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Household food insecurity disease profile among underweight children aged between 6 and 60 months admitted to Potchefstroom hospital, North-West province

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HOUSEHOLD FOOD INSECURITY AND DISEASE PROFILE AMONG UNDERWEIGHT CHILDREN AGED BETWEEN 6 AND 60 MONTHS ADMITTED TO THE POTCHEFSTROOM HOSPITAL, NORTH-WEST PROVINCE

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A research report submitted to the Faculty of Health Sciences
In partial fulfilment of the requirements for the degree
Of
Master of Medicine in Family Medicine
Department of Family Medicine
University of the Witwatersrand

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18th October 2019

I DECLARATION

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

Signed: ..... (signature of candidate)

Date: 18th October 2019

II DEDICATION

I would like to dedicate this work to: my precious wife, Guyguy Binda
And to my children Délices-Agate, Onyx-Rael and Beryl-Daniella;
To my brothers and sisters and;
To my whole family,
For their love and many sacrifices.

III ABSTRACT

Introduction

In South Africa, children aged between 6 and 60 months constitute a priority group considering that malnutrition remains a major health problem among them. Many studies have identified factors associated with undernutrition in different populations. One of these factors is food insecurity, defined by the fact that households do not have an adequate quantity of the right kind of foods necessary. Literature reports undernutrition as a major public health problem in developing countries, and many children die from its complications. In the researcher's practice area of Potchefstroom, this is a serious problem which needs further clarification and attention.

Aim: To explore household food insecurity and assess the disease profile among underweight children aged between 6 and 60 months admitted to the Potchefstroom Hospital.

Methods

This was a quantitative, observational cross-sectional study, conducted in the general paediatric ward at the Potchefstroom Hospital, North-West Province. A total of 100 parents or guardians of children aged between 6 to 60 months admitted from December 2016 to December 2017 were interviewed. Anthropometric measurements were taken and recorded. The household food insecurity access scale measurement tool of the Food and Agriculture Organisation was used to classify the households as food secure, insecure or at risk. Logistic regression was used to test the strength of association between food insecurity, disease profile and socio-demographic characteristics of the participants.

Results

The majority of participating children were female (54%, n=54), less than 24 months (88%, n=88), born in urban areas (61%, n=61). The majority of participants' households had 2 children younger than 5 years (48%, n=48). Most of them were severely underweight (70%, n=70), HIV negative (81%, n=81), and had their immunisations up to date (63%, n=63). Most of the children came from families with food insecurity (96%) and were admitted with either acute gastroenteritis (46.0%, n=40) or lower respiratory tract infection (43.6%, n=38).

In univariate analysis, immunisation status (p=0.019), acute diseases (p=0.042), household size (p=0.005) and number of children younger than 5 years in households (p=0.002) were found to be associated with food insecurity.

Conclusion

This study showed that food insecurity is highly prevalent among underweight children admitted to Potchefstroom Hospital and appears to underpin the acute gastroenteritis and lower respiratory tract infection in this setting. Household factors such as size and number of younger children were found mainly to be associated with food insecurity. These findings underscore the need for exploration of food security as part of the social context of under-5year old children who present to primary healthcare.

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VII LIST OF ACRONYMS AND ABBREVIATIONS

AGE: Acute gastroenteritis

CPD: Continuous Professional Development

DHIS: District Health Information System

DOH: Department of Health

EDL: Essential Drug List

ENT: Ear, nose and throat

EMTCT: Elimination of Mother to Child Transmission

EPI: Expanded Programme of Immunization

FAO: Food and Agriculture Organisation of the United Nations

ICU: Intensive Care Unit

IMCI: Integrated Management of Childhood Illnesses

Km: Kilometre(s)

Kg: Kilogram(s)

LRTI: Lower respiratory tract infection

MAM: Moderate Acute Malnutrition

MDG: Millennium Development Goals

OM: Otitis media

PHC: Primary Health Care

PMTCT: Prevention of Mother to Child Transmission

RTHB: Road to Health booklet

SADHS: South African Demographic and Health Survey

SAM: Severe Acute Malnutrition

SD:	Standard Deviation
SDG:	Sustainable Development Goals
SPSS:	Statistical Packages for Social Sciences
SSA:	Sub-Saharan Africa
SSR:	Self-sufficiency index or ratio
STG:	Standard Treatment Guidelines
UNDP:	United Nations Development Programme
UNICEF:	United Nations Children's Fund
WHO:	World Health Organisation

VIII LIST OF DEFINITIONS

Acute diseases:

Diseases or disorders of abrupt onset, those are of short duration, rapidly progressive, and in need of urgent care. The measure of the time scale is in contrast to “subacute” and “chronic”.

Acute gastroenteritis:

Nonspecific term of various inflammatory problems of the gastrointestinal tract, of abrupt onset and short term; and presenting most commonly with diarrhoea, vomiting and/or nausea.

Food security:

The state of having reliable access, by all people at all times, to a sufficient quantity of affordable, nutritious food needed for a healthy life.

Household:

A person or group of related persons who live together in the same dwelling unit(s); who acknowledge one adult male or female as the head of the household; who share the same housekeeping arrangements; and who are considered as a single unit.

Lower respiratory tract infection:

Often used as a synonym of pneumonia, can also be applied to other types of infections, such as lung abscesses and acute bronchitis. It usually presents with cough, shortness of breath, sputum and low-grade fever.

National food self-sufficiency index or ratio (SSR):

It is defined as: SSR= production X 100 / (production + imports – exports).
In the context of food security, it is often used to indicate the extent to which a country relies on its own production resources. i.e. the higher the ratio the greater the self-sufficiency.

Undernutrition:

It is defined as a form of malnutrition resulting from a reduced supply of food or from inability to digest, assimilate, and use the necessary nutrients.

Underweight:

It is defined as one of the forms of undernutrition where the child's weight is less than the norm for that child's age.

A child whose weight-for-age is below the Z-score -3 line, is considered to be severely underweight and the one whose weight-for-age is between the -2 line and -3 line of the Z-score is moderately underweight.

CHAPTER 1: INTRODUCTION

1.1 Background

Children aged between 6 and 60 months constitute a priority group due to vulnerabilities and high-risks of mortality and morbidity during their growth phase. [1]This group comprises 12% of the population in South Africa, [2] and are particularly susceptible to being food insecure, resulting in malnutrition.

Undernutrition remains a major public health problem in developing countries. [1-4] Globally, there are approximately 73 million undernourished children of which almost 11 million (15%) die per annum, from undernutrition and its complications. [3] Most of these deaths are preventable through economic development and public health measures, such as implementing of the United Nations Sustainable Development Goals (SDG). These SDG aim to end poverty and fight inequality and injustice among people by 2030, and a section of them particularly address the vulnerabilities of children under 5 years of age. [5]

Although there was a marked decline in poverty in South Africa since 2000, [2] the goal of eradicating poverty had not been reached in 2017. A third of the South African population still experiences hunger and undernutrition; the North-West Province is among the most affected provinces. [6] Poverty is directly linked to food insecurity. Lack of income hinders households from procuring adequate quantity and right kind of foods needed. In simple terms, this is referred to as "food insecurity" and is a significant risk factor for malnutrition. [6] The Food and Agriculture Organisation (FAO) of the United Nations defines food security as, "access by all people at all times to the food needed for a healthy life." [7]

Malnutrition comprises of two forms, namely under and overnutrition. [1, 2] Undernutrition is determined by deviations of anthropometric indicators from normal references and has categories including stunting, wasting and underweight. [8] Wasting (low weight for height) and stunting (low height for age) are respectively associated with acute and chronic undernutrition; while underweight (low weight for age) represents both acute and chronic types of undernutrition. [8]

Consumption of sufficient quantities of nutritionally adequate, safe and appropriate foods in early age helps to ensure good nutritional status, therefore to avoid undernutrition and protect against childhood illnesses. [9]

In recognition of their vulnerability to malnutrition, the World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF) in a joint statement on child growth standards and the identification of severe acute malnutrition, advocated for the identification and management of malnutrition and its complications among the age group 6 to 60 months for an adequate child growth. [10] The same cut-off age will be considered in this study.

The focus of this study is on underweight since height is for most part not plotted in the Road to Health booklets (RTHB), [11] making it difficult to diagnose wasting and stunting on a once-off measurement. Many studies conducted worldwide, have identified associated factors of undernutrition in different populations. One of the factors associated with undernutrition is food insecurity. Promoting food security is one pathway leading to abolishment of hunger by 2030 as aimed for by SDG and by implication reducing the burden of undernutrition.

1.2 Rationale

The researcher has examined many underweight children aged 6-60 months during his rotation in Primary Health Care (PHC) and in the Department of Paediatrics at Potchefstroom Hospital. Although their symptoms varied from cough, diarrhoea, vomiting and fever to skin and ear problems, most had underlying acute or chronic undernutrition. HIV infection and/or tuberculosis also seem to be common co-morbidities. Some of them died though proper management had been initiated. Most of these patients were referred from socioeconomically disadvantaged areas of the catchment population of the hospital.

The District Health Information System (DHIS) reported that 7.7% of children between 6 and 60 months of age were diagnosed with severe undernutrition (including underweight) in the PHC facilities in 2017. [11] Data suggest that 14.3% of children under the age of 5 years, who were admitted to Potchefstroom Hospital between 2011 and 2014, were undernourished. [11] HIV/AIDS,

tuberculosis, bronchopneumonia and acute gastroenteritis were reported as the most commonly associated diagnoses.

Food insecurity is known to be prevalent in South Africa, in general and particularly in North West, among other provinces. [11] Yet to date, no formal study has been conducted in Potchefstroom area aiming to determine the prevalence of household food insecurity andto look at the association of food insecurity, socio-demographic characteristics and health problems in underweight children aged between 6 and 60 months. Knowing these is important for developing clinical and social responses to the problem of undernutrition in this setting.

1.3 Aim and objectives

1.3.1 Study aim**:** To explore household food insecurity and assess the disease profile among underweight children aged between 6 and 60 months admitted to the Potchefstroom Hospital.

1.3.2 Study objectives:

- To describe the socio-demographic characteristics of the participating children
- To describe the presenting medical problems of participating children during the hospital admission
- To determine the proportion of children with food insecurity
- To explore the relationship between food insecurity, disease profile and socio-demographic characteristics in these children.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The researcher did a literature search on Google and PubMed, using the following key words: 'food insecurity', 'diseases', 'children', and 'underweight'. Publications not older than 10 years were considered, written in English and limited to the aforementioned search words.

In this chapter, the literature review will be arranged in the following way:

1. Undernutrition and underweight. Definitions, prevalence of undernutrition and its determinants
2. Food insecurity. Its definitions, its states worldwide and in South Africa, its negative effects and factors associated with it
3. Food insecurity and underweight

2.2 Undernutrition and underweight

2.2.1 Definitions

The UNICEF defines undernutrition as, "the outcome of insufficient food intake (hunger) and repeated infectious diseases." [12]

It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition). [12]

Underweight in children is defined as one of the forms of undernutrition where the child's weight is less than the norm for that child's age. [12, 13] A child whose weight-for-age is below the -2 line is moderately underweight, and below the -3 line is severely underweight. [10, 13]

2.2.2 Prevalence and determinants

Studies and surveys published over a period of more than 40 years (1970-2013) aimed to investigate the changes in the prevalence of undernutrition in South African children [14] and in the rest of Africa. [15, 16] They came to the conclusion that despite a substantial economic growth, political and social transitions and national nutritional programs, undernutrition remains persistent, stagnant and prevalent in South Africa. [14 -16]

The review has demonstrated a significant difference in its prevalence between rural and urban areas; rural children (6.7- 66%) being more affected by undernutrition, than their urban

counterparts (3.1- 32.4%) who also face overnutrition. [14] Moreover, a sex disparity was found in the higher rate for undernourished boys than girls. [14] It is important to note the difference between these reviews. The first two deal with stunting and the last one, with underweight. However, the conclusion is seemingly the same (a higher prevalence in rural than in urban areas). [14, 15]. It is important to mention that the maximum of articles reviewed are cross sectional studies, and they are known to be good to measure the prevalence of health outcomes or determinants of heath, such as undernutrition. But the review addresses a broad topic (nutrition, which comprises under and overnutrition [1, 2]), it has still mentioned elements of epidemiology of undernutrition. Because it is not focused on a specific question (e.g. prevalence of undernutrition), thoroughness was then not attained.

UNICEF reported in its document titled, "Consultant for a development of a national school nutrition guideline" [17] that a percentage of children under the age of five are stunted (27%), underweight (12%), and wasted (5%). [17]
This has been confirmed by various South African studies, [2, 7, 18, 19] all concluding that the most prevalent form of undernutrition is stunting. Though the systematic review included only studies conducted in community children, without any acute disease, [19] the conclusion needs still to be taken in account since the study design is one of the strongest levels of evidence.

Diseases in general (including gastroenteritis, respiratory infections, HIV/AIDS, etc.) have been mentioned as immediate causes of child undernutrition, as they lead to an inadequate dietary intake and increased energy intake. [17-24] Furthermore, child undernutrition has also been recognised as a cause of diseases, justifying the well-established concept of "vicious" cycle between nutrition and diseases, especially infections. [16-22, 24]

Rather than from epidemiological causes, the main determinant of inadequate weight gain is sociocultural in origin, such as: household food insecurity, inappropriate feeding practices, maternal undernutrition, low income or poverty, low maternal education, lack of safe running tap water in the house or yard, delayed health consultation, non-adherence to the immunization programme, and more than four children per household. [14-17, 20-28]

Conclusions of systematic reviews being more reliable than those of single studies, the findings of two of studies mentioned here [14, 15]can be considered accurate and the same evidence (household food insecurity linked to undernutrition) expected to be reproduced in this study results.

2.3 Food insecurity

Food insecurity is closely linked to poverty, low income and unemployment. [6] Poverty is one of the determinants of food insecurity, affecting all the individuals in a household, but is particularly devastating to children. The fact that households do not have enough of the right kinds of food or sufficient food can have serious implications for a child's physical and mental development, amongst others, undernutrition. [6]

2.3.1 Definitions

Food insecurity is a broad term and it is defined in different ways by many different organizations worldwide. It is defined as the inability of people to secure adequate food. [6, 7] Moreover food insecurity is the most broadly-used measure of food deprivation in developed countries such as the United States of America. For example, in Texas (one of the fifteen U.S. states most affected by food insecurity), one in seven people (14.3%) is affected by the problem. [29, 30]

Food insecurity means "consistent access to adequate food is limited by a lack of money and other resources at times during the year." [29, 30]

The FAO, in its 2010's state of food insecurity report, stipulated that: "food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." [5] Food insecurity therefore arises when the mentioned conditions of food security are not achieved.

In another way, the Department of Nursing, University of Medical Sciences of Iran defines food insecurity as "means limited or uncertain access to sufficient and healthy food in terms of nutrition, or even restricted ability to get food through socially acceptable manners." [31]

Households are categorised in 3 groups depending on the score of the Household Food Insecurity Access Scale (HFIAS) of the FAO, being: food secure (score 0-2), at risk (score 3-12) and food insecure (score 13-27). [30]

2.3.2 State of food security worldwide

Food insecurity constitutes a global problem. This could explain why eradication of extreme poverty and hunger was the first MDG for 2015 and still remains the fundamental SDG for the next fifteen years. [32] Globally, about 793 million people (11% of world population) still lack sufficient food to lead active, healthy lifestyles. [33] This is an improvement compared to the past decade when the number was about one billion (15% of world population). The problem remains widespread in developing countries, such as Iran [31] and sub-Saharan Africa (SSA) [32, 33] where a third of the world population lives. In Ethiopia, one of the poorest countries in Africa (also part of the SSA), for instance, food insecurity remains increasing and affects more or less 45% of the population. [34]

Many developing countries (including South Africa) are on their way to reaching one of the SDG by targeting hunger and halving the number of undernourished children (from 23.3 to 12.9%). [33] Unfortunately, an evaluation at a previous World Food Summit found the progress too slow in SSA, compared with the rest of the world, such as Latin America and South Eastern Asia, which have made tremendous strides in this area. [33]

2.3.3 State of food security in South Africa

As reported by a review of national surveys on food security [32, 35] and confirmed by FAO [34] and the Department of Agriculture, Forestry and Fisheries in 2011,[36] South Africa seems to be food secure at a national level but not at a household level, especially in rural areas.

It has been reported that 14.3 million of the total South African population (25%) experience hunger and undernutrition, most of them being children, women and the elderly. [6] Landless, female-headed and poor households with children remain the most affected groups. [6]
Although different methods have been used to assess food security in South Africa, these have yielded different results due to the complexity of the concept. For instance, the general

household survey conducted in 2009 reported inadequate food access in South African households (urban-20% and rural-35 %). [35] The Free State, Eastern Cape, KwaZulu Natal, Limpopo and North-West provinces are the most affected at more than 30%. [2, 35]

A systematic search of national surveys (high level of evidence) concluded a decrease of food insecurity nationwide below 20% of prevalence. [32] This is a picture seen globally in the country. The local trend would be important to be checked and this study aims for that.

2.3.4 Targets, indicators and measurements

The South African government committed itself to reduce poverty and food insecurity by half between 2004 and 2014. [33] The review of national surveys reported a reduction in the prevalence of food insecurity since 1999 and national statistics point to a slight reduction in poverty. [2, 32] Although there are no specific and accepted measures of food security in South Africa, researchers use various methods to assess it at a national or household level, depending on the objectives and purpose of the study done. [33]

At household level, the first measure (indicator) is food poverty, assessing whether the amount spent by a household on food is adequate to purchase enough for a low-cost food plan. The second indicator is low energy availability; it assesses whether the food energy available to a household is less than the sum of its members' recommended energy intakes. [33]

At national level, the following measures can be mentioned: The National Food Consumption Survey (NFCS); the Food Insecurity and Vulnerability Information and Mapping System (FIVIMS); the Community Survey (CS); the South African Social Attitudes Survey (SASAS) and the Labour Force Survey (LFS). [33]

It is important to mention here that the development of a household food security target should take the following into consideration: the household composition and its geographical location (either rural or urban, formal or informal settlements); the income and education of its members; and the distance to food markets and other institutions. [35, 36]

2.3.5 Negative effects of food insecurity

A significant amount of scientific literature demonstrates the association between food insecurity and the detrimental effects on children's health and development. [37- 39]There is evidence that household food insecurity is linked to an inadequate intake of many important nutrients in children. As a result, they have low resistance to disease and an overall poor health status, which in turn may culminate in hospitalisation. [38, 39]

Furthermore, food insecurity negatively impacts on the behavioural and psychological functioning of children and their learning potential, leading to aggression, anxiety, depression and attention deficit disorder. [39] This results in the perpetuation of poverty. [37-39] Food insecurity increases children's risk of poor school readiness and performance at an early stage, and later poor academic performance. [39]

Numerous other studies show the negative effects of food insecurity on children's health and development. [37-43] One of the studies mentioned here has used the same research tool than this study (Household Food Insecurity Access Scale Measurement Tool) found that food insecurity was linked with poor health and iron deficiency in children aged 1-5 years. [41]

A systematic review conducted among U.S children regarding the relationship between food weight statuses [42] came to a conclusion that there is little evidence that food insecurity promotes gain weight over time, but more researches were still needed to confirm any relationship between food insecurity and weight status.

All of the above studies that have shown the negative effects of food insecurity on children's health agree on the importance of targeting food insecurity as an urgent issue that needs to be addressed for a better maintenance of health in both children and adults.

2.3.6 Factors associated with food insecurity

A cross-sectional study conducted between 2014 and 2015, in the urban state of Alagoas, North-Eastern Brazil, [44] in a representative probabilistic sample of 3366 families, using the Brazilian food insecurity measurement, found the following factors independently and significantly

associated with food insecurity: female head of household, head of family having no income, female head of household being overweight or obese, household of four or more members, small houses, household income less than minimum wage, household members residing in a non-masonry house or not residing in their own house ($p<0.001$). Surprisingly, family residing in rural areas was not associated with food insecurity ($p=0.232$). The associated factors were all related to the greater social vulnerability of the family. [44]

A survey done in Bangladesh (a developing country like South Africa) determined factors associated with child hunger (6-59 months of age) among food insecure households in a nationally representative sample. The survey concluded that gender ($p<0.001$) and education status of household heads ($p<0.05$) were significantly associated with child hunger. [45]

A recent American study determined factors associated with food insecurity two to five years after the initial exposure to hurricane Katrina. It was more likely that females having poor physical or mental health and low social support would report food insecurity over time, whereas Whites and having higher income were less likely to report it. [46]

Cross sectional studies are good for population-based surveys and to assess the prevalence of diseases in clinic-based patients. They are not the appropriate designs to test associations. Therefore, other studies such as randomised clinical trials (RCTs) should be considered to get a close picture of factors associated with food insecurity.

A systematic review conducted in South Africa, on studies published between 1994 and 2014, among them RCTs, focused on the state and lived experience of food insecurity. The review was done at a sub-national scale, showed attempts to determine the reliability or validity of data analysis and included 169 studies. [47]
The review found that female headed-households (64%) compared to male headed-households (42%) was a factor associated with food insecurity in the peri-urban Free State Province.[45, 47] HIV/AIDS, distance to markets, lack of available land, droughts, lack of water, dependence on social grants, poverty and lack of income were also mentioned among the most common factors associated with food insecurity in South Africa.[45, 47]

Poverty and lack of income have been reported in about 50% of the studies reviewed. It was found that rural areas were more affected by poverty. For instance, 76% of rural Limpopo people were concerned about having insufficient money for food. [47]

2.4 Food insecurity and underweight

2.4.1 Interaction between food insecurity and underweight

Maxwell and Smith have considered undernutrition, measured by growth faltering in children (including underweight), as an indicator of food insecurity. [26] They have discussed the initiatives taken by organisations relating to food security and nutrition. Among them are the establishment of FAO (1945), UNICEF (1946) and even the Lagos Plan of Action for the Organisation of African Union (1980). [26] Already in the early years of the last century, initiatives were taken worldwide and in Africa to tackle the issues of undernutrition and food insecurity.

Other sources have mentioned food insecurity as a cause or risk factor for undernutrition (underweight). [33, 28-29] Generally, poverty and food shortage are the main catalysts of food insecurity and undernutrition worldwide, and particularly in Africa. Both food insecurity and undernutrition have diverse consequences for health and development in every human being, including children aged between 6 and 60 months. [29] This means that in a house where there is not enough food for children, they become underweight and are therefore exposed to childhood illnesses and infections.

While food security is still under threat worldwide, child undernutrition is falling and adult obesity rising. [48] This could be difficult to understand, but the main explanation is that nutritional outcomes depend on many factors (mentioned earlier [14-28]), not food security alone.

The association between household food insecurity and nutritional status remains controversial. Some studies found underweight and others overweight or obesity to be related to household food insecurity. [39, 42] The American Psychological Association reported that household food insecurity occurs disproportionately among children and families at high risk of obesity, making it difficult to determine causal effects. [39]

Furthermore, an Ecuadorean study aiming to explain the relationship between household food security and malnutrition, reported that food insecurity was associated with lower dietary quality and diversity. [49] This could lead to child undernutrition due to low nutritional intake on the one side and on the other side to abdominal obesity because the households tend to procure high-calorie foods to compensate for the lack of quantity. [49]

This is a gap in the studies previously done and there is a need to check which one of the forms of malnutrition is linked with household food insecurity: under or overnutrition?

2.4.2 Food insecurity, underweight and disease profile

Several studies have found that malnutrition is strongly associated with infections. [16-22, 50-51] In fact, malnutrition, being immunosuppressant, can lead to increased risk of infections. [50-52] Moreover, many infections, such as gastrointestinal infections, HIV/AIDS, etc. can lead to malnutrition. [18, 50-51]

A study done in low-income American households, [39] focused on the adult women, came to a conclusion that occurrence of chronic diseases (diabetes and dyslipidaemia) and poor management of the same diseases could also be linked to household food insecurity, due to unhealthy diet and stress. Though the study has been done in adults, we think it could indirectly affect small children, who are dependent of these adults.

The United States Department of Agriculture released a report on food insecurity and health which concluded that low food security or food insecurity was a stronger predictor of chronic diseases than income, among working-age adults. Poor nutrition was believed to play a direct role in most of those conditions. [51]

Regarding South Africa, undernutrition was found to be the commonest cause of morbidity and mortality in the age group 6 to 60 months in a tertiary hospital in the Limpopo Province. [52] This was the conclusion arrived at from a retrospective review, on causes of death in children younger than 60 months, conducted in the Pietersburg/Mankweng hospital complex over a period of three years where a total of 1266 death certificates were accessed and reviewed. [52] This study did not look for a link with food insecurity.

Another study conducted among children aged between 6 and 60 months admitted to the Potchefstroom Hospital, [18] confirmed the findings in an Iranian study, [30] where diseases like tuberculosis, bronchopneumonia and acute gastroenteritis were noted to be commonly associated with undernutrition (including underweight).

In the South African study as opposed to the Iranian, HIV/AIDS was found to be another common cause of hospitalisation of these children. [18] Both these studies explored the link between undernutrition and disease, though the association with food insecurity was only checked in the Iranian one.

2.5 Summary and conclusion of literature review

Undernutrition (including underweight) is a problem among children aged between 6 and 60 months admitted to hospitals for various sicknesses, some causing death. Household food insecurity and many other socio-economic and cultural factors are its determinants.

Food insecurity may predispose children to acute diseases, and adults to chronic diseases that are linked to poor nutrition. Meantime diseases like HIV/AIDS and poverty have been mentioned among many factors associated with low food security. This is true worldwide and in South Africa, where the North-West Province has been flagged among the most affected places.

There is a paucity of literature on the association between food insecurity, occurrence of disease and undernutrition among children aged 6 to 60 months, in North-West Province.

CHAPTER 3: METHODS

3.1 Study design

This was a quantitative, observational cross-sectional study.

3.2 Study setting

The study was conducted in the general paediatric ward at the Potchefstroom Hospital. It is a 335-bed institution, located in the JB Marks sub district, North-West Province and the general paediatric ward has 41 beds. The hospital receives patients from Potchefstroom town (six clinics and two community health centres) and its surroundings (rural Ventersdorp and many farms and informal settlements - some of them have established clinics and some are assisted by mobile clinics). Potchefstroom and Ventersdorp are the two main components of the JB Marks sub district, having merged as one sub district recently. Ventersdorp had a district hospital (level 1), that has since been downgraded to a community health centre. Hence, a higher number of sick patients needing a level 2 treatment (including paediatric) are referred to Potchefstroom Hospital.

According to the National Census 2011, [53] Potchefstroom covers an area of 185.4 km^2 with a total population of 162 762, living in 17 372 households. This population comprises of 50.86% female (82 794) and 49.14% male (79 967). The majority of the population is Black African people (116 011 or 71.27 %). The other race groups are represented as follows: White (33 939 or 20.90%), Coloured (11 003 or 6.76%), Indian or Asian (1 544 or 0.09%) and other (265 or 0.01%). The languages spoken are Setswana (41.1%), Afrikaans (27.9%), Sesotho (10.9%), Xhosa (9.5%) and other (10.6%).

According to the same National Census done in 2011, [53] Ventersdorp has a total population of 56 702; among them 29 246 (51.57%) are males and 27456 (48.43%) females. The majority race group is Black African (51 101 or 90.12%). The other race groups are as follows: White (3 346 or 5.90%), Coloured (1 539 or 2.71%) and Indian or Asian (172 or 0.03%). The average household size in the JB Marks sub district and the North-West Province has declined from 4.0 in 1996 to 3.2 in 2011. [5]

3.3 Study population

The study population included all children aged between 6 to 60 months who were underweight and admitted to the Potchefstroom Hospital, during the study period (from December 2016 to December 2017).

3.4 Sample size and sampling

3.4.1 Sample size

The sample size (100) was based on a number selected for convenience.

3.4.2 Sampling methods

Convenience consecutive sampling was done based on availability, until the target was reached. Children aged between 6 and 60 months old, underweight, admitted for any disease were consecutively selected by the researcher when they arrived at the ward for admission.

The ward clerk informed the researcher (telephonically, by short message system) every time that a child aged between 6 and 60 months was admitted. The researcher provided ward clerk with airtime/data bundles. For patients admitted after working hours on a weekday or during a weekend, the researcher was notified the following day or Monday respectively.

3.4.3 Inclusion and exclusion criteria

3.4.3.1 Inclusion criteria

All children aged between 6 and 60 months, admitted to the Potchefstroom Hospital, being underweight, and for whom consent had been obtained from the parents or guardians who were able to speak English, Setswana or Afrikaans.

3.4.3.2 Exclusion criteria

- Children who were too sick to participate in the study, and who needed admission to Intensive Care Unit (ICU).
- Children with conditions categorised as surgical.
- Children (with parents or guardians) not living in JB Marks sub district.

3.5 Tools and methods of data collection

The researcher collected the data at the Paediatric ward of the Potchefstroom Hospital. The researcher attended every second or third afternoon of the week, after he had seen his patients at the clinic (where he works) and when the ward rounds were completed by the paediatric team. He briefly introduced himself to the parent or guardian and the child. Then he explained the purpose of the study to them and that the questionnaire would take approximately 20 minutes of their time to answer.

The researcher informed them that the information they provided would be treated as confidential. Every parent or guardian was given an information sheet (Appendix 1), explaining the purpose of study, its confidentiality and all the ethical issues as well as providing the researcher's contact details.

The children who did not meet the inclusion criteria were excluded from the study but were still managed appropriately according to the national guidelines and protocols in place. Parents or guardians of children meeting the inclusion criteria could then decide either to participate in the study or decline to participate and just opt to have their children's health problem(s) managed. The parents or guardians who agreed to participate were requested to sign the consent form (Appendix 2) and a researcher-administered questionnaire was then used to collect data on socio-demographic features and disease profile of participants. The researcher was assisted by the Ward Clerk, who interpreted them (directly from English) in Setswana and Afrikaans, for parents who did not speak English. The questionnaire was adapted from the questionnaire used in a Botswana study on malnutrition among children younger than 60 months. (Appendix 3). [54]

The questionnaire (Appendix 4) was a combination of two documents. The first part was from the same questionnaire from the Botswanan study[54] used for the data entry sheet and the information on it was extracted from the patients' files. The author of the study has been notified, by mail, that the researcher has used his questionnaire. The second was a validated tool known as "the household food insecurity access scale measurement tool" of the FAO. [55] The Cronbach's Alpha calculation for the questionnaire used for food security status was 0.9. Therefore, it is reliable. For reliability, this value must be superior to 0.7. [56]

The researcher measured the height or the length, the weight, the mid-upper arm circumference (MUAC) and the head circumference (if the child was younger than 2 years old) and recorded them on the patient's data entry sheet. The height and the head circumference were measured with the same metric tape measure (brand name [EMPISAL, model EMT-001 and item number 00553087]), for children who were unable to stand. Depending on the child's ability to stand, length or height was measured. Recumbent (lying down) length was measured for children less than 2 years old. Height was measured in children standing upright, usually for those 2 years and older. [57] For the latter a wall mounted stadiometer was used.

The measurements were done with the children undressed, shoes, socks and hair ornaments removed. The researcher explained the steps of the procedure to the mothers and requested their assistance; either in holding their children or reassuring them that the procedure was not harmful. They had to keep the children still and calm to get accurate measurements. [57] For children younger than 2 years measurements were taken on a board to keep them straight. Those older than 2 years were measured standing upright, against the wall in the ward, with a stadiometer. The edge of the flexible, non-elastic, plastic tape measure was placed from the top of the head to the heel (in both positions- lying or standing). The researcher marked and read the corresponding height or length in centimetres.

The measurements were done twice to make sure the researcher obtained the accurate data. If the difference between the 2 measurements was more than 1cm, he did a third measurement and considered the most accurate. The eventual result was immediately captured on the data sheet of each participant.

The children were weighed naked, using two different scales, depending on the age of the child. These were purchased by the researcher before the data collection period. One was used for the younger children (6 to 24 months) and the other one for the older ones (more than 24 months). Both scales were the portable UNISCALE type, and calibrated. They used 2 and 6AAA alkaline batteries 1.5 volts (V).Firstly, the TOMTOP electric digital baby scale with its liquid-crystal display (LCD) in kilograms (kg), a 150 kg capacity, an accuracy of 100g, a dimension of 265x165x20mm, and weighing 573 g. Secondly, the UNISCALE, manufactured by UNICEF, with its 200kg/100 g (capacity/accuracy), a dimension of 260x345x55mm, and weighing 4.9 kg.

Both solidly built and durable, electronic (digital reading), measuring up to 150 kg, to a precision of 100g and allowing tared weighing. This is according to WHO recommendations. [57]

"Tared weighing" [57] means that the researcher had to reset the scale to zero while the mother remained on the scale after being weighed herself. The child was handed to the mother on the scale. Only the child's weight in kg registered on the scale. The researcher then recorded it immediately on the data entry sheet. This procedure was done for the children younger than 2. The older ones stepped onto the scale by themselves, standing very still on the second scale, until the LCD screen displayed the weight in kg; and the researcher recorded it on the data entry sheet.

A MUAC 3-colour tape, child 11.5 Red/PAC-50, made by WHO was used for the measurement of MUAC. After the researcher had determined the mid-point between the elbow and the shoulder of the left upper limb, he placed the tape measure around the arm, which was held relaxed and hang down the side of the body. He ensured that the tape neither pinched the arm nor was left loose and read the measurement from the window of the tape and recorded it immediately on the data entry sheet. [10, 57] To ensure that measurements were as accurate as possible, the researcher kept the equipment clean and stored it at normal indoor temperature, protected from humidity and moisture, as recommended by WHO. [57]
The researcher classified the child's nutritional status according to WHO standards, if not previously done based on all the anthropometric measurements and according to Z scores. Abnormal measurements were classified as moderate or severe undernutrition (underweight).Cut-off points for Z-scores used were often <-2 and >+2 Z-scores to classify low and high weight-for-age respectively. [10, 57]

The researcher used a Z-score cut-off point of <-2 SD to classify low weight-for-age (underweight) as moderate underweight, and <-3 SD as cut-off point of being severely underweight. Although height was measured it was not used. Weight-for-height is used to establish severe acute malnutrition (SAM) and moderate acute malnutrition (MAM), if the Z-score is respectively <-3 SD or <-2 SD. [57] Underweight was the focus of this study, and not SAM or MAM.

The researcher plotted the measurements on the child's RTHB and transferred them to the data entry sheet. The researcher used the RTHB of each child as a source for previous diagnosis of underweight. He read out the questions from the questionnaire (Appendix 4) to the participants and documented the answers they provided. He was assisted by the Ward Clerk who interpreted the questions (directly from English) to Setswana and Afrikaans, for parents who did not speak English; their answers were then interpreted back into English and captured appropriately. At the end of the interview, the researcher summed the codes from the response options to get the final score out of 27. He then categorised each household as either food secure if the score was 0-2 or at risk for scores between 3 and 12 or food insecure (13-27). The researcher collected all the questionnaires and data entry sheets as they were completed and kept them safe by locking them up in a cupboard in his office at the sub-district premises.

3.6 Data capturing and analysis

3.6.1 Data capturing

Data was transferred onto a Microsoft Excel spread sheet designed by the researcher after consultation and approval by an accredited statistician from the Department of Statistics, North-West University, and Potchefstroom Campus.

They were then then imported to the statistical computer software (SPSS version 23) for analysis.

3.6.2 Data analysis

Data analysis was done using SPSS version 23 and expert statistical consultation was involved when compiling the statistical analysis.

Descriptive statistics was used to describe the socio-demographic characteristics of the study samples and the diseases they presented with. Results were presented as frequencies and percentages for categorical variables, and means with standard deviations for numerical variables.

The proportions of food security and food insecurity were also determined. Group comparisons between the two groups were done with socio-demographic characteristics and disease profile using ANOVA and Kruskall-Wallis tests.
The chi-square test was used to analyse the relationship between food insecurity and underweight categories. Logistic regression was used to test the strength of association between food insecurity, disease profile and socio-demographic characteristics of the participants. A p-value of <0.05 was considered as statistically significant.

3.7 Ethics

Ethical approval was obtained from the Human Research Ethics Committee (HREC- Clearance Certificate M160665), University of the Witwatersrand, Johannesburg. Additional approval was granted by the management of the Potchefstroom Hospital and the North-West Province Research Committee.

Since participating children were minors and could not per se consent, I sought assent from the parents or guardians for the children to participate. Therefore, the assent form became the consent form. It was provided and explained verbally to the children's parents or guardians. Only parents or guardians who agreed to participate by signing the consent form had their children included in the study. The parents or guardians who refused to have their children participate were not forced or discriminated against. Their right to refuse was respected and their children received the same care as the others.

Confidentiality was maintained by ensuring that all data entry sheets and questionnaires were anonymous and locked away. The identities of patients and parents, guardians or caregivers were coded and a coding number allocated to each file was entered separately per MS Excel sheet on the researcher's laptop. Each child's RTHB and/or file was numbered (from 001 to 100) and colour-coded in order to avoid duplication. Access to this information was password protected, only known to the researcher.

3.8 Budget and funding

Table 3.1: List of items and estimated costs in Rand

ITEM	ESTIMATED COST IN RANDS (R)
Cost of paper and stationery	1 000
Cost of printing and editing	4 500
Consultation fees for statistician	2 500
Tea and airtime for the Ward Clerk	500
Scales	1 250
Tape measure	50
TOTAL	**9 800**

The study was funded by the researcher.

CHAPTER 4: RESULTS

A total of 100 parents or guardians of underweight children were interviewed and the results of the study are presented in three sections of this chapter as follows: firstly, the socio-demographic characteristics of the children studied; secondly, the proportion of those children who presented with acute diseases and the types of acute diseases they presented with; and thirdly, the association between food insecurity and underweight status in these children.

4.1 Socio-demographic characteristics of participants

Table 4.1: Socio-demographic characteristics of the study population

Variable	Frequency N (%)	Cumulative frequency (%)
Gender		
Female	54 (54%)	54 (54%)
Male	46 (46%)	100 (100%)
Age group		
6-12 months	41 (41%)	41 (41%)
13-24 months	47 (47%)	88 (88%)
25-36 months	7 (7%)	95 (95%)
37-48 months	3 (3%)	98 (98%)
49-59 months	2 (2%)	100 (100%)
Birthplace		
Urban	61 (61%)	61 (61%)
Peri urban	12 (12%)	73 (73%)
Rural	27 (27%)	100 (100%)

Household size		
2	0 (0%)	0 (0%)
3	1 (1%)	1 (1%)
4	16 (16%)	17 (17%)
5	19 (19%)	36 (36%)
6	19 (19%)	55 (55%)
7	23 (23%)	78 (78%)
8	11 (11%)	89 (89%)
9+	11 (11%)	100 (100%)
Number of children under 5 per household		
1	23 (23%)	23 (23%)
2	48 (48%)	71 (71%)
3	22 (22%)	93 (93%)
4	7 (7%)	100 (100%)

In Table 4.1, the majority of underweight children were female, less than 24 months, born in urban areas and came from households with 7 members and 2 children younger than 5.

4.2 Clinical characteristics of participants

Table 4.2: Clinical characteristics of the study population

Variables	N (%)
Underweight category	
Moderate	30 (30%)
Severe	70 (70%)
Total	*100(100%)*
HIV status	
Positive	19 (19%)
Negative exposed	37 (37%)
Negative non-exposed	44 (44%)
Total	*100 (100%)*
Immunisation up-to-date	
Yes	63 (63%)
No	24 (24%)
Not sure (no RTHB)	13 (13%)
Total	*100(100%)*

In Table 4.2, the majority of participants were severely underweight, HIV negative non-exposed and had their immunization up-to-date.

Table 4.3: Disease profile of the study population

Variables	N (%)
Presence of acute diseases	
Yes	87 (87%)
No	13 (13%)
Total	*100(100%)*
Acute diseases presented with	
AGE	40 (46.0%)
LRTI	38 (43.6%)
Others	9 (10.4%)
Total	*87 (100%)*

In Table 4.3, the majority of underweight children admitted to hospital presented with acute diseases cited in the IMCI booklet [7] as some of common childhood illnesses (LRTI, AGE, ear nose and throat (ENT) infections, etc.). Most of them were diagnosed with either AGE or with LRTI. A small number of underweight children were admitted with either complications of chronic conditions or diseases not mentioned in IMCI booklet or with social problems.

4.3 Proportion of children with food insecurity

Table 4.4: Detailed results of food insecurity questionnaire (HFIAS) (See pages 55-58)

Questions	0	1	2	3	Missing	Total
1	22 (22%)	78 (78%)	-	-	-	100 (100%)
1a	-	35 (35%)	41 (41%)	2 (2%)	22 (22%)	100 (100%)
2	5 (5%)	95 (95%)	-	-	-	100 (100%)
2a	-	42 (42%)	46 (46%)	7 (7%)	5 (%)	100 (100%)
3	7 (7%)	93 (93%)	-	-	-	100 (100%)
3a	-	50 (50%)	40 (40%)	3 (3%)	7 (7%)	100 (100%)
4	8 (8%)	92 (92%)	-	-	-	100 (100%)
4a	-	47 (47%)	44 (44%)	1 (1%)	8 (8%)	100 (100%)
5	11 (11%)	89 (89%)	-	-	-	100 (100%)
5a	-	49 (49%)	39 (39%)	1 (1%)	11 (11%)	100 (100%)
6	11 (11%)	89 (89%)	-	-	-	100 (100%)
6a	-	50 (50%)	37 (37%)	2 (2%)	11 (11%)	100 (100%)
7	45 (45%)	55 (55%)	-	-	-	100 (100%)
7a	-	39 (39%)	16 (16%)	0 (0%)	45 (45%)	100 (100%)
8	28 (28%)	72 (72%)	-	-	-	100 (100%)
8a	-	52 (52%)	19 (19%)	1 (1%)	28 (28%)	100 (100%)
9	57 (57%)	43 (43%)	-	-	-	100 (100%)
9a	-	1 (1%)	33 (33%)	9 (9%)	57 (57%)	100 (100%)

Table 4.4 shows that question 9(read as “In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?”) received

the more “No”. The one that received more “Yes” is question 2 (“In the past four weeks, were you or any household member unable to eat the kinds of foods you preferred because of a lack of resources?”)

Table 4.5: Proportion of underweight children per food security categories

Food security status	Moderate underweight	Severe underweight	Total
Food insecure	16 (16%)	55 (55%)	71 (71%)
At risk	12 (12%)	13 (13%)	25 (25%)
Food secure	2 (2%)	2 (2%)	4 (4%)
Total	30 (30%)	70 (70%0	100 (100%)

Table 4.5 shows that the majority of participants’ children were severely underweight and came from families with food insecurity issue. The severely underweight children were found 3 times more in food insecure households than the moderately ones. While they were equally distributed under the “at risk” and the food secure households.

4.4 Tests of association between food insecurity and other variables

Table 4.6: Food security categories and disease profile in study population

Disease profile ⬇	Food insecure N (%)	Not food insecure N (%)	Total N (%)	p-values
AGE	35 (35%)	5 (5%)	40 (40%)	0.245
LRTI	28 (28%)	10 (10%)	38 (38%)	0.398
Others	5 (5%)	4 (4%)	9 (9%)	x
No acute diseases	5 (5%)	8 (8%)	13 (13%)	x
Total n (%)	73 (73%)	27 (27%)	100 (100%)	-
HIV positive	17 (17%)	2 (2%)	19 (19%)	0.159
HIV negative	51 (51%)	30 (30%)	81 (81%)	-

Total	68 (68%)	32 (32%)	100(100%)	-

- x: Too small or unable to calculate p-values
- Prediction was done between the categories, food insecure (71) and not food insecure (29). The latter is the sum of the food secure (4) and at risk to be food insecure (25).

In Table 4.6, two-thirds of underweight children who developed acute diseases came from food insecure households. In a total of 73 food insecure cases, there were 68 (93%) hospital admissions with acute diseases while the not food insecure group of 27 individuals had 19 (70%) acute diseases among them. The proportion of acute diseases is higher in the food insecure group. The majority of HIV positive children came from food insecure households. There was no statistically significant relationship between food insecurity and the type of acute disease (AGE- p=0.245 and LRTI- p=0.398) or the HIV status (p=0.159).

Table 4.7: Underweight prevalence among the study population and for food security categories

Food security categories	**Underweight categories**		Total
	Severe underweight	**Moderate underweight**	
Food insecure	55 (77.5%)	16 (22.5%)	71 (71%)
Not food insecure	15 (52%)	14 (48%)	29 (29%)
Total	70 (70%)	30 (30%)	100 (100%)

In Table 4.7, the group of food insecure households has more severe underweight children than the moderate ones (ratio 3:1); while for the group of food secure and at risk (ratio is more or less 1: 1 [same proportion of severe and moderate underweight]).

Table 4.8: Independent t-test between food insecurity and socio-demographic numerical variables

Variables	Food security categories[1]	Mean	Standard Deviation	Mean difference	95% C.I of the difference		p-values
					Lower	Upper	
Age(months)	**0**	19.28	11.225	4.036	-0.358	8.431	0.071
	1	15.24	9.539	4.036	-0.740	8.813	0.096
Household size	**0**	5.52	1.595	-1.102	-1.831	-0.374	0.003*
	1	6.62	1.693	-1.102	-1.820	-0.385	0.003*
Number of children under 5 in household	**0**	1.69	0.604	-0.620	-0.972	-0.268	0.001*
	1	2.31	0.872	-0.620	-0.924	-0.316	0.001*

Food security categories[1]: 0 is for the not food insecure group; 1 for food insecure group.

In Table 4.8, an independent t-test was done between food insecurity and the socio-demographic characteristics. Only numerical variables could be presented with means and standard deviations. The results showed that the household size (p=0.003) and the number of children under 5 in a household (p=0.001) were significantly associated with food insecurity.

Table 4.9: Univariate logistic regression for food insecurity predictors

Variables	OR	95% C.I for OR		p-value
		Lower	Upper	
Age (months)	0.964	0.925	1.005	0.082
Gender	0.629	0.260	1.519	0.303
Birth weight (Kg)	0.645	0.289	1.440	0.284
Place of birth	1.339	0.563	3.189	0.887
RTHB	1.146	0.333	3.943	0.829

Underweight category	0.312	0.125	0.780	0.013*
Immunisation status *	6.125	1.362	29.377	0.019*
Acute diseases *	0.290	0.088	0.956	0.042*
HIV status	0.397	0.106	1.482	0.169
Household size *	1.548	1.140	2.103	0.005*
Number of children under 5 in household *	2.886	1.495	5.574	0.002*

Based on the results of the univariate logistic regression analysis depicted in Table 4.9 and, there was a statistically significant association between food insecurity and immunisation status (p=0.019), acute diseases (p=0.042), household size (p=0.005) and number of children under 5 in a household (p=0.002).

4.4 Summary of results

The main findings of the results are as follows: the majority of underweight children were female (54%, n=54), less than 24 months (88%, n=88), born in urban areas (61%, n=61). The majority of households had 2 children younger than 5 (48%, n=48).

Most of them were severely underweight (70%, n=70), HIV negative (81%, n=81), and had their immunization up-to-date (63%, n=63). Most of the children came from families with food security problems and were admitted with either AGE (46.0%, n=40) or LRTI (43.6%, n=38).

In univariate regression analysis, immunisation status (p=0.019), acute diseases (p=0.042), household size (p=0.005) and number of children younger than 5 years in households (p=0.002) were found to be associated with of food insecurity.

CHAPTER 5: DISCUSSION

5.1 Discussion

This chapter examines the key study findings and compares them with the literature, highlighting the implications.

5.1.1 Socio-demographic characteristics

5.1.1.1 Age (group)

The study findings were in line with a Botswanan study, [58] where a higher prevalence of undernutrition was also found in children aged 25-36 months.

It is known that breastfeeding promotes physical development by improving childhood nutrition and prevents acquisition of infectious and non-infectious diseases that may lead to undernutrition. [27-28, 48-50, 59] Exclusive breastfeeding is promoted by the South African department of health till the age of 6 months. There is a place of recommending breastfeeding to continue in children beyond 6 months, mixed with other dietary measures to promote an adequate nutritional status for the younger children. This is supported by studies conducted in some developing countries, such as Ethiopia, [3] Serbia, [8] South Africa, [18] Colombia [25] and Nepal, [60] confirming that less children on exclusive breastfeeding have been found to be underweight compared with the ones not breastfed. The younger ones cannot fight for their own survival in a household where there is insufficient food, or many other children and adults to feed. Therefore, under normal circumstances, an age below 2 will pair with other factors to predict undernutrition in children. The age of the parents or guardians was not inquired in the questionnaire. This constitutes a limitation to this study.

A systematic review of 169 studies conducted in South Africa did not find age to be a factor associated with food insecurity. [19] Nevertheless, an Indian study done in West Bengal [61] reported that a child's age acts as a strong predictor of nutritional status in developing countries, without calculating the rates in categorization of severity (moderate vs severe). Meanwhile in a suburb of the city of Lubumbashi, DRC, a survey done after the 1998-2003-armed conflict, concluded that children's age was a strong predictor of emaciation (younger than 12 months) and a risk of increased stunting (older than 11 months). [20] This could be attributed to poverty or lack of

resources in a war-torn zone and may be seen as a limitation for this generalization to the area of this study (not a war zone).

5.1.1.2 Gender

Finding that most of the underweight children were female was unexpected, since most studies have proven the opposite trend. No clear explanation could be given for this finding, except that of chance, since the demographic details in the area of study showed an almost 50% equal distribution of both genders.[53]

An Ethiopian community based, cross-sectional study assessing the magnitude and factors associated with undernutrition in children aged 6-59 months came to the conclusion that male children were 2.5 times (AOR= 95% CI: 1.5-4.1) more likely to be underweight than female.[3]This study did not report on the probability of one gender being the more underweight. In contrast studies done in West Bengal [61] and Nepal [63] came to a different conclusion: girls were more likely to be underweight than boys. These were conducted mostly in rural areas, where culture results in females being less empowered in education, leading them to be the neglected portion of communities including their female children.

The results in the Ethiopian study found a significant statistical association between the gender of underweight children and the underweight status. [3] However no association between gender and food insecurity was found in this study (p=0.303). This could be understood that in South African cultures, gender possibly does not play the strong discriminatory role evident in some other developing countries.

5.1.1.3 Birthplace

Studies conducted in South Africa [7, 16] and in Botswana [58] found that the majority of underweight children came from rural areas. This did not match up with our findings where the vast majority were born in urban areas (61%). Considering birthplace, the majority of children born in rural and peri-urban areas were severely underweight. Poverty and lack of resources could be the culprits explaining the situation in those areas. Social Development structures need to strengthen

their services to alleviate the burden of undernutrition and household food insecurity in remote places.

Meanwhile the West Bengali study on malnutrition in under-five children, its determinants and strategies for control has in contrast focussed on the place of residence, [61] and not birthplace, being among the strong predictors of child nutritional status in developing countries.

This could be reflected as well in our study, where some of the children were born in urban areas (Potchefstroom Hospital) but the parents are from rural areas (Ventersdorp and other farming areas). The mothers could have been referred for delivery to a level 2 hospital for any medical or obstetrical reason, or they could have been in the vicinity of an urban area at the time of labour. Therefore, birthplace does not correspond always with place of residence in the study context.

5.1.1.4 Children younger than 5, per household

Children younger than 5 per household was reported to be associated with food insecurity in our study (p=0.001). The trend of our findings is consistent with that reported in Bangladesh, [64] where most households with underweight children had 2 or 3 children younger than 5. Moreover, the number of children per household younger than five years old is mentioned by many studies as a strong predictor of undernutrition and food insecurity in developing countries, such as Iran, [4] South Africa [7] and India. [61]

The expectation was to see more children per household aged under 5 being underweight, but in the study area the guideline on contraception may have been of assistance here.

The emphasis on family planning is done during the antenatal clinic for every pregnant woman; and once they deliver, they are offered contraception, before discharge from maternity. That could explain why fewer households had 3 or more children aged under 5.

5.1.1.5 Other characteristics

Other socio-demographic and economic characteristics not checked in this study but mentioned by other studies as strong predictors of underweight need to be mentioned. This is seen as a limitation of this study. Those factors are: ethnic groups, [7, 16] poverty,[23,24] absence of drinking tap water, [21]orphanage, [8] low maternal age, [60] and education,[3, 21, 26] age of household head, [65]children's factors, such as parity, [3, 24] lack of vitamin A supplementation and de-worming, [66] and seeing traditional practitioner first. [24]

5.1.2 Description of various medical conditions presented

The second objective of the study was to describe the various medical conditions presented by the underweight children during their hospital admission. Moreover, we found it important to discuss shortly first their clinical characteristics, i.e. the HIV and immunisation status in order to explain the occurrence of some acute diseases described.

5.1.2.1 Clinical characteristics of participating children

5.1.2.1.1 Underweight categories

A study done in an Ethiopian agro-pastoralist community [3] found exactly the opposite of what we found in our community (that is also agro-pastoralist). In the Ethiopian study, severely underweight children were in the minority while in our study they were in the majority; though it has been observed that there has been a substantial decrease in the proportion of malnourished children admitted to the Potchefstroom Hospital over the past decade.[18]An apt factual explanation is that severely underweight children are more often admitted to hospital than the moderately underweight ones. The latter are only admitted if they are very sick. Strict respect of guidelines/protocols and strengthening of multidisciplinary team (dietitian, social worker, etc.) working at PHC level are of great assistance here.

A study describing the clinical and anthropometric profile of under-five, undernourished children admitted to a referral hospital in Botswana reported the similar severity of the underweight trend i.e. severe (95% vs 70%) and moderately (5% vs 30%). [58] The explanation for this is that a referral hospital receives sick patients from primary health care institutions and the moderately underweight, unless very sick, are still managed at PHC level. This was expected to happen and the positive implication is that clear guidelines and policies for proper referral have been compiled and are complied with timeously.

Another implication for referral hospitals is financial, since the stay of these underweight children in wards tends to be long and rehabilitation or weight gain slow.

5.1.2.1.2 HIV status

HIV/AIDS has been reported to be linked to food insecurity in South Africa [46] but we did not find the same relationship in this study (p=0.159). The difference observed is due to the fact that

that study reported on the serological status of the heads of households and not on the children in the household, while this study dealt with the children's HIV status. The advent of HIV/AIDS has been reported not only as a potential risk for undernutrition [22, 23,63] but also as an obstacle to the efforts at improving children's nutritional status when it comes to undernutrition. [39] It is also a common cause for mortality in under-five children in South Africa. [2]

In the Botswanan study, [58] 10% of underweight children were HIV positive; in this one it was almost double (19%). This could be explained by a poor PMTCT/EMTCT implementation. Without a doubt, though, Botswana has been a step ahead of South Africa in terms of introducing new guidelines to its HIV programme (e.g. universal testing and treating) and even by reinforcing the care of patients with HIV infection. Hence, this trend can be understood and would have been expected. However, the number of HIV positive children in South Africa is expected to drop with the strict and correct implementation of EMTCT programme (in place), that aims to eliminate mother-to-child HIV transmission.

5.1.2.1.3 Immunisation status

A quarter of the children participating were not up-to-date with immunisation, with another group for whom it was not sure at all since the RTHB was unavailable to prove their status. This isolated factor could explain the fact that two-thirds of were severely underweight, since association between immunisation and underweight has been proven in some studies done in Africa. [3, 59] We did not look for association between immunisation and underweight, but between immunisation and food insecurity and we found a statistically significant association (p=0.019). On the other hand, a Serbian study among undernourished children in the Roma settlements found no correlation between undernutrition and whether children were immunised. [8]

Well immunised children are protected against the occurrence of childhood sicknesses, proved to be risks for undernutrition. [17-18, 20-23] Therefore, poor immunisation could be linked to underweight. However, the study results did not come to the same conclusion.

This finding may be explained by the fact that a significant number of admitted children did not have their RTHB present in the hospital for the researcher to confirm their immunisation status. They were hence classified under "not sure".

5.1.2.2 Underweight children and disease profile

5.1.2.2.1 Presence of acute diseases in underweight children

The presence of acute diseases was a strong predictor for the occurrence of underweight in children admitted to the Potchefstroom Hospital (p=0.001). Not all patients were admitted with acute diseases listed in the IMCI booklet as health problems among the targeted age. Some of them had complications of chronic conditions or conditions not listed (HIV renal complications, eczema, meningitis, tonsillitis). Hence, results do not present 100% presence of acute diseases.

In the Botswanan study, [58] there was no secondary diagnosis for the vast majority of the children. This was not in line with this study and was unexpected because the Botswanan study took place at a tertiary hospital. It is expected there to have sicker patients, with more diseases, than the ones found at the Potchefstroom regional hospital.

5.1.2.2.2 Types of acute diseases

This study has reported diarrheal diseases and respiratory tract infections (RTI) as the commonest acute diseases found in the children participating. This is almost in line with the results of the Botswanan study where cough was found to be the commonest symptom and RTI the commonest acute disease in underweight children admitted to hospital. [58]

Many other studies report RTI among the most prevalent risks of underweight, [24, 26, 50] which once more corresponds with these study findings.

In South Africa, HIV/AIDS could be playing a huge role in the occurrence of these two conditions, and this figure could be anticipated as such, but not in the Serbian study where the lower HIV prevalence could explain the fact that no relationship between their children's undernutrition and diarrheal episodes was found. [8]

5.1.3 Proportion of children with food insecurity

A great number of households were food insecure, almost three quarters in total. This was far above the proportions (20-35%) given by South African studies. [6, 32] The South African trend proved that the highest number of food insecure households was found in rural areas, [32] but this study found that only one third of the underweight children were born in rural areas. Therefore, this study should have found a higher number of food secure households, and not the opposite.

The opposite being observed could be explained by the fact that not only geographical position (urban vs rural) determines household food security but many other demographic and socio-economic factors such as education, participation in nutritional programmes, reception of infrastructural support (irrigation), household income and access to credit. [67, 68] Talking about lack of participation in nutritional programs, this could explain why more households confirmed they did not have the appropriate kinds of foods or nutrients needed to maintain an adequate nutritional status.

These factors, and especially social grants, were not explored in this study. Hence, the need in future for another study aimed to look at determinants of food insecurity in households with underweight or malnourished children.

5.1.4 Association between food insecurity, underweight and disease profile

5.1.4.1 Food insecurity and underweight

It is common knowledge that food security prevents children from becoming underweight [27, 32] and therefore fewer underweight children are expected in food secure homes. This study found that the majority of underweight children were from food insecure households, and underweight status was strongly related to food insecurity (p=0.013). The snapshot found in this study sample was far higher compared to the South African food insecurity rate in 2017(20%). North-West Province at that point was 20% and the highest rate was found in the Free State (33.5%). [2]

A study done in Bogota, Colombia, a developing country like South Africa, reported that food insecure children were thrice more likely to be underweight than the food secure children (95% CI= 1.6-5.4; p=0.0007), [65] which corresponds to this study findings (71% vs. 29%, OR=3.356, p=0.039).

Though there was a decrease in the food insecurity rate between the surveys done in 1999 and 2008 in South Africa, poverty still causes food insecurity that leads to undernutrition in younger children. [48] The triad (poverty, food insecurity and undernutrition) has not only affected developing countries in Africa [6] and South America [49] but has also been reported in developed countries like the United States of America.[38, 69] Unfortunately, this study did not assess poverty directly to enable us to provide evidence in the conclusion. Though household income was not

checked in this study, we can speculate that most of the underweight children admitted to the Potchefstroom Hospital were from poor families. Families with high income usually have medical aids and get admitted to private hospitals.

5.1.4.2 Food insecurity and other variables

Research has established a strong relationship between food insecurity and poor health, [36, 65] but most studies have tested this relationship in adults. A senior research analyst of the American Centre on Budget and Policy Priorities wrote: "Food insecurity among children, adults and elderly is linked with worse diet quality, chronic conditions and poorer health." [68, 69] The observation does not correlate with this study's findings because the majority of underweight children were admitted with acute diseases, and not chronic ones.

However, HIV/AIDS as a chronic condition has to be mentioned here (almost 20%). Studies done worldwide [44-47] have found mostly household factors relating to food insecurity rather than health problems, except for HIV/AIDS in South Africa. [47] This implies that South African health institutions have to strengthen their policies and guidelines on management and control of this pandemic disease.

Variables found to be predictors of food insecurity in this study were not found in a study done in the United States of America, a developed country, where household factors were the most often mentioned. [69] Household income was cited as the strongest predictor, followed by household characteristics such as race or ethnicity. [69] Unfortunately, these factors were not assessed in this study but household size and number of children under 5 were found to be most important. Therefore, household factors tend to be strong predictors of household food insecurity. Hence strengthening a biopsychosocial approach in every consultation is of utmost importance.

In summary, this study has highlighted the relationship between food insecurity, underweight and other variables such as acute diseases and household characteristics (size and number of children under 5).

5.2 Limitations of the study

- The parents or guardians were not considered as participants in the study. Therefore, many factors predicting undernutrition and food insecurity in the households (race, household income, parents' education, cultural behaviours, age, etc.) were not included in the study.
- It was assumed that the children participating were typical of all patients that would visit the hospital in any year, since the sampling was done by convenience.
- The questionnaire used in the first portion of document tools was validated in Botswana, but not in South Africa.
- Some data were based on self-reports and could have resulted in participants answering in ways to please the researcher.
- Anthropometric measurements depending on both the researcher measurements and the clinical staff's ones recorded in patient's charts could make the collection unreliable.
- Language difficulties could have affected the perceived meaning of some terms such that the quality of the answers received were altered, since the Afrikaans and Setswana statements were translated for the researcher.
- The unclear definitions of urban, peri-urban and rural could influence our results negatively regarding birthplace or place of residence of our study participants.
- Birthplace was considered as a socio-demographic characteristic of the study population. This could have been confused with the place of residence, which is not always the birthplace.

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CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study shows that food insecurity is highly prevalent among underweight children admitted in the research setting and appears to underpin admission with acute diseases (mostly AGE and RTI) in Potchefstroom hospital.

Furthermore, the children's immunisation status, the acute diseases they present with and household characteristics (size and the number of children under 5) correlate for the occurrence of food insecurity in households.

These findings raise the importance of strengthening the implementation of existing guidelines (such as IMCI) for proper care of sick children, especially ensuring that household food security is explored during consultations in primary care.

6.2 Recommendations

- There is ample opportunity for other studies to be done in the sub district, to investigate other socio-demographic and socio-economic characteristics not included in this study such as household income, maternal or paternal level of education, head of household characteristics, etc.
- There is also a need for a qualitative study to gain a deep understanding of the parents' or guardians' perception on food security.
- PHC clinics should prioritise the care of younger children, especially below 2 years, by promoting breastfeeding, appropriate education on feeding and immunisation. The IMCI booklet includes very short and helpful advice on feeding which should be used by health educators and nurses.
- Questions to probe the state of food security need to be incorporated into the IMCI guidelines for all children presenting with AGE, LRTI and any form of undernutrition.
- Improve education on contraception to avoid households from having more than one child under 5, which is a risk of underweight in low-income households.

- Support the national strategy to fight poverty and advocate for indigent families to receive more income (including social grants) to tackle the triad of poverty, food insecurity and undernutrition, detrimental to vulnerable children.

REFERENCES

1. Algur, V., Yadavannavar, M.C. & Patil S.S. 2012. Assessment of nutritional status of under-five children in urban field practice area. *Int J Cur Res Rev*, 4(22): 122-6.
2. Hall, K., Sambu, W., Berry L., *et al*. 2017. South African Early Childhood Review 2017. *Cape Town: Children's Institute, University of Cape Town and Ilifa Labantwana*, 12-14. Available:http://www.mandelainitiative.org.za/images/past-dialogues/Hall-Early-Childhood-Development.pdf.
3. Asfaw, M., Wondaferash, M., Taha, M., *et al*. 2015. Prevalence of undernutrition and associated factors among children aged between six to fifty-nine months in Bule Hora district, South Ethiopia. *BMC Public Health*, 15: 41.https://doi.org/10.1186/s12889-015-1370-9.
4. Kavosi, E., Hassanzadeh, R.Z., Kavosi Z., *et al*. 2014. Prevalence and determinants of undernutrition among children under six: a cross-sectional survey in Fars province, Iran. *Int J Health Policy Manag*., 3(2): 71–6. doi: 10.15171/IJHPM.2014.63.
5. UNDP. Sustainable Development Goals. Available: http://www.undp.org/globalgoals.
6. Abdu-Raheem, K.A. & Worth, S.H. 2011. Household food security in South Africa: Evaluating extension paradigms relative to the current food security and development goals. *S. Afr. J. Agric. Ext.*, 39(2): 91-103. Available: https://www.ajol.info/index.php.
7. Vorster, H. 2010. The link between poverty and malnutrition: A South African perspective. *Health SA Gesondheid,* 15 (1): 435-41. Available: https://hsag.co.za/index.php.
8. Janevic, T., Petrovic, O., Bjelic, I., *et al*. 2010. Risk factors for childhood malnutrition in Roma children settlements in Serbia. *BMC Public Health,* 10: 1-8. doi: 10.1186/1471-2458-10-509.
9. Cai, X., Wardlaw, T. & Brown, D.W. 2012. Global trends in exclusive breastfeeding. *Int. Breastfeed J,* 7 (1): 12. https://doi.org/10.1186/1746-4358-7-12.
10. WHO child growth standards and the identification of severe acute malnutrition in infants and children: A joint statement by the World Health Organization and the United Nations Children's Fund. Available: http://www.who.int/publications.
11. Routine Raw Data Report (2017/01/01- 2017/12/31). Tlokwe Sub district. In Data File: DHIS_#ZA_NW. 2018 Feb.
12. Undernutrition: Definition. Available: www.unicef.org.

13. Department of Health. Road to health (boys and girls). 2012. *Government Printing Works*, Pretoria: 14-15.
14. Monyeki, M.A., Awotibede, A., Strydom, G.L., *et al*. 2015. The Challenges of underweight and overweight in South African children: Are we winning or losing the battle? A systematic review. *Int J Environ Res Public Health*, 12: 1156-73. doi: 10.3390/ijerph120201156.
15. Wondimagegn, Z.T. 2014. Magnitude and determinants of stunting among children in Africa: A systematic review. *Curr Res Nutr Food Sci*., 2 (2): 778-88. doi: http://dx.doi.org/10.12944/CRNFSJ.2.2.05.
16. Keino, S., Plasqui, G., Ettyang, G., *et al*. 2014. Determinants of stunting and overweight among young children and adolescents in sub-Saharan Africa. *Food Nutr Bull*, 35(2): 167-8. Available: https://www.ncbi.nlm.nih.gov/pubmed/25076764.
17. Nutrition at glance: South Africa. Available: http://siteresources.worldbank.org.
18. Van Deventer, C., Roberts, G. & Wright, A. 2016. Improving childhood nutrition and wellness in South Africa: involving mothers/caregivers of malnourished or HIV positive children and healthcare workers as co-designers to enhance a local quality improvement intervention. *BMC Health Services Research*, 16: 358. http://wiredspace.wits.ac.za.
19. Said-Mohamed, R., Micklesfield, L.K., Pettifor, J.M., *et al*. 2015. Has the prevalence of stunting in South African children changed in 40 years? A systematic review. *BMC Public Health*, 15(1): 534. Available: https://link.springer.com/article/10.1186/s12889-015-1844-9.
20. Mukatay, A.W., Kalenga, P.M., Dramaix, M., et al. 2010. Factors associated with malnutrition in children aged under five years in Lubumbashi (DRC). *Santé Publique*, 22(5): 541-50. Available: https://www.ncbi.nlm.nih.gov/pubmed/21360863.
21. Walson, J.L. & Berkley, J.A. 2018. The impact of malnutrition on childhood infections. *Curr Opin Infect Dis*, 31(3): 231-6. doi: 10.1097/QCO.0000000000000448.
22. Mwadianvita, C.K., Kanyenze, F.N., Wembonyama, C.W., *et al*. 2014. Nutritional status of children aged 6 to 59 months with HIV but not on ARVs in Lubumbashi. *Pan Afr Med J*., 19: 7. doi: 10.11604/pamj.2014.19.7.3932.
23. Tamiru, M.W., Tolessa, B.E. & Abera, S.F. 2015. Undernutrition and associated factors among under-five age children of Kunama ethnic groups in Tahtay Adiyabo Woreda,

Tigray Regional State, Ethiopia: Community Based Study. *Int. J. Food Sci Nutr.*, 4(3): 277-88. Available:http://article.sciencepublishinggroup.com/html/10.11648.j.ijnfs.20150403.15.

24. Black, R.E, Victoria, C.G., Walker, S.P., *et al.* 2013. Maternal and child under nutrition and overweight in low and middle-income countries. *Lance*t, 382(9890): 396. doi: 10.1016/S0140-6736(13)60937-X.
25. Arias, M., Tarazona, M.C., Lamus, F., *et al*. 2013. Nutritional state associated with social determinants in Arhuaco children aged less than 5 years-old. *Rev Salud Publica (Bogota)*, 15(4): 613-25. Available: https://www.thefreelibrary.com/Nutritional+state...-a0439036216.
26. Maxwell, S. & Smith, M. Household food security: A conceptual review. Available: http://www.ifad.org/hfs/tools/hfs/hfspub.
27. Folaranmi T. Food insecurity and malnutrition in Africa: Current trends, causes and consequences. Available: http://www.consultancyafrica.com.
28. FAO. 2017. The State of food security and nutrition in the world. Available: http://www.fao.org/3/a-I7695e.pdf.
29. Hunger and food insecurity in the US. What is food insecurity? Available: https://www.feedingtexas.org/learn/food-insecurity.
30. Borji, M., Moradi, M., Otaghi, M & Tartjoman, A. 2018. Relationship between nutritional status, food insecurity and causes of hospitalization of children with infectious diseases. *J Compr Ped.*, 9(2): e63870. doi: 10.5812/compreped.63870.
31. Wuehler, S.E. & Nadjilem, D. 2011. Situational analysis of infant and young child nutrition policies and programmatic activities in Chad. *Matern Child Nutr.*, 7(1): 63-82. doi: 10.1111/j.1740-8709.2010.00311.x.
32. Labadarios, D., Mchiza, Z.J., Steyn, N.P., *et al*. 2011. Food security in South Africa: a review of national surveys. *Bull of the WHO*, 89: 891-9. doi: 10.2471/BLT.11.089243.
33. Betebo, B., Ejajo, T., Alemseged, F & Massa, D. 2017. Household food insecurity and its association with nutritional status of children 6-59 months of age in East Badawasho District, South Ethiopia. *J Environ Public Health*, 2017: 2. https://doi.org/10.1155/2017/6373595.
34. FAO Statistics Division. FAO Hunger Map 2015: Millennium Development Goal 1 and World food summit hunger targets. Available: http://www.fao.org/economic/less.

35. Chitiga-Mabugu, M., Nhemachena, C., Karuaihe, S., *et al.* 2013. Measurement of food security in South Africa: Policy paper. *NDA*, 7-11. https://www.nda.org.za/assets/resources.
36. Du Toit, D.C., Ramonyai, M.D., Lubbe, P.A., *et al*. 2011. Food Security. Available: http://www.nda.agric.za/docs/genreports/foodsecurity.pdf.
37. Ke, J. & Ford-Jones, E.L. 2015. Food Insecurity and hunger: A review of the effects on children's health and behaviour. *Pediatr Child Health*, 89-91. https://www.ncbi.nlm.nih.gov.
38. Black, M. Household food insecurity: Threats to children wellbeing. American Psychological Association. Available: http://www.apa.org/pi/ses/resources/indicator/2012.
39. Laraia, B.A. 2013. Food Insecurity and Chronic Disease. *Adv. Nutr*., 4: 203–12. doi:10.3945/an.112.003277.
40. Metallinos-Katsaras, E., Must, A. & Gorman, K. 2012. A longitudinal study of food insecurity on obesity in preschool children. *J Acad Nutr Diet.*, 112(12): 1949-58. doi: 10.1016/j.jand.2012.08.031.
41. Cook, J.T. 2013. Impacts of Child Food Insecurity and Hunger on Health and Development in Children: Implications of Measurement Approach. Paper, National Statistics and Food and Nutrition Board, 7-11. Available: https://sites.nationalacademies.org.
42. Larson, N., & Story, M. 2011. Food insecurity and weight status among U.S. children and families: a review of the literature. *Am J of Prev Med.,* 40(2), 166-73. doi: 10.1016/j.amepre.2010.10.028.
43. Costa, N.S., Santos, M.O., Carvalho, C.P., *et al*. 2017. Prevalence and factors associated with food insecurity in the context of the economic crisis in Brazil. Curr Dev Nutr, 1(10): 3-5. doi: 10.3945/cdn.117.000869.
44. Haque, A., Farzana, F.D., Sultana, S., *et al*. 2017. Factors associated with child hunger among food insecure households in Bangladesh. *BMC Public Health*, 17: 205. Available: https://link.springer.com/article.
45. Clay, L.A., Papas, M.A., Gill, K.B., *et al*. 2018. Factors Associated with Continued Food Insecurity among Households Recovering from Hurricane Katrina. *Int J Environ Res Public Health*, 15(8): 1647. doi: 10.3390/ijerph15081647.

46. Misselhorn, A & Hendricks, S.L. 2017. A systematic review of sub-national food insecurity research in South Africa: Missed opportunity for policy insights. *PLoS ONE* 12(8): e0182399. Available: https://doi.org/10.1371/journal.pone.0182399.
47. Said-Mohamed, R., Micklesfield, L.K., Pettifor, J.M., *et al*. 2015. Has the prevalence of stunting in South African children changed in 40 years? A systematic review. *BMC Public Health*, 15(1): 534. Available: https://link.springer.com/article/10.1186/s12889-015-1844-9.
48. Weigel, M.M., Armijos, R.X, Racines, M., *et al*. 2016. Food Insecurity Is Associated with Undernutrition but Not Overnutrition in Ecuadorian Women from Low-Income Urban Neighbourhoods. *Journ Of Env & Publ Health*, 2016 (8149459): 12-3. http://dx.doi.org/10.1155/2016/8149459.
49. Caballero, B., Finglas, P.M. & Toldrá, F. 2016. Nutrition and infection. *Encyclopaedia of Food and Health*, 98-103. Available: https://www.elsevier.com/books/encyclopedia-of-food-and-health/caballero/978-0-12-384947-2.
50. Krawinkel, M.B. 2012. Interaction of nutrition and infections globally: An overview. *Ann Nutr Metab*, 61(suppl 1):39–45. doi: 10.1159/000345162.
51. Seligman, H.K., Laraia, B.A. & Kushel, M.B. 2010. Food insecurity is associated with chronic disease among low-income NHANHES participants. *J Nutr*., 140(2): 304-10. doi: 10.3945/jn.109.112573.
52. Ntuli, S.T., Malangu, N. & Alberts, M. 2013. Causes of deaths in children under 5 years old at a tertiary hospital in Limpopo province, South Africa. *Glob J Health Sci*., 5(3): 95-100. doi: 10.5539/gjhs.v5n3p95.
53. Lehohla, P. 2012. Census 2011 Municipal Report, North West. Statistics South Africa. Pretoria:17-51. Available: https://www.statssa.gov.za/publications/P03014/P030142011.pdf.
54. Kadima, Y.E. 2012. Factors influencing malnutrition among children under 5 years of age in Kweneng West District of Botswana (Master in Public Health). UNISA: 1-3 (Appendix D).
55. Becquey, E., Martin-Prevel, Y., Traissac, P., *et al*. 2010. Household Food Insecurity Access Scale and an index-member dietary diversity score contribute valid and

complementary information on household food insecurity in an urban West-African setting. *The Journal of Nutrition,* 140(12): 2233-40. doi: 10.3945/jn.110.125716.

56. Govender, I., Mabuza, L.H., Ogubanjo, G.A., *et al*. 2014. African Primary Care Research: Performing surveys using questionnaires. *Afr J Prm Health Care Fam Med*., 6(1): 2-3. Available: http://dx.doi.org/10.4102/phcfm.v6i1.589.
57. World Health Organisation. 2012. WHO global database on child growth and malnutrition: children-schools and health; their nutrition and health in Kenya. Available: https://www.who.int/nutrition/EB128_18_backgroundpaper2.
58. Madondo, A., Macintyre, U.E. & Ntuli, B. 2012. The clinical and anthropometric profile of undernourished children aged under 5 admitted to Nyangabgwe Referral Hospital in Botswana. *SAJCH*, 6(4): 123-7. Available: http://www.sajch.org.za/index.php/SAJCH/article/view/450.
59. Scherbaum, V. 2016. The role of breastfeeding in the prevention of childhood malnutrition. *World Rev Nutr Diet.,* 115: 82-97. Available: https://www.karger.com/Article/Abstract.
60. Niraula, S.R., Barnal, S.P., Paudel, S., *et al*. 2013. Prevalence and associated risk factors with malnutrition among under- five Nepalese children of Borbote Village, Ilam. *Health Renaissance,* 11(2): 111-18. doi: 10.3126/hren.v11i2.8217.
61. Sahu, S.K., Kumar, S.G., Bhat, B.V., *et al*. 2015. Malnutrition among under-five children in India and strategies for control. *J Nat Sci Biol Med*., 6 (1): 18-23. Available: http://www.jnsbm.org/article.asp?issn=0976-9668.
62. World Bank Data Team. 2012. Child malnutrition: how did boys and girls fare in the past decade. Available: https://blogs.worldbank.org.
63. Kathri, R.B., Mishra, S.R., Khanal, V., *et al*. 2015. Factors associated with underweight among children of former- Kamaiyas in Nepal. Front. *Publ Health*: 3, 11.
64. Ahsan, K.Z., El Arifeen, S., Al-Mamun, A., *et al*. 2017. Effects of individual, household and community characteristics on child nutritional status in the slums of urban Bangladesh. *Arch of Publ Health*, 75(9): 5-9. doi: 10.1186/s13690-017-0176-x.
65. Hackett, M., Melgar-Quinonez, H. & Alvarez, M.C. 2009. Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia. *Rev Panam Salud Publica*, 25(6): 506-10. Available:https://www.semanticscholar.org/paper.

66. Awasthi, S., Peto, R., Pande, V.K., *et al*. 2008. Effects of deworming on malnourished preschool children in India: an open-labelled, cluster-randomized trial. *PLoS Negl Trop Dis*, 223. doi: 10.1371/journal.pntd.0000223.
67. Ngema, P.Z, Sibanda, M. & Musemwa, L. 2018. Household food security status and its determinants in Maphumulo local municipality, South Africa. *Sustainability*, 10 (3307): 8-17. https://doi.org/10.3390/su10093307.
68. Ghattas, H. 2014. Food Security and Nutrition in the context of the Global Nutrition Transition. Technical Paper. Beirut, American University of Beirut. Available: http://www.fao.org/economic/ess/essfs/voices/en.
69. Nord, M., Coleman-Jensen, A., Andrews, M.S., *et al*. 2011. Household food security in the United of States. *Adv. Nutr*., 2 (2): 153-4. doi: 10.3945/an.110.000216.

APPENDICES

APPENDIX 1: PATIENT INFORMATION SHEET

Study title: Household food insecurity and disease profile among underweight children aged between 6 and 60 months admitted to the Potchefstroom Hospital, North-West Province.
Dear Sir/ Madam.

I, **Baguma Jean-Claude NDAGANO**, a Medical Doctor and registrar in the Department of Family Medicine, University of the Witwatersrand, Johannesburg, am conducting research on the relationship between household food insecurity and disease profile in underweight children admitted to the Hospital. Research is just the process to learn the answer to a question. In this study, I would like to explore household food insecurity and disease profile among underweight children aged between 6 and 60 months admitted to the Potchefstroom Hospital.

I am asking you to partake, and to grant your permission for your child to be included, in this research study that aims to describe the socio-demographic characteristics of underweight children aged between 6 and 60 months and the common diseases they present with when they are admitted to the Potchefstroom Hospital, and then to establish the relationship between food insecurity and the nutritional status of those children.

I would therefore like you to answer some questions about yourself, your child, your home and the other people living in your home. After I have finished asking questions, I would like to weigh your child, measure his or her height, mid upper arm circumference and head circumference (if the age is younger than 2 years) in order to classify his or her nutritional status. I will also assess his or her physical appearance and ask to see his or her Road to Health chart or booklet to retrieve some more information. This will take approximately 20 to 30 minutes.

There is no expected risk that you or your child would experience during participation of the study. We may use a translator during the interview in case you do not speak English. We will confirm or correct the nutritional status of your child after measurements have been taken and

this will benefit your child in the provision of appropriate management in hospital and after discharge.
Your participation in this study remains voluntary. If for any reason, you or your child do not wish to participate in this study or if at any stage during the study you or your child decide to withdraw, you are free to do so and I guarantee you that it will not affect your child's treatment. If you decide to withdraw, you may do so without providing any reason.

After the results are available any pertinent information on the study will be given to you.
I will put all the information collected in a locked cupboard in a secure designated place (until the required number is reached) where nobody else except the researcher will have access to it and the questionnaires will be coded to an extent that no one will know to whom the information belongs. The raw data will be captured on a computer, accessed by the researcher and the statistician only and the results presented without any names of the participants.

In case of queries regarding this study, you may contact the researcher, Dr B.J. Ndagano on 0826865248 (Email:drndagano@gmail.com or his supervisor, Dr C. Lion-Cachet on 083 395 7376 (Email:clcachet@gmail.com).

This research protocol has been approved by the Human Research Ethics Committee, University of Witwatersrand, Johannesburg. If you have any queries, concerns or complaints regarding the ethical activities surrounding the study, please feel free to contact the Chairman, Professor P. Cleaton-Jones on 011 717 2301 (Email:Peter.Cleaton-Jones1@wits.ac.za) or the Administrative Officer, Zanele Ndlovu on 011 717 1234 (Email: Zanele.Ndlovu@wits.ac.za).

Thank you for taking the time to read this information sheet.

APPENDIX 2: CONSENTFORM

Dear Participant,

Currently, your child is admitted to Ward 11 for treatment of problems he/she is experiencing. The Potchefstroom Hospital not only renders treatment but is also actively involved in conducting research aimed at improving the quality of care that we deliver. From time to time such research involves the use of patient records from which information is extracted. The use of such information is subject to the following:

- Approval granted by the Human Research Ethics Committee, University of the Witwatersrand, Johannesburg.
- Identity of a patient from whose file information is extracted is never revealed to anyone with the exception of the researcher unless specific consent is obtained to do so. The information gathered does not contain the name of the patient but only a coded number so as to maintain anonymity.

We are involved in a research study that requires us to use information from your child's file, including his/her HIV status and also to take measurements of your child (such as weight, height, head circumference and mid upper arm circumference – if child is younger than 2 years old).

Therefore, we would like to obtain your consent:

- To use information from your child's file for the purpose of this research, including his/her HIV status, subject to the aforementioned conditions.

- To take above mentioned measurements of your child

If you choose not to give consent, this will not compromise your child's treatment in any way. If at any time you choose to withdraw consent you are free to do so and will not prejudice, in any way, your child's care at the hospital.

Should you wish to contact us at any stage regarding consent, contact Dr Baguma Jean-Claude Ndagano at 082 686 5248 or Dr Carien Lion-Cachet at 083 395 7376.

A Consent Given

I, _____ hereby give consent for my child's records to be used as per the above-mentioned conditions, including HIV status and also for the measurements to be taken for the purposes of this research.

PATIENT: _____ DATE: _____

B Consent Not Given

I, _____ do not give consent for my child to participate to this research.

PATIENT: _____DATE: _____

APPENDIX 3: DATA ENTRY SHEET

(This entry sheet will be completed by the researcher retrieving information from the child's RTHC and/or admission file.)

STUDY NUMBER:

AGE (in months): ❑…….

PLACE OF BIRTH: ☐

RURAL = 1 URBAN =1 PERI-URBAN = 3 UNKNOWN = 4

SEX: ☐

MALE = 1 FEMALE =2

BIRTH WEIGHT: ☐

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

DATE OF DIAGNOSIS (NUTRITIONAL STATUS): ☐

Before this admission = 1 At this admission = 2

ANTHROPOMETRIC MEASURES (TAKEN BY THE RESEARCHER):

Weight ……...Kg Height …...…cm

Head circumference ……cm MUAC ……cm (if child is younger than 2 years old)

Plotted by the researcher and confirmed the diagnosis of the nutritional status?

Yes = 1 No= 2 ☐

Z-score …… Nutritional status ……

Is the Road to Health booklet readily available? ☐

Yes=1 No=2

Nutritional status: ☐

Moderate underweight = 1 Severe underweight = 2 Normal = 3 Other = 4

Is the child up to date with immunization? ☐

Yes = 1 No = 2 Unsure = 3

APPENDIX 4: QUESTIONAIRE

(This questionnaire will be completed by the researcher during the interview with the child's parent or caregiver.)

A CHILD INFORMATION

Diagnosis of admission **……** ☐

Did the child have one of the following conditions:

❑Cough ❑ diarrhoea ❑vomiting ❑fever ❑ear problems

two weeks prior to the time of the diagnosis of underweight?

Yes = 1 No=2 Unsure = 3

What is the child's HIV status?……. ☐

Positive = 1 Negative = 2 Unknown = 3

If HIV negative, has he/she been exposed to HIV?…… ☐

Yes = 1 No = 2 Unknown = 3

What does the child eat?…… ☐

Milk only = 1 Addition of semi-solids = 2 Solids = 3

B HOUSEHOLD INFORMATION

1 How many people live in your household? (*Write the number*) **……** ☐

2 How many people living in your household are younger than 5 years old? **……..…** ☐

(*Write the number, including the child admitted at the hospital*)

C HOUSEHOLD FOOD INSECURITY ACCESS SCALE MEASUREMENT TOOL

Nº	Question	Response Options	Code
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	❑
1(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
2	In the past four weeks, were you or any household member unable to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	❑
2(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
3	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	❑
3(a)	How often did this happen?	1 = Rarely (once or twice in the past four	❑

		weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
4	In the past four 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 resources to obtain other types of food?	0 = No (skip to Q5) 1 = Yes	❑
4(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	❑
5(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
6	In the past four weeks, did you or any	0 = No (skip to Q7)	❑

	other household member have to eat fewer meals in a day because there was not enough food?	1 = Yes	
6(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	❑
7(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	❑
8(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	❑
9	In the past four weeks, did you or any	0 = No (questionnaire is finished)	❑

	household member go a whole day and night without eating anything because there was not enough food?	1 = Yes	
9(a)	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks	❑

Score: ……/ 27

INTERPRETATIONS

At the end, the researcher will summarize the codes for each frequency-of-occurrence question on the household food insecurity access score (HFIAS) as follows:

1 The maximum score for a household is 27 (the household response to all 9 questions is "often", coded with response code of 3).

2 The minimum score is 0 (the household response in "no" to all 9 occurrence questions, then the interviewer skipped all the frequency-of-occurrence questions).

3 The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) the household experienced.

Categories of food security are: food secure (0-2), at risk (3-12), food insecure (13-27).

The average HFIAS score can be calculated by dividing the sum of HFIAS scores in the sample with the number of HFIAS scores (households) in the sample.

Score: ……/ 27

Conclusion:

❑Food secure ❑At risk ❑Food insecure (*thick the corresponding category*).

DATE OF INTERVIEW …… (YY/MM/DD)

INTERVIEWER'S SIGNATURE ……

PRINT NAME: ……

R14/49 Dr Baguma Jean-Claude Ndagano

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160665

NAME: (Principal Investigator)	Dr Baguma Jean-Claude Ndagano
DEPARTMENT:	Family Medicine Potchefstroom Hospital, North West Province
PROJECT TITLE:	Household Food Insecurity and Disease Profile among Underweight Children Aged between 6 and 60 Months Admitted to the Potschefstroom Hospital, North-West Province
DATE CONSIDERED:	24/06/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Carien Lion-Cachet
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	10/12/2016

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

DECLARATION OF INVESTIGATORS

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

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

health
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POTCHEFSTROOM HOSPITAL

OFFICE OF THE CLINICAL MANAGER

18 October 2016

PERMISSION LETTER TO CONDUCT RESEARCH

TO: Dr. BJ Ndagano
Potchefstroom Sub District

FROM: Dr. JMM Shakung
Clinical Manager
Potchefstroom Hospital

Dear Dr. BJ Ndagano

This is to inform you that the Potchefstroom Hospital Patient Safety Group (PSG) that sat on 11/10/2016 has given you permission to proceed with your research titled: **Household Food Insecurity and Disease Profile among Underweight Children aged between 6 and 60 months admitted to the Potchefstroom Hospital, North West Province.**

We wish you all the best with your research and look forward to sharing in the results of your findings.

Sincerely

DR. JMM SHAKUNG
CLINICAL MANAGER
POTCHEFSTROOM HOSPITAL.

OFFICE OF THE CLINICAL MANAGER
POTCHEFSTROOM HOSPITAL
2016 -10- 18
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