shifted to the children or because stunting is a long term consequence rather than showing immediate effects.

A recent study conducted by Thornton et al. with the aim of revealing the relationship between dietary diversity and food security in South Africa showed that household hunger has an influence on food variety and food quantity (Thornton, 2016). An increase in household income was shown to improve dietary intake and a variety in diet and can therefore improve nutritional status (Barnes et al., 2017). HFIAS showed a significant association with dietary diversity of children in a number of studies (Ike, 2015; Roba et al., 2019; and some studies even described household dietary diversity score as a possible indicator of household food insecurity (Hoddinott & Yohannes, 2002; Hussein et al., 2018).

It is, therefore, noted in the current study and confirmed with literature that household food security shows a correlation to the dietary diversity of children, which influences the WHZ and WAZ in children. Therefore, when households are not food secure, a less varied diet would be consumed. A lower CDDS has shown a correlation to a lower WHZ as well as a lower WAZ, increasing the risk of undernutrition.

5.7.4 CDDS and age of the child

There is a strong positive and significant correlation between DDS and the child's age, showing that dietary diversity improved in older children. This is expected as new foods are introduced gradually as a child increases in age. It is important to introduce more variety of food as a child increases in age since the child may be at risk of nutritional deficiencies from six months if complementary feeding is insufficient. The birth iron stores are depleted after six months and breast milk is low in iron, which is why it is critical to also include protein- and iron rich food (Kleinman, 2009).

In this study, the comparison with the PFBDGs showed that only a fifth of children aged 6-12 months had daily consumption of a protein source, only half had daily vitamin A rich vegetables and less than 10% had daily fruit intake. Suitable complementary feeding practices are vital to reduce the risk of malnutrition. A systematic review found that when education regarding complementary food is combined with provision of affordable complementary foods, a decrease in WAZ and HAZ were noted in children (Lassi et al., 2013).

Further studies also suggested protein-rich food as a successful strategy to decrease stunting in children, showing the importance of introducing protein- rich food early on (Eaton et al., 2017).

5.8 Contributing factors to malnutrition

The study has found a number of possible contributing factors to malnutrition with children and caregivers from this area displaying similar outcomes than other underprivileged communities. More emphasis should be placed in ensuring that dietary diversity improves, but it will be difficult to comply in a food insecure situation. Some of the contributing factors to malnutrition include poor socio-economic factors; specifically a lack of further education by the caregivers, poor household income and household food insecurity, leading to insufficient accessibility to nutritionally adequate diets. Poor dietary practices include poor continuation of breastfeeding, a high intake of grains and high-sugar snack foods with a poor intake of protein-rich foods, dairy, fruit and vegetables. It is clear that one of the driving forces of malnutrition is poor socio-economic status. This is displayed as poor household food insecurity, leading to poor dietary diversity of children which is also significantly correlated to the nutritional status of the child (presenting as anthropometric measurements). An increase in dietary diversity showed an increase in weight and height of the child and an increase in the age of the child also showed an increase in DDS. Statistical correlations showed that the caregiver also had a significant impact on the nutritional status of the child. Heavier caregivers often had heavier children, increasing the risk of NCD. Simultaneously, smaller caregivers often had smaller children. In this case, genetics have shown to possibly play a role but environmental factors also may have an influence, for example if a caregiver is underweight, the child may be at risk of IUGR and therefore be smaller.

Socio-economic factors showed to be one of the leading causes of malnutrition in the area. Household income and the presence of a grant showed a correlation to the MUAC of the child. Statistical analysis also showed that a lack of food security led to a lower diversity in the diet. A lower CDDS was in change correlated to the HAZ and WHZ of the child, indicating that a lower dietary diversity would increase the risk of undernutrition. The WHZ of the child showed a correlation to the BMI of the caregiver, showing that within households, the double burden of malnutrition was not noted, but rather the same trend of nutritional status as the child. A lack of food security within a household will therefore influence the weight of the caregiver as well as of the child; showing a caregiver and a child with a lower weight. Simultaneously, a lack of food security could also lead to poor food choices and excessive consumption when it is available, contributing to overweight in caregiver and child. The contributing factors to malnutrition were found to be multifactorial with basic, immediate and underlying contributing factors, as described in the UNICEF conceptual framework. It is therefore important to use a holistic approach when managing a child with malnutrition to ensure that all possible contributing factors are explored. PHC is of utmost importance, by equipping caregivers with accurate knowledge and providing support to enable them to make the best nutritional decisions with limited resources available.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This study was conducted to identify the contributing factors of malnutrition in children 0-60 months in Dora Nginza Hospital, Ibhayi, where malnutrition was noted. The results showed a high prevalence of stunting as well as a moderate number of patients with MAM and a few patients with SAM. Overweight was noted in a few children, with a high prevalence of overweight and obesity in caregivers. Socio-economic factors were described, the dietary intake patterns and DDS of children were determined, the HFIAS was determined and growth patterns of the children were established. Further, relationships between socio-economic and household factors, dietary patterns, food security and anthropometry were also determined in order to identify contributing factors to malnutrition.

6.2 Summary of literature

It is well known that malnutrition is multi-factorial. The UNICEF conceptual framework is still found to be one of the best depictions of the causes of malnutrition, summarizing it as basic causes (human, economic and organisational resources), underlying causes (inadequate access to food, inadequate care for women and children and insufficient health services or an unhealthy environment) and immediate causes (disease and dietary intake). The literature found some of the basic causes of malnutrition which include poverty, unequal distribution of resources and a lack of education of caregivers. Some of the underlying causes found include malnourished caregivers which would increase the risk of malnutrition in the child, prematurity, disease, poor hygiene and a lack of food security. The immediate causes of malnutrition include disease conditions and a poor dietary intake.

6.3 Conclusions from this study

The demographic profile of the participants at DNH (caregivers and children) was similar to what was described in the Eastern Cape. Poverty and unemployment was prevalent despite the majority finishing high school. Households were of moderate size and most had access to clean, safe water although almost half had insufficient household income to ensure livelihood.

Feeding practices showed that breastfeeding initiation rate was high (87%) but only about half of these continued breastfeeding beyond six months. Tea was given frequently to children and the FFQ showed that grains (specifically soft porridge) were the most consumed food followed by margarine, potatoes, white bread and chips. Protein and dairy sources were fairly poorly consumed with yoghurt and peanut butter being most consumed. Chicken and *processed meat* were the most consumed meat. Fruit and vegetable intake was poor and the most consumed were pumpkin, carrots and bananas.

DDS showed that over half of participants had an excellent score and while almost a quarter had a lower than adequate score. The CDDS showed that over 90% of children had an adequate dietary diversity. The DDS does not correlate with the high level of undernutrition in children as well as the socio-economic status, and may have been

influenced by other factors including time of the month (for example after pay was received).

The HFIAS results found that almost two out of five households were food insecure and almost a third was at risk of hunger. Almost half of caregivers reported that they had to eat a smaller variety of food due to a lack of resources; they could not always eat the food they wanted to eat, ate smaller meals than necessary and ate fewer meals in a day. Almost two-thirds worried that their household would not have enough food.

The growth patterns of the children were described. Just over a quarter of children included in the study were stunted and almost a fifth was underweight-for-age. Around 7% of participants were classified as MAM or SAM and another 7% were overweight or obese. Stunting was found to be similar to other National studies, but underweight and wasting was more prevalent. Overweight in children showed to be lower than National studies.

A significant weak positive correlation was found between BMI of caregivers and HAZ and WHZ showing that heavier caregivers often had larger children and smaller caregivers tend to have smaller children. This influence could be due to the influence of genetics or other environmental factors (for example, if a mother is malnourished she may have a smaller child). A correlation was also seen between CDDS and anthropometric indicators (WAZ, WHZ and MUAC) showing that an improvement in dietary diversity can improve the nutritional status of the child. A relationship was however also observed between HFIAS and DDS, showing that in households where food insecurity was higher, DDS would be lower. All of the mentioned indicators indicate once again the influence of poverty and a lack of food security on the increased risk of malnutrition for the child.

6.4 What are the contributing factors to malnutrition of children 0-60 months in Dora Nginza Hospital, Eastern Cape?

6.4.1 The correlations between nutritional status of the caregiver and the child

A significant correlation was found between the BMI of caregivers and the WHZ and HAZ of the child. This shows that bigger caregivers usually have bigger children and smaller caregivers may have smaller and shorter children. The relationship noted could indicate the possible influence of genetics on the size of a child and it can also show the influence of socio-economic circumstances on the nutritional status of the caregiver and the child. Unlike the expectation, the double burden of malnutrition was not noted within the households since the caregiver and the child mostly had a similar nutritional status (underweight, normal weight or overweight). The double burden of malnutrition was however noted within the community with both under- and overnutrition present.

WHO also reported that children have an increased risk of obesity when they have an obese caregiver (WHO, 2017). A study by Dubois et al., which included data from four countries and included over 24 000 children and included children from birth to 19 years, showed that the BMI of mothers were significantly and highly correlated with HAZ and BMIZ of children, showing a strong genetic component (Dubois et al., 2012). Childhood obesity is characterized by the susceptibility to obesity together with poor dietary intake and a sedentary lifestyle (Dubois et al., 2012). Together with the risk of obesity for a child with a larger caregiver, a child may also be predisposed to undernutrition due to

malnourished caregivers (Duggal & Petri Jr., 2018).

The intrauterine environment has shown consistently throughout literature to be one of the main causes of stunting showing to be directly related to the size of the infant (Khan et al., 2011) and other studies also identified a less than optimal intrauterine environment as one of the leading causes of stunting (Khan et al., 2011, WHO, 2017, Oenema, Campeau and Delmuè, 2017, Anon, 2018).

The study has found a significant positive correlation between the nutritional status of the caregiver and the child. Considering the area of data collection which has a high level of unemployment, poverty and food insecurity, it is clear that in these food insecure households, the caregiver and the child are similarly affected regarding nutritional status when food is either plentiful or unavailable. The antenatal environment, including the mother's nutritional status, nutritional intake and lifestyle factors will also influence the size of the child postnatal.

6.4.2 Correlations between food security, dietary diversity and nutritional status

The contributing factors to malnutrition in DNH were found to be consistent to other literature explored. Stunting and wasting were especially prevalent in children with more than half of caregivers who were overweight. In contrast to the expectation of observing the *double burden of malnutrition* within households, the BMI of caregivers instead showed a significant positive correlation with the child's nutritional status, suggesting the influence of genes or other environmental factors including IUGR on the weight of the child. Household food insecurity was prevalent and indicated a significant positive correlation with dietary diversity, showing that a lack of food security can lead to the consumption of a less diverse diet. Poor dietary diversity was also correlated to the nutritional status of the child, indicating the influence and ripple effect of the socio-economic status. Poor household income showed to lead to a less diverse diet in children which in turn led to decreased WAZ, WHZ and MUAC of the child. The caregivers would reflect a similar nutritional status as the child.

6.4.2.1 HFIAS and DDS

In this study, a significant correlation was found between HFIAS and the DDS, indicating that a higher food security score was seen with a higher level of dietary diversity in children. This also indicated that lower dietary diversity would be present in a household with lower food security. This relationship is to be expected since a higher availability of resources would equate to more finances available to purchase food.

One of the underlying factors on the UNICEF conceptual framework for malnutrition is insufficient access to food (UNICEF, 1990). In order for a household to be food secure, food needs to be available, accessible, consumed and there should be a stable food supply (Piniel, 2016).

SANHANES-1 data showed that only 45.6% of the population were food secure, 28.3% were at risk of hunger and 26% were food insecure (experienced hunger) (Shisana et al., 2013). The Eastern Cape was one of two provinces within which the prevalence of food insecurity was more than 30% (Shisana et al., 2013). The current study results showed even higher food insecurity with 37.5% who experienced hunger.

Household hunger increases the risk of malnutrition due to the consumption of insufficient calories and nutrients, and it also increases the risk of eating unhealthy, non- age-appropriate or foods that are not suitable for consumption anymore. This may further lead to disease which can increase the risk of malnutrition (Shisana et al., 2013; Misselhorn and Hendriks, 2017).

The study results showed a correlation between household food security and dietary diversity, showing a more diverse diet when food security is experienced. A diverse diet (improved CDDS) has in turn improved the MUAC, WAZ and WHZ in children as discussed below.

6.4.2.2 Household income and MUAC

The household income as well as the presence of a social grant (which would also improve household income) also showed a positive correlation with the MUAC of the child, indicating that nutritional status is improved when a higher household income is present. Financial constraints were shown as one of the major causes of malnutrition and individuals within households with a low income or no income were at high risk of undernutrition (Arthur et al., 2015).

6.4.2.3 CDDS, MUAC and WHZ, WAZ

The study results found a significant positive correlation between dietary diversity of the child and WAZ, WHZ and the MUAC of the child. This indicates that children with a more varied diet showed to have improved anthropometric indicators and a poorer dietary diversity would also influence nutritional status negatively. This correlation noted is significant since it indicates that a more varied diet (improved CDDS) has the potential to reduce undernutrition. It is however important that interventions do not increase the risk of overnutrition while combatting undernutrition.

Literature has confirmed these findings with a study in India and Iran, showing a higher weight and height with an increased DDS in children (Hooshmand, 2013). Stunting and wasting was also associated with a lower DDS (Hooshmand, 2013). A study in Ghana among children under five years of age showed a consistent positive relationship with WAZ, HAZ and WHZ. These indicators improved with an increase in DDS (Frempong and Annim, 2017). A study in Nigeria among children younger than five, showed a significant positive relationship between DDS and HAZ and children with a low DDS were more likely to be stunted (Ogechi & Chilezi, 2017).

6.4.2.4 CDDS and age of the child

A strong correlation was also found between DDS and the age of the child, showing an improved CDDS in older children. This correlation is to be expected since older children consume a larger variety of food, yet it is still important to emphasize the need to provide younger children with a variety of food as well. The PFBDGs should be utilised as part of counselling on complimentary food to ensure that a variety is provided.

6.5 Limitations of the study

The limitations of the study include that a homogenous sample was used, where a more heterogeneous sample would allow for comparison between groups (e.g. rural and urban). The sample size was small. The data was collected at an outpatient department of a hospital, therefore disease conditions may influence the nutritional status of participants and therefore the data collected may not be completely representative of the general healthy population. The research study assumed that participants answered questions truthfully and that researchers aimed not to ask the participant leading questions which could alter the response. One limitation may be that participants could have reported more health conscious since the recruitment took place at a health facility. Due to the wide range of contributing factors that could be included for investigation in the study, time limitations restricted the complete utilisation of all possible data collected.

6.6 Recommendations

The following recommendations were developed based on the outcomes of this study.

6.6.1 Recommendations for dieticians and other health workers

Harmful dietary practices including the early introduction of liquid and food (before the age of six months) was prevalent and almost three-quarters of children were given tea or coffee daily which could inhibit iron absorption. Healthcare workers should advise caregivers against these and other less optimal practices.

Caregivers' nutritional status showed to have a significant impact on the nutritional status of their child. The NTP should be fully utilized within healthcare facilities to identify underweight caregivers and to start blanket nutrition supplementation during pregnancy to reduce the risk of IUGR, prematurity and LBW for their child. It is also important not to increase the risk of overnutrition, therefore weight gain should be carefully monitored and supplementation provided should be balanced in nutrients together with promoting a healthy diet.

Family-based interventions should be encouraged; where nutritional support for the caregiver as well as the child should be provided and ideally providing nutritional support to a caregiver even before pregnancy to reduce the risk of IUGR and LBW. Children of overweight caregivers' are also at a higher risk of being overweight and growth should be monitored routinely and referred to a Dietitian for family nutrition intervention and education to reduce the risk of overweight for the child.

Height/ length should be monitored routinely and HAZ should be determined to early identify stunting. Stunted children are at an increased risk of becoming overweight and nutritional interventions should focus on promoting a healthy diet, especially with a focus on protein-rich food as it has shown an improvement in stunting in some studies.

Nutritional interventions recommended should consider the socio-economic circumstances of the household and advise how to provide the most optimal nutrients and dietary diversity with a limited household income.

Breastfeeding support groups should be initiated to encourage continuation of breastfeeding since breastfeeding initiation rates are high but continuation of breastfeeding is poor. This forms part of MBFI 10 steps to successful breastfeeding.

Vegetable gardens were found to be a successful intervention to improve DDS, micronutrient intake, Vitamin A and iron status of children and whenever possible, caregivers should be taught on how to grow their own vegetables.

HCWs should motivate as much as possible for more vacancies for nutrition-professionals to be appointed within the surrounding areas of DNH to ensure a wider-reach. Focus areas should especially be at clinics where there is no Dietitian or Nutritionist available.

Programs where community members are trained to provide accurate knowledge and support to families within the communities, for example the “mentor mother initiative,” should be further supported and strengthened.

Interventions should always be “double-duty actions,” to provide support for undernourished children and caregivers while preventing overnutrition.

6.5.2 Recommendations for future research

A similar study regarding complementary factors of malnutrition can be compared to a sample outside of the hospital to eliminate the influence of possible underlying disease. The recommendation would also be to include smaller age-groups in order to investigate nutritional guidelines more specific to each age group.

More research is required on the best nutritional intervention programs to reduce stunting. Most studies found that the effects of stunting are mostly irreversible, yet others have commented on nutritional strategies that have shown some improvement, especially the introduction of optimal protein sources from six months. The results are currently still inconclusive and further intervention studies would be able to add to describing optimal management. Research regarding the influence of optimal fruit and vegetable intake on the prevalence of stunting can also be explored.

Maternal undernutrition and IUGR have, throughout literature, shown an impact on long-term poor nutritional status of children. Intervention studies regarding the supplementation of underweight caregivers and the effect hereof on the outcome of the child could be implemented. Improving maternal nutritional status could have a significant impact on the growth of children.

Further research and large-scale interventions are needed to alleviate food insecurity within this area. More research is needed regarding the evaluation of the sufficiency of the social grant and possibly combining it with a food parcel to help alleviate food insecurity and improve dietary diversity as was shown to be effective in some countries.

Further research is needed regarding contributing factors of poor continuation of breastfeeding. Throughout South Africa and also in this study, there is a high initiation rate of breastfeeding, but poor continuation of breastfeeding.

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ADDENDA

Appendix A: Research- administered Questionnaire

Title: *Contributing factors to malnutrition among children 0-60 months in Ibhayi and Motherwell, Eastern Cape*

Researcher: Pamela Michelle Clarke, BSc. Dietetics

Study leader: Prof XG Mbhenyane

Co- study leader: Liana Steenkamp (NMMU)

Please answer the following questions as honestly as possible.

A.HOUSEHOLD AND SOCIO- ECONOMIC INFORMATION OF THE PRIMARY CAREGIVER

1. Code: _____

2. Age of Caregiver:

<16yrs	16- 20yrs	21- 25yrs	26- 30yrs	31- 35yrs	36- 40yrs	>40yrs
1	2	3	4	5	6	7

3. Gender:

Female	Male
1	2

4. Race:

Black	Indian	White	Asian	Coloured	Other
1	2	3	4	5	6

5. Education level:

No schooling	Grade1- completed	3	Grade 4- completed	6	Grade 7-9 completed	Grade 10- 12 completed	Any tertiary education
1	2	3	4	5	6		

6. Type of employment:

Full-time employed	Part-time employed	Self-employed	Unemployed	Studying	Studying & working
1	2	3	4	5	6

7. How many children do you have?

1	2	3	4	5	6	>6
1	2	3	4	5	6	7

8. How many children live in your household? (Under the age of 18 years)

1- 2	3 -4	5 -6	7+
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1	2	3	4
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9. How many adults live in your household?

1- 2	3 -4	5 -6	7+
1	2	3	4

10. How many people in your household are working?

0	1	2	3	3+
1	2	3	4	5

11. Does your child receive a SASSA grant monthly?

Yes	No
1	2

12. If yes, indicate how many children you receive the grant.

1- 2	3 -4	5 -6	7+
1	2	3	4

13. Other sources of income for the household

Husband	Pension grant	Parents	Grandparents	Friends	Other	None
1	2	3	4	5	6	7

14. Total income for the household

<R300	R301- R600	R601- R900	R901- R1200	R1201- R1500	R1500 – R2000	>R2000
1	2	3	4	5	6	7

15. What type of dwelling do you live in?

Flat	Shack	RDP house	Free-standing house	Small holding/ farm (Labourer)	Small holding/ farm (Owner)	Other
------	-------	-----------	---------------------	--------------------------------	-----------------------------	-------

1	2	3	4	5	6	7
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16. Source of running water at home?

Yes, tap inside the house	Yes, tap outside the house in the yard	Communal tap	Borehole	River or well	No water
1	2	3	4	5	6

17. Source of electricity at home?

Yes, electricity	No electricity	Solar
1	2	3

18. Energy for cooking at home?

Electricity	Gas	Paraffin	Wood	Combination: specify
1	2	3	4	5

19. Do you have a vegetable garden at home?

Yes	No
1	2

20. Types of sanitation at home?

Flush toilet inside the house	Flush toilet outside the house	Pit latrine	Bucket system	Other, specify
1	2	3	4	5

21. Type of Sewerage system at home?

Municipality	Own Sewage	None	Other
1	2	3	4

B. GENERAL INFORMATION OF THE CHILD**8a. Age of the child in years and months**

8b. Tick the appropriate box

0 – 6 months	6- 12 months	1- 2 years	2- 3 years	3- 4 years	4- 5 years
1	2	3	4	5	6

9. Gender

Female	Male
1	2

10. Race

Black	Indian	White	Asian	Coloured	Other
1	2	3	4	5	6

11. Do you think your child has a good appetite?

Yes	No
1	2

12. Is your child's appetite currently the same as usual or has it changed this past week?

The same appetite	Increased appetite	Decreased appetite
1	2	3

12.1 Give possible reasons for changes in the appetite

More variety of food available	Giving the child more food that he/ she likes	The child was sick	The child is sick now	Other
1	2	3	4	5

13. Are you currently breastfeeding your child?

Yes	No
1	2

14. If you have stopped breastfeeding, explain why:

The child is old enough	The child didn't want the milk anymore	I was afraid the child wasn't getting enough milk	I had to go back to work or school	I'm afraid of giving my child HIV	My family told me to stop	Other	N/A
1	2	3	4	5	6	7	8

15. If you are not currently breastfeeding your child, did you breastfeed your child before?

Yes	No	N/A
1	2	3

15.1 If yes, for how long did you breastfeed your child?

0- 2 months	2- 4 months	4- 6 months	6- 8 months	8- 10 months	10- 12 months	12- 24 months	>24 months	N/A
1	2	3	4	5	6	7	8	9

C. HOUSEHOLD FOOD INSECURITY QUESTIONNAIRE

For every *yes* answer, add 1 point and 0 points for *no* answers

16. In the past 4 weeks (30 days), did you worry that your household would not have enough food?

Yes	No
1	2

17. During the past 4 weeks were you or any household member not able to eat the kinds of foods you like more because of having too little money?

Yes	No
1	2

18. In the past 4 weeks did you or any household member have to eat a small variety of foods due to a lack of money?

Yes	No
1	2

19. In the past 4 weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of money to buy other types of food?

Yes	No
1	2

20. In the past 4 weeks did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

Yes	No
1	2

21. In the past 4 weeks (30 days), did you or any household member have to eat less meals in a day because there was not enough food?

Yes	No
1	2

22. In the past 4 weeks (30 days), was there ever no food to eat of any kind in your house because of a lack of resources to get food?

Yes	No
1	2

23. In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food?

Yes	No
1	2

24. In the past 4 weeks (30 days), did you or any household member go a whole day and night without eating anything because there was not enough food?

Yes	No
1	2

25. Total score: _____

D. 24 HOUR RECALL-DIETARY INTAKE

Please specify what the child ate and drank yesterday; let's start when the child woke up. Did he /she have anything to eat or drink? Proceed through the day following the child's activities', when finished summarise it for the caregiver. Any forgotten items can be added.

40. Day of the week recalled.

1 Mon	2 Tues	3 Wed	4 Thu	5 Fri	6 Sat	7 Sun
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41. Was yesterday typical / eating routine for the child?	1.Yes	2.No	
42. Did the child eat at a feeding scheme or crèche yesterday?	1. Yes	2.No	3. Do not know
43. Did this child go to bed hungry last night?	1.Yes	2.No	3. Do not know
44. Did the child eat from the same pot as the rest of the family at the main meal?	1.Yes	2.No	3.Do not know
45. Did the child eat from the same plate as siblings, at the main meal yesterday?	1.Yes	2.No	3. Do not know

46. Does the child follow any special diet?

Yes	1	No	2
-----	---	----	---

47. If yes, specify

Diabetic	1
Allergies	2
Other, specify _____	3
N/A	4

48. How many times a week does your child eat breakfast?

Everyday	1
3-5 x per week	2
1-2 x per week	3
Do not know	4
Never	5

49. Household level only: Did you or anyone in your household eat anything (meal or snack) OUTSIDE of the home yesterday?

Yes	1
No	2
Do not know	3

50. Individual level only: Did your Child eat anything (meal or snack) OUTSIDE of the home yesterday?

Yes	1
No	2
Do not know	3

51. 24 HOUR RECALL- DIETARY INTAKE

Enter each item eaten. Include preparation methods if possible

Time	Food item the child ate yesterday
Breakfast	
Morning snacks	
Lunch	
Afternoon snack	
Supper	

Evening snacks	

E. DIETARY DIVERSITY QUESTIONNAIRE

When the respondent 24 recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Question Number	Food group	Examples	YES=1 NO=0
52.1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + <i>insert local foods e.g. Pap, Phutu, porridge or pastes or other locally available grains</i>	
52.2	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrots, squash, or sweet potatoes that are orange inside + <i>other locally available vitamin-A rich vegetables (e.g. red sweet pepper)</i>	
52.3	WHITE TUBERS AND ROOTS	white potatoes, white yams, white cassava, or other foods made from roots	
52.4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild ones + <i>locally available vitamin-A rich leaves such as amaranth, cassava leaves, kale, spinach etc.</i>	
52.5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant), including wild vegetables	
52.6	VITAMIN A RICH FRUITS	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + <i>other locally available vitamin A-rich fruits</i>	
52.7	OTHER FRUITS	other fruits, including wild fruits	
52.8	ORGAN MEAT (IRON RICH)	liver, kidney, heart or other organ meats or blood-based foods	
52.9	FLESH MEATS	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds	
52.10	EGGS	chicken, duck, guinea hen or any other egg	
52.11	FISH	fresh or dried fish or shellfish	
52.12	LEGUMES, NUTS AND SEEDS	beans, peas, lentils, nuts, seeds or foods made from these	
52.13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
52.14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
52.15	RED PALM PRODUCTS	Red palm oil, palm nut or palm nut pulp sauce	
52.16	SWEETS	sugar, honey, sweetened soda or sugary foods such as chocolates, candies, cookies and cakes	
52.17	SPICES, CONDIMENTS, BEVERAGES	spices(black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages OR <i>local examples</i>	
Question 52.18	Total Score Yes:/17 = _____ %		

F. FEEDING PRACTICES AND FOOD FREQUENCY**53. Which food is best for children less than 6 months?**

Breastmilk only	1
Infant formula only	2
Both breastmilk & infant formula	3
Soft porridge	4
Don't know	5
Other	6

54. For how long should a child be breastfed?

< 6 month	1
6 to 12 months	2
12 to 18 months	3
19-23 months	4
24 months and above	5
Don't know	6

55. Which other food can be used as a substitute for porridge?

Rice, Bread	1
Meat, Milk	2
Banana, Mango	3
Cabbage, Pumpkin	4
Don't know	5
Other	6

56. Which other food can be used as an alternative to meat?

Legumes	1
Spinach	2
Potatoes	3
Don't know	4
Other	5

57. How much milk or other dairy products is needed per day for children 2 to 5 years?

None	1
½ - one cup	2
1½-2½ cups	3
Don't know	4
Other	5

58. Which one of the following can be used as an alternative to milk?

Coffee creamer	1
Cheese	2
Peanut butter	3
Don't know	4

59. How many fruits should a child of 2-5 years eat daily?

None	1
One	2

2-3	3
4-5	4
Don't know	5
Other, specify-----	6

60. How much of vegetables should a child of 2-5 years eat daily?

None	1
¼ cup	2
1 cup	3
2 cups	4
Don't know	5
Other, specify-----	6

61. How many times per day should a child of 2-5 years eat?

Once	1
Twice	2
Three times and more	3
Don't know	4

62. What are your sources of nutrition information? (Can choose >1)

Television	1
Clinic	2
Community health worker	3
Friend	4
Family	5
Radio	6
Newspaper/magazines	7
None	8
Other	9

63. Was the study child given infant formula?

Yes	1
No	2
Don't know	3

64. From what age was it given?

< 1 month	1
1-3 months	2
4-5 months	3
6 months	4
Not applicable	5
Other: specify-----	6

65. How was it given?

Bottle-feeding	1
Cup feeding	2
Spoon feeding	3
Not applicable	4
Other, specify-----	5

66. At which age was solid foods first introduced to the child?

0-1 months	1	1- 2 months	2- 3 months	3- 4 months	4- 5 months	5-6 months	6	>6 months	Have not started
1		2	3	4	5	6		7	8

67. Which solid food was first given?

Maize meal soft porridge	1
Infant cereal	2
Ready to eat bottled baby food	3
Vegetables	4
Other	5
N/A (not started yet)	6

68. How many meals are presently given to the study child per day?

One	1
Two	2
Three and more	3
Other, specify-----	4

69. Who usually feeds/ assists this child during meal times?

Feed him/herself	1
Caregiver	2
Other siblings	3
Other: specify-----	4

70. How many days per week does the child eat vegetables?

None	1
One day	2
2-3 days	3
7 days	4
Uncertain	5
Other: Specify-----	6

71. How many days per week does the child eat fruits?

None	1
One day	2
2-3 days	3
7 days	4
Uncertain	5
Other: Specify-----	6

72. How many days per week does the child eat meat products (e.g. meat, fish, eggs)?

None	1
One day	2
2-3 days	3
7 days	4
Not sure	5
Other: Specify-----	6

73. Do you give your child tea or coffee to drink?

Yes	No
1	1

74. If yes, how do you prepare the tea or coffee?

No milk or sugar	Sugar, without milk	Milk, no sugar	Milk and sugar	N/A
1	2	3	4	5

75. FOOD FREQUENCY QUESTIONNAIRE

How often do you give the following food to the study child? (Please indicate the frequency)

Food items	Daily	4-6x/week	1-3x/week	Occasionally/ Seasonally	Never
Code	1	2	3	4	5
Cereals/starches					
75.1. Stiff porridge					
75..2.Soft porridge					
75.3. Breakfast cereal e.g. corn flakes, weetbix					
75.4. Rice					
75.5. Brown Bread					
75.6. Samp					
75.7. Potatoes					
75.6 Pasta					
75.7 White bread					
75.8 Other					
Dairy products					
76.1 Eggs					
76.2 Fresh milk					
76.3 Fresh Milk powder e.g. Nespray					
76.4 Cheese					
76.5 Yoghurt					
76.6 Amasi					
76. 7 Other					
Animal foods					
77.1 Polony					
77.2 Viennas					
77.3 Beef					
77.4 Chicken					
77.5 Chicken feet and heads					
77.6. Chicken Livers					
77.7. Chicken offal					
77.8. Pork					
77.9 Fish					
77.10 Lamb					
77.11 Other					
Legumes					
78.1. Beans					
78.2 Soya products					
78.3. Peanuts					

78.4. Peanut butter					
78.5 Lentils					
78.6 Other					
Fruit					
79.1. Orange					
79.2 Naartjie					
79.3. Apple					
79.4. Pear					
79.5 Banana					
79.6 Mango					
79.7 Grapes					
79.8. Guava					
79.9. Peaches					
79.10 Paw- paw					
79.11 Avocado					
79.12 Fruit juice (Specify)					
79.13 Other					
Vegetables					
80.1 Pumpkin					
80.2 Cabbage					
80.3 Carrot					
80.4 Beetroot					
80.5 Spinach					
80.6. Tomatoes					
80.7 Sweet potatoes					
80.8 Other (specify)					
Miscellaneous					
81.1 Fat cakes					
81.2 Cold drinks					
81.3 Sweets					
81.4 Chips					
81.5 Biscuits					
81.6 Ice cream					
81.7 Margarine					
81.8 Jam					
81.9 Other (specify)					

G. INFORMATION FROM THE RTHB

82. Birth weight of the child: Is the weight for age:

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line
1	2	3	4	5	6	7

82.1 Gestational age

Full term	Premature
1	2

82.2 If premature, indicate the gestational age if recorded in the RthB

83. Are the immunisations up to date?

Yes	No	N/A
1	2	3

84. On the RTHB, for the Weight for Age chart, complete where the Z-score is at each age category**84.1 One month**

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.2 Three months

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.3 Six months

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.4 One year

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.5 One and a half years

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.6 Three years

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.7 Four years

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

84.8 Five years

<-3SD line	<-2SD line	<-1 SD line	<median	<+1SD line	<+2 SD line	>+2SD line	N/A
1	2	3	4	5	6	7	8

ANTHROPOMETRIC MEASUREMENTS

Repeat every measurement to ensure accuracy and use the mean of the values

85 Child's weight

Weight 1	Weight 2	Average

86 Child's height/ length

Height 1	Height 2	Average

87 Child's MUAC (if >6 months)

MUAC 1	MUAC 2	Average

88 Caregiver Weight

Weight 1	Weight 2	Average

89 Caregiver height

Height 1	Height 2	Average

Thank you

Appendix B: Ethics approval letter



UNIVERSITEIT
STELLENBOSCH
UNIVERSITY
Project ID #: 0926

Health Research Ethics Committee (HREC)

Approval Notice

New Application

Title: Contributing factors to malnutrition in children 0- 60 months in Ibhayi, Eastern Cape

HREC Reference # S17/10/192

Dear Ms P Clarke

The **New Application** received on 08/12/2017 07:04 was reviewed by members of **Health Research Ethics Committee** via **expedited** review procedures on 17/01/2018 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: **17-Jan-2018 – 16-Jan-2019**

Please remember to use your Project Id (0926) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review

Please note you can submit your progress report through the online ethics application process, available at: <https://applyethics.sun.ac.za/Project/Index/1004> and the application should be submitted to the Committee before the year has expired. Please

see [Forms and Instructions](#) on our HREC website for guidance on how to submit a progress report.

The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Translation of the consent document(s) to the language(s) applicable to your study participants should now be submitted to the HREC.

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see: <https://www.westerncape.gov.za/general-publication/health-research-approval-process>.

Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and instructions, please visit: [Forms and Instructions](#) on our HREC website [Links Application Form Direct Link](#)

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,

Franklin Weber
HREC Coordinator
Health Research Ethics Committee 1 (HREC 1)

*Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239*

The Health Research Ethics Committee complies with the SA National Health Act No. 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles, Structures and Processes 2015 (Department of Health).

Appendix C: NHRD permission letter



Enquiries: Zonwabele Merile Tel no: 083 378 1202
Email: Zonwabele.Merile@echealth.gov.za Fax no: 043 642 1409
Date: 24 January 2018

RE: CONTRIBUTING FACTORS TO MALNUTRITION AMONG CHILDREN 0-60 MONTHS IN IBHAYI AND MOTHERWELL, EASTERN CAPE (EC_201801_011).

Dear Pamela Clarke

The department would like to inform you that your application for on the abovementioned research topic has been approved based on the following conditions:

1. During your study, you will follow the submitted amended protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Eastern Cape Health Research Committee secretariat. You may also be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.



SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

Appendix D: Consent form participants

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT: Contributing factors to malnutrition in children 0- 60 months in Ibhayi, Eastern Cape

REFERENCE NUMBER: _____

PRINCIPAL INVESTIGATOR: Pamela Clarke

ADDRESS: University of Stellenbosch
Tygerberg Campus
Francie van Zijl Drive
7505

CONTACT NUMBER: 078 6729543

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about:

Where will the study take place?

The study will take place at Dora Nginza Hospital at the Paediatric Outpatient Department (POPD) only, no other sites will be included.

How many people can take part in the study?

The aim is to include close to 400 participants. Everyone who wishes to take part in the study and meet the criteria during the data collection period, will be allowed to take part.

Aims and objectives of the study

The study aims to find reasons why some children are not growing well and why others gain too much weight. We will use questions and some measurements to provide valuable

information in this study. The information gathered can possibly be a stepping stone to improve services or include more programs to help children to grow better.

The procedures of the study

Everyone who comes to the POPD at Dora Nginza Hospital during the time that the data is collected and those who meet the criteria will be allowed to participate in the study. Before data is collected, information about the study will be given to the caregiver. The information will include why the study is done, what will happen and your right to withdraw from the study any time. If the caregiver decides to take part in the study, she will have to sign for permission to take part (written informed consent). Firstly, the caregiver will be asked to answer the questions from the questionnaire as explained by the researcher- or research assistant. Secondly, the weight, length and mid-upper arm circumference of the child will be obtained as well as the weight and height of the caregiver.

Why have you been invited to participate

You have been invited to participate because your child is within the right age group that is being investigated, you are from the local area and your child is healthy enough to take part in the study. You, and your child's participation will help to collect information to find out what are different factors that may determine the growth and weight of the child.

What will your responsibilities be?

Your responsibilities will be to answer all questions as truthfully and thoroughly as possible.

Will you benefit from taking part in this research?

There are no direct benefits for you or your child to take part in the research study, but your participation will likely help us to improve the service to patients in the future and also to provide some guidelines to training programs that may be implemented in the communities to improve the growth of children.

Are there any risks involved in your taking part in this research?

There are no risks involved in the research study. The only slight discomfort may be for your child to be weighed and measured.

If you do not agree to take part, what alternatives do you have?

Participation in the study is voluntary and you are allowed to withdraw at any time.

Who will have access to your medical records?

The information collected will be treated as confidential and protected. If the results are published in a thesis and publication, your identity will be protected by remaining anonymous. The researcher, research assistant, the study leader and the statistician will be the only people who will have access to the collected information.

Will you be paid to take part in this study and are there any costs involved?

No, you will not be paid to take part in the study and there will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

- You can contact Pamela Clarke at telephone number, 0786729543 if you have any further queries or encounter any problems.

- You can contact the Health Research Ethics Committee at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by your study doctor.
- You will receive a copy of this information and consent form for your own records.

Declaration by caregiver

By signing below, Iagree to take part in a research study entitled, *Contributing factors to malnutrition in children 0- 60 months in Ibhayi and Motherwell, Eastern Cape*

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressured to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) on (*date*) 2018.

Signature of caregiver

Signature of witness

Declaration by investigator

I (*name*) declare that:

- I explained the information in this document to
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (*If an interpreter is used then the interpreter must sign the declaration below.*)

Signed at (*place*) on (*date*) 2018.

Signature of investigator

Signature of witness

Declaration by interpreter

I (*name*) declare that:

- I assisted the investigator (*name*)to explain the information in this document to (*name of participant*) using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her questions satisfactorily answered.

Signed at (*place*) on (*date*)2018

Signature of interpreter

Signature of witness

Appendix E: Manual for training of the research assistant

Please go through this manual to make sure you understand what the correct procedures are when doing anthropometric measurements.

Obtaining consent and helping the caregiver to answer the questions

This just serves as an example of how to approach caregivers, it can be phrased in your own words as long as the core message comes across.

1. Introduce yourself to the caregiver; state your name and the reason for the visit

Good day, my name is..... (insert name here) and I am a research assistant. We are doing a study to find some valuable information in the community. Would you mind if I take some of your time to explain the study to you?

If the caregiver agrees, then explain the purpose of the study

The research study has the goal of finding out more about the people who live in the area and come to the hospital, including what they eat, where they live and their family environment. To be able to obtain this goal, we will ask people who visit the outpatient department to take part in a study if they meet our list of inclusion criteria. Please note that participation is voluntary. You do not have to participate if you do not want to and you are allowed to withdraw at any time from the study.

What will be required from you is to answer some questions about you and your child's food intake with the help of the researcher/ - assistant. You will also be weighed and your height taken and the weight, height and mid-upper arm circumference of your child will be taken. You will receive no direct benefit by taking part in the study and only your expenses for participating can be paid for. The study has a very low risk for participants and no invasive procedures will be used. All information gathered for the study will be kept anonymous and the data collected will be stored in a safe place.

2. Ask the caregiver if she would like to participate in the study. If she agrees, go through the consent form with the caregiver. Explain in a language that is easily understandable to the caregiver. Make sure that the caregiver signs the consent form if she chooses to participate and once she is well informed about the study.

3. Continue with the research administered questionnaire. Ensure that you read the questions carefully and that the caregiver understands what is being asked. Repeat the questions if necessary. Ensure that you are not using leading questions; do not change your tone of voice or sound shocked or surprised at an answer. Read the questions and the possible answers and encourage the caregiver to give the first answer that comes to mind.

4. Continue with the anthropometry measurements as specified

Measurements of the child >2 years of age

Before doing any measurements, ensure the participant's privacy and dignity.

As far as possible, take the measurements in a separate room with a closed door.

The person should wear minimal clothing e.g. a light gown or underwear. Ask the person or caregiver to remove hats, shoals, shoes and jewellery that the child may be wearing. Be sensitive to various cultural beliefs and traditions- take into consideration clothing items not removed due to religious or cultural reasons.

Do not take measurements on weak or ill persons.

Take two measurements and use the mean of the values.

1. Measuring the height of the child (>2years)

The participant must be barefoot

Nothing should cover the head- remove caps, hats or shoals

The patient must stand on the baseboard with their back facing the stadiometer

The head, shoulders, buttocks and heels should touch the stadiometer

The patient should stand with heels together, arms to the side, legs straight, shoulders relaxed and their head facing directly forward

Just before the measurement, the person should inhale, hold their breath and maintain an upright position (height taken at maximum inspiration)

Bring the measuring stick down until it touches the head with enough pressure to compress the hair

The measurement should be read on eye level with the head board

Take measurement to the nearest 0, 1cm

2. Measuring the weight of the child > 2years

Zero calibrate the scale before weighing.

The patient must be barefoot

The patient should only wear minimal clothing

The patient should stand on the centre of the scale and look straight ahead

The patient should stand unassisted

The measurement should be taken to the nearest gram

Take two measurements; using the mean of the measurements.

The measurements should be <100g difference

3. Measuring the weight of the child <2years old

Ensure you are using a paediatric scale

Take the babies weight without clothing or nappy

If it is not possible, the baby can be weighed with a clean nappy

Ensure the scale is calibrated before use and "zeroed" before obtaining the measurement

Ensure the child does not move while taking the measurement

Take measurement to the nearest gram

Use the mean of the two measurements

4. Measuring the length of the child (<2years old)

Two people are required to ensure an accurate measurement

The measuring board should have a fixed headboard with a moveable foot board and a ruler attached to the one side

Nothing must cover the head

Remove shoes and socks

Place the child on the board facing upwards

The child's shoulders and buttocks must touch the backboard, and the shoulders and hips at the right angles to the long axis of the body

Person 1 must hold the crown of the child's head firmly against the headboard

Person 2 must gently flatten the child's knees to ensure they are fully extended and flatten the child's feet onto the footboard, toes pointing upwards

Take the measurement to the nearest 0, 1cm

Take the mean of the 2 measurements

5. Measuring the mid-upper arm circumference of the child

Take the measurements on the left arm

Ask the patient to stand straight, with feet together

Bend the patient's left arm to form a 90° degree angle, with the palm of the hand directing upwards

The midpoint of the arm is between the two bones, the *acromion* and the *olecranon*, measured at the back of the arm

Mark the midpoint on the arm

Ask the participant to stand straight with their arms relaxed along the sides, palms facing towards his body

Take the measurement on the left arm, perpendicular to the straightened arm

Take the measurement around the arm on the same level as the midpoint of the arm using the MUAC tape

Ensure that the measuring tape does not compress the skin when taking the measurement

Take the measurement to the nearest 0, 1cm

6. Measuring the weight of the caregiver

Zero calibrate the scale before weighing.

The patient must be barefoot

The patient should only wear minimal clothing

The patient should stand on the centre of the scale and look straight ahead

The patient should stand unassisted

Take two measurements; using the mean of the measurements.

The measurements should be <100g difference

7. Measuring the height of the caregiver

The participant must be barefoot

Nothing should cover the head- remove caps, hats or shoals

The patient must stand on the baseboard with their back facing the stadiometer

The head, shoulders, buttocks and heels should touch the stadiometer

The patient should stand with heels together, arms to the side, legs straight, shoulders relaxed and their head facing directly forward

Just before the measurement, the person should inhale, hold their breath and maintain an upright position (height taken at maximum inspiration)

Bring the measuring stick down until it touches the head with enough pressure to compress the hair

The measurement should be read on eye level with the head board

Take measurement to the nearest 0, 1cm

References (see reference list with thesis for full references in full)

ADSA, 2009

Cashin & Oot, 2018

Stewart & Marfell-Jones (2011)