Impact of a nutrition education programme on the nutritional status of children aged 3 to 5 years and the nutritional practices and knowledge of their caregivers in rural Limpopo Province, South Africa

by

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DECLARATION

"I hereby declare that this thesis for the qualification PhD in Nutrition at the University of the Free State is my own work and was not handed in for another qualification at another institution. I furthermore waive copyright of the thesis in favour of the University of Free State."

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Lindelani Fhumudzani Mushaphi

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Date

Dedicated to

my son Livhuwani, my father Rembuluwani and my late mother Irene, my brother Mukundi, my sisters Nthanyiseni and Mbavhalelo, my nieces Rolindela, Nanza and Onkhundisa, and my nephews Muhluleri, Kundi and Rembu, for their encouragement and support.

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SUMMARY OF THE STUDY

LIST OF ABBREVIATIONS

ACC/SCN	Administrative Committee on Coordination/ Sub-committee on Nutrition
AI	Adequate intake
BMI	Body mass index
BMI/A	Body mass index for age
BFHI	Baby friendly hospital initiative
BINP	Bangladesh Integrated Nutrition Programme
C	Control group
CDC	Centre for Disease Control and Prevention
cm	centimetre
CI	Confidence interval
dl	decilitre
DOH	South Africa Department of Health
DRIs	Dietary reference intakes
E	Experimental group
EAR	Estimated average requirement
EER	Estimated energy requirement
FAO	Food and Agricultural Organization of the United Nations
FANTA	Food and Nutrition Technical Assistance
FBDGs	Food-based dietary guidelines
FGPs	Food guide pyramids
fL	femtolitre
FNB	Food and Nutrition Board
HIV/AIDS	Human immunodeficiency virus/ Acquired immunodeficiency syndrome
ICDDR	International Centre for Diarrhoeal Disease Research
IFPRI	International Food Policy Research Institute
INP	Integrated Nutrition Programme
IOM	Institute of Medicine
kg	kilogram
kj	kilojoules
km	kilometre
l	litre
m^2	meter squared
Max	maximum
MCV	Mean cell volume/ mean corpuscular volume
Min	minimum
ml	millilitre
NCHS	National Centre for Health Statistics
ND	Not available
NFCS	National Food Consumption Survey
NFCS-FB	National Food Consumption Survey Fortification Baseline
ng	nano gram
NHANES	National Health and Nutrition Examination Survey
NEIP	Nutrition education intervention programme
PEM	Protein Energy Malnutrition
RDA	Recommended Dietary Allowance
SAFBDGs	South African Food-based Dietary Guidelines

SAPFBDGs	South African Paediatric Food-based Dietary Guidelines
SAINP	South African Integrated Nutrition Programme
SAVACG	South Africa Vitamin A Consultative Group
SD	Standard deviation
TIBC	Total iron-binding capacity
TINP	Tamil Nadu Integrated Nutrition Project
H/A	Height for age
HAZ	Z-scores for height for age
UL	Tolerable upper intake levels
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
UNSCN	United Nations Sub-Committee on Nutrition
UNU	United Nations University
USA	United States of America
USDA	United States Department of Agriculture
µmol	micro mol
µg	microgram
yrs	years
W/A	Weight for age
WAZ	Z-scores for weight for age
WFP	World Food Programme
W/H	Weight for height
WHZ	Z-scores for height for age
WHO	World Health Organization

CHAPTER 1.
INTRODUCTION

1.1 Introduction

Protein energy malnutrition (PEM) continues to be a major public health problem in the world, especially in developing countries. It is estimated that, globally, nearly 20 million children under the age of five years are suffering from severe acute malnutrition (World Health Organization (WHO)/ World Food Programme (WFP)/ United Nation Sub-Committee on Nutrition (UNSCN)/ United Nations children's fund (UNICEF, 2007). In addition, UNSCN (2006) estimated that, globally, about 150 million children under the age of five are underweight, while 180 million are stunted. Malnutrition is more prevalent in developing countries, where it affects one out of every three pre-school children (UNSCN, 2004). The UNSCN (2011) further estimates that 22% of children in Asian countries are underweight. A similar trend was also estimated for African countries, where 20% of children are underweight (UNSCN, 2011). About 23.1% (18% stunted; 5.1% severely stunted) of children in South Africa suffer from chronic malnutrition according to the National Food Consumption Survey Fortification Baseline (NFCS-FB, 2005).

Micronutrient malnutrition, such as vitamin A and iron deficiency, is still a major public health problem in developing countries. The WHO (2002) estimated that deficiencies in vitamin A and iron each ranked among the top ten leading causes of death in developing countries. In addition, micronutrient deficiencies have a significant impact on human welfare and on the economic development of poorer countries. Micronutrient deficiencies can lead to serious health problems, including reduced resistance to infectious disease, mental retardation, blindness and, in some cases, death, according to the Food and Agriculture Organization of the United Nations (FAO, 2003). According to the FAO (2003), micronutrient deficiencies also substantially affect the nutritional status, health and development of a significant percentage of the population in many countries, both developed and developing.

The UNSCN (2011) estimates that 163 million children in developing countries are vitamin A deficient. Mason *et al*. (2001) earlier estimated that 140 million children younger than five years had vitamin A deficiency globally. It has also been estimated that, globally, 127 million pre-school children were sub-clinically vitamin A deficient (West *et al*., 2002). Furthermore, nearly 100 million of those children with vitamin A deficiency live in South Asia and sub-Saharan Africa (Mason *et al*., 2001). In Sub-Saharan Africa, 36 million pre-school children are affected by vitamin A deficiency (Micronutrient Initiative, 2001). Although the extent of clinical vitamin A deficiency in South Africa is not as severe as it is in some of the other sub-Saharan countries, one out of three children were identified as marginally vitamin A deficient in the South Africa Vitamin A Consultative Group study (SAVACG, 1995). Recent data indicate that two out of three children in South Africa have poor vitamin A status (NFCS-FB, 2005).

Iron deficiency anaemia is the most prevalent and common micronutrient deficiency amongst children in the world today. It is estimated by the Administrative Committee on Coordination/Sub-Committee on Nutrition (ACC/SCN, 2000) that more than three billion people in developing countries are iron deficient. Almost 50% of pre-school children in developing countries suffer from iron deficiency anaemia (UNICEF/UNU/WHO, 2001; ACC/SCN, 2000). A similar trend was observed in Vietnam, where more than 50% of preschool children were found to be anaemic (Nhien *et al*., 2008). Tatala *et al*. (2004) observed that 45% of school children in Tanzania had iron deficiency, while 31% were categorised as having iron deficiency anaemia. In the SAVACG (1995) study, it was reported that 21% of pre-school children were anaemic, while the recent NFCS-FB (2005) found that almost one third of children in South Africa were anaemic and one out of seven children had poor iron status.

The high prevalence rate of micronutrient deficiencies observed in developing countries is mainly due to the inadequate intake of dietary energy and protein, the low content of micronutrients in the diet and poor bioavailability (Rivera *et al.*, 2003). Poor dietary intake of energy and protein and frequent infections are also associated with poor growth and development in children (WHO, 2008). Furthermore, poor dietary intake and frequent infections contribute up to half of all anaemia observed in children (WHO, 2008). The diets given to children in most rural areas lack variety and this also results in malnutrition.

Adequate intake of micronutrients is essential for preventing common micronutrient disorders, such as vitamin A and iron deficiencies. According to Aphane *et al. (*2003), most countries have to improve the micronutrient status of the population by changing practices at the household level and by protecting the nutritional benefits of traditional practices that are eroding because of factors such as urbanisation and modernisation. When income increases, people often reduce breastfeeding, stop gathering wild foods and eat fewer green leafy vegetables due to ignorance or poor knowledge of nutrition. The mass media can be a powerful force in helping to preserve positive traditional practices. In this way, improved communication strategies could improve dietary practices. Babu (2000) also suggested that improved availability of adequate information on the existence and uses of indigenous foods by rural households could prevent most diseases associated with micronutrient deficiencies.

Indigenous foods play an important role in the lives of rural populations. Therefore, the indigenous and traditional food systems of poor and rural communities need to be promoted in the search for solutions to the global problems of poverty, hunger and malnutrition (Faber & Wenhold, 2007). According to Faber and Wenhold (2007), a decline in the use of indigenous foods results in nutritional deficiencies, especially among children in rural areas. The diets of most people in rural areas consist predominantly of plant-based staple foods, while indigenous fruit as well as other fruit, vegetables, including indigenous vegetables, and animal products are rarely consumed. The reason for this could be the fact that most rural people do not earn a regular income and cannot purchase most of the food items, even if they were available. Furthermore, in semi-desert and other parts of the dry savanna areas of Africa, the deficiency of vegetables in the diet is a major cause of vitamin A deficiency.

The consumption of indigenous vegetables, fruits and legumes is the most sustainable way of reducing and controlling micronutrient deficiencies in resource-poor communities (Aphane *et al.*, 2003). In a study done in Malawi, it was found that most indigenous vegetables are rich in micronutrients such as vitamin A, vitamin C and calcium (Babu, 2000). Vitamin C intake can further improve the bioavailability of iron in populations consuming plant-based diets (Gallagher, 2008: 96). In addition, indigenous vegetables, besides being rich in micronutrients, have the added advantage of possessing other desirable traits, such as tasting acceptable to local communities, growing easily, and being resistant to pests and diseases (Aphane *et al.*, 2003). Therefore, encouraging the use of indigenous vegetables and fruits could be the most direct, low-cost solution to improving the micronutrient status of children in many rural areas and further improving their quality of life.

Nutrition education has shown a significant benefit in increasing nutritional knowledge and improving infant feeding practices amongst mothers who receive nutrition education compared to mothers who do not receive nutrition education (Guldan *et al.,* 2000). Ladzani *et al*. (2000) reported that a nutrition education programme had significantly improved breastfeeding and infant feeding practices in rural areas amongst local women who had been trained. It was also shown that teaching mothers about complementary feeding improved the mother's knowledge and the children's diets (Ilett & Freeman, 2004). In addition, Guldan *et al*. (2000) indicated that children of mothers who received nutrition education had lower rates of anaemia and were significantly heavier and taller than the control group.

Walsh *et al.* (2002) indicated that, in the Free State and Northern Cape Province, nutrition education significantly improved the weight for age of boys and girls in urban areas and of boys in one rural study area. Walsh *et al.* (2002) further reported that nutrition education accompanied by food aid succeeded in improving the weight status of children, but was unable to facilitate catch-up growth in stunted children after two years of intervention. Stunting is a chronic form of malnutrition and takes longer to develop than underweight, so catch-up growth also takes longer in stunted children.
Nutrition education presents some unique challenges in the health education area. In order for nutrition education to be more effective, the educational methods should be selected on the basis of what is appropriate for the target groups and the setting (Smith & Smitarisi, 2005). Face-to-face education, either in groups or on a one-to-one basis,

has been the traditional approach to nutrition education. Advice to add nutritious foods to the diet should include not only information about what foods should be given, but also about the amounts and frequency of consumption. Nutrition education may also require the development of skills to grow and prepare specific foods. On this basis, it can be seen that face-to-face methods are likely to be the most effective method of nutrition education.

Mass media strategies, on the other hand, are based on a marketing and communication model that tends to deal with simple messages. Nutrition education rarely deals with a single behaviour or single food. Using the mass media has also been effective in raising community awareness of a nutrition problem, most commonly as part of a multi-channel approach in which the mass media support other actions or face-to-face activities (Smith & Smitasiri, 2005). When mass media are used in rural areas; they often are not effective, since a large percentage of people do not have access to the mass media (radio/television) or are illiterate. Therefore, targeted populations may not be reached with the mass media, whereas face-to-face strategies encourage community involvement and participation. Smith and Smitasiri (2005) recommend face-to-face strategies in disadvantaged communities as the best way of changing behaviour.

1.2 Problem statement

Limpopo is one of the provinces in South Africa with the highest prevalence of malnutrition amongst children (one to nine years). According to the National Food Consumption Survey (NFCS, 1999), 34.2% of children aged one to nine years in Limpopo Province were stunted, while 13% were severely stunted, which indicates chronic malnutrition. The prevalence rate of stunting in Limpopo Province is thus higher than the national average of 23.1%. Mamabolo *et al*. (2006) observed that 35% and 48% of children at one and three years respectively were stunted in the central region of Limpopo Province. The results of the NFCS (1999) and Mamabolo *et al*. (2006) study reveal that chronic malnutrition is still a major problem in Limpopo Province.

The NFCS (1999) also revealed that 12.6% of children in Limpopo Province were underweight, with 2.6% being severely underweight. In addition, 14% of children in Limpopo Province aged 12 to 36 months were underweight (NFCS, 1999). The NFCS-FB (2005) indicated that 12.3% of children in Limpopo Province were underweight. After six years, a similar prevalence rate of underweight in Limpopo Province was thus observed.

In Limpopo Province, 7.5% of children aged one to nine years were wasted and 11.0% of children aged one to three years were wasted (NFCS, 1999). According to the NFCS-FB (2005), 4.4% of children aged one to nine years in Limpopo Province were wasted. The prevalence of wasting was high amongst children aged one to three years, which indicates that acute-severe malnutrition is a challenge. In both the NFCS (1999) and the NFCS-FB (2005), children in rural and commercial farm areas had higher prevalence rates of malnutrition when compared with that in other parts of the country. The high prevalence rate of malnutrition observed in Limpopo could be due to the fact that the province is predominantly rural and most communities are nutritionally compromised.

At the time that the SAVACG study was undertaken in 1994, marginal vitamin A deficiency was observed in 45% of children in Limpopo Province (SAVACG, 1995). In the recent NFCS-FB (2005) study, 63.2% of children in Limpopo Province had marginal vitamin A deficiency and 12.5% of children had vitamin A deficiency. These results indicate that the marginal vitamin A status that was found in the Limpopo Province in 1995 (SAVACG, 1995), had worsened in 2005 (NFCS-FB, 2005).

Limpopo Province is one of the provinces with the highest prevalence of iron deficiency among children. The NFCS-FB (2005) study observed that 34.1% of children in Limpopo Province were anaemic. A similar observation was made by Mamabolo *et al*. (2006) in the Central Region of Limpopo Province were 33% of children had biochemical iron deficiency. In the NFCS (1999), one out of two children were found to have an intake of approximately less than half of the recommended levels for a number of important nutrients (vitamin A, iron).

According to the NFCS (1999) study, 54% of households in the Limpopo Province experienced hunger, while 26% were at risk of hunger. The NFCS (1999) further indicated that higher percentages of households in rural areas experienced hunger when compared with urban households. In the NFCS-FB (2005), nearly two thirds (63.2%) of households in Limpopo Province were found to be experiencing hunger, while 26.3% were at risk of hunger. Limpopo Province was amongst the provinces with the highest number of households experiencing hunger. The number of households that are at risk of or experiencing hunger has increased since 1999 (NFCS-FB, 2005).

In Limpopo Province, like many other rural areas, children's diets are predominately cereal based (high in carbohydrates), with minimal intake of animal products. Mamabolo *et al*. (2006) indicated that children in Central Limpopo Province received nearly 70% of their energy intake from carbohydrates, while fat contributed less than 20%. The average protein intake was adequate, but comprised mainly protein from vegetable sources, which are poor sources of iron and of certain essential amino acids.

It is important to encourage the use of indigenous mixed dishes, since the combination of grains with protein of a low biological value helps to improve the quality of total protein (Gallagher, 2008: 64). Indigenous mixed dishes, such as *tshidzimba* (samp, beans, jugo beans and groundnuts), *dovhi* (biltong and groundnuts or dried vegetables and groundnuts), *thophi* (pumpkin and maize meal) and dried beans are commonly used in the Limpopo Province, mostly in rural areas (Mbhatsani, 2008). Therefore, hunger can be addressed by encouraging the use of indigenous mixed dishes such as *tshidzimba* (samp, beans, jugo beans and groundnuts), *dovhi* (biltong and groundnuts or dried vegetables and groundnuts) and *thophi* (pumpkin and maize meal), which are rich in macronutrients such as protein and carbohydrates. Nesamvuni *et al.* (2001) demonstrated that indigenous vegetables (*murudi*, *vowa, phuri, muxe* and *nngu*) commonly used by the Vha-Venda in Limpopo Province are good sources of vitamin C, beta-carotene and folate. Steyn *et al*. (2001) further indicated that the most commonly consumed indigenous vegetables and fruits in Limpopo Province are good sources of micronutrients such as calcium, magnesium, iron, potassium, zinc, vitamin C and carotene.

According to Nesamvuni *et al*. (2001), in 2001, Vha-Venda women aged 20 to 50 years in Limpopo Province consumed indigenous vegetables (such as *muridi, vowa, phuri, muxe, mushidzhi* and *nngu*) once a week during the summer rainy season. Steyn *et al.* (2001) indicated that most indigenous vegetables were consumed twice or more times per week by Vha-Venda and Ba-Pedi households in Limpopo Province. Low fruit and vegetable intake was observed in the study done in the central region of Limpopo Province amongst children aged one and three years (Mamabolo *et al*. 2006). Despite the increased recognition of indigenous vegetables and fruit as good sources of micronutrients, they are still consumed in lower amounts by children. Thus it seems that, although indigenous foods have been suggested as a possible solution to addressing micronutrient deficiencies in rural areas, they are not always consumed by all vulnerable groups, even when they are available (Aphane *et al.*, 2003).

Thus, according to the literature, more than one third of children in Limpopo Province, especially preschool children, are suffering from acute or chronic undernutrition. In addition, an important proportion of children are suffering from marginal vitamin A deficiency, while one third of children are iron deficient. On the other hand almost two thirds of households are experiencing hunger or are at risk of hunger. Furthermore, Limpopo Province has indigenous foods that are considered rich in both macronutrients and micronutrients and which have the potential to improve the nutritional status of children. The extent of the use of indigenous foods in most rural areas of Limpopo Province is not known. To improve the micronutrient status of children it would be important to determine the extent to which indigenous foods are still being used in rural areas. Nutrition education may be used to improve the knowledge of and practices related to nutrition of caregivers in terms of the use of indigenous foods, which could improve the diets and nutritional status of children.

This study was undertaken in an attempt to determine the impact of a nutrition education intervention programme (NEIP) on the nutritional knowledge and practices of caregivers, as well as the nutritional status (weight, height and micronutrient status) of children aged between three and five years in the Mutale Municipality in Vhembe district, Limpopo Province. Mutale Municipality is a mainly rural area and most of the indigenous foods are still available. The NEIP aims to improve the nutritional knowledge and nutritional practices of caregivers and to encourage the use of indigenous foods that are known to be rich in micronutrients, with a view to improving the dietary intake (including indigenous foods), micronutrient status and nutritional status (weight and height) of preschool children (three to five years).

1.3 Aim and objectives

1.3.1 Aim of the study

The main aim of this study was to determine the impact of a nutrition education programme on the nutritional knowledge and practices of caregivers, and the nutritional status of children aged three to five years in Mutale Municipality.

1.3.2 Objectives of the study

In order to meet the main aim of the study, the following objectives were set:

1.3.2.1 To determine the following before and 12 months after implementation of the nutrition education programme:

- (i) nutritional status of children and caregivers
    - (a) the weight and height status of children and caregivers;
    - (b) biochemical micronutrient (vitamin A and iron) status of children aged three to five years;
- (ii) the nutritional practices of caregivers of children aged three to five years (with emphasis on the use of indigenous foods);
- (iii) nutritional knowledge of caregivers of children aged three to five years (with emphasis on the use of indigenous food).

1.3.2.2 To determine socio-demographic information and related factors.

1.4 Importance of the study

The successful implementation of the nutrition education programme may improve nutritional knowledge and practices of caregivers and thus enable them to improve the dietary intakes of children, not only by including the locally available indigenous foods regularly, but also to improve the quality and quantity of food offered to the children. Therefore, encouraging caregivers to use indigenous food may improve household food security and reduce the rate of malnutrition among children. The research findings may be used to guide policy makers in the Department of Health and Social Development in Limpopo Province to implement the nutrition education programme, and may benefit the community at large.

1.5 Limitations of the study

The human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) status of the participants was not determined. HIV/AIDS status could affect the nutritional status of children, as malnutrition and HIV/AIDS are closely related and can affect each other. According to Food and Nutrition Technical Assistance (FANTA, 2004), HIV infection affects nutrition through increases in resting energy expenditure, reductions in food intake, nutrient malabsorption and loss, and complex metabolic alterations that culminate in the weight loss and wasting common in AIDS. Furthermore, weight loss and wasting are associated with increased risk of opportunistic infections. The immune system will be impaired as a result of HIV/AIDS and can contribute to malnutrition. Thus, malnutrition both contributes to and is a result of HIV disease progression.

In this study it was not determined whether the children were de-wormed or not. Worms can affect the nutritional status of children. The FAO (1997a) indicated that children with parasites lose blood and iron daily, which is the leading cause of anaemia in children and can affect the overall nutritional status of children.

The prevalence of anaemia was not determined because haemoglobin values were not determined. The lack of haemoglobin values may thus affect the interpretation of anaemia. However, serum iron, serum ferritin, serum transferrin and % transferrin saturation were used to determine the iron status of children and together these parameters provide a good overview of iron status.

1.6 Structure of thesis

Chapter 1 outlines the motivation for the study and the problem statement. The aims, objectives, limitations and importance of the study are also outlined in this chapter.

Chapter 2 will focus on the literature review related to the topic. Chapter 3 presents the research methods and techniques used for selecting the participants, the study design, data collection and data analysis. The results of the study are presented in Chapter 4. In Chapter 5 the results of the study are discussed. Chapter 6 contained the conclusions drawn from the study and the recommendations. A summary, both in English and Afrikaans is also included at the end of the thesis.

CHAPTER 2.

LITERATURE REVIEW

2.1 Introduction

Nutritional status can be influenced by various factors, including those summarised in the UNICEF conceptual framework of causes of malnutrition in children (UNICEF, 1990) which include immediate, underlying and basic causes. Some of the nutrition-related factors may be changed by nutrition education; however, certain basic and underlying causes of malnutrition cannot be changed by nutrition education, as these need bigger socio-economic interventions.

Nutrition education can be defined as “communication activities aimed at achieving a voluntary change in nutrition related behaviour to improve the nutritional status of the population” (Andrien, 1994). Nutrition education can also be defined as “any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition related behaviours conducive to health and well-being” (Nnakwe, 2009: 294). It has been shown that nutrition education can improve the nutritional knowledge and practices of individuals, thus improving their nutritional status (Kilaru *et al*., 2005; Lanerolle & Atukorala, 2006). Nutrition education therefore may play a role in improving the nutrition knowledge and the way caregivers feed their children, which could contribute to an improvement of the nutritional status of the children.

For the purpose of this study, the nutritional status of children, the causes of malnutrition, and nutrition education programmes will be discussed according to the outline shown in Figure 2.1

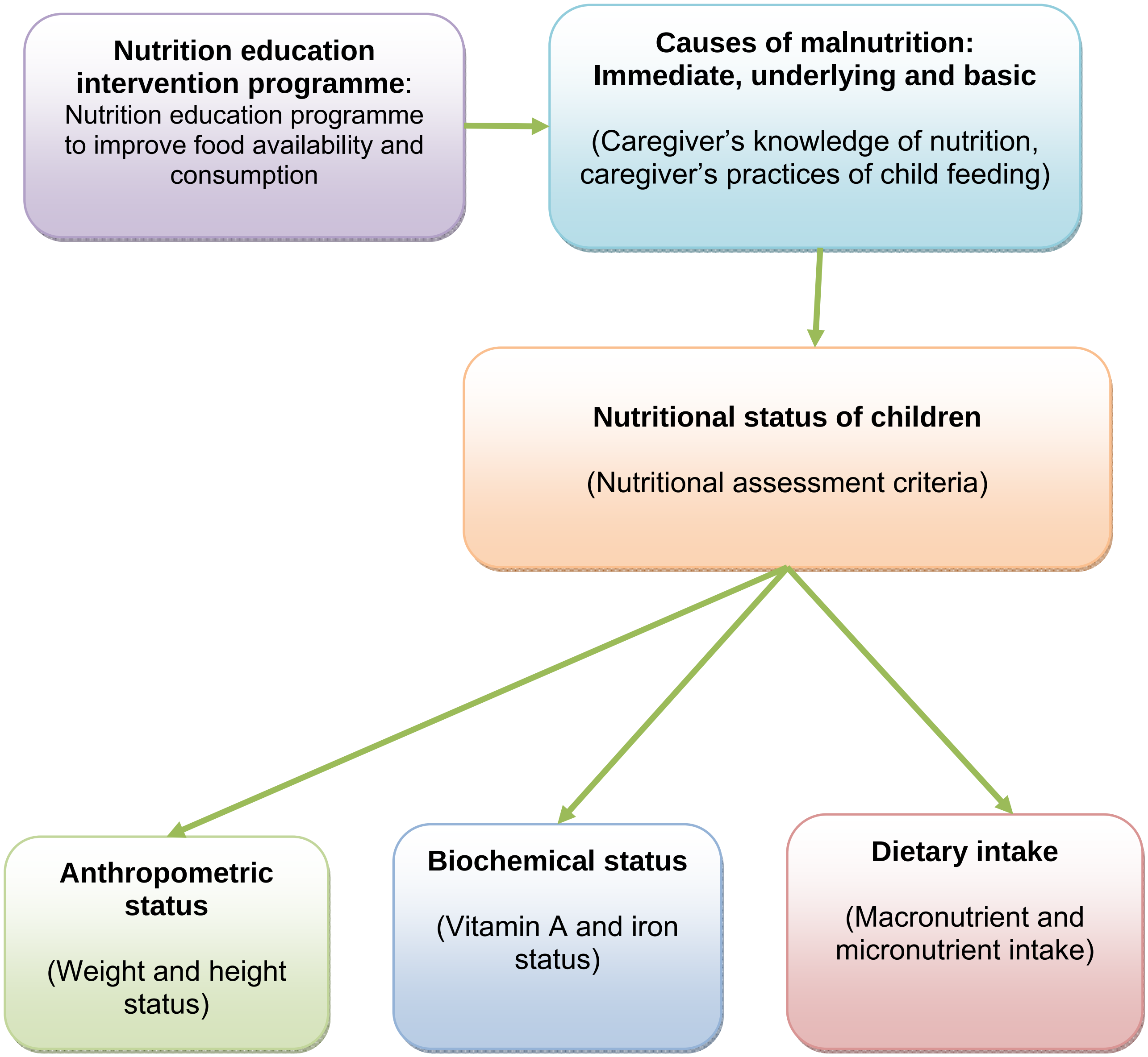

Figure 2.1 **Diagram showing the association between nutrition education, nutritional knowledge and practices of caregivers and nutritional status of children.**

2.2 Nutritional status of children

Nutritional status is defined as "a person's physiological level of nourishment in terms of energy and protein stores, micronutrient status and metabolic functioning" (FAO, 2005). The assessment of nutritional status is defined as "the science of determining nutrition status by analyzing an individual's medical, dietary, and social history; anthropometric data, biochemical data, clinical data and drug-nutrient interactions" (Hammond, 2008:

383). For the purpose of this discussion, the interpretation of the anthropometric, biochemical and dietary intake of children will be emphasised.

2.2.1 Anthropometric nutritional status of children

Anthropometry is the "science of measuring the size, weight and proportions of the human body" (Hammond, 2008: 383). Anthropometric nutritional status includes, for example, weight and height status, body composition (skin-fold thickness, waist circumference, head circumference and mid-upper arm circumference), body density (underwater weighing), air-displacement plethysmography and bioelectrical impedance (to estimate the percentage of fat and lean tissue in the body) (Lee & Nieman, 2007: 3). The interpretation of the weight and height status of children will be highlighted, with the emphasis on growth charts and body mass index (BMI).

2.2.1.1 Growth charts

The development and the interpretation of growth charts will be discussed for the purpose of this study.

(i) Development of growth charts

From the early 1900s, a variety of growth references were developed and used in the United State of America (USA) (Kuczmarski *et al*., 2002). The growth chart that was widely used between 1946 and 1976 was known as Stuart/Meredith growth chart. The Stuart/Meredith growth chart was developed on the basis of weight and height measurements taken on a small sample of white children from 1930 to 1945 (Stuart & Meredith, 1946). Most of these earlier references have considerable limitations, including a lack of coverage for infants and preschool children and differences between boys and girls. These limitations led several expert groups to recommend the development of more representative growth charts, hence the development of the 1977 National Centre for Health Statistics (NCHS) growth charts (Kuczmarski *et al*., 2000). The NCHS growth charts were developed on the basis of the growth of formula-fed children in the USA. The children were only measured every three months, which is not adequate to describe the rapid and changing rate of growth in early infancy.

In 1978, the Centre for Disease Control and Prevention (CDC) developed a modified version of the 1977 NCHS growth curves (Dibley *et al*., 1987). Despite the limitations of the 1977 NCHS normalised growth charts, they were recommended for international use by the WHO until the more representative growth charts were developed in 2006 (WHO, 1995; Kuczmarski *et al*., 2002). The 1977 NCHS growth charts are also referred to as the WHO/NCHS or CDC/WHO or NCHS/CDC/WHO growth charts, and they were widely used in paediatric practices and public health for more than 20 years. The CDC revised and published the 1977 NCHS growth charts in 2000. The more representative survey data from the USA was used for the development of the 2000 CDC growth charts.

The WHO (2006b) introduced the new WHO child growth standards with the aim of replacing the USA NCHS growth references. The approach taken to develop the new references was different from that taken in the past, with the new aim being to represent how the child should grow. De Onis *et al*. (2004) showed that the new WHO child growth standards described the growth of children whose care has followed recommended health practices and behaviour associated with healthy outcomes. The mothers of the children selected for the construction of the new WHO child growth standards engaged in fundamental health promoting practices, namely breastfeeding and not smoking (WHO, 2006b). In addition, the new WHO child growth standards were based on international multicentre countries' exclusively breastfed sample of healthy children living under conditions likely to favour achievement of their full genetic growth potential. The new curves may therefore be considered as prescriptive or normative references, as opposed to the traditional descriptive references based on geographically representative samples of children, regardless of feeding or other behaviours.

(ii) The interpretation of growth

Anthropometric indices can be interpreted using percentiles and z-scores which are used to compare the growth of a child or group of children with that of a reference population (WHO, 1995). The discussion will focus on percentiles and z-scores.

(a) Percentiles

A percentile is the "rank position of an individual on a given reference distribution, stated in terms of what percentage of the group the individual equals or exceeds" (WHO, 1995). Percentile growth charts are a quick screening tool for an individual child, but are not of use in population-based nutrition surveys of young children (Garza & De Onis, 2004). The NCHS major percentiles of the growth charts include the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles, and the main percentiles were retained in the revised growth chart of the 2000 CDC charts.

The more representative survey data of both breastfed and formula-fed infants in the USA was used for the development of the 2000 CDC growth chart percentiles. The percentile cut-off points include the 3rd, 5th, 10th, 25th, 50th, 75th, 90th and 97th percentiles (Gibson, 2005: 305; Kuczmarski *et al*., 2002). In a clinical setting, percentiles are commonly used because the interpretation of percentiles is straightforward.

According to WHO (2006b) the percentiles which fall below the 3rd percentile indicate underweight, wasting or stunting; the 15th to less than the 85th percentiles indicate healthy weight or height, while 85th to 97th percentile indicates overweight. The percentile equal to or greater than the 97th percentile indicates obesity or above normal height.

(b) Z-scores

The z-score (standard deviation score) is the deviation of the value for an individual from the median value of the reference population, divided by the standard deviation for the reference population (WHO, 1995). The WHO also used the z-score classification based on the modified 1977 NCHS growth curves (WHO, 1995; Kuczmarski *et al*., 2002). Z-scores are widely used as a "system for analysing and interpreting of anthropometric measurements" (WHO, 1995). Furthermore, z-scores are gender and age independent, thus permitting the presentation of children's growth status by combining both males and females. The three anthropometric indices can be expressed as weight-for-age z-scores (WAZ), height-for-age z-scores (HAZ) and weight-for-height z-scores (WHZ).

The z-scores based on the modified 1977 NCHS growth curves indicate that a z-score from minus two standard deviations (-2SD) to smaller than or equal to plus two standard deviations (≤ +2SD) indicates a normal weight or height (WHO, 1995). The z-score classifications of anthropometric indices in children based on the 2000 CDC values as compiled by the International Centre for Diarrhoeal Disease Research (ICDDR, 2004) are indicated in Table 2.1. The z-score classification of anthropometric indices in children according to the new WHO standards is shown in Table 2.2 (WHO, 2009).

Table 2.1 Z-score classification to determine nutritional status in children (ICDDR, 2004)

Z-score classification	WAZ	WHZ	HAZ	BMI/A
> +2SD	Overweight	Overweight	Above normal	Overweight
≥ -1SD to ≤ +2SD	Normal weight	Normal weight	Normal height	Normal weight
< -1SD to ≥ -2SD	Mildly underweight	Mildly wasted	Mildly stunted	Mildly underweight
< -2SD to ≥ -3SD	Moderately underweight	Moderately wasted	Moderately stunted	Moderately underweight
< -3SD	Severely underweight	Severely wasted	Severely stunted	Severely underweight

Table 2.2 Z-score classification to determine nutritional status of children (WHO, 2009)

Z-score classification	WAZ	WHZ	HAZ	BMI/A
< -3SD	Severely underweight	Severely wasted	Severely stunted	Severely wasted
-3SD to < -2SD	Underweight	Wasted	Stunted	Wasted
-2SD to < -1SD	Mild underweight	Mildly wasted	Mild stunted	Normal
-1SD to +1SD	Normal WAZ	Normal WHZ	Normal height	Normal weight
>+1SD to ≤ +2SD	Possible growth problem	Possible risk of overweight	Normal height	Possible risk of overweight
>+2SD to ≤ +3SD	Possible growth problem	Overweight	Normal height	Overweight
>+3SD	Possible growth problem	Obese	Above normal	Obese

A z-score from minus one standard deviation (-1SD) to smaller than or equal to plus two standard deviations (≤ +2SD) indicates a normal weight or height, as shown in Table 2.1 (ICDDR, 2004), while Table 2.2 shows that a z-score from -1SD to +1SD indicates a normal weight or height (WHO, 2009). Furthermore, Table 2.1 shows that a z-score between < -2SD and ≥ -3SD indicates moderate underweight, moderate wasting or moderate stunting, while Table 2.2 indicates that z-scores <-2SD indicates underweight, wasting or stunting (ICDDR, 2004; WHO, 2009).

1. Weight for age status

Weight for age is used to measure a child's weight in relation to his age (WHO, 1995). In addition, weight for age helps to identify children who are underweight or overweight. Weight is the first parameter to be affected by dietary intake or disease in young children. Therefore, weight for age is an indicator of acute undernutrition on the one hand, and overweight or obesity on the other. Weight is the only measurement that has to be taken, while the age of the child will be determined from the records or by asking the mother. However, in situations where the child's age cannot be determined accurately it will be difficult to interpret weight for age accurately using estimated age.

Underweight is defined as a weight for age below -2SD of the reference population, while a weight for age of below -3SD of the reference population is classified as severe underweight (WHO, 2000). Furthermore, WHO classifications for assessing the public health significance of malnutrition indicated that a prevalence of underweight that is less than 10% indicates a low prevalence of malnutrition, whereas 10 to 19% indicates a medium prevalence (WHO, 1995). In addition, 20 to 29% indicates a high prevalence, while > 30% indicates a very high prevalence of underweight.

2. Height for age status

Height for age is a measure of how tall or short the child is relative to his age (WHO, 1995). Height does not increase rapidly in children and a low height for age reflects chronic malnutrition, which is due to long-term starvation or shortage of food or repeated illness. Height for age helps to identify children who are stunted or those who are very tall or above normal height.

Stunting is defined as a height for age of below -2SD of the reference population. In addition, a height for age of below -3SD of the reference population is classified as severe stunting (WHO, 2000). The WHO (1995) classification for assessing the public health significance of malnutrition indicates that the prevalence rate of stunting among children is considered low when it is less than 20%, whereas 20 to 29% indicates a medium prevalence of stunting. Furthermore, 30 to 39% indicates a high prevalence, while more than 40% indicates a very high prevalence of stunting among children (WHO, 1995).

3. Weight for height status of children

Weight for height reflects body weight in proportion to attained growth in height (WHO, 1995). The WHO (2006b) indicated that weight for height also helps to identify children who may be at risk of becoming overweight or obese. Weight for height is a good indicator of short-term effects, such as seasonal changes in food supply or short-term nutritional stress brought about by illness (Cogill, 2001). Furthermore, weight for height is a good indicator of severe-acute undernutrition. Therefore, weight for height is not recommended for the evaluation of change in a population because it is highly susceptible to seasonal changes (Cogill, 2001). In cases where the age of the child is unknown, weight for height is used to measure how thin or fat a child is compared to his height and is useful in determining whether a child is wasted or not (WHO, 1995). Weight for height is simple and convenient to use, but it is difficult to detect a shift from muscle to fat and may underestimate obesity trends because it is difficult to distinguish between fat mass and muscle mass (Cole, 2002). It is important to note if the child has oedema, this can influence the weight for height interpretation (Cogill, 2001). If the child is severely stunted it could affect the weight for height and may lead to the child being erroneously classified as well nourished.

Wasting is defined as a weight for height of below -2SD of the reference population, while a weight for height of below -3SD of the reference population is classified as severe wasting (WHO, 2000). The WHO (1995) classification for assessing the public health significance of malnutrition indicates that the prevalence rate of wasting among children is considered low when the prevalence is less than 5%, whereas 5 to 9.9% indicates a medium prevalence of wasting. Furthermore, 10 to 14% indicates a high prevalence, while more than 15% indicates a very high prevalence rate of wasting among children (WHO, 1995).

2.2.1.2 Body Mass Index

Body Mass Index (BMI) is an anthropometric index that is calculated using body weight in kilograms divided by height in metres squared (WHO, 1997). It is important to note that BMI is not a diagnostic tool and does not measure fat directly. BMI for age (BMI/A) is “derived from weight and height measurements, it is inexpensive, easy to use in practice, non-invasive and is associated with little or no harm” (Daniels, 2009). BMI/A is used especially to identify children who are at risk of growth problems such as overweight or obesity. If a high BMI/A is observed in a child, it is important to determine if excess fat is a problem by assessing physical activity, the dietary intake of the child and by doing additional measurements such as skin-fold thickness.

BMI/A for children can be interpreted using percentiles and z-scores. The percentiles are used to indicate the relative position of the child’s BMI score among children of the same gender and age (WHO, 2006a). The BMI for children, unlike that for adults, considers gender and age because, as children grow, the amount of fat changes and the amount of body fat differs between girls and boys. The percentiles for BMI/A include the 3^{rd}, 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 85^{th}, 90^{th}, 95^{th} and 97^{th} percentiles (Kuczmarski *et al*., 2000). A BMI/A which falls below the 5^{th} percentile indicates underweight, the 5^{th} to less than the 85^{th} percentile indicates healthy weight, the 85^{th} to less than the 95^{th} percentile indicates overweight, and the percentile equal to or greater than the 95^{th} percentile indicates obesity (Kuczmarski *et al*., 2002). BMI/A is a useful screening tool for assessing possible weight problems or risk of illness related to excess body fat in children aged two years and above (Gibson, 2005: 319).

A BMI/A z-score above +2SD indicate overweight according to the 2000 CDC z-score classification (Table 2.1). According to the WHO (2009), a BMI/A z-score of >+1SD to ≤ +2SD indicates a possible risk of overweight, as shown in Table 2.2.

2.2.2 Biochemical micronutrient status of children

Laboratory tests provide the most objective and quantitative data on nutritional status, especially micronutrient status (Lee & Nieman, 2007: 320). Biochemical tests can be used to detect nutrient deficiencies and are useful indicators of recent nutrient intake. In addition, biochemical tests are based on measurements of nutrients or their concentration in the blood, urine or body tissue. Laboratory tests are not affected by emotions and other subjective factors, and can supplement other methods of assessing nutritional status (Gibson, 2005: 373). However, biochemical tests are affected by subject-related factors (age, sex, ethnicity, race, genetic pre-disposition), health-related factors (inherited or acquired diseases, infections, inflammation, stress, medication use), biological factors (nutrient interaction, homeostatic regulation) and sampling difficulty (including possible sample contamination and haemolysis) (Gibson, 2005: 373). The assessment of vitamin A and iron status of children will be discussed in this section.

2.2.2.1 Vitamin A status of children

Vitamin A status can be grouped into five categories, which include deficient, marginal, adequate, excessive and toxic (Lee & Nieman, 2007: 335). According to the WHO (1996) vitamin A deficiency can also be classified as marginal or subclinical and clinical vitamin A deficiency. Clinical vitamin A deficiency can be characterised by night blindness, Bitot's spots, corneal xerosis and xerophthalmia (Gibson, 2005: 485).

The most common biochemical test used to assess vitamin A status is serum retinol concentration. A serum retinol of < 200 μg/L (0.7 μmol/L) is classified as a marginal level, while < 100 μg/L (0.35 μmol/L) is classified as deficient (Gibson, 2005: 485; Lee & Nieman, 2007: 336). Furthermore, 200 to 299.9 μg/L (0.7 to 1.04 μmol/L) is classified as an adequate status, while above 300 μg/L (1.05 μmol/L) indicates a normal status. A clinical vitamin A deficiency can be classified by a serum level of < 100 μg/L.

A prevalence rate of marginal vitamin A deficiency that is between 2% and < 10% indicates a mild public health problem; a prevalence rate ≥ 10% and < 20% indicates a moderate public health problem; while a prevalence ≥ 20% indicates a severe public health problem (WHO, 1996).

2.2.2.2 Iron status of children

Iron status can be categorised into iron overload, normal status and iron deficiency. Furthermore, iron deficiency can manifest in a number of ways, ranging from depleted iron stores to iron deficiency anaemia (Gibson, 2005: 445; Lee & Nieman, 2007: 33; Gaw *et al*., 2008: 112). Clinical signs of iron deficiency anaemia include pale skin, fingernails with cuplike depressions and the inside eyelid may be light pink instead of red (Stopler, 2008: 814).

(i) Biochemical indicators of iron status

Biochemical indicators that are recommended for assessing iron deficiency status include serum iron, total iron-binding capacity (TIBC) and serum transferrin saturation, serum ferritin, haemoglobin and serum mean cell volume/mean cell haematocrit (Gibson, 2005: 459; Lee & Nieman, 2007: 328; Litchford, 2008: 422; Stopler, 2008: 815).

(a) Serum iron measures the amount of circulating iron that is bound to transferrin. Serum iron can be used for assessing iron overload or acute iron poisoning. It is a relatively poor index of iron status because of large day-to-day variations, even in healthy individuals, and it should be evaluated in the light of other laboratory values (Litchford, 2008: 422).

(b) Total iron-binding capacity and transferrin saturation: Total iron-binding capacity is a direct measure of all protein available to bind mobile iron and is dependent on the number of free binding sites on the plasma iron-transport protein transferrin (Litchford, 2008: 422). On the other hand, transferrin saturation is used to differentiate between iron deficiency anaemia and other types of anaemia and is considered to be a more sensitive indicator of iron deficiency. Transferrin saturation can be measured directly or indirectly as total iron-binding capacity (TIBC). The cut-off values indicative of iron deficiency as developed by the National Health and Nutrition Examination Survey (NHANES) are transferrin saturation of less than 14% and 15% in children aged three to four years and five to 10 years respectively. If the transferrin saturation is high it indicates iron overload (Lee & Nieman, 2007: 328). TIBC, transferrin saturation and serum iron values continue to appear normal until iron deficiency actually develops. Therefore, these tests cannot detect decreasing iron stores and pre-anaemic deficiencies (Litchford, 2008: 422).

(c) The serum ferritin level is the most sensitive parameter of assessing body iron stores, with a normal level greater than 12 μg/L. These parameters reflect deficient, excess or normal iron status (Lee & Nieman, 2007: 328; Gaw *et al*., 2008: 112). Serum ferritin levels cannot, however, indicate the severity of iron deficiency. In addition, serum ferritin levels increase in the presences of acute and chronic infections, inflammatory disease and liver disorders due to an increased rate of serum ferritin synthesis. In the presences of infections and inflammation it is difficult, if not impossible, to diagnose marginal iron deficiency, and this needs to be taken into consideration when interpreting results.

(d) Haemoglobin concentration is commonly used to assess iron deficiency anaemia. Normal levels of haemoglobin should be 112 g/L and 114 g/L in children aged two to 4.9 years and five to 7.9 years respectively, while NHANES III recommended 112 g/L as a cut-off value for children aged three to five years (Gaw *et al*., 2008: 112; Gibson, 2005: 447). Haemoglobin concentration levels cannot differentiate iron deficiency anaemia from other types of anaemia, and can be affected by chronic infections and other conditions that mimic iron deficiency anaemia. In addition, haemoglobin cannot be used to diagnosis early iron deficiency because it is only affected at the late stage of disease (third stage).

(e) Mean cell volume or mean corpuscular volume (MCV) is a measure of the average size of red blood cells expressed in femtoliter (fL), and if the red blood cells are abnormally small it indicates iron deficiency (Gibson, 2005: 452). MCV is not affected by sampling errors, because the red blood cells are not affected by dilution in the interstitial fluid or puncture in capillary blood samples. People of African origin generally have lower MCV when compared to other ethnic groups. A low MCV value indicates the severity of iron deficiency anaemia. The cut-off point values for MCV are less than 79 fL in children aged three to five years (Gibson, 2005: 453).

No single biochemical test can be used to diagnose iron status, because different indicators are affected by other factors such as infections, inflammatory diseases, use of alcohol and liver disease. Therefore, the assessment of iron status should be done by at least three or more measurements, preferably serum ferritin, serum iron and total circulating transferrin (Stopler, 2008: 815).

(ii) Stages of iron deficiency

Iron status can be categorised into three stages (Gibson, 2005: 445; Lee & Nieman, 2007: 33; Gaw *et al*., 2008: 112) or four stages (Stopler, 2008: 811).

(a) The three stages are outlined below (Gibson, 2005: 445; Lee & Nieman, 2007: 327; Gaw *et al*., 2008: 112):

(i) Stage I: Iron depletion is characterised by low iron stores, which can be confirmed by serum ferritin levels of less than 12 μg/L.

(ii) Stage II: Iron deficiency without anaemia is considered an early or mild iron deficiency and adverse physiologic consequences can begin to occur. This stage is assessed by transferrin saturation of < 12% in children aged one to two years, < 14% in children aged three to four years and < 16% in children age five to 10 years, and increased erythrocyte protoporphytin. Haemoglobin levels may decrease but still remain within the normal range.

(iii) Stage III: Iron deficiency with anaemia, which is assessed by a combination of haemoglobin < 110 g/L in children aged six to 59 months or haemoglobin < 115 g/L in children aged five to 11 years, serum ferritin < 12 μg/L and MCV < 80 fL together.

(b) The four stages of iron deficiency are summarised as ranging from iron overload to iron deficiency anaemia (Stopler, 2008: 811). Stage I and stage II (negative iron balance) are referred to as the iron depletion stage, where iron stores are low and there is no dysfunction. Stage I negative iron balance is characterised by reduced iron stores, while stage II negative stage is characterised by severe iron store depletion with no dysfunction. Stage III and stage IV negative balance are shown by iron deficiency with inadequate body iron, causing dysfunction and disease. Stage III negative iron balance is not accompanied by anaemia, whereas stage IV negative iron balance is accompanied by anaemia.

The prevalence rate of iron deficiency anaemia is categorised as a severe public health problem if ≥ 40% of children aged six to 59 months or five to 11 years have haemoglobin levels of <110 / 115 g/L (UNICEF/ United Nations University (UNU) /WHO, 2001). In addition, the prevalence rate of 20% to 39% of iron deficiency indicates a moderate public health problem, 5% to 19% indicates a mild public health problem, while 0 to 4.9% indicates a normal prevalence rate (UNICEF/UNU/WHO, 2001).

2.2.3 Dietary intake

Dietary intake is defined as “the amount of a nutrient that a person receives through their food intake or diet” (Smolin & Grosvenor, 2008: 40). The food consumed provides different nutrients that are useful for the growth, development and well-being of a person. It is important to evaluate the food consumed by people in order to determine if it provides adequate nutrients. There are numerous standards that have been developed to serve as a guide for planning and evaluating diets and food supplies for individuals and populations in different countries (Khan & Al-Kanhal, 1998; Escott-Stump & Earl, 2008: 338). Dietary standards are used to interpret food consumption records of individuals and populations. Adequacy of diet can be assessed by various guidelines, including nutrient based guidelines, food guide pyramids (FGPs), food-based dietary guidelines (FBDGs), US dietary goals and food exchange systems. A nutrient-based approach for the evaluation of dietary intake can be useful to identify specific nutrient deficiencies in the diet, but this does not easily translate into practical guidelines that can be understood by the general public (WHO/FAO, 2004). To achieve this, a food-based approach is more relevant.

2.2.3.1 Nutrient based guidelines

Nutrient-based guidelines include the dietary reference intakes (DRIs) and recommended nutrient intakes (RNIs) which will be discussed in the following section.

(i) Dietary reference intakes

The recommended dietary allowance (RDA) was first established in 1941 and has been continuously revised in order to incorporate the most recent research findings (Escott-Stump & Earl, 2008: 338; Food and Nutrition Board and Institute of Medicine, (FNB & IOM, 2000). The RDA was initially developed to address nutrient deficiencies and focused on the levels of nutrients required for healthy populations to prevent deficiency diseases. Despite the limitations of the RDA, it served as the nutrient standard in many countries, both developed and developing (Lee & Nieman, 2007: 17). The limitations of the RDA have led to the development of a more comprehensive set of nutritional and dietary standards that adequately address nutritional concerns. The DRI model includes four reference values or components, namely estimated average requirements (EAR), adequate intake (AI), tolerable upper intake level (UL) and RDA (Escott-Stump & Earl, 2008: 338; Lee & Nieman, 2007: 25-26; Smolin & Grosvenor, 2008: 36). Each reference value or component has specific characteristics and uses.

The EAR is defined as the amount of nutrients required to meet the 50% of nutrient needs of healthy people in a particular life stage and gender group. EAR values are used for planning and evaluating the adequacy of nutrient intakes of populations (not individuals) and serve as the basis of RDA (Smolin & Grosvenor, 2008: 36).

The RDA is defined as the average daily dietary intake level that is sufficient to meet the nutrient requirement of nearly all (97% to 98%) of the healthy population of individuals in a particular life stage and gender group. The RDA serves as a target for individuals, not as a benchmark of adequacy of diets of the population.

The AI is defined as a level of intake based on experimentally derived intake levels or approximations of observed mean intakes by groups of healthy people. AI is used as a goal when an RDA cannot be set due to insufficient data to calculate an EAR or RDA.

The UL represents the maximum level of nutrient intake in order to reduce the risk of adverse or toxic effects caused by increased consumption of nutrients in concentrated forms or from enrichment, fortification and supplements. The UL represents levels of nutrient intake that can be tolerated without posing a risk of adverse effect or toxicity to almost all people in the specific age gender group. UL is used as a guide for limiting intake when planning diets and evaluating the possibility of overconsumption.

The different reference values/components of the DRIs are used for assessing and planning the nutrient intake of healthy individuals or populations with the intent of promoting and preventing chronic and deficiency diseases (Escott-Stump & Earl, 2008: 338; Smolin & Grosvenor, 2008: 36). It is recommended that the DRIs should be used with other methods of nutritional assessment and not as an only means of assessing nutrient adequacy.

(ii) Recommended nutrient intakes

Recommended nutrient intakes (RNI) were developed by the WHO and are defined as "a daily intake set at the EAR plus two standard deviation (2SD), which meets the nutrients requirements of almost all (97.5%) apparently healthy individuals in an age and sex-specific population group" (WHO/FAO, 2004). The RNI were established to define the requirements for essential nutrients, but are not as effective as food-based guidelines in addressing the nutritional problems of the world (FAO/WHO, 2001). The RNIs are not intended to be used to define daily requirements for individuals. However, a healthy people who are meeting their RNI are more likely to be reaching their daily requirements of specific nutrients.

2.2.3.2 Food guide pyramids

Food guide pyramids (FGPs) are "a graphic representation of patterns of daily food choices that constitute a healthy diet and convey the concepts of variety, proportionality and moderation" (Lee & Nieman, 2007: 51). FGPs are nutrition education tools that translate dietary standards or guideline recommendations into choices that make up healthy dietary and lifestyle patterns for people with little or no training in nutrition (Smolin & Grosvenor, 2008: 42; Lee & Nieman, 2007: 51).

FGPs have been developed in different countries in response to eating patterns, nutrition-related health problems or public health concerns. Examples of FGPs include the United States Department of Agriculture (USDA) FGPs, Asian pyramids, Mediterranean pyramids, Latin American pyramids, Puerto Rican pyramids and vegetarian pyramids (Escott-Stump & Earl, 2008: 342; Nutrition Insights, 1997). This discussion will focus on Asian pyramids, Mediterranean pyramids and USDA FGPs, because they all illustrate eating patterns that are consistent with current nutritional recommendations and can be used to plan diets consisting of different food items. The USDA FGPs, Asian and Mediterranean food pyramids encourage regular physical activity or daily exercise, and moderate consumption of alcoholic beverages (Nutrition Insights, 1997). They all emphasise the consumption of a variety of foods, which will ensure that all nutrients required for good health are acquired. In addition, they all encourage eating plenty of plant products (grain products, vegetables, legumes and fruits) daily, while meat, fats, chicken and dairy products should be eaten in smaller amounts and less regularly.

The Mediterranean diet pyramid was developed to represent the eating patterns of the traditional Mediterranean cultures of Crete, Greece and southern Italy. This diet demonstrates a reasonable diet for reducing and preventing chronic disease such as cardiovascular disease and cancer, leading to high life expectancy even with limited medical services (Escott-Stump & Earl, 2008: 349). Similarly, the Asian diet pyramid was developed as a model of healthy eating and plays an important role in preventing and treating certain health conditions. The Asian diet pyramid represents the diet of countries such as Bangladesh, Cambodia, China, India, Indonesian, Japan and many other Asian countries. Both Mediterranean and Asian diets emphasise the importance of obtaining most of one’s energy from plant-based foods such as grains, legumes, nuts, fruit and vegetables, while using minimal amounts of energy from animal food and fat (Escott-Stump & Earl, 2008: 350).

The USDA FGPs are divided into five major food groups and provides a graphic outline of what constitutes a healthy diet. This pyramid conveys the concepts of variety, proportion and moderation. It also forms a method for determining appropriate patterns for daily food choices based on the recommended number and size of servings from the different food groups for different age groups. The foods are arranged according to their energy content, with cereals and grains at the base of the pyramid, indicating that foods from this group should form a larger part of the meal or diet (Escott-Stump & Earl, 2008: 339; Smolin & Grosvenor, 2008: 45). On the other hand, the foods at the apex of the pyramid should be consumed sparingly. These include fats, oils and sweets.

The USDA FGPs were adapted to mypyramids, which are more visible but are not always clearly understood by the public, and are used to educate Americans about the importance of physical activity (Escott-Stump & Earl, 2008: 342). Mypyramids now emphasise concepts such as activity, moderation, proportion, portion size and variety when choosing foods. The mypyramids were also developed for children, to assist parents when choosing foods and to increase the variety of new foods regularly when introducing foods to the children's diet (Smolin & Grosvenor, 2008: 608). Mypyramids for children use child-friendly graphics and the amount of food recommended for each group is shown. They also include physical activity, the number of portions that should be included, as well as portion size.

2.2.3.3 Food-based dietary guidelines

The food-based dietary guidelines (FBDGs) are a "practical means of assisting people to reach appropriate nutritional goals" (Clay, 1997). FBDGs should promote appropriate diets, healthy lifestyles and also consider customary dietary patterns. In addition, they should be appropriate for different populations, and each country should develop its own FBDGs that are appropriate for the population.

In 1992, the FAO and WHO convened the International Conference on Nutrition so that strategies and actions to improve nutritional well-being could be identified (FAO/WHO, 1992). Thereafter, the consultation of 22 experts to discuss the preparation and use of FBDGs was convened. Hence, the experts recommended the development and implementation of FBDGs throughout the world.

The aim of FBDGs was to translate scientific, nutrient-based recommendations into total diet concepts that are meaningful and understandable to the population (Kersting *et al.*, 2005). According to Clay (1997), FBDGs are intended to help individuals to consume diets that can alleviate health problems, and not solely to close a gap between estimated and recommended nutrients intakes. Therefore, FBDGs should be clear and understandable so that consumers are able to use the FBDGs by using simple and practical slogans. The FBDGs should consist of short and clear messages that have been tested for comprehension, appropriateness and applicability to the consumer (Clay, 1997; Vorster *et al*., 2001; Kersting *et al*., 2005).

Recommendations for the development of FBDG for different population groups include the following: the FBDGs should be population based and take into account the prevailing food consumption patterns and nutrition-related health problems within a country; the nutrition- and diet-related problems of public health significance, as well as the affected population group, should be identified and the estimates of the magnitude of the problem should be used to establish priorities (Clay, 1997; Vorster *et al*., 2001; Kersting *et al*., 2005). The team that will develop the FBDGs should be multi-disciplinary and include sectors such as agriculture, education, communication and food and nutrition science, as well as representatives from the food industry (Clay, 1997). In addition, the FBDGs should be tested on the public to evaluate the in-depth understanding of the guidelines by the consumers.

The South African FBDGs (SAFBDGs) were based on the existing dietary patterns and locally available foods with the aim of addressing identified nutrition-related public health problems in South Africa (Vorster *et al*., 2001). The SAFBDGs consist of 11 messages and are recommended for healthy people aged seven years and older.

The paediatric SAFBDGs (PSAFBDGs) were developed for infants and children younger than seven years. The guidelines were drafted in line with scientific and local public health evidence and existing SAFBDGs for people older than seven years (Bourne, 2007). The PSAFBDGs are divided into three age categories, namely birth to six months, older than six months to less than 12 months, and older than one year to less than seven years. The PSAFBDGs consist of ten messages and eight of those messages are similar to the SAFBDGs for people who are seven years and older. The PSAFBDGs encourage caregivers to feed children five small meals daily and take children to a clinic every three months (Bourne, 2007). In contrast, SAFBDGs for people who are seven years and older consist of 11 messages. Both guidelines (SAFBDGs for people seven years and older and PSAFBDGs) are based on locally available foods and use terminology that is understandable to the community.

(i) Enjoy the variety of foods:

Both guidelines (FBDGs and PFBDGs) aim to encourage people to enjoy their food and eat a variety of foods, since there in no single food or meal that can provide all the nutrients needed by the body.

(ii) Make starchy foods the basis of most meals

Both guidelines (FBDGs and PFBDGs) aim to increase the intake of cereals and grains and to make sure that starchy foods are the central or main food when planning meals. Furthermore, it aims to promote an increased intake of carbohydrate-rich foods and encourage the intake of unrefined and fortified starchy foods (brown bread, coarse maize-meal, samp) that contain vital vitamins, fibre and minerals. Starchy vegetables, e.g. sweet potatoes, provide useful amounts of vitamin A and C.

(iii) Eat plenty of vegetables and fruit every day

Both guidelines (FBDGs and PFBDGs) aim guideline is aimed at promoting the consumption of vegetables and fruit daily because they are good source of micronutrients. Micronutrients play an important role in strengthening the immune system. It is important for caregivers to give indigenous vegetables and fruits (when available) as they are good source of micronutrients and they are also accessible in rural areas. Furthermore, the daily consumption of vegetables and fruit protects against cancers of the stomach, oesophagus and lungs. Vegetables and fruit also play a role in protecting the body against cardiovascular disease, particularly if attention is paid to flavonoid intake as well as potassium, folate and fibre.

(iv) Eat dry beans, split peas, lentils and soya

Legumes (dry beans, baked beans, butter beans, and jugo beans) are rich in protein, carbohydrates, soluble and insoluble dietary fibre components and a variety of minerals and vitamins. In addition, they also contain non-nutritive compounds such as protease inhibitors, phytate, saponins, plant sterols and isoflavones. Legumes should be eaten two to three times per week. It is also important to encourage children to eat legumes and nuts such as beans and peanuts as they are good source of protein.

(v) Chicken, fish, meat, milk or eggs can be eaten daily

Chicken, fish, meat, milk and eggs are all animal-based foods and are all sources of good quality protein. Protein is needed for growth, maintenance and repair of body tissue. Dairy products such as milk and maas, and the soft edible bones of fish (pilchards, sardines) are good sources of calcium, which is essential for healthy bones and teeth, blood clotting and for healing wounds. Therefore, children should be given milk every day in order to meet their calcium requirements. However, if the intake of animal foods is high it may be related to an increased risk for some chronic diseases. Children should be encouraged to eat chicken, fish, meat and eggs every day. Where culturally acceptable, caregivers can also give their children edible insects such as mopani worms, termites and locusts.

(vi) Eat fats sparingly

An increased intake of fat is associated with chronic diseases such as cardiovascular disease, obesity and certain types of cancer (breast, colon and prostate). Yet a diet that is very low in fat may have adverse effects on the health and growth of young children. Therefore, a moderate fat intake providing less than 30% of total energy is recommended.

(vii) Eat salt sparingly

The guideline encourages a low consumption of salt and the use of iodated salt. However, the high intake of salt over a long period of time may lead to an increase in blood pressure in genetically susceptible people. Salt should be used sparingly during meal preparation and at the table, and the intake of processed foods high in salt should be limited.

(viii) Drink a lot of clean safe water

Water is an essential nutrient that is often neglected. The body needs water for survival, since most biochemical reactions occur in water and water is an active participant in these reactions. In addition, water is a major component of the thermoregulatory system of the body. Therefore, children should be offered clean safe water regularly.

(ix) Be active

This guideline is aimed at encouraging people to be involved in physical activity. An individual should engage in moderate to vigorous activity for 30 minutes at least on most of the days of the week. Exercise is also associated with a reduction in cardiovascular diseases mortality. Children should be encouraged to play outdoors every day.

(x) Use food that contains sugar sparingly and not between meals

The guideline encourages people to use sugar and food that contain sugar sparingly because it can suppress the appetite of young children. This will affect their nutrient intake and consequently affect their overall health in the long run.

2.3 Causes of malnutrition in children

The causes of malnutrition are complex, ranging from biological and social to environmental factors. The causes of malnutrition can be classified as immediate, underlying and basic, as illustrated in Figure 2.2 (UNICEF, 1990).

2.3.1 Immediate causes of malnutrition in children

The immediate causes of malnutrition in children are associated with dietary intake, psycho-social care (stress, trauma) and disease-related factors (UNICEF, 1990).

Inadequate dietary intake in young children compromises immune function, which may lead to disease or to disease being more severe or prolonged. The International Food Policy Research Institute (IFPRI, 2000) has indicated that dietary intake and diseases are interdependent, because disease reduces appetite and the absorption and utilisation of ingested nutrients, and increases catabolic losses. According to UNICEF (1990), children with inadequate dietary intakes are more susceptible to disease than children who are well nourished. Therefore, undernutrition may develop as a result of diseases and dietary inadequacies interacting in a mutually reinforcing manner (Allen & Gillespie, 2001). These interactions between inadequate dietary intake and disease, in the form of a vicious cycle, have been referred to as the malnutrition infection complex.

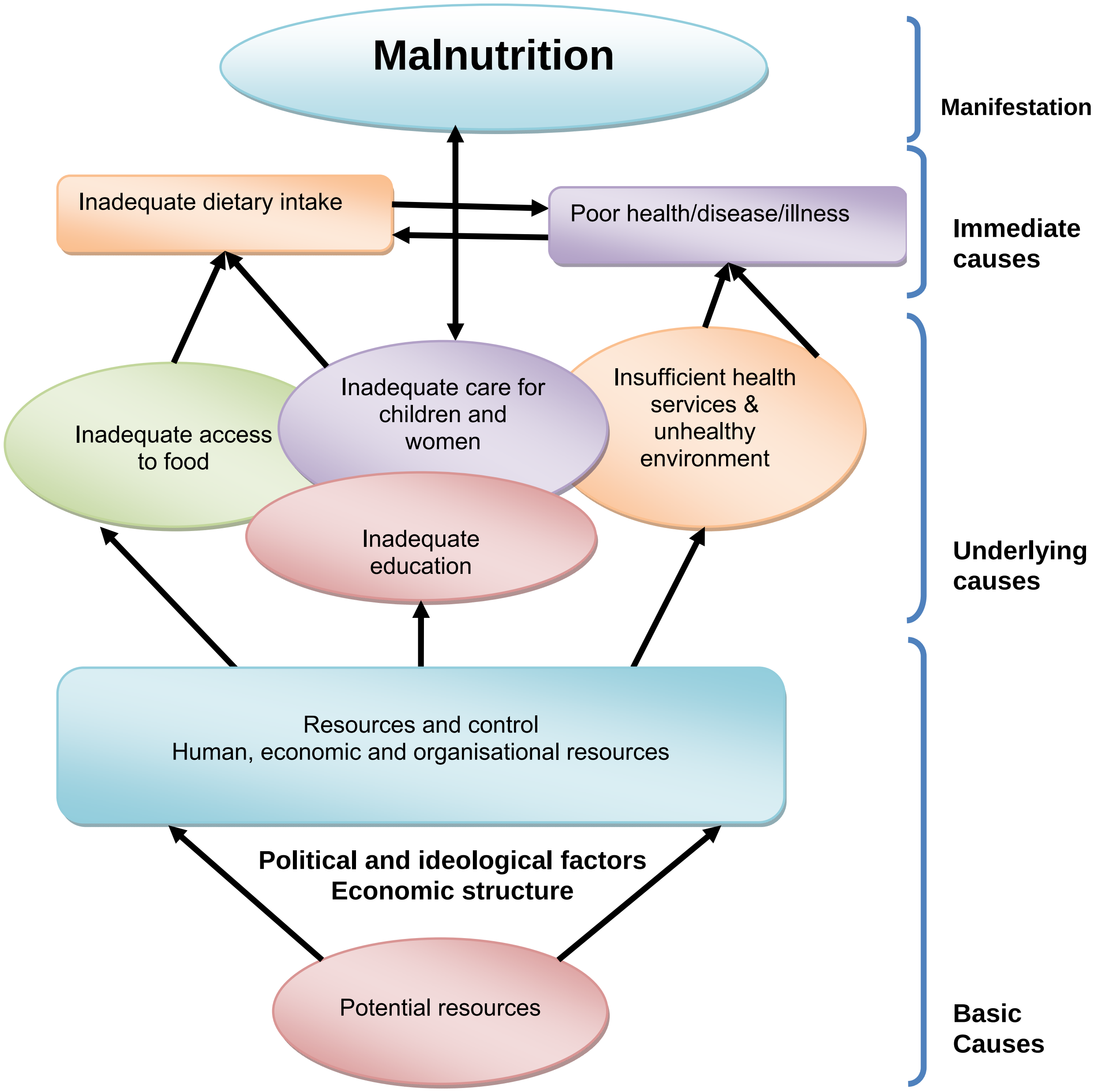

Figure 2.2 UNICEF conceptual frameworks for causes of malnutrition (Adapted from UNICEF, 1990)

Infectious diseases such as diarrhoea, acute respiratory disease and HIV/AIDS are most common in young children and are the leading cause of death amongst children. Infection increases nutrient needs and, at the same time, may reduce appetite, leading to low food intake and impaired absorption of nutrients, which may result in malnutrition.

Allen and Gillespie (2001) have indicated that the impaired absorption of nutrients due to intestinal infections or parasites or combinations of these problems may contribute to poor growth in children. Therefore, inadequate dietary intake may not be the only cause of malnutrition, since the presence of disease may reduce bioavailability or increase needs or nutrient losses and can thus also be an immediate cause of malnutrition (Stratton *et al*., 2003).

Poor infant feeding practices are the leading cause of malnutrition amongst children. The WHO/UNICEF (2003) indicated that breastfeeding is the ideal way of providing children with the nutrients required for healthy growth and development. Several studies have indicated that inappropriate breastfeeding practices are associated with malnutrition in children under five years of age (Onayade *et al*., 2004; Muchina & Waithaka, 2010). The FAO/WHO (1992) also recommended that children should be breastfed for two years and beyond, with appropriate and timely complementary foods being provided. Furthermore, if complementary feeding is introduced too early or too late, and the foods usually given are nutritionally inadequate and unsafe, this could lead to malnutrition in children. The WHO/UNICEF (2003) further indicated that children who are not breastfed are more likely to suffer from infectious diseases such as diarrhoea, which results in malnutrition in children. On the other hand, when children are introduced to complementary foods, the type and quantity of food, as well as the quality of food given, should be taken into consideration (WHO/UNICEF, 2003). The time of introducing complementary foods places most children at risk of being malnourished, because they are fed inadequate and unsafe foods.

2.3.2 Underlying causes of malnutrition in children

UNICEF (1990) has indicated that the underlying causes of malnutrition in children include food insecurity, inadequate care for mother and child, lack of education and information of caregivers, as well as inadequate health services and a poor health environment, which includes poor sanitation and water supplies.

2.3.2.1 Household food security

Household food security exists when “all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 2004). The three key dimensions of food security include food availability (which is achieved when sufficient quantities of safe and nutritious food are consistently available), access to food (which depends on adequate resources) and utilisation of the food (which is the proper biological use of food) (IFPRI, 2000). Food insecurity is directly related to inadequate dietary intake, which may lead to poor nutritional status of children (Chanyalew, 2005). Food insecurity, whether due to poor food accessibility or availability, is directly related to an inadequate dietary intake and increased levels of stunting and underweight (NFCS, 1999). Therefore, food security is the pre-condition for adequate dietary intake. However, adequate food may not always translate into good nutritional status, because there could be poor food distribution in the household, or disease. Disease and infections can lead to malabsorption, or poor food preparation methods can destroy nutrients and thus children from a food secure household may still suffer from malnutrition (Iram & Butt, 2006).

Other factors that are also linked to household food security include the family’s standard of living, income, number of people in the household and access to land for food production (Nyariki & Wiggins, 1997). Improving the living standards of families through the empowerment of mothers with the aim of augmenting family income may help to reduce the incidence of malnutrition in children younger than five years (Odunayo & Oyewole, 2006). Household size influences the way the family shares food amongst its members; the bigger the family, the greater the chance of children suffering from chronic malnutrition (Nyariki & Waggins, 1997). Kleynhans *et al.* (2006) indicated that most children who were stunted where from bigger families compared with non-stunted children.

2.3.2.2 Health services and environment

A lack of access to basic health services and a healthy environment are the underlying causes of malnutrition in children. Kabubo-Mariara *et al*. (2008) indicated that access to health services was an important determinant of a child's nutritional status. It was also demonstrated in the study done in Morogoro Municipality (Tanzania) by Maseta *et al*. (2008) that there is an association between access to health services and the nutritional status of children. Maseta *et al*. (2008) indicated that the prevalence of wasting in children was higher amongst children who were not attending growth-monitoring programmes than in those who were attending such programmes.

Access to safe drinking water is a basic right of all human beings, and children's well-being is highly dependent on both the quality and availability of water and how well this precious resource is managed (United Nations Environment Programme (UNEP)/ UNICEF/WHO, 2002). Unfortunately, most water sources in developing countries are contaminated by waste material such as human or animal waste and sewage. Most people do not have access to clean safe water and a simple latrine. As a result, many rivers and lakes are heavily polluted by human waste and this poses a major challenge in most rural and low-income populations (UNEP/UNICEF/WHO, 2002). Limpopo Province, like many other rural areas, has challenges relating to access to clean safe water, since it was found in 1994 that more than 75% of household used communal taps and 14% collected water from a river or dam (SAVACG, 1995). It is virtually impossible to maintain the necessary sanitary conditions at home if there is too little water, and this can lead to outbreaks of debilitating or fatal diseases among children.

Unsanitary conditions and practices at household level, such as the absence of sanitary latrines, unsafe waste disposal and unhygienic behaviour in childcare and food preparation, create a dangerous environment with health risks such as diarrhoeal diseases, which can lead to poor nutritional status in young children (UNEP/UNICEF/ WHO, 2002; Maxizya-Dixon *et al*., 2004). It has been shown that the lack of a latrine in a household can be associated with stunting, and children with better nutritional status often have access to clean safe water compared to their counterparts who do not have access to clean safe water (Pryer *et al.*, 2003; Wamani *et al*., 2006). Pongou *et al.* (2006) indicated that improved access to household water, sanitation and cooking fuel had a positive effect on the nutritional status of children.

2.3.2.3 Education and information

The education level of women, who are the main caregivers of children, has an influence on the quality of care, because more educated women are more able to process information on nutrition, acquire skills and display positive caring behaviours than less educated women, and this is reflected in the child's nutritional status. According to the IFPRI (2000), improved education levels in women were responsible for almost 43% of the total reduction in child malnutrition that took place from 1970 to 1995. Several studies have shown that children of mothers with no formal education or only primary education were more likely to be stunted when compared to their counterparts with mothers who had secondary or college education (Chen & Li, 2008; Semba *et al*., 2008; Hendricks *et al*., 2006; Sakisaka *et al*., 2006; Wamani *et al*., 2004; Tharakan & Suchindran, 1999). The low prevalence rate of stunting in children of mothers with higher education levels could be attributed to the fact that literate mothers have fewer children, which can enable them to provide better care. They also have access to health information, leading them to adopt improved behaviour related to maternal and child health care, feeding and eating practices, which ultimately influences the nutritional status of children. In addition, women with no education are more likely to embrace the traditional status quo and less open to changes for better health and family practices, which may influence the way they feed their children.

Caregivers' nutritional knowledge affects the way they feed their children, and consequently affects the nutritional status of the children. According to UNICEF (1990), poor nutritional knowledge plays a role in most of the multi-sectoral factors, such as inadequate food intake and unhygienic dietary practices involved in the development of malnutrition. Lack of awareness and a lack of nutrition knowledge about feeding amount, frequency, type of food and balanced diet contribute significantly to poor nutritional status of children younger than five years of age, even in families where adults meet their daily requirements (Jones *et al.*, 2005; Kilaru *et al*., 2005; Levitt *et al*., 2009; Manu & Khetarpaul, 2006).

2.3.2.4 Mother and child care

UNICEF (1997) defined care for nutrition as "practices at household level of those who give care to children translating the available food and health care resources into a child's survival, growth and development". Care practices and resources for care are important components in child health and development. So far, care practices and resources for care are underestimated and are not given consideration by those responsible for nutrition, since they are viewed as activity that are mainly performed by women and that are time consuming (UNICEF, 1997). On the other hand, inadequate care for women and young children can compromise the growth and development of children. WHO/UNICEF (2003) indicated that improved health status of caregivers influences infant feeding practices, however the caregiver's knowledge of care practices and access to resources have a larger influence. Moreover, the caregiver's knowledge will have an impact on the nutritional status of children. Therefore, training and education should be aimed at giving women skills to create better opportunities for improved care for themselves and their children.

2.3.3 Basic causes of malnutrition in children

The basic causes of malnutrition include resources and the control of human and organisational, economic structure, political and ideological superstructure. In addition, basic causes of malnutrition include culture, religion, tradition and belief that play a role in how children are fed and cared for, which consequently affects the nutritional status of children (UNICEF, 1990).

Authority, cultural and religious structures often give more resources to men, resulting in women having less access to productive resources such as access to credit, improved technologies, seed and fertilizers, because women have less influence or power within the household and community, leading to unfair distribution of food within the household (Ajani, 2008). Religion and cultural norms also constrain women's rights, while reproduction and household responsibilities impinge on their time and mobility, leading to poor care of themselves and their children, resulting in poor nutritional status.

A lack of rural infrastructure, limited access to modern inputs and irrigating infrastructure, poor roads and storage facilities, limited knowledge about modern farming techniques and limited access to credit all lead to low food productivity, limited participation in markets and a lack of investment (FAO, 2009). If governments can ensure that most rural people have access to resources such as land for food production, modern agricultural technologies and credit, household food security can be improved significantly, resulting in adequate dietary intake and better nutritional status of the families (Ajani, 2008). Governments should develop agricultural and economic policies and provide financial institutions that support smaller rural farmers with the provision of input to revive the agricultural sector, which has been neglected for decades (FAO, 2009).

The economic growth of a country, especially equitable growth, when social services become affordable and accessible and when adequate investment is made in human resources (including the empowerment of women), is more likely to improve the nutritional status of the community, particularly that of young children (FAO, 2009).

2.4 Nutrition education intervention programmes

Nutrition interventions include a broad array of programmes and activities with many different goals (Kristal, 2008: 169). Nutrition intervention programmes are designed for various reasons, ranging from the treatment of disease to the prevention of specific diseases or changing people's dietary behaviour, both directly and indirectly. Most nutrition intervention strategies include a nutrition education and promotion component with the aim of improving the nutritional knowledge and dietary behaviour of the targeted population. Nutrition education is essential for promoting knowledge of nutrition as well as nutritional practices, which have the potential to result in the better nutritional status of the targeted population (Nnakwe, 2009: 293). It is important to note that nutrition education intervention programmes are used to create awareness and increase the intake of quality foods, including fruit and vegetables (Guldan *et al.*, 2000; Jones *et al.*, 2005; Kilaru *et al.*, 2005).

Nutrition intervention programmes often include components of dietary diversification, integrated nutrition programmes, food fortification, micronutrient supplementation, promotion of breastfeeding, integrated food security and nutrition programmes, and school feeding programmes and growth monitoring should include nutrition education (Nnakwe, 2009: 293). Dietary diversification and integrated nutrition programmes will be discussed in more detail in the following section. Both dietary diversification and integrated nutrition programmes are interventions that include a component of nutrition education, with an emphasis on food production and improved quality of the diet.

2.4.1 Dietary diversification

Dietary diversification refers to "varied approaches that are aimed at ensuring that people consume a variety of foods that provides adequate quantity and quality of all essential nutrients for necessary health" (Ruel, 2001). These authors also emphasise that dietary diversification is important to improve the intake of critical nutrients, which may include both macronutrients and micronutrients (He Kim, 2003; Ruel, 2001). Dietary diversification encompasses a wide variety of interventions that aim to increase the production and availability of food, and access to food, to increase the consumption of foods rich in micronutrients, or to increase the bioavailability of the micronutrients in the diet (the amount of micronutrients that can be absorbed and utilised by the body) (Ruel, 2001). Examples of dietary diversification strategies include increased production of micronutrient-rich foods (agricultural programmes and policies to increase commercial production of fruits and vegetables and promotion of home gardens and small animal production), increased intake of micronutrient rich foods through nutrition education and communication, social marketing and behavioural change programmes, and increased bioavailability of micronutrients. Increased bioavailability of micronutrients can be accomplished by promoting home-processing techniques, such as fermentation or germination to increase bioavailability, as well as plant breeding that includes the increased concentration of micronutrients and reduced concentration of substances that inhibit the absorption of nutrients.

Home gardens and small animal farming projects help in improving household food security and also increase household income when a surplus is produced (vegetables and animals are sold, which can reduce poverty by generating income that will assist the family to buy other basic supplies). Promoting the production of horticultural crops with a high carotene content, such as carrots, pawpaw and leafy vegetables, increases access to and consumption, leading to improved vitamin A status of the community (Babu, 2000; Faber *et al*., 2002b). However, home gardens and small animal farming should be integrated with nutrition education to ensure that the small farmers also consume the food they produce before they sell everything. Several studies have shown that the home garden, coupled with nutrition education, increased the intake of vitamin A-rich foods, leading to improved micronutrient status of children (Chakravarty, 2000; Faber *et al*., 2002a; Jones *et al*., 2005; Ruel & Levin, 2000).

Babu (2000) indicated that most indigenous vegetables (cowpea leaves, pumpkin leaves, *Amaranthus* leaves) that are consumed in Malawi are rich in micronutrients such as vitamin A, vitamin C and calcium. Therefore, traditional and indigenous foods are likely to be a more sustainable as well as long-term solution to the elimination of micronutrient deficiencies (Hong, 2003). However, Oiye *et al.* (2009) observed that almost all households in Western Kenya consumed vitamin A-rich indigenous vegetables and fruits at least once per week. There is a need to protect and promote the consumption of indigenous foods in order to improve overall the health and nutritional status of the population (Venter *et al*., 2007). In most countries, important improvements in the micronutrient status of the population can be achieved by changing practices at the household level, and by protecting and promoting nutritionally beneficial traditional practices that are eroding (Aphane *et al*., 2003). In addition, nutrition education will assist in changing knowledge, attitudes and household dietary practices and may also be required to contribute to positive changes in food consumption and nutritional status (Jones *et al*., 2005).

2.4.2 Integrated nutrition programmes

Integrated nutrition programmes (INP) are combinations of various intervention strategies to achieve nutrition objectives through inter- and intra-collaboration between nutrition sections and other sections in the health sector, as well as other government departments and nongovernmental organisations (Allen & Gillespie, 2001; Behr, 2008:

44; DOH, 2008a). Countries such as Bangladesh, Tamil Nadu in India and South Africa have implemented integrated nutrition programmes over the past decades, after realising that nutrition problems are not caused by inadequate dietary intake only, and they need a multi-disciplinary approach to address all causes of malnutrition. The Tamil Nadu Integrated Nutrition Project (TINP) started its first programme in 1980 and the second one in 1991 (Allen & Gillespie, 2001). In 1996, the Bangladesh Integrated Nutrition Programme (BINP) was implemented (Allen & Gillespie, 2001).

WHO (1999) have recommended that INP should address both nutrition and psychosocial issues that affect the nutritional status of the population, especially of children and women. Integrated strategies are more effective and efficient when compared with fragmented approaches, because there is increased access to services and they use the same facilities to address multiple causes of malnutrition simultaneously (Allen & Gillespie, 2001). In addition, integrated strategies should incorporate child psychology in health services by including developmental milestones on health cards and messages on how to facilitate psychological development, the promotion of child services combined with supplementary feeding for malnourished children, community development and income-generating projects, maternal health services and nutrition education (WHO, 1999).

The TINP was successful in reducing severe malnutrition and the infant mortality rate in South India, while moderate undernutrition and low birth weight were not reduced significantly. In Bangladesh, the BINP was also successful in reducing severe malnutrition significantly in the participating district. The success of this project has shown that nutrition intervention strategies that target the broader health system and are effectively supervised and managed can significantly improve the nutritional status of the targeted population (Allen & Gillespie, 2001).

The South African INP (SAINP) was recommended by the Nutrition Committee in 1994 to replace the fragmented nutrition intervention programmes of the past (DOH, 2004). The aim of the SAINP is to ensure optimum nutrition for all people by preventing and managing malnutrition. The SAINP focuses on eight key performance areas, namely disease-specific nutrition support, treatment and counselling; maternal nutrition; infant and young child feeding; youth and adolescent nutrition; micronutrient malnutrition control; food service management; nutrition education, promotion and advocacy; and community-based interventions (DOH, 2008a). Nutrition education should be integral to all nutrition intervention strategies in the SAINP.

The SAINP is implemented as an integral part of the primary health care approach within the District Health System. There are several interventions that were implemented under SAINP, such as the promotion, protection and support of breastfeeding; vitamin A supplementation for postpartum women and young children aged six to 59 months; mandatory fortification of maize meal, white bread and brown bread flour; community-based growth monitoring and promotion; integrated community development projects; and nutrition promotion, education and advocacy (DOH, 2008a).
The success of the SAINP depends on encouraging community participation and involvement and ensuring a buy-in by community leaders such as traditional leaders and community members (DOH, 2008a). In addition, collaboration with other sections within the health sector, such as finance, environmental health and clinic personnel, and with other departments, such as agriculture and water affairs, is encouraged.

Considerable progress has been made in the development of nutrition policy and guidelines for the improvement of the nutritional status of vulnerable groups in South Africa (Labadarios *et al*., 2008: 152). Furthermore, the mandatory micronutrient fortification of staple foods has increased the micronutrient intake of most people in the country. The salt iodation programme has reduced the number of people with iodine deficiency disorder, while folic acid deficiency is rare. Since the implementation of the Baby Friendly Hospital Initiative (BFHI) in 1994, 42.5% of health facilities in South Africa have been designated baby friendly (DOH, 2008a). In addition, community-based poverty alleviation projects have been implemented throughout the country in collaboration with other departments, such as agriculture, water affairs and education.

2.5 Value of nutrition education programmes

According to Smith and Smitarisi (2005), nutrition education should be designed with the aim of improving knowledge, skills and supports needed to adequately improve nutritional status of the targeted population. Furthermore, nutrition education should strengthen the capacity of local communities to solve their own local food and nutrition problems. Therefore, nutrition education should be able to empower targeted communities so that they can use the local resources more effectively. When planning nutrition education, one needs to take into account the availability of foods, people's access to food and other factors such cultural practices and traditional influences that may impact on food choices (Smith & Smitarisi, 2005; Stuart & Achterberg, 1997). Furthermore, nutrition education should also accommodate the social and technological changes that are happening in communities. At the same time, it is important to note that nutrition education in isolation cannot solve complex social and economic problems.

Nutrition education programmes combined with other services and implemented over a long period can improve nutritional status of children and nutritional practices of caregivers. In the study done by Ghoniem *et al*. (2004) in three day care centres in Egypt, nutritional status of children improved after the implementation of health education in combination with other related interventions (providing two meals and fruits snacks per day; as well as improving kitchens, dining rooms and utensils). A similar trend was observed in a study undertaken in the Free State and Northern Province where nutrition education and food aid was able to improve weight status of children but unable to facilitate catch-up growth as stunting did not improve (Walsh *et al*., 2002).

A study undertaken in Iran by Salehi *et al*. (2004) indicated that mothers who received community based education were aware of shortcomings in their own diets and were able to encourage their children to eat more than before. In addition, the mothers on the experimental group gave their children foods that were enriched without increasing the cost. The Salehi *et al*. (2004) study was implemented over a period of a year. A similar observation was made in the study done by Lanerolle and Atukorala (2006) where nutrition education was able to improve nutrition knowledge and consumption of local vitamin A rich foods after ten weeks of implementing nutrition education among Sri Lanka adolescent school girls. These studies reveal that nutrition education was able to improve knowledge and attitudes among targeted populations.

2.6 Summary of literature review

Current literature has shown that weight and height measurement growth charts are used the most in assessing children's growth in the clinical setting. Percentiles are commonly used in the clinical setting for an individual child, while z-scores are used in assessing the nutritional status of the population in nutrition surveys. The most commonly used anthropometric indices are weight for age, height for age and weight for height. Weight for age identifies children who are underweight or overweight in relation to their age; height for age identifies children who are stunted or tall in relation to their age; and weight for height helps to determine whether a child is wasted or not and also identifies children who are at risk of overweight or obesity. The BMI/A has recently been published and is used to identify children who are at risk of overweight or obesity.

Important biochemical assessments of children of lower socio-economic status included the assessment of vitamin A and iron status. Serum retinol is the most commonly used indicator to determine vitamin A status, while several indictors, such as serum iron, serum ferritin, haemoglobin, serum transferrin saturation % and MCV, are used to assess the iron status of the people. Iron indicators are affected by several factors, such as infections and inflammatory disease. Therefore it is important to use three or more iron indicators when assessing iron status, since no single biochemical test can be used to diagnose iron status.

Dietary standards are used for planning and evaluating the adequacy of the diet of individuals and the population. The adequacy of the diet can be evaluated by different guidelines, which include nutrient based guidelines (DRIs & RNIs), FGPs and FBDGs. The DRIs are used as a set of nutrient reference values and have four components (EAR, AI, UL and RDA), which are used for assessing and planning the nutrient intake of healthy people in order to promote and prevent chronic diseases and nutrient deficiency. On the other hand, FGPs and FBDGs are used as nutrition education tools that assist in translating dietary standards or guideline recommendations into healthy eating patterns for people with no nutrition training. The food guides also promote the consumption of a variety of food in moderation and also encourage physical activity.

The UNICEF conceptual framework of causes of malnutrition explains malnutrition as an interrelated and complex outcome of immediate, underlying and basic determinants. Some of the immediate causes of malnutrition, such as inadequate dietary intake, and underlying causes such as knowledge and practices relating to nutrition, can be addressed through nutrition education, while other causes may not be addressed adequately by nutrition education. Therefore, there is a need for a large scale socio-economic intervention strategy that could help to address factors such as access to health care services, unemployment, food insecurity and access to clean water and sanitation.

The implementation of nutrition intervention strategies should be done in an integrated fashion so that it will be able to address most causes of malnutrition. Nutrition education programmes should be an integral part of all nutrition intervention strategies in order to create awareness, increase knowledge of nutrition and increase the intake of quality foods. Dietary diversification is important in improving the consumption of a variety of food through food production and promoting the use of indigenous foods. On the other hand, INP aims to solve nutritional health-related problems through the implementation of combined interventions that are targeted at the same population. Nutrition education has a large impact on knowledge of nutrition and feeding practices, and it forms part of dietary diversification and INP. Nutrition education programmes can be used to encourage the use of locally indigenous foods.

CHAPTER 3.

METHODOLOGY

3.1 Introduction

The aim of this study was to determine the impact of a nutrition education programme on the nutritional status of children aged three to five years, as well as the nutritional knowledge and practices of caregivers in Mutale Municipality. In this chapter, the research methodology used to collect the necessary data will be described, including the study design, study sample, measurements, selection and training of field workers, pilot study, nutrition intervention, data collection procedures, statistical analysis and problems encountered.

3.2 Study design

A pre-test–post-test control group design was chosen. The data was collected at the beginning (baseline data) of the study in both the control and the experimental group. The experimental group received nutrition education, while the control group did not. The intervention programme was implemented for a period of 12 months. After the intervention, final data was collected in both groups.

3.3 Study sample

3.3.1 Study population

The study population included caregivers and children aged three to five years. For the purpose of the study, the caregiver refers to the legal guardian of the child or the mother of the child.

3.3.2 Study area

The study was conducted in Mutale Municipality in the Vhembe District of Limpopo Province. Mutale is one of four municipalities in the Vhembe District and is 147 km east of Musina and 45 km north of Thohoyandou. Mutale Municipality consists of nine wards, with the number of villages per ward ranging from five to 34 (Mutale Municipality, 2004).

In 2001, the total population of Mutale Municipality was 78 922 (Statistics South Africa, 2001). At that time, Mutale Municipality had 10 194 children aged zero to four years (Statistics South Africa, 2001). The children used in this study were aged three to five years. Statistics South Africa categorises children in age groups from zero to four years and from five to 10 years, etc., hence the zero to four years category was used to estimate the number of children aged three to five years in Mutale (Table 3.1).

In 2001, the total number of households in Mutale Municipality was 17 151; the number of households per ward ranged from 1 400 to 2 322 (Table 3.1). This municipality falls in a rural area, with no electricity in most villages. The communities rely on firewood for fuel, and water comes from communal taps, rivers or wells.

Mutale Municipality has 14 clinics and one health centre (Table 3.1). The mobile clinic has 155 visiting points and each village is visited once per month. The mobile clinic teams are stationed at the Mutale Health Centre (Mutale Municipality). The other institutions available in the Mutale Municipality are 108 schools, one tertiary institution (Provincial Traffic Training Collage), a court of law and two police stations. For their monthly income, the Mutale community depends on government (as civil servants), farming, mining, and construction and business services.

The Health Centre, court of law and police station are in Ward 3. A small shopping complex together and a taxi rank are situated next to the Health Centre and the court of law in Ward 3. Wards 3, 4 and 5 have access to tar roads and running water in the households. The Tshikondeni coal mine is situated in Ward 9. According to the Mutale Municipality, 70% of people have access to running water, either in the household or from street (communal) taps. Most residents of the Mutale communities buy food from the Thohoyandou shopping complex once a month, and from local general dealers as the needs arises.

Table 3.1. Number of children and households per ward of Mutale Municipality (Statistics South Africa, 2001)

Ward name	Number of villages per ward of Mutale Municipality	Number of health facilities	Number of household per ward	Children aged 0 – 4 years per ward
Ward 1	13	2 clinics	2238	1272
Ward 2	11	2 clinics	1749	1035
Ward 3	5	1 health centre	1626	834
Ward 4	8	2 clinics	2046	1107
Ward 5	11	1 clinic	1464	846
Ward 6	9	2 clinics	1899	1248
Ward 7	8	1 clinic	1527	1044
Ward 8	29	2 clinics	2280	1377
Ward 9	34	2 clinics	2322	1431
Total	**128**	**15**	**17151**	**10194**

3.3.3 Sample selection

The Department of Biostatistics of the University of the Free State was consulted on the selection of the final sample. Wards 1 and 6 were purposively selected from the Mutale Municipality (Table 3.1). The selection of Ward 1 as the experimental group (1E) and Ward 6 as the control group (6C) was based on their similarities in terms of access to health care facilities, water and the shopping complex.

Three villages were initially selected from each ward (1E and 6C) using simple random sampling. The names of villages in each ward were placed in a container and field workers picked out names in the presence of the researcher until the required number of villages was reached per ward (1E & 6C). All households in the six villages with caregivers and children aged three to five years that gave consent were included in the sample. The aim was to select at least 60 households with caregivers with children aged three to five years from each ward to add up to a total of 120. When the required sample was not reached from the selected villages, one more village was selected from each (1E & 6C) using simple random sampling. The names of the remaining villages were then placed in the container and the field worker picked one village from each ward (1E & 6C). The total number of villages selected was eight, four in each ward (Table 3.2).

All the households from the selected villages who had caregivers with children aged three to five years were visited by the trained field worker or researcher. The trained field workers and researcher entered different households, starting from the household in the chief's kraal. The researcher entered the first household while the field workers entered the second, third and fourth households, and then they moved to the fifth, sixth, seventh and eighth household until all household in the village were visited. Where a caregiver had more than one child who met the criteria, all children were included as part of the sample. At baseline, the total number of children that met the inclusion criteria was 129 (Table 3.2). At post-intervention, only 89 children were found. Consent for blood sampling was only given for 78 children at baseline and 69 children post-intervention. Thus blood samples were taken for 78 of the 129 children at baseline and 69 of the 89 children post-intervention (Figure 3.1).

Table 3.2. Number of total sample in both experimental and control groups

Ward	Name of village	Number of children at baseline	Number of children at post-intervention
Ward 1 – Experiment (1E)	Tshixwadza	15	10
	Matshavhawe 2	6	5
	Mavhode	12	10
	Mapuloni	33	16
	Sub-total	**66**	**40**
Ward 6 – control (6C)	Folovhodwe	21	15
	Muswodi-Dipeni	22	18
	Musunda	7	7
	Gumela	13	9
	Sub-total	**63**	**49**
Total		129	89

3.3.4 Inclusion criteria

Households with a caregiver of children aged three to five years that agreed to participate and signed the assent form were included in the study (Appendix 1 and 2). At the onset of the study, caregivers with children aged three to five years and who were 21 years and older were included in the study. Where the mother was younger than 21 years, the father of the child was requested to sign the informed consent form after the purpose of the study had been explained.

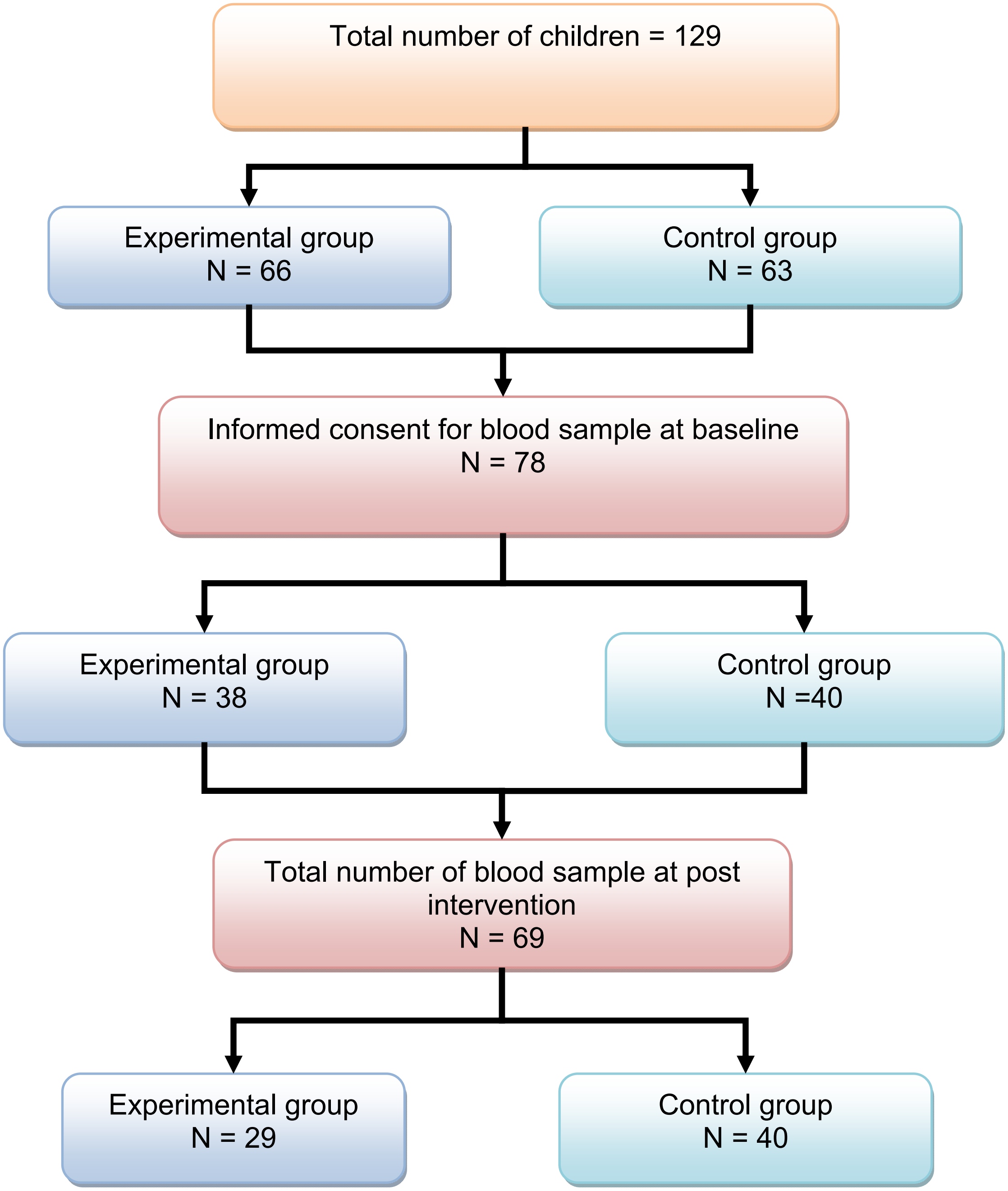

Figure 3.1. Flow diagram of blood sample size

3.4 Measurements

In the following section, the variables and techniques selected for this study are described.

3.4.1 Variables

Variables included the anthropometric nutritional (weight and height) status of the children and caregivers, the micronutrient status of the children, and nutritional practices, nutritional knowledge, as well as socio-demographic status.

3.4.1.1 Nutritional status

Nutritional status refers to the anthropometric status of the children and caregivers and the biochemical micronutrient status of the children.

(i) The anthropometric variables included the weight and height status of the children and the caregivers.

(a) The anthropometric status of the children

The weight and height status of the children refers to their current weight and height, expressed as weight for height (W/H), weight for age (W/A), height for age (H/A) and BMI for age (BMI/A). W/H, W/A, H/A and BMI/A were interpreted using z-scores (Table 3.3 and Table 3.4). According to the WHO (2009), a z-score classification of <-2 to ≥-3SD indicates the cut-off points for underweight, stunting and wasting (Table 3.3), while the 2000 CDC z-score indicates the cut-off points at <-2 to -3SD for moderate underweight, moderate stunting and moderate wasting (Table 3.4). Cut-off points for severe stunting, severe underweight and severe wasting are <-3SD according to the 2000 CDC and WHO classifications (ICDDR, 2004; WHO, 2009).

Table 3.3 Z-score classifications to determine nutritional status of children (WHO, 2009)

Z-score classification	WAZ	WHZ	HAZ	BMI/A
< -3SD	Severely underweight	Severely wasted	Severely stunted	Severely wasted
-3SD to < -2SD	Underweight	Wasted	Stunted	Wasted
-2SD to < -1SD	Mild underweight	Mildly wasted	Mild stunted	Normal
-1SD to +1SD	Normal WAZ	Normal WHZ	Normal height	Normal weight
>+1SD to ≤ +2SD	Possible growth problem	Possible risk of overweight	Normal height	Possible risk of overweight
>+2SD to ≤ +3SD	Possible growth problem	Overweight	Normal height	Overweight
>+3SD	Possible growth problem	Obese	Above normal	Obese

Table 3.4 Z-score classification of anthropometric indices in children (ICDDR, 2004)

Z-score classification	**WAZ**	**WHZ**	**HAZ**	**BMI/A**
> +2SD	Overweight	Overweight	Above normal	Overweight
≥ -1SD to ≤ +2SD	Normal weight	Normal weight	Normal height	Normal weight
< -1SD to ≥ -2SD	Mildly underweight	Mildly wasted	Mildly stunted	Mildly underweight
< -2SD to ≥ -3SD	Moderately underweight	Moderately wasted	Moderately stunted	Moderately underweight
< -3SD	Severely underweight	Severely wasted	Severely stunted	Severely underweight

(b) The weight and height status of the caregivers refers to the current weight for height squared, from which the BMI was calculated (kg/m^2) and categorised as shown in Table 3.5.

Table 3.5 BMI classification for adults (WHO, 2000)

BMI classification	**Interpretation**
< 18.5 kg/m^2	Underweight
18.5 – 24.9 kg/m^2	Normal weight
25 – 29.9 kg/m^2	Overweight
30 – 34.9 kg/m^2	Class I - Obese
35 – 39.9 kg/m^2	Class II – Obese
≥ 40 kg/m^2	Class III – Extremely obese

(ii) Biochemical micronutrient status of children aged three to five years refers to serum concentrations of vitamin A (serum retinol) and iron (serum iron, serum ferritin, serum transferrin and % transferrin saturation).

(a) Vitamin A status refers to serum retinol or serum vitamin A. Ranges for interpretation of serum vitamin A are indicated in Table 3.6.

Table 3.6 Interpretation of vitamin A status in children

Classification	Serum retinol levels (NFCS-FB, 2005)	Laboratory levels (**Drs Du Buisson, Kramer Inc./Ing.)**
Vitamin A deficiency	<10 µg/dl	< 100 µg /L
Marginal vitamin A status	10 – 19.9 µg/dl	100 – 199.9 µg/L
Adequate status	20 – 29.9 µg/dl	200 – 299.9 µg/L
Normal/ well-nourished status	> 30 µg/dl	> 300 µg/L

(b) Iron status for the purpose of this study, refers to concentrations of serum iron, serum ferritin, serum transferrin and % transferrin saturation. Ranges for the interpretation of serum iron, serum ferritin, serum transferrin and % transferrin saturation are indicated in Table 3.7.

Table 3.7 Interpretation of iron status of children

Iron indicators	Interpretation	Interpretation	Interpretation
Serum iron Gibson (2005: 471)	≥115 μg/dL (normal)	< 60 μg/dL (mild depletion)	< 40 μg/dL(depletion)
Serum iron*	5.0 – < 16.7 μmol/L (normal)	< 5.0 μmol/L (depletion)	> 16.7 μmol/L (high)
Serum ferritin (WHO, 2004)	≥ 15 μg/l (iron stores are present)	< 12 - 15μg/l (Iron depleted)	< 30 μg/l (depleted iron stores (infection)
Serum ferritin*	7 – 140 ng/ml (normal)	< 7 ng/ml (depletion)	> 140 ng/ml (high)
Serum transferrin (Gibson, 2005: 415)	> 2.0 g/L (normal)	1.5 – 2.0 g/L (mild)	< 1.0 g/L (severe)
Serum transferrin*	1.5 – 3.5 g/L (normal)	< 1.5 g/L (depletion)	> 3.5 g/L (high)
%saturation transferrin (Gibson, 2005: 471)	10 - 20% (normal)	< 15% (low)	> 20% (high)
% transferrin saturation *	17 – 42% (normal)	< 17% (low)	> 42% (high)

***Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)**

3.4.1.2 Nutritional practices and nutritional knowledge

(i) Nutritional practices refer to the number of meals, types of food from food groups (starchy foods, protein foods, vegetables, fruit, snacks) and indigenous foods habitually given, as well as frequency at which specific foods (vegetables, fruit, milk and snacks) were given and the macronutrient and micronutrient intake.

(a) The recommended number of meals per day that should be given to the child was more than three per day (Bourne, 2007; Burgess & Glasauer, 2004).

(b) Type of food refers to the food usually given to the children, such as starchy foods (porridge, rice, samp and bread), protein foods (meat, beans and milk), vegetables (including indigenous vegetables), fruit (including indigenous fruit), indigenous edible insects (such as adult insects, Mopani worms, locusts and termites) and indigenous dishes (*tshidzimba* (samp, beans, jugo beans and ground nuts), *dovhi* (biltong or dried vegetables and ground nuts), *thophi (*pumpkin, maize-meal and sugar).

(c) Frequency of giving specific foods refers to the times specific types of food, such as vegetables, fruit and milk were given per week (e.g. daily, three to five times per week, less than three times per week or never).

(d) Macronutrient intake refers to the usual intake of energy, protein, carbohydrates and fat. The adequacy of usual macronutrient intake by the children was compared to the EAR, AI as well as RDA of the DRIs (Escott-Stump & Earl, 2008: 338).

(e) Micronutrient intake refers to the usual intake of micronutrients, with an emphasis on vitamin A and iron intake. The adequacy of usual micronutrient intake by children was compared to the EAR, AI as well as RDA of the DRIs (Escott-Stump & Earl, 2008: 338).

(ii) Nutritional knowledge refers to whether the caregiver knows the number of meals per day that should be given to children (three to five years), the types of foods that should be given to children (starchy foods, protein foods, fat, vegetables, fruit, indigenous vegetables, indigenous fruit and indigenous dishes), the knowledge they have of indigenous foods, and the frequency of giving specific foods (vegetables, fruit and porridge per week) to keep healthy. Knowledge was considered adequate if at least 60% and above of the questions were answered correctly. The marking guide is attached (Appendix 3).

3.4.2 Techniques

A structured interview schedule was used for data collection in interviews by four trained research team members (researcher and three field workers). Standard anthropometric techniques were used by the same trained research team members to determine the weight and height of the children and caregivers. Standard laboratory techniques were used to analyse blood samples for the iron and vitamin A status of the children.

3.4.2.1 Interview schedule and interview

(i) Interview schedule

The interview schedule consisted of four questionnaires, which included the socio-demographic, 24-hour recall, nutritional practices and nutritional knowledge questionnaires (Appendix 4, sections A, B, C and D).

(a) The socio-demographic questionnaire was adapted from the questionnaire of a study titled "Determination of the breastfeeding and weaning practices of mothers and nutritional status of children under 12 months in the Vhembe District in the Limpopo Province" (Mushaphi, 2002) (Appendix 4, section A).

(b) The nutritional practices questionnaire was developed focusing on the aspects of infant feeding practices that are expected to be practised and known by caregivers as recommended in the literature on child feeding practices (Bourne, 2007; Burgess & Glasauer, 2004; Smolin & Grosvenor, 2008: 608) (Appendix 4, section B). The questions on the use of indigenous foods were developed based on the known local and indigenous foods in the area. After the pilot study was completed, more indigenous foods were included in the questionnaire.

(c) A 24-hour recall questionnaire was used to determine the nutritional practices, food intake of children and portion sizes of children (Appendix 4, section C). The 24-hour recall was chosen because it provides detailed information on food consumption and is relatively easy to administer. As one 24-hour recall does not represent the usual daily intake, multiple 24-hour recalls are recommended (Gibson, 2005: 80; Lee & Nieman, 2007: 84). For this study, two 24-hour recalls were applied on a weekday and a weekend day, one week apart, and the average was calculated.

(d) A nutritional knowledge questionnaire was developed for this study based on the literature that focuses on infant feeding, as well as the South African Food-based dietary guidelines (SAFBDG) (Appendix 4, section D).

(ii) Interview

The interview schedule was completed during an interview with the caregiver in their language of choice (Tshivenda). Interviews were conducted by the researcher and trained field workers face to face in the caregiver's home. The specific interviewing method was chosen because some of the caregivers were illiterate and it would have increased the understanding of the questions. An interview thus ensured that accurate information was collected.

3.4.2.2 Anthropometry

Anthropometric measurements were taken for the children and the caregivers, using standard procedures described in Lee and Nieman (2007: 171-173). Weight and height measurements were taken twice to ensure accuracy. Anthropometric measurements were taken on the same day as the interviews at baseline, and after 12 months of intervention, by the trained researcher and trained field workers. The anthropometric measurements were recorded on a record sheet (Appendix 5, section A). The same techniques were used for taking weight and height in the children and the caregivers.

(i) Weight

Weight was measured using a calibrated solar digital scale (Tanita model HS-301). The scale was placed on a flat, hard surface that allowed participants to stand securely without rocking or tipping. The participants stood still in the middle of the scale's platform without touching anything and with the weight equally distributed on both feet. The participant was weighed with light clothing and without shoes. The average of two weights was recorded numerically on the record sheet to the nearest 0.01 kg. The accuracy of the weighing scales was checked daily against known weights, as recommended by Lee and Nieman (2007: 171-173).

(ii) Height

Height was measured with a stadiometer (portable height measuring 2 m tape – model: PHT). The participants were standing without shoes, with heels together, arms to the sides, legs straight, shoulders relaxed and head in the Frankfort horizontal plane (looking straight ahead). Heels, buttocks, scapulae (shoulder blades) and back of the head were against the vertical surface of the stadiometer. Just before the measurement was taken, participants were asked to inhale deeply, hold the breath and maintain an erect posture while the headboard was lowered to the highest point of the head with enough pressure to compress the hair. The height was taken twice and recorded to the nearest 0.1 cm, as recommended by Lee and Nieman (2007: 171-173).

3.4.2.3 Laboratory tests

A professional paediatric nurse was responsible for taking blood samples a few days after the interview. The blood samples were analysed in the Ampath Pathology Laboratory (Drs Du Buisson, Kramer Inc./Ing.) using standard laboratory procedures. The blood was used to determine the iron and vitamin A status of the children aged three to five years before and after the intervention. The results were recorded on a specific record sheet as shown in Appendix 5 (section B).

(i) Procedure for blood sample collection

The standard methods used for drawing blood are outlined below (Training Manual for National Food Consumption Survey – Fortification Baseline South Africa, 2004).

- The professional paediatric nurse always wore non-powdered gloves and did not touch her hair or skin. Hair, skin, powdered gloves and sweat may contaminate the blood specimen and interfere with analysis.
- The skin of the child's hand was cleaned with alcohol-soaked cotton wool balls. They were allowed to dry and venepuncture was done, avoiding contact with the needle insertion point.
- The butterfly needle technique was used for blood collection. This technique is used because the veins of the hand may collapse easily if the vacuum tube technique is used (Mulder, 2002: 297). This technique is more suitable for small, narrow and short veins like those in the hand and forearm, as the needle is short and sharp.
- 5 ml of blood was placed into each of two tubes (yellow and purple top).
- Only two attempts were made to draw blood from a child. Failure to do so was recorded as a missing value.
- The sample code and name of the child was written clearly on the tube label using block letters. The time and date of sample collection were also written on the tube label.
- All blood samples were wrapped immediately in foil to protect them from sunlight and were put in a plastic bag with the name and code of the child. Blood samples were stored on ice in a cooler box.
- Butterfly needles were disposed of in waste disposal containers.

- Blood samples were taken to Ampath Pathology Laboratory (Drs Du Buisson, Kramer Inc./Ing.) in Louis Trichardt on the day of collection for analysis.

(ii) Techniques for blood analysis

The blood samples were analysed in Ampath Pathology Laboratory using the techniques outlined in Table 3.8.

Table 3.8. Techniques for blood analysis (Ampath Pathology Laboratory: Drs Du Buisson, Kramer Inc. /Ing.)

Variables	Test tube	Method for blood analysis
Vitamin A Serum retinol (µg/L)	Purple top test tube – EDTA	UV detection method
Iron	Yellow top test tube – SST	
Serum iron (µmol/L)		Colorimetric method
Serum ferritin (ng/ml)		Chemiluminescence
Serum transferrin (g/L)		Immunoturbidimetric

3.4.3 Validity and Reliability

The validity of an instrument is "the extent to which the instrument measures what it is supposed to measure" (Leedy & Ormrod, 2005: 28). The interview schedule was developed to include relevant questions related directly to the purpose of the study and according to the eating patterns recommended for children aged three to five years (Burgess & Glasauer, 2004). Two experts in the field of nutrition evaluated the interview schedule for content validity.

"Reliability is the consistency with which a measuring instrument yields a certain result when the entity being measured has not changed" (Leedy & Ormrod, 2005: 29). To improve reliability, the researcher translated the interview schedule from English into Tshivenda (the local language). Translators were consulted to check if the English and Tshivenda interview schedules had the same meaning.

The field workers were trained in interview techniques and were standardised against each other. Precautions were taken to ensure reliable answers, e.g. probing and cross-questioning were used, especially in the 24-hour recall questionnaire, to reduce over- and/or underreporting of food intake. The 24-hour recall questionnaire requires knowledge of portion sizes, which can easily be under/overestimated. In order to reduce the chance of under/overestimation of portion sizes, food models, household utensils and food pictures (from South African Sugar Association) were used.

To ensure reliability, 10% of the interview schedules were randomly selected and the caregivers were interviewed again a week after baseline and post-intervention. The caregivers were selected randomly from each village and different research team members were allocated to the caregiver. In cases where caregivers were selected who had been interviewed by the same person, another caregiver was selected at random. The selected caregivers were allocated to a different interviewer (researcher and three field workers) from the first interview. The quality control interview was conducted on different days from the initial interview. The quality control data was analyzed and compared to the other data. However, differences between the data were not observed as questions were closed ended and caregivers gave the same answers on both occasions.

The questionnaires were tested in a pilot study to determine whether the questions were clearly understood by the population. The nutrition education programme was developed before the collection of baseline data and was adapted after the collection of baseline data. Anthropometric measurements were taken twice, as recommended by Lee and Nieman (2007: 171–173), and the weighing scales were calibrated every day before data collection.

3.5 Selection and training of field workers

Three field workers who had completed a BSc (Nutrition) and were able to speak and write Tshivenda were available and willing to participate in the study. The researcher trained the field workers before the pilot study and data collection (Appendix 6). The training covered data collection procedures and techniques for anthropometric measurements.

3.5.1 Responsibility of the researcher and fieldworkers

The responsibilities of the researcher and fieldworkers will be outlined in this section.

(i) Responsibilities of the researcher

The researcher was trained in blood handling, which includes labelling and packaging, by an Ampath Laboratory technician.

The researcher was responsible for:

- training field workers in data collection procedures (how to complete interview schedule and consent form, and to explain the ethical issues on the information and consent form);
- adapting and compiling the nutrition education programme using the SAFBDGs and the South African Paediatric Food-based dietary guidelines (SAPFBDGs);
- developing the interview schedule, record sheet, consent form and information sheet;
- duplicating the interview schedule, record sheet, consent form and information sheet;
- interviewing the caregivers and recording data on the interview schedule together with the field workers;
- supervising the data collection process:
    - o during the pilot study the researcher checked the data collection process and identified questions that needed to be changed or clarified.
    - o after interviewing the first four caregivers, the research team assembled and discussed the process of the interview. The researcher clarified the questions the field workers had on data collection procedures. At the end of each day of data collection, the researcher and field workers went through all the interview schedules and data collection process.
    - o the researcher checked all the interview schedules at the end of each day of data collection for completeness and correct coding of the questionnaires.

(ii) Responsibilities of the field workers

The field workers were responsible for:

- accurate collection of the data:
    - o explaining the data collection procedure and helping the participants to complete the informed consent forms;
    - o interviewing the caregivers and recording data on the interview schedule;
    - o taking weight and height measurements of the caregivers and children.

3.6 Pilot study

The purpose of the pilot study was to evaluate and scrutinise the data collection process and determine whether the participants understood the questions correctly. The pilot study was conducted by three field workers and the researcher in one village, which was selected purposively from a ward and was not part of the main study. The researcher and field workers tested the interview schedule on 16 caregivers. Each field worker and researcher completed four questionnaires. The questions and data collection procedures were adapted after the pilot study. The following changes were made:

- Questions on the availability of livestock and land for food production were rephrased and optional answers were created. Questions on their source of nutrition information, source of fuel for cooking and source of water were adapted and optional answers were created. The question on how often the child eats breakfast per week was rephrased to 'How many times a week does your child eat breakfast?' and optional answers were also removed.
- The list of indigenous foods that were mentioned during the pilot study were added and an explanation of indigenous food was included.
- The age group three to five years of the children was specified in all questions that asked what the caregivers did with their children.
- A question to determine the presence of the road to health card was added, as well as one to determine whether the child had received vitamin A supplementation in the past six months.

3.7 Nutrition intervention programme

An outline of the nutrition education programme is shown in Appendix 7. The researcher was the only one responsible for facilitating the nutrition education programme in all the villages.

3.7.1 Development of the nutrition intervention programme

The nutrition education programme was developed with the following aims:

- To provide knowledge and understanding of the importance of eating a variety of foods to caregivers;
- To instil good eating habits and improve the nutritional status of children;
- To provide understanding of the importance of eating plenty of vegetables and fruit (including indigenous vegetables and fruit).

The nutrition education programme was based on the South African Food-based Dietary Guidelines (SAFBDGs), South African Paediatric Food-based Dietary Guidelines (SAPFBDGs), the Family Nutrition Guide (Burgess & Glasauer, 2004) and mypyramids for children (Smolin & Grosvenor, 2008: 608) (Appendix 7). After the baseline data had been collected, more information on indigenous foods was added to the nutrition education programme in order to improve the caregiver's nutritional practices and knowledge about these foods.

The implementation of a nutrition education intervention programme needs to consider the most suitable strategy to convey the message to the specific population group. According to the FAO (2005), the communication mechanism depends on the context and cultural preferences and on how people normally receive/obtain information. The learning methods that could be used when giving nutrition information to a group of people include group discussions, lectures, demonstrations and active participatory methods (FAO, 1997b). The active participatory methods include case studies, role plays, simulation, songs and games.

In the present study, the group discussion method was chosen. The discussion approach was chosen because it is an excellent way to promote interaction between group members and it allows caregivers to participate actively in the programme.

3.7.2 Implementation of the nutrition education intervention programme

The implementation of the nutrition education programme was undertaken after the completion of baseline data collection in all the villages. The caregiver's nutritional knowledge and practices were evaluated (at baseline) to determine gaps in nutrition knowledge and practices. After completion of the baseline data collection, which took about 11 months, the intervention started. The time lapse was between March 2007 and February 2008. The nutrition education programme was implemented on two occasions, that is every week during the first three months and during the last three to four months on the experimental group in the 12-month period of implementation (Appendix 8).

On the day of each presentation, the topic of the day was introduced to the group of caregivers. Thereafter, the researcher asked specific questions related to the topic to assess prior knowledge of the topic and to stimulate discussion (Appendix 6). At the end of the lesson, the caregivers were asked questions to assess their understanding. The caregivers were allowed to ask questions during the presentation and at the end of presentation. Visual aids were also used to encourage participation by the caregivers and group discussion (Appendix 7). Two presentations were undertaken on the same day, with a break of five minutes in between, and each presentation lasted 20 to 30 minutes. The size of the groups of caregivers during the nutrition education presentation sessions ranged from six to 20 (Appendix 8). After completion of the second round of nutrition education presentations in November 2008, the final data collection was started.

3.8 Procedure for data collection

Figure 3.1 illustrates the data collection procedure, which includes the ethical approval, baseline data collection, intervention and final data collection.

3.8.1 Ethical aspects

3.8.1.1 Ethical approval was obtained from the Ethics Committee of the Faculty of Health Sciences, University of the Free State (ETOVS NR 24/06) (Appendix 9).

3.8.1.2 Permission to conduct the study in the villages was obtained from area chiefs (Appendix 10 and 11). The dates for data collection were communicated to the chief before visiting the community.

3.8.1.3 Written informed consent was obtained from the caregivers (Appendix 1). Where the mother was younger than 21 years, the father of the child was requested to sign the informed consent form after the purpose of the study had been explained to him. The researcher/fieldworkers discussed details of the study with the caregiver of the child before the consent form was signed. The caregiver was also given an information sheet explaining the details of the study (Appendix 2). The information sheet clearly stated that all the information would be treated with confidentiality, that the results of the study may be published in scientific journals, that the caregivers will participate voluntarily and that the caregivers were allowed to withdraw from the study at any point should they wish to discontinue.

3.8.1.4 All children with clinical signs of severe malnutrition or a medical condition were referred to the local clinic. Both the consent form and the information sheet were written in the local language (Tshivenda) (Appendix 1A & 2A).

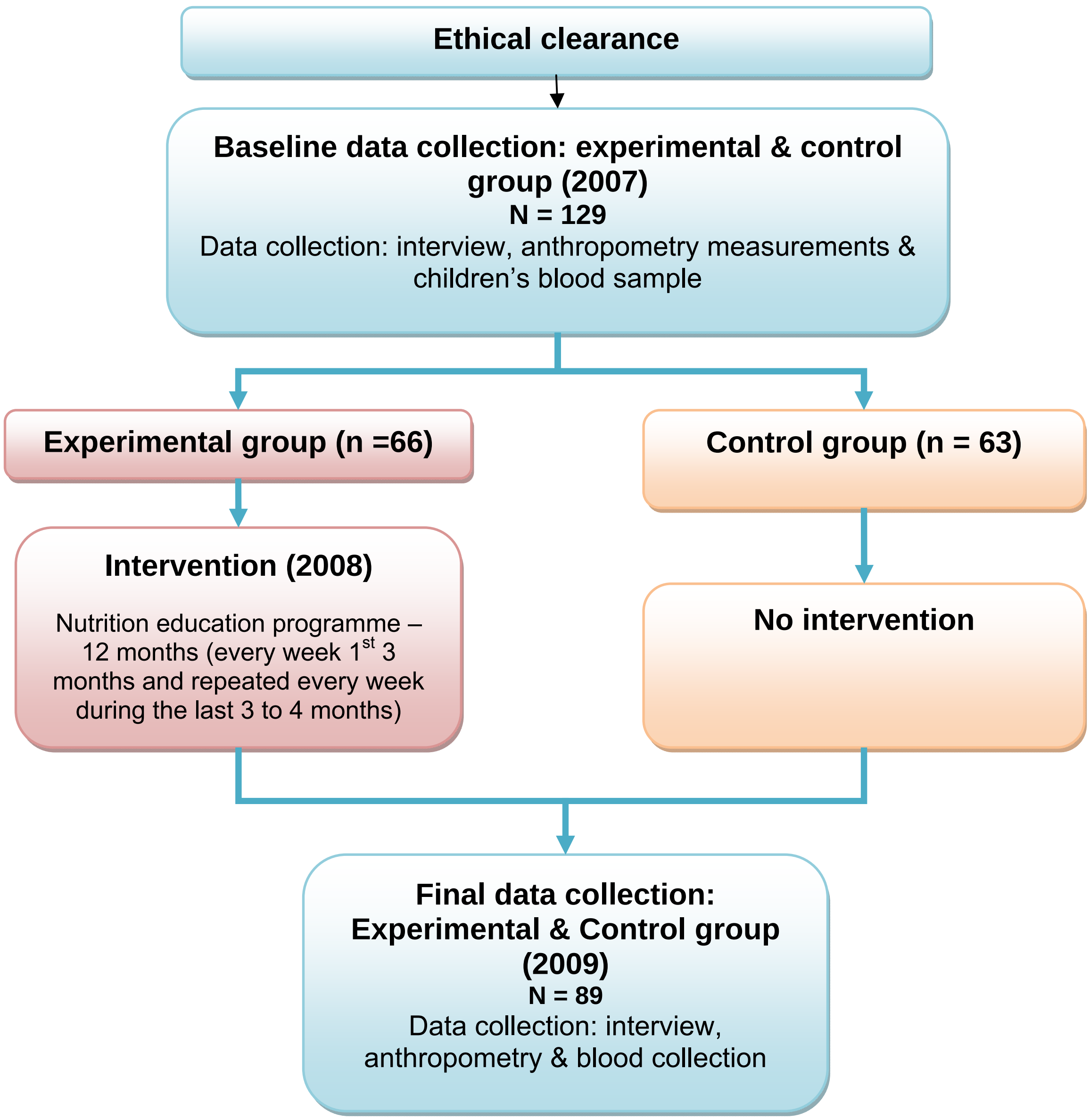

Figure 3.2 Flow diagram of data collection procedure

3.8.2 Baseline data collection procedure

The researcher informed the chief or community leaders of the data collection dates (data collection schedule) (Appendix 8). At baseline, the caregivers in both the experimental and control groups were assessed on nutritional practices, dietary intake using two 24-hour recalls, nutritional knowledge, anthropometric measurements and biochemical data (Appendix 4 and 5). Each research team member (researcher and three field workers) had questionnaires, weight and height equipment. The selection of the households started with the household in the chief's kraal. The research team members each entered four different households in the same street. The researcher entered the first household and then moved to the fifth household, while the first field worker entered the second household and moved to the sixth household, the second field worker entered the third household and moved to the seventh household, and the third field worker entered the fourth household and moved to the eighth household, etc. This system of entering the households was maintained until the all the household had been visited. The members of the research team determined if the household had children who met the selection criteria, explained the purpose of the study and obtained written informed consent from the caregivers. The caregivers with children who met the selection criteria were interviewed by the researcher or trained field worker. Weight and height measurements were taken on the same day as the interview.

The blood samples of all the children in the village were taken three to four days after the initial visit (interview) by a professional paediatric nurse. The researcher accompanied the professional paediatric nurse to the household for blood collection. The nurse was responsible for collecting the blood. The researcher labelled the test tubes, wrapped the blood sample in foil and packaged the blood samples as required by the laboratory. The researcher was also responsible for transporting the blood samples to the laboratory in Louis Trichardt. The distance between the villages and the laboratory was ± 140 km, which allowed the researcher to take blood samples to the laboratory every day.

3.8.3 Nutrition education intervention programme

The experimental group received nutrition education over a period of 12 months, while the control group did not receive nutrition education. The nutrition education intervention programme covered ten topics, and each topic was presented twice. Two related topics were presented on the same day with a break of five minutes in between presentations. The caregivers assembled in the chief's kraal or at the primary school or pre-school on the day of nutrition education, as per the appointment made during the prior visit. Two villages were visited on the same day, one in the morning and the other in the afternoon (Appendix 8). The number of caregivers taught at a time ranged from six to 20.

3.8.4 Final data collection

The final data collection was undertaken in both the experimental and control groups after the completion of nutrition education, starting in February 2009. The research team visited the household and interviewed the caregivers on nutritional practices, dietary intake (two 24-hour recalls) and their nutritional knowledge. Anthropometric measurements and biochemical data were also collected. The caregivers were interviewed at home and the anthropometric measurements were taken on the same day, while blood samples were taken on a different day. Two 24-hour recalls were done on two different days (weekday and weekend day). During the final data collection, some of children were at school or preschool. Hence, the anthropometric and biochemical measurements of the children were taken at their school or pre-school in the presences of the caregiver. The chief made the necessary arrangements with the local schools and pre-schools.

3.9 Statistical analysis

Data was analysed by the Department of Biostatistics of the University of the Free State, using Statistical Analysis Software (SAS®) version 9.2. The data was expressed using median, minimum and maximum values to describe continuous data. Frequencies and percentages were used to describe categorical data, and 95% confidence intervals were used for median and percentage differences to determine the impact of the intervention programme. The 95% confidence intervals (CI) for unpaired data were calculated for the median differences between groups, intervention and control group, to determine the impact of the intervention programme. The 95% confidence intervals for paired data were calculated for the median differences between pre and post values for each group, to determine if there were differences between the pre and post intake for each group. For the categorical data, the 95% CI for the difference in percentages/proportions was calculated between groups. The confidence interval presents a range of values that are considered to be reasonable for the population according to Gardner and Altman (2000: 17). The 24-hour recall data was analysed using the Food Finder III computer programme version 1.1.3 (South African Medical Research Council, 2002).

3.10 Problems encountered during the study

3.10.1 Sample fall-out

At baseline, 129 children and 125 caregivers participated in the study, while only 89 children and 85 caregivers were available for the final data collection (69% and 68% of the children and caregivers respectively). The data collection took place over three years, and the main reasons for the fall-out were that some children had moved with their parents to other areas which were not included in the study by the time of the follow-up survey.

According to Myer and Karim (2007: 161) “it is critical to note that it is not actually the amount of loss to follow-up that introduces bias, but rather how the loss to follow-up is distributed with respect to exposure and outcome status”. In other words, if the loss of sample occurred evenly in both groups of comparison, the study results will be unbiased (Myer and Karim, 2007: 161). Drop-outs occurred in both groups and were generally evenly distributed (E = 60.6%; C = 77.8%). Only the data of caregivers and children who completed the study was thus compared.

3.10.2 Field workers

One field worker received permanent employment in the middle of the data collection process. An additional field worker was recruited and trained to replace the field worker who resigned. The training was the same as given to the other field workers. After training, the field worker was able to collect reliable and valid data.

3.10.3 Blood samples

Blood samples were not collected from all the children, because only 60.5% of the caregivers gave consent for blood to be taken at baseline. At the final data collection, 74.2% given consent for blood to be collected. Some caregivers were afraid that their children would be tested for HIV/AIDS or infected with HIV/AIDS. The caregivers who agreed that blood could be drawn from the children were given the results as soon as they were available from the laboratory in order to encourage other caregivers to give consent for blood being drawn.

3.10.4 Haemoglobin

Haemoglobin levels were not determined. Only serum iron, serum ferritin, serum transferrin and % transferrin saturation were determined. Therefore, the prevalence of anaemia could not be determined. The serum iron, serum ferritin, serum transferrin and % transferrin saturation were used to determine the iron status of the children. No single indicator of iron can be used on its own to determine iron status because it is affected by several factors, such as infections and inflammatory diseases. It is important to use three or more iron indicators to assess iron status. Stopler (2008: 825) recommends the use of concentration of serum iron, serum ferritin and concentration of total circulating transferrin in order to determine iron status.

3.10.5 Sharing of nutrition education information

It is possible that caregivers from the experimental groups shared information with the caregivers from the control groups. In order to minimise the sharing of information by the caregivers, the experimental and control groups were from two different wards, which were situated 35 to 50 km apart.

CHAPTER 4.

RESULTS

4.1 Introduction

The aim of the study was to determine the impact of a nutrition education programme on the nutritional knowledge and practices of caregivers and the nutritional status of children aged three to five years. The baseline results and comparison of baseline and post-intervention results will be described, followed by a short summary. The diagram below indicates the sample size at each stage of data collection (Figure 4.1).

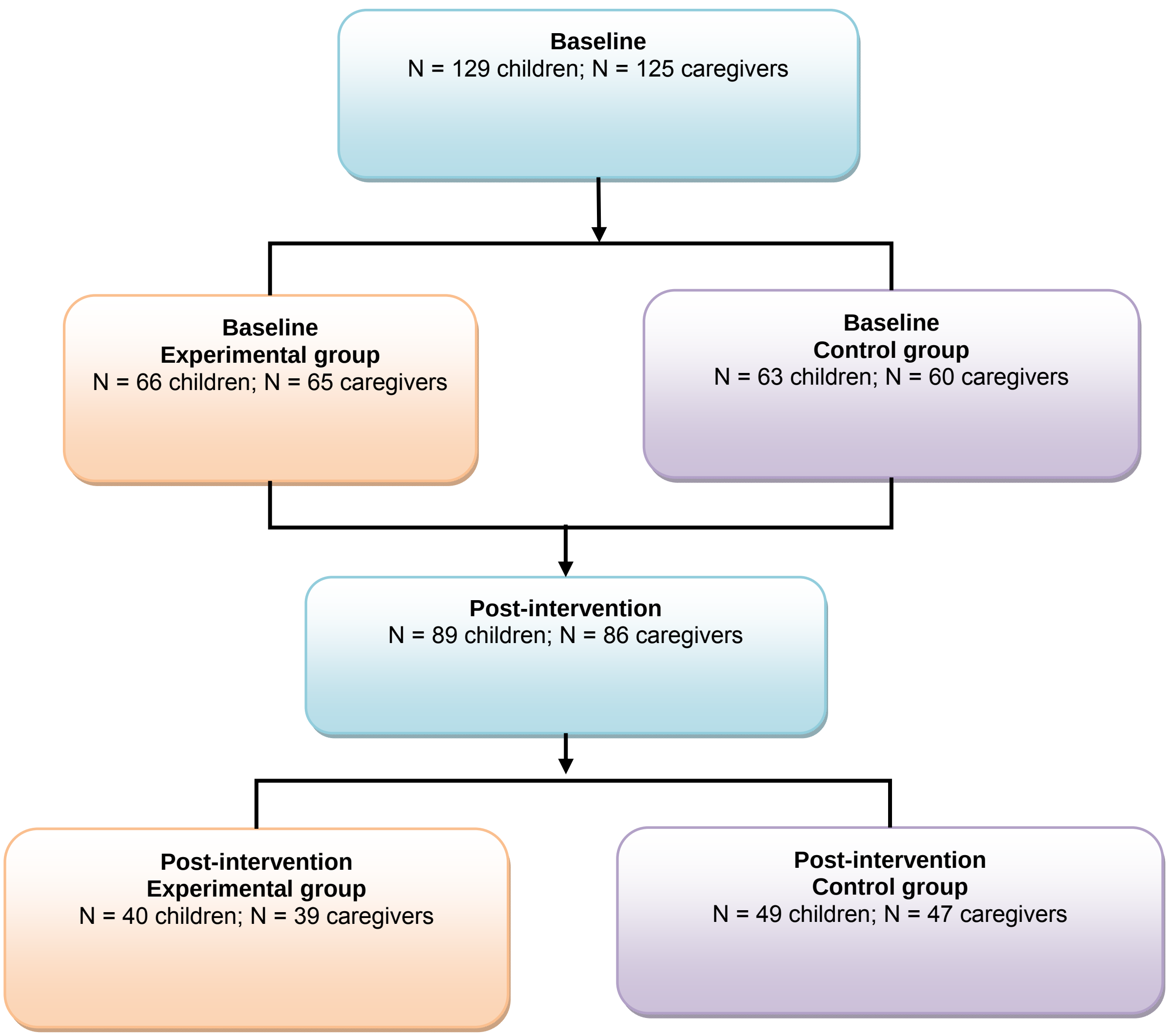

Figure 4.1 Flow diagram indicating the study sample size

4.2 Baseline results

The baseline results will be presented as socio-demographic information, anthropometric status (weight and height) of children and caregivers, micronutrient status of children, nutritional practices and nutritional knowledge of the caregivers.

The sample was selected from eight villages, four of which made up the experimental group and the remaining four comprising the control group (Table 4.1). The sample consisted of 129 children, of whom 66 were in the experimental group (E) and 63 in the control group (C). The experimental group had an equal number of male (n = 33) and female (n = 33) children, while the control group had nearly equal numbers (male = 30; female = 33). There were only 125 caregivers, as some caregivers cared for more than one child. The number of participants in the different tables may vary due to unexpected fall-out, and therefore the sample size will be indicated in each table.

The initial plan was to include all households with children aged 3 to 5 years and their caregivers residing in six chosen villages at baseline. This would total at least 120 households (E = 60; C = 60). However, at the end of the baseline survey in the six proposed villages, only 83 participants could be recruited (all available households were visited). Because the initially planned sample of 120 had not been met, two additional villages were added to increase the number to at least 120 participants.

After intervention, some of the children were cared for by a different caregiver to the one included in the baseline survey, hence the differences in socio-economic status, especially educational level and marital status of the caregiver. The comparisons for nutritional status and nutritional practices were completed for all participants (even if they only participated in one of the two surveys) while comparisons for nutrition knowledge were only completed for caregivers who were present for both the baseline and follow-up surveys.

The 95% CI for median differences between E- and C-groups at baseline were calculated for the anthropometrical and nutrient intake data of the children. That was done to determine comparability of the E and C group at baseline

Table 4.1 Number of children (three to five years) from the different villages (n = 129)

Experimental group (E)			**Control group (C)**		
Village	**N = 66**	**%**	**Village**	**N = 63**	**%**
Tshixwadza	15	22.7	Folovhodwe	21	33.3
Matshavhawe	6	9.1	Muswodi	22	34.9
Mavhode	12	18.2	Musunda	7	11.1
Mapuloni	33	50	Gumela	13	20.6

4.2.1 Socio-demographic and related factors

The median number of people living in the households was six. The number of people per household ranged from two to 14 in the experimental group and from three to 12 in the control group.

Table 4.2 indicates that most of the caregivers (E = 64.6%; C = 63.3%) had secondary education (grade 8 to 12), while fewer than 25% had never attended school (E = 24.6%; C = 18.3%). In both groups the source of income was mainly the parents (E = 49.2%; C = 86.6%), while some children depended on their grandparents for support (E = 30.8%; C = 20.0%). The type of income was mainly child support grant (E = 75.4%; C = 78.3%) and pension grants (E = 16.0%; C = 10.0%). The income of most households was R1 000.00 or less per month (E = 66.2%; C = 68%) and between R1 001.00 and R2 000.00 per month (E = 24.6%; C = 25%).

Most of caregivers were married (E = 49.2%; C = 63.3%), while 31.7% (C) to 41.5% (E) were never married. In both groups, more than 40% of the households had chickens (E = 44.6%; C = 43.3%), while some households had goats (E = 16.9%; C = 35%) and cattle (E = 13.9%; C = 10%). The majority of caregivers had fields to plough (E = 80%; C = 58.3%) and nearly one third had vegetable (E = 27.7%; C = 30%) and fruit gardens (E = 32.3%; C = 21.7%).

Table 4.2 Socio-demographic information (n = 125)

Socio-demographic information	Experimental group (n = 65)		Control group (n = 60)	
Educational level	**N**	**%**	**N**	**%**
Never attended school	16	24.6	11	18.3
Grade 1 – 4	4	6.2	3	5
Grade 5 – 7	3	4.6	7	11.7
Grade 8 – 10	21	32.3	18	30
Grade 11 – 12	21	32.3	20	33.3
Tertiary education	0	0	1	1.7
Source of income				
Mother	16	24.6	29	48.3
Father	16	24.6	23	38.3
Grandparents	20	30.8	12	20.0
Aunt/Uncle/Sibling	4	6.2	-	-
Type of income				
School educator	3	4.6	3	5
Child grants	49	75.4	47	78.3
Pension grants	16	24.6	10	16.7
Self-employed	4	6.2	2	3.3
Health worker	0	0	1	1.7
Household income				
≤ R1000.00	43	66.2	41	68
R1001.00 – R2000.00	16	24.6	15	25
R2001.00 – R3000.00	1	1.54	2	3.33
R3001.00 – R4000.00	3	4.6	0	0
R5000.00 or above	2	3.1	2	3.33
Marital status				
Never married	27	41.5	19	31.67
Married	32	49.2	38	63.3
Widowed	3	4.6	2	3.3
Other	3	4.6	1	1.7
Livestock	**N**	**%**	**N**	**%**
Chickens	29	44.6	26	43.3
Goats	11	16.9	21	35.0
Cattle	9	13.9	6	10.0
Pigs	4	6.2	1	1.7
Land for production				
Vegetable garden	18	27.7	18	30.0
Fruit garden	21	32.3	13	21.7
Field to plough	52	80	35	58.3
Source of cooking fuel				
Firewood	64	98.5	57	95.0
Electricity	14	21.5	13	21.7
Paraffin	2	3.1	3	5.0
Gas	0	0	3	5.0
Source of water				
Communal tap	50	76.9	50	83.3
River	21	32.3	19	31.7
Well	23	35.4	5	8.3
Borehole	3	4.6	5	8.3
Home tap	1	1.54	0	0
Rain water	3	4.6	1	1.7
Source of nutrition information				
Radio	54	83.1	50	83.3
Television	29	44.6	17	28.3
Newspaper	10	15.4	13	21.7
Magazine	3	4.6	8	13.3

Firewood was the main source of cooking fuel (E = 98.5%; C = 95%), while electricity was also available to some of the household (E = 21.5%; C = 21.7%) (Table 4.2). The main source of water was communal taps (E = 76.9%; C = 83.3%), while water from rivers (E = 32.3%; C = 31.7%) and wells (E = 35.5%; C = 8.3%) was also used. Radio was the main source of nutrition information (E = 83.1%; C = 83.3), while a considerable number used television (E = 44.6%; C = 28.3%), and printed media such as newspapers (E = 15.4%; C = 21.7%) and magazines (E = 4.6%; C = 13.3%). The experimental and control group were comparable at baseline in terms of socio-demographic data.

4.2.2 Anthropometric nutritional status of children and caregivers

The results of the anthropometric nutritional status of the children and caregivers will be presented in the following section.

4.2.2.1 Anthropometric status of children

The median birth weight, birth length, current height, current weight and current BMI will be described using median values due to the smaller sample size. The height for age (H/A), weight for age (W/A), weight for height (W/H) and BMI for age (BMI/A) will be compared with WHO (2009) z-score classification and 2000 CDC z-scores classification.

(i) Median birth weight, birth length, current height, current weight and BMI

The median birth weight (E = 3.2 kg; C = 3.2 kg) and birth length (E = 48 cm; C = 48 cm) for children was the same for both groups (Table 4.3). The median height (E = 98.8 cm; C = 98.4 cm), median weight (E = 15.6 kg; C = 15.0 kg) and median BMI (E = 13.3 kg/m^2; C = 13.6 kg/m^2) for the children were nearly the same in both groups.

Table 4.3 Median birth weight, birth length, current height, current weight and BMI of children

Anthropometric variables	Experimental group				Control group			
	N	Median	Min	Max	N	Median	Min	Max
Birth weight (kg)	58	3.2 kg	1.7	4.2	56	3.2 kg	1.5	4.9
Birth length (cm)	58	48 cm	35	59	55	48.0 cm	37	53
Current height (cm)	66	98.8 cm	86.0	111.5	63	98.4 cm	84.0	112.9
Current weight (kg)	66	15.6 kg	10.8	19.2	63	15.0 kg	10.2	19.6
Current BMI (kg/m^2)	66	13.3 kg/m^2	8.4	22.9	63	13.6 kg/m^2	8.5	22.2

(ii) Height for age

Table 4.4 indicates that, when using the WHO (2009) z-scores classification, most of the children (E = 80.3%; C = 79.1%) had normal HAZ (-1SD to ≤ +2SD), while nearly one fifth (E = 15.2%; C = 19.4%) were stunted (-3SD to < -2SD). However, according to the 2000 CDC z-scores, more or less half of the children (E = 53.0%; C = 48.4%) had normal HAZ (≥ -1SD to ≤ +2SD), while more than one quarter (E = 27.3%; C = 30.7%) were classified as mildly stunted (< -1SD to ≥ -2SD) and less than one fifth were moderately stunted (< -2SD to ≥ -3SD) (E = 15.2%; C = 19.4%). At baseline, there were no statistical significant differences, according to the 95% confidence interval (CI) for the median difference [0; 0] between experimental group and control group, regarding HAZ.

Table 4.4 Z-score classification of height for age in terms of WHO (2009) and 2000 CDC

Z-score classification	Interpretation	Experimental group (n = 66)		Control group (n = 63)		95% CI for median difference
		N	%	N	%	
Height-for-age z-score classification using WHO (2009)						
< -3SD	Severely stunted	3	4.6	1	1.6	CI [0; 0]
-3SD to < -2SD	Stunted	10	15.2	12	19.4	CI [0; 0]
-2SD to < -1SD	Mild stunted	0	0	0	0	
-1SD to +1SD	Normal height	35	53.0%	30	48.4	CI [0; 0]
>+1SD to ≤ +2SD	Normal height	18	27.3%	19	30.7	CI [0; 0]
Height-for-age z-score classification using 2000 CDC						
< - 3 SD	Severely stunted	3	4.6	1	1.6	CI [0; 0]
< - 2 SD to ≥ -3 SD	Moderately stunted	10	15.2	12	19.4	CI [0; 0]
< - 1 SD to ≥ -2 SD	Mildly stunted	18	27.3	19	30.7	CI [0; 0]
≥ -1 SD to ≤ +2 SD	Normal HAZ	35	53.0	30	48.4	CI [0; 0]

(iii) Weight for age

According to the WHO (2009) z-score classification, 15.8% (C) to 20.2% (E) of the children were classified as having a possible growth problem (>+1SD to ≤ +3SD), while most of the children (E = 71.2%; C = 76.2%) had normal WAZ (-1SD to +1SD) as shown in Table 4.5. However, the 2000 CDC z-score classification 19.7% (E) to 34.9% (C) of the children as mildly underweight (< -1SD to ≥ -2SD) while most of the children (E = 71.2%; C = 57.1%) were within a normal WAZ range (≥ -1SD to ≤ +2SD), and a few (E = 6.1%; C = 8.0%) were classified as moderately underweight (< -2SD to ≥ -3SD). At baseline, there were no statistical significant differences, according to the 95% CI for the median difference [0; 0] between experimental group and control group, regarding WAZ.

Table 4.5 Z-score classification of weight for age in terms of WHO (2009) and 2000 CDC

Z-score classification	Interpretation	Experimental group (n = 66)		Control group (n = 63)		95% CI for median difference
		N	%	N	%	
Weight-for-age z-score classification using WHO (2009)						
< -3SD	Severely underweight	1	1.5	0	0	CI [0; 0]
-3SD to < -2SD	Underweight	4	6.1	5	8.0	CI [0; 0]
-2SD to < -1SD	Mild underweight	0	0	0	0	
-1SD to +1SD	Normal WAZ	47	71.2	48	76.2	CI [0; 0]
>+1SD to ≤ +2SD	Possible growth problem	13	19.7	7	11.0	CI [0; 0]
>+2SD to ≤ +3SD	Possible growth problem	1	1.5	3	4.8	CI [0; 0]
Weight-for-age z-score classification using 2000 CDC						
< - 3SD	Severely underweight	1	1.5	-	-	CI [0; 0]
< - 2SD to ≥-3SD	Moderately underweight	4	6.1	5	8.0	CI [0; 0]
< -1SD to ≥- 2SD	Mildly underweight	13	19.7	22	34.9	CI [0; 0]
≥ -1SD to ≤+ 2SD	Normal WAZ	47	71.2	36	57.1	CI [0; 0]
> +2SD	Overweight	1	1.5	-	-	CI [0; 0]

(iv) Weight for height

When using the WHO (2009) z-score classification, most children had normal WHZ (-1SD to +1SD) in both groups (E =87.9%; C = 88.8%) while 3.0% (E) to 4.8% (C) were classified as wasted (-3SD to < -2SD), as shown in Table 4.6. According to the 2000 CDC z-score classification, most of the children (E = 84.9%; C = 85.7%) had normal WHZ (≥ -1SD to ≤ +2SD), while a few (E = 10.6%; C = 12.7%) were classified as mildly wasted (< -1SD to ≥ -2SD). At baseline, there were no statistical significant differences, according to the 95% CI for the median difference [0; 0] between experimental group and control group, regarding WHZ.

Table 4.6 Z-score classification of weight for height in terms of WHO (2009) and 2000 CDC

Z-score classification	Interpretation	Experimental group (n = 66)		Control group (n = 63)		95% CI for median difference
		N	%	N	%	
Weight-for-height z-score classification using WHO (2009)						
< -3SD	Severely wasted	1	1.5	0	0	CI [0; 0]
-3SD to < -2SD	Wasted	2	3.0	3	4.8	CI [0; 0]
-2SD to < -1SD	Mildly wasted	0	0	0	0	
-1SD to +1SD	Normal WHZ	58	87.9	56	88.8	CI [0; 0]
>+1SD to ≤ +2SD	Possible risk of overweight	3	4.6	3	4.8	CI [0; 0]
>+2SD to ≤ +3SD	Overweight	2	3.0	1	1.6	CI [0; 0]
Weight-for-height z-score classification using 2000 CDC						
< - 3 SD	Severely wasted	1	1.5	0	0	CI [0; 0]
< - 1SD to ≥ -2SD	Mildly wasted	7	10.6	8	12.7	CI [0; 0]
≥ -1SD to ≤ + 2SD	Normal WHZ	56	84.9	54	85.7	CI [0; 0]
> +2 SD	Overweight	2	3.0	1	1.6	CI [0; 0]

(v) BMI for age

According to the WHO (2009) z-score classification, more than 80% of children (E = 80.3%; C = 85.7%) had a normal BMI/A (-1SD to +1SD), while few children (E = 6.1%; C = 1.6%) were classified as overweight (>+2SD to ≤ +3SD) (Table 4.7). According to the 2000 CDC z-score classification, most of the children (E = 89.4%; C = 98.4%) had a normal BMI/A (≥ -2SD to ≤ +2SD), while very few children (E = 6.1%; C = 1.6%) were overweight (> +2SD). At baseline, there were no statistical significant differences, according to the 95% CI for the median difference [0; 0] between experimental group and control group, regarding BMI/A.

Table 4.7 BMI-for-age z-score classification in terms of WHO (2009) and 2000 CDC

Z-score classification	Interpretation	Experimental group (n = 66)		Control group (n = 63)		95% CI for median difference
		N	%	N	%	
BMI-for-age z-score classification using WHO (2009)						
< -3SD	Severely wasted	1	1.5	0	0	CI [0; 0]
-3SD to < -2SD	Wasted	2	3.0	0	0	CI [0; 0]
-2SD to < -1SD	Normal	0	0	0	0	
-1SD to +1SD	Normal BMI/A	53	80.3	54	85.7	CI [0; 0]
>+1SD to ≤ +2SD	Possible risk of overweight	6	9.1	8	12.7	CI [0; 0]
>+2SD to ≤ +3SD	Overweight	4	6.1	1	1.6	CI [0; 0]
BMI-for-age z-score classification using 2000 CDC						
< - 3 SD	Severely underweight	1	1.5	0	0	CI [0; 0]
< - 2 SD to ≥ - 3 SD	Underweight	2	3.0	0	0	CI [0; 0]
< - 1SD to ≥ - 2 SD	Normal BMI/A	6	9.1	8	12.7	CI [0; 0]
≥ -1 SD to ≤ + 2 SD	Normal BMI/A	53	80.3	54	85.7	CI [0; 0]
> +2 SD	Overweight	4	6.1	1	1.6	CI [0; 0]

4.2.2.2 Anthropometric status of caregivers

The median weight (E = 64.4 kg; C = 67.2 kg) and the median height (E = 1.58 m; C = 1.59 m) were nearly the same in both groups. Fewer than half of the caregivers were classified as overweight (E = 40.0%; C = 43.3%) and 11.7% (C) to 18.4% (E) were classified as obese, while 38.8% (E) to 43.4% (C) had normal weight, as shown in Table 4.8.

Table 4.8 BMI classification of caregivers (WHO, 2000)

BMI classification	Interpretation	Experimental group (n = 65)		Control group (n = 60)	
		N	%	N	%
> 18.5 kg/m^2	Underweight	2	3.1	1	1.7
18.5 – 24.9 kg/m^2	Normal weight	25	38.5	26	43.3
25 – 29.9 kg/m^2	Overweight	26	40.0	26	43.3
30 – 34.9 kg/m^2	Class I - Obese	9	13.8	6	10.0
35 – 39.9 kg/m^2	Class II – Obese	3	4.6	1	1.7

4.2.3 Micronutrient status of children

The micronutrient status of the children refers to their vitamin A and iron status. The blood samples were only drawn from the children whose caregivers gave consent, hence the number is low (E: n = 38; C: n = 40).

More than 90% of the children in both groups had road to health cards (E = 92.1%; C = 93.3%). Of those who had road to health cards, only 21.4% (C) to 25.9% (E) had been given vitamin A supplementation in the past six months.

4.2.3.1 Vitamin A status

The median serum vitamin A concentration in the experimental group was 324.5 µg/L, with a minimum of 124 µg/L and a maximum of 582 µg/L, which is within the normal range (> 300µg/L). In the control group, the median was 226.5 µg/L, with a minimum of 137.0 µg/L and a maximum of 365.0 µg/L, which is within the adequate range (200 to 299.9µg/L).

Most children in both groups had adequate serum vitamin A concentrations (E = 62.5%; C = 53.3%), while nearly one third had marginal serum vitamin A status (E = 29.2%; C = 30.0%) (Table 4.9). Fewer than 10% of the children (E = 8.3%) in the experimental group had a serum vitamin A deficiency, while 16.7% (C) had a normal serum vitamin A concentration.

Table 4.9 Categories of serum retinol concentrations

Categories of serum retinol	Concentration levels for different categories	Experimental group (n = 24)		Control group (n = 30)	
		N	%	N	%
Vitamin deficiency	< 100 µg/L	2	8.3	-	-
Marginal vitamin A status	100 – 199.9 µg/L	7	29.2	9	30.0
Adequate status	200 – 299.9 µg/L	15	62.5	16	53.3
Normal/ well nourished status	> 300 µg/L	-	-	5	16.7

4.2.3.2 Iron status

The median serum iron in both groups was the same (E = 12.3 µmol/L; C = 12.2 µmol/L), and the levels were within the normal range (5.0 to < 16.7 µmol/L), while the % transferrin saturation was at the low end of the normal range for both groups (E = 17.5%; C = 17.0%), as shown in Table 4.10. The median serum ferritin (E = 39.0 ng/mL; C = 34.0 ng/mL) and serum transferrin (E = 2.7g/L; C = 2g/L) levels were within the normal range for both groups.

Table 4.10 Median serum iron, serum ferritin, serum transferrin and transferrin saturation %

Blood indicators (normal ranges)	Experimental group (n = 30)				Control group (n = 30)			
	N	Median	Min	Max	N	Median	Min	Max
Serum iron (5.0 - < 16.7 µmol/L)	30	12.3	4.1	22.9	30	12.2	6.0	21.5
Serum ferritin (7 – 140 ng/mL)	30	39.0	9.0	75.0	30	34.0	9.0	142.0
Serum transferrin (1.5 – 3.5 g/L)	30	2.7	2.2	3.5	30	2	2.3	3.3
% transferrin saturation (17 – 42%)	30	17.5	6.0	42.0	30	17.0	8.0	33.0

As indicated in Table 4.11, the majority of children in both groups (E = 73.3%; C = 86.7%) had normal serum iron concentrations, while 20% and fewer had high serum iron concentrations (E = 20.0%; C = 13.3%). Most children had normal concentrations of serum ferritin (E = 100%; C = 96.7%), serum transferrin (E = 96.7%; 100%) and % transferrin saturation (E = 96.7%; C = 100%). More than 73% of children serum concentrations of iron indicators (serum iron, serum ferritin, serum transferrin and %transferrin saturation) were in the normal range.

Table 4.11 Serum iron indicators in children

Iron indicators	Serum concentration level	Experimental group (n = 30)		Control group (n = 30)	
Serum iron [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
		N	**%**	**N**	**%**
(depletion)	< 5.0 µmol/L	2	6.7	-	-
(normal)	5.0 - < 16.7 µmol/L	22	73.3	26	86.7
(high)	> 16.7 µmol/L	6	20.0	4	13.3
Serum ferritin [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(normal)	7 – 140 ng/ml	30	100.0	29	96.7
(high)	> 140 ng/ml	-	-	1	3.3
Serum transferrin [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(normal)	1.5 – 3.5 g/L	29	96.7	30	100.0
(high)	> 3.5 g/L	1	3.3	-	-
% transferrin saturation [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(low)	< 17%	1	3.3	-	-
(normal)	17 – 42%	29	96.7	30	100.0

4.2.4 Nutritional practices of caregivers

Nutritional practices were determined by asking specific questions regarding the number of meals usually given to the children per day, the types of food usually given (according to the food groups), and the frequency of giving specific foods per week. The adequacy of the usual energy and nutrient intake were also determined.

4.2.4.1 Number of meals given to children per day

Most of the children were receiving three meals per day (E = 75.4%; C = 63.3%) or more than three meals per day (E = 21.5%; C = 31.7%) (Table 4.12).

Table 4.12 Number of meals given to children per day

	Experimental group (n = 65)		Control group (n = 60)	
Number of meals	**N**	**%**	**N**	**%**
Once per day	1	1.5	0	0
Two per day	0	0	3	5.0
Three per day	49	75.4	38	63.3
More than three	14	21.5	19	31.7
Do not know	1	1.5	0	0

4.2.4.2 Types of foods usually given

The results will be presented according to the types of food that were usually on the plate of the child, snacks that were usually given to the child and indigenous foods that were given to the child.

(i) Types of foods that were usually on the child's plate

Table 4.13 shows that more than 96% of the caregivers usually included starchy foods such as porridge, bread or samp (E = 100%; C = 100%), vegetables (E = 100%; C = 96.7%), protein-rich foods such as meat, beans, eggs, fish, milk or mopani worms (E = 98.5%; C = 100%), and fats such as cooking oil or margarine (E = 93.9%; C = 96.7%) on the child's plate daily.

Table 4.13 Foods that were usually on the child's plate

	Experimental group (n = 65)		Control group (n = 60)	
Food items	**N**	**%**	**N**	**%**
Starchy foods such as porridge or bread or samp	65	100.0	60	100.0
Vegetables	65	100.0	58	96.7
Protein-rich foods (meat or beans or eggs or fish or milk or mopani worms)	64	98.5	60	100.0
Fat such as cooking oil or margarine	61	93.9	58	96.7

(ii) Types of snacks usually given to the child

The most popular snacks were vegetables and fruit (E = 100%; C = 98.3%), Simba chips, sweets and cold drinks (E = 96.8%; C = 93.2%), fruit juice (E = 96.8%; C = 91.5%), yoghurt (E = 90.3%; C = 84.8%) and peanuts (E = 80.7%; C = 83.1%) (Table 4.14).

Table 4.14 Types of snacks given to children

	Experimental group (n = 62)		Control group (n = 59)	
Types of snacks	**N**	**%**	**N**	**%**
Vegetables and fruits	62	100.0	58	98.3
Simba chips, sweets, cold drink	60	96.8	55	93.2
Fruit juice	60	96.8	54	91.5
Yoghurt	56	90.3	50	84.8
Peanuts	50	80.7	49	83.1

(iii) Consumption of indigenous foods

The consumption of indigenous foods is influenced by access as well as the seasonal availability. Table 4.15 shows that the indigenous vegetables that were given to most of the children in both groups included pumpkin leaves (E = 98.5%; C = 95.0%), night shave leaves (E = 98.5%; C = 86.7%), small pig weed (E = 93.8%; C = 78.3%), wild-jute plant (E = 81.5%; C = 90.0%), cow peas leaves (E = 80.0%; C = 86.7%) and spider flower (E = 76.9%; C = 81.7%).

The indigenous fruit that were given to most children in both groups were mango (E = 98.5%; C = 100%), paw-paw (E = 76.9%; C =95%) and guavas (E = 76.9%; C = 88.3%). Most children in the experimental group were given indigenous fruits such as *bequa.magalies* (E = 90.8%; C = 56.7%), medlar (E = 55.4; C = 36.7%), pineapple (E = 55.4%; C = 43.35) and baobab fruit (E = 38.5%; C = 93.3%), while most children in the experimental group were given avocado (E = 40%, C = 3.3).

The indigenous mixed dishes that were consumed by most of the children in both groups included *nawa* (beans) (E = 93.9%; C = 96.7%), *tshidzimba* (samp, beans or jugo beans, groundnuts) (E = 83.1%; C = 76.7%) and *thophi* (pumpkin & maize-meal) (E = 81.5%; C = 60.0%). The least consumed indigenous mixed dish in both groups (E = 9.2%; C = 6.7%) was *tshimbundwa* (traditional bread made from maize).

Table 4.15 Types of Indigenous foods given to children

Tshivenda name	English & scientific name	Experimental group (n = 65)		Control group (n = 60)	
		N	%	N	%
Indigenous vegetables					
Mushinzhi	Black Jack / *Bidens pilosa*	54	83.1	47	78.3
Murudi	Spider flower or spider plant / *Cleome gynandra*	50	76.9	49	81.7
Delele	Wild-jute plant / *Corchus hirstirus or corchorus olitorius*	53	81.5	54	90.0
Muxe	Night shave leaves / *Solanum retroflexum Dun.*	64	98.5	52	86.7
Dzaluma	*Stinging nettle / Laportea peduncularis*	55	84.6	15	25.0
Vowa/ Thebe	Small pig weed / *Amaranthus thunbergii*	62	93.8	47	78.3
Phuri/ thanga	Pumpkin leaves / *Cucurbita moschata*	64	98.5	57	95.0
Munawa	Cow pea's leaves / *Vigna unguiiulate*	52	80.0	52	86.7
Muvhazwi		5	7.8	4	6.7
Tshimbavhe	African cucumber / *Mormodica balsamina*	3	4.6	3	5.0
Mufungwi		3	4.6	-	-
Mutohotoho	Spindle pod / *C. Monophylla*	3	4.6	-	-
Mutshatsha	Wild watermelon / *Citrus lanatus*	1	1.5	3	5.0
Mufhafhe	Wild cucumber / *C. Zeyheri*	-	-	6	10.0
Tshiphinatshi	Spinach	18	27.7	13	21.7
Mutshaina	China spinach	20	30.8	10	16.7
Khavhishi	Cabbage	21	32.3	11	18.3
Indigenous fruit					
Mazwilu	Medlar / *Vangueria infestusta Burch*	36	55.4	22	36.7

Table 4.15 Types of Indigenous foods given to children (Cont.)

Tshivenda name	English & scientific name	Experimental group (n = 65)		Control group (n = 60)	
		N	%	N	%
Indigenous fruit					
Mavhungo/ Makwakwa	Wild peach / *Strychnos spinosa lam*	25	38.5	16	26.7
Nombelo	*Bequa.magalies*	59	90.8	34	56.7
Mbuyu	Baobab fruit / *Adansonia digitata*	25	38.5	56	93.3
Manngo	Mango / *Mangifera indica*	64	98.5	60	100.0
Papawe	Paw-paw / *Carica papaya*	50	76.9	57	95.0
Magwavha	Guavas / *Psidium guajava*	61	76.9	53	88.3
Tshienge	Pineapple / *Ananas comosus*	36	55.4	26	43.3
Muomva	Banana / *Musa acuminate*	30	46.2	20	33.3
Maswiri	Oranges / *Citrus sinensis*	25	38.5	16	26.6
Niiyi	*Bercheia discolor*	5	7.7	17	28.3
Maafukhada	Avocado	26	40	2	3.3
Thawi		5	7.7	-	-
Thaladzi		6	9.2	-	-
Mahuhuma	Baboon's breakfast / *Hexalobu monopetahus*	1	1.5	-	-
Thondo		5	7.7	-	-
Tanzwa		4	6.2	-	-
Thombe		2	3.1	1	1.7
Pfuka		1	1.5	1	1.7
Maberegisi	Peaches	9	13.9	2	3.3
Indigenous mixed dishes					
Tshidzimba	Samp, beans or jugo beans, groundnuts	54	83.1	46	76.7
Dovhi	Ground nuts & dried vegetable / biltong & ground nuts	33	50.8	42	70.0
Thophi	Pumpkin & maize-meal	53	81.5	36	60.0
Tshimbundwa	Traditional bread made from maize	6	9.2	4	6.7
Tshigume/ mugumo	Traditional peanut butter	12	18.5	9	15.0
Nawa	Beans	61	93.9	58	96.7
Indigenous edible insects					
Nemeneme/ nthwa	Adult insects	54	83.1	20	33.3
Mashonzha	Mopani worms	53	81.5	51	85.0
Nzie	Locusts	62	95.4	53	88.3
Manzhulu	Termites	45	69.2	19	31.7

The indigenous edible insects that were consumed by the majority of children in both groups included mopani worms (E = 81.5%; C = 85.0%) and locusts (E = 95.4%; C = 88.3%) (Table 4.15). Most children in the experimental group consumed adult insects (E = 83.1%; C = 33.3%) and termites (E = 69.2%; C = 31.7%).

4.2.4.3 Frequency of giving vegetables, fruit and milk per week

The frequency of consuming the given vegetables, fruit and milk per week is shown in Table 4.16. According to Table 4.16, most of the children in the experimental group consumed vegetables three to five times per week (E = 49.2%; C = 31.7%), while most of the children in the control group consumed vegetables less than three times per week (E = 30.8%; C= 51.7%).

Table 4.16 Frequency of consuming vegetables, fruit and milk per week

Frequency per week	Experimental group		Control group	
Vegetables	**N = 65**	**%**	**N = 60**	**%**
Daily	12	18.5	6	10.0
3 to 5 times per week	32	49.2	19	31.7
Less the 3 times per week	20	30.8	31	51.7
Do not know	1	1.5	2	3.3
Never	-	-	2	3.3
Fruit	**N = 65**	**%**	**N = 60**	**%**
Daily	10	15.4	10	16.7
3 to 5 times per week	16	24.6	13	21.7
Less than 3 times per week	34	52.3	31	51.7
Do not know	4	7.7	6	10.0
Milk	**N (21)**	**%**	**N (25)**	**%**
3 to 5 times per week	4	19.1	3	12.0
Less than 3 times per week	13	61.9	16	64.0
Do not know	4	19.1	6	24.0

Most children in both groups consumed fruit less than three times per week (E = 52.3%; C = 51.7%), while less than a quarter consumed fruit three to five times a week (E = 24.6%; C = 21.7%). Milk was consumed less than three times per week by most children in both groups (E = 61.9%; C = 64%), while 19.1% (E) to 24% (C) of the caregivers did not know how often they gave milk to the children per week. About 32.3% (E=21 of 65) to 41.7% (C=25 of 60) of the children were given milk (Table 4.16). Table 4.17 shows that, of the children who received milk, 56.0% (C) to 76.2% (E) received one cup of milk at a time, while 23.8% (E) to 44.0% (C) received half a cup of milk at a time.

Table 4.17 Amount of milk given to children at a time

Amount of milk	Experimental group (n = 21)		Control group (n = 25)	
	N	**%**	**N**	**%**
Half a cup	5	23.8	11	44.0
One cup	16	76.2	14	56.0

4.2.4.4 Usual energy and nutrient intake

Few children had allergies (E: n = 12; C: n = 3) that could influence their food intake and few children had eaten away from home in the past week (E: n = 5; C: n = 11). Fortified maize-meal was used by 46.6% (E) to 88.3% (C), while 12.6% (C) to 26.2% (E) were using both fortified maize-meal and self grind maize-meal.

The median energy intake (E = 4064.1 kJ; C = 3954.3 kJ) in both groups was lower than the estimated energy requirements (EER: male = 7316 kJ; female = 6896 kJ) (Table 4.18). The median total protein (E = 27.7 g; C = 31.9 g) and carbohydrate intake (E = 162.2 g; C = 158.3 g) were adequate when compared to EAR and RDA for both age groups one to three years and four to eight years. In addition, the median iron (E = 3.8 mg; C = 4.0) and zinc intake (E = 3.2 mg; C = 3.3) were adequate in both groups when compared to the EAR for the age group one to three years.

The median vitamin C intake (E = 23.3 mg; C = 10.2 mg) was adequate in both age groups in the experimental group when compared with the EAR and RDA (Table 4.18). The median vitamin A (E = 93.8 mcg; C = 87.7 mcg) and folate intake (E = 74.5 mcg; C = 66.1 mcg) were inadequate in age group one to three years and four to eight years in both groups when compare to EAR. Furthermore, the median calcium intake (E = 130.3 mg; C = 118.6 mg) was inadequate when compared with AI for age group one to three years and four to eight years. The intake of the non-heme iron (95% CI for the median difference [0.05; 0.48]) and vitamin C (95% CI for the median difference [2.25; 33.5]) were significantly different at baseline in the two groups (from 24 hour recall: E = fortified maize meal, spinach, beans & roasted pumpkin seeds; C = fortified maize meal, spinach & amaranths). The intake of other nutrients was not statistically significant between the experimental and control group which shows that the nutrient intake of the two groups was comparable at baseline as indicated in Table 4.18.

Table 4.18 Median nutrient intake

Nutrient intake	EER /EAR	RDA	AI	Experimental group (n = 66)			Control group (n = 63)			95% CI for median difference
				Median	Min	Max	Median	Min	Max	
Energy (kJ)	EER 3 – 8 yrs (male 7316 kJ); (female 6896 kJ)	-	-	4064.1	2107.5	7356.9	3954.3	2307.9	7728.2	CI [-310.4; 473.5]
	EAR									
Total protein (g)	·	1 – 3 yrs (13.0 g); 4 – 8 yrs (19 g)		27.7	13.1	56.4	31.9	15.2	55.6	CI [-6.1; 1.8]
Plant protein (g)				17.5	11.5	28.2	18.1	9.5	32.0	CI [-1.4; 1.73]
Animal protein (g)				9.6	0	36.4	12.6	0	32.5	CI [-5.7; 0.9]
Total fat (g)	ND	ND	ND	16.3	3.1	47.5	17.2	6.4	57.8	CI [-2.9; 3.8]
Carbohydrates (g)	1 – 3 yrs (100 g) 4 – 8 yrs (100 g)	1 – 3 yrs (130 g) 4 – 8 yrs (130 g)		162.2	96.1	304.8	158.3	76.6	267.1	CI [-8.5; 20.9]
Calcium (mg)			**1 – 3 yrs (500 mg); 4 – 8 yrs (800 mg)**	130.3	40.5	640.2	118.6	21.0	480.1	CI [-16.6; 32.5]
Iron (mg)	1 – 3 yrs (3.0 mg); 4 – 8 yrs (4.1 mg)	1 – 3 yrs (7.0 mg); 4 – 8 yrs (10 mg)		3.8	2.4	8.6	4.0	2.1	7.1	CI [-0.34; 0.6]
Haeme iron (mg)				0.07	0	0.32	0.09	0	0.7	CI [-0.03; 0.6]
Nonhaeme iron (mg)				1.1	0.21	2.8	0.9	0	3.2	**CI [0.05; 0.48]**
Zinc (mg)	1 – 3 yrs (2.2 mg); 4 – 8 yrs (4.0 mg)	1 – 3 yrs (3.0 mg); 4 – 8 yrs (5.0 mg)		3.2	1.6	6.2	3.3	1.9	6.2	CI [-0.39; 0.35]
Vitamin A (mcg)	1 – 3 yrs (210 mcg); 4 – 8 yrs (275 mcg)	1 –3 yrs (300 mcg); 4 – 8 yrs (400 mcg)		93.8	25.2	427.4	87.7	16.2	799.3	CI [-7.68; 38.8]
Total carotene (mcg)				341.1	17.5	1233.5	150.7	0	1222.8	CI [-15.0; 5.5]
B-carotene (mcg)				334.7	12.9	1173.2	137.6	0	1167.5	CI [-7.2; 235.9]
A-carotene (mcg)				7.1	0	121.5	4.2	0	203.7	CI [0.0; 5.3]
Folate (mcg)	1 – 3 yrs (120 mcg); 4 – 8 yrs (160 mcg)	1 – 3 yrs (150 mcg); 4 – 8 yrs (200 mcg)		74.5	23.3	222.8	66.1	28.7	216.1	CI [-3.15; 23.6]
Vitamin C (mg)	1 – 3 yrs (13 mg); 4 – 8 yrs (22 mg)	1 – 3 yrs (15 mg); 4 – 8 yrs (25 mg)		23.3	0.01	295	10.2	0.05	275.8	**CI [2.25; 33.5]**

EAR = Estimate average requirement; EER = Estimated energy requirements
RDA = Recommended Dietary Allowance; AI = Adequate intake

4.2.5 Nutritional knowledge of caregivers

The knowledge of nutritional of the caregivers included knowledge regarding the number of meals to be offered to the child, types of foods that should be offered, frequency of giving specific foods and knowledge of the types of indigenous foods. The median score of the caregivers for knowledge of nutrition was between 84.2% (C) and 86.8% (E).

Most caregivers (E = 50.8%; C = 61.7%) indicated that children should eat meals three times a day, while more or less one third (E = 30.8%; C = 35%) indicated that children should eat more than three meal per day (Table 4.19).

Table 4.19 Knowledge of the number of meals to be offered to children (three to five years)

Number of meals per day	Experimental group (n = 65)		Control group (n = 60)	
	N	%	N	%
Twice per day	1	1.5	0	0
Three time per day	33	50.8	37	61.7
More than three per day	20	30.8	21	35.0
Do not know	11	16.9	2	3.3

Most caregivers indicated that children should eat starchy foods such as bread or porridge or samp (E = 98.5%; C = 100%), protein-rich foods such as beans or meat (E = 98.5%; C = 98.3%), vegetables (E = 100%; C = 100%) and fruit (E = 98.5%; C = 96.7%), as well as a variety of foods (E = 93.8%; C = 91.7%), as shown in Table 4.20.

Table 4.20 Knowledge of types of foods that should be given to children (three to five years)

Types of foods	Experimental group (n = 65)		Control group (n = 60)	
Food items	**N**	**%**	**N**	**%**
Food groups				
Variety of foods (foods from different groups)	61	93.8	55	91.7
Starchy food such as porridge, bread	64	98.5	60	100.0
Protein rich foods such beans, eggs, meat, fish	64	98.5	59	98.3
Fat such as cooking oil, margarine	55	84.6	55	91.7
Vegetables such as spinach	65	100.0	60	100.0
Fruit such as mango, paw-paw	64	98.5	58	96.7
Sugar	57	87.7	58	96.7
Snacks (peanuts, potato based chips)	63	96.9	59	98.3
Indigenous/traditional foods				
Indigenous vegetables (such black jack, murudi)	62	95.4	58	96.7
Indigenous fruit (such nombelo, mbuyu)	65	100.0	57	95.0
Dried beans	65	100.0	59	98.3
Edible insects *(Mashonzha, manzhulu, nzie, nemeneme)*	60	92.3	54	90.0

The majority of caregivers indicated that children should be given indigenous vegetables (E = 95.4%; C = 96.7%), indigenous fruit (E = 100%; C = 95%), dried beans (E = 100%; C = 98.3%) and edible insects (E=92.3%; C=90%) (Table 4.20).

More than 75% of the caregivers indicated that food such as dried beans (E = 81.5%; C = 80%), mopani worms (E = 75.4%; C = 85%) and vegetables mixed with groundnuts (E = 67.7%; C = 75%) can be given in place of meat (Table 4.21).

Table 4.21 Knowledge of types of food that can be given in place of meat

Types of food that can be given instead of meat	**Experimental group (n = 65)**		**Control group (n = 60)**	
	N	**%**	**N**	**%**
Dried beans be used in place of meat	53	81.5	48	80.0
Mopani worms be used in place of meat	49	75.4	51	85.0
Vegetables mixed with groundnuts in place of meat	44	67.7	45	75.0

Most caregivers in both groups indicated that children should be given low fat milk (E = 49.2%; C = 75%), while less than a quarter of the caregivers indicated that children should be given full-cream milk (E = 21.5%; C = 21.7%), as shown in Table 4.22.

Table 4.22 Knowledge of the type of milk that should be given to children (three to five years)

Type of milk	**Experimental group (n = 65)**		**Control group (n = 60)**	
	N	**%**	**N**	**%**
Full-cream milk	14	21.5	13	21.7
Low fat milk	32	49.2	45	75.0
Do not know	19	29.2	2	3.3

According to Table 4.23, most caregivers in both groups indicated that they knew indigenous vegetables such as *murudi* (E = 100%; C = 96.7%) and indigenous fruit such as *mazwilu* (E = 98%; C = 85%), *nombelo* (E = 98.5%; C = 90.0%) and *mavhungo* (E = 96.9%; C = 85%). Furthermore, the majority of caregivers in both groups indicated that they knew indigenous mixed dishes such as *tshidzimba* (E = 98.5%; C = 96.7%), *thophi* (E = 98.5%; C = 98.3%) and *dovhi* (E = 96.9%; C = 100%), while a few caregivers in both groups knew *tshimbundwa* (E = 33.9%; C = 28.3%).

In the experimental group, most of the caregivers indicated that they knew indigenous vegetables such as *mufungwi* (E = 89.2%, C = 25%) and *fhuri* (E = 33.3%; C = 6.7%).

Table 4.23 Knowledge of types of indigenous foods in Limpopo Province

Tshivenda	English & scientific names	Experimental group (n = 65)		Control group (n = 60)	
		N	%	N	%
Indigenous vegetables					
Murudi	Spider flower or spider plant / *Cleome gynandra*	65	100.0	58	96.7
Mufungwi		58	89.2	15	25.0
Fhuri	Pumpkin	22	33.3	4	6.7
Dzaluma	Stinging nettle / *Laportea peduncularis*	2	3.1	-	-
Vowa	Small pig weed / *Amaranthus thunbergii*	4	6.2	3	5.0
Mushidzhi	Black Jack / *Bidens pilosa*	1	1.5	-	-
Indigenous fruit					
Mazwiliu	Medlar / *Vangueria infestusta Burch*	64	98.5	51	85.0
Nombelo	*Bequa.magalies*	64	98.5	54	90.0
Mavhungo/ kwakwa	Wild peach / *Strychnos spinosa lam*	63	96.9	51	85.0
Niiyi	Living long fruit / *Bercheia discolour*	3	4.6	20	33.3
Mbuyu	Baobab fruit / *Adansonia digitata*	1	1.5	9	15.0
Tsuma	African ebony / *Dospyros mespiliformis Hochest*	-	-	4	6.7
Thombe		15	23.1	2	3.3
Tanzwa	Small sour plum / *Pouzolzia mixta*	2	3.1	1	1.7
Thondo		7	10.8	2	3.3
Thabva		-	-	6	10.0
Manngo	Mango / *Mangifera indica*	2	3.1	1	1.7
Papawe	Paw-paw / *Carica papaya*	1	1.5	4	6.7
Mahuyu	Figs / *F. sycomorus*	5	7.7	3	5.0
Madoro		1	1.5	2	3.3
Nthu	Wild apricot / *Dovyalis zeyheri*	4	6.2	1	1.7
Madoro		1	1.5	2	3.3
Nthu	Wild apricot / *Dovyalis zeyheri*	4	6.2	1	1.7
Maembe		1	1.5	-	-
Khukhuma		-	-	2	3.3
Thomboti		2	3.1	-	-
Maswiri	Oranges / *Citrus sinensis*	3	4.6	3	5.0
Indigenous mixed dishes					
Tshidzimba	Samp, jugo beans, beans, groundnuts	64	98.5	58	96.7
Thophi	Pumpkin and maize-meal	64	98.5	59	98.3
Dovhi	Groundnuts and dried vegetable or biltong	63	96.9	60	100
Tshimbundwa	Traditional bread made from maize	22	33.9	17	28.3
Phonda	Jugo beans	25	38.5	6	10.0
Nawa	Beans	4	6.2	1	1.7
Tshikoli	Mealie-cob	12	18.5	-	-
Murambo	Sweet potato / *Pomoea batatas*	11	16.9	6	10
Tshigume/ Mugumo	Traditional peanut butter (toasted dry groundnuts & dry maize)	2	3.1	-	-
Mathuthu	Boiled dried maize grain	4	6.2	2	3.3
Maranga		-	-	1	1.7

The knowledge of the frequency at which specific foods should be given to children is shown in Table 4.24. According to Table 4.24, more than one third of the caregivers in both groups indicated that children should consume vegetables and fruit daily to keep healthy (E = 36.9%; C = 40%), while more than 40% of caregivers in both groups indicated that children should consume vegetables and fruit three to five times per week (E = 44.6%; C = 45%). Less than 15% of the caregivers in both groups indicated that children should consume vegetables and fruit less than three times per week (E = 12.3%; C = 13.3%). Eighty-five percent (C) and 90.8% (E) of caregivers indicated that children should be given food such as sugar or jam sparingly, and less than 12% indicated that sugar or jam can be given as often as liked (E = 9.2%; C = 11.7%).

About half of the caregivers in both groups indicated that children aged three to five years should be given less than six cups of water per day (E = 50.8%; C = 51.7%). Between 23.0% (E) to 38.3% (C) indicated that children should drink six to eight cups of water, while 10% (C) to 26.2% (E) did not know how much water the child should drink per day (Table 4.24).

Table 4.24 Knowledge of the frequency of consuming certain foods

	Experimental group (n = 65)		**Control group (n = 60)**	
Frequency of eating vegetables or fruit to keep healthy				
Frequency	**N**	**%**	**N**	**%**
Daily	24	36.9	24	40.0
3 to 5 times per week	29	44.6	27	45.0
Less than 3 times per week	8	12.3	8	13.3
Do not know	4	6.2	1	1.7
How often should children (3 to 5 years) eat porridge?				
Daily	54	83.1	51	85.0
3 to 5 times per week	9	13.9	6	10.0
Less than 3 times per week	-	-	3	5.0
Do not know	2	3.1	-	-
How often should sweets and cold drinks be used?				
Daily	3	4.6	5	8.3
At special occasions	57	87.7	53	88.3
Do not know	5	7.7	2	3.3
How often should potato/ maize chips be used?				
Daily	6	9.2	8	13.3
Sparingly	40	61.5	39	65.0
As much as liked	19	29.2	13	21.7
Sugar and jam can be used				
As often as liked	6	9.2	7	11.7
Sparingly	59	90.8	51	85.0
Do not know	-	-	2	3.3
How much clean water should children drink per day				
Less than 6 cups	33	50.8	31	51.7
6 to 8 cups	15	23.0	23	38.3
Do not know	17	26.2	6	10.0

The majority of caregivers in both groups indicated that fat (E = 95.4%; C = 95%) and salt (E = 100%; C = 96.7%) should be used sparingly when preparing food, and that one should add very little water when preparing vegetables (E = 92.3%; C = 96.6%) (Table 4.25).

Table 4.25 Knowledge of how to use fat, water and salt during food preparation

	Experimental group (n = 65)		Control group (n = 60)	
When preparing food fat should be used	**N**	**%**	**N**	**%**
As much as liked	3	4.6	3	5.0
Sparingly	62	95.4	57	95.0
When cooking vegetables one should				
Cover it with water	5	7.7	1	1.7
Add very little water	60	92.3	58	96.6
Do not know	-	-	1	1.7
When preparing food one should use salt				
Sparingly	65	100.0	58	96.7
As much as liked	-	-	2	3.3

4.3 Comparisons of baseline and post-intervention data

The results of a comparison between baseline and post-intervention data will be presented under the following sub-headings: socio-demographic information, anthropometric status (weight and height) of children and caregivers, nutritional practices and knowledge of nutrition of the caregivers, and micronutrient status of the children.

In the sample of 89 children, 40 were in the experimental group and 49 were in the control group (Table 4.26 and Figure 4.1). There were only 86 caregivers, as some children were cared for by the same caregiver. The experimental group had an equal number of male (n = 20) and female (n = 20) children, while the control group had nearly the same number of male (n = 25) and female (n = 24) children. The data that was compared was of caregivers and children who completed the study.

Table 4.26 Villages and number of children (three to five years) at post-intervention

Experimental group (n = 40)			Control group (n = 49)		
Village	**N**	**%**	**Village**	**N**	**%**
Tshixwadza	10	25.0	Folovhodwe	15	30.6
Matshavhawe	4	10.0	Muswodi	18	36.7
Mavhode	10	25.0	Musunda	7	14.3
Mapuloni	16	40.0	Gumela	9	18.4

4.3.1 Comparison of socio-demographic and related factors

The median number of people living in a household was six in both groups and had not changed at post-intervention. Some of the socio-demographic information changed because some children (E = 7; C = 7) were cared for by different caregivers at baseline and post-intervention. There were few changes that were observed at post-intervention in the socio-demographic information.

The percentage of caregivers who had primary education increased in the experimental group (E = 25.6%) at post-intervention (Table 4.27). In both groups the percentage of households that had an income of less than R1 000.00 per month decreased, although not significantly, while the percentage of households with an income of between R1 001.00 and R2 000.00 increased slightly.

The marital status did not change significantly and firewood was still the main source of cooking fuel in both groups (Table 4.27). Although the radio was still the main source of nutrition information at post-intervention, the number of people receiving nutrition information from television increased slightly in the experimental group.

Table 4.27 Socio-demographic information at baseline and post-intervention

Socio-demographic information	Experimental group (n =39)		Control group (n = 47)	
	Baseline	Post	Baseline	Post
Educational level				
Never attended school	9 (23.1%)	2 (5.1%)	8 (17.0%)	8 (17.0%)
Grade 1 – 4	3 (7.7%)	6 (15.4%)	3 (6.4%)	3 (6.4%)
Grade 5 – 7	3 (7.7%)	4 (10.2%)	4 (8.5%)	9 (19.2%)
Grade 8 – 10	13 (34.2%)	16 (41.0%)	16 (34.0%)	12 (25.5%)
Grade 11 – 12	11 (28.9%)	10 (25.6%)	16 (34.0%)	13 (27.7%)
Tertiary education	-	1 (2.6%)	-	2 (4.3%)
Source of income				
Mother	10 (25.6%)	14 (35.9%)	21 (44.7%)	24 (51.1%)
Father	11 (28.2%)	15 (38.5%)	17 (36.2%)	21 (44.7%)
Grandparents	12 (30.8%)	7 (17.9%)	8 (17.0%)	8 (17.0%)
Aunt/ Uncle/ Sibling	1 (2.6%)	-	-	-
Type of income				
School educator	1 (2.6%)	1 (2.6%)	3 (6.4%)	5 (10.6%)
Child grants	29 (74.4%)	31 (79.5%)	39 (82.98%)	38 (80.8%)
Pension grant	6 (15.4%)	10 (25.6%)	6 (12.8%)	15 (31.9%)
Self-employed	1 (2.6%)	1 (2.6%)	-	3 (6.4%)
Health worker	-	3 (7.7%)	1 (2.1%)	2 (4.3%)

Table 4.27 **Socio-demographic information at baseline and post-intervention (Cont.)**

Socio-demographic information	Experimental group (n =39)		Control group (n = 47)	
	Baseline	Post	Baseline	Post
Household income				
Less than or R1000.00	22 (56.4%)	14 (35.9%)	34 (72.3%)	14 (29.8%)
R1001.00 – R2000.00	12 (30.8%)	14 (35.9%)	9 (19.2%)	22 (46.8%)
R2001.00 – R3000.00	2 (5.1%)	5 (12.8%)	2 (4.3%)	6 (12.8%)
R3001.00 – R4000.00	2 (5.1%)	1(2.6%)	-	3 (6.4%)
R5000.00 or above	1(2.6%)	4 (10.2%)	2 (4.3%)	2 (4.3%)
Marital status				
Never married	12 (30.8%)	10 (25.6%)	17 (36.2%)	13 (27.7%)
Married	22 (56.4%)	26 (66.7%)	27 (57.5%)	32 (68.1%)
Widowed	2 (5.1%)	3 (7.7%)	2 (4.3%)	2 (4.3%)
Other	3 (7.7%)	-	1 (2.1%)	-
Livestock				
Chickens	17 (43.6%)	18 (46.2%)	22 (46.8%)	18 (38.3%)
Goats	9 (23.1%)	6 (15.4%)	16 (34.0%)	20 (42.6%)
Cattle	7 (17.9%)	5 (12.8%)	5 (10.6%)	6 (12.8%)
Pigs	3 (7.7%)	2 (5.1%)	1 (2.1%)	1 (2.1%)
Land for production				
Vegetable garden	12 (30.8%)	17 (43.6%)	15 (31.9%)	24 (51.1%)
Fruit garden	12 (30.8%)	19 (48.7%)	12 (25.5%)	17 (36.2%)
Field to grow maize	33 (84.6%)	34 (87.2%)	30 (63.8%)	27 (57.5%)
Source of cooking fuel				
Firewood	37 (94.9%)	39 (100%)	44 (93.6%)	47 (100)
Electricity	9 (23.1%)	13 (33.3%)	12 (25.5%)	9 (19.2%)
Paraffin	2 (5.1%)	3 (7.7%)	2 (4.3%)	-
Gas	-	3 (7.7%)	2 (4.3%)	3 (6.4%)
Source of water				
Well	14 (35.9%)	10 (25.6%)	5 (10.6%)	-
Home tap	1 (2.6%)	2 (5.1%)	-	2 (4.3%)
Communal tap	27 (71.1%)	32 (82.1%)	38 (80.9%)	47 (100%)
Borehole	2 (5.1%)	-	5 (10.6%)	1(2.1%)
River	11 (28.2%)	2 (5.1%)	15 (31.9%)	3 (6.4%)
Source nutrition information				
Radio	32 (82.1%)	26 (66.7%)	39 (83.0%)	34 (72.3%)
Television	16 (41.0%)	22 (56.4%)	13 (27.7%)	14 (29.8%)
Newspaper	4 (10.2%)	6 (15.4%)	8 (17.0%)	10 (21.3%)
Magazine	1 (2.6%)	4 (10.2%)	6 (12.8%)	6 (12.8%)

4.3.2 Comparison of anthropometric nutritional status of children at baseline and post intervention

The results of HAZ, WAZ, WHZ and the BMI/A z-scores at baseline and post-intervention are shown in Tables 4.28, 4.29, 4.30 and 4.31 respectively. According to Tables 4.28 to 4.31, none of the anthropometric values changed significantly in both groups, according to the 95% CI for the median difference (E = [0; 0]; C = [0; 0]) at post-intervention. Furthermore, when two groups (E and C) were compared at post intervention there was no statistical difference between the experimental group and control group regarding HAZ (95% CI for the median difference [0; 0]), WAZ (95% CI for the median difference [0; 0]), WHZ (95% CI for the median difference [0; 0]) and BMI/A z-scores (95% CI for the median difference [0; 0]).

Table 4.28 Z-score classification of height for age at baseline and post-intervention (WHO 2009 & 2000 CDC)

Z-score classification	Interpretation	Experimental group		Control group	
		Baseline n = 40	Post n = 39*	Baseline n = 49	Post n = 44**
Height-for-age z-score classification using WHO (2009)					
< -3SD	Severely stunted	1 (2.5%)	3 (7.7%)	0	2 (4.6%)
-3SD to < -2SD	Stunted	6 (15.0%)	5 (12.8%)	11 (22.4%)	7 (15.9%)
-2SD to < -1SD	Mildly stunted	0	0	0	0
-1SD to +1SD	Normal HAZ	31 (77.5%)	30 (76.9%)	34 (69.4%)	31 (70.5%)
>+1SD to ≤ +2SD	Normal HAZ	2 (5.0%)	1 (2.6%)	4 (8.2%)	0
Height-for-age Z-score classification using 2000 CDC					
< - 3SD	Severely stunted	1(2.5%)	3 (7.7%)	0	2 (4.6%)
< - 2 SD to ≥-3SD	Moderately stunted	6 (15.0%)	5 (12.8%)	11(22.4%)	7 (15.9%)
< -1SD to ≥ -2SD	Mildly stunted	12 (30.0%)	11 (28.2%)	11 (22.4%)	11 (25.0%)
≥ -1SD to ≤ + 2SD	Normal HAZ	21 (52.5%)	20 (51.3%)	27 (55.1%)	24 (54.6%)

* indicates one missing value in the experimental group ** indicates five missing values in the control group

Table 4.29 Z-score classification of weight for age at baseline and post-intervention (WHO 2009 & 2000 CDC)

Z-score classification	Interpretation	Experimental group		Control group	
		Baseline n = 40	Post n = 39*	Baseline n = 49	Post n = 44**
Weight-for-age z-score classification using WHO (2009)					
< -3SD	Severely underweight	1 (2.5%)	0	0	0
-3SD to < -2SD	Underweight	1 (2.5%)	0	4 (8.2%)	2 (4.6%)
-2SD to < -1SD	Mildly underweight	0	0	0	0
-1SD to +1SD	Normal WAZ	37 (92.5%)	38 (97.4%)	44 (89.8)	40 (90.9%)
>+1SD to ≤ +2SD	Possible growth problem	1 (2.5%)	1 (2.6%)	1 (2.0%)	2 (4.6%)
Weight-for-age z-score classification using 2000 CDC					
< - 3SD	Severely underweight	1 (2.5%)	0	0	0
≥ - 3SD to <- 2 SD	Moderately underweight	1 (2.5%)	0	4 (8.2%)	2 (4.6%)
<- 1 SD to ≥ - 2SD	Mildly underweight	10 (25.0%)	11 (28.2%)	13 (26.5%)	10 (22.7%)
≥ -1SD to ≤ + 2 SD	Normal WAZ	28 (70.0%)	28 (71.8%)	32 (65.3%)	32 (72.7%)

* indicates one missing value in the experimental group ** indicates five missing values in the control group

Table 4.30 Z-score classification of weight for height at baseline and post-intervention (WHO 2009 & 2000 CDC)

Z-score classification	Interpretation	Experimental group		Control group	
		Baseline n = 40	Post n = 39*	Baseline n = 49	Post n = 44**
Weight-for-height z-score classification using WHO (2009)					
< -3SD	Severely wasted	1 (2.5%)	0	0	0
-3SD to < -2SD	Wasted	0	0	0	0
-2SD to < -1SD	Mildly wasted	0	0	0	0
-1SD to +1SD	Normal WHZ	35 (87.5%)	33 (84.6%)	46 (93.9%)	38 (86.4%)
>+1SD to ≤ +2SD	Possible risk of overweight	3 (7.5%)	6 (15.4%)	2 (4.1%)	5 (11.4%)
>+2SD to ≤ +3SD	Overweight	1 (2.5%)	0	1 (2.0%)	1 (2.3%)
Weight-for-height z-score classification using 2000 CDC					
< - 3SD	Severely wasted	1 (2.5%)	0	0	0
< - 1 SD to ≥ - 2 SD	Mildly wasted	6 (15.0%)	5 (12.8%)	4 (8.2%)	3 (6.8%)
≥ -1 SD to ≤ + 2SD	Normal WHZ	32 (80.0%)	34 (87.2%)	44 (89.8%)	40 (90.9%)
> + 2SD	Overweight	1 (2.5%)	0	1 (2.0%)	1 (2.3%)

* indicates one missing value in the experimental group ** indicates five missing values in the control group

Table 4.31 Z-score classification of BMI for age at baseline and post-intervention (WHO 2009 & 2000 CDC)

Z-score classification	Interpretation	Experimental group		Control group	
		Baseline n = 40	Post n = 39*	Baseline n = 49	Post n = 44**
BMI-for-age z-score classification using WHO (2009)					
< -3SD	Severely wasted	1 (2.5%)	0	0	0
-3SD to < -2SD	Wasted	1 (2.5%)	0	0	1 (2.3%)
-2SD to <-1SD	Normal	0	0	0	0
-1SD to +1SD	Normal BMI/A	31 (77.5%)	34 (87.2%)	42 (85.7%)	38 (86.4%)
>+1SD to ≤ +2SD	Possible risk of overweight	5 (12.5%)	5 (12.8%)	6 (12.2%)	4 (9.1%)
>+2SD to ≤ +3SD	Overweight	2 (5.0%)	0	1 (2.0%)	1 (2.3%)
BMI-for-age z-score classification using 2000 CDC					
< - 3SD	Severely underweight	1 (2.5%)	0	0	0
< - 2 SD to ≥ - 3 SD	Underweight	1 (2.5%)	0	0	1 (2.3%)
< - 1SD to ≥ - 2 SD	Normal BMI/A	6 (15.0%)	7 (18.0%)	5 (10.2%)	6 (13.6%)
≥ -1 SD to ≤ + 2SD	Normal BMI/A	30 (75.0%)	32 (82.0%)	43 (87.8%)	36 (81.8%)
> + 2SD	Overweight	2 (5.0%)	0	1 (2.0%)	1 (2.3%)

* indicates the missing value in the experimental group ** indicates the missing values in the control group

4.3.3 Micronutrient status of children at baseline and post-intervention

The micronutrient status of the children refers to the serum concentration of vitamin A and iron. At baseline, few caregivers (E = 17; C = 26) gave consent for blood to be taken because they were afraid that the children would be infected with HIV. However, in both groups, more caregivers gave consent for blood to be taken at post-intervention (E = 29; C = 40). Thus, due to the small blood sample size, the biochemical micronutrient status at baseline and post-intervention will not be compared, but only shown and described.

At post-intervention, the percentage of children who had a road to health card had not changed. At baseline, nearly a quarter of the children (E = 22.7%; C = 23.8%) were given vitamin A supplementation and this had not changed at post-intervention.

4.3.3.1 Vitamin A status

The median serum vitamin A in both groups (E = 307 µg/L; C = 399 µg/L) was adequate (> 300 µg/L). At baseline, a few children in both groups (E = 38.5%; C = 30.8%) had marginal vitamin A status (100 to 199.9 µg /L), while a few children in the experimental group (E = 7.7%) had vitamin A deficiency (< 100 µg /L) (Table 4.32). All the children in both groups had adequate to normal vitamin A status at post-intervention.

Table 4.32 Categories of serum vitamin A concentration

Serum vitamin A categories	Serum concentration	Experimental group		Control group	
		Baseline (n = 13)	Post (n =23)	Baseline (n = 26)	Post (n = 38)
Vitamin A deficiency	< 100 µg /L	2 (7.7%)	-	-	-
Marginal vitamin A status	100 – 199.9 µg/L	5 (38.5%)	-	8 (30.8%)	-
Adequate status	200 – 299.9 µg/L	7 (53.9%)	7 (30.4%)	14 (53.9)	2 (5.3%)
Normal/well-nourished status	> 300 µg/L	-	16 (69.6%)	4 (15.4%)	36 (94.7%)

4.3.3.2 Iron status

The median serum iron (5.0 – < 16.7 µmol/L), serum ferritin (7 – 140 ng/ml), serum transferrin (1.5 – 3.5 g/L) and % transferrin saturation (17 – 42%) were within the normal range in both groups at both baseline and post-intervention (Table 4.33).

Table 4.33 Median serum iron, serum ferritin, serum transferrin and % transferrin saturation at baseline and post intervention

Blood indicators	Experimental group						Control group					
	Baseline (n = 17)			Post-intervention (n = 29)			Baseline (n = 26)			Post-intervention (n = 40)		
	Median	Min	Max	Median	Min	Max	Median	Min	Max	Median	Min	Max
Serum iron (5.0 – < 16.7 µmol/L)	12.3	4.1	22.9	11.2	4.9	20.6	12.2	6.0	21.5	14.4	4.0	28.9
Serum ferritin (7 – 140 ng/ml)	39.0	9.0	75.0	47.0	10.0	163.0	34.0	9.0	142.0	43.0	15.0	126.6
Serum transferrin (1.5 – 3.5 g/L)	2.7	2.2	3.5	2.7	2.1	27.0	2	2.3	3.3	2.7	2.2	3.6
% transferrin saturation (17 – 42%)	17.5	6.0	42.0	16.0	6.0	34.0	17.0	8.0	33.0	21.0	6.0	44.0

According to the categories for iron status indicators, the number of children that were in the adequate categories for serum iron, serum ferritin, serum transferrin and % transferrin saturation did not change in both groups at post-intervention (Table 4.34).

Table 4.34 Serum concentration levels of iron status of children at baseline and post-intervention

Iron indicators	Serum concentration level	Experimental group		Control group	
		Baseline n = 17	Post n = 29	Baseline n = 26	Post n = 40
Serum iron [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(depletion)	< 5.0 µmol/L	1(5.9%)	1 (3.5%)	-	1 (2.5%)
(Adequate)	5.0 - < 16.7 µmol/L	15 (88.2%)	22 (75.9%)	23 (88.5%)	26 (65.0%)
(high)	> 16.7 µmol/L	1 (5.9%)	6 (20.7%)	3 (11.5%)	13 (32.5%)
Serum ferritin [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(Adequate)	7 – 140 ng/ml	17 (100%)	28 (96.6%)	25 (96.2%)	40 (100%)
(high)	> 140 ng/ml	-	1 (3.5%)	1 (3.9%)	-
Serum transferrin [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(Adequate)	1.5 – 3.5 g/L	16 (94.1%)	28 (96.6%)	26 (100%)	39 (97.5%)
(high)	> 3.5 g/L	1 (5.9%)	1 (3.5%)	-	1 (2.5%)
% transferrin saturation [Laboratory values (Drs Du Buisson, Kramer Inc./Ing.)]					
(low)	< 17%	1 (5.9%)	1 (3.5%)	-	1 (2.5%)
(Adequate)	17 – 42%	16 (94.1%)	28 (96.6%)	26 (100%)	38 (95.0%)
(high)	> 42%	-	-	-	1 (2.5%)

4.3.4 Comparisons of nutritional practices of caregivers at baseline and post-intervention

Nutritional practices included the number of meals per day, types of food usually given (according to the food groups) and frequency of giving specific foods per week, as well as the adequacy of the usual energy and nutrient intake at baseline and post-intervention. The statistical comparision was done between the baseline and post intervention values for experimental group as well as for the control group to determine how each group has changed or improved after the intervention.

4.3.4.1 Number of meals at baseline and post-intervention

At post-intervention, the percentage of caregivers in the experimental group who were giving three meals per day had decreased significantly (95% CI for the percentage difference [- 44.6%; - 2.3%]). The percentage had not changed in the control group (Table 4.35).

Table 4.35 Comparison of number of meals given to children per day

Number of meals per day	Experimental group (n = 39)		Control group (n = 47)	
	Baseline	Post	Baseline	Post
Two per day	-	-	2 (4.2%)	-
Three per day	34 (87.2%)	23 (59.0%)	30 (63.8%)	31 (66.0%)
More than 3 times per day	5 (12.8%)	16 (41.0%)	15 (32.0%)	16 (34.0%)

4.3.4.2 Types of foods that usually were on the child's plate at baseline and post-intervention

The results will be presented according to the types of food that were usually on the child's plate daily, the types of snacks usually given to the child and indigenous foods that were given to the child.

(i) Types of food usually on the child's plate at baseline and post-intervention

The types of food usually on the child's plate did not change after intervention in both groups (Table 4.36).

Table 4.36 Foods that are usually on the child's plate at baseline and post-intervention

Food items usually given	Experimental group (n = 39)		Control group (n = 47)	
	Baseline	Post	Baseline	Post
Porridge or bread or samp	39 (100%)	39(100%)	47 (100%)	47 (100%)
Vegetables	39 (100%)	39(100%)	47 (100%)	47 (100%)
Protein rich foods such as meat or beans or eggs or fish or milk or mopani worms	38 (97.4%)	39 (100%)	47 (100%)	47 (100%)
Fats such as oil or margarine	35 (89.7%)	39 (100%)	45 (95.7%)	47 (100%)

(ii) Type of snacks usually given to the child at baseline and post-intervention

As shown in Table 4.37, the percentage of caregivers who were giving peanuts (E = 95% CI for the percentage difference [9.1%; 37.5%]) and yoghurt (E = 95% CI for the percentage difference [7.1%; 34.8%]) as snacks had increased significantly in the experimental group, while in the control group only the use of peanuts as snack (95% CI for the percentage difference [4.2%; 27.2%]) had increased significantly according to the 95% CI for the percentage difference.

Table 4.37 Types of snacks given to children at baseline and post-intervention

Types of snacks	Experimental group		Control group	
	Baseline (n = 35)	Post (n = 39)	Baseline (n = 46)	Post (n = 47)
Peanuts	28 (80.0%)	39 (100%)	37 (80.4%)	47 (100%)
Vegetables and fruits	39 (100%)	39 (100%)	44 (95.7%)	47 (100%)
Potato/ maize-based chips	36 (92.3%)	39 (100%)	43 (93.5%)	46 (97.9%)
Fruit juice	36 (92.3%)	39 (100%)	40 (86.9%)	46 (97.9%)
Yoghurt	28 (80.0%)	39 (100%)	36 (78.3%)	41 (87.2%)

(iii) Consumption of indigenous foods at baseline and post-intervention

Table 4.38 shows that the intake of the following indigenous vegetable had increased significantly in the experimental group: black jack (95% CI for the percentage difference [8.2%; +37.6%]), spider flower (95% CI for the percentage difference [6.5%; 34.3%]), wild-jute plant (95% CI for the percentage difference [9.1%; 37.5%]) and stinging nettle (95% CI for the percentage difference [0.5%; 26.4%]), while the in control group only stinging nettle (95% CI for the percentage difference [8.1%; 43.6%]) had increased significantly according to the 95% CI for the percentage difference at post-intervention.

The intake of the following indigenous fruits had increased significantly in the experimental group: medlar (95% CI for the percentage difference [10.6%; 42.9%]), wild peach (95% CI for the percentage difference [14.0%; 51.9%]), baobab fruit (95% CI for the percentage difference [25.5%; 59.6%]), paw-paw (95% CI for the percentage difference [12.4%; 42.6%]), and pineapple (95% CI for the percentage difference [15.3%; 51.2%]), while in the control group medlar (95% CI for the percentage difference [10.4%; 37.7%]), wild peach (95% CI for the percentage difference [7.3%; 44.1%]) and pineapple (95% CI for the percentage difference [6.1%; 41.5%]) had increased significantly at post-intervention. A statistically significant increase was noticed in the percentage of caregivers in both groups who were giving indigenous mixed dishes such as groundnuts with dried vegetable or groundnuts with biltong (E = 95% CI for the percentage difference [9.8%; 47.0%]; C = 95% CI for the percentage difference [5%; 35.9%]), pumpkin with maize-meal (E = 95% CI for the percentage difference [0.3%; 30.1%]; C = 95% CI for the percentage difference [12.1%; 41.4%]) and traditional peanut butter (E = 95% CI for the percentage difference [17.5%; 53.4%]; C = 95% CI for the percentage difference [21.8%; 57.3%]) to their children. In the control group, traditional bread made from maize (95% CI for the percentage difference [26.2%; 55.5%]) had also increased significantly, while in the experimental group only a tendency towards increase was shown.

The percentage of caregivers who were giving indigenous edible insects such as mopani worms (95% CI for the percentage difference [4.6%; 31.6%]) and termites (95% CI for the percentage difference [2.7%; 27.8%]) had increased statistically significantly in the experimental group at post-intervention.

Table 4.38 Types of Indigenous foods given to children at baseline and post-intervention

Types of indigenous foods		Experimental group (n = 39)			Control group (n= 47)		
Tshivenda	**English & Scientific name**	**Baseline**	**Post**	**95% CI for % difference**	**Baseline**	**Post**	**95% CI for % difference**
Indigenous vegetables							
Mushinzhi	Black Jack/*Bidens pilosa*	28 (71.8%)	39 (100%)	[8.2%; 37.6%]	36 (76.6%)	42 (89.4%)	
Murudi	Spider flower or spider plant/*Cleome gynandra*	27 (69.2%)	38 (97.4%)	[6.5%; 34.3%]	40 (85.1%)	41 (87.2%)	
Delele	Wild-jute plant/*Corchorus hirstirus or Corchorus olitorius*	29 (74.4%)	39 (100%)	[9.1%; 37.5%]	43 (91.5%)	47 (100%)	
Muxe	Night shave leaves/*Solanum retroflexum* Dun.	38 (97.4%)	39 (100%)		42 (89.4%)	47 (100%)	
Dzaluma	*Stinging nettle/Laportea peduncularis*	31 (79.5%)	38 (97.4%)	[0.5; 26.4%]	11 (23.4%)	23 (48.9%)	[8.1%; 37.6%]
Vowa/ Thebe	Small pig weed/*Amaranthus thunbergii*	38 (94.4%)	39 (100%)		37 (78.7%)	45 (95.7%)	
Phuri	Pumpkin leaves/*Cucurbita moschata*	38 (97.4%)	39 (100%)		44 (93.3%)	47 (100%)	
Munawa	Cow pea's leaves/*Vigna unguiculata*	32 (82.0%)	39 (100%)		42 (89.4%)	44 (93.6%)	
Muvhazwi		2 (5.1%)	2 (5.1%)		3 (6.4%)	1 (2.1%)	
Tshimbavhe	African cucumber/*Mormodica balsamina*	2 (5.1%)	2 (5.1%)		3 (6.4%)	4 (8.5%)	
Mufungwi		-	2 (5.1%)		-	-	
Muthohothoho	Spindle pod/*C. monophylla*	1 (2.6%)	4 (10.2%)		-	-	
Mutshatsha	Wild watermelon/*Citrullus lanatus*	-	2 (5.1%)		2 (4.3%)	6 (12.8%)	
Mufhafhe		-	-		5 (10.6%)	5 (10.6%)	
Tshiphinatshi	Spinach	10 (25.6%)	8 (20.1%)		11 (23.4%)	12 (25.5%)	
Khavhishi	Cabbage	13 (33.3%)	12 (30.8%)		9 (19.1%)	10 (21.3%)	
Mutshaina	China spinach	12 (30.8%)	8 (20.1%)		8 (17.0%)	12 (25.5%)	
Indigenous fruits							
Mazwilu	Medlar/*Vangueria infestusta Burch*	23 (58.9%)	34 (87.2%)	[10.6%; 42.9%]	18 (38.3%)	31(63.8%)	[10.4%; 37.7%]
Maramba/mavhungo	Wild peach/*Strychnos spinosa lam*	16 (41.0%)	30 (76.9%)	[14.0%; 51.9%]	14 (29.8%)	27 (57.4%)	[7.3%; 44.1%]
Nombelo	*Bequa.magalies*	36 (92.3%)	39 (100%)		30 (63.8%)	34 (72.3%)	
Mbuyu	Baobab fruit/*Adansonia digitata*	13 (33.3%)	31 (82.1%)	[25.5%; 59.6%]	45 (95.7%)	45 (95.7%)	
Manngo	Mango/*Mangifera indica*	39 (100%)	39 (100%)		47 (100%)	47 (100%)	
Papawe	Paw-paw/*Carica papaya*	25 (64.1%)	37 (94.9%)	[12.4%; 42.6%]	46 (97.8%)	47 (100%)	
Magwavha	Guavas/*Psidium guajava*	35 (89.7%)	39 (100%)		43 (87.8%)	47(100%)	
Tshienge	Pineapple/*Ananas comosus*	18 (46.2%)	33 (87.2%)	[15.3%; 51.2%]	22 (46.8%)	34 (72.3%)	[6.1%; 41.5%]
Muomva	Banana/*Musa acuminate*	18 (46.2%)	6 (17.9%)		18 (38.3%)	6 (12.8%)	
Maswiri	Oranges/*Citrus sinensis*	15 (38.5%)	5 (12.8%)		14 (29.8%)	5 (10.6%)	
Niiyi	Living long fruit/*Bercheia discolour*	3 (7.7%)	3 (7.7%)		15 (31.9%)	28 (59.6%)	
Maafukhada	Avocado	18 (46.2%)	4 (10.3%)		2 (4.3%)	5 (10.6%)	
Thawi		3 (7.7%)	13 (33.3%)		-	4 (8.5%)	
Thaladzi		2 (5.1%)	17 (43.6%)		-	3 (6.4%)	
Mahuhuma	Baboon's breakfast/*Hexalobus monopetahus*	1 (2.6%)	4 (10.3%)		-	3 (6.4%)	
Thondo		3 (7.7%)	3 (7.7%)		-	1 (2.1%)	
Tanzwa	Small sour plum/*Pouzolzia mixta*	4 (10.3%)	2 (5.1%)		-	5 (10.6%)	
Thombe		1 (2.6%)	5 (12.8%)		1 (2.1%)	-	

Table 4.38 Types of indigenous foods given to children at baseline and post-intervention (Cont.)

Types of indigenous foods		Experimental group (n = 39)			Control group (n= 47)		
Tshivenda	**English & Scientific name**	**Baseline**	**Post**	**95% CI for % difference**	**Baseline**	**Post**	**95% CI for % difference**
Indigenous fruits							
Pfuka		1 (2.6%)	2 (5.1%)		1 (2.1%)	1 (2.1%)	
Mbubulu	Transvaal red milkwood/*Mimusops zeyheri*	-	2 (5.1)		-	-	
Maberegisi	Peaches	6 (15.4%)	3 (7.7%)		2 (4.2%)	2 (4.3%)	
Indigenous mixed dishes							
Tshidzimba	Samp, beans or jugo beans, groundnuts	33 (84.6%)	36 (92.3%)		37 (78.7%)	45 (95.7%)	
Dovhi	Ground nuts & dried vegetable or biltong	18 (46.2%)	30 (76.9%)	[9.8%; 47.0%]	32 (68.1%)	43 (91.5%)	[5.0%; 35.9%]
Thophi	Pumpkin & maize-meal	30 (76.9%)	37 (94.9%)	[0.3%; 30.1%]	31 (66.0%)	43 (91.5%)	[12.1%; 41.4%]
Tshimbundwa	Traditional bread made from maize	5 (12.8%)	10 (25.6%)		2 (4.2%)	21 (44.7%)	[26.2%; 55.5%]
Tshigume	Traditional peanut butter	9 (23.1%)	24 (61.4%)	[17.5%; 3.4%]	7 (15.0%)	27 (57.4%)	[21.8%; 57.3%]
Nawa	Beans	36 (92.3%)	39 (100%)		46 (97.9%)	45 (95.7%)	
Edible insect							
Nemeneme/ nthwa	Adult insect	30 (76.9%)	33 (84.6%)		18 (38.3%)	26 (57.4%)	
Mashonzha	Mopani worms	28 (71.8%)	36 (92.3%)	[4.6%; 31.6%]	42 (89.4%)	42 (89.4%)	
Nzie	Locust	37 (94.9%)	38 (97.4%)		42 (89.4%)	41 (87.2%)	
Manzhulu	Termites	28 (71.8%)	35 (89.7%)	[2.7%; 27.8%]	17 (36.2%)	23 (48.9%)	

4.3.4.3 Frequency of consumption of certain foods at baseline and post-intervention

According to Table 4.39, the percentage of caregivers who gave vegetables daily after intervention increased slightly in the experimental group and decreased slightly in the control group. The percentage of caregivers who were giving fruit three to five times per week showed a tendency towards increase in both groups at post-intervention.

The number of caregivers who were giving milk had increased from 11 to 26 in the experimental group. The number of caregivers who were giving milk less than three times per week increased from eight to 14.

Table 4.39 Frequency of eating vegetables, fruit and milk per week at baseline and post-intervention

Frequency of eating different foods	**Experimental group (n = 39)**		**Control group (n = 47)**	
Frequency per week	**Baseline**	**Post**	**Baseline**	**Post**
Vegetables	**n = 39**	**n = 39**	**n = 47**	**n = 47**
Daily	6 (15.4%)	9 (23.1%)	5 (10.6%)	3 (6.4%)
3 to 5 time per week	19 (48.7%)	22 (56.4%)	15 (31.9%)	20 (42.6%)
Less the 3 time per week	14 (35.9%)	8 (20.5%)	24 (51.1%)	22 (46.8%)
Do not know	-	-	1 (2.1%)	2 (4.3%)
Never	-	-	2 (4.3%)	-
Fruit	**n = 39**	**n = 39**	**n = 47**	**n = 47**
Daily	7 (17.9%)	7 (17.9%)	8 (17.0%)	5 (10.6%)
3 to 5 times per week	6 (15.4%)	11 (28.2%)	11 (23.4%)	16 (34.0%)
Less than 3 times per week	23 (59.0%)	17 (43.6%)	22 (46.8%)	23 (48.9%)
Do not know	3 (7.7%)	4 (10.3%)	6 (12.8%)	3 (6.3%)
Milk	**n = 11**	**n = 26**	**n = 21**	**n = 26**
3 to 5 times per week	2 (18.2%)	1 (3.9%)	3 (14.3%)	3 (11.5%)
Less than 3 times per week	8 (72.7%)	14 (53.9%)	13 (61.9%)	12 (46.2%)
Do not know	1 (9.1%)	11 (42.3%)	5 (23.8%)	11(42.3%)

In the experimental group, the percentage of children who were given milk increased significantly (95% CI for the percentage difference [15.5%; 54.8%]) using the 95% CI for the percentage difference, while in the control group the percentage did not change.

For the children who received milk, the number of children in both groups who were given half a cup of milk increased, while the number of children who were given a cup of milk decreased at post-intervention, although the change was not statistically significant (Table 4.40).

Table 4.40 **Comparison of amount of milk given to children at baseline and post-intervention**

Amount of milk	**Experimental group**		**Control group**	
	Baseline (n = 11)	**Post-intervention (n = 26)**	**Baseline (n = 21)**	**Post-intervention (n = 26)**
Half cup	3 (27.3%)	18 (69.2%)	12 (57.1%)	15 (57.7%)
One cup	8 (72.7%)	8 (30.8%)	9 (42.9%)	11 (42.3%)

4.3.4.4 Usual energy and nutrient intake at baseline and post-intervention

The number of children in both groups who had allergies did not change. At post-intervention the number of children who had eaten away from home decreased slightly in both groups. The number of households that were using fortified maize-meal had shown a tendency towards increase in the experimental group, while the control group did not change after intervention. The number of people who were using both fortified maize-meal and self-ground maize-meal showed a tendency towards increase in both groups.

At post-intervention, the median energy and plant protein intake in the experimental group had not changed, while in the control group the energy intake (95% CI for the median difference [34.7; 921.7]) and plant protein intake (95% CI for the median difference [2.81; 7.2]) had increased significantly (Table 4.41). The median carbohydrate intake did not change (95% CI for the median difference [-26.38; 13.95]) in the experimental group, while in the control group the median carbohydrate intake increased significantly (95% CI for the median difference [7.8; 29.0]). In both groups, the median iron (E = 95% CI for the median difference [0.04; 1.89]; C = 95% CI for the median difference [0.5; 2.5]) and folate (E = 95% CI for the median difference [1.41; 70.1]; C = 95% CI for the median difference [55.7; 117.0]) intake increased significantly. The median zinc intake increased significantly (95% CI for the median difference [0.32; 1.15]) in the control group, while in the experimental group it increased only slightly. The median vitamin A (mcg) intake increased slightly in the experimental group, while it did not change in the control group. When the two groups (E and C) were compared at post intervention, there was a significant difference between experimental and control group in the intake of plant protein (95% CI for the median difference [-6.1; -0.5]), carbohydrate (95% CI for the median difference [-44.1; -5.1]) and folate (95% CI for the median difference [-84.9; -4.8]) towards the control group.

Table 4.41 Median nutrient intake at baseline and post-intervention

Nutrient intake	EER/ EAR	RDA	AI	Experimental group (n = 40)							Control group (n = 49)						
				Baseline			Post-intervention			95% CI for median difference	Baseline			Post-intervention			95% CI for median difference
				Med	Min	Max	Med	Min	Max		Med	Min	Max	Med	Min	Max	
Energy (kJ)	EER 3-8 yrs (male 7316 kJ; female 6896 kJ)			4025	2107.5	7356.9	4087.2	2874.6	5936.1	CI [-242.9; 487.5]	3921.5	2308	7728	4359	3443	6480	CI [34.7; 921.7]
Total protein (g)		1-3 yrs (13.0 g) 4-8 yrs (19 g)		25.6	13.2	56.4	27.6	17	52.9	CI [-6.28; 8.57]	30.9	15.2	55.6	31.7	22	56	CI [-3.2; 8.1]
Plant protein (g)				18.2	13.2	28.2	20	11.9	28.5	CI [-1.51; 4.92]	18.1	9.5	32	22.8	14.8	32.8	CI [2.81; 7.2]
Animal protein (g)				9.1	0	36.4	8.2	0.06	30.3	CI [-6.94; 4.1]	11.5	0.29	32.5	9.7	0.13	26.5	CI [-4.9; 2.3]
Total fat (g)	ND	ND	ND	16.2	3.1	47.5	17.0	7.1	33.9	CI [-2.91; 8.1]	16.1	6.4	57.8	14.4	8.2	42.8	CI [-5.1; 2.9]
Carbohydrates (g)	1-3 yrs (100 g); 4-8 yrs (100 g)	1 – 3 yrs (130 g); 4-8 yrs (130 g)		160.8	96.1	304.8	160.6	115.3	222.7	CI [-26.38; 13.95]	157.7	76.6	267.1	176.6	138	234.4	CI [7.8; 29.01]
Calcium (mg)	-	-	1 – 3 yrs (500 mg); 4-8 yrs (800 mg)	107	40.5	640.2	125.5	32.8	437.8	CI [-31.0; 65.8]	109.8	21	479.2	124.8	53.2	307.4	CI [-27.5; 34.5]

Notes: EAR = Estimate average requirement EER = Estimated energy requirements RDA = Recommended dietary allowance
AI = Adequate intake

Table 4.41 Median nutrient intake at baseline and post-intervention (Cont.)

Nutrient intake	EAR	RDA	AI	Experimental group (n = 40)							Control group (n = 49)						
				Baseline			Post-intervention			95% CI for for median difference	Baseline			Post-intervention			95% CI for median difference
				Med	Min	Max	Med	Min	Max		Med	Min	Max	Med	Min	Max	
Iron (mg)	1 – 3 yrs (3 mg) 4 – 8 yrs (4.1 mg)	1-3 yrs (7 mg); 4-8 yrs (10 mg)		4	2.5	8.6	5.0	2.2	9.7	CI [0.04; 1.89]	3.9	2.1	7.1	5.3	2.8	9.4	CI [0.5; 2.5]
Haeme iron (mg)				0.07	0	0.31	0.04	0	2.2	CI [-0.07; 0.035]	0.07	0	0.67	0.09	0	1.1	CI [-0.04; 0.04]
Nonhaeme iron (mg)				1.1	0.43	2.8	1.1	0.02	3.9	CI [-0.29; 0.32]	0.9	0	3.2	0.82	0	4.3	CI [-0.2; 0.1]
Zinc (mg)	1 – 3 yrs (3.0) 4 – 8 yrs (4.0)	1-3 yrs (3 mg); 4-8 yrs (5 mg)		3.1	1.6	6.2	3.6	2.1	6.1	CI [-0.37; 0.8]	3.1	1.9	6.23	3.9	2.4	7.0	CI [0.32; 1.15]
Vitamin A (mcg)	1-3 yrs (210 mcg) 4 – 8 yrs (275 mcg)	1-3 yrs (300 mcg); 4-8 yrs (400 mcg)		94.3	25.2	427.4	101.6	4.6	3006.8	CI [-30.85; 34.64]	85.5	16.2	799.3	83.2	11.2	4353	CI [-21.7; 43.2]
Total-carotene (mcg)				363	23.5	1233.5	430.2	0.26	3294.7	CI [-125.05; 223.95]	119.5	0	1222.8	156.6	0	3206	CI [-61.8; 193.2]
B-carotene (mcg)				344	17	1173.2	425.9	0	2809.4	CI [-67.93; 254.3]	117.2	0	1167.5	146.5	0	3205	CI [-58.2; 141.1]
A-carotene (mcg)				4.6	0	121.5	7.1	0	955.7	CI [-8.65; 7.75]	3.5	0	162.0	5.6	0	112.5	CI [-2.6; 8]
Folate (mcg)	1-3 yrs (120 mcg); 4 – 8 yrs (160 mcg)	1-3 yrs (150 mcg); 4-8 yrs (200 mcg)		79.2	34.9	222.8	111.5	34	535.8	CI [1.41; 70.1]	70.5	28.7	210.1	160.8	46.1	368.9	CI [55.7; 117.0]
Vitamin C (mg)	1 -3 yrs (13 mg); 4 – 8 yrs (22 mg)	1-3 yrs (15 mg); 4-8 yrs (25 mg)		35.3	0.01	295.2	11	0.5	229	CI [-39.9; 4.76]	9.3	0.05	275.8	8.4	1.7	85.7	CI [-4.2; 1.8]

Notes: EAR = Estimate average requirement EER = Estimated energy requirements
RDA = Recommended dietary allowance AI = Adequate intake

4.3.5 Nutritional knowledge of the caregivers at baseline and post-intervention

The nutritional knowledge of the caregivers, include the number of meals to be offered to children, the types of foods that should be given, the frequency of giving specific foods and the types of indigenous foods at baseline and post-intervention. Only caregivers who started at baseline and had completed post-intervention were included when analysing the nutritional knowledge questionnaires (E = 33; C = 42). The median nutrition knowledge score of the caregivers did not change significantly after intervention (E = 89.8%; C = 86.7%) in both groups.

4.3.5.1 Number of meals to be offered to children aged three to five years at baseline and post-intervention

Table 4.42 shows the percentage of caregivers who indicated that children should be offered more than three meals per day had shown a tendency to increase in both groups after intervention.

Table 4.42 Knowledge of the number of meals to be offered to children (three to five years) at baseline and post-intervention

Number of meals per day	Experimental group (n = 33)		Control group (n = 42)	
	Baseline	**Post**	**Baseline**	**Post**
Twice per day	-	-	-	3 (7.1%)
Three time per day	13 (39.4%)	16 (48.5%)	27 (64.3%)	19 (45.2%)
More than three per day	13 (39.4%)	17 (51.5%)	13 (31.0%)	20 (47.7%)
Do not know	7 (21.2%)	-	2 (4.8%)	-

4.3.5.2 Types of foods to be offered to children aged three to five years at baseline and post-intervention

Knowledge of what food should be given to children aged three to five years did not change in both groups (Table 4.43). However, the percentage of caregivers who knew that fat such as cooking oil or margarine should be included in the child's diet had increased significantly (95% CI for the percentage difference [0.5%; 35.5%]) in the experimental group after intervention.

Table 4.43 Knowledge of the types of foods that should be given to children (three to five years) at baseline and post-intervention

	Experimental group (n = 33)		Control group (n = 42)	
Food items	**Baseline**	**Post**	**Baseline**	**Post**
Starchy food such as porridge, bread	33 (100%)	33 (100%)	42 (100%)	41 (97.6%)
Protein rich foods such as beans, eggs, meat, fish	32 (97.0%)	33 (100%)	41 (97.6%)	41 (97.6%)
Fat such as cooking oil, margarine	25 (75.8%)	31 (94.0%)	40 (95.2%)	40 (95.2%)
Vegetables such as spinach	33 (100%)	33 (100%)	42 (100%)	42 (100%)
Snacks (peanuts, potato-based chips)	32 (97.0%)	33 (100%)	41 (97.6%)	41 (97.6%)
Fruits such as mango, paw-paw	33 (100%)	33 (100%)	40 (95.2%)	42(100%)
Indigenous vegetables such black jack, murudi	32 (97.0%)	33 (100%)	40 (95.2%)	42(100%)
Indigenous fruit such as nombelo, mbuyu	33 (100%)	33 (100%)	40 (95.2%)	42 (100%)
Variety of foods (foods from different groups)	30 (90.9%)	32 (97.0%)	40 (95.2%)	41 (97.6%)
Dried beans	33 (100%)	33 (100%)	41 (97.6%)	42 (100%)
Edible insects *(mashonzha, manzhulu, nzie, nemeneme)*	31 (93.9%)	33 (100%)	38 (90.5%)	39 (92.9%)

At post-intervention, the percentage of caregivers who indicated that dried beans, mopani worms and vegetables mixed with groundnuts could be used in place of meat had not changed, as shown in Table 4.44.

Table 4.44 Knowledge of types of food that can be given in place of meat at baseline and post-intervention

Types of food that can be given instead of meat	**Experimental group (n = 33)**		**Control group (n = 42)**	
	Baseline	**Post**	**Baseline**	**Post**
Dried beans be used in place of meat	28 (84.8%)	27 (81.8%)	34 (81.0%)	32(76.2%)
Mopani worms be used in place of meat	27 (81.8%)	27 (81.8%)	35 (83.3%)	33 (78.6%)
Vegetables mixed groundnuts in place of meat	25 (75.8%)	26(78.8%)	33(78.6%)	34 (81.0%)

In the experimental group, the percentage of caregivers who indicated that children should be given full-cream milk increased significantly after intervention (95% CI for the percentage difference [2.6%; 43.3%]), while the percentage who did not know which type of milk to be given to the child showed a tendency to decrease (Table 4.45).

Table 4.45 Knowledge of the types of milk that should be given to children (three to five years) at baseline and post-intervention

Type of milk	**Experimental group (n = 33)**		**Control group (n= 42)**	
	Baseline	**Post**	**Baseline**	**Post**
Full-cream milk	4 (12.1%)	12 (36.4%)	6 (14.3%)	6 (14.3%)
Low fat milk	16 (48.5%)	18 (54.5%)	35 (83.3%)	32 (76.2%)
Do not know	13 (39.4%)	3 (9.1%)	1 (2.4%)	4 (9.5%)

Table 4.46 shows that the percentage of caregivers who were familiar with indigenous vegetables (spider flower and pumpkin) and indigenous fruits such as medlar, bequa.magalies and wild peach did not change in both groups post-intervention. In the control group after intervention, the percentage of caregivers who knew indigenous mixed dishes such as *tshidzimba, thophi*, *dovhi* did not change, while the percentage who were familiar with *tshimbundwa* increased significantly (95% CI for the percentage difference [13.3%; 49.8%]).

Table 4.46 Knowledge of indigenous foods in Limpopo Province at baseline and post-intervention

Tshivenda	**English & scientific names**	**Experimental group (n = 33)**		**Control group (n = 42)**	
		Baseline	**Post**	**Baseline**	**Post**
Indigenous vegetables					
Murudi	Spider flower or spider plant/*Cleome gynandra*	33 (100%)	33 (100%)	42 (100%)	39 (92.9%)
Mufungwi		29 (87.9%)	31 (93.9%)	11 (26.2%)	23 (54.8%)
Fhuri	Pumpkin	13 (39.4%)	14 (42.4%)	4 (9.5%)	7 (16.7%)
Mushidzhi	Black Jack/*Bidens pilosa*	1 (3.0%)	-	-	-
Vowa		2 (6.1%)	2 (6.1%)	3 (7.1%)	2 (4.8%)
Indigenous fruit					
Mazwiliu	Medlar/*Vangueria infestusta Burch*	33 (100%)	33 (100%)	36 (85.7%)	41 (97.6%)
Nombela	*Bequa.magalies*	32 (97.0%)	33 (100%)	39 (92.9%)	42 (100%)
Mavhungo/ makwakwa	Wild peach/*Strychnos spinosa lam*	32 (97.0%)	33 (100%)	35 (83.3%)	39 (92.9%)
Niiyi	Living long fruit/*Bercheia discolour*	1 (3.0%)	2 (6.1%)	16 (38.1%)	13 (31.0%)
Mbuyu	Baobab fruit/*Adansonia digitata*	-	2 (6.1%)	5 (11.9%)	6 (14.3%)
Tsuma	African ebony/*Dospyros mespiliformis Hochest*	-	1 (3.0%)	4 (9.5%)	-
Thombe		10 (30.3%)	9 (27.3%)	2 (4.8%)	-
Tanzwa	Small sour plum/*Pouzolzia mixta*	1 (3.0%)	1 (3.0%)	-	-
Thondo		4 (12.1%)	4 (12.1%)	2 (4.8%)	1 (2.4%)
Nthu		1 (3.0%)	2 (6.1%)	1 (2.4%)	-
Maembe		1 (3.0%)	-	-	-
Khukhuma		-	-	1 (2.4%)	1 (2.4%)
Mahuyu	Figs	4 (12.1%)	1 (3.0%)	2 (4.8%)	1 (2.4%)
Thabva		-	1 (3.0%)	6 (14.3%)	1 (2.4%)
Indigenous mixed dishes					
Tshidzimba	Samp, jugo beans, beans, groundnuts	32 (97.0%)	33 (100%)	41 (97.6%)	42 (100%)
Thophi	Pumpkin and maize-meal	32 (97.0%)	33 (100%)	42 (100%)	42 (100%)
Dovhi	Groundnuts and dried vegetable or biltong	32 (97.0%)	33 (100%)	42 (100%)	42 (100%)
Tshimbundwa	Traditional bread made from maize	13 (39.4%)	12 (36.4%)	10 (23.8%)	24 (57.1%)
Phonda	Jugo beans	11 (33.3%)	10 (30.3%)	5 (11.9%)	6 (14.3%)
Tshikoli	Mealie-cob	6 (18.2%)	2 (6.1%)	-	2 (4.8%)
Murambo	Sweet potato/*Pomoea batatas*	6 (18.2%)	5 (15.2%)	7 (16.7%)	-
Mathuthu	Boiled dried maize grain	2 (6.1%)	2 (6.1%)	2 (4.8%)	2 (4.8%)
Maranga		-	2 (6.1%)	-	-

4.3.5.3 Knowledge of frequency with which children should eat different foods at baseline and post-intervention

The percentage of caregivers in the experimental group who indicated that vegetables or fruit should be eaten daily decreased slightly, while the number who indicated that vegetables or fruit should be given three to five times per week had shown a tendency to increase after intervention (Table 4.47). In addition, the percentage of caregivers who indicated that porridge should be eaten daily and that sugar and jam should be given sparingly did not change in both groups. The percentage of caregivers who indicated that potato/maize chips should be given to children sparingly increased significantly (E = 95% CI for the percentage difference [20.1%; 34.8%]; C = 95% CI for the percentage difference [11.9%; 44.9%]) in both groups after intervention. In the experimental group, the caregivers who indicated that children should be given less than six cups of water per day had decreased slightly, while the percentage of caregivers who indicated that children should be given six to eight small cups of water per day had shown a tendency to increase after intervention.

Table 4.47 Knowledge of frequency with which children should eat certain foods at baseline and post-intervention

Frequency	Experimental group (n = 33)		Control group (n = 42)	
	Baseline	Post	Baseline	Post
Frequency of eating vegetable or fruits to keep healthy				
Daily	12 (36.4%)	7 (21.2%)	15 (35.7%)	19 (45.2%)
3 to 5 times per week	13 (39.4%)	17 (51.5%)	21 (50.0%)	16 (38.1%)
Less than 3 times per week	4 (12.1%)	6 (18.2%)	5 (11.9%)	4 (9.5%)
Do not know	4 (12.1%)	3 (9.1%)	1 (2.4%)	3 (7.1%)
Frequency of eating porridge				
Daily	28 (84.8%)	28 (84.8%)	36 (85.7%)	34 (81.0%)
3 to 5 times per week	3 (9.0%)	4 (12.1%)	6 (14.3%)	7 (16.7%)
Less than 3 time per week	-	1 (3.0%)	-	1 (2.4%)
How often sweets and cold drink should be used				
Daily	2 (6.1%)	2 (6.1%)	3 (7.1%)	1 (2.4%)
At special occasionally	29 (87.8%)	31 (93.9%)	38 (90.5%)	41 (97.6%)
Do not know	2 (%)	-	1 (2.4%)	-
How often potato/ maize chips should be given				
Daily	3 (9.1%)	1 (3.0%)	4 (9.5%)	3 (7.1%)
Sparingly	19 (57.6%)	32 (97.0%)	27 (64.3%)	39 (92.9%)
As much as liked	11 (33.3%)	-	11 (26.2%)	-
How sugar and jam can be used				
As often as liked	2 (6.1%)	1 (3.0%)	6 (14.3%)	2 (4.8%)
Sparingly	31 (93.9%)	32 (97.0%)	35 (83.3%)	39 (92.9%)
Do not know	-	-	1 (2.4%)	1 (2.4%)
How much clean water should children drink per day				
Less than 6 cups	17 (51.5%)	14 (42.4%)	16 (38.1%)	15 (35.7%)
6 to 8 cups	8 (24.2%)	14 (42.4%)	22 (52.4%)	23 (54.8%)
Do not know	8 (24.2%)	5 (15.2%)	4 (9.5%)	4 (9.5%)

The results of the knowledge that fat and salt should be used sparingly when preparing food had not changed in both groups after the intervention, as shown in Table 4.48.

Table 4.48 Knowledge of how to use fat, water and salt during food preparation, at baseline and post-intervention

	Experimental group (n = 33)		Control group (n= 42)	
	Baseline	**Post**	**Baseline**	**Post**
When preparing food fat should be used				
As much as liked	1 (3.0%)	-	1 (2.4%)	1 (2.4%)
Sparingly	32 (97.0%)	33 (100%)	41 (97.6%)	41 (97.6%)
When cooking vegetables one should				
Cover it with water	2 (6.1%)	-	1 (2.4%)	-
Add very little water	31 (94.7%)	33 (100%)	40 (95.2%)	42 (100%)
Do not know		-	1 (2.4%)	-
When preparing food one should use salt				
Sparingly	33 (100%)	33 (100%)	41 (97.6%)	42 (100%)
As much as liked	-	-	1 (2.4%)	-

4.4 Summary of results

The sample was selected from eight villages, four of which comprised the experimental group and four which comprised the control group. At baseline the sample consisted of 129 children and 125 caregivers. The experimental group had 66 children, with an equal number of males (n = 33) and females (n = 33), while the control group had 63 children, with 47.6% males (n = 30) and 52.4% females (n = 33). At post-intervention the sample comprised 89 children and 86 caregivers. The experimental group had 40 children, with an equal number of male (n = 20) and female (n = 20) children, while the control group had 49 children, with 51.0% male (n = 25) and 49.0% female (n = 24) children. The caregivers and children who completed the study from baseline to post-intervention were included for comparison.

At post-intervention the socio-demographic information and anthropometric nutritional status of the children had not changed significantly in both groups. At post-intervention, all the children in both groups had adequate to normal vitamin A status. More than half of the children in the control group and 62.5% of the children in the experimental group had adequate serum vitamin A, while nearly one third had marginal vitamin A status in both groups. More than 70% of the children in both groups had adequate serum iron, serum ferritin, serum transferrin and % transferrin saturation post-intervention.

In the experimental group, the percentage of children who received more than three meals per day had shown a tendency towards increase. The percentage of children who were given milk, yoghurt, indigenous vegetables (black jack, spider flower and wild-jute plant), indigenous fruit (baobab fruit and paw-paw) and indigenous edible insects (mopani worms and termites) had increased significantly in the experimental group. Furthermore, the median vitamin A intake had shown a tendency towards increase in the experimental group, even though it was still inadequate.

In both groups, the percentage of children who were given indigenous vegetables (stinging nettle), indigenous fruit (meldar, wild peach and pineapple) and indigenous mixed dishes (*dovhi*, *tshigume* and *thophi*) had increased significantly. The median intakes of iron and folate had increase significantly in both groups after intervention, but folate was still inadequate when compared with EAR. On the other hand, vitamin C intakes had shown a tendency towards decrease in both groups after intervention. At baseline, more than 90% of the caregivers usually included starchy foods, protein-rich foods and vegetables on the child's plate daily, and this had not changed at post-intervention in both groups. The median protein and carbohydrate intakes were adequate at baseline as well as post-intervention.

In the control group, the percentage of children who were given traditional bread made from maize had increased significantly. The intakes of energy, carbohydrate, plant protein and zinc had increased significantly in the control group.

In the experimental group, the percentage of caregivers who knew that they should include full-cream milk and fat such as cooking oil and margarine in the children's diet had increased significantly at post-intervention. In addition, the percentage of caregivers who were aware that children should be given six to eight small cups of water showed a tendency towards increase in the experimental group.

In the control group, the percentage of caregivers who knew traditional bread made from maize (*tshimbundwa)* increased significantly. At post-intervention, the percentage of caregivers who knew that children should be offered more than three meals per day showed a tendency towards increase in both groups. In addition, more than 90% of the caregivers in both groups knew that children should be given starchy foods, protein-rich foods, vegetables, including indigenous vegetables, fruit, including indigenous fruit and dried beans at baseline and this did not change significantly at post-intervention. Furthermore, the percentage of caregivers who indicated that children should be given potato/maize chips sparingly had increased significantly at post-intervention in both groups. The percentage of caregivers who knew indigenous mixed dishes such as *tshidzimba, thophi* and *dovhi* did not change at post-intervention in both groups.

CHAPTER 5.

DISCUSSION

5.1 Introduction

In this chapter, the important observations from the results regarding the impact of the NEIP on the nutritional status of children (three to five years) and the nutrition practices and nutrition knowledge of the caregivers will be discussed. Where possible, the results will be compared with the available literature. Unfortunately, very few other studies have been undertaken in South Africa on the impact of nutrition education programmes, which makes it difficult to compare the findings.

The sample was selected from eight villages, with four villages constituting the experimental group and four villages the control group. At baseline, the sample consisted of 129 children and 125 caregivers, while only 89 children and 85 caregivers were available post-intervention.

5.2 Limitation of the study

The prevalence of HIV/AIDS status was not determined in the present study. As HIV/AIDS infection is associated with weight loss, wasting and an increased risk of opportunistic infection AIDS (FANTA, 2004), these could have had an influence on the impact of the nutrition intervention programme on the nutritional status of the children. However, the nutritional status of the children in both groups did not change after intervention and thus it is unlikely that there was any association with HIV.

In the present study, it was not determined whether the children had been de-wormed. The FAO (1997a) indicated that children with parasites lose blood and iron daily, which is the leading cause of anaemia in children. Furthermore, parasites depend on the host for nutrients and this could have contributed to the poor iron status of the children and could have affected the overall nutritional status of the children in both groups. If the children had not been de-wormed, however, it would have had the same impact before and after intervention.

In the present study, serum C-reactive protein concentration was not measured. The serum C-reactive protein concentration indicates acute inflammation which could affect serum retinol and serum ferritin concentrations. However, serum C-reactive protein concentration would have had the same impact on the interpretation of the serum retinol and serum ferritin before and after intervention in both groups. But unfortunately, serum C-reactive protein was not determined at both baseline and post intervention.

Despite the lack of haemoglobin values to determine the presence of anaemia, other iron indicators (serum iron, serum ferritin, serum transferrin and % transferrin saturation) were used to describe the iron status of the children, and the combination of these parameters was considered an adequate measure of iron status.

The number of blood samples at baseline was low, which made it difficult to determine the impact of the nutrition education intervention programme on the vitamin A and iron status of children. However, the blood samples were used to determine the vitamin A and iron status of the children at baseline as well as post-intervention.

When developing a nutrition intervention, the ideal is to base the programme on problems already identified in a specific community. In the present study, however, the NEIP was developed (based on health problems perceived to exist in the community) prior to baseline data collection. The reason for this is that both the Evaluation Committee and Ethics Committee that had to provide approval to undertake the study felt that they needed to approve the intervention as well the fieldwork before data collection commenced. This factor is probably the reason for poor improvement of knowledge and practices, as the problems were not first identified and then addressed. In essence, the intervention included some sections that were not really problematic in the area. The NEIP did, however, have a positive effect on some issues that needed improvement and were addressed during the intervention.

Cross-contamination of acquired knowledge is always a possibility, as the experimental group may share information with the control group (Polit and Beck, 2004: 201-202). In the present study, cross-contamination was minimised by selecting a control and an experimental group from two different wards, with villages 35 to 50 km apart. However, it is not certain whether or not the caregivers shared the information, but it is unlikely that they did. On the other hand, other interventions such as radio shows on the local radio stations focusing on infant feeding could have had an impact on the nutritional knowledge of both the experimental and the control group.

When using the 24-hour recall method, there is a possibility that the caregivers under- or over-report the consumption of food items (Gibson, 2005: 80; Lee and Nieman, 2007: 84). Furthermore, the participants are more likely to withhold or alter information about what they ate because of poor memory or embarrassment, or to please or impress the researcher. However, under- or over-reporting was minimised by using the average of two 24-hour recalls on two different days, probing and using food models and household utensils to ensure that food portion size was determined as accurately as possible.

Some of indigenous food items that were not included in the food composition tables or Food Finder programme may have resulted in the underestimation of intakes. However, recipes used for cooking the indigenous food items were added to the Food Finder programme and similar alternative food items were also used when the dish was not listed in the tables.

The South African government implemented a vitamin A supplementation programme in 2002 (DOH, 2008b). Since the baseline of the present study was conducted in 2007 and the intervention in 2008, the vitamin A supplementation programme may have impacted on the vitamin A status of the children in both groups. Furthermore, the available road to health charts of the children showed that nearly a quarter of the children (E = 22.9%; C = 23.8%) were given vitamin A supplementation in both groups at baseline. Limpopo Province was among the provinces in which about 80% coverage of vitamin A supplementation was reached in 2008, during the campaign (DOH, 2008b).

The South African government also implemented a food fortification programme in 2003. Staple food (maize-meal and bread flour) is fortified with vitamin A, thiamin, riboflavin, niacin, folic acid, vitamin B6, iron and zinc (DOH, 2002). The fortification programme could also have contributed to the improvement in the vitamin A and iron intake of the children, which would have resulted in better iron and vitamin A status. When analysing the 24-hour recall, the type of maize-meal the families were using at the time was also taken into consideration. At baseline, 39.5% (E) to 93.9% (C) were using fortified maize-meal, only while 23.7% (E) to 6.1% (C) were using both fortified maize-meal and self-ground maize-meal. However, after intervention, the number of caregivers who were using fortified maize-meal showed a tendency towards increase in the experimental group, while the control group did not change. Furthermore, the number of people who were using both fortified maize-meal and self-ground maize-meal showed a tendency towards increase in both groups. The intake of fortified maize-meal may have contributed to the overall intake of micronutrients, which may have improved the vitamin A and iron status of the children.

5.3 Socio-demographic data and related factors

The socio-demographic data at post-intervention did not change significantly. At baseline, 17% (C) to 23% (E) of the caregivers had never attended school. A similar trend was observed in an earlier study in South Africa, where it was found that 25% of caregivers of children aged one to nine years had no schooling (NFCS, 1999). Wamani *et al*. (2006) also reported that 21% of mothers with children aged 0 to 23 months in rural Uganda had no schooling. On the other hand, Matthews *et al*. (2009) reported a higher percentage (39%) of caregivers who had no schooling in underdeveloped areas of North Western Nigeria. The results of the present study reveal that more than 17% of the caregivers were illiterate, which is comparable with the studies conducted in rural Uganda (Wamani *et al*., 2006) and in South Africa (NFCS, 1999).

At baseline and post-intervention, more than 74% of the households in both groups depended mainly on child support grants. Smuts *et al*. (2008) reported a much lower number of households that depended on child grants in rural districts of the Eastern

Cape (37%) and KwaZulu-Natal (14%). At post-intervention, the percentage of households with an income of less than or R1 000.00 per month had decreased slightly, while the percentage of households with an income of R1 001.00 to R2 000.00 showed a tendency towards an increase. In addition, more or less 60% of the households' income was R1 000.00 or less per month at baseline in the experimental group (E = 56%; C = 72.3%). These findings are comparable to those of the NFCS (1999), which reported that 58% and 49% of households' income in South Africa, and specifically in Limpopo Province, was below R1 000.00 per month respectively. In a study done in rural localities of Northwest Ethiopia, preschool children who belonged to families with low income were at greater risk of being wasted, underweight and stunted (Edris, 2007). In the present study, the majority of the caregivers were unemployed and depended on child support grants for their main source of income, which could have had a negative impact on the nutritional status of the children.

At baseline and post-intervention, more than 90% of the households were using firewood as the main source of cooking fuel in both groups. A similar trend was observed amongst caregivers of children aged zero to 71 months in the rural districts of the Eastern Cape (86%) and KwaZulu-Natal (71%), where firewood was the main source of cooking fuel (Smuts *et al*., 2008). Similarly, a study in four tribal blocks of Thane District in India showed that 95.8% of mothers with children younger than six years were using firewood as the main source of cooking fuel (Khandare *et al*., 2008). On the contrary, the NFCS (1999) indicated that only 49% of households with children age one to nine years in Limpopo Province were using firewood/coal as the main source of cooking fuel at the time of its survey. In the present study, and in studies done in other developing areas, such as the rural districts of the Eastern Cape and KwaZulu-Natal (Smuts *et al*., 2008), and of India (Khandare *et al*., 2008), most communities still relied on firewood as the main source of cooking fuel.

At baseline and post-intervention, communal tap water was the main source of cooking water, while the number of people who were getting water from a river, borehole or well showed a tendency towards decrease after the intervention. Similar observations were made in the SAVACG (1995) study, where main source of water in 75.7% of households in Limpopo was a communal tap, and 14.2% fetched water from a river or dam. Matthews *et al*. (2009) indicated that, in underdeveloped areas of North Western Nigeria, a common source of drinking water was rivers or lakes (24%), private wells (23%), taps inside the house (18.7%) and boreholes (14.1%). The main source of drinking water in the rural districts of KwaZulu-Natal (50%) and the Eastern Cape (76%) was a river (Smuts *et al*., 2008). A considerable number of people in low socio-economic rural areas still do not have access to clean safe water, as they still use water from rivers, dams or lakes.

In the present study, mass media such as radio (E = 83.1%; C = 83.3%) and television (E = 44.6%; C = 28.3%) were the main source of nutrition information for most of the caregivers. A similar trend was observed in the NFCS (1999), where radio (79%) was reported to be the main source of nutrition information. Thus it seems as if most communities in low socio-economic areas rely on radio as a significant source of nutrition information.

In summary, it seems as if the socio-demographic data of the present study was comparable to that in other studies in rural or developing areas, and that it was comparable before and after the intervention. The findings of previous studies and of this study indicate that a considerable number of people in developing countries/areas still do not have access to basic services, as demonstrated by the number of people still using water from rivers, firewood as the main source of fuel, depending on social grants and having an income of less than R2 000.00 per month.

5.4 Anthropometric nutritional status of children

In a study undertaken by Walsh *et al*. (2002) in the Free State and Northern Cape Provinces to determine the nutritional status of children, nutrition education and food aid implemented over a two-years period by community health workers significantly improved the weight for age of boys and girls in urban areas, and of boys in one rural area. Although nutrition education and food aid succeeded in improving the weight status of these children, it was unable to facilitate catch-up growth in stunted children after two years of intervention. Ghoneim *et al*. (2004) indicated that the number of children aged two to five years from three day care centres in Alexandria, Egypt who were stunted and wasted decreased significantly after one year of implementing health education among the parents, providing two meals and fruit snacks per day, plus upgrading the kitchens, dining rooms and utensils. Contrary to this, a study done by Hu *et al.* (2009) in the capital city of Anhui Province in China indicated that the height for age and weight for age of kindergarten children did not improve significantly after a one-year nutrition education intervention implemented by trained nutrition graduate students and research assistants using national guidelines for China. In the current study, similar observations were made, with a nutrition education programme not making a significant difference to the nutritional status. The prevalence of stunting, underweight, wasting and overweight did not change (95% CI for the median difference [0; 0]) in both groups at post-intervention. The NEIP of the present study was implemented by one person over a period of one year, while the studies by Walsh *et al*. (2002) and Ghoneim *et al*. (2004) were implemented by two or more people over two years. Due to the shorter duration of the current study, population coverage was limited, while the studies done by Walsh *et al*. (2002) and Ghoneim *et al*. (2004) had higher coverage by using more than one person to deliver nutrition education over a longer period of time. Furthermore, the present study only used nutrition education, while the studies done by Walsh *et al*. (2002) and Ghoneim *et al*. (2004) combined nutrition education with a feeding programme, which may have contributed to the improvement observed in the nutritional status of the children in their studies.

The results of the present study indicated that the prevalence rate of stunting (HAZ) was low in the experimental groups when using both WHO (2009) and 2000 CDC z-score classification. In the present study, the prevalence of stunting in the control group was low (< 20%) to medium (20 to 29%) using both the WHO (2009) and 2000 CDC z-score classification. Furthermore, the majority (77.6% of control group to 82.5% of experimental group) of children had a normal HAZ at baseline when using the WHO

(2009) classification system, while only about half (E = 52.5%; C = 55.1%) had normal HAZ when the 2000 CDC classification system was used.

In the present study, 2.5% (E) to 8.2% (C) of the children were underweight at baseline when using the WHO (2009) classification system, indicating a relatively low prevalence of underweight. However, the 2000 CDC z-score classification indicated that nearly a quarter of children in both groups (E = 25%; C = 26.5%) were mildly underweight. On the other hand, more than 80% of children in both groups (E = 92.5%; C = 89.8%) had a normal WAZ when using the WHO (2009) classification, while the 2000 CDC z-score classification indicated that a lower percentage of children in both groups (E = 70.0%; C = 65.3%) had a normal WAZ at baseline.

The results of the present study indicated that less than 16% of the children were mildly wasted (E = 15.0%; C = 8.2%) when using the 2000 CDC z-score at baseline, indicating medium (5% to 9.9%) to very high (>15%) prevalence of wasting. However, very few children (E = 2.5%) in the experimental group were found to be severely wasted when using the WHO (2009) cut-off points for WHZ. More than 80% of the children in both groups had normal WHZ when using both WHO (2009) (E = 87.5%; C = 93.9%) and 2000 CDC (E = 80.0%; C = 89.8%) z-score classification at baseline. In contrast to WAZ and HAZ, both classification systems seem to give similar results as far as WHZ is concerned.

Very few children in both groups were overweight at baseline when using both the WHO (2009) and 2000 CDC classification for BMI/A. However, 77.5% (E) to 85.7% (C) had normal BMI/A at baseline when using the WHO classification, while a higher percentage were classified as normal using the 2000 CDC classification (E = 90.0%; C = 98.0%).

The anthropometric results of the present study were interpreted differently when using the 2000 CDC and WHO (2009) z-score classifications. The differences observed may reflect the differences in development of the two z-score classifications. The new WHO (2009) z-score classification is based on children from different countries, including

Africa, who were breastfed and given optimal health care in the WHO Multicentre Growth Reference Study (De Onis *et al*., 2004). On the other hand, the 2000 CDC system is based on American children who were mostly formula fed (Dibley *et al*., 1987). Hence, the growth patterns of the two groups of children used to develop the standards were not the same.

5.5 Micronutrient status of children

At baselines in the present study, more or less one third of the children in both groups had marginal vitamin A status (100 to 199.9 μg/L), signifying a severe public health problem (≥ 20%) of marginal vitamin A according to the WHO (1996) classification. A similar trend was observed in the SAVACG (1995) study, where 33% of children aged six to 71 months in South Africa were found to have marginal vitamin A deficiency. On the contrary, the NCFS-FB (2005) revealed a higher prevalence of marginal vitamin A deficiency amongst children aged one to nine years in South Africa (49%) and Limpopo (63.2%). However, two studies that were done in preschool children in rural Vietnam reported a much lower prevalence of vitamin A deficiency (11.3%) (Nhien *et al*., 2008) and marginal vitamin A deficiency (12%) (Khan *et al*., 2007), indicating a moderate public health problem. After the intervention, all the children in the present study had normal (> 300 μg/L) to adequate (200 to 299.9 μg/L) vitamin A status. The improvement observed in the vitamin A status of the children could be attributed to the fact that the government implemented a food fortification programme in 2003 with the aim of improving the micronutrient status of people in South Africa. Maize-meal and bread in South Africa are fortified with vitamin A, thiamin, riboflavin, niacin, folic acid, vitamin B6, iron and zinc (DOH, 2002). The vitamin A status of children in both groups most probably improved because the numbers of children who were given fortified maize-meal had shown a tendency towards increase in the experimental group, while the number of children who were given both fortified and self-ground maize-meal had also shown a tendency towards increase in both groups at post-intervention. Since improvements occurred in both the control and experimental groups, the improvements cannot be attributed to the NEIP.

At baseline, the majority of children in both groups had normal values for serum iron (E = 73.3%; C = 86.7%), while more than 13% of the children had high serum iron levels (E = 20.0%; C = 13.3%). In addition, more than 94% of the children in both groups had normal values for serum ferritin, serum transferrin and % transferrin saturation, which remained the same after intervention. Contrary to the present study, Keskin *et al*. (2005) reported that iron deficiency was more prevalent in primary school boys from low socio-economic status in urban Turkey. According to Litchford (2008: 422), high serum iron values in children may reflect day-to-day variations or may indicate iron overload. The interpretation of serum iron should thus be done with caution, because it may be elevated later in the day even in healthy individuals. However, the blood samples were collected in the morning in order to minimise the day-to-day variations. The normal serum values observed for all iron indicators may be due to the participation of the children in a de-worming programme, although this was not determined in this study. In addition, more than 90% of all children in the present study were given vegetables, fortified bread and maize-meal porridge, which may have contributed to adequate iron status. The number of children who were given fortified maize-meal had shown a tendency towards increase in the experimental group, while in both groups the number of children who were given both fortified maize-meal and self-ground maize-meal had also shown a tendency towards increase at post-intervention.

In summary, about one third of children in both groups had marginal vitamin A status, while the majority of children had normal values for serum iron, serum ferritin, serum transferrin and % transferrin saturation at baseline. In addition, the vitamin A status and iron indicators were mostly normal at post-intervention in both groups, which probably could be due to the vitamin A supplement and fortification programme of the government. Furthermore, the NEIP could not have contributed to improvement of iron and vitamin A status of the children, since the changes were observed in both groups.

5.6 Nutritional practices of caregivers

The current NEIP was based on the principles of the SAFBDGs, SAPFBDGs (Bourne, 2007) and mypyramids for kids (Smolin and Grosvenor, 2008: 608). The NEIP also focused on how to feed children aged three to five years, with the emphasis on eating a variety of foods, making starchy foods the basis of most meals, offering animal foods, giving plenty of vegetables and fruit (including indigenous vegetables and fruit) and using salt, fat and sugar sparingly (Appendix 7).

The NEIP included ten lesson plans as described in Appendix 7. These lesson plans were presented by one person (the researcher) in the first three months and repeated during the last three to four months of the 12 months of implementation in the experimental group. Two related lessons were presented on the same day, with a five-minute break in between, and each presentation lasted 20 to 30 minutes. In addition, two villages were visited on the same day – one in the morning and one in the afternoon. A group discussion method was used during the presentations. Visual aids were used and the caregivers were asked questions to stimulate discussion.

5.6.1 Number of meals per day

According to the SAPFBDGs (Bourne, 2007) on which the current nutrition education intervention programme was based, children should be given five meals per day. In the study done in the Free State by Walsh *et al*. (2003), most of the respondents indicated that children should be given three or more meals per day at baseline. A similar observation was made in the present study, where most caregivers indicated that children were receiving three or more than three meals per day in both groups. However, after intervention the percentage of children who received more than three meals per day showed a tendency towards increase in the experimental group, and this improvement could probably be attributed to the NEIP. A similar trend was observed in the study done in rural Karnataka by Kilaru *et al*. (2005), who found after the implementation of community-based nutrition education that children were offered at least four meals a day. After six months of implementation of intensive nutrition education, with or without a supplementary feeding programme, amongst moderately malnourished children in Bangladesh, the number of children who were offered more than three meals a day improved significantly (Roy *et al*., 2005). The results of the present study and of previous studies show that, if caregivers are given information on how frequently to feed the child, they are more likely to improve their practices.

5.6.2 Types of foods usually given to children

In the present study, all the caregivers (in both the control and experimental groups) reported that they were usually including starchy foods such as maize porridge, bread or samp on their children's plate daily. This practice forms part of cultural eating habits and the nutrition education intervention programme had no impact on it. A similar trend was observed in the NFCS (1999), where maize and brown bread were found to be amongst the most commonly consumed food items in children aged one to nine years. The diets of children in an informal settlement in the Free State (Dannhauser *et al*., 2000) and rural KwaZulu-Natal (Faber *et al*., 2001) were predominantly maize-meal porridge, which is a South African staple food. Manu and Khetarpaul (2006) indicated that most rural Indian preschool children consumed wheat daily. Maize-meal porridge is a staple food in South Africa, hence the majority of children were given starchy foods with each meal.

At baseline, most of the caregivers in both the control and experimental groups were usually including protein-rich foods, such as meat, beans, eggs, fish or mopani worms on the child's plate daily. This did not change after intervention. The nutrition education intervention in the present study was unable to affect protein intake, since more than 98% of the children were given protein-rich foods on their plate daily, even though the amount that was usually given was not known in this study. According to the 24-hour recall in the present study, the protein-rich foods that were commonly given were chicken feet, chicken heart, chicken giblets or chicken liver. Contrary to the present study, most children under the age of five years in developing countries such as South Africa (NFCS, 1999), Tanzania (Tatala *et al.*, 2004), Pakistan (Muller and Krawinkel, 2005), and rural Vietnam (Iram and Butt, 2006) consumed diets with very low amounts of meat and meat products. Recently, Smuts *et al*. (2008) observed that more than half of the children aged zero to 71 months in rural districts of KwaZulu-Natal and the Eastern Cape seldom or never consumed meat products.

According to the SAPFBDGs and mypyramids for children, children should be given at least 250 ml of milk to drink every day. This recommendation formed part of the intervention programme in the present study. After intervention, the number of children who were receiving milk (95% CI for the percentage difference [15.5%; 54.8%]) and yoghurt (95% CI for the percentage difference [7.1%; 34.8%]) had increased significantly in the experimental group, but not in the control group, possibly due to the intervention. A similar trend was observed by Walsh *et al*. (2003) in their study in the Free State, where the percentage of respondents who were giving milk increased significantly in the experimental groups after intervention. Gibson *et al*. (2003) made a different observation, finding that the intake of dairy products did not change after a community-based dietary diversification intervention was implemented in rural southern Malawi. Walsh *et al*. (2003) also reported that most respondents in their study in the Free State were giving children milk to drink or to eat with porridge at baseline. Contrary to their findings, only 28.2% of children in the experimental group and 44% of children in the control group of this study were given milk to drink at baseline. Furthermore, at baseline only 11 caregivers were giving milk in the experimental group, and eight of those 11 (E = 72.7%) caregivers were giving milk less than three times per week as determined by the nutritional practices questionnaire. However, 26 caregivers were giving milk at post-intervention, although 14 of the 26 (54.0%) were giving milk less than three times per week in the experimental group. Even though the number of children who were given milk had increased in the experimental group at post-intervention, the frequency of giving milk and the overall number who received milk was still very low as determined in the questionnaire related to dietary intake.

In the present study, the number of caregivers who usually included vegetables on the child’s plate daily did not change after the intervention, since more than 90% of the children were already eating vegetables in both groups at baseline, as reported by their caregivers. In a study undertaken by Yunus *et al*. (1996), the number of rural young children in Bangladesh who were given vegetables rich in beta-carotene increased from 28% to 96% 12 months after implementing a nutrition education programme. Vijayaraghavan *et al*. (1997) indicated that rural Indian preschool children from households that were participating in a home garden project combined with an extensive nutrition education programme for three years increased the consumption of carotene-rich foods to at least more than once per week. At baseline in this study, nearly half of children in the experimental group consumed vegetables three to five times per week, while half of children in the control group consumed vegetables less than three times per week. After intervention, the percentage of children who were receiving vegetables three to five times per week showed a tendency towards increase in both groups, as determined by the nutritional practices questionnaire. In previous studies, the high consumption of vegetables amongst children was attributed to seasonal availability (Dannhauser *et al*., 2000; Iram and Butt, 2006; NFCS, 1999). Seasonal availability may also have played a role in this study, since data was collected during the time when most vegetables were available.

In summary, the results of the present study indicate that the majority of caregivers in both groups were usually including starchy foods, protein-rich foods and vegetables on the child's plate at baseline and thus did not show a difference after NEIP. The number of children who were given milk and the frequency of giving milk were very low at baseline as well as post-intervention.

5.6.3 Consumption of indigenous foods

Indigenous foods form an important part of the diet of the rural people in South Africa (Faber *et al*., 2010; Nesamvuni *et al*., 2001; Steyn *et al*., 2001; Van Rensburg *et al*., 2007a). More than 90% of rural communities in South Africa use wild edible herbs (Shackleton, 2003). Similar observations were made in the present study, in which it was found that more than 90% of the children consumed indigenous vegetables, indigenous fruits, indigenous mixed dishes and indigenous edible insects at baseline. At post-intervention, the number of children who consumed indigenous foods did not change significantly in both groups, since most children were consuming these foods at baseline. The high consumption of indigenous foods observed in the present study may also be attributed to the seasonal availability of foods such as indigenous vegetables and indigenous fruit at both baseline and post-intervention (from January to April and

October to December). Indigenous vegetables and fruit are available more during autumn and summer in the study area.

In the present study, 69.2% to 100% of the children consumed indigenous vegetables such as pumpkin leaves (*Cucurbita moschata*), wild-jute plant (*Corchorus hirstirus* or *Corchorus olitorius*), night shave leaves (*Solanum retroflexum dun.*), small pig weed (*Amaranthus thunbergii*) and spider flower (*Cleome gynandra*) at baseline in both groups. A similar observation has been made in other studies, where more than 70% of people in rural communities of Malawi and South Africa were found to consume indigenous vegetables such as *Amaranthus hybridus, Biddens pilosa, B. biternata, Cleome gynandra* and *Corchorus tridens* (Babu, 2000; Faber *et al*., 2010; Nesamvuni *et al*., 2001; Van Rensburg *et al*., 2007a; Van Rensburg *et al*., 2007b).

After intervention, the percentage of children who consumed indigenous vegetables such as black jack (*Bidens pilosa*) (95% CI for the percentage difference [8.2%; 37.6%]), spider flower (*Cleome gynandra*) (95% CI for the percentage difference [6.5%; 34.3%]) and wild-jute plant (*Corchorus hirstirus* or *Corchorus olitorius*) (95% CI for the percentage difference [9.1%; 37.5%]) had increased significantly in the experimental group. In the study done by Vijayaraghavan *et al*. (1997), the number of preschool children who were consuming vegetables such as amaranth and palak increased from 50% to 75% after the implementation of a home gardening and nutrition education programme in rural India. The improvement observed in both the present study and the study done in rural India shows that targeted nutrition education can improve the feeding practices of caregivers.

After intervention, the percentage of children who were given stinging nettle (*laportea peduncularis*) (E = 95% CI for the percentage difference [0.5%; 26.4%]; C = (95% CI for the percentage difference [8.1%; 43.6%]) had increased significantly in both groups. The increase in the percentage of children who were given stinging nettle in both groups may be attributed to seasonal availability. Furthermore, most of these indigenous vegetables are collected in the field when ploughing or during harvest and when collecting firewood.

At baseline, indigenous fruit such as mango and guavas were reported to be given to more than 90% of children in both groups in the present study and this did not change significantly after intervention. Smuts *et al*. (2008) reported that tropical fruits such as mango and paw-paw were consumed more regularly in rural districts of KwaZulu-Natal than in rural districts of the Eastern Cape. The more regular consumption of tropical fruits observed in rural districts of KwaZulu-Natal and in the present study may be due to availability and accessibility. The NFCS (1999) revealed that most caregivers included fewer fruit in their children's diet and that the intake was highly dependent on local seasonal availability. A similar observation was made by Iram and Butt (2006) in India and by Dannhauser *et al*. (2000) in informal settlements of the Free State, where consumption of fruit was low and dependent on seasonal availability. Tropical fruit such as mango and guavas are available to almost all households in the Vhembe region of Limpopo Province, hence the high consumption of mango.

Paw-paw was consumed by only two thirds of the children in the experimental group at baseline and this increased significantly (95% CI for the percentage difference [12.4%; 42.6%]) at post-intervention. On the other hand, a study done in rural India revealed that the number of preschool children who were consuming papaya increased from 8% to 12% after the implementation of home gardening programmes combined with extensive nutrition education (Vijayaraghavan *et al*., 1997). Furthermore, the percentage of children who consumed indigenous fruit such as baobab fruit (*Adansonia digitata)* increased significantly (95% CI for the percentage difference [25.5%; 59.6%]) in the experimental group. The improvement observed in the present study and in the study done by Vijayaraghavan *et al*. (1997) shows that nutrition education is able to raise awareness of the importance of eating paw-paw and baobab fruit in the experimental group.

In the present study, the consumption of pineapple increased from 46% to more than 70% in both groups after intervention, as reported by caregivers on the questionnaire. Furthermore, the percentage of children who consumed indigenous fruit such as meldar (*Vangueria infestusta Burch*) (E = 95% CI for the percentage difference [10.6%; 42.9%]; C = 95% CI for the percentage difference [10.4%; 37.7%]) and wild peach (*Strychnos spinosa lam*) (E = 95% CI for the percentage difference [14.0%; 51.95%]; C = 95% CI for the percentage difference [7.3%; 44.1%]) increased significantly in the both groups. The increased percentage of children who consumed indigenous fruit in both groups may also be attributed to the fact that most of the indigenous fruit is collected from the mountain or field by teenagers/young adults when collecting firewood or ploughing the field, hence the high intake of indigenous fruit in both groups. Furthermore, the study areas were mainly mountains in both groups, which made indigenous fruit more accessible. As the population grows, it increases the need for land for accommodation. As a consequence, people cut down trees, including indigenous fruit trees, and they therefore remain only in the mountain areas.

At baseline, nearly half of the children were eating fruit (including indigenous fruit) less than three times per week in both groups (E = 52.3%; C = 51.7%), while just over 20% of children were eating fruit (including indigenous fruit) three to five times a week (E = 24.6%; C = 21.7%). At post-intervention, the percentage of children who were eating fruit (including indigenous fruit) three to five times per week had shown a tendency towards increase in both groups, while the percentage of children who were receiving fruit less than three times per week had shown a tendency towards decrease in the experimental group. At post-intervention, most of the children were attending preschool or primary school and they were given fruit at least twice per week as part of the feeding scheme, which increased the frequency of consuming fruit in both groups.

The consumption of indigenous mixed dishes such as *dovhi* (ground nuts and dried vegetables/biltong and ground nuts) (E = 95% CI for the percentage difference [9.8%; 47.0%]; C = 95% CI for the percentage difference [5%; 35.9%]), *thophi* (pumpkin and maize-meal) (E = 95% CI for the percentage difference [0.3%; 30.1%]; C = 95% CI for the percentage difference [12.1%; 41.4%]) and *tshigume* (traditional peanut butter) (E = 95% CI for the percentage difference [17.5%; 53.4%]; C = 95% CI for the percentage difference [21.8%; 57.3%]) had increased significantly in both groups after intervention. In addition, the intake of *tshimbundwa* (traditional bread made from maize) had increased significantly (95% CI for the percentage difference [26.2%; 55.5%]) in the control group, while in the experimental group the percentage had shown a tendency towards increase. Even though the data collection period at baseline and post-intervention was not different, the increase in consumption of indigenous mixed dishes observed in both groups could be due to the fact that these indigenous mixed dishes were usually prepared and consumed during and post-harvest, when most of the ingredients were easily accessible and available. Furthermore, at post-intervention, most children were attending a day-care centre, preschool or primary school and some of the indigenous mixed dishes were served as part of the national school nutrition programme.

In the present study, most children in both groups consumed *mashonzha* (mopani worms) and *nzie* (locust), while *nemeneme* or *nthwa* (adult insects) and *mazhulu* (termites) were consumed mainly by children in the experimental group at baseline. After intervention, the percentage of children who consumed indigenous edible insects such as *mashonzha* (mopani worms) (95% CI for the percentage difference [4.6%; 31.6%]) and *mazhulu* (termites) (95% CI for the percentage difference [2.7%; 27.8%]) increased significantly in the experimental group. Most caregivers reported that they give their children edible insect and it was reflected on the 24 hour recall. The NEIP encouraged caregivers to give children indigenous edible insects, since they are a good source of protein and can be used as an alternative to animal foods.

Despite the high intake of indigenous foods in both groups, the impact of the NEIP was observed in the consumption of some indigenous vegetables (black jack, spider flower and wild-jute plant), indigenous fruit (paw-paw and baobab fruit), and indigenous edible insects (mopani worms and termites), of which the intake had improved in the experimental group but not in the control group at post-intervention.

5.6.4 Nutrient intake

Manu and Khetarpaul (2006) reported that the energy intake of preschool children in India was below the RDA recommended by the Indian Council of Medical Research. In South Africa, the NFCS (1999) revealed that children aged one to nine years had median energy intakes that were below 67% of EER. A similar observation was made by Mamabolo *et al*. (2006), who reported that children aged three years in central Limpopo Province had energy intakes that were mostly below 67% of the DRI. At baseline, the median energy intake of children in the present study was below the recommended EER for age in both the experimental and control groups. Furthermore, the energy intake increased significantly (95% CI for the median difference [34.7; 921.7]) in the control group, but it was still lower than the EER after intervention. However, the anthropometric nutritional status indicated that more than 84% of the children in both groups had normal WHZ when using the both WHO (2009) while more than 80% of children had WHZ when using 2000 CDC classification at baseline as well as post-intervention.

Several studies conducted in various countries, such as South Africa, India and Pakistan, have revealed that the diets of the majority of preschool children were predominantly cereal based, hence the high intake of carbohydrates (Faber *et al*., 2001; Uppal *et al*., 2005; Iram and Butt, 2006; Manu and Khetarpaul, 2006). A similar observation was made in the present study, where the majority of children were found to be consuming cereal-based diets, resulting in high median carbohydrate intakes that were above the EAR recommended for age. At post-intervention, the median intake of carbohydrates increased significantly (95% CI for the median difference [7.8; 29.0]) in the control group, while it did not significantly (95% CI for the median difference [-26.38; 13.95]) change in the experimental group. At baseline, the median protein intake was adequate in both groups and this did not change significantly (E = 95% CI for the median difference [-6.28; 8.57]; C = 95% CI for the median difference [-3.2; 8.1]) after intervention. The adequate median protein intakes were supported by the fact that more than 95% of the children in both groups were consuming protein-rich foods at baseline as well as after intervention.

In the experimental group, the median haem iron intake did not increase significantly (95% CI for the median difference [-0.07; 0.035]) at post-intervention. To the contrary the study done amongst preschool children in rural Malawi, median haem iron was higher in the intervention group after one year of implementing a community-based nutrition education programmes (Gibson *et al.*, 2003). These findings were supported by the observation that more than 95% of caregivers included protein foods on the child's plate daily in the present study on the basis of the questionnaire, and the fact that the children were given animal-based food (chicken feet, chicken hearts or chicken giblets), which may have improved the median haem iron intake. Since the improvement was observed in the experimental group, it can possibly be attributed to the NEIP.

The median vitamin A intakes showed a tendency towards increase in the experimental group at post-intervention. The study done by Gibson *et al*. (2003) amongst preschool children in rural Malawi showed that vitamin A intake was higher in the intervention group after one year of implementing a community-based nutrition education programme. Faber *et al*. (2002a) also reported that one year after implementing nutrition education together with home-based food production in rural KwaZulu-Natal, dietary vitamin A intake had increased significantly in children aged two to five years. Despite the improvement observed in the experimental group in the intake of vitamin A, it was still below the EAR and RDA after intervention. The studies done by Dannhauser *et al.* (2000) in the Free State and by Mamabolo *et al*. (2006) in the central region of Limpopo Province revealed that the diet of most children lacked variety, resulting in a low intake of most micronutrients, including vitamin A. Furthermore, the intake of certain indigenous vegetables and indigenous fruit had increased significantly in the experimental group, which may have contributed to the high intake of vitamin A. The results of the present study also show that the number of children who were given vegetables three to five times per week showed a tendency towards increase in the experimental group.

After intervention, the iron (E = 95% CI for the median difference [0.04; 1.89]; C = 95% CI for the median difference [0.5; 2.5]) and folate intake increased significantly (E = 95%

CI for the median difference [1.41; 70.1]; C = 95% CI for the median difference [55.7; 117.0]) in both groups. On the contrary, Gibson *et al*. (2003) indicated that total iron and folate intake did not change in children in their experimental group after implementing a community-based dietary intervention in rural Malawi. In addition, the iron intake at baseline was adequate, while folate intake was inadequate in both groups in the present study. A similar observation was made by Mamabolo *et al.* (2006), who found the intake of folate to be inadequate. Furthermore, Mamabolo *et al*. (2006) indicated that most children aged one to three years in the central region of Limpopo Province consumed inadequate amounts of most micronutrients due to a diet that lacked variety. In the present study, the increase in the median intake of iron and folate in both groups may be attributed to the increase in the intake of vegetables and fruit by children in both groups. The school feeding programme may also have played a role in increasing the intake of iron and folate, since the majority of children were attending preschool or primary school and may have been given vegetables such as spinach and fruit at least twice per week as also reflected in 24 hour recall. Furthermore, the intake of fortified maize-meal and bread may have contributed to the overall improvement in the intake of iron and folate, since these products are fortified with these nutrients.

The median zinc intake increased significantly (95% CI for the median difference [0.32; 1.2]) in the control group, while median zinc showed a tendency towards increase in the experimental group. In addition, the zinc intake was adequate among the children aged one to three ,years while for children aged four to eight years it was inadequate. In the study done by Gibson *et al*. (2003), the median zinc intake was greater in the experimental group after implementation of a community-based nutrition education programme. The results of the study done by Mamabolo *et al*. (2006) revealed that the zinc intake was inadequate in children aged one to three years. In the present study, the 24-hour recall showed that the majority of children were given chicken feet, chicken hearts, chicken giblets or chicken liver in one or two meals per week, and these are good sources of zinc. Since improvements were observed in both the control and experimental groups, they cannot be attributed to the NEIP. Furthermore, it could have been possible that 24 hour recall and nutritional practices questionnaire was not sensitive enough to detect the effects of the NEIP.

In summary, the impact of the NEIP on nutritional practices was minimal, since most children were already given indigenous foods at baseline. However, significant increases in the number of children who consumed certain indigenous vegetables, indigenous fruit and indigenous edible insects were observed in the experimental group, as their consumption was emphasised during the nutrition education sessions. The intake of milk and yoghurt increased significantly in the experimental group, which could be attributed to NEIP. In addition, the number of meals offered to children in the experimental group showed a tendency towards increase. On the other hand, the majority of caregivers were including starchy foods, protein-rich foods and vegetables on their children's plate daily at baseline, and thus this did not change after the intervention.

5.7 Nutritional knowledge of caregivers

In the present study, the median nutrition knowledge scores of the caregivers were 84.2% (E) to 86.8% (C) at baseline, and this did not change significantly after 12 months of implementing the NEIP. Contrary to the findings of the present study, Ghoneim *et al*. (2004) observed significant increases in mothers' knowledge scores, from 78.5% at baseline to 91.8% after one year of implementing health education, as well as providing two meals and fruit snacks per day in an experimental group. A similar observation was made in a study of the children of Iranian nomadic mothers by Salehi *et al*. (2004), who showed that the mothers' knowledge scores increased from 62.3% to 79.6% after the implementation of nutrition education. The lack of improvement in the scores for knowledge of nutrition in the present study may be due to the fact that some questions assessed their knowledge of indigenous foods, which was already very good at baseline, leaving little room for improvement. The present study was conducted in rural areas, where most people still know and use indigenous foods as part of their daily diet.

According to the SAPFBDGs (Bourne, 2007) and mypyramid for kids (Smolin and Grosvenor, 2008: 608), children should be given four meals or more per day. These guidelines were included in the nutrition education programme. At baseline, nearly 40% of the caregivers in the experimental group and nearly two third of the caregivers in the control group indicated that children should be given only three meals per day. However, at post-intervention, the percentage of caregivers who indicated that children should be given more than three meals per day showed a tendency towards increase in both groups. The increase in the percentage of caregivers in the control group who knew that children should be offered more than three meals may also be attributed to the fact that there are other interventions aimed at improving knowledge of nutrition, such as radio shows on the local radio stations, especially at the time of national health days or events.

The SAPFBDGs (Bourne, 2007) and mypyramid for kids (Smolin and Grosvenor, 2008: 608) encourage the offering of a variety of foods to children. At baseline, more than 90% of the caregivers in both groups indicated that children should be offered a variety of foods, and the results did not change significantly after the intervention. In the study done by Salehi *et al*. (2004), mothers of nomadic Iranian children in an experimental group knew after one year of a community-based education intervention that they should offer a variety of foods to their children. In contrast, the results of the present study leave little room for improvement in the experimental group after the intervention, since almost all the caregivers were aware that children should be given different types of foods.

The study done in the Free State by Walsh *et al*. (2003) indicated that, at baseline, most of the respondents in Heidedal knew that one should include starchy foods, vegetables and milk in the children’s diet. At baseline and post-intervention in the present study, more than 90% of the caregivers in both groups also knew that children should be given starchy foods, protein-rich foods and protective foods. The baseline results of the present study left little room for improvement after the intervention, since the majority of the caregivers were aware that children aged three to five years should be given starchy foods, protein-rich foods and protective foods before the intervention. These results were also supported by the majority of the caregivers, who were providing starchy foods, protein-rich foods and protective foods. Furthermore, in the present study, the 24-hour recalls showed that children were given starchy foods, protein-rich foods or vegetables, including indigenous vegetables, in two or more meals at both baseline as well as post-intervention.

Dietary fat helps in the digestion, absorption and transportation of fat-soluble vitamins in the body (Gallagher, 2008: 50). Furthermore, dietary fat also provides the body with energy, which is essential for children's growth and development (Gallagher, 2008: 50). The results of the present study revealed that the percentage of caregivers who knew that fat such as cooking oil or margarine should be included in the children's diet increased significantly (95% CI for the percentage difference [0.5%; 35.5%]) in the experimental group, while the percentage did not change in the control group. As part of the NEIP, the caregivers were encouraged to include moderate amounts of fat in the children's diet to provide additional energy. The improvement observed in the experimental group may reflect the possible impact of nutrition messages given to caregivers in the experimental group, since the NEIP encouraged caregivers to include moderate amounts of fat in the children's diet. Despite this, the majority of children in both groups were given fat such as margarine and cooking oil at baseline as well as post-intervention.

According to Madisa and Tshamekang (1997), indigenous plants are considered good food for children and for the poor in rural areas. The present study was conducted in rural areas where indigenous foods still form a major part of the diet. Hence, in the present study the majority of the caregivers in both groups indicated at baseline that children should be given indigenous vegetables, indigenous fruit and dried beans. The percentage did not change significantly after the intervention. Despite the fact that the majority of caregivers were aware that children should be given indigenous vegetables and indigenous fruit, the frequency of giving other vegetables and fruit was low, which probably influenced the median intake of vitamin A and vitamin C in both groups. Furthermore, vegetable and fruit intake could be attributed to seasonal availability.

Many people in rural areas have unique and specialised knowledge of indigenous food systems that have been passed from one generation to the other over the years (Van Rensburg *et al*., 2007b). Hence, the results of the present study revealed that more than 90% of the caregivers in both groups knew indigenous mixed dishes such as *tshidzimba*, *thophi* and *dovhi*, while 28.3% (C) to 33.9% (E) of the caregivers knew *tshimbundwa*. Furthermore, more than 85% of the caregivers in the present study indicated that they knew indigenous fruits such as *mazwilu*, *nombelo* and *mavhungo*, and indigenous vegetables such as *murudi* and *mufungwi*. The results of the present study showed that, in both groups, the majority of the caregivers knew most of the indigenous foods in their area at baseline.

At baseline, nearly one third of the caregivers (E = 36.4%; C = 35.7%) knew that children should eat vegetables and fruit every day in order to stay healthy, and this did not change significantly in both groups. In the study done by Nayak *et al*. (2001) in the Rayalaseema region of Andhra Pradesh in South India, the number of preschool mothers in the experimental group who were aware that children should be given green leafy vegetables in order to maintain good eyesight improved significantly after the implementation of a home garden programme together with a nutrition communication strategy. On the contrary, the results of the present study reveal that the majority of caregivers were not aware that children should be offered vegetables and fruit every day in order to keep healthy. However, the percentage of caregivers who were giving children vegetables daily and three to five times per week increased from 15.4% to 23.1% and from 48.7% to 56.4% respectively in the experimental group. A similar trend was observed in the study done by Nayak *et al.* (2001), where the number of preschool mothers who were aware that children should be given green leafy vegetables more than three times per week increased from 9.8% to 41.8% in the experimental group after intervention.

At post intervention, the percentage of caregivers who knew that dried beans, mopani worms and vegetables mixed with nuts can be given in the place of meat did not change significantly in both groups, since more than 80% of the caregivers knew this before the intervention. These results were also supported by the reported practices of the caregivers, since most children were given dried beans, mopani worms and *dovhi* at baseline as well as after intervention in both groups.

At baseline, less than 15% of the caregivers (E = 12.1%; C = 14.3%) knew that children should be given full-cream milk in both groups. However, at post-intervention the percentage of caregivers who knew that children should be given full-cream milk had increased significantly in the experimental group. A similar trend was observed in the study done by Walsh *et al*. (2003), which showed that the number of respondents who knew that children should be given full-cream milk to drink or eat with porridge increased significantly at post-intervention, possibly due to the nutrition intervention. The results of the present study also show a significant improvement in the application of this practice, as seen by the increase in the number of caregivers who were giving milk in the experimental group post-intervention.

According to the SAPFBDGs (Bourne, 2007), children can be offered sweet treats or drinks in small amounts with meals. In the present study, more than 87% of the caregivers indicated that children aged three to five years can be given sweets or sugary drinks on special occasions, and this did not change after intervention. In addition, almost all the caregivers in both groups knew that sugar and jam should be used sparingly at baseline as well as after the intervention. The results in the present study were also supported by the fact that most children were offered potato/maize-based chips sparingly.

Vegetables provide micronutrients such as beta-carotene, minerals and water-soluble vitamins. However, water-soluble vitamins can dissolve in the presence of water. Therefore, when cooking vegetables one needs to add only small amounts of water and to cook the vegetables until just tender in order to avoid leaching losses through discarding the remaining water. Faber *et al*. (2010) indicated that African leafy vegetables are usually boiled in a little water, with no water remaining after cooking. At baseline, the results of the present study showed that more than 90% of the caregivers indicated that one should add very little water when preparing vegetables and this number did not change significantly post-intervention. Most caregivers knew how to cook vegetables and this could be due to the fact that the methods for preparing indigenous vegetables were usually passed from one generation to the next. It is a cultural practice that, when cooking indigenous vegetables, one should add only small amounts of water to avoid discarding water at the end of the cooking process.

In summary, the impact of NEIP on the nutrition knowledge scores of the caregivers was not significant in the experimental group, since most of the caregivers had good knowledge at baseline. However, the nutritional knowledge test given caregivers may have not been sensitive enough to indicate the differences in knowledge at baseline and post intervention. In addition, some of the questions used to evaluate the knowledge of nutrition of the caregivers also included knowledge related to indigenous foods, which the majority of people in rural areas already have. Waldick (2009) and Van Rensburg *et al*. (2007b) have indicated that people in rural areas have unique and specialised knowledge of indigenous foods and still use these foods as part of their diet. This was confirmed by the present study. Furthermore, indigenous knowledge is passed from one generation to the next over the years (Van Rensburg *et al*., 2007b). However, the number of caregivers who knew that fat (95% CI for the percentage difference [0.5%; 35.5%]) and full-cream milk (95% CI for the percentage difference [2.6%; 43.3%]) should be included in the diet of children aged three to five years had increased significantly in the experimental group, while it did not change in the control group. Since this was the only area in which an improvement could be made, it can be attributed to the NEIP.

5.8 Impact of the nutrition education intervention programme

In the present study, the NEIP was implemented by one person (researcher) who visited the villages at the time of nutrition education, and this could have contributed to the low coverage resulting in the few changes observed in the experimental group after intervention. Furthermore, the majority of caregivers were already following a healthy diet, as determined by 24-hour recalls and the questionnaire at baseline, which left little room for improvement. The NEIP had a positive impact on the following parameters: the children who were given more than three meals showed a tendency towards increase in the experimental group after intervention. In addition, the intake of dairy products such as milk and yoghurt increased significantly in the experimental group after intervention. The increase in the percentage of children who were consuming indigenous vegetables such as black jack, spider flower and wild-jute may be attributed to the impact of the NEIP, since it encouraged the caregivers to give children plenty of vegetables, including indigenous vegetables that are available in their areas. The NEIP seemed to improve the intake of paw-paw and baobab fruit in children in the experimental group. The intake of indigenous edible insect such as mopani worms and termites also increased significantly in the experimental group after the intervention. The percentage of children who were eating fruit three to five times per week showed a tendency towards increase in both groups, which may have also contributed to the increase in vitamin A intake that showed a tendency towards increase in the experimental group.

On the other hand, the percentage of children who were given starchy foods, protein-rich foods, protective foods and fat such as cooking oil and margarine did not change in both groups after the intervention, since the practice was already established and could not be improved. In addition, the intake of carbohydrates and protein was adequate when compared with the EAR/RDA of the recommended age groups at baseline as well as post-intervention.

Certain improvements in practices and knowledge could not be attributed to the NEIP, since certain improvements occurred in the control group as well. In both groups, the percentage of children who consumed indigenous mixed dishes (*dovhi* and *thophi*), indigenous vegetables (stinging nettle), indigenous fruit (meldar, wild peach and pineapple) and peanuts increased significantly. Furthermore, in both groups, iron and folate intake increased significantly, while vitamin C showed a tendency towards decrease. Calcium intake was inadequate at baseline and showed a tendency towards increase in both groups. In the experimental group, the percentage of caregivers who knew that children aged three to five years should be given fat such as cooking oil and full-cream milk increased significantly in the experimental group, while it did not change in the control group. Furthermore, the percentage of caregivers who indicated that children aged three to five years should be offered six to eight small cups of water showed a tendency towards increase after intervention in the experimental group.

Probably due to other interventions, such as radio shows, changes were also observed in the control group and not in the experimental group. At post-intervention the intake of indigenous mixed dishes *(tshimbundwa*), carbohydrates, plant protein and zinc had increased significantly in the control group, but not in the experimental group.

Before intervention, the knowledge of nutrition of the caregivers was good since they scored more than 80% at baseline, and this did not change significantly after intervention. At baseline, almost all the caregivers knew that children should be given variety foods, starchy foods, protein-rich foods and protective foods, and this did not change after intervention.

Another factor that could have contributed to the few differences between the experimental and the control group could be the geography and availability of services. The villages were in a radius of 50 km from each other, and received services from the same municipality and health institutions. They also purchased food from the same small towns and probably interacted in public space.

CHAPTER 6.

CONCLUSION AND RECOMMENDATIONS

This chapter outlines the conclusions drawn and recommendations made on the basis of the present study.

6.1 Conclusion

The socio-demographic data of the present study was comparable to that in other studies done in developing or rural area at baseline, as well as post-intervention. In addition, the socio-demographic information was comparable in both groups at baseline and post-intervention. Like any other rural and developing areas, most of the caregivers were unemployed and relied on social grants, with an income of less than R2 000.00 per month, which may have a negative impact on their caring capacity. Furthermore, a considerable number of households did not have access to clean safe water, while the majority of households relied on firewood as a source of cooking fuel.

The anthropometric nutritional status of children did not change after 12 months of implementing the NEIP, as was demonstrated by the fact that the incidence of stunting, underweight and wasting did not change significantly in both groups. In addition, nearly one third of the children in both groups had marginal vitamin A status and 7.7% (E) had vitamin A deficiency at baseline. However, the fortification and vitamin A supplementation programme implemented in South Africa may have contributed to the improved vitamin A status after the intervention. Hence, children from both groups had adequate to normal vitamin A status after intervention, while all iron indicators were within adequate levels, both at baseline and post-intervention.

The impact of nutrition education was only observed in some nutritional practices, since the majority of caregivers were usually including most of the food items, such as starchy foods, protein-rich foods and vegetables on the child's plate daily at baseline, which left little room for improvement as a result of the NEIP. The children in both groups received mainly three to more than three meals per day at baseline. However, after intervention, the number of children who were given more than three meals per day had shown a tendency towards an increase in the experimental group. Milk was amongst the least given food items, while yoghurt was consumed by more than 80% of the children in both groups.

The intake of fruit was very low, since only 17% of children in both groups were given fruits daily at baseline. At post-intervention, the number of children who were given fruit daily decreased in the control group, while the number did not change in the experimental group.

The results at baseline as well as post-intervention revealed that the majority of children were eating indigenous foods, which reflect the diet of rural people. Despite that, there were significantly improved intakes of certain indigenous vegetables (black jack (95% CI for the percentage difference [8.2%; 37.6%]), spider flower (95% CI for the percentage difference [6.5%; 34.3%]) and wild-jute plant (95% CI for the percentage difference [9.1%; 37.5%]), indigenous fruit (baobab fruit (95% CI for the percentage difference [25.5%; 59.6%]) and paw-paw (95% CI for the percentage difference [12.4%; 42.6%]) and indigenous edible insects (mopani worms (95% CI for the percentage difference [4.6%; 31.6%]) and termites (95% CI for the percentage difference [2.7%; 27.8%]) in the experimental group, while in the control group this did not change.

On the other hand, a significantly improved intake of indigenous foods such as stinging nettles (E = 95% CI for the percentage difference [0.5%; 26.4%]; C = 95% CI for the percentage difference [8.1%; 37.6%]), meldar (E = 95% CI for the percentage difference [10.6%; 42.9%]; C = 95% CI for the percentage difference [10.4%; 37.7%]), wild peach (E = 95% CI for the percentage difference [14.0%; 51.9%]; C = 95% CI for the percentage difference [7.3%; 44.1%]), pineapple (E = 95% CI for the percentage difference [15.3%; 51.2%]; C = 95% CI for the percentage difference [6.1%; 41.5%]), *dovhi* (E = 95% CI for the percentage difference [9.8%; 47.0%]; C = 95% CI for the percentage difference [5.0%; 35.9%]), *thophi* (E = 95% CI for the percentage difference

[0.3%; 30.1%]; C = 95% CI for the percentage difference [12.1%; 41.4%]) and peanut (E = 95% CI for the percentage difference [9.1%; 37.5%]; C = 95% CI for the percentage difference [4.2%; 27.2%]) was observed in both groups after the intervention. These improvements could have been attributed to the seasonal availability of these fruit and vegetables, or to other intervention strategies that were implemented at the same time.

Furthermore, the median intake of iron (E = 95% CI for the median difference [0.04; 1.89]; C = 95% CI for the median difference [0.5; 2.5]) and folate (E = 95% CI for the median difference [1.41; 70.1]; C = 95% CI for the median difference [55.7; 117.0]) increased significantly in both groups. The inadequate intake of calcium at baseline as well as at post-intervention in both groups might have been caused by the low milk intake of children in both groups. However, the calcium intake showed a tendency towards increase in both groups after the intervention. The percentage of children who were consuming milk (95% CI for the percentage difference [15.5%; 54.8%]) and yoghurt (95% CI for the percentage difference [7.1%; 34.8%]) had increased significantly in the experimental group, but not in the control group. However, the frequency of consuming milk was probably too low to have a significant impact on the calcium intake. The median vitamin C intake showed a tendency towards decrease in both groups, which may reflect the low intake of citrus fruits in both groups.

Furthermore, the median carbohydrate and protein intakes were adequate when compared to EAR and RDA at baseline as well as post-intervention, which may reflect the usual inclusion of starchy foods (porridge, bread or samp) and protein-rich foods (meat, beans, eggs, fish, milk or mopani worm) on the child's plate daily.

Despite the essential role that is played by energy intake in the body of children, energy intake was inadequate in both groups at baseline as well as post-intervention when compared to the EER. However, the energy intake increased significantly (95% CI for the median difference [34.7; 921.7]) in the control group, while it did not change significantly in the experimental group. Factors other than the NEIP were thus responsible for this increased energy intake in the control group. However, the weight status of the children in the control group did not increase significantly after the intervention. The inadequate intake of energy in both groups could be attributed to under reporting, even though it was minimized using food models and kitchen utensils to estimate the food intake.

The majority of people in rural areas have specialised knowledge of indigenous foods, as they form part of their daily diet. This may have contributed to the high scores for knowledge of nutrition in both groups at baseline as well as post-intervention, since most questions were based on indigenous foods.

Regardless of the fact that most caregivers had good knowledge of nutrition at baseline, very few caregivers in both groups knew that children aged three to five years should be given full-cream milk. After intervention, the percentage that knew that full cream milk should be given to children increased significantly (95% CI for the percentage difference [2.6%; 43.3%]) in the experimental group. In addition, the majority of caregivers were aware that children should be given fat to help meet the high energy requirements of children aged three to five years, and this knowledge increased significantly (95% CI for the percentage difference [0.5%; 35.5%]) in the experimental group, while did not change in the control group.

The NEIP emphasised the importance of drinking clean safe water, and the percentage of caregivers who knew that children should be given six to eight small cups of water daily showed a tendency towards increase in the experimental group, while in the control group it did not change.

The majority of caregivers in both groups were aware at baseline as well as post-intervention that children should be given a variety of foods, such as starchy foods, protein-rich foods, vegetables and fruit. This was also reflected in their nutritional practices, with the majority of caregivers including these foods (starchy foods, protein-rich foods and vegetables) on the child’s plate. Furthermore, the majority of caregivers knew different indigenous foods (vegetables, fruit, mixed dishes and edible insects) at baseline as well as after intervention, as they form part of their daily diet in rural areas. At baseline, most of the caregivers were aware that children aged three to five years should be given frequent small meals throughout the day due to their small stomachs and their high energy requirements. In addition, the number of caregivers who knew that children aged three to five should be offered more than three meals per day showed a tendency to towards increase in both groups after the intervention.

The limitation of the study was taken into consideration when interpreting the data from the present study. Some of the participants from both groups dropped out of the study, resulting in smaller sample size at post-intervention. However, only the data of participants who completed the baseline and post-intervention were included for comparison. Furthermore, the small number of blood samples at baseline made it difficult to determine the impact of the NEIP on micronutrient status. Hence, the micronutrient status of children was only described at baseline and post-intervention.

6.2 Recommendations

Based on the results and the limitations experienced when conducting this study, the following recommendations are made.

For micronutrient studies it is recommended that all children be de-wormed at baseline. Therefore, it is recommended that further nutrition intervention studies of this kind should take the HIV/AIDS status and the de-worming status of children into consideration, since parasites affect nutritional status significantly.

Indigenous knowledge is passed from one generation to the next and people in the rural areas have specialised knowledge of indigenous foods (Van Rensburg *et al*., 2007b). However, it is recommended that further studies be conducted that focus on identifying the available indigenous foods and on improving the consumption of indigenous foods (vegetables, fruit, edible insect and mixed dishes) by school children and youth in the rural and semi-rural areas of South Africa in an effort to improve food security.

The methods of cooking indigenous foods are passed from one generation to the next through verbal communication and nutrient content of some indigenous foods is not known. Therefore it is recommended that a study should be undertaken focusing on developing a recipe book of indigenous foods with the aid of elderly people from different ethnic groups to ensure that this knowledge is not lost to future generations. The recipe book will also preserve the knowledge of how to prepare indigenous foods and further teach young generations the cooking methods. Furthermore, these recipes using indigenous foods could also be analysed in order to determine their nutrient content so that they can be included in the South African food composition tables.

Indigenous foods are underutilised in less remote areas. Van Rensburg *et al*. (2007b) indicate that most indigenous knowledge systems are undervalued and lost because most people who still use indigenous foods are from rural areas and often the poorest of the poor. Therefore, in order to preserve this indigenous knowledge, it is recommended that the training of dieticians and nutritionists should include a section on the benefits and use of different indigenous foods so that they can also promote the consumption of indigenous foods in people through nutrition education.

Indigenous vegetables and fruit are not formally cultivated and marketed. Therefore, the researcher recommends that the Department of Agriculture makes seeds (indigenous vegetables and fruit) available and promotes the cultivation of indigenous vegetables and fruit by small-scale farmers. Furthermore, indigenous foods (vegetables, fruit and edible insects) can be sold by food vendors and so increase the availability of these indigenous foods, while at the same time improving the income-generating potential of the vendors.

The NEIP was able to improve some nutritional practices in the present study, even though the coverage was low. The coverage could be increased by involving nutrition staff in district offices and other community health workers in the implementation of a similar programme. The NEIP developed in the present study should be adapted for the Department of Health (Nutrition Section – Vhembe District Office) so that health care workers can present it in different areas during radio shows, community meetings and at health facilities.

In the present study, the NEIP was developed before baseline data collection and this could have contributed to the low improvement rate observed on nutrition knowledge and nutritional practices of caregivers. Therefore, it is recommended that nutrition intervention programmes be developed after the analysis of baseline data when actual gaps in knowledge and practices have been identified. This will help in developing appropriate intervention programmes which address the real needs of the community.

6.3 Value of the study

In accordance with the findings of Van Rensburg *et al*. (2007b) and Waldick (2009), the results of the present study reveal that most of the people in the studied areas are still using indigenous food, especially vegetables, fruit, mixed dishes and edible insects. The study also showed that nutrition education generally can improve the nutritional practices of caregivers in the targeted population, since some of the practices improved significantly after intervention. However, a limited impact of the nutrition intervention programme on knowledge of nutrition was observed, since most of the caregivers had knowledge of nutrition at baseline, especially in relation to indigenous foods, and population coverage was generally low.

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APPENDIX 1

CONSENT TO PARTICIPATE IN RESEARCH

You have been asked to participate in a research study. You have been informed about the study by ____

You have been informed about any available compensation or medical treatment if injury occurs as a result of study-related procedures;

You may contact Mushaphi LF (082 444 7326 or 015 962 8334) at any time if you have questions about the research or if you are injured as a result of the research.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number (051) 4052812 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to terminate participation.

If you agree to participate, you will be given a signed copy of this document as well as the participation information sheet, which is a written summary of the research.

The research study, including the above information has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

_____________________ _________________________

Signature of participant Date

_______________________ ___________________________

Signature of witness Date

APPENDIX 1A

THENDELO YA U DZHENELELA THODULUSO NGA VHO-MME A VHANA

Vha humbelwa uri vha dzhenelele thoduluso iyi. Nne ____________________________ ndi tenda u dzhenelela kha thoduluso iyi.

Ndo vhudziwa nga ha thoduluso iyi nahone ndi a pfesesa zwine vhathodulusi vha do ita zwone. Vha nga nkwama kha nomboro hedzi (082 444 7326 or 015 962 8334) tshifhinga tshinwe na tshinwe, arali havha na thaidzo dzo livhanaho na thoduluso iyi. Ndo vhudziwa ngaha dzilafho arali ha nga vha na u huvhala zwo vhangwa nga thoduluso iyi.

Vha nga kwama vha nwaleli vha Univesithi ya Free Stata kha nomboror hedzi (051) 405 2812 arali ha vha ba thaidzo malugana na thoduluso heyi.

Vha dzhenelela nga u funa, a vha kombetshidziwi u dzhenelela nahone vhanga litsha tshifhinga tshinwe na tshinwe. Arali vha tshi tenda u dzhenelela, vha nga ntsainela afho fhasi.

Ndi a tenda uvha tshipida tsha thoduluso iyi. Ndo talutshedziwa nga mulomo zwine zwa do itiwa nahone ndo zwipfesesa.

__________________________ ________________

Muano nga mubebi wa nwana Duvha

__________________________ ________________

Muano nga muvhudzisi Duvha

APPENDIX 2

INFORMATION SHEET

Study title: Impact of nutrition education programme on nutritional status of children aged 3 to 5 years and the nutritional practices and knowledge of their caregivers in rural of Limpopo Province, South Africa.

Greeting: Thank you for allowing me to ask you questions. I would like to find out if in your household there are children aged 3 to 5 years old. If there are children aged 3 to 5 years, I would like to know what you usually give them to eat and drink. There are no rights or wrong answers. Everything you tell me is in confidential.

We are doing research on the nutritional status and nutritional practices and knowledge of the caregivers. In this study, we want to learning about the impact of nutrition education programme on improving nutritional status of children age 3 to 5 years and the nutritional practices and knowledge of their caregivers.

We are asking/inviting you and our child to participate in a research study. The inconvenience of the participants in the study is minimal. It will only take some time to answer questions and it might be uncomfortable for the child when the blood sample is drawn.

There are no negative effects on the child or the mother foreseen. All the information that the caregivers provide will be treated in confidentiality. The information received from the caregivers will be used only for the purposes of the study. The results of the whole group will be published in journals. The caregiver will be informed about infant feeding will beneficial to other children. The caregivers will save money because they will use the locally available foods that are cheaper.

Participation is voluntary, and refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled; the subject may discontinue participation at any time without penalty or loss of benefits to which the subject is otherwise entitled.

Efforts will be made to keep personal information confidential. Absolute confidentiality cannot be guaranteed. Person information may be disclosed if required by law. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the Ethics Committee of the Faculty of Health Sciences, University of Free State.

Enquires:

Contact person: ***Mushaphi LF***

Contact numbers: ***082 444 7326/ 015 962 8334***

APPENDIX 2A (Tshivenda information sheet)

FOMO YA THENDELANO

Thoho: Thoduluso ya malisele a vhana na ndivho ya vho-mme a vhana nga ha malisele a vhana vha minwaha miraru u yak ha mitanu. Ra dovha ra funza vho-mme nga ha kulisele kwa vhana.

Ndumeliso: Ndi livhuwa u newa tshifhinga tsha uri ndi kone u amba navho. Ndi tama u divha uri huna nwana kana vhana vha re na minwaha miraru u yak ha mitanu. Arali vha na vhana vha re na minwaha miraru u swika kha mitanu, ndi tama u divha uri vha vha nea zwiliwa-de nahone lungana kha duvha. Zwothe zwine vha do fhindula zwone ndi tshipiri vhukati hanga navho. A huna phindulo ire yone kana is yone.

Ndi khou ita thoduluso nga ha maalutshele a vhana na kulele kwavho. Ndi do dovha nda tama u divha uri musi vho-mme vho funziwa nga ha malisele a vhana, zwi a kwama naa malisele a vhana na maulutshele avho. Ndi humbela mme a nwana na nwana ri tshi itela u tola uri nwana u na vithamini A na ayoni muvhilini wawe. Ndi do humbela garata ya nwana ya tshikalo. Ri do sedza uri nwana ofhiwa naa vithamini A, maduvha a mabebo, na tshileme tsha mabebo. U dzhiwa ha malofha zwi do itwa nga muongi ozwi gudelaho.

Vha humbeliwa u dzhenelela kha thoduluso iyi, vho tendelwa u vhudzisa mbudziso dza zwine vha sa pfesese. Vha tendelwa u dzhenelela nga u funa na u litsha arali huna hune vha sa pfesese. Zwine ra do amba, zwi dovha tshiphiri vhukati hashu. Zwine vha do amba zwone zwi do shumiselwa thoduluso iyi fhedzi. Mvelelo dza tshigwada tshothe tsho dzhenelelaho dzi do bveledziswa kha bugu dza vho-rasantsi.

Arali vhana mbudziso:

Vha kwama: ***Mushaphi LF***

Nomboro dza lutingo: ***082 444 7326/ 015 962 8334***

APPENDIX 3

MARKING GUIDE

The answers are marked with x

NUTRITIONAL KNOWLEDGE QUESTIONNAIRE

100. How often should children 3 to 5 years be fed a day? 41

1. Once
2. Twice
3. Three times
4. More than three times X
5. Do not know

<u>Which of the following foods must be on the plate of the children 3 to 5 years and older</u>

101. Starchy foods, such as porridge or samp or bread 42

1. Yes X
2. No
3. Do not know

102. Protein foods, such as beans or eggs or fish or meat or milk 43

1. Yes X
2. No
3. Do not know

103. Fats, such as oil or margarine 44

1. Yes X
2. No
3. Do not know

104. Vegetables 45

1. Yes X
2. No
3. Do not know

105. Sugar 46

1. Yes X
2. No
3. Do not know

106. Should vegetables and fruits be given to the children (3 to 5 years)? 47

1. Yes X
2. No
3. Don't know

107. Should the children (3 to 5 years) be given snacks? 48

1. Yes X
2. No
3. Don't know

108. Should fruits be given to children (3 to 5 years) as snack? 49

1. Yes X
2. No
3. Don't know

Indigenous food refers to traditional foods, which originate locally in that area with respect to region and district. These include both plants and animal foods.

109. Do you know of indigenous foods that grow in Limpopo Province? 50

1. Yes X
2. No

If yes, do you know the following indigenous foods?

110. *Tshidzimba* 51

1. Yes X
2. No

53

111. Thophi

1. Yes X
2. No

112. *Dovhi* 54

1. Yes X
2. No

113. *Tshimbundwa* 55

1. Yes X
2. No

114. *Mazwilu* 56

1. Yes X
2. No

115. *Nombelo* 57

1. Yes X
2. No

116. *Murudi* 58

1. Yes X
2. No

117. *Mufungwi* 59

1. Yes X
2. No

118. *Mavhungo/ khwakhwa* 60

1. Yes X
2. No

119. Other indigenous foods 61 – 62

____

____

____

____

120. Can children 3 to 5 years be given indigenous vegetables? 63

1. Yes X
2. No
3. Do not know

121. Can children 3 to 5 years be given indigenous fruits? 64

1. Yes X
2. No
3. Do not know

122. Should children 3 to 5 years be given a variety of foods? 65

1. Yes X
2. No
3. Don't know

123. Can dried beans be used in the place of meat? 66

1. Yes X
2. No
3. Do not know

124. Can your children 3 to 5 years have dried beans? 67

1. Yes X
2. No
3. Do not know

125. Children 3 to 5 years should use the following milk: 68

1. Full-cream X
2. Low-fat milk
3. Do not know

126. Can mopani worms be used in place of meat? 69

1. Yes X
2. No
3. Do not know

127. Should the children 3 to 5 years be given mopani worms, termites, locust and *nemeneme*? 70

1. Yes X
2. No
3. Do not know

128. How often should children 3 to 5 years eat porridge? 71

1. Everyday X
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know

129. Sugar and jam can be used 72

1. As often as liked
2. Sparingly X
3. Do not know

130. How often should sweets and cold drinks be used? 73

1. Everyday
2. At special occasions X
3. Do not know

131. How often should simba chips, cheese curls and niknaks be used? 74

1. Everyday
2. Sparingly X
3. As much as liked
4. Do not know

132. When preparing food fat should be used 75

1. Sparingly X
2. As much as liked
3. Do not know

133. It is good for children 3 to 5 years to eat cooked pumpkin leaves and carrots for healthy eyes. 76

1. Yes X
2. No
3. Do not know

134. How often should children 3 to 5 years eat vegetables or fruits to keep healthy?

77

1. Everyday X
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know

135. When cooking vegetable one should 78

1. Cover it with water
2. Add very little water X
3. Do not know

136. Vegetable with groundnut can be used instead of meat 79

1. Yes X
2. No
3. Do not know

137. When preparing food one should use salt 80

1. Sparingly X
2. As much as liked
3. Do not know

138. How much clean water should your children 3 to 5 years drink per day.**1**

1. Less than 6 cups X
2. 6 to 8 cups
3. Do not know

APPENDIX 4

INTERVIEW SCHEDULE

Impact of a nutrition education programme on the nutritional status of children aged 3 to 5 years and the nutritional practices and knowledge of their caregivers in rural Limpopo Province, South Africa

Family Code: **1 – 4**

☐☐☐☐

5 – 10

☐☐☐☐☐☐

Date of the interview: yy…… mm …… dd ……..

Name of the interviewer: ___________________ 11

☐

<u>Greeting</u>

Thank you for giving up your time to participate in this study. There is no right or wrong answers. Everything you tell me is confidential. Is there anything you want to ask now? Are you willing to go on with the questions?

SECTION A: DEMOGRAPHIC QUESTIONNAIRE

1. Family name: …………………………………………………..
2. Caregiver's age (date of birth): yy……mm……dd……. 12 – 17

☐☐☐☐☐☐

3. Education of the caregiver: Highest grade passed 18

☐

1. Never attended
2. Grade 1 – 4
3. Grade 5 – 7
4. Grade 8 – 10
5. Grade 11 – 12
6. Tertiary education, specify...………..

4. Marital status: 19

1. Never married
2. Married
3. Widowed
4. Other, specify ……………………….

5. Number of people living in a household. …………………… 20 – 21

<u>Source of income:</u>

6. Mother 22

1. Yes
2. No

7. Father 23

1. Yes
2. No

8. Grandparents 24

1. Yes
2. No

9. Other, specify ………….. 25

<u>Type of employment/income:</u>

10. School educator 26

1. Yes
2. No

11. Health worker 28

1. Yes
2. No

12. Child grant 29

1. Yes
2. No

13. Pension / grant 30

1. Yes
2. No

14. Self employed 31

1. Yes
2. No

15. Other, specify …………… 32

16. Household income per month: 33

1. 1000 or less
2. 1001 – 2000
3. 2001 – 3000
4. 3001 – 4000
5. 5000 or more

<u>What type of livestock do you have at home?</u>

17. Chicken 34

1. Yes
2. No

18. Goat 35

1. Yes
2. No

19. Cattle 36

1. Yes
2. No

20. Pigs 37

1. Yes
2. No

21. Other, Specify …………………………. 38

Land for production:

22. Vegetable garden 39

1. Yes
2. No

23. Fruit garden 40

1. Yes
2. No

24. Field 41

1. Yes
2. No

Source of receiving nutrition information

25. Radio 42

1. Yes
2. No

26. Television 43

1. Yes
2. No

27. Newspaper 44

1. Yes
2. No

28. Magazine 45

1. Yes
2. No

29. Other, specify …………………

46

Source of fuel for cooking:

30. Fire wood 47

1. Yes
2. No

31. Electricity 48

1. Yes
2. No

32. Gas 49

1. Yes
2. No

33. Paraffin 50

1. Yes
2. No

34. Other, specify ………………………..

51

Where do you get water?

35. Well 52

1. Yes
2. No

36. Tap (home) 53

1. Yes
2. No

37. Tap (communal) 54

1. Yes
2. No

38. Borehole 55

1. Yes
2. No

39. River 56

1. Yes
2. No

40. Other, specify ……………… 59

SECTION B: NUTRITIONAL PRACTICES QUESTIONNAIRE

41. How often do you give your children 3 to 5 years food per day 60

☐

1. One
2. Two
3. Three
4. More than three
5. Do not know

<u>Which of the following foods are usually on your children's plates daily?</u>

42. Porridge or bread or samp 61

☐

1. Yes
2. No

43. Vegetables 62

☐

1. Yes
2. No

44. Meat or beans or eggs or fish or milk or mopani worms 63

☐

1. Yes
2. No

45. Oil or margarine 64

☐

1. Yes
2. No

46. How often do you give your children 3 to 5 years vegetables to eat? 65

1. Everyday
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know
5. Never

Do you give your children 3 to 5 years the following indigenous vegetables?

47. Black jack/ *Mushinzhi* 66

1. Yes
2. No

48. *Murudi* 67

1. Yes
2. No

49. *Delele* 68

1. Yes
2. No

50. *Muxe* 69

1. Yes
2. No

51. *Dzaluma* 70

1. Yes
2. No

52. *Vowa/thebe* 71

1. Yes
2. No

53. Pumpkin leaves/ *phuri* 72

1. Yes
2. No

54. Cow pea's leaves/ *munawa* 73

1. Yes
2. No

55. Other Indigenous vegetables 74 – 75

____

____

____

____

56. How often do you give your children 3 to 5 years fruits to eat? 76

1. Everyday
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know
5. Never

<u>Do you give your children 3 to 5 years the following indigenous fruits?</u>

57. *Mazwilu* 77

1. Yes
2. No

58. *Maramba/khwakhwa/mavhungo* 78

1. Yes
2. No

59. *Nombelo* 79

1. Yes
2. No

60. *Mbuyu* 80

1. Yes
2. No

61. Mango **1**

1. Yes
2. No

62. Pawpaw 2

1. Yes
2. No

63. Guavas 3

1. Yes
2. No

64. *Tshienge*/ pineapple 4

1. Yes
2. No

65. Other indigenous fruits 5 – 6

____

____

____

____

66. Do you give your children 3 to 5 years snacks in between the meals? 7

1. Yes
2. No
3. Do not know

<u>If yes, what type of snacks do you usually give to your children 3 to 5 years?</u>

67. Peanuts 8

1. Yes
2. No

68. Vegetables and fruits 9

1. Yes
2. No

69. Simba chips, sweets, cold drink 10

1. Yes
2. No

70. Juices 11

1. Yes
2. No

71. Yoghurt 12

1. Yes
2. No

72. Other, specify …………. 13

73. Do you give your children 3 to 5 years milk to drink? 14

1. Yes
2. No

74. If yes, how often do you give your children 3 to 5 years milk to drink? 15

1. Everyday
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know
5. Not applicable

75. If yes, how much milk do you give to your children 3 to 5 years to drink? 16

1. 125 ml (1/2 cups)
2. 250 ml (1 cup)
3. 500 ml (2 cups)
4. Other amount, specify……
5. Not applicable

Do you give your children 3 to 5 years the following indigenous dishes?

76. *Tshidzimba* 17

1. Yes
2. No

77. *Dovhi* 18

1. Yes
2. No

78. *Thophi* 19

1. Yes
2. No

79. *Tshimbundwa* 20

1. Yes
2. No

80. *Tshigume/ mugumo* 21

1. Yes
2. No

81. *Nawa*/ Beans 22

1. Yes
2. No

<u>Do you give your children 3 to 5 years the following edible insects?</u>

82. *Nemeneme*/ Adult insect 23

1. Yes
2. No

83. Mopani worms/ *Mashonzha* 24

1. Yes
2. No

84. Locust/ *Nzie*

25

1. Yes
2. No

85. Termites/ *Manzhulu*

26

1. Yes
2. No

SECTION C: 24 HOUR RECALL - DIETARY INTAKE

Please tell me what the child ate yesterday and indicate how the food was given to the child, how much of the food the child ate at a time and how many times a day the child ate meals. To help you to describe the amount of food, I will show you models of different amounts of the food. Please say which model is closest to the amount eaten. Amounts must be reported as cups (c), tablespoon (T), Serving spoon (SP), teaspoon (t).

86. Does the child follow any special diet? 27

1. Yes
2. No

87. If yes, specify type: 28

1. Diabetic
2. Allergies
3. Other, specify ………………….

88. Did the children 3 to 5 years eaten away from home during the last week?

29

1. Yes
2. No
3. Don't know

89. If yes, specify the number of times 30

90. Name the place/s: ……………….. 31

91. Does the child eat maize-meal porridge? 32

1. Yes
2. No
3. Don't know

92. If yes, what type do you have at home now? 33

1. Give brand name: ……………..
2. Do not know
3. Grind self
4. Grind self/ Give brand name …….

93 Do you use this maize-meal all the time? 34

1. Yes
2. No
3. Do not know

94. Where do you get the maize-meal that you use? 35

1. Shop, specify ………….
2. Employer
3. Harvest/grind self
4. Harvest/ shop; ………..…
5. Other, specify ……………
6. Don’t know

95. How many times a week does your child eat breakfast? ……… 36

24 HOUR RECALL

96. Which day of the week? ……………… 37

97. 24 HOUR RECALL - DIETARY INTAKE (first)

					Office use								
Time	What the child eat yesterday?	How was it prepared/ what was added	Amount in cup/spoon	Amount ml/g	Code				Weight (g)				
													(1-8)
													(9-16)
													(17-24)
													(25-32)
													(33-40)
													(41-48)
													(49-56)
													(57-64)
													(65-72)
													(73-80)
													(1-8)
													(9-16)
													(17-24)
													(25-32)
													(33-40)
													(41-48)
													(49-56)
													(57-64)
													(65-72)
													(73-80)
													(1-8)
													(9-16)
													(17-24)
													(25-32)

													(33-40)
													(41-48)
													(49-56)
													(57-64)

98. Was this a typical day of the week day/ weekend day? 38

1. Yes
2. No

99. If not, what was different? 39 – 40

SECTION D: NUTRITIONAL KNOWLEDGE QUESTIONNAIRE

100. How often should children 3 to 5 years be fed a day? 41

1. Once
2. Twice
3. Three times
4. More than three times
5. Do not know

Which of the following foods must be on the plate of the children 3 to 5 years and older

101. Starchy foods, such as porridge or samp or bread 42

1. Yes
2. No
3. Do not know

102. Protein foods, such as beans or eggs or fish or meat or milk 43

1. Yes
2. No
3. Do not know

103. Fats, such as oil or margarine 44

1. Yes
2. No
3. Do not know

104. Vegetables 45

1. Yes
2. No
3. Do not know

105. Sugar 46

1. Yes
2. No
3. Do not know

106. Should vegetables and fruits be given to the children (3 to 5 years)? 47

1. Yes
2. No
3. Don’t know

107. Should the children (3 to 5 years) be given snacks? 48

1. Yes
2. No
3. Don’t know

108. Should fruits be given to children (3 to 5 years) as snack? 49

1. Yes
2. No
3. Don’t know

<u>Indigenous food refers to traditional foods, which originate locally in that area with respect to region and district. These include both plants and animal foods.</u>

109. Do you know of indigenous foods that grow in Limpopo Province? 50

1. Yes
2. No

If yes, do you know the following indigenous foods?

110. *Tshidzimba* 51

1. Yes
2. No

53

111. Thophi
1. Yes
2. No

112. *Dovhi* 54

1. Yes
2. No

113. *Tshimbundwa* 55

1. Yes
2. No

114. *Mazwilu* 56

1. Yes
2. No

115. *Nombelo* 57

1. Yes
2. No

116. *Murudi* 58

1. Yes
2. No

117. *Mufungwi* 59

1. Yes
2. No

118. *Mavhungo/ khwakhwa* 60

1. Yes
2. No

119. Other indigenous foods 61 – 62

____

____

____

____

120. Can children 3 to 5 years be given indigenous vegetables? 63

1. Yes
2. No
3. Do not know

121. Can children 3 to 5 years be given indigenous fruits? 64

1. Yes
2. No
3. Do not know

122. Should children 3 to 5 years be given a variety of foods? 65

1. Yes
2. No
3. Don’t know

123. Can dried beans be used in the place of meat? 66

1. Yes
2. No
3. Do not know

124. Can your children 3 to 5 years have dried beans? 67

1. Yes
2. No
3. Do not know

125. Children 3 to 5 years should use the following milk: 68

1. Full-cream
2. Low-fat milk
3. Do not know

126. Can mopani worms be used in place of meat? 69

1. Yes
2. No
3. Do not know

127. Should the children 3 to 5 years be given mopani worms, termites, locust and *nemeneme*? 70

1. Yes
2. No
3. Do not know

128. How often should children 3 to 5 years eat porridge? 71

1. Everyday
2. 3 – 5 x per week
3. < 3 x per week

4. Do not know

129. Sugar and jam can be used 72

1. As often as liked
2. Sparingly
3. Do not know

130. How often should sweets and cold drinks be used? 73

1. Everyday
2. At special occasions
3. Do not know

131. How often should simba chips, cheese curls and niknaks be used? 74

1. Everyday
2. Sparingly
3. As much as liked
4. Do not know

132. When preparing food fat should be used 75

1. Sparingly
2. As much as liked
3. Do not know

133. It is good for children 3 to 5 years to eat cooked pumpkin leaves and carrots for healthy eyes. 76

1. Yes
2. No
3. Do not know

134. How often should children 3 to 5 years eat vegetables or fruits to keep healthy? 77

1. Everyday
2. 3 – 5 x per week
3. < 3 x per week
4. Do not know

135. When cooking vegetable one should 78

1. Cover it with water
2. Add very little water
3. Do not know

136. Vegetable with groundnut can be used instead of meat 79

1. Yes
2. No
3. Do not know

137. When preparing food one should use salt 80

1. Sparingly
2. As much as liked
3. Do not know

138. How much clean water should your children 3 to 5 years drink per day.**1**

1. Less than 6 cups
2. 6 to 8 cups
3. Do not know

24 HOUR RECALL – DIETARY INTAKE (SECOND)

139. Which day of the week? ……………… **1**

140. 24 HOUR RECALL - DIETARY INTAKE (second)

					Office use		
Time	What the child eat yesterday?	How was it prepared/ what was added	Amount in cup/spoon	Amount ml/g	Code	Weight (g)	
							(1-8)
							(9-16)
							(17-24)
							(25-32)
							(33-40)
							(41-48)
							(49-56)
							(57-64)
							(65-72)
							(73-80)
							(1-8)
							(9-16)
							(17-24)
							(25-32)
							(33-40)
							(41-48)
							(49-56)
							(57-64)
							(65-72)
							(73-80)

141. Was this a typical day of the week day/ weekend day? 2

1. Yes
2. No

142. If not, what was different? 3 – 4

____

____

____

____

APPENDIX 4A: TSHIVENDA INTERVIEW SCHEDULE

NDUMELISO

Ndi khou livhuwa u di dina havho uri vha dzhenelele kha ngudo hei. A huna phindulo ire yone na i si yone. Zwothe zwine vha do amba ndi tshiphiri tshashu. Huna zwinwe zwine vhatama u vhudzisa zwino? Vho di imisela u ya phanda na dzi mbudziso?

TSHIPIDA TSHA U THOMA (A): DEMOGRAPHIC QUESTIONNNAIRE

1. Dzina la muta wa havho:……………………………………………………..
2. Vho bebiwa lini: Nwaha …………………Nwedzi……………Duvha……
3. Murole muhulwanesa we vha phasa
   1. A thongo ya tshikoloni
   2. Murole wa u thoma uya kha wa vhuna
   3. Murole wa vhutanu uya kha wa sumbe
   4. Murole wa vhumalo uya kha wa fumi
   5. Murole wa vhu fumithihi uya kha wa vhufumimbili
   6. Pfunzo dza ntha,kha vha taluse…………

4. Vho maliwa:
   1. A thongo vhuya nda maliwa
   2. Ndo maliwa
   3. Ndo lovhelwa
   4. Zwinwe vho,kha vha taluse……………

5. Vha dzula vha vhangana a fha hayani………………

<u>Vha wana ngafhi tshelede:</u>

6. Mme
   1. Ee
   2. Hai

7. Khotsi
   1. Ee
   2. Hai

8. Makhulu
   1. Ee
   2. Hai

9. Munwe vho,kha vha taluse……………………………………………………….

<u>Ndila ine vha dzhenisa ngayo tshelede</u>

10. Mudededzi
    1. Ee
    2. Hai

11. Mushumela vhapo
    1. Ee
    2. Hai

12. Mundende wa vhana
    1. Ee
    2. Hai

13. Mundende wa vhaaluwa 1. Ee
2. Hai

14. Vha tou di shuma 1. Ee
2. Hai

15. Zwinwe vho,kha vha taluse…………………………………………………………

16. Tshelede ino dzhena mutani nga nwedzi:
1. 1000 kana fhasi
2. 1001-2000
3. 2001-3000
4. 3001-4000
5. 5000 u ya ntha

Vho fuwa mini hayani?

17. Khuhu 1. Ee
2. Hai

18. Mbudzi 1. Ee
2. Hai

19. Kholomo 1. Ee
2. Hai

20. Nguluvhe 1. Ee
2. Hai

21. Zwnwe vho,kha vha taluse…………………………………...

<u>Shango la u bveledza zwiliwa</u>

22. Ngade ya miroho
1. Ee
2. Hai

23. Ngade ya mitshelo 1. Ee
2. Hai

24. Tsimu ya mavhele 1. Ee
2. Hai

<u>Zwiko zwa mafhungo nga ha kulale</u>

25. Radio
1. Ee
2. Hai

26. Thelevishini
1. Ee
2. Hai

27. Gurannda
1. Ee
2. Hai

28. Dzi bugu (Magazini)

1. Ee
2. Hai

29. Zwinwe vha,kha vha taluse……………………………………

Zwine vha shumisa musi vha tshi bika

30. Khuni

1. Ee
2. Hai

31. Mudagasi

1. Ee
2. Hai

32. Xasi

1. Ee
2. Hai

33. Pharafeni

1. Ee
2. Hai

34. Zwnwe vho,kha vha taluse………………………………….

Vha wana ngafhi madi?

35. Tshisimani

1. Ee
2. Hai

36. Bommbi (hahani)

1. Ee
2. Hai

37. Bommbi (badani)

1. Ee
2. Hai

38. Gwedzhoni

1. Ee
2. Hai

39. Mulamboni

1. Ee
2. Hai

40. Hunwe vho,kha vha taluse……………………………………..

TSHIPIDA TSHA VHUVHILI (B): NUTRITIONAL PRACTICES QUESTIONNAIRE

41. Vha nea lungana zwiliwa nwana wa minwaha miraru uya kha mitanu nga duvha?

1. Luthihi
2. Luvhili
3. Luraru
4. Lu no fhira luraru
5. A thi divhi

<u>Ndi zwi fhio zwiliwa kha zwitevhelaho zwine nwana wavho a dzulela u zwila?</u>

42. Vhuswa,vhurotho ka tshidammba
    1. Ee
    2. Hai
43. Miroho
    1. Ee
    2. Hai
44. Nama kana nawa kana makumba kana khovhe kana mafhi kana mashonzha
    1. Ee
    2. Hai
45. Mapfura kana madzharini
    1. Ee
    2. Hai
46. Vha nea hani miroho vhana vha minwaha miraru uya kha mitanu uri vhale?
    1. Duvha na duvha
    2. Luraru uya kha lutanu kha vhege
    3. Lusa swiki luraru kha vhege
    4. A thi divhi
    5. A thi munei

<u>Vha a nea vhana vha minwaha miraru uya kha mitanu miroho ya mupo i tevhelaho?</u>

47. Mushidzhi
    1. Ee
    2. Hai
48. Murudi
    1. Ee
    2. Hai
49. Delele
    1. Ee
    2. Hai
50. Muxe
    1. Ee
    2. Hai
51. Dzaluma
    1. Ee
    2. Hai
52. Vowa/Thebe
    1. Ee
    2. Hai
53. Phuri
    1. Ee
    2. Hai
54. Munawa
    1. Ee
    2. Hai

55. Minwe miroho

____
____
____
____

56. Vha nea vhana vha minwaha miraru u ya kha mitanu lungana uri vhale?

1. Duvha na duvha
2. Luraru uya kha lutanu kha vhege
3. Lu sa swiki luraru kha vhege
4. A thi divhi
5. A thi munei

Vha a nea vhana vha vho vha minwaha miraru uya kha mitanu mitshelo ya mupo i tevhelaho?

57. Mazwilu

1. Ee
2. Hai

58. Maramba/Khwakhwa/Mavhungo

1. Ee
2. Hai

59. Nombelo

1. Ee
2. Hai

60. Mbuyu

1. Ee
2. Hai

61. Manngo

1. Ee
2. Hai

62. Papawe

1. Ee
2. Hai

63. Magwavha

1. Ee
2. Hai

64. Tshienge

1. Ee
2. Hai

65. Minwe mitshelo ya mupo

____
____
____
____

66. Vha a nea vhana vhavho vha minwaha miraru uya kha mitanu zwidzhangudzhangu nga vhukati ha zwiliwa?

1. Ee
2. Hai
3. A thi divhi

<u>Arali phindulo hu ee, vha anzela unea vhana vhavho vha minwaha miraru uya kha mitanu zwidzhangudzhangu de?</u>

67. Nduhu

1. Ee
2. Hai

68. Miroho na mitshelo

1. Ee
2. Hai

69. Masimba,malegera,nyamunaithi

1. Ee
2. Hai

70. Dzhusi

1. Ee
2. Hai

71. Yogathi

1. Ee
2. Hai

72. Zwinwe vho, kha vha taluse……………………………………………………..

73. Vha a nea vhana vha minwaha miraru uya kha mitanu mafhi a u nwa?

1. Ee
2. Hai

74. Arali phindulo hu ee vha nea hani vhana vhavho vha minwaha miraru uya kha mitanu mafhi a u nwa?

1. Duvha na duvha
2. Luraru uya kha lutanu kha vhege
3. Lusa swiki luraru kha vhege
4. A thi divhi
5. N/A

75. Arali phindulo hu ee, vha nea vhana vha minwaha miraru uya kha mitanu mafhi mangafhani uri vhanwe?

1. Bigiri yo dengana
2. Bigiri yo dala
3. Bigiri mbili
4. Tshinwe tshikalo,kha vha taluse……………

<u>Vha a nea vhana vhavho vha minwaha miraru uya kha mitanu zwiliwa zwi tevhelaho zwa mvelo?</u>

76. Tshidzimba

1. Ee
2. Hai

77. Dovhi

1. Ee
2. Hai

78. Thophi
1. Ee
2. Hai

79.Tshimbundwa
1. Ee
2. Ee

80. Tshigume/mugumo
1. Ee
2. Hai

81. Nawa
1. Ee
2. Hai

Vha a nea vhana vhavho vha minwaha miraru uya kha mitanu zwikhokhonono zwino liwa zwitevhelaho?

82. Nemeneme
1. Ee
2. Hai

83. Mashonzha
1. Ee
2. Hai

84. Nzie
1. Ee
2. Hai

85. Madzhulu
1. Ee
2. Hai

TSHIPIDA TSHA VHURARA(C):24 HOUR RECALL-DIETARY INTAKE

Ndi do tama vha tshimmbudza zwiliwa zwe nwana ala mulovha. Vha sumbedzise na uri zwiliwa zwe ala zwo vha zwo bikiswa hani,nwana o la zwiliwa zwingafhani nga tshifhinga na uri izwo zwiliwa o zwila lungana nga duvha. U vha thusa u talusa tshikalo tsha zwiliwa, ndi do vha sumbedza zwikalo zwa zwiliwa zwo fhambanaho. Vha do amba uri tshikalo tshifhio tshi tsini na zwiliwa zwe nwana ala. Tshikalo tshifanela u vhambedziwa sa khaphu(c), lebula ya ula ngayo (T), lebula ya u avha (sp), lebula ya tie (t).

86. Huna zwinwe zwiliwa zwe nwana a iliswa?
1. Ee
2. Hai

87. Arali phindulo hu ee, kha vha taluse uri o iliswa nga mulandu wa mini?
1. Vhulwadze ha swigiri
2. Dzialedzhi
3. Zwinwe vho,kha vha taluse…………….

88. Nwana wavho wa minwaha miraru uya kha mitanu o la nnda vhege yo fhelaho naa?
1. Ee
2. Hai
3. A thi divhi

89. Arali phindulo hu ee, kha vha sumbedzise uri o la lungana

90. O la ngafhi…………………………………………………………

91. Nwana wavho u a la vhuswa ha mugayo?
1. Ee
2. Hai

92. Arali phindulo hu ee, ndi u fhio mugayo une vha khou shumisa hayani havho zwino?
1. Dzina la mugayo:………………………
2. A thi divhi
3. Ri tou tohola mavhele rine vhane
4. Ri tou tohola/ra dovha ra renga (Dzina)………..

93. Vha shumisa wo noyo mugayo tshifhinga tshothe?
1. Ee
2. Hai
3. A thi divhi

94. Mugayo une vha khou shumisa vho u wana ngafhi?
1. VHengeleni,kha vha taluse
2. Kha mutholi
3. Ri tou kana /ra tohola
4. Ri tou kana /ra isa tshigayoni
5. Zwinwe vho,kha vha taluse
6. A thi divhi

95. Nwana wavho u la lungana zwiliwa zwa nga matsheloni kh vhege?..........

<u>24 HOUR RECALL</u>

96. Duvha lifhio la vhege?...

97. 24 HOUR RECALL- DIETARY INTAKE (YA U THOMA)

					Zwi shumiwa ofisini								
Tshifhinga	Nwana ola mini mulovha	Zwo vha zwo bikiswa hani/zwo shelwa mini	Tshikalo nga khaphu/lebula	Tshikalo ml/g	Khoudu				Weiti(g)				

98. I li duvha ndi la vhukati kana mafheleloni a vhege?

1. Ee
2. Hai

99. Arali zwi songo ralo, phambano ndi mini

____

____

TSHIPIDA TSHA VHUNA (D): NUTRITIONAL KNOWLEDGE QUESTIONNAIRE

100. Vhana vha minwaha miraru uya kha mitanu vha fanela ula lungana nga duvha?

1. Luthihi
2. Luvhili
3. Luraru
4. Luno fhira luraru
5. A thi divhi

<u>Ndi zwifhio zwiliwa kha zwi tevhelaho zwine zwa fanela u wanala dziphuleithini dza vhana vha minwaha miraru uya kha mitanu na u fhira.</u>

101. Zwliwa zwa tshitatshi zwi nonga vhurotho, vhuswa kana tshidammba

1. Ee
2. Hai
3. A thi divhi

102. Zwiliwa zwa phurotheini sa nawa, makumba, khovhe, nama kana mafhi

1. Ee
2. Hai
3. A thi divhi

103. Mapfura sa madzharini na mapfura a ole

1. Ee
2. Hai
3. A thi divhi

104. Miroho

1. Ee
2. Hai
3. A thi divhi

105. Swigiri

1. Ee
2. Hai
3. A thi divhi

106. Zwo fanela uri vhana vha minwaha miraru uya kha mitanu vha newe miroho na mitshelo?

1. Ee
2. Hai
3. A thi divhi

107. Zwo fanela uri vhana vha minwaha miraru uya kha mitanu vha newe zwidzhangudzhangu?

1. Ee
2. Hai

3. A thi divhi

108. Zwo tea uri vhana vha minwaha miraru uya kha mitanu vha newe mitshelo sa zwidzhangudzhangu?

1. Ee
2. Hai

A thi divhi

<u>Zwiliwa zwa mupo na zwa nwelo zwine zwa wanala na u liwa kha vhupo ha havho. Hezwi zwiangaredza zwiliwa zwi no bva kha zwilinwa na zwipuka.</u>

109. Vha a divha zwiliwa zwa mupo zwine zwa wanala kha dzingu la Limpopo?

1. Ee
2. Hai

110. Tshidzimba

1. Ee
2. Hai

111. Thophi

1. Ee
2. Hai

112. Dovhi

1. Ee
2. Hai

113. Tshimbundwa

1. Ee
2. Hai

114. Mazwilu

1. Ee
2. Hai

115. Nombelo

1. Ee
2. Hai

116. Murudi

1. Ee
2. Hai

117. Mufungwi

1. Ee
2. Hai

118. Mavhungo/khwakhwa

1. Ee
2. Hai

119. Zwinwe zwiliwa zwa mvelo

120. Zwo tea uri vhana vha minwaha miraru uya kha mitanu vha newe miroho ya mvelo?

1. Ee
2. Hai

121. Zwo tea uri vhana vha minwaha miraru uya kha mitanu vha newe mitshelo ya mupo?

1. Ee
2. Hai

122. Vhana vha minwaha miraru uya kha mitanu vho fanela uri vha newe zwiliwa zwo fhambanaho?

1. Ee
2. Hai

123. Zwo tea uri hu shumiswe nawa vhudzuloni ha nama?

1. Ee
2. Hai
3. A thi divhi

124. Zwo tea uri vhana vha minwaha miraru uya kha mitanu vha newe nawa?

1. Ee
2. Hai
3. A thi divhi

125. Vhana vha minwaha miraru uya kha mitanu vha fanela u shumisa mafhi afhio?

1. O dalaho mapfura
2. O fhungudzwaho mapfura
3. A thi divhi

126. Zwo fanela uri hu shumiswe mashonzha vhudzuloni ha nama?

1. Ee
2. Hai
3. A thi divhi

127. Zwo fanela uri vhana vha minwaha miraru uya kha mitanu vha newe mashonzha,madzhulu, nzie na nemeneme?

1. Ee
2. Hai
3. A thi divhi

128. Vhana vha minwaha miraru uya kha mitanu vho fanela u newa vhuswa hani?

1. Duvha na duvha
2. Luraru uya kha lutanu kha duvha
3 Lu sa swiki luraru nga duvha
4. A thi divhi

129. Swigiri na dzhamu zwi nga shumiswa hani?

1. Nga zwinzhi
2. Nga zwituku
3. A thi divhi

130. Malegere na nyamunaithi zwi fanela u shumiswa hani?

1. Duvha na duvha
2. Nga maduvha a madakalo
3. A thi divhi

131. Masimba nga u fhambana hao a tea u shumiswa hani?

1. Duvha na duvha
2. Nga zwituku
3. Nga zwinzhi
4. A thi divhi

132. Musi ri tshi bika zwiliwa ri fanela u shumisisa hani mapfura?

1. Nga zwituku
2. Nga manzhi
3. A thi divhi

133. Zwo fanela uri vhana vha minwaha miraru uya kha mitanu vhale muroho wa phuri na kherothi u itela mutakalo wa vhudi wa mato?

1. Ee
2. Hai
3. A thi divhi

134. Vhana vha minwaha miraru uya kha mitanu vha fanela ula miroho na mitshelo lungana u itela uri vha dzule vha na mutakalo wa vhudi?

1. Duvha na duvha
2. Maduvha mararu uya kha matanu nga vhege
3. Lu sa fhiri luraru kha vhege
4. A thi divhi

135. Musi ri tshi bika miroho ro fanela u

1. Shela madi manzhi manzhi
2. Shela madi o linganaho
3. A thi divhi

136. Muroho wo kodeliwaho u nga shumisiwa vhudzuloni ha nama

1. Ee
2. Hai
3. A thi divhi

137. Musi ri tshi bika zwiliwa ri fanela u shumisa hani muno

1. Nga zwituku
2. Nga munzhi
3. A thi divhi

138. Vhana vha minwaha miraru uya kha mitanu vha fanela unwa madi mangafhani nga duvha

1. Bigiri dzi sa swiki rathi
2. Bigiri dza rathi uya kha dza malo
3. A thi divhi

139. Duvha lifhio la vhege?...

140. 24 HOUR RECALL-DIRTARY INTAKE (ya vhuvhili)

					Zwi shumiwa ofisini								
Tshifhinga	Nwana ola mini mulovha	Zwo vha zwo bikiswa hani/zwo shelwa mini	Tshikalo nga khaphu/lebula	Tshikalo ml/g	Khoudu			Weiti(g)					

141. I li duvha ndi la vhukati kana mafheleloni a vhege?

1. Ee
2. Hai

142. Arali zwi songo ralo, phambano ndi mini

APPENDIX 5

RECORD SHEET

SECTION A

Code 1 – 4

Name of the interviewer: ………………………

1. Child's name: ……………………………………..……………
2. Child's date of birth: yy……mm………dd……………… 5 – 10
3. Birth weight (kg): ………………………………………………… 11 – 13
4. Birth height (cm): ……………………………………………… 14 – 15
5. Date of interview: yy………mm…………dd………. 16 – 21
6. Name of village: ………………………………………………… 22
7. Gender
   1. Male
   2. Female 23
8. Child's weight (kg): 1. ____________________
   2. ____________________ 24 – 27

9. Child's height (cm) 1. ______________________

2.________________________ 28 – 32

| | | | . | |

10. Mother's weight (kg) 1. ________________________

2. ________________________ 33 - 37

| | | | . | |

11. Mother's height (m) 1. ________________________

2. ________________________ 38 – 41

| | . | | |

12. Blood sample – collected 1. Yes. 2. No. 42

☐

13. If no, what is the reason: …………………………………………… 43

☐

14. Do your children have road to health cards? 44

☐

1. Yes

2. No

15. Check road to health card for immunization: Did the child receive vitamin A in the past six months?

1.Yes

2. No 45

☐

SECTION B

Type of blood	Blood values						Code						
Plasma retinol (µg/dL)													(46 – 50)
Serum Iron (µmol/L)													(51 – 66)
Serum Ferritin (µg/L)													(67 – 72)
Serum transferrin													(74 – 76)
Transferrin (% saturation)													(77 – 80)

APPENDIX 5A
BAMMBIRI LA REKHODO (RECORD SHEEET)
TSHIPIDA TSHA U THOMA (A)

Dzina la muvhudzisi: …………………………………………………….

1. Dzina la nwana………………………………………………….
2. Mabebo a nwana:
   nwaha………………nwedzi………………duvha………………….
3. Tshileme tsha nwana a tshi bebiwa (kg)…………………………….
4. Vhulapfu ha nwana a tshi bebiwa (cm)…………………………………
5. Duvha la dzimbudziso:
   nwaha……………….nwedzi……………duvha………………
6. Dzina la shango:…………………………………………………….
7. Mbeu ya nwana
   1. Mutukana
   2. Musidzana
8. Tshileme tsha nwana(kg): 1. ________________
   2. ________________
9. Vhulapfu ha nwana(cm) 1. ________________
   2. ________________
10. Tshileme tsha mme (kg) 1. ________________
    2. ________________
11. Vhulapfu ha mme (M) 1. ________________
    2. ________________
12. Nwana u khou dzhiiwa malofha 1. Ee 2. Hai
13. Arali phindulo hu hai,ndi ngani asa dzhiiwi…………………………………………..
14. Nwana wavho una garata ya mabebo?

1. Ee 2. Hai

15. Nwana o wana VithaminiA minwedzini ya rathi yo fhelaho?

1. Ee 2. Hai

TSHIPIDA TSHA VHUVHILI (B)

Type of blood	Blood values						Code						
Plasma retinol (µg/dL)													(46 – 50)
Serum Iron (µmol/L)													(51 – 66)
Serum Ferritin (µg/L)													(67 – 72)
Serum transferrin													(74 – 76)
Transferrin (% saturation)													(77 – 80)

APPENDIX 6

TRAINING MANUAL FOR FIELDWORKERS

1. SAMPLE SELECTION

- Identify households to be included on the study.
- Visit the selected household.
- Introduce yourself.
- Explain the purpose of the study.
- Determine if the household is eligible for inclusion.
- Obtain consent.
- Fill in the socio-demographic, nutritional practices, food frequency questionnaire and nutritional knowledge with the caregivers.
- Obtain anthropometric measurements.
- Collect blood samples.

2. CONSENT

- Complete the consent form for each household you visit. The consent form assures us that the household participated in the study voluntarily.

2.1. Ethics and informed consent

- The intervention of the subjects in the study is minimal, with time and inconvenience in the asking of questions and small amount of discomfort when blood sample is drawn.

2.2. Procedure for consent by the fieldworker

- After the household have been identified, enter the household and request to speak to the head of the house. Introduce yourself and request the permission to conduct the study. Explain the procedure for conducting the study.
- If permission is granted, identify if the household has a child who meets the inclusion criteria. Discuss the study verbally with them, stating clearly the objectives of the study, what is expected of them and voluntary and confidential nature of their participation. If permission is not granted or if the children do not meet the criteria move to the next household.
- Allow them to read the informed consent. Allow the caregiver to ask any questions regarding the study and answer them to the satisfaction of the client.

Once everything has been agreed upon, ask them to complete and sign the informed consent.

3. CONDUCTING THE INTERVIEW

3.1. Interview schedule

- During each interview that you conduct, you have to complete the following: Socio-demographic data, nutritional practices, 24 hour-recall, nutritional knowledge questionnaire and record sheet.

3.2. Anthropometric equipment

- You will use the following equipment to determine the nutritional status (anthropometric status). A solar scale and a stadiometer (portable height measuring 2m tape – model: PHT) was used for taking weight and height.
- Procedures for taking anthropometric measurement will be explained under techniques.

3.3. Interview skills

- Apply the following guidelines when conducting interviews.
  - Introduce yourself
  - Explain briefly that you are collecting data for the study that is focusing on infant feeding with emphasis on indigenous foods.
  - Explain that you are going to ask questions on socio-demographic data, nutritional practices, food frequency questionnaire and nutritional knowledge. Explain that you need to weigh and measure the child as well as take a small sample of blood from the child.
  - Request the caregiver to sign the consent form.
  - Assure the caregiver of the confidentiality of the information she gives you and the importance of answering truthfully.
  - Ask the questions in the order that they appear on the interview schedule.
  - Ask the questions as they are written on the questionnaire.
  - Do not try to influence the way the interviewee answers. Do not lead her or put words in her mouth.

- Keep control of the interview. Do not hurry the interviewee. Allow her to think.
- Make sure that you have completed all the questions on the interview schedule and record sheet.

3.4. Blood samples

- A Pediatric nurse specially trained to draw blood of children will draw the blood sample.

4. TECHNIQUES

4.1. Anthropometric measurements

4.1.1. Weight

- The children will be weighed using solar scale. The children will be weighed following the standards for taking weight.
- The children will be weighed in light clothing and without shoes. The average of two weighing will be recorded numerically on the questionnaire to the nearest 0.01kg (Lee and Nieman, 2003).
- The accuracy of the weighing scales will be checked daily against known weights.

4.1.2. Height

- Height will be taken following the standard procedures. The height will be measured for children two to three years who are cooperative and able to stand without assistance.
- The height will be measured using a stadiometer (portable height measuring 2m tape – model: PHT). The height will be taken with the subject standing without shoes, heals close together and against the wall (Lee and Nieman, 2003).
- Height/ length will be taken twice. The length/height will be recorded to the nearest 0.1cm (Lee and Nieman, 2003).

4.2. Biochemical Measurements (for Pediatric nurse only)

- Always wear the non-powdered gloves and do not your hair or skin. Hair, skin, gloves and sweat may contaminate the blood specimen and interfere with analysis.
- The preparation of the skin is important. Clean well around the intended venepuncture area with alcohol soaked cotton wool ball. Allow to dry and do the venepuncture avoiding contact with the needle insertion point (Training Manual for National Food Consumption Survey South Africa, 2004).
- Topla that is a local aneastia will be applied on the hand.
- Use butterfly needle technique for blood collection. Butterfly needle technique is used because the veins of hand collapse easily if the vacuum tube technique is used (Mulder, 1999, pp. 297). This technique is more suitable for small, narrow and short vein as those in the hand and forearm, as the needle is short and sharp.
- The 5 to 10ml of blood will be place into plain vacuum tubes.
- Only two attempts should be made to draw blood from a child. Failure to do so will be recorded as a missing value.
- Write clearly on the labels using block letters. Write the time and date of sampling on the tube labels.
- All blood samples drawn must be returned to the cooler box within two hours from the time the blood sample was drawn.
- Dispose of syringe or butterfly needle in the waste disposal container.

APPENDIX 7

NUTRITION EDUCATION INTERVENTION PROGRAMME

This nutrition education intervention programme was adapted from South African Food Based Dietary Guidelines, South African Pediatric Food Based Dietary guidelines and Family Nutrition Guide (Burgess and Glasauser, 2004). Nutrition education intervention programme covered ten topics and each topic was presented twice in four Villages in Mutale Municipality. The nutrition education was implemented on two occasions on every week in the first three months and repeated during the last 3 to 4 months on the experimental group in the period of 12 months. Two related topics were presented on the same day with a five minutes break in between. Two villages were visited on the same day one in the morning and the other village in the afternoon. The number of caregivers taught at time ranged from 6 to 20 people. The researcher was responsible for facilitating all the lesson plans.

CONTENTS

1. Enjoy the variety of foods
2. Feeding children aged 3 years and older
3. Make starchy foods the basis of most meals
4. Eat plenty of vegetables and fruits every day
5. Eat dry beans, split peas, lentils and soya
6. Chicken, fish, meat, milk or eggs can be eaten daily
7. Eat fats sparingly
8. Use food and drinks containing sugar sparingly and not between meals
9. Use salt sparingly
10. Hygiene and safety

THE AIM OF NUTRITION EDUCATION PROGRAMMES:

- To provide knowledge and understanding on the importance of eating a variety of foods;
- To instill good eating habits and improve nutritional status of children;

- To provide understanding on importance of eating a plenty of vegetables and fruits (including indigenous vegetables and fruits);

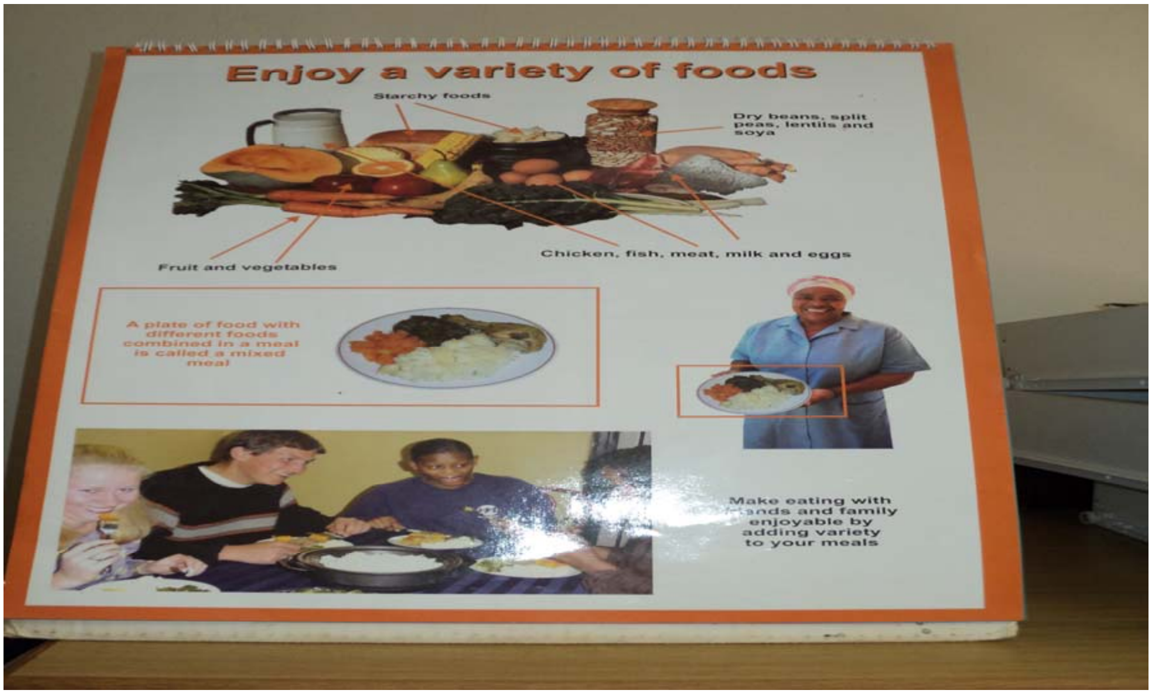
LIST OF TEACHING AIDS

- Food modules
- Sugar association food picture
- South African Food Base Dietary Guideline flip charts

LESSON 1

Topic: Enjoy a variety of foods

Teaching aid



Aim

- To create an opportunity for caregivers to gain information and knowledge about how to enjoy a variety of foods

Objectives: At the end of this lesson, the caregivers will be able to:

- Know the importance of enjoying a variety of food;
- Gain information on how variety can be achieved in a meal; and
- Plan mixed meals using a variety of foods.

Pre-assessment

- List the foods that are available and are eaten by your family.
- What does it mean to enjoy a variety of foods?
- How do you encourage children to eat more food?
- How can you make sure that young children eat a variety of foods?

Content of lesson

- **Enjoy a variety of foods**
  - Healthy eating means eating a variety of foods to supply different nutrients that the bodies need.
  - Different foods contain different nutrients such as protein, carbohydrates, fats, minerals, vitamins, water and dietary fiber that help the body to function properly.
  - Food is necessary to stay alive, to give us energy and to provide the nutrients our bodies need to grow and develop.
  - The children's body needs a variety of different foods. No single food or meal can provide us with all the nutrients we need.
- **What is a variety of foods?**
  - A variety of foods means eating more than one type of food at each meal, eating different foods on different days and preparing food in different, healthy ways.
  - Mixed meals are usually eaten three times a day and snacks in between (breakfast, lunch, supper and snacks). A starchy food cannot provide all the nutrients needed by the body. We need to balance our eating pattern by adding other foods such as vegetable, fruits, dry beans, meat, fish, chicken, eggs and milk.
  - By eating mixed meals, we add variety to our plates, make the meal more enjoyable and we get all the nutrients we need.
- **Do snacks add variety?**
  - Snacks, such as cakes, chocolates, biscuits, sweets, chips, ice cream and cold drinks (all containing lots of fats and or sugar) should not replace a mixed meal.
  - It can also suppress the child's appetite (keep them as a special treat after mixed meals or for special occasions).
  - Snacks are important to meet the higher energy and nutrient needs of growing children.

- Unsalted peanuts, fruits, raw carrots or yoghurt are good choices of snack foods.

- **Conclusion**
  - There are no bad foods, only unhealthy eating habits
  - It is not necessary to buy expensive foods; we can plan our meals from the variety of locally available foods.
  - We should help our children to enjoy a variety of foods.

Activities

Divide caregivers into smaller groups of three to four

Each group should make three different meal using variety of foods.

Group discussion

- Make different meal combinations. Help caregivers make choices that they enjoy at home

LESSON 2

Topic: Feeding children aged 3 years and older

Teaching aid

Aim

- To create an opportunity for caregivers to gain knowledge and understanding about how to feed 3 years and older children.

Objectives

- Know how to feed children aged three and older

Content of lesson

- By the age of 3 years, most children can feed themselves. But families should continue to watch and encourage children at mealtimes, especially if they are sick.
- Give family meals that contain a variety of different foods and are not too spicy, sugary or salty.

- Give three meals and 1 to 2 snacks a day. Where families eat from the same pot, it is a good idea to give young children their own plate or bowl so they receive their fair share of food.

Use a variety of foods for children's meals

- Some fat-rich foods to increase the energy content. Fresh fruit and vegetables, especially ones rich in vitamin C and A. Eggs, milk foods and iron-rich animals foods (meat, offal, poultry, fish) daily or as often as possible.

Increasing energy intake and bioavailability of nutrient

- ➢ **Porridge made with fermented flours.**
- Young children need foods rich in energy and nutrients because they cannot eat large amount food at each meal. Children's stomach is small.
- Porridge is the most common food for young children, but its energy and nutrient content is often too low to meet their nutrients needs fully.
- This is due to the high starch content of staple foods, such as maize and sorghum.
- Give children sour porridge (fermented) because it contains more energy when compared to unfermented porridge.
- ➢ **Ways to make porridge more energy and nutrient-rich and easy to eat are by:**
- Adding energy-rich (oil/butter) and nutrient-rich foods (such as flour of groundnuts and other legumes or sunflower seed) to the porridge
- Making porridge with fermented cereals flours. Porridge made with fermented cereal flour does not thicken as much as ordinary porridges. They are made with less water and so contain more energy and nutrients in a smaller volume.
- Legumes flours are used to enrich cereal flours.
- ➢ **Other advantages of these flours are**:
- Iron is better absorbed.
- It is easier to digest and safer because germs cannot grow easily in fermented porridge.

Encouraging young children to eat

- Young children are often slow and messy eaters who are easily distracted. They eat more when their parents supervise mealtimes and actively and loving encourages them to eat.
- Caregivers should sit with children and encourage them to eat by talking with them and telling them how good the food is.
- Make mealtimes happy times
- Feed young children with rest of the family but give them their own plate to make sure they get and eat their share.
- Make sure children are not thirsty because thirsty children eat less, but do not fill up the child's stomach with too much drink before or during the meal
- Try to feed children as soon as they are hungry, do not wait for them to start crying for food,
- Do not feed when children are tired or sleepy;
- Avoid giving children sugary or spicy foods. Sugary foods suppress children's appetite.
- Make mealtimes interesting learning times, e.g. teach the names of foods.

Sometimes even healthy children fussy eaters, check that the child is not sick, undernourished or unhappy. Caregivers should give more attention when the child eats well and less when the child is trying to gain attention by refusing food. Play games to persuade a reluctant child to eat more.

Learning Activities

Group discussion

Materials

South African Food based dietary guideline Poster

LESSON 3

Topic: Make starchy foods the basis of most meals

Teaching aid

Fortified foods and log

Aim:

- To create an opportunity for caregivers to gain information and knowledge about how to make starchy foods the basis of most meals

Objectives: At the end of the lesson, the caregivers will:

- Understand the importance of starchy foods as the basis of a meal;
- Identify examples of starchy foods;
- Know why we should mix starchy foods with other foods; and
- Know that coarse (unrefined) starchy foods and fortified starchy foods are better for our health.

Pre-assessment:

- List the starchy foods that are locally available.
- How do you prepare starchy foods?
- Why should starchy foods be part of each mixed meals?

Content and sequence

- Starchy foods provide the body with energy and other important nutrients.
- Starchy foods e.g. maize-meal, samp, bread, rice, potatoes and sweet potatoes
- Starchy foods should form the largest part of each meal – starchy foods should be eaten in larger amounts than the other foods at a meal.

Why are starchy foods so important?

- Starchy foods are rich in carbohydrate – the main source of energy for the body. Unrefined and fortified starchy foods (brown bread, coarse maize-meal) contain vital vitamins, fiber and minerals. Starchy vegetables e.g. sweet potatoes provide useful amounts of vitamin A and C.

Mix starchy foods with other foods

- To make a good mixed meal, other foods, such as vegetables, fruits, beans, meat, fish, chicken, eggs, and milk should be combined with starchy foods.

Conclusion

Starchy foods provide body with energy and fiber. The fortified starchy foods such as maize meal and bread provide the body with vitamins and minerals. The

Evaluation

List the starchy foods that you know.

Give examples of fortified starchy foods.

Caregivers should plan a meal using the locally available starchy foods.

Materials

South African Food based dietary guideline Poster

LESSON 4

Topic: Eating plenty of vegetables and fruits everyday

Teaching aid

Aim:

- To create an opportunity for participants to gain information and knowledge about how to include plenty of vegetables and fruits in their eating plan every day.

Objectives: At the end of this lesson, the caregivers will:

- Know the importance of eating vegetables and fruit;
- Understand the term plenty and
- Be able to include vegetable and fruit in their family's daily meals.

Pre-assessment:

- Why should we eat plenty of vegetables and fruits?
- List the vegetables and fruit that are locally available (including indigenous)
- How do you prepare vegetables?

Content of lesson

Why should we eat plenty of vegetables and fruits?

- There are many good reasons for eating plenty of vegetables and fruits every day.
- Vegetables and fruits are high in vitamins and minerals, which help to strength the body's immune system to resist illnesses such as infections, diarrhea, and colds.
- All types of vegetable and fruits are good for us and can be eaten as part of a healthy eating plan. They may be eaten as part of main meals and/or snacks.
- Most fresh vegetables and fruits are rich in vitamin C and A. Vitamin C is essential for the formation and maintenance of body issues.
- It promotes the absorption of iron and calcium as well as the healing of wound and increases the body's resistance to infections. Vitamin A is essential for our health and well-being.
- Vitamin A is especially important for good vision, protecting the body against infections and ensuring adequate growth and development.
- Vegetables and fruits taste good and provide colour and texture to meals. Get children into the habit of eating fruits when they are hungry between meals.

What does "plenty" mean?

- Plenty means that we should eat at least 3 portions vegetables and fruits every day. This can be accomplished by the following:
- Get children into habit of eating vegetables and fruits
- Give children vegetables or fruits as snack instead of sweets or potato/ maize based chips.
- Give children vegetables or fruits during meals

How can we prepare vegetables?

- Always wash fresh vegetables and fruit in clean, safe water before using.
- Vegetables should be cooked in a very little water for a short time, until just tender to preserve nutrients and flavour.

How to cut costs of vegetables?

- Eating plenty of vegetables and fruit can be expensive. We can be clever and
- Buy vegetables and fruits that grow in the area because are cheaper.
- Grow our own vegetables and fruit to have a constant supply
- Collect and use traditional wild vegetables and fruits.
- Some leaves of vegetables are good source of nutrients such as beetroot and pumpkin leaves.

List indigenous vegetables available in your area

Phuri, munawa, mushidzhi, mufungwi, dzaluma, mutohotoho, murudi, vowa, nngu, muvhazwi, mulembu, delele, etc.

List indigenous fruits

Mahuyu, mazwilu, mavhungo, maramba, niiyi, mbuyu, maembe, tungulu tanzwa, mango, maswiri, muomva, magavha, tombothi, nombelo, pfuka, mahuhuma, etc.

Activities

- Discussion
- Discuss ways to prepare and cook vegetables and fruits to preserve nutrients.
- Discuss the reasons for people not eating plenty of vegetables or fruits
- Discuss growing of vegetables and fruits at home.

Materials

South African Food based dietary guideline Poster

LESSON 5

Topic: Eat dry beans, splits peas, lentils and soya regularly

Teaching aid

Aim:

To create an opportunity for caregivers to gain information and knowledge about the importance of eating dry beans; splits peas, lentils and soya regularly.

Objectives: At the end of this lesson, the caregivers will:

- Understand the importance of eating dry beans, split peas and soya in mixed meals
- Be able to provide ideas how to include dry beans, split peas, lentils, more often into our eating plan and
- Know how to prepare dry beans, splits beans, lentils, and soya.

Pre-assessment:

- What is the importance of eating dry beans regularly?
- How do we prepare dry beans?
- List examples of mixed dishes that include beans.

Content of lesson

Importance of eating dry beans regularly

- These foods are also known as plant proteins or legumes should be eaten two to three times per week. Foods included in this category are dry beans, baked beans, butter beans, peanuts, peanut butter and jugo beans.
- They can be used instead of meat or added to meat as a meat extender. They also more economical than meat. When dry beans, are combined with starchy food, the protein from the two foods complement each other and make a better quality protein.
- Eating plant protein, such as beans regularly will ensure proper bowel functioning (prevent constipation).
- Beans can be combined with other foods
    - Tshidzimba – samp, beans, groundnuts, jugo beans)
    - Dovhi – biltong and ground nuts or dried vegetables with ground nuts
    - Bovhola – phuri, ground nuts, baby marrow and pumpkin flowers
    - Green vegetables with ground nuts
    - Tshigume/ mugumo (traditional peanut butter) – toasted ground nuts and dried maize grind together.

How do we include dry beans in our meals?

- These foods can cause gas if you are not used to eating them. If you have never eaten these foods, you should not start eating them every day at once. Eat them once a week at first, then twice a week and then continue to eat them at least three times a week.

Can these foods be eaten instead of chicken, fish or meat?

- We can eat them instead of meat and still be healthy.

- They are cheaper than meat or can extend a meat dish.
- They should be eaten with starchy foods and vegetables in a mixed meal.

Learning activities

Group discussion

How often do you eat dry beans or groundnuts in a week?

How can you include dry beans in a mixed meal?

Materials

South African Food based dietary guideline Poster

LESSON 6

Topic: Chicken, fish, meat, milk or eggs can be eaten daily

Teaching aid

Aim:

To create an opportunity for caregivers to gain information and knowledge about the guideline “chicken, fish, meat, milk or eggs can be eaten daily”.

Objectives:

- Understand why these foods are important
- Make wise economics choices.

Content of lesson

- Chicken, fish, meat, milk and eggs are all animal-based foods and are all sources of good quality protein. Protein is needed for growth, maintenance and repairs of body tissue.
- Dairy products such as milk and maas and soft edible bones of fish (pilchards, sardines) are good sources of calcium, essential for healthy bones and teeth, blood clotting and for healing wounds.

- Chicken, fish, meat and egg yolks are good sources of iron, in a form that is well absorbed, as well as vitamin B12 and zinc, necessary for the prevention of anaemia.
- Anaemia is caused by too little iron in the blood, which can lead to tiredness, a reduced ability to work and lower resistance to infection.

Choose animal-based foods wisely

- Buy eggs – they are good values for money. Offal is also rich in protein and iron. It is usually cheaper and can sometimes be used instead of expensive cuts of meat.
- Chicken offal and liver are cheaper than red or chicken meat. There are good source of protein, iron and vitamin A. Dry beans, lentils and soya-based foods are excellent alternatives to red meat.

Must these foods be eaten every day?

- No, small portions of these foods can be eaten every day (such as chicken thigh or fish fillet), but need not be eaten every day.
- People, who choose not to eat animal-based food, can obtain protein from plant-based foods such as beans, split peas, lentils, soya products, nuts and seeds.
- Try to have 2 to 3 meatless days per week by substituting meat with dry beans, lentils or soya. If we eat too little animal-based foods and do not eat a variety of nutritious foods in sufficient quantities, we develop nutrient deficiencies, such as iron, zinc and vitamin A deficiencies.
- Small amount of these foods can be eaten every day. A small portion is considered a serving e.g. one chicken thigh or a piece of fish.
- Cut off all the visible fat from meat before cooking.
- Substitute dry beans, as well as nuts and other seeds for meat.
- Substitute traditional foods such as mopani worms, locust and other insects for meat because they are good sources of protein and low in fat.

These foods are expensive. What should we do?

- Buy and eat small amounts of these foods.
- Buy eggs that are good value for money
- Choose offal that is usually cheaper than meat.
- Buy tinned fish that is healthy and cheaper than fresh fish.
- Replaces or extend meat with dry beans.
- Add groundnuts to the vegetables

Learning activities

Group discussion

Materials

South African Food based dietary guideline Poster

LESSON 7

Topic: Use salt sparingly

Teaching aid

Aim

To create an opportunity for caregivers to gain information and knowledge about the use of iodated salt in our food and how to use it sparingly

Objectives: At the end of the lesson, caregivers will be able to:

- Understand why we have to eat salt sparingly;
- Understand the sources of salt in our diet;
- Understand the term "iodated" mean; and
- Understand what iodine deficiency disorders (IDD) is and how to prevent IDD.

Pre-assessment

- Where do you buy salt?

- How do you use and store salt?

Content and sequence

- Most of the salt we eat comes from processed foods. The rest comes from the salt added at the table and salt added during cooking.

Do our bodies need salt?

- Yes, our bodies need salt from food, because salt helps our bodies to have the amount of fluid not too much and not too little.

Why do we have to eat salt sparingly?

- When we eat too much salt, we can develop conditions and illnesses such as:
- High blood pressure, heart disease, stroke
- Fluid retention (when our bodies keep water).
- Kidney failure

How can we use salt sparingly?

- Using salt is a habit. If we are used to lots of salt it is difficult to stop using salt. Try to reduce the amount a little at time.
- Do not put salt on the table
- Add a little salt at the end of cooking process because part of the iodine is lost during the cooking process.
- Try to eat only a small amount of processed and canned foods, which contain lots of salt.

Which other products contain salt?

- Seasoning salt, stock cubes and spices
- Fast foods or takeaway foods
- Processed foods, such as Vienna and canned meats

Buy iodated salt

- Iodine is a mineral that the human body needs for brain development, health and growth of children. If a person does not get enough iodine, the person could develop various mental and physical conditions known as iodine deficiency disorders (IDD).

Who can develop IDD?

- Any person who does not take enough iodine

How does IDD affect people?

- Pregnant women have natural abortions, such as still birth and miscarriages
- New born babies are small and brain damage can occur
- Children do not grow properly. They have learning difficulties and do not do well at school
- Sufferers get tired easily. People can develop goiter. Goiter is swelling in the neck. This indicates that the body has a serious shortage of iodine

How much iodated salt does a person need to prevent IDD?

- A small pinch of iodated salt every day is enough to prevent IDD. Keep iodated salt in a dry container with a tight-fitting lid or sealed in a plastic bag to prevent iodine from getting lost (evaporate)

Learning activities

Group discussion

- Ask caregivers to list some of the foods they ate yesterday. Ask them to indicate which foods contain added salt.
- Discuss ways in which foods can be prepared using a small amount of salt.

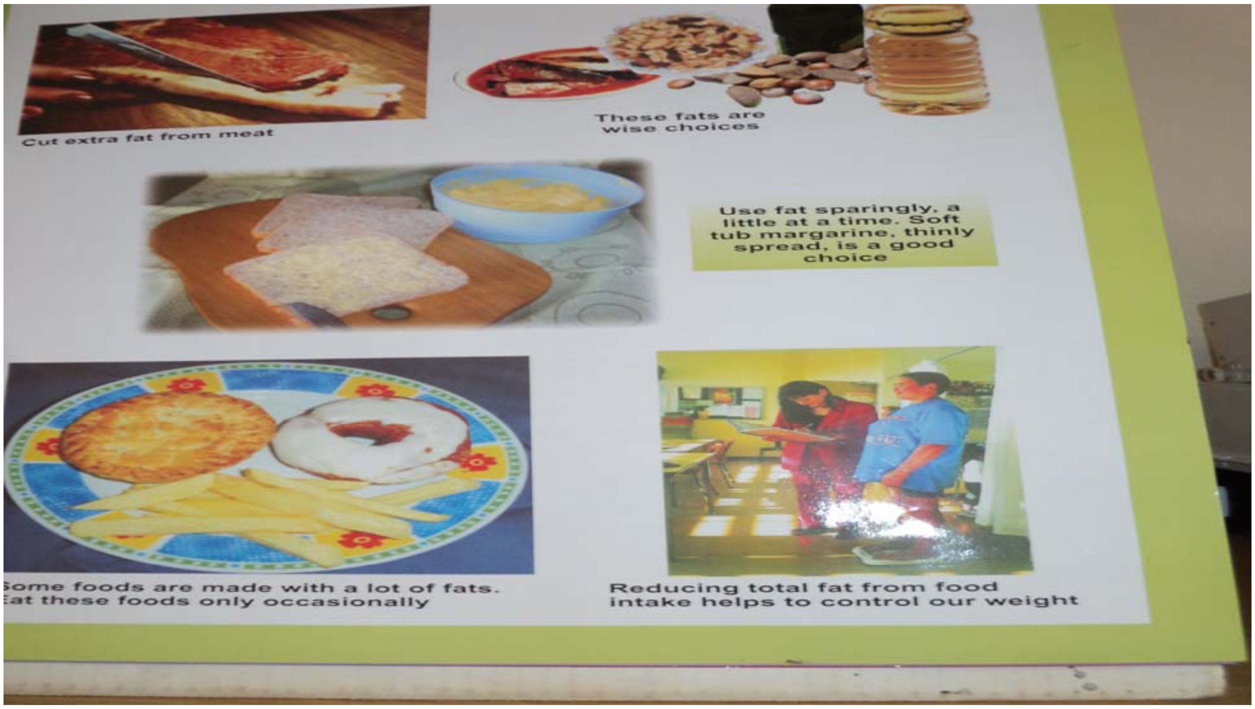
Materials

South African Food based dietary guideline Poster and examples of iodated salt and non-iodated salt.

LESSON 8

Topic: Eat fats sparingly

Teaching aid



Aim

To create an opportunity for caregivers to gain information and knowledge about different kinds of fat and why they should be eaten sparingly

Objectives: At the end of the lesson, mothers/caregivers will be able to:

- Understand why our bodies need fat;
- Understand, which fats and oils, are wise choices and
- Understand why fat should be eaten sparingly.

Content of the lesson

- Some fats are good and some are not so good. However, it is important to know that eating too much of any type of fat is not healthy.

Do our bodies need fat?

- Yes, our bodies need fat because:
- Fats give us energy and keep us warm
- Fats help us to absorb certain important nutrients

- However, eating too much food high in fat we are more prone to heart attacks, strokes or becoming over weight. Examples of foods high in fat include fried chips and crisps, vetkoek, doughnuts and other pastries (pie), coffee creamer and drippings from meat.

Which fats and oils are wise choices?

- Vegetable oils, such as sunflower and canola. Sunflower is the most commonly used oil in South Africa.
- Soft tub margarine
- Oily fish, such as pilchards, tuna, sardines (once a week)
- Sunflower seeds, peanuts and peanut butter, pecan nuts
- Avocados

Which fats and oils are less wise choices?

- Fat that we can see on red meat, meat drippings, lard
- Butter, brick margarine and white cooking fat (holsum)
- Fat that we cannot see includes coffee creamers, vetkoek and doughnuts, pies, pastries, biscuits, ice cream, chips and crisps.
- When oil is heated and cooled often, it becomes harmful to our bodies. When the oil changes colour (about three uses), it should not be used again.

We should eat fat sparingly

- We should eat only a little at time and little throughout a day
- Try to mix foods that have fat with those that do not have fats, such as vegetables, dry beans and starchy foods.

Learning activities

Group discussion

- Ask the caregivers to list some of the foods they ate yesterday. Ask them to indicate which of those foods contain animal fat and plant fats.
- Ask the caregivers what they will do to reduce the fat content of their food.

Material

South African Food based dietary guideline Poster

LESSON 9

Topic: Use food and drinks containing sugar sparingly and not between meals

Teaching aid

Aim:

To create an opportunity for caregivers to gain information and knowledge about sugar in our diet, how to use it sparingly and not to eat it between meals

Objectives: At the end of the lesson, mothers/caregivers will be able to:

- Understand why sugar should be eaten sparingly and not between meals; and
- Know which foods contain sugar.

Pre-assessment:

- List food and drinks that you usually use that contain sugar
- How often do you use this foods

Content of lesson

Most of us love sugar, sweets and everything that is sweet. Too much of a good thing is not good for us. However, food and drinks containing sugar are not totally prohibited in healthy eating plan. The key is not to have food and drinks containing sugar between meals, but to reserve them for special occasions.

Why is too much sugar not good for us?

- In the past sugar has been unfairly blamed for causing a number of health conditions such as diabetes and heart disease.
- On the other hand, we know that too much sugar is not good for our health in the long term. Sugar is rich in energy, but it contains no other nutrients.
- Too much sugar can cause obesity, especially when eaten with fatty foods. Too much sugar and sugary foods and drinks can make us full and cause us to eat less healthy foods such as vegetables, fruits and milk.
- This is especially true for children who are smaller eaters than adults are. Too much sugar, especially when eaten in food that sticks to teeth for a long time (such as toffees) cause tooth decay.

How should we use sugar?

Sparingly

- Use only a little at a time and as few times as possible in a day. Eat small amounts at a time and as little as possible.

Which foods contain sugar?

Foods like the example listed below, have sugar added to them and pose a health problem when they are used instead of good mixed meals or when they are eaten in excess:

  - Cold or fizzy drinks and soft drinks (Even the diet/unsweetened fizzy drinks cause tooth decay due to acid erosion of the enamel. It is therefore not healthy for our teeth to drink them in large quantities or regularly);
  - Sweets, cakes, biscuits, sweet pastries like koeksisters and éclairs;

- Chocolates and ice cream;
- Syrup and jam - Squash (which you mix with water make a cold drink).

Should we have no sugar?

- If you do like something sweet, save it for special occasions.
- Eat something sweet with meals, not between meals.
- Give the children milk, vegetables, fruits or fruit juice instead of soft drinks and squashes.

Oral hygiene

- Healthy teeth come from good genes and good dental care. However, the foods we eat can also affect the health of our teeth.
- We have to clean our teeth twice a day and rinse our mouths with clean water after eating or drinking anything sweet.
- Dairy foods like yoghurt, milk and some cheeses provide protection against dental cavities.

Learning activities

Group discussion

Ask caregivers which foods and drinks containing sugar they regularly eat and give to children.

Which vegetables they add sugar during cooking process.

Materials

Poster with food items containing sugar

Food models

LESSON 10

KEEPING FOOD AND SAFE AND CLEAN

Aim:

To create an opportunity for caregivers to gain information and knowledge about food hygiene and safety

Objectives: The caregivers should be able to:

- Understand the importance of personal and food hygiene.
- Understand the causes of food poisoning

Pre-assessment

When do we wash our hands?

Why foods and drinks must be safe and clean

Content of lesson

Why foods and drinks must be safe and clean

- It is important that the food we eat and the water we drink is clean and safe.
- Therefore, it is essential to prepare meals in a safe, hygienic way. If germs (such as harm-full microorganisms and parasites) get into our foods and drinks, they may give us food poisoning (resulting, e.g. in diarrhea or vomiting).
- The people most likely to become sick are young children and people who are already ill.

We can prevent food poisoning by following a few basic and simple rules of hygiene that aim to:

- Prevent germs from reaching foods and drinks. Many germs come from human or animal faeces. Germs can reach food via dirty hands, flies and other insects, mice and other dirty utensils. Water supplies if they are not protected from faeces.

- Prevent germs from multiplying in foods and reaching dangerous levels. Germs breed fastest in food that is warm and wet (e.g. porridge), especially if it contains sugar or animal protein, such as milk.

To help families have clean safe foods and drinks:

- Find out about disposal of faeces, hand washing practices, the source and storage of water and ways in which food is prepared. This helps you identify ways in which germs may be reaching foods and water, and foods in which germs may breeding;
- Suggest practical ways to improve water and food hygiene. Some of the suggestions listed below may be relevant and useful. But remember not to overburden families with too much advice.

Personal hygiene

Advice people to:

- Wash hands with clean water and soap (or ashes): after going to the toilet, cleaning a baby's bottom or cleaning clothes, dirty bed linen or surfaces contaminated with faeces. It is most important to wash hands after contact with faeces; before and after preparing food and eating; before and after feeding a child or sick person (make sure they wash their hands too).
- Dry hands by: shaking and rubbing them together or using a clean cloth that is kept only for this purpose.
- Keep fingernails short and clean;
- Avoid coughing or spitting near food or water;
- Cover any wounds on hands to prevent contamination of food during its preparation;
- Use a latrine and keep it keep clean and free of flies;
- Teach small children to use a potty. Put children's faeces in the latrine
- Clean up faeces from animals.

Clean and safe water

- Advice mothers to: use safe water, such as treated pipe water or water from a protected source, such as a borehole or protected well. If the water is not safe, it should be boiled (rapidly for one minute) before it is drunk or used in uncooked foods (e.g. fruit juices);
- Use clean covered containers to collect and store water.

Buying and storing food

- Buy fresh foods, such as meat or fish on the day they will eat then. Look for signs of poor-quality food
- Cover raw and cooked foods to protect them from insect, rodents and dust;
- Store fresh food (especially foods from animals) and cooked foods in a cool place, or a refrigerator if available;
- Keep dry foods such as flours and legumes in a dry, cool place protected from insect, rodents and other pest;
- Avoid storing leftover foods for more than a few hours and reheat them thoroughly until hot and steaming (bring liquid food to rolling boil).

Preparing food

- Keep food preparation surfaces clean. Use clean, carefully washed dishes and utensils to store, prepare, serve and eat food
- Prepare food on a table where there is less dust;
- Wash vegetables and fruit with clean water. Peel if possible;
- Prevent raw meat, offal, poultry and fish from touching other foods, as these animal foods often contain germs. Wash surfaces touched by these raw foods with hot water and soap;
- Cook meat, offal, poultry and fish well. Meat should have no red juices;
- Boil eggs so they are hard. Do not eat raw or cracked eggs;
- Boil milk unless it is from a safe source. Soured milk may be safer than fresh milk

Hygiene around the home

- Keep the surroundings of the home free from animal faeces and other rubbish;
- Keep rubbish in a covered bin and empty it regularly so it does not attract flies;
- Make compost for the garden with suitable waste food, garden rubbish and animal faeces. Composting destroys germ in faeces.

Activities

Group discussion

REFERENCES

South African Food Based Dietary Guideline. This nutrition education programme was developed using South African Food Based Dietary Guideline.

Burgess A and Glasauer P. 2004. *Family Nutrition Guide*. Rome: FAO United Nations.

Bourne LT. 2007. South African Paediatric food-based dietary guidelines. *Maternal and Child Nutrition*, 3: 227 – 229.

APPENDIX 7A

TSHIVENDA NUTRITION EDUCATION

Pfunzo nga ha kulele

Heyi pfunzo ya nutrition yo dzudzanyiwa u bva kha malele kwao ano tutuwedziwa Afurika tshipembe na F*amily nutrition guide* (Burgess and Glasauser, 2004). Pfunzo ido netshedziwa vhalondoti vha vhana ubva kha mashango mararu a Masipala wa Mutale. Shango linwe na linwe li do funziwa luvhili kha vhege lwa minwedzi ya fumimbili.Thoho inwe na inwe ido funzwa luvhili.

ZWIRENGOMU

1. Kha vha diphine nga zwiliwa zwo fhambanaho
2. Zwiliwa zwa tshitatshi zwi tea uvha zwinzhi phuletini yavho
3. Kha vha le miroho na mitshelo duvha linwe na linwe
4. Vhale dzinawa uya nga u fhambana hadzo
5. Nama ya khuhu, nama tswuku, khovhe, mafhi na makumba vhanga zwila duvha linwe na linwe
6. Vha shumise muno mutuku
7. Vha shumise mapfura matuku
8. Vha shumise zwiliwa zwa swigiri nga zwituku nahone husi vhukati ha zwiliwa
9. U lisa vhana vha minwaha miraru uya ntha
10. Kulondotele kwa zwithu

NDIVHO YA PFUNZO YA *PFUSHI*

- U fha pfunzo na u pfesesa kha ndeme ya u la zwiliwa zwo fhambanaho.
- U tutuwezda kulele kwa vhudi na u khwinifhadza nutritional status ya vhana
- U ita uri huvhe na u pfesesa nga ha ndeme ya ula miroho na mitshelo nga vhunzhi (hutshi katelwa miroho na mitshelo ya daka)

ZWISHUMISWA

1. Zwifanyiso zwa Sugar Association in South Africa
2. Tshati ino tutuwedza kulele kwo teaho fhano Afurika tshipembe

NGUDO YA U THOMA

Thoho: Kha vha diphine nga zwiliwa zwo fhambanaho.

Ndivho khulwane: U ita uri vhalondoti vh vhana vhavhe na ndivho nga ha ula zwiliwa zwofhambanaho.

Ndivho: Mafheleledzono a pfunzo hehi vhalondoti vha vhana vha do kona u:

- U divha ngaha ndeme y aula zwiliwa zwo fhambanaho.
- U divha uri zwi konadzea hani uri muthu a fhedze o la zwiliwa zwo fhambanaho.
- U pulana zwiliwa zwo tanganaho u tshi khou shumisa zwiliwa zwo fhambanaho.

Dzi mbudziso

- Ndi zwifhio zwiliwa zwino wanala zwa dovha zwa liwa nga mita tavho?
- Kha vha talutshedze zwithu zwine zwa vha tutuwedza ula nga ndila yeneyo.
- Zwi amba mini u di phina nga zwiliwa zwo fhambanaho?
- Vha nga vha hani na vhutanzi uri vha khuo la zwiliwa zwo fhambanaho?

Zwire ngomu kha ngudo

- ❖ Kha vha di phine nga zwiliwa zwo fhambanaho
  - Kulele kwa mutakalo zwi amba ula zwiliwa zwofhambanaho u itela uri mivhili yashu pfushi dzine ya dzi toda.
  - Zwiliwa zwofhambanaho zwi ri fha pfushi dzo fhambanaho dzinonga phurotheini, *zwatshitatshi*, mapfura, dziminerala, dzivithamini, madi na matete zwino thusa muvhili uri u shume zwavhudi.

- ❖ Zwiliwa zwo fhambanaho ndi mini?
  - Zwiliwa zwo fhambanaho zwi amba ula tshakha dzino fhira nthihi dza zwiliwa kha zwiliwa zwinwe na zwinwe, ula zwiliwa zwo fhambanaho kha maduvha o fhambanaho na kubikele kwa zwiliwa kwo fhambanaho, ku rena mutakalo.
  - Zwiliwa zwo tanganaho zwi dzulela u liwa luraru kha duvha (Zwliwa zwa matsheloni, masiari na madekwana). Zwiliwa zwa tshitatshi a zwi koni u fha muvhili pfushi dzothe dzo fhambanaho dzino todea. Ri fanela u ita uri kulele kwashu kuvhe kwavhudi nga u shela zwinwe zwiliwa zwinong miroho, mitshelo, nawa dzo omiswaho, nama, khovhe, khuhu, makumba na mafhi.
  - Nga u la zwiliwa zwo tanganaho, ri vha ri tshi khoou uta uri zwiliwa zwivhe na muthetshelo wa vhudi ra dovha ra wana pfushi dzo fhambanaho.
- ❖ Zwidzhangudzhangu zwi a ita uri zwiliwa zwi fhambane?
  - Zwidzhangudzhangu sa khekhe, tshokholeithi, mabantsi, malegere, nyamunaithi (zwothe zwina swigiri nnzhi kana mapfura manzhi) a zwongo fanela u liwa vhudzuloni ha zwiliwa.
  - Zwinga tsitsa lutamo lwa zwiliwa kha vhana (Vhana kha vha newe vhono la zwiliwa kana vhatou newa nga tshifhinga).

- Zwidzhangudzhangu ndi zwa ndeme kha u fha maanda na dzinwe pfushi kha vhana vhahulwane.
- Nduhu dzi sina muno, mitshelo, kherothi I songo bikiwaho na yogathi ndi Zwidzhangudzhangu zwavhudi.

Mafhedzo

- A huna zwiliwa zwisi zwavhudi, fhedzi hu tou vha na malele a si a vhudi.
- A zwongo tea u renga zwiliwa zwa u dura, ringa pulana zwiliwa zwi tshi khou bva kha zwiliwa zwo fhambanaho zwino wanala mahayani.
- Ri fanela u thusa vhana vhashu uri vha di phine nga zwiliwa zwo fhambanaho.

Ndila ya kugudele

Vhaundi vha vhana vha fanela u khethekana nga vhararu kana vhana kha tshigwada. Tshigwada tshinwe na tshinwe tshi fanela u it zwiiwa zwo fhambanaho (tsumbo zwiliwa zwa nga matsheloni) nga u shumisa zwiliwa zwo fhambanaho.

U guda nga tshitshigwada

Kha vha tanganyise zwiliwa zwo fhambanaho. Kha vha thusiwe u nanga zwiliwa zwine vha zwila hayani.

NGUDO YA VHUVHILI
Thoho: Zwiliwa zwa tshitatshi kha zwi vhe zwinzhi kha phulethi yavho.

Ndivho khulwane: U fha ndivho na pfunzo kha vhalondoti vha vhana ngaha ula zwiliwa zwa
tshitatshi zwinzhi.

Ndivho:

- U pfesesa ndeme ya zwiliwa zwa tshitatshi
- U talusa tsumbo dza zwiliwa azw tshitatshi
- U divha uri ndi ngani ri tshi tea u tanganyisa zwiliwa zwa tshitatshi na zwinwe zwiliwa
- Kha vha divhe uri awiliwa zwa tshitatshi zwi re na matete na zwo engedzedziwaho pfushi ndi zwa vhudi kha mutakalo washu.

Dzi mbudziso

- Kha vha ambe zwiliwa zwa tshitatshi zwine zwa wanala kha vhupo ha havho?
- Vha bikisa hani zwiliwa zwa tshitatshi?
- Ndi ngani zwiliwa zwa tshitatshi zwo fanela u vha tshipida u vha tshipida tsha zwiliwa zwo tanganaho?

Zwire ngomu kha ngudo

- Zwiliwa zwa tshitatshi zwi ri fha maanda na dzinwe pfushi dza ndeme mivhilini yashu**.**
- Zwiliwa zwa tshitatshi tsumbo vhuswa, tshidammba, vhurotho, raisi, madabula na murambo.
- Zwiliwa zwa tshitatshi zwi tea u vha zwone zwinzhi zwa dovha zwa leswa u fhira zwinwe zwiliwa.

❖ **Ndi ngani zwiliwa zwa tshitatshi zwi zwa ndeme?**

- Zwliwa zwa tshitatshi zwo dala pfushi ino rifha maanda (carbohydrate). Zwliwa zwa tshitatshi zwi re na matete zwa dovha zwa engedzezdwa pfushi (vhurotho ha buraweni, mugayo) zwina dzi vithamini dza ndeme, matete na dzi mineral. Miroho ya tshitatshi tsumbo murambo zwi ri fha vithamini A na C nga tshikalo tshoteaho.

❖ **Kha vha tanganyise zwiliwa zwa tshitatshi na zwinwe zwiliwa.**

- U ita zwiliwa zwotanganaho kha vha tanganyise zwiliwa zwinonga miroho, mitshelo, nawa, nama tswuku, khovhe, nama ya khuhu, makumba na mafhi zwifanela u tanganyisiwa na zwiliwa zwa tshitatshi.

Mafhedzo
U tutuwedza mbuelo dza ula zwiliwa zwa tshitatshi zwi rena matete zwa dovha zwa engedzedzwa pfushi.

Tsedzuluso (Dzimbudziso)

- Kha vha ambe zwiliwa zwa tshitatshi zwine vhazwidivha.
- Vhalondoti vha vhana vha fanela u p0ulana zwiliwa vha tshikhou shumisa zwiliwa zwatshitatshi zwino wanala vhuponi ha havho.

NGUDO YA VHURARU

Thoho: U la miroho na mitshelo nga vhunzhi duvha linwe nalinwe

Ndivho khulwane: U ita uri vhathu vhavhe na pfunzo na ndivho ngaha ula miroho na mitshelo nga vhunzhi duvhalinwe na linwe**.**

Ndivho**:** Mafhedzoni a ngudo heyi, vhalonditi vha vhana vha do:

- Divha ndeme ya ula miroho na mitshelo
- U pfesesa ipfi vhunzhi
- U kona u shumisa miroho na mitshelo kha zwiliwa zwa duvha linwe na linwe mutani.

Dzi mbudziso

- Ndi ngani ri tshi fanela ula miroho na mitshelo nga vhunzhi?
- Kha vha ambe miroho na mitshelo ino wanala vhuponi ha havho (vha anga redze naya daka).
- Vha bikisa hani miroho?

Zwire ngomu kha ngudo

❖ Ndi ngani ri tshifanela ula miroho na mitshelo nga vhunzhi?

  - HUna mbuno nnzhi dza vhudi kha ula miroho na mitshelo duvha linwe na linwe.
  - MIroho na mitshelo zwina dzi vithamini mineral nnzhi, zwine zwa thusa u khwathisa maswole a muvhili uri a kone u lwa na malwadze a nonga u shuluwa na mphigela (mukhushwane).
  - Tshakha dzothe dza miroho na mitshelo ndi dza vhudi kha rine nauri zwo fanela u liwa uri rivhe na mutakalo wa vhudi. Zwi nga di liwa sa zwiliwa vhukuma kana sa zwidzhangudzhangu.
  - Vhunzhi ha miroho na mitshelo yo ofuma vithamini A Na C. vithamini C ndi ya ndeme kha u vhumba na u tikedza dzithishu dza muvhili.
  - I thusa kha u nweledza ayoni na khalisiamu, u fhodza zwilinda na u ita uri muvhili u sa sokou farwa nga malwadze. Vithamini A ndi ya ndeme kha mutakalo.
  - Vithamini A ndi ya ndeme kha kuvhonele kwa vhudi, u tsireledza muvhili kha malwadze na u ita uri nyaluwo I vhe ya vdudi.
  - Miroho na mitshelo ina mudifho wa vhudi zwa dovha zwa fha muvhala na mbonalelo ya vhudi kha zwiliwa. Vhana vhatea u dowedzwa ula mitshelo musi vha na ndala nga tshipida tsha vhukati ha zwiliwa.

❖ Vhunzhi zwi amba mini?

  - Vhunzhi zwi amba uri ri fanela u la miroho na mitshelo luraru kana u fhira duvha linwe na linwe. Hezwi zwi nga angaredzwa nga zwitevhelaho:
  - Vhana kha vha dowedzwe u la miroho na mitshelo.

- Kha vha nee vhana miroho na mitshelo sa zwidzhangudzhangu vhudzuloni ha malegere na masimba.
- Vhana vha fanela u fhiwa miroho na mitshelo nga tshifhinga tsha u la.

❖ Ri nga bika hani miroho?

- Kha vha tanzwe miroho na mitshelo nga madi a vhudi, o tsireledzeaho vha saathu la tshifhinga tshothe.
- Miroho na mitshelo I fanela u bikiwa nga madi matuku lwa tshifhinga tshituku, uri zwi si vhibve lokalulaho u itela dzipfushi na muvango zwi si thithisee.

❖ Vhanga fhungudza hani mbadelo kha miroho na mitshelo?

- U la miroho na mitshelo minzhi zwi nga dura. Ri nga thanya ra:
- Renga miroho na mitshelo zwino wanala kha vhupo vhune ra dzula khaho ngauri a zwiduri.
- Ri nga di tavhela miroho na mitshelo uri ri dzule ri nazwo.
- Ri nga shumisa miroho na mitshelo ya mvelo naya daka.
- Manwe matari a miroho ndi a vhudi kha pfushi sa bitiruti na muroho wa phuri (thanga).

Ndila ya kugudele

- U talutshedza na u sumbedza
- U talutshedza ndila dza u bika na u lugisa miroho na mitshelo u tsireledza pfushi
- U talutshedza vhathu dzimbuno dza u sa la miroho na mitshelo
- U talutshedza kutavhele kwa mmiroho na mitshelo hayani
- U sumbedza kulugisele kwone kwa miroho.

Zwishumiswa

- Zwifanyiso zwa asosoesheni ya swigiri ya Afurika tshipembe(South African Sugar Association Pictures)
- Miroho ya mupo
- Madi
- Khuni
- Bodo ya milenzhe
- Lufo

NGUDO YA VHUNA

Thoho: Vhale nawa dzo omiswaho, nawa dala, thumbe na soya nga tshifhinga.

Ndivho khulwane: U ita uri vhalondoti vha vhe na ndivho ngaha ndeme y aula dzinawa na soya nga tshifhinga.

Ndivho: Ngudo heyi I tshi fhela vhalondoti vha tea:

- U pfesesa ndeme ya u la nawa dzo omiswaho, nawa dala, thumbe na soya kha zwiliwa zwo vangwaho.
- Kha vha kone u tanganya nawa dzo omiswaho, thumbe, nawa dala na soya kha kulele kwavho.
- Vha divhe kubikele kwa hone.

Dzi mbudziso

- Ndeme ya u la nawa dzo omiswaho ndi ifhio?
- Nawa dzo omiswaho dzi bikiswa hani?

Zwire ngomu kha ngudo

- ❖ Ndeme ya u la nawa dzo omiswaho
  - Hezwi zwiliwa zwi divhea sa zwi no fha phurotheini ya zwilinwa, zwi fanela u liwa luvhili uya kha luraru kha vhege. Zwi angaredza zwiliwa zwinonga nawa dzo omiswaho, nawa dza tshikotini, mabogisi na nduhu.
  - Nawa dzinga shumimiswa vhudzuloni ha nama kana dzo tanganyisiwa na nama u itela uri tshisevho tshidale. Dzi a rengea u fhira nama. Musi nawa dzo tanganyisiwa na zwiliwa zwirena tshitatshi, phurotheini ino bva kha zwiliwa zwivhili i a thusedza ha bva phurotjeini ya vhudi.
  - U la phurotheini ya zwimedzwa, sa nawa zwido thusedza kha u sa maneliwa (uya nduni thukhu zwavhudi). Nawa dzi nga kha di tanganyisiwa na zwinwe zwiliwa (sa Tshidzimba tshine tsha bikiwa ho tanganyisiwa nawa, nduhi na mabogisi).

- ❖ Ri nga kona hani u tanganyiswa nawa dzo omiswaho na zwiliwa zwashu?
  - Hezwi zwi liwa zwi nga ita uri muthu a bvise muya arali a songo zwidowela. Arali ri saathu zwila, arongo fanela u zwila duvha linwe na linwe. Ri nga thoma nga u zwila luthihi kha vhege, luvhili kha vhege ra kona u engedza uya kha luraru nga vhege.

- ❖ Izwi zwiliwa zwi nga liwa vhudzuloni ha nama ya khuhu, khovhe kana nama tswuku?
  - Ri nga zwila vhudzuloni ha nama ra divha na mutakalo.
  - Ndi zwa mutengo wa fhasi kha nama na uri zwi nga shumisa u engedza nama.
  - Zwo fanela u liwa na zwiliwa zwa tshitarshi na miroho kana zwiliwa zwotanganelaho.

Ndila ya kugudele

- U talutshedza kha tshigwada
- Vha la lungana nawa dzo omiswaho kana nduhu kha vhege?
- Ri nga kona hani u tanganya nawa dzo omiswaho kha zwiliwa?

Zwishumiswa

- Zwifanyiso zwa zwiliwa na mabammbiri mahulu o fanyiswaho zwiliwa
- Zwifanyiso zwa asosiesheni ya swigiri ya Afurika tshipembe
- Nawa na nduhu.

NGUDO YA VHUTANU

Thoho: Nama ya khuhu, khovhe, namatswuku, makumba na mafhi zwi nga liwa duvha linwe na linwe.

Ndivho khulwane: U nea tshikhala vhaundi tsha u wana ndivho ngaha u la nama ya khuhu, khovhe, nama tswuku, makumba kana mafhi zwi nga liwa duvha linwe na linwe.

Ndivho:

- U pfesesa uri ndingani izwi zwiliwa zwi zwa ndeme
- U ita phetho ya vhutali ya ikonomi.

Zwire ngomu kha ngudo

- Nama ya khuhu, khovhe, nama tswuku, makumba na mafhi zwothe ndi zwiliwa zwino bva kha zwipuka na uri zwi ri fha phurotheini ya vhudi. Phurotheini i a todea kha nyaluwo na u vhuedzedza dzithishu dza muvhili.
- Zwiliwa zwa deri zwino nga mafhi a luvhisi, mafhi o khekhaho na marambo a khovhe a songo khwathaho(khovhe dza tshikotini) ndi zwa vhudi kha u fha khalisiamu, u khwathisa marambo na mano, u imisa malofha musi muthu o huvhala na u fhodza zwilonda.
- Nama ya khuhu, khovhe, nama tswuku na tshipida tsha dzivha tsha gumba ndi zwa vhudi kha ufha ayoni, ine ya kona u dzhena zwavhudi muvhilini, vithamini B12 na zink khau thivhila anemia.
- Anemia i vhangwa nga ayoni thukhu malofhani, zwine zwa nga livhisa kha u neta, u fhungudzea ha kushumele na u tsitsela fhasi tshikhala tsha u lwa na malwadze.

❖ Kha vha nange zwiliwa zwino bva kha zwifuwo nga ndila ya vhudi.
  - Kha vha renge makumba ngauri a a rengea. Mala na one o dala phurotheini na ayoni. A a rengea na uri a nga shumiswa vhudzuloni ha nama ino dura.
  - Mala a khuhu na zwivhindi ndi zwa mutengo wa fhasi ri tshi vhambedza na nama tswuku kana ya khuhu. Hezwi zwiliwa zwi ri fha phurotheini, ayoni na vithamini A. Nawa dzo omiswaho, thumbe na soya ndi zwiliwa zwa khwine zwine ra nga zwi shumisa vhudzuloni ha nama tswuku.

❖ Izwi zwiliwa zwifanela u liwa duvha linwe na linwe?
  - Hayi. Zwipida zwituku zwa hezwi zwiiwa zwi nga liwa duvha linwe na linwe (sa tshizwa tsha khuhu kana tshipida tsha khovhe).
  - Vhathu vhasa funi ula zwiliwa zwino bva kha zwipuka, vha nga wana phurotheini kha zwilinwa zwino nga nawa, thumbe, nduhu na soya.
  - Kha vha lingedze u sa la nama lwa maduvha mararu kha vhege vha tshi khou la dzi nawa dzo omiswaho, thumbe na soya. Arali ri tshila zwiliwa zwituku zwino bva kha zwipuka ri sa li zwiliwa zwofhambanaho zwino fha

pfushi dzo fhambanaho na hone dzo lingana ri nga vha na thahalelodza pfushi sa ayoni, zink na vithamini A.

- Zwipida zwituku zwa hezwi zwiliwa zwinga liwa duvha linwe na linwe, fhedzi a zwongo fanela u liwa duvha linwe na linwe. Zwipida zwituku zwine zwa nga liwa zwianganyela tshizwa tsha khuhu kana tshipida tsha khovhe.
- Kha vha tshetshele kula mapfura ano vhonala kha nama vha saathu bika.
- Khavha shumise zwikhokhonono zwinonga mashonzha, nzie na zwinwe vhudzuloni ha nama ngauri zwiri fha phurotheini ya vhudi zwa dovha zwavha na mapfura matuku.

❖ Hezwi zwiliwa zwi a dura. Ringa ita mini?

- Khavha renge vha le zwipida zwituku zwa hezwi zwiliwa
- Khavha renge makumba ngauri a a renea
- Khavha nange mala ngauri ha duri a tshi vhambedzwa na nama
- Khavha renge khovhe ya tshikotini ine ya vha na mutakalo ya dovha ya rengea i tshi vhambedzwa na khovhe thethe
- Khavha shumise nawa vhudzuloni ha nama kana vha engedzedze nama nga nawa
- Kha vha kodele muroho.

***Ndila ya kugudele*: U talutshedza nga tshigwada

Zwishumiswa

- Zwifanyiso zwa zwiliwa kana mabammbiri mahulu o fanyiswaho zwiliwa
- Zwifanyiso zwa Asosiesheni yaSwigiri ya Afurika Tshipembe (South African Sugar Association Pictures).

NGUDO YA VHURATHI

Thoho: Kha vha shumise muno mutuku

Ndivho khulwane: U nea tshikhala vhaundi kha u vha na ndivho ngaha u shumisa muno wo sheliwaho ayodini na u u shumisa nga zwituku.

Ndivho: Nga mafheleloni a heyi ngudo vhaundi vhafanela u

- Pfesesa uri ndingani vha tshi fanela u shumisa muno mutuku;
- Pfesesa urimuno u rifha mini kha zwiliwa zwashu;
- Pfesesa uri u engedzezdwa ayodini zwi amba mini;
- Pfesesa uri thahalelo ya ayodini (IDD) ndi mini na uri ri nga I thivhela hani.

Dzi mbudziso

- Vha renga ngafhi muno?
- Vha u shumisa na u u vhea nga ndila de?

Zwire ngomu kha ngudo

- Vhunzhi ha muno u ne ra ula ubva kha zwiliwa zwo bveledzwaho. Munwe wa waniwa kha muno wo vheiwaho tafulani kana wo sheliwaho hu tshi bikiwa.

❖ Mivhili yashu i a toda muno?

- Ee, mivhili yashu i a toda muno u no bva kha zwiliwa, ngauri muno u ri thusa uri mivhili yashu ivhe na tshiludi tsho linganaho tshisi tshituku kana tshinzhi.

❖ Ndi ngani ri tshi fanela u shumisa muno nga zwituku?

- Musi ri tshi lesa muno, ri nga vha na malwadze ano nga: mutsiko wa malofha ure ntha, vhulwadze ha mbilu na u oma mirado.
- Tshiludi tshi nga thithisea(musi mivhili yashu i tshi vhea madi)
- U thisea ha tswio.

❖ Ringa shumisa hani muno nga mutuku?

- U shumisa muno ndi ndowelo, arali ro dowela u la muno munzhi azwongo leluwa u litsha muno. Kha vha lingedze u tou fhungudza tshikalo tsha muno nga zwituku nga tshifhinga.
- Vha songo vhea muno tafulani
- Kha vha shele muno mutuku mafhedzoni a u bika nga uri ayodini i a fhufha musi vha tshi khou bika.
- Kha vha lingedze u la zwiliwa zwo dzulaho zwo lugela u liwa na zwa zwikotini nga zwituku ngauri zwo dalesa muno.

❖ Ndi zwi fhio zwinwe zwiliwa zwire na muno?

- Zwipaisisi
- Zwiliwa zwine vha tou renga zwo dzula zwo bikiwa
- Dzi nama dza zwikotini na dzi viana.

- ❖ Kha vha renge muno wo sheliwaho ayodini
  - Ayodini ndi mineral ine muvhili wa i toda kha u bveledza muvhili, mutakalo na nyaluwo ya vhana. Arali muthu a sa wani ayodini yo linganaho, a nga vha na thaidzo dza muhumbulo na muvhili.

- ❖ Ndi nnyi ane a nga vha na thaidzo ya thahalelo ya ayodini?
  - Muthu munwe na munwe a wani ayodini.

- ❖ Thaidzo ya thahalelo ya ayodini i kwama hani vhathu?
  - Vhaimana vhaa tshinyaleliwa kana nwana a lovha atshi bebiwa
  - Vhana vha bebiwa vha vhatuku vha dovha vha vha na thaidzo dza maluvhi
  - Vhana a vha aluwi zwavhudi. Vha a lega u guda vha dovha vhasa kone tshikoloni
  - Vhathu vha rena thaidzo ya thahalelo ya ayodini a vha lengi u neta. Vha nga vha na gulokulo. Arali muthu avha na gulokulo zwiamba uri thaidzo ya thahalelo ya ayodini yo no vha khulwane.

- ❖ Ndi muno mungafhani wo sheliwaho ayodini une muthu a fanela u u shumisa uri a si vhe na thahalelo ya ayodini?
  - Muno mutuku wo lingana kha u thivhela thahalelo ya ayodini
  - Kha vha vhee muno kha tshikhonthina tsho omaho tshino vala zwavhudi, kana vha u shele kha tshekasi vha dzule vho li vhofha u itela iuri ayodini i si fhufhe.

Ndila ya kugudele

- U guda nga tshigwada
- Kha vha vhudzise vhalondoti vha vhana uri vha ambe zwinwe zwa zwiliwa zwe vhala mulovha.Vhalondoti vha sumbedze zwiliwa zwo sheliwaho muno.
- Kha vha talutshedze ndila dzine ra nga bika ngadzo zwiliwa ri tshi khou sumisa muno mutuku.

Zwishumiswa

- Zwifanyiso zwa zwiliwa
- Tsumbo dza muno wo sheliwaho ayodini na u songo sheliwaho.

NGUDO YA VHUSUMBE

Thoho: Kha vha le mapfura nga matuku

Ndivho khulwane: U nea tshikhala vhaundi uri vhavhe na ndivho ngaha tshakha dza mapfura dzo fhambanaho na uri ndi ngani mapfura a tshi tea u liwa nga matuku.

Ndivho: Mafhedzoni a heyi ngudo vho mme/ vhaundi vha do kona u:

- Pfesesa uri ndi ngani mivhili yashu I tshi toda mapfura
- Pfesesa uri ndi afhio mapfura a vhudi kha u shumisa
- Pfesesa uri ndingani ri tshi fanela u la mapfura nga matuku.

Zwire ngomu kha ngudo

- Manwe mapfura ndi a vhudi, manwe a si vhe a vhudi. Fhedzi ndi zwa ndeme u divha uri u la mapfura nga manzhi, a vhudi kana asi a vhudi a zwo ngo tea.

❖ Mivhili yashu I a toda mapfura?

- Ee , mivhili yashu I a toda mapfura ngauri:
- Mapfura a ri fha maanda a dovha a ita uri ri dzule ri tshi khou dudelwa
- Mapfura a thusa khau nweledza dzinwe dzipfushi dza ndeme
- Fhedzi, ula zwiliwa zwinzhi zwo dalaho mapfura zwi ita uri ri vhe zwipondwa zwa malwadze a mbuilu, u oma mirado kana u vha na mivhili mihulu.Tsumbo dza zwiliwa zwodalesaho mapfura dzi angaredza matshipisi, magwinya, magwinya o dodzwaho khirimu nga vhukati, dzi phai na zwinwe vho.

❖ Ndi a fhio mapfura ane a vha a vhudi?

  - Mapfura a no bva kha miroho a nonga sa s*unflower* na *canola. Sunflower* ndi one mapfura a tshiludi a no shumisesa fhano Afurika Tshipembe.
  - *Mapfura a u dodza (Magarini)*
  - Dzi khovhe dza mapfura dza zwikotini
  - Dzi thanga dza *sunflower,* Nduhu na bodoro ya nduhu
  - Afukhada.

❖ Ndi a fhio mapfura a si a vhudi?

  - Mapfura a no wanala kha nama tswuku
  - Bodoro, madzharina a tshidina
  - Mapfura an era sa kone u a vhona a a ngaredza mafhiane ra shela kha dzi kofi, magwinya, dzi phai, mabesikitsi, *ice cream* na zwinwe
  - Musi mapfura a tshiludi o bikiwa lwa tshifhinga tshinzhi, a vha khombo kha mivhili yashu. Musi mapfura a tshi shanduka muvhala (o no shumiswa luraru) hongo fanela u dovha u shumisiwa.

❖ Ri fanela ula mapfura nga matuku

  - Ri fanela ula mapfura matuku ngatshifhinga duvha lothe

- Kha vha lingedze u tanganyisa zwiliwa zwirena mapfura na zwisina, zwi nonga miroho, nawa dzo omiswaho na zwiliwa zwa tshitatshi.

Ndila ya kugudele

- U guda nga tshigwada
- Vhaundi kha vha vhudziswe zwiliwa zwe vhala mulovha. Kha vha sumbedze uri kha zwiliwa zwe vhala ndi zwifhio zwi rena mapfura a no bva kha zwipuka na a no bva kha zwilinwa.
- Vhaundi kha vha vhudzisiwe uri vha do ita mini u fhungudza mapfura kha zwiliwa zwavho.

Zwishumiswa

- Zwifanyiso zwa zwiliwa, dzi bugu dzo fanyiswaho zwiliwa.

NGUDO YA VHUMALO
Thoho: Kha vha shumise zwiliwa na zwinwiwa zwine zwa vha na swigiri nga zwituku nahoine husi vhukati ha zwiliwa.
Ndivho khulwane: U nea tshikhala vhaundi uri vha vhe na ndivho ngaha swwigiri zwiliwani zwashu, u i shumisa ngas zwituku na u sa I shumisa vhukati ha zwiliwa.
Ndivho: Mafhedzoni a heyi ngudo, vho mme/vhaundi vha do kona u:

- Pfesesa uri ndi ngani ri tshi fanela ula swigfiri nga zwituku na hone hu si vhukati ha zwiliwa
- U divha zwiliwa zwirena swigiri.

Dzimbudziso

- Kha vha ambe zwiliwa na zwinwiwa zwine vha dzulela u zwila na u zwinwa zwi rena swigiri
- Vhala hani (lungana) hezwi zwiliwa.

Zwirengomu kha ngudo

- Vhunzhi hashu ri a funa swigiri na zwithu zwothe zwino tapila. Zwithu zwinzhi zwavhudi zwa dalesa zwi vha zwisi zwavhudi kha rine. Fhedzi, zwiliwa na zwinwiwa zwirena swigiri a zwonga tou iledzwa tshothe kha kulele kwo teaho. Tsha ndeme ndi u sa zwila vhukati ha zwiliwa, fhedzi vha zwile nga zwifhinga zwa tshipentshala.

❖ Ndi ngani swigiri nnzhi isi yavhudi kha rine?

- Tshifhinga tsho fhelaho swigiri yo vha itshi ambiwa nga ndila isi ya vhudi kha u vhanga malwadze arena tshivhalo a nonga vhulwadze ha swigiri na ha mbilu.
- Nga kha lunwe lurumbu, ri a zwidivha uri swigiri nnzhi a si yavhudi kha mutakalo washu lwa tshifhinga tshilapfu. Swigiri i rifha maanda manzhi, ya dovha ya vha na dzinwe pfushi.
- Swigiri nnzhi I nga ita muvhili wokalulaho, ngamaanda arali i tshi liwa na zwiliwa zwo dalesaho mapfura.Swigiri nnzhi, zwiliwa na zwinwiwa zwirena swigiri zwi nga ita uri ripfe ro fura zwa ita uri ri le zwituku zwiliwa zwirena mutakalo sa miroho, mitshelo na mafhi.
- Hezwi ndi zwavhukuma kha vhana vhane vhala nga zwituku u fhira zwine vhahulwa vha lisa zwone. Swigiri nnzhi ngamaanda musi I tshi khou liwa na zwiliwa zwiune zwa nzmbatela manoni lwa tshifhinga tshilapfu (sa kofi) zwivhanga u tshinyala ha mano.

❖ Ringa shumisa hani swigiri nga zwituku?

- Kha vha shumise swigiri thukhu nga tshifhinga nahone lusi lunzhi nga duvha. Kha vhale swigiri thukhu nga tshifhinga nahone lusi lunzhi.

- ❖ Ndi zwifhio zwiliwa zwirena swigiri?
    - Zwiliwa zwo ambiwaho hafha fhasi zwina swigiri yo sheliwaho khazwo na uri zwina malwadze arali zwo shumiswa vhudzuloni ha zwiliwa zwirena mutakalo kana zwoleswa nga zwinzhi:
    - Nyamunaithi (na dzenedzi dzine hapfi a dzina swigiri dzi a tshinya mano zwi tshi khou itiswa nga esidi. Zwino a zwongo tea uri rinwe dzinyamunaithi nga nnzhi u itela mano ashu).
    - Malegere, dzikhekhe, mabesikitsi
    - Dzi tshokholeithi na *ice cream*
    - Dzi dzhamu
    - Zwikwatshi

- ❖ A rongo fanela ula swigiri?
    - Arali vha tshi toda tshiliwa tsha u tapila nga vha tshile nga tshifhinga tsha tshipentshala.
    - Kha vhale tshiliwa tsha u tapila na zwinwe zwiliwa nahone husi vhukati ha zwiliwa.
    - Kha vha nee vhana mafhi, miroho, mitshelo kana dzhusi ya mitshelo vhudzuloni ha nyamunaithi na zwikwatshi.

- ❖ U thogomela hanwani
    - Mano arena mutakalo a bva kha u a thogomela zwavhudi. Fhedzi, zwiliwa zwine rala zwinga khakhisa mutakalo wa mano ashu.
    - Ri fanela u tamba mano luvhili kha duvha ra tukisa milomo ashu nga madi a vhudi musi ri tshi fhedza ula kana unwa zwinwe na zwinwe zwine zwa tapila.
    - Zwiliwa zwa deri sa yogathi, mafhi na dzinwe dzi tshizi zwia tsireledza kha u vhaisala ha mano.

Ndila ya kugudele

- U guda nga tshigwada

- Vhaundi kha vha vhudziswe uri ndi zwifhio zwiliwa na zwinwiwa zwirena swigiri zwine vha dzulela u zwila na u zwinea vhana.
- Ndi ifhio miroho ine vhathu vha shela swigiri vha tshi I bika.

Zwi shumiswa

- Mabambiri mahulu o fanyiswaho zwiliwa zwo fhambanaho zwirena swigiri
- Zwifranyiso zwa zwiliwa.

NGUDO YA VHUTAHE

Thoho: U lisa vhana vha minwaha miraru uya ntha.

Ndivho khulwane: U nea tshikhala vhaundi u vha na ndivho na u pfesesa ngaha uri vhana vha minwaha miraru u ya ntha vha tea u liswa hani.

Ndivho: Kha vha divhe u lisa vhana vha minwaha miraru uya ntha.

Zwirengomu kha ngudo

- Musi vhana vhono swikisa minwaha miraru, vhunzhi havho vhanga kona u di lisa. MIta I fanela u isa phanda na u sedza na u tutuwedza vhana nga tshifhinga tsha zwiliwa, ngamaanda musi vha tshi khou lwala.
- Kha vha nee muta wavho zwiliwa zwo fhambanaho zwine zwa savhe na tshipaisisi tshinzhi, swigiri nnzhi kana muno munzhi.
- Kha vha nee vhana zwiliwa luraru na zwidzhangudzhangu lithihi kana luvhili nga duvha. Hune muta wa la u bva kha bodo nthihi, ndi zwavhudui u nea vhana dziphulethini dzavho uri vhale zwo linganaho.

❖ Kha vha shumise zwiliwa zwo fhambanaho kha vhana.
  - Zwinwe zwiliwa zwirena mapfura u engedzedza maanda. Miroho na mitshelo yo pfumaho vithaminiA na C. Makumba, mafhi na zwiliwa zwino bva kha zwipuka zwodalaho ayoni (nama, mala , khuhu, khovhe)zwi nga liwa duvha linwe na linwe kana tshifhinga tshinwe na tshinwe arali zwi hone.

❖ Vhuswa ho itwaho nga fulauru dzo vhilaho
  - Vhana vhatuku vha toda zwiliwa zwino nea maanda na dzipfushi ngauri dzithumbu dzavho ndi thukhu na uri vha nga si le zwiliwa zwinzhi nga tshifhihnga.
  - Vhuswa ndi tshone tshiliwa tsho doweleaho kha vhana vhatuku, fhedzi pfusi na u nea maanda ha hone ndi hutuku kha ho fanelaho.
  - Hezwi zwi khou vhangwa nga tshitatshi tshinzhi kha zwiliwa zwino liwa tshifhinga tshothe sa miugayo na sogamu.

❖ Ndila dza u ita uri vhuswa vhunee maanda manzhi na pfushi nzhi na uri vhu leluwe u vhula ndi nga:
  - U shela zwiliwa zwo dalaho maanda (mapfura/bodoro) na zwiliwa zwodalaho pfushi (nduhu dzo sindiwaho na dzinwe dzinawa kana thanga dza *sunflower*) kha vhuswa.U bika vhuswa ho vhilaho (mutuku). Vhuswa ha mutuku a vhu khwathisa vhuswa zwaho. Vhuitwa nga madi matuku ha fha maanda manzhi na pfushi vhu vhutuku.
  - Nawa dzo sindiwaho dzi a shuma u engedzedza pfushi kha vhuswa.

❖ Zwinwe zwavhudi nga dzifulauri hedzi ndi:

- Ayoni I a nwelela zwavhudi
- Zwoleluwa u gaya zwadovha zwa tsireledzea ngauri zwitshili a zwikoni u aluwa zwavhudi kha vhuswa ho vhilaho.

❖ U tutuwedza vhana vhatuku ula
  - Vhana vhatuku vhala nga u ongolowa. Vhala zwavhudi arali vhabebi vhatsini vha tshi khou vha tutuwedza uri vhale.
  - Vhaundi vhatea u dzula na vhana vha tshi khhu vhatutuwedza uri vhale vha tshi khou amba navho na u vha vhudza uri zwiliwa zwi khou difha.
  - Tshifhinga tsha zwiliwa kha tshivhe tsha madakalo.
  - Vhana kha vha liswe nga tshifhinga tshine munwe na munwe a la ngatsho mutani, fhedzi vha lele kha dziphulethi dzavho uri vhale zwo linganaho.
  - Kha vha vhone uri vhana a vha na dora ngauri arali nwana a na dora u la zwituku, fhedzi vha songo nwisa nwana zwiludi thumbu ya dala musi a tshi toda u la kana nga tshifhinga tsha zwiliwa.
  - Kha vha lingedze u fha vhana zwuliwa nga tshifhinga tsha musi vha na ndala, vha songo lindela vha tshi tou lilela zwiliwa.
  - Vha songo lisa o neta ka a tshi khou kumedza
  - Kha vha ite uri tshifhinga tsha zwiliwa tshi vhe tshifhinga tshavhudi tshau guda, tsumbo khavha funze vhana madzina a zwiliwa.
  - Tshinwe tshifhinga na vhana vho takalahoa vhali zwavhudi, kha vha lavhelese uri nwana u khou lwala, *a sa khou aluwaho zwavhudi* kana hango takala. Vhaundi vha tea u lavhelesa musi nwana a tshi la zwavhudi namusi a sa li zwavhudi na musi nwana a tshi khou hana zwiliwa. Khavha tambe mitambo u tutuwedza nwana sa funi zwiliwa uri ale.

Ndila ya kugudele
  - U guda nga tshigweada

Zwishumiswa
- Zwifanyiso zwa zwiliwa na mabambiri mahulu o fanyiswaho zwiliwa
- Zwifanyiso zwa asosiesheni ya swigiri ya Afurika tshipembe.

NGUDO YA VHUFUMI
Thoho: U dzudza zwiliwa zwo tsireledzea zwadovha zwavha zwavhudi.
Ndivho khulwane: U nea tshikhala vhaundi uri vha vhe na ndivho ngaha zwiliwa zwo tsireledzeaho zwa dovha zwavha zwavhudi (zwi sina tshikha).
Ndivho: Vhaundi vhatea u kona u:

- Ndeme ya u dzudza zwiliwa zwizwavhudi an muthu a sina tshikha
- Pfesesa zwivhangi zwa phoizeni zwiliwani.

Dzi mbudziso

- Ri tamba lini zwanda zwashu?
- Ndi ngani zwiliwa na zwinwiwa zwi tshi tea uvha zwavhudi zwa dovha zwa tsireledzea?

Zwi rengomu kha ngudo

- ❖ Ndi ngani zwiliwa na zwinwiwa zwi tshi tea u vha zwavhudi zwa dovha zwa tsireledzea.
  - Ndi zwa ndeme uri zwiliwa zwine ra la na madi an era nwa ndi zwa vhudi zwa dovha zwa tsireledzea.
  - Zwino, ndi zwa ndeme u lugisa zwiliwa nga ndila yo tsireledzeaho, zwi sina mashika. Arali zwitshili (sa microorganisms na parasites dzino ofhisa) dza dzhena kha zwiliwa na zwinwiwa, zwi nga vhanga phoizeni ya zwiliwa (zwa livhisa kha tsumbo, u tanza na u shuluwa).
  - Vhathu vhane vha nga lwqalesa ndi vhana vhatuku na vhathu vhane vho dzula vha tshi khou lwala.

- ❖ Ri nga thivhela phoizeni zwiliwani nga u tevhela maga o leluwaho a vhudi o livhiswaho kha:
  - U thvhela zwitshili kha u swikelela zwiliwa na zwinwiwa. Vhunzhi ha zwitshili zwi bva kha malwa a vhathu kana a zwifuwo. Zwitshili zwi nga swikelela zwiliwa nga kha zwanda zwi re na mashika, thunzi na zwinwe zwikhokhonono, mbevha na zwishumiswa zwa khishini zwirena tshikha. Madi aralu a songo tsireledziwa kha malatwa.
  - Kha vha thivhele u engedzedzea ha zwitshili kha zwiliwa na u swikelela tshipida tsha khombo. Zwitshili zwi a anda vhiukuma kha zwiliwa zwino dudela kana zwo nukalaho (sa vhuswa), nga maanda arali vhu na swigiri kana mafhi.

- ❖ U thusa mita uri vha vhe na zwiliwa na zwinwiwa zwavhudi zwa dovha zwa tsireledzea:
  - Kha vha wane ndila ine vha lata ngayo malatwa, kutambele kwa zwanda, hune vha wana na u vhea hone madi na ndila dzine vha bika ngadzo. Hezwi zwi ri thusa u divha ndila dzine zwitshili zwa nga vha zwi tshi khou

dzena ngayo zwiliwani na madini, na zwiliwa zwine zwitshili zwa nga anda khazwo.

- Kha vha eletshedze ngaha ndila dza u khwinifhadza zwiliwa na madi zwavhudi. Dzinwe ngeletshedzo dzo ambiwaho afho fhasi dzi nga thusa. Kha vha humbule u sa tsika muta nga ngeletshedzo dzo andesaho.

❖ Vhu di thogomeli ha muthu: Kha vha tutuwedze vhathu u:

- Tamba zwanda nga madi a vhudi na tshisibe (kana miora): musi vha tshi bva nduni thukhu, u tanzwa nwana marahoni kana u kuvha zwiambaro, malagane a tshikha kana fhethu hu re na malatwa. Ndi zwa ndeme vhukuma u tamba zwanda musi vha tshi bva u di kwamanya na malatwa, musi vha sa athu fara na ula zwliwa na musi vha tshi fhedza, musi vha tshi fhedza u lisa nwana kana muthu ane a khou lwala (kha vha ite uri na vhone vha tambe zwanda).
- Kha vha omise zwanda nga: u zwi fhulutedza zwone zwine kana vha shumise labi la vhudi lo tou vhetshelwaho u phumula zwanda fhedzi.
- Kha vha dzudze nala dza zwandani dzi thukhu na hone dzi sina tshikha.
- Vha songo hotolela tsini na zwiliwa kana madi.
- Kha vha thivhedze tshilinda tshinwe na tshinwe tshi re zwandani u thivhela u fhirisela zwitshili kha zwiliwa musi vha tshi lugisa zwiliwa.
- Kha vha shumise ku bunga kwa vhana na uri vha ku dzudze ku kwa vhudi ku sa kwamiwi nga dzi thunzi.
- Kha vha funze vhana vhatuku u shumisa ku bunga kana tshikiki Vha vhee malatwa a vhana kha ku bunga ku no tou rengiwa.
- Vha kumbve malatwa a zwifuwo.

❖ *Ndi* o kunaho a dovha a tsiredzea

- Kha vha tutuwedzu vho mme u: shumisa madi o tsireledzeaho sa madi o tolwaho a no bva bommbini kana madi a no bva fhuethu ho tsireledzeaho sa gwedzhoni kana tshisimani tsho tsireledzeaho. Arali madi a songo tsireledzwa a tea u vhiliswa (lwa minete muthihi) a sa athu mwiwa kana u shumisiwa kha u lugisa zwiliwa zwi sa bikiwi (tsumbo dzhusi ya mitshelo).
- Kha vha shumise mafagi a vhudi a re na mitibo u vhea madi.

❖ U renga na u vhea zwiliwa

- Kha vha renge zwiliwa zwa fureshe, sa nama kana khovhe nga tshifhinga vha do zwila zwenezwo. Kha vha lavhelese zwiga zwino sumbedza uri zwiliwa a si zwa khwine.
- Kha vha thivhedze zwiliwa zwo bikiwaho na zwi songo bikiwaho u thivhela zwikhokhonono na buse.

- Kha vha vhee zwiliwa zwa fureshe (nga maanda zwiliwa zwinio bva kha zwifuwo) na zwiliwa zwo bikiwaho fhethu ho fholaho kana tshixwatudzini arali tshi hone.
- Kha vha vhee zwiliwa zwo omaho zwino nga fulauru na nawa fhethu ho omaho, ha fhola ha dovha ha tsireledzea kha zwikhokhonono.
- Vha songo vhea zwiliwa zwo salaho lwa dziawara dzi re na tshivhalo na uri vha dudedze zwiliwa u swika zwi tshi tou fhisa vhukuma (zwa tshiludi zwi tea u vhila).

❖ U lugisa zwiliwa
  - Kha vha dzudze fhethu hune vhalugisela hone zwiliwa hu ha vhudi. Kha vha shumise zwigodelo na dzi ndishidzo kunaho u vhea, u lugisa na u lela zwiliwa.
  - Kha vha lugise zwiliwa kha tafula I sin abuse.
  - Kha vha tanzwe miroho na mitshelo nga madi a vhudi. Vha sotole makanda arali zwi tshi konadzea.
  - Kha vha vhone uri nama tswiku i songo bikiwaho, mala, nama yakhuhu na khovhe zwi songo kwama zwinwe zwiliwa ngauri hezwi zwiliwa kanzhi zwi vha zwina zwitshili. Kha vha tanzwe fhethu ho kwamiwaho nga hezwi zwiliwa zwi songo bikwaho nga madi a u fhisa na tshisibe.
  - Kha vha bike nama tswuku, mala, nama ya khuhu na khovhe zwivhibve. Nama tswuku a yon go tea u vha na malofha.
  - Kha vha vhilise makumba a vhibve. Vha songo la makumba a songo bikiwaho kana o fhanduwaho.
  - Kha vha vhilise mafhi nga nnda arali o vha o vhewa fhethu ho tsireledzeaho. Mafhi o vhilaho o tsiredzea kha a luvhisi.

❖ U thogomela hahani
  - Kha vha dzudze hayani hu sina malatwa a zwifuwo na dzinwe tshikha.
  - Kha vha dzudze mashika kha tshiravha tshi no vala na uri vha shulule mashika tshifhinga tshothe uri hu sa vhe na thunzi.
  - Kha vha ite manyoro a ngadeni nga zwiliwa zwo teaho zwo tshinyalaho, mashika a ngadeni na malatwa a zwifuwo.

Ndila ya kugudele
  - U guda nga tshigwada.

APPENDIX 8

DATA COLLECTION SCHEDULE
Baseline - 2007

Date	Activities	Name of village
05 March 2007	Baseline data collection	Tshixwadza
06 March 2007	Baseline data collection	Tshixwadza
07 March 2007	Baseline data collection	Tshixwadza
09 March 2007	Baseline data collection	Matshavhawe
12 March 2007	Baseline data collection	Matshavhawe
14 March 2007	Baseline data collection	Folovhodwe
16 March 2007	Baseline data collection	Muswodi
27 March 2007	Baseline data collection	Tshixwadza
28 March 2007	Baseline data collection	Folovhodwe
29 March 2007	Baseline data collection	Musunda
30 March 2007	Baseline data collection	Muswodi
13 April 2007	Baseline data collection	Mavhode
16 April 2007	Baseline data collection	Musunda
24 April 2007	Baseline data collection	Mavhode
30 April 2007	Baseline data collection	Musunda
07 May 2007	Baseline data collection	Muswodi
08 May 2007	Baseline data collection	Matshavhawe
14 May 2007	Baseline data collection	Folovhodwe
15 May 2007	Baseline data collection	Muswodi
18 May 2007	Baseline data collection	Musunda
11 June 2007	Baseline data collection	Matshavhawe
12 June 2007	Baseline data collection	Tshixwadza
13 June 2007	Baseline data collection	Muswodi
14 June 2007	Baseline data collection	Mavhode
15 June 2007	Baseline data collection	Folovhodwe
06 September 2007	Baseline data collection	Mapuloni
13 September 2007	Baseline data collection	Mapuloni
14 September 2007	Baseline data collection	Gumela
17 September 2007	Baseline data collection	Mapuloni
20 September 2007	Baseline data collection	Gumela
27 September 2007	Baseline data collection	Mapuloni
08 October 2007	Baseline data collection	Gumela
09 October 2007	Baseline data collection	Gumela
10 October 2007	Baseline data collection	Mapuloni
15 October 2007	Baseline data collection	Gumela
16 October 2007	Baseline data collection	Gumela
17 October 2007	Baseline data collection	Mapuloni
22 October 2007	Baseline data collection	Mapuloni
23 October 2007	Baseline data collection	Gumela

Topics covered during Nutrition Education Intervention Programme

1. Enjoy the variety of foods
2. Feeding children aged 3 years and older
3. Make starchy foods the basis of most meals
4. Eat plenty of vegetables and fruits every day
5. Eat dry beans, split peas, lentils and soya
6. Chicken, fish, meat, milk or eggs can be eaten daily
7. Eat fats sparingly
8. Use food and drinks containing sugar sparingly and not between meals
9. Use salt sparingly
10. Hygiene and safety

Nutrition education Intervention implementation period - 2008

Date	Topic covered	Repeated lesson first 30 minutes	Place	Comments	Number of participants
First Intervention					
12 February 2008	Enjoy the variety of foods & Feeding children aged 3 years and older		Tshixwadza & Mavhode		Tshix (12) Mavh (9)
13 February 2008	Enjoy the variety of foods & Feeding children aged 3 years and older		Matshavhawe & Mapuloni		Matsha (6) Mapu (20)
14 February 2008	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Enjoy the variety of foods & Feeding children aged 3 years and older	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
26 February 2008	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Enjoy the variety of foods & Feeding children aged 3 years and older	Matshavhawe & Mapuloni		Matsha (6) Mapu (20)
27 February 2008	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
12 March 2008	Eat dry beans, split peas, lentils and soya &	Make starchy foods the basis of most meals &	Matshavhawe & Mapuloni		Matsha (6) Mapu (20)

	Chicken, fish, meat, milk or eggs can be eaten daily	Eat plenty of vegetables and fruits every day			
13 March 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
18 March 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Matshavhawe & Mapuloni		Matsha (6) Mapu (20)
19 March 2008	Use salt sparingly & Hygiene and safety	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
25 March 2008	Use salt sparingly & Hygiene and safety	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Matshavhawe & Mapuloni		Matsha (6) Mapu (20)

26 March 2008		Use salt sparingly & Hygiene and safety	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
08 April 2008		Use salt sparingly & Hygiene and safety	Matshavhawe & Mapuloni		Matsha (6) Mapu (20)
Second intervention					
19 August 2008	Enjoy the variety of foods & Feeding children aged 3 years and older		Tshixwadza & Mavhode		Tshix (12) Mavh (9)
20 August 2008	Enjoy the variety of foods & Feeding children aged 3 years and older		Matshavhawe & Mapuloni		Matsha (6) Mapu (20)
26 August 2008	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Enjoy the variety of foods & Feeding children aged 3 years and older	Tshixwadza & Mavhode		Tshix (12) Mavh (9)
27 August 2008	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Enjoy the variety of foods & Feeding children aged 3 years and older	Matshavhawe & Mapuloni	Matshavhawe – not taught attending to funeral preparation in the village	Mapu (20)
02 September 2008	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Tshixwadza & Mavhode		Tshix (12) Mavh (9)

03 September 2008	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Enjoy the variety of foods & Feeding children aged 3 years and older	Matshavhawe		Matsha (6)
03 September 2008	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Mapuloni		Mapu (23)
09 September 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Tshixwadza & Mavhode	Mavhode – two caregivers attend the lecture (lecture was repeated at the end)	Mavh (2)
10 September 2008	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Make starchy foods the basis of most meals & Eat plenty of vegetables and fruits every day	Matshavhawe		Matsha (6)
10 September 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Mapuloni		Mapu (22)

16 September 2008	Use salt sparingly & Hygiene and safety	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Tshixwadza & Mavhode		Tshix (11) Mavh (9)
07 October 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Matshavhawe		Matsha (6)
07 October 2008	Use salt sparingly & Hygiene and safety	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Mapuloni		Mapu (18)
08 October 2008		Use salt sparingly & Hygiene and safety	Tshixwadza & Mavhode		Tshix (10) Mavh (8)
21 October 2008	Use salt sparingly & Hygiene and safety	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Matshavhawe		Matsha (4)

21 October 2008		Use salt sparingly & Hygiene and safety	Mapuloni		Mapu (15)
28 October 2008		Use salt sparingly & Hygiene and safety	Matshavhawe		Matsha (5)
11 November 2008	Eat fats sparingly & Use food and drinks containing sugar sparingly and not between meals	Eat dry beans, split peas, lentils and soya & Chicken, fish, meat, milk or eggs can be eaten daily	Mavhode	Lecture was repeated to cover caregivers who did not attend on 09 September	Mavh (10)

Final data collection – 2009

Date	Activity	Name of Village
22 January 2009	Final data collection	Mapuloni
28 January 2009	Final data collection	Matshavhawe
18 February 2009	Final data collection	Tshixwadza
19 February 2009	Final data collection	Gumela
24 February 2009	Final data collection	Muswodi
04 March 2009	Final data collection	Mavhode
05 March 2009	Final data collection	Folovhodwe
11 March 2009	Final data collection	Musunda
12 March 2009	Final data collection	Folovhodwe
18 March 2009	Final data collection	Muswodi
13 May 2009	Final data collection	Matshavhawe
14 May 2009	Final data collection	Mavhode
26 May 2009	Final data collection	Gumela
27 May 2009	Final data collection	Folovhodwe
28 May 2009	Final data collection	Mavhode
02 June 2009	Final data collection	Matshavhawe
04 June 2009	Final data collection	Musunda
21 July 2009	Final data collection	Gumela
23 July 2009	Final data collection	Folovhodwe
27 July 2009	Final data collection	Mavhode
30 July 2009	Final data collection	Matshavhawe
04 August 2009	Final data collection	Musunda
06 August 2009	Final data collection	Mapuloni
11 August 2009	Final data collection	Folovhodwe
13 August 2009	Final data collection	Muswodi
17 August 2009	Final data collection	Tshixwadza
18 August 2009	Final data collection	Mapuloni
20 August 2009	Final data collection	Mavhode
16 September 2009	Final data collection	Folovhodwe
17 September 2009	Final data collection	Gumela
22 September 2009	Final data collection	Mapuloni
23 September 2009	Final data collection	Mavhode
12 October 2009	Final data collection	Mapuloni
14 October 2009	Final data collection	Gumela
19 October 2009	Final data collection	Tshixwadza
21 October 2009	Final data collection	Mapuloni
26 October 2009	Final data collection	Gumela
28 October 2009	Final data collection	Muswodi

APPENDIX 9

Ethical approval letter from University of Free State

UNIVERSITEIT VAN DIE VRYSTAAT
UNIVERSITY OF THE FREE STATE
YUNIVESITHI YA FREISTATA

Direkteur: Fakulteitsadministrasie / Director: Faculty Administration
Fakulteit Gesondheidswetenskappe / Faculty of Health Sciences

Research Division
Internal Post Box G40
☎(051) 4052812
Fax nr (051) 4444359

E-mail address: gndkhs.md@mail.uovs.ac.za

Ms H Strauss

2006-02-16

MS LF MUSHAPHI
C/O PROF A DANNHAUSER
DEPT OF HUMAN NUTRITION
CR DE WET BUILDING
UFS

Dear Ms Mushaphi

ETOVS NR 24/06
RESEARCHER: MS LF MUSHAPHI
PROJECT TITLE: IMPACT OF A NUTRITION EDUCATION PROGRAMME ON THE NUTRITIONAL STATUS OF CHILDREN AGED 3 TO 5 YEARS AND THE NUTRITIONAL PRACTICES AND KNOWLEDGE OF THEIR CAREGIVERS IN RURAL LIMPOPO PROVINCE, SOUTH AFRICA"

You are hereby kindly informed that the Ethics Committee approved the above-mentioned study at their meeting held on 14 February 2006 on condition that permission is obtained from the Chief/Government Official Municipal Manager and that the Informed Consent has to be available in the language the participant prefers.

Your attention is kindly drawn to the following:

- A progress/final report have to be submitted after completion of the study or within a year after approval of the project
- That all extentions, amendments, serious adverse events, termination of a study etc have to be reported to the Ethics Committee
- These documents have been accepted as complying with the Ethics Standards for Clinical Research based on FDA, ICH GCP and Declaration of Helsinki guidelines as well as the Clinical Trials Guidelines 2000: Dept of Health RSA and MRC Guidelines on Ethics for Medical Research

Will you please quote the Etovs number as indicated above in subsequent correspondence to the secretariat.

Yours faithfully

DIRECTOR: FACULTY ADMINISTRATION

339, Bloemfontein 9300, ☎ (051) 405 3013, 401 2847, (051) 444 3103, gndkit.md@mail.uovs.ac.za
Republiek van Suid-Afrika, Republic of South Africa

APPENDIX 10

Letter to chief to request permission

P.O. Box 161
Makonde
0984

To: The Municipal Manager
Mutale Municipality, Vhembe District
Limpopo Province

From: Mushaphi LF
Date: 30 July 2005

Requisition to conduct research at the Mutale Municipality

Dear sir/ madam

I hereby apply for permission to conduct research at Mutale Municipality. The research proposal has been presented and approved by the Ethic Committee of Faculty of Health Sciences of the University of Free State. I am studying PhD in Nutrition. My research topic: impact of a nutrition education programme on the nutritional status of children aged 3 to 5 years and nutritional practices and knowledge of their caregivers.
The objectives of the study are: to determine

- micronutrients status of children;
- nutritional practices of mothers/caregivers of children;
- anthropometric nutritional status of children;
- impact of nutrition education on micronutrient status of children.

In the selected villages children will be weighed and the blood will be collected to children aged 3 to 5 years. The caregivers will provide information on nutritional practices and knowledge. The caregivers will be encouraged to used indigenous foods for infant feeding. Only caregivers who agree to participant will be part of the study.
Enclosed in please find an attached copy of my proposal and letter of approval.

Thanking you in advance

....

Student (Mushaphi LF)

....

Supervisor (Dannhauser A)

....

Co-supervisor (Walsh C)

APPENDIX 11

Letters from chiefs

G.P.-S. 01/02

P. 21 (81/143198)

P/Bag x 5050
THOHOYANDOU.
0950
2009.9.23

KHANHO TSAHO:

1. Nne vhamusanda vho-Ramushwana Mashudu Peggy vha Mutshatshawe II nga fhasi ha khosi vho-Rambuda.

2. Ndi khou tanziela uri vho. Mrs. Mushaphi Lindelani Fhumudzani ID. 7110070829080 vha shumaho University ya Venda. Ro shumisana navho ubva mahola nga 2008.

Wauho A fulufhedzeaho:
Musanda M.P. Ramushwana. (MPRamushwana)
MATSHAVHAWE. Village.

HEADMAN M.P. RAMUSHWANA
MATSHAVHAWE II
PRIVATE BAG X 1142
PO DZIMAULI
MUTALE DISTRICT VENDA

Enquiry:N.F Mashathini
tel: 072 191 4888

P/Bag x 1142
DZIMAULI
0975
12 August 2009

CONFIRMATION FOR CONDUCTING A RESEARCH PROJECT.

The above-mentioned matter refers

Dear Sir/Madam

To MUSHAPHI LINDELANI THUMULANI. I as a headman of Mapuloni village,I welcome the above-mentioned student from your University to conduct her research project in my area of jurisdiction.

Such a research 's outcomes will contribute intensively in my community in terms of kowledge exploration.It ,again,remains as a source of the community and the department itself.

I wish you a good and a prosperous fiedwork throughout your hardwork in relation to your research project.

Yours Truly

Mashathini ----------SIGN.

N.F MASHATHINI

HEADMAN
MUKHORO AZWIFARWI THOMAS
2009 -09- 08
MAPULONI VILLAGE
PRIVATE BAG X 1142
DZIMAULI 0975

Gumela Village

Mutale municipality

Mutale

University of Venda

P/Bag x 5050

Thohoyandou

0950

Dear Sir/ Madam

To whom it may concern

This letter serves to inform you that **Ms. LF Mushaphi (ID NO. 7110070829080)** is allowed to conduct research in our village. For any enquiries please contact maluta Elmon Negumela.

Yoursfaithfully 0732041961

CHIEF NEGUMELA
BOX 704
6 DEC 2005
MATAVHELA. 0990
CELL: 071 077 9206

Musunda Village

Mutale municipality

Mutale

University of Venda

P/Bag x 5050

Thohoyandou

0950

Dear Sir/ Madam

To whom it may concern

This letter serves to inform you that **Ms. LF Mushaphi (ID NO. 7110070829080)** is allowed to conduct research in our village. For any enquiries please contact Rambuda M. J.

Yoursfaithfully

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Yoursfaithfully

NDOU ND
Civic Secretary

MUSWODI DIPENI
Civic Association

Appendix 12

Editor's letter

TAALSENTRUM
LANGUAGE CENTRE
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UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

16 November 2011

To Whom It May Concern:

It is hereby confirmed that the dissertation by Lindelani Mushaphi has been edited by the Language Service.

The editing option chosen was the 'comprehensive edit'. This includes the following:

- comment on problematic sentence and paragraph structure
- comment on significant and prevalent stylistic problems (e.g. problems with coherence and register)
- comment on repetition of text
- comment on vague formulations or possible ambiguities
- edit headings for clarity, appropriateness and parallelism
- remove redundancies
- correct abbreviations and acronyms that have been used incorrectly (not subject terminology)
- correct faulty quotations (we do not check or change the content of quotations)
- correct referencing style of in-text references
- correlate parts: check and correct incorrect cross-references, internal page references, footnote/endnote numbers and text, and the table of contents
- translation of the abstract

The function 'track changes' of MS Word was used to indicate changes to the document and has been electronically sent to the client on 15 November 2011.

Please contact me should you have any enquiries.

Regards

MvdWaal

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Summary

Globally, the prevalence of acute malnutrition and micronutrient deficiency is high in young children, especially in developing countries. This study was undertaken to determine the impact of a nutrition education intervention programme (NEIP) on the nutritional knowledge and practices of caregivers, as well as the nutritional status of children between the ages of three to five years in the Mutale Municipality in Vhembe district, Limpopo Province.

A pre-test–post-test control group design was chosen using eight villages (four villages in the experimental group (E); four villages in the control group (C). At baseline, the study population was 125 caregivers and 129 children aged three to five years (E = 66; C = 63 children). After intervention, 86 caregivers and 89 children (E = 40; C = 49 children) were found. Only participants who participated at baseline and post-intervention were included for comparison.

A valid structured interview schedule was used to determine nutritional practices and knowledge. The nutrient intake was determined by two 24-hour recalls. Weight and height (to determine weight/height status) and blood samples (vitamin A and iron status) were taken using standard techniques. The NEIP was developed by the researcher using South African Food-based Dietary Guidelines (SAFBDGs) and South African Paediatric Food-based Dietary Guidelines (SAPFBDGs) as basis. The NEIP was implemented on the experimental group on two occasions, namely every week during the first three months and then during the last three to four months in a period of 12 months.

Data were analysed using Statistical Analysis Software (SAS®) version 9.2 and expressed using median, minimum and maximum values to describe continuous data. Frequencies and percentage were used to describe categorical data and 95% confidence intervals were used for median and percentage differences to determine the

impact of the intervention programme. The 24-hour recall data were analysed using Food Finder III version 1.1.3.

The study revealed that the socio-demographic information and anthropometric nutritional status of the children did not change after intervention in both groups. Furthermore, at baseline, nearly one third of the children in both groups had marginal vitamin A status. However, after intervention, all children in both groups had adequate to normal vitamin A status, which could be due to the vitamin A supplementation and food fortification programme of the SA Government. The iron indicators were within adequate levels at pre- and post-intervention in both groups.

The impact of NEIP was observed in some of the nutritional practices, since the majority of caregivers usually included starchy foods, protein-rich foods and vegetables in the child's plate daily at baseline in both groups. However, the number of children who were given more than three meals per day showed a tendency towards an increase in the experimental group. The intake of milk and yoghurt improved significantly in the experimental group. The majority of children were eating indigenous foods. However, the intake of black jack, spider flower, wild jute plant, baobab fruit, paw-paw, mopani worms and termites improved significantly in the experimental group.

The median carbohydrate and protein intake was adequate when compared to EAR/RDA in both groups at pre- and post-intervention. The median energy, carbohydrate and plant protein intake had increased significantly in the control group. The intake of iron and folate had increased significantly in both groups, while zinc intake increased significantly in the control group. After the intervention, the intake of *tshimbundwa* (traditional bread made with maize) also increased significantly in the control group. Furthermore, the intake of stinging nettle, meldar, wild peach, pineapple, *dovhi*, *tshigume* and *thophi* had improved significantly in both groups.

The nutrition knowledge score was good at baseline, as the majority of caregivers in both groups were aware that children should be given a variety of foods, indigenous foods, starchy foods, protein-rich foods, vegetables and fruit. However, in the experimental group the percentage of caregivers who knew that children should be given full-cream milk and fat increased significantly at post-intervention. On other hand, the percentage of caregivers who knew *tshimbundwa* increased significantly in the control group.

The majority of caregivers were including most of the food items on the child's plate (starchy, protein-rich foods, vegetables and indigenous) at baseline, which left little room for improvement. However, the impact of NEIP was observed in some nutritional practices. On the other hand, minimal impact of the NEIP on nutrition knowledge was observed, since most of the caregivers had good nutritional knowledge at baseline.

It is recommended that the NEIP developed in this study be adapted for the Department of Health (Nutrition Section) so that healthcare workers can present it in different communities using different media so as to increase coverage.

Key words: Nutritional status, nutritional practices, nutritional knowledge, micronutrients status, nutrition education programme, indigenous foods

Opsomming

Wêreldwyd, en veral in ontwikkelende lande, ly menige jong kind aan akute wanvoeding en mikrovoedingstoftekorte. Hierdie studie bepaal die uitwerking van ŉ voedingsvoorligting-intervensie program (NEIP) op die voedingskennis en -praktyke van versorgers sowel as die voedingstatus van kinders tussen drie- en vyfjarige ouderdom in die Mutale-munisipaliteit in die Vhembe-distrik van Limpopo.

ŉ Voortoets-natoets-kontrolegroepontwerp is gekies en op agt dorpe toegepas (vier dorpe in die eksperimentele groep (‘E’); vier dorpe in die kontrolegroep (‘C’). Met die basislynopname het die studiepopulasie uit 125 versorgers en 129 kinders tussen drie- en vyfjarige ouderdom bestaan (E = 66; C = 63 kinders). Ná die intervensie was daar 86 versorgers en 89 kinders (E = 40; C = 49 kinders). Slegs deelnemers wat aan die basislyn én ná die intervensie deelgeneem het, is vir vergelyking in ag geneem.

ŉ Geldige, gestruktureerde onderhoudskedule is gebruik om voedingspraktyke en -kennis te bepaal. Voedingstofinname is deur twee toetse 24 uur uitmekaar vasgestel. Met behulp van standaardtegnieke is massa en lengte gemeet (om massa/lengte-status te bepaal) en bloedmonsters geneem (om vitamien A- en ysterstatus te bepaal). Die navorser het die intervensie (NEIP) aan die hand van die Suid-Afrikaanse voedselgebaseerde dieetriglyne (SAFBDG), asook die Suid-Afrikaanse pediatriese voedselgebaseerde dieetriglyne (SAPFBDG) ontwikkel. Die intervensie (NEIP) is twee keer in ŉ tydperk van 12 maande, naamlik weekliks vir die eerste drie maande asook weekliks vir die laaste drie tot vier maande, op die eksperimentele groep toegepas.

Data is met behulp van statistiese ontledingsagteware (SAS®), weergawe 9.2, ontleed, en gemiddelde, minimum en maksimum waardes is gebruik om kontinue data te beskryf. Kategoriese data is met behulp van frekwensies en persentasies beskryf, terwyl 95%-vertrouensintervalle vir gemiddelde- en persentasieverskille gebruik is om die impak van die intervensie te bepaal. Die 24-uur herroep data is met behulp van Food Finder III, weergawe 1.1.3, ontleed.

Die studie het aan die lig gebring dat die sosiodemografiese inligting en antropometriese voedingstatus van kinders nie in enige van die twee groepe ná die intervensie verander het nie. Met die basislynopname het bykans ŉ derde van die kinders in albei groepe ŉ marginale vitamien A-status gehad. Tog het alle kinders in albei groepe ná die intervensie ŉ voldoende tot normale vitamien A-status getoon, wat moontlik aan die vitamien A-aanvulling- en voedselverrykingsprogram van die SA Regering toegeskryf kan word. Ystervlakke was voldoende by albei groepe voor én ná die intervensie.

Die uitwerking van die intervensie (NEIP) kon in net sommige van die voedingspraktyke opgemerk word, aangesien die meeste versorgers in albei groepe met die basislynopname reeds daagliks styselryke voedsel, proteïenryke voedsel en groente by die kinders se etes ingesluit het. Die aantal kinders in die eksperimentele groep wat meer as drie etes per dag ontvang het, het egter ŉ opwaartse neiging getoon. Melk- en jogurtinname by die eksperimentele groep het ook beduidend verbeter. Die meeste kinders het voor die intervensie reeds inheemse kos ingeneem. Tog het die eksperimentele groep se inname van wewenaarsgras, spinnekopblom, wilde juteplant, kremetartvrug, papaja, mopaniewurms en termiete aansienlik toegeneem.

Die gemiddelde koolhidraat- en proteïeninname in albei groepe was voldoende in vergelyking met die geraamde gemiddelde aanbevelings ('EAR')/aanbevole dieettoelaag ('RDA') voor én ná die intervensie. Nietemin het die gemiddelde energie-, koolhidraat- en plantproteïeninname by die kontrolegroep beduidend toegeneem. Albei groepe se yster- en folaatinname het aansienlik gestyg, terwyl sinkinname by die kontrolegroep ŉ beduidende toename getoon het. Ook die inname van *tshimbundwa* (tradisionele brood gemaak van mieliemeel) het by die kontrolegroep ná die intervensie aansienlik toegeneem. Voorts het die inname van brandnetel, wildemispel, wildeperske, pynappel, *dovhi*, *tshigume* en *thophi* by albei groepe beduidend gestyg.

Die voedingskennisvlak met die basislynopname was goed, aangesien die meeste versorgers in albei groepe daarvan bewus was dat kinders ŉ verskeidenheid kossoorte, inheemse voedsel, stysel- en proteïenryke voedsel, groente en vrugte moet inneem. Tog was die persentasie versorgers in die eksperimentele groep wat weet dat kinders volroommelk en vet moet inneem betekenisvol hoër ná die intervensie. Daarenteen het die persentasie versorgers in die kontrolegroep wat van *tshimbundwa* weet beduidend toegeneem.

Die meeste versorgers het met die basislynopname reeds die meeste van die vereiste kositems by die kinders se maaltye ingesluit (stysel- en proteïenryke voedsel, groente en inheemse voedsel), waarop daar dus nie veel verbeter kon word nie. Die uitwerking van die intervensie (NEIP) kon egter in sommige voedingspraktyke opgemerk word. Aan die ander kant het die intervensie (NEIP) oënskynlik ŉ minimale uitwerking op voedingskennis gehad, aangesien die meeste versorgers met die basislynopname reeds oor goeie voedingskennis beskik het.

Daar word aanbeveel dat die intervensie wat vir hierdie studie ontwikkel is, vir die Departement van Gesondheid (Afdeling Voeding) aangepas word, sodat gesondheidsorgwerkers dit met behulp van verskillende media in verskillende gemeenskappe kan aanbied ten einde so veel mense moontlik daarmee te bereik.

Sleutelwoorde: Voedingstatus, voedingspraktyke, voedingskennis, mikrovoedingstofstatus, voedingsvoorligting-intervensie, inheemse kos