EVALUATION OF A FEEDING PROGRAMME IN ADDRESSING MALNUTRITION IN A PRIMARY SCHOOL

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Thesis submitted in fulfilment of the requirements for the degree of DTech: Food Service Management in the Department of Hospitality and Tourism, Faculty of Human Sciences, Vaal University of Technology.

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June 2006

The financial assistance of the Vaal University of Technology and National Research Foundation, towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to Vaal University of Technology and National Research Foundation.

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ACKNOWLEDGEMENTS

This is a project that came together with substantial financial support and effort from different sources. I cannot express my gratitude in sufficient words, for having been allowed to make such a significant contribution to a community in an informal settlement in the Vaal Triangle. Personally, I have grown spiritually throughout this whole experience and therefore, wish to express my gratitude to the following individuals who enabled this research project and document to be successfully and timeously completed:

- Prof. Wilna Oldewage-Theron, my supervisor, for her guidance, assistance, motivation and patient ear in difficult times.
- The Department of Education, for allowing us access to the school that participated in the study.
- Mrs. Mochela and Mr. Rampa, the Principal and Deputy Principal of Setlabotjha Primary School for accommodating us with friendly assistance throughout the study.
- The Community of Eatonside, for receiving us with open arms and always being available when we needed their input.
- The staff and children of the Setlabotjha Primary School, for being willing to assist in this research.
- The BTech and MTech students and staff from the Vaal University of Technology who assisted and acted as fieldworkers.
- Verena Nolan and Christa Grobler for all the statistical analysis.
- Jeanette Kearney, for her role in this study and companionship throughout the intervention.
- My husband James, for his encouragement, support and assistance throughout the study.
- My mother, for always believing in me and encouraging me throughout the study.
- To God above, for giving me the strength and ability to complete this very worthwhile community project.

My sincere thanks to all these people.

ABSTRACT

The main objective of this study was to determine the level of malnutrition in a primary school (children aged six to 13 years old) in an informal settlement and to plan and implement a school-feeding intervention programme. Before and after the intervention blood was drawn from 160 children. Quantitative Food Frequency Questionnaires and 24-hour recall questionnaires were completed in interviews with the parents. Anthropometric measurements included weight-for-age, BMI-for-age and height-for-age.

The baseline results (QFFQ and 24-hour recall) indicated that zinc (64%), iron (83%) and energy intake levels (59%) were lower than the recommended range for children in this age group when compared to the DRIs (Dietary Reference Intakes). Food most commonly purchased and consumed were maize meal, tea, sugar and oil as indicated by the top 20 foods purchased list. With regard to anthropometric indices, 10% were severely underweight (weight-for-age below $\leq 5^{th}$ percentile from the reference NCHS median), 15% were severely wasted (BMI-for-age $\leq 5^{th}$ percentile) and 15.3% severely stunted (height-for-age $\leq 5^{th}$ percentile). A maize meal wholewheat vetkoek was developed that provided 25% of the daily needs of the children for zinc and iron, making use of ingredients from the top 20 list. The vetkoek was biochemically tested and optimised to ensure optimal nutritional content. The vetkoek was also sensory analysed by a sample of school children (n=30) for acceptability. The vetkoek was administered for seven months, daily except for school holidays and weekends, to 60 randomly selected children forming the experimental group, with 60 other children receiving a fruit as the control group and 40 children receiving the Primary School Nutrition Programme.

The post-intervention results indicated that the children in all three groups significantly improved in weight and height and their zinc and iron intake also increased significantly. The post-intervention dietary intake results showed that the product contributed

significantly to the quality of the diet. The vetkoek group consumed 358% of iron and 176% of zinc when compared to the DRIs, with the PSNP group consuming 167% of iron and 99% zinc and the fruit group 200% of iron and 120% of zinc. Although few statistically significant changes occurred biochemically, clinical changes occurred in all three groups. This study proved that any food provision can have a beneficial impact on the growth of a malnourished child.

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GLOSSARY OF TERMS

%	Percentage
°C	Degree Celsius
μg	Micro-gram
μL	Micro-litre
μmol	Micro-mol
AAS	Atomic Absorption spectrophotometry
ADA	American Dietetic Association
AFA	Arm fat area
AI	Adequate Intake
AMA	Arm muscle area
AMDR	Adequate Macronutrient Distribution Range
ANC	African National Congress
ANOVA	Analysis of Variance
APHA	American Public Health Association
ARC	Agricultural Research Centre
BMI	Body Mass Index
Bt20	Birth to Twenty Research Programme – WITS University
Ca	Calcium
CDC	Center for Disease Control
CIS	Commonwealth of Independent States
Cfu/g	Colony forming units per gram of sample
CHD	Coronary Heart Disease
CHOL	Cholesterol
Cr	Chromium
CRP	C-reactive protein
CSS	Central Statistical Services
Cu	Copper

DHAA	Dehyrdo-Ascorbic Acid
Dl/DL	Decilitre
DoH	Department of Health
DRIs	Dietary Reference Intakes
EAR	Estimated Average Requirement
EDTA	Ethylene diaminetetra-acetic acid
EER	Estimated Energy Requirements
FAO	Food and Agricultural Organization of the United Nations
FBDG	Food Based Dietary Guidelines
Fe	Serum iron
FFQ	food frequency questionnaires
FFTG	Food Fortification Task Group
Fl	Fluid
FNIC	Food and Nutrition Information Center
g	gram
GCIS	Government Communication and Information System
h/a	height-for-age
Hb	Haemoglobin
$HClO_4$	Hydro Perchloric acid
Hct	Haematocrit
HDL	High-density lipoprotein
HNO_3	Concentrated nitric acid
HPLC	High Perfomance Liquid Chromatography
HSRC	Human Science Research Council
I	Iodene
IQ	Intelligence Quotient
IDA	Iron deficiency anaemia
IDD	Iodine deficiency disorders
IFPRI	International Food Policy Research Institute

ILSI	International Life Science Institute
INP	Integrated Nutrition Program
IOM	Institute of Medicine of the National Academies
IRIN	United Nations Integrated Regional Information Networks
K	Potassium
Kcal	Kilo-calories
KJ/kj	Kilojoules
Km	Kilometres
L/	Litre
$LiNo_3$ (Li)	Lithium
MAC	Mid-upper arm circumference
MCV	Mean cell volume
MDGs	Millennium Development Goals
MDM	Mid day meal programmes
mg	Milligram
Mg	Magnesium
MI	Micronutrient Initiative
MLL	Minimum Living Level
Mm	Millimetre
Mmol	Millimol
MRC	Medical Research Council
MRCV	Mean Red Cell Volume
N/n	Sample size
Na	Sodium
NCHS	National Centre for Health Statistics
NFCS	National Food Consumption Survey
NGOs	Non Governmental Organisations
nm	Nanomol
nmol	Nanomol

NNMB	National Nutrition Monitoring Bureau
NSLP	National School Lunch Programme
PE	Petroleum Ether
PEM	Protein energy malnutrition
pmol	picomol
PSNP	Primary School Nutrition Programme
QFFQ	Quantitative Food Frequency Questionnaire
®	Registered trade mark
RBC	Red blood cell count
RCV	Red cell volume
RDA	Recommended Daily Allowance
RDP	Reconstruction and Development Programme
RE	Retinol equivalents
RSA	Republic of South Africa
RtHC	Road to Health Chart
SA	South Africa
SAVACG	South African Vitamin A Consultative Group
SD	Standard deviation
Se	Selenium
SGB	School Governing Body
SMMEs	Small and medium enterprises
THUSA	Transition and Health during Urbanisation in SA
TRIG	Triglycerides
TSF	Triceps skinfold
UK	United Kingdom
UL	Tolerable upper intake levels
UN	United Nations
UNICEF	United Nations Children's Fund
USA	United States of America

USAID	United States Aid Agency
UV	Ultra violet
VAD	Vitamin A deficiency
VAGI	Vitamin A Government Initiative
VIC	Vitamin Information Center
Vit	Vitamin
VUT	Vaal University of Technology
w/a	weight-for-age
w/h	weight-for-height
WBC	White blood cell count
WHO	World Health Organisation
WHP	Waist-to-Hip Ratio
WITS/Wits	University of the Witwatersrand
Zn	Zinc

Chapter 1

Introduction and background to the problem

1.1 Introduction

Almost 40 percent, or 184 million, of the developing world's children under five have stunted growth due to inadequate nutrition. Although the world-wide prevalence of stunting is declining by about 0,5% of a percentage point each year, more than half the children in certain regions of the developing world, such as Southeast Asia, are severely below the normal height-for-age. However stunting in Sub-Saharan Africa increased by 0.13% a year during 1980-1995 (Lang 1998:22). United Nations Children's Fund (UNICEF) (2001) ranked South Africa on the under-5 mortality rate as 66th in the world, which indicates that a lot of children under five still dies in South Africa. Lang continues to note that child growth is considered a good indicator of overall socio-economic development and human welfare in developing countries. Stunting is a physical indicator of a broad spectrum of nutritional deficiencies and is often linked to poor mental development. Stunting is a cumulative process of poor growth that primarily occurs before the age of three years and is not easily reversed.

Every day countless children around the world are exposed to dangers that hamper their growth and development. Globally 10.6 million children die every year before they reach the age of five, from malnutrition and disease (UNICEF 2001).

A child that eats enough to satisfy immediate hunger could still be malnourished. Furthermore malnutrition could largeiy be viewed as an invisible emergency, since three quarters of the children who die world-wide of malnutrition-related causes, are mildly to moderately malnourished and show no outward signs of problems (UNICEF 1998:1).

Child malnutrition is not only confined to the developing world. In some industrialised countries, widening income disparities, coupled with reductions in social protection, have worrying effects on the nutritional well-being of children. Another element involved is urbanisation which frequently results in poor dietary intake, subsequently resulting in undernutrition (UNICEF 1998:1; Macintyre 1998:437).

1.2 Background to the problem

Bellamy (1998:18-27) indicated in a study that the nutritional status of South African children is below the average when compared to the rest of the world. In Africa, one of every three children is underweight, with black and coloured children having the highest prevalence (25% and 17% respectively). Rural black children are the most vulnerable group (UNICEF 1998: 1; Vorster *et al.* 1998:31).

According to UNICEF (2001:2) opportunities to enhance children's health and nutrition present themselves at three critical stages: early childhood, the primary school years and adolescence. Support and intervention at each of these stages builds upon and reinforces the previous stage and holds enormous promise for breaking the intergenerational cycle of poverty and underdevelopment that threatens children and women. Support and intervention also present the exciting possibility of breaking the cycle within a single generation.

Malnutrition has decreased in most other developing countries but it is still foreseen that malnutrition in children in the Sub-Saharan district will actually increase from a 1995 rate of 31.1% to 32.4% by 2020 (International Food Policy Research Institute (IFPRI 2000:81). Although national strategies and policies are extremely important in addressing the problem, specific problems should be based on the real need in a specific area or group and also address the underlying and basic causes of malnutrition. Programmes and future studies should therefore be flexible, adaptable and include research into the sequencing of intervention to improve child nutrition and into the cost of various interventions (UNICEF 1990:11-12; Vorster *et al.* 1998:33; IFPRI 2000:96).

According to UNICEF, greater involvement on the part of NGO's (Non Governmental Organisation) were requested in complementing national efforts and joint international action in this field. Families, communities, local governments, NGO's, social, cultural, religious, business and other institutions, including the mass media, are encouraged to play an active role in supporting the goals enunciated in this plan of action. The experience of the 1980's shows that it is only through the mobilisation of all the sectors of society, including those that traditionally did not consider child survival, protection and development as their major focus, that significant progress can be achieved in these areas (UNICEF 1990:26).

History indicates that societies meeting the nutritional needs of women and children also increase their capacities for greater social and economic progress, because the causative factors of undernutrition are all interrelated and it is difficult to isolate and classify them (UNICEF 1998:3; Vorster *et al.* 1998:21).

A 1996 World Bank study found that when children suffer from hunger, poor nutrition or ill health, they become more susceptible to disease and are more likely to discontinue schooling (American Public Health Association (APHA 2000:13).

In South Africa, undernutrition continues to be the major problem facing children. This form of malnutrition is caused by poor food intake and increased infections in young children (UNICEF 1998:4; (Food and Agricultural Organization of the United Nations) FAO 1998:2).

If current trends continue, the prevalence of child malnutrition is projected to remain high in the year 2020, with roughly 20 percent of all developing-country children under age five, or 140 million children, malnourished (IFPRI 2000: xiii). Researchers, should therefore continue with studies to find suitable products to assist children in growth and also to assist policy makers in finding possible solutions to malnutrition.

It is essential to identify the causes of malnutrition in the community to ensure the actions undertaken to address the problem are applicable and relevant to the local setting and needs. The nutritional status of children is a good indicator of the state of the whole community. This project will concentrate on the effects of a nutritious breakfast given to school children.

1.3 Motivation for this study

Growth faltering is common in children in developing countries. The reasons vary, but the most common reasons are childhood infections and/or inadequate quantity or quality of weaning foods. Children vary enormously in the way they grow. In order to assist a child to grow optimally, a variety of foods that are nutrient dense should be offered in the diet. No single food can supply all the nutrients in the quantity a child needs, for example milk supplies calcium but little iron, meat supplies iron but little calcium. For children to have a nutritious diet, a variety of foods must be offered (Allen *et al.* 1991: 95, Martin 1995:23, Wardley *et al.* 1997:75-78).

Many changes occur in a child's life when formal education begins. Lunch eaten at school is different to lunch eaten at home. Getting to school on time and having to walk distances to school can interfere with breakfast; children might be unwilling to get up in time to have breakfast and busy parents may not have time to provide their children with breakfast (Wardley *et al.* 1997:75-78).

Several studies have indicated that breakfast plays an important role in the intellectual and physical performance of school children. Children who do not eat breakfast have been shown to have changes in brain function, particularly in the speed of information retrieval in working memory; this is especially true in children who are already malnourished. There is considerable data indicating that iron deficiency is associated with impaired development during infancy, with an adverse effect on the Intelligence Quotient (IQ), learning tasks in pre-school children and poor educational achievement in children of school age (Wardley *et al.* 1997:75-78; Kruger *et al.* 2002:5-12 and van Stuijvenberg *et al.* 1999:497-503).

Adequate breakfast is defined as the consumption of one-quarter of the days protein and energy requirements of a child (Kruger *et al.* 2002:5-12). Kruger *et al.*(2002: 5-12) also concluded that very little information is available on the breakfast patterns of South African children. Cooked breakfast supplied double the number of kilojoules compared to a breakfast of porridge or bread and two to three times the fat. Although if the porridge was served with milk the protein content was the same as that of the cooked breakfast (Kruger *et al.* 2002:5-12). A study by Morrel and Atkinson (2001:111-116) in America, indicated that no differences on school attendance and performance were detected between children who received a breakfast which exceeded 15g of protein daily (recommended by nutrition experts) and a breakfast consisting of fruit juice, cereal/bread and milk.

The children receiving the cereal breakfast cleaned their plates more regularly (64%) than the children receiving the protein breakfast (53%) (Wardley *et al.* 1997:75-78). This indicates that a simple breakfast of porridge and milk with perhaps a fruit or fruit juice, is likely to be popular with school children and presenting them with a sufficient start to the day.

Official recognition that poor children are unable to properly benefit from school if they are underfed was widely received even before 1906. According to Colquhoun *et al.* (2001: 117-124), school meals cannot compensate all the nutritional deficiencies of poor children's diets, but it is recognised that they can make an important contribution. This is confirmed by Powell *et al.* (1998:873) in a study in Jamaica, where breakfast was given to children in a school and resulted in improvement in the children's school attendance. Weight gain was relatively greater than height, leading to a small increase in BMI in the children who received the breakfast. The breakfast consisted of a cheese sandwich or spiced bun with cheese and flavoured milk (2419-2953kj and 27g protein). The children in this school were situated in a mountainous rural area where the children had to walk long distances to get to school. Children from poor household gained more weight than children from better homes. The children in this study were not severely malnourished, however their nutritional status improved while receiving breakfast, suggesting that school-feeding programmes could be an effective method to improve nutritional status in countries where undernutrition is a serious problem. Powell *et al.* (1998:87) did however find that in large programs sufficient and regular food deliveries are a challenge.

A summary of school-feeding programmes by Kruger *et al.* (2002:5-12) indicated that 14-19% of school children studied skipped breakfast and that children from low income households that have breakfast eat tea and bread. Children should be encouraged to eat a nutritionally balanced breakfast every morning; this could consist of one of the following:

- High fibre cereal with skimmed milk
- Porridge with skimmed milk and a glass of fruit juice
- Whole wheat toast spread thinly with butter or margarine, boiled egg or a slice of cheese and fresh fruit or juice (Wardley *et al.* 1997:107).

A school breakfast of porridge and milk can make an important contribution to the daily nutritional needs of a child. Voster *et al.* (1992:95) indicated that 200ml of whole milk contributes 20-30% of the Recommended Daily Allowance (RDA) for protein, calcium, riboflavin and vitamin B12 for a seven to ten year old child and less than 10% of the daily allowances of energy, iron, zinc and most vitamins.

Malnutrition is a world-wide problem at its most immediate level, malnutrition is a consequence of disease and inadequate dietary intake. The implications of malnutrition include both growth failure and functional disability (UNICEF 1998:1; Vorster *et al.* 1998:19).

Enhancement of children's health and nutrition is a priority that requires immediate attention. The lives of thousands of children can be saved every day, since the causes of their deaths are largely preventable (UNICEF 1990:3).

Over the past two years, a set of goals for children have been formulated in several international forums attended by virtually all governments, relevant United Nations agencies and NGO's. One of these goals is the reduction of severe and moderate malnutrition, among children under five years old, by the year 2015 to one half of the 1990 levels. Although national strategies and policies are extremely important in addressing the problem, specific problems should be based on the real need in a specific area or group. Programmes should however be flexible and adaptable (UNICEF 1990:11-12 and Vorster *et al.* 1998:33).

1.4 Objectives of the study

The main focus of this study was to determine the extent to which a feeding programme affected the nutritional status of previously disadvantaged primary school children in the Vaal Triangle. This was achieved by determining the nutrient intake and nutritional status of primary school children, aged six to thirteen years, in an informal settlement in the Vaal Triangle before and after the implementation of a school-feeding programme.

The Vaal Triangle forms part of the Gauteng province as a strong manufacturing sector, and is situated approximately 70km south from Johannesburg.

The specific aims of this project included:

a. Establishing of the socio-demographic profile, dietary intake patterns, nutritional status and collecting development history of primary school children in the Vaal Triangle.

b. Developing a nutritionally balanced meal/snack (to be defined after needs analysis) to administer to the children and testing it for consumer acceptability.

c. In a cluster controlled randomised trial, evaluating the effect of the meal/snack on the nutritional status of the children.

1.5 Relevance of the study

Glewwe and Jacoby (1995:167) found strong evidence in a number of studies that delayed primary school enrolment was caused by nutritional deficiencies in early childhood. The authors further found little, if any, support for alternative explanations of delayed enrolment. Family income, measured by per-capita expenditures, has a significant impact on school enrolment delays only when treated as an external influence. School fees however rarely affect school enrolment delays. It was found that better nourished children tend to start school earlier and subsequently enter the labour force earlier.

Poverty in childhood is a root cause of poverty in adulthood. Impoverished children often grow up to be impoverished parents who in turn bring up their own children in poverty. In order to break the generation cycle, poverty reduction must begin with children (UNICEF 2004:15).

Faced with such assaults on children, it is worth reconsidering what the key rights of childhood should be, as agreed to by the 192 States party to the Convention on the Right of the Child. Children have the right to survival, food and nutrition, health and shelter. Children also have the right to be encouraged both informally and formally, from birth. Children have the right to a loving understanding family environment where the primary concern is their best interests, providing guidance appropriate to their evolving capacities and prepares them to live an individual life in society in a spirit of peace, dignity, tolerance, freedom, equality and solidarity (UNICEF 2004:11).

1.6 Organisation of the research report

Each objective of this study will be treated as a separate entity and thus the results of each objective can be presented and reported on its own as shown in Figure 1.1. Following the introductory chapter, a review of literature will be presented in chapter 2. The literature synthesis presents background information regarding the global and South African prevalence of malnutrition amongst children, as well as the causes and interventions currently in use world-wide. School-feeding programmes globally and in SA are also discussed.

Chapter 3 includes the pilot study undertaken, that determined the anthropometric, nutritional status and eating patterns of the children in the primary school. The study design and development of the vetkoek are described in Chapter 4, Chapter 5 deals with the intervention study where the acceptability and effect of the vetkoek are discussed, evaluated and summarised.

In Chapter 6 the results of the nutrition education investigation are discussed, evaluated and summarised.

Chapter 7 presents a synthesised discussion of the whole study, conclusions and recommendations.

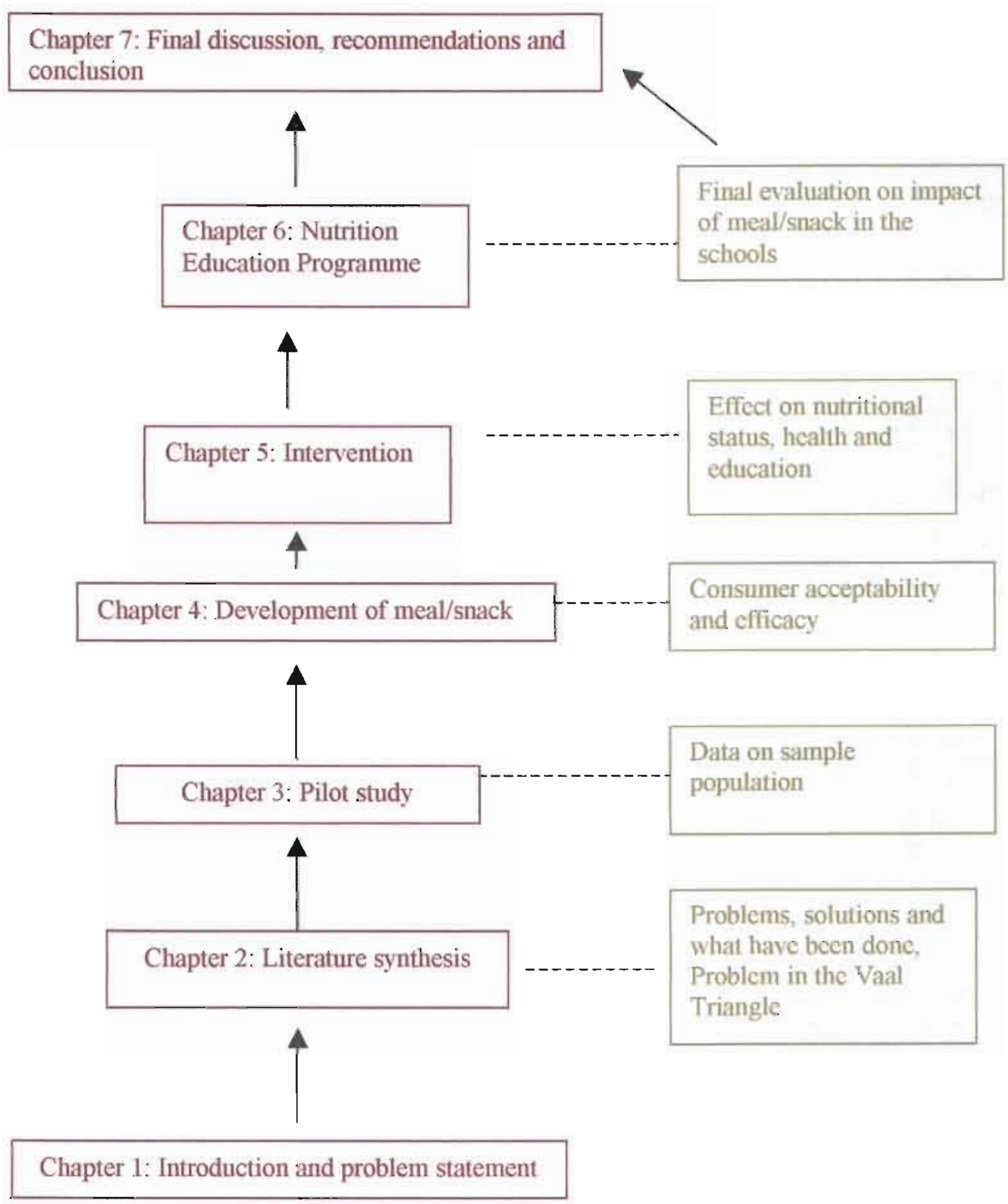

Figure 1.1: Organisation of the research report.

Chapter 2

Literature synthesis: Malnutrition amongst children

2.1 Introduction

Geographic studies in England have been used to provide evidence that the long-term effect of an adverse environment in fetal life and infancy may be the determinants of chronic disease in later life. The best environment for children to develop self-control of energy intake is one where parents provide healthy food choices but allow children to assume control of how much they consume (Bronner 1996:894).

2.2 The world-wide nutrition problem

Hunger and malnutrition remain some of the most devastating problems facing the majority of the world's poor and needy and will continue to dominate the health of the world's poorest nations. Nearly 30% of humanity including infants, children, adolescents, adults and elderly in the developing world, are currently suffering from one or more of the multiple forms of malnutrition. The tragic consequences of malnutrition include death, disability, stunted mental and physical growth and as a result, retarded national socio-economic development. Fourty nine percent (49%) of the 10 million deaths among children under five years each year in the developing world, are associated with malnutrition (World Health Organisation) WHO 2000b:1).

According to Strain (1994:107) the United States of America (USA) and South Africa (SA) were the only two countries in 1994 that did not provide health insurance coverage for all children. Bellamy (1998:18-27) indicates that the nutritional status of South African children, seen in a world context, is below the average. In Africa, one of every three children is underweight, with black and coloured children having the highest prevalence (25% and 17% respectively). Rural black children are the most vulnerable group (UNICEF 1998: 1; Vorster *et al.* 1998:31).

A new definition of childhood based on human rights is reflected in the Convention of the Rights of the child, adopted by the United Nations (UN) General Assembly in 1989. The convention is the first international human rights treaty to assimilate a universal set of standards concerning children in a unique instrument and the first to recognise children's rights as a legally binding imperative (UNICEF 2004: 3). The convention represents the culmination of a process of recognising the rights of children and the special status of childhood that gained significant momentum as the 20th century progressed. Work on the convention began in earnest in 1979 and spanned a decade. It involved exhaustive negotiation and research into different cultural interpretations of childhood. The process of negotiating, drafting and approving the convention brought governments, international agencies and NGO's to agreement around the moral necessity of protecting children's rights (UNICEF 2004: 3).

According to the Convention of the Rights of the Child, every child has the right to:

- Non-discrimination
- Actions taken in their best interests
- Identity
- Family relations and parental guidance
- Protection from illicit transfer and illegal adoption
- Freedom of expression, thought, conscience and religion
- Freedom of association and peaceful assembly
- State protection of privacy, home, family and correspondence
- Access to appropriate information
- Protection from abuse and neglect
- Special protection and assistance if deprived of the family environment
- Protection from armed conflict

- Special care if disabled
- Health and access to health-care services
- Benefit from social security
- A decent standard of living
- Education
- Rest and leisure, play and recreation, culture and the arts
- Protection from child labour, trafficking, sexual and other forms of exploitation, and drug abuse
- Protection from torture and deprivation of liberty
- Dignity and worth, even if the child has infringed the law (UNICEF 2004: 4)

UNICEF also reported in 2004 that since the convention was adopted, the world has seen concrete results. Positive outcomes include the following: substantial increases in the provision of essential goods and services, such as immunisation, insecticide-treated mosquito nets and oral rehydration salts, required by children require if they are to survive and remain healthy. In the decade between 1990 and 2000, the global under-five mortality rate declined by eleven percent and the underweight prevalence among children under five fell from 32 to 28 percent in developing countries. For the same period global access to safe drinking water rose from 77 to 82 percent. Child deaths from diarrhoea, the foremost killer of children at the beginning of the 1990's, declined by half during the decade, saving and estimated 1 million lives.

The 190 governments that convened at the UN General Assembly Special Session on Children in May 2002 pledged to accelerate progress on child development. Their commitment was reflected in a new international compact – "A world fit for children". That complemented the Millennium development goals (MDG's), adopted 20 months earlier at the UN Millennium Summit. These goals have a strong focus on children and realisation of their rights. Progress is however behind on almost all these goals and UNICEF indicates that failure to achieve the Millennium goals will have tragic consequences for children. Table 2.1 gives an indication of the progress made in the world for reaching the MDG's.

Table 2.1: Failure to achieve the Millennium Development Goals: Implications for childhood (UNICEF 2004:8).

FACTOR	GOAL	TARGETS, 2015	PROGRESS, 1990-2003/04
Poverty	Eradicate extreme poverty and hunger	Reduce by half the proportion of people living on less than a dollar a day. Reduce by half the proportion of people who suffer from hunger.	Mixed: On current trends and projections, this goal and its related targets will be achieved in aggregate terms, mostly owing to strong economic growth in China and India. However, most sub-Saharan African countries will in all likelihood miss these targets.
Primary education	Achieve universal primary education	Ensure that all boys and girls complete a full course of primary schooling	Mixed: Several regions are on target to meet this goal, including Central and Eastern Europe and the Commonwealth of Independent states (CEE/CIS) and Latin America and Caribbean. East Asia and the Pacific have almost met the target a full decade ahead of schedule. Shortfalls appear likely across sub-Saharan Africa.
Gender equality	Promote gender equality and empower women	Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015.	Insufficient: Despite significant progress towards gender parity in primary schools, shortfalls are still likely in about one third of developing countries at the primary level and over 40% of countries at the secondary level.

Table 2.1: Continued: Failure to achieve the Millennium Development Goals: Implications for childhood (UNICEF 2004:8).

FACTOR	GOAL	TARGETS, 2015	PROGRESS, 1990-2003/04
Child survival	Reduce child mortality	Reduce by two thirds the mortality rate among children under five.	Seriously off track: The fourth MDG is commonly regarded as the furthest from being achieved. Only one region – Latin America and the Caribbean – is on track, although substantial progress has been made in several East Asian countries.
Families and women	Improve maternal health	Reduce by three quarters the maternal mortality ratio.	Seriously off track: Only 17% of countries, according to 32% of the developing world's population, are on track.
Health	Combat HIV/AIDS	Halt and begin to reverse the spread of HIV/AIDS. Halt and begin to reverse the incidence of malaria and other major diseases.	Seriously off track: HIV prevalence is rising in many countries. While prevalence rates ate highest in southern Africa, the rate of increase is sharpest in Europe and Central Asia, and absolute numbers are large in China and India. Malaria is proving difficult to contain, while the global incidence of tuberculoses is rising.
Water and sanitation	Ensure environmental sustainability	Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation.	Mixed: The world is on track to meet the target for drinking water, as global access to improved drinking water sources increased from 77% in 1990 to 83% in 2002. However, progress in sub-Saharan Africa has fallen short. Sanitation remains an even greater challenge: on current trends, the target will be missed by a margin of more than half a billion people

UNICEF concluded that worryingly, in several regions and countries some of the advances in fulfilling children's rights of recent decades, e.g. reduction of child mortality rates, increasing net primary school enrolment and important strides in creating a protective environment for children; appear at risk of reversal from three key threats: poverty, armed conflict and HIV/AIDS.

2.3 Malnutrition in South Africa

The 1999 National Food Consumption Survey (NFCS) (Labadarios *et al.* 2000) indicated that at national level one out of five children in SA, aged one to nine years, are stunted. Gauteng showed a prevalence of stunting as 20%. Nationally the prevalence of stunting decreased with age from 25,5% in children aged one to three years, to 21% in those aged four to six years and to 13% in those aged seven to nine years old. A similar pattern emerged for the prevalence of underweight whilst the prevalence of wasting remained constant in all age groups at less than 4% (Vitamin Information Centre (VIC) 2001: 3).

Table 2.2: Mean nutrient intake of children 7-9 years old in Gauteng and SA (Labadarios 2000).

Nutrient	RDA	Gauteng	SA
Vit E	7IU	4.1	5.1
Vit C	45mg	31	48
Phosphorus	500mg	604	678
Calcium	800mg	282	315
Zinc	10mg	5.1	5.8
Iron	10mg	5.8	6.9

UNICEF (2004:108) indicated that the nutritional status of South African children, seen in a world context, is below the average. Table 2.3 indicates the findings by UNICEF in 2004.

Table 2.3: South Africa: basic population indicators (UNICEF 2004:108)

Basic indicators	Under five mortality rank %	Population under 18 (thousands) – 2003	Annual no. of births- (thousands) - 2003	Annual no. of under five deaths 2003
South Africa	65	17 770	1006	66

The NFCS furthermore indicated that children seven to nine years old in Gauteng (Table 2.2) have a lower intake of nutrients than children in the rest of South Africa in general and this is reflected in the baseline results of this study. According to the NFCS, 82% percent of these children take in less than two-thirds of RDA for vitamin A in South Africa, In terms of iron status, 10% of children in South Africa are iron depleted or deficient, one in twenty is severely iron depleted or deficient and one in twenty has iron deficiency anaemia. Anaemia and poor iron status are more prevalent in urban areas (SAVACG 1995:185). According to Vorster *et al.* (1997:12) multiple micro-nutrient deficiencies are present in rural black school children in the form of vitamin A, iron, folate, vitamin E and vitamin B6, in grade one to three in the Cape. For the same study it was reported that 7% were anaemic and 24% had low serum ferritin concentrations, but less than 5% had sub-clinical vitamin A deficiency.

Table 2.4: Summary of available data on anthropometry of primary school children in South Africa (6-16 years) (Voster *et al.* 1997b: 35).

Group (dates of study)	N Studies	N Provinces	N Children (groups) #	Percentage <3rd or <5th NCHS percentile or −2SD (Z score)					
				Weight-for-age		height-for-age		weight-for-height	
				Range	Mean(SD) ²	Range	Mean(SD)²	Range	Mean(SD)²
White 1976-1995	8	4	21	0-20	3.7 (4.8)	0-12	3.7 (3.5)	0-16.7	6.9 (8.3)
Coloured 1979-1993	6	3	24	1-55	26.4 (18.1)	9.1-52	24.3 (16.4)	0-20	7.8 (7.7)
Indian 1975-1993	3	2	10	0-51.5	37.6 (15.8)	0-27	13.5 (19.1)	-	-

Table 2.4 continued: Summary of available data on anthropometry of primary school children in South Africa (6-16 years) (Voster *et al.* 1997b: 35).

Group (dates of study)	N Studies	N Provinces	N Children (groups) #	Percentage <3rd or <5th NCHS percentile or –2SD (Z score)					
				Weight-for-age		height-for-age		weight-for-height	
				Range	Mean(SD) ²	Range	Mean(SD)²	Range	Mean(SD)²
Urban Blacks 1978-1995	8	3	22	3.6-55	26.1 (18.6)	7.7-54.6	19.9 (15.4)	0-22.4	2.6 (5.2)
Rural blacks 1978 – 1993	10	5	34	2-80	48.9 (24.6)	18-56	33.6 (17.2)	0-33.8	7.2 (8.4)
Rural & Urban blacks; 1980-1992	2	1		12.2-42	24.4 (8.8)	23.8-32.4	27.8 (4.3)	3.3-7.4	5.4 (2.1)

SD: Standard deviation

\# Subgroups: age and gender

² Means calculated without correction of number of subjects in each study i.e.means of reported % for each subgroup

* SAVACG –Study; 95% confidence interval and not SD given

n/N Sample size

NCHS National Centre for Health Statistics

Analysis of the data from a number of smaller studies conducted from 1976 to 1996 in which haemoglobin, red blood cell folate concentration, serum ferritin, vitamin E, alkaline phosphatase concentrations, calcium and retinol binding protein were measured, indicated the following:

- Iron and folate deficiencies exist in certain white primary school children.
- Iron and folate deficiencies exist in many coloured primary school children.
- Iron deficiency is a problem in Indian pre-school children.
- Multiple micro-nutrient deficiencies exist in rural black pre-school children (vitamin A, iron, folate, vitamin E, vitamin B6).
- Although rickets is rarely diagnosed in SA, the low serum calcium values in rural black children indicate a sub-optimal calcium and vitamin D status (Vorster *et al.* 1997b:12).

According to Walsh (1995:4) the prevalence of the malnutrition problem in South Africa is not clearly defined due to the previous absence of a national nutrition surveillance programme. The only data available still consists of single fragmented surveys that have been undertaken amongst isolated groups. A study by Napier (1999:58) indicated that 39% of Children in day-care centers in the Vaal Triangle are stunted, the children from that study will now be primary school children. Nutrition interceptions of the Birth to Twenty Research Programme - Wits University (Bt20) were conducted from 1991 to 2000 when the children chosen for the programme were 1,5,7,9 and 10 years of age. Black children provided nutrition information. The intake of 26 nutrients was assessed and calcium, iron, zinc and biotin were the most common nutrients that fell below the RDA, with a large percentage of children well below the recommended intake. It was also found that the nutrient intake of these children appeared to deteriorate from 1995 to 2000 with the lowest intake for most nutrients recorded at 10 years (Health & Hygiene 2005:28).

In order to address the nutrition problem in South Africa, the South African government has identified the following programmes as the key medium to long-term programmes to drive the implementation of the Reconstruction and Development Programme (RDP):

- meeting basic needs – urban and rural development,
- human resource management,
- democratisation and institutional reform,
- economic restructuring (Republic of South Africa (RSA)1994:12).

Spowart (1998:26) indicates that "South Africa lacks a National Nutrition Surveillance System". The necessity of surveillance was recognised by the nutrition committee (1994) and a system has been developed and implemented in clinics. It includes monitoring the growth and well-being of under five year olds, giving special attention to vulnerable groups, which include women's health, people living in rural areas, rehabilitation, mental and chronic illnesses and the elderly. This, together with the introduction of a National Health System which would ensure that medical attention is available for all ((ANC) African National Congress 1994), forms part of the new strategies and policies of the Directorate of Nutrition within the Department of Health (DoH).

2.4 Factors contributing towards the development of malnutrition

It was suggested by UNICEF (1990) that in order to improve nutritional status the following are required: adequate household security, a healthy environment, control of infections and adequate maternal and child-care. According to Solomons *et al.* (1993:327), poor growth appears to be strongly influenced by environmental factors as well as nutrition. Figure 1.1 indicates the immediate, underlying and basic causes of malnutrition (UNICEF 1998:2). Three clusters of underlying causes lead to inadequate dietary intake and infectious disease: inadequate access to food in a household; insufficient health services and an unhealthy environment and poor health services, including inadequate care for children and women (UNICEF 1998:4; FAO 1998:2).

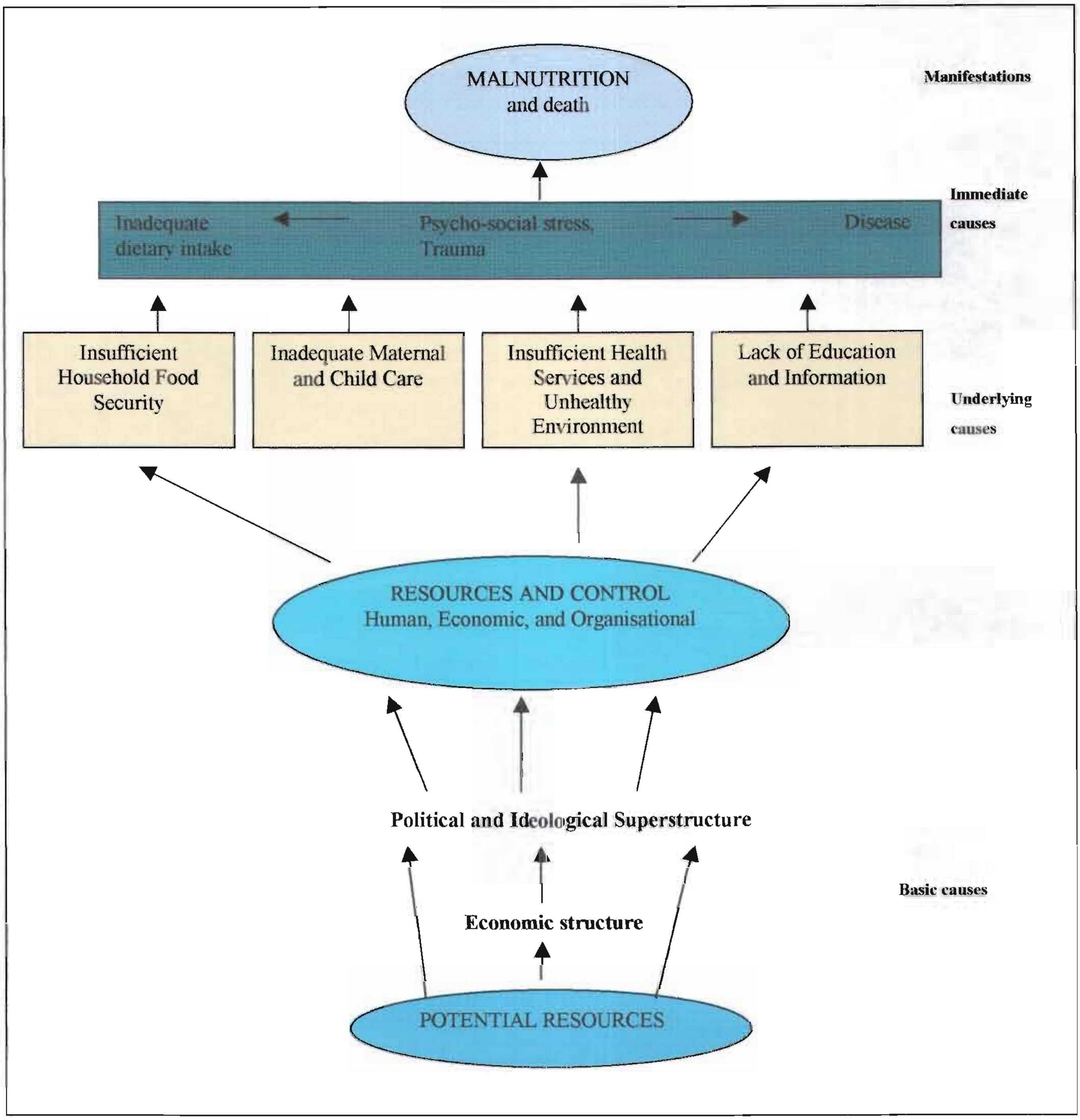

Figure 2.1: Immediate, underlying and basic causes of malnutrition (UNICEF 2004)

2.4.1 Immediate causes of malnutrition

The interplay between the two most significant immediate causes of malnutrition, inadequate dietary intake and illness, tend to create a vicious circle: A malnourished child, whose resistance to illness is compromised, falls ill, and nutrition worsens (DoH 1998:12 and Bellamy 1998:4).

2.4.1.1 Inadequate dietary intake

Young children are often at risk of being malnourished. They have very high energy and nutrient requirements for their body size, in comparison to adults. Proper care and feeding is essential for their normal growth, development and activity. They should be encouraged to eat enough of a variety of energy and protein-rich foods and fruit and vegetables for growth and body maintenance (FAO 1996:14).

Marasmus occurs in infants who are weaned very early and who are fed diets that are low in calories as well as protein (Robinson & Weighley 1980:52).

There are many reasons why people fail to consume enough vitamins and minerals in their diets. Vitamin A and iron are found in certain fruits, vegetables, and animal products that may be seasonal or too expensive. The manner in which people prepare and consume food may further reduce their nutrient intake. Many cultures have rules for what pregnant and nursing women, children, the elderly or persons recovering from illness should eat; these rules often exclude many micro-nutrient-rich foods (USAID 1993:5).

Breastfeeding provides the best nourishment and protects children from infection. However, a child must have complimentary foods at the age of six months, since breastmilk no longer meets all the nutritional needs. From about six months to 18 months of age the child needs frequent feeding, at least four times a day, and requires meals that are both in both energy and nutrients and also easy to digest (Bellamy 1998:4).

Micro-nutrient deficiencies also play a role: A child that is for example deficient in Vitamin A, faces a 25% greater risk of dying. Even when it does not threaten life itself, malnutrition in early childhood can cause stunting or disability, hinder brain development and children's capacity to learn, hampering their ability to acquire skills that are critical to their life changes (UNICEF 2004:17).

2.4.1.2 Disease and illness

Poverty threatens childhood by exposing millions of children to diseases that could be easily prevented or cured through inexpensive medicines and vaccines. Two million children under the age of five still die every year because they were not immunised with commonplace vaccines. Seven out of ten deaths among children under the age of five in developing countries can be attributed to a few main causes: acute respiratory infections, diarrhoea, measles or malaria (UNICEF 2004:17).

Two forms of Protein-Energy-Malnutrition (PEM), kwashiorkor and marasmus, are seen in infants and young children. These conditions are often seen in conditions of severe poverty, or as a result of parental ignorance regarding infant feeding and/or child neglect. Kwashiorkor appears after the infant has been weaned from the mother's breast. Usually the infant obtains enough calories, but the high carbohydrate foods do not supply enough protein (Robinson & Weighley 1980:52).

When a child is sick the following difficulties are experienced in eating well: fatigue, vomiting, nausea, poor appetite, pain from the disease or treatment, drowsiness from medication, fear and anxiety. Just as with adults, the emotional, psychological, social, and physical needs of sick children require careful consideration (FAO 1998:14;

Stanfield 1996:323). Frequent infections, especially measles, diarrhoea and acute respiratory infections can cause vitamin deficiency in a community and therefore malnutrition (DoH 1998:12).

Nutrition deficits, based on an insufficient diet, are not the sole explanations of early growth failure and ultimate short stature. Recurrent, overt infections of the respiratory and gastrointestinal tracts can also induce growth failure. It is also stated that these infections act by reducing dietary intake and possibly by redirecting nutrients way from physiological processes that result in growth and toward processes related to host defence and catabolism. Epidemiological studies have demonstrated relationships between the frequency of infections and growth failure; it is believed that the former causes the latter (Solomons *et al.* 1993: 327).

Good health is necessary to ensure optimal nutritional status, and good nutrition is needed for maintaining health, growth and development. The WHO reported that "Prevention of infection and management of infectious diseases, in order to minimise their incidence, duration and severity, are essential for optimising nutrition. Access by all to adequate health care services is needed to ensure priority actions such as immunisation, early diagnosis and management of infectious diseases such as diarrhoea, respiratory diseases, measles, malaria and TB". Health and nutrition education and growth monitoring are also facilitated by the promotion of primary health care (WHO 2000:2).

AIDS is already the leading cause of death world-wide for people aged fifteen to forty nine; in 2003 alone, 2.9 million people died of AIDS and 4.8 million people were newly infected with HIV. Over 90% of people currently live with HIV/AIDS are in developing countries. Sub-Saharan Africa is experiencing rising child mortality rates due to HIV/AIDS and sharp reductions in life expectancy is expected for millions of orphans.

Although the problem is most acute in this region, prevalence rates are also rising in other parts of the world (UNICEF 2004:11).

When households have members that are HIV/AIDS positive a child's life can be severely affected. By 2003, 15 million children under the age of 18 had been orphaned by HIV/AIDS. In 2001 the number of AIDS-orphans stood at 11.5 million world-wide. Eight out of ten of these children live in sub-Saharan Africa. It is estimated that by 2010, more than 18 million African children will have lost one or both parents to HIV/AIDS (UNICEF 2004:67). The number of children, who lost both mother and father, will increase by about 2 million over the same period. Millions more live in households with sick and dying family members (UNICEF 2004:67).

According to UNICEF (2004:67), the illness or death of a mother or caregiver during a child's first year jeopardises the fulfilment of that child's basic needs (including access to adequate health care, sanitation and nutrition) subsequently threatening their right to survival. HIV/AIDS also deprives children of the right to live in a family environment, which is crucial for the development of a positive self-identity and self-esteem. The disease increases the likelihood that children will be institutionalised, live on the street or be subjected to child labour. In Figure 2.2 malnutrition is depicted as the greatest cause of child mortality.

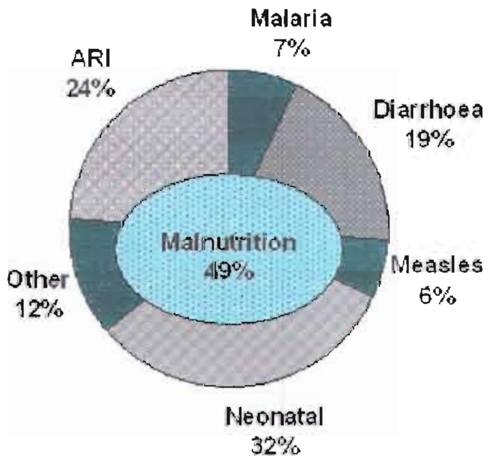

Figure 2.2: Causes of child mortality.

2.4.1.3 Psycho-social stress and trauma

Early nurturing and stimulation lay down the neurological pathways that promote improved learning, health and behaviour throughout life. The influence of early nurturing and stimulation on brain development includes impacts on the immune and stress regulation systems (UNICEF 2004). Children who have a healthy interaction with parents develop emotionally and physically, and even if malnourished still experience higher growth rates. Several studies have found that malnourished children who were verbally and cognitively stimulated have higher growth rates than those who were not (UNICEF 2004). Households under stress from hunger, poverty and disease will be adopting a range of strategies to relieve their impact through complex multiple livelihood strategies (De Klerk *et al.* 2004).

2.4.2 Underlying causes

The underlying causes of malnutrition include insufficient household food security, inadequate maternal and childcare, insufficient health services and unhealthy environment and lack of education and information.

2.4.2.1 Household food insecurity

Food security historically refers to the overall regional, national and global food supply and shortfalls in supply compared to requirements. Maxwell (1996:291) defined household insecurity as "secure access at all times to sufficient food for a healthy life".

Due to urbanisation growth in urban poverty, food insecurity, and malnutrition shifted in their concentration from rural to urban (Garrett 2000). A number of factors will affect the future shape of urban food insecurity and malnutrition. Because urban dwellers must buy most of their food, urban food security depends mostly on whether the household can afford to buy food, given prices and incomes. High cost of food result from inefficient urban food-marketing systems and because the poor usually can buy only small quantities of food at a time rather than in bulk. Inflation and depreciation in the exchange rate can push prices up. Policies to improve urban food security must therefore seek to improve market efficiency and maintain stable prices (Garrett 2000).

Income security is also crucial to food security for urban dwellers. To lift the poor from poverty, programs and policies should concentrate on crating jobs. Urban food security may also have a direct link with agriculture. Evan in larger cities the urban poor may have a home garden or raise small animals as part of a coping strategy. The production is often done by women and can compliment the household income and improve the quality of the urban diets (Garrett 2000).

Food security is not enough for good nutrition. A healthy household environment and good care and feeding practices are essential as well (Garrett 2000).

Based on the WHO health-related framework, food and nutrient security includes action to ensure that:

• Pregnant mothers have access to the foods needed to meet the nutritional requirements of pregnancy.
• The growing foetus has it's iodine requirements met.
• Infants have access to breast-milk, exclusively for the first six months of life, with continued breast-feeding.
• Infants and young children consume an adequate, safe and balanced diet to ensure optimal growth.
• Iodine requirements are met through the intake of iodised salt.
• Vitamin A requirements are met through the diet, fortified foods and supplementation, if necessary.
• Iron requirements are met through a balanced diet, fortified food and supplementation, if necessary.

• Folate requirements are met, particularly by adolescent girls and pregnant women.

• Households and families have access to sufficient safe food throughout the year to meet all nutrient requirements of all household members (WHO 2000:10).

Urban planners and local governments should consider how to incorporate environmentally sound urban agriculture in their plans. Governments, development agencies and communities must work to promote policies, including those that promote rural development, to confront rising urban poverty, hunger and malnutrition to achieve the 2020 vision for sustainable food and nutrition security for all (Garrett 2000).

2.4.2.2 Inadequate maternal and child care

In the majority of households, women usually take responsibility for the home and child care (Kibel and Wagstaff 1995:97) and when the health of women is compromised care of the children usually suffer as a result.

Inadequate maternal and childcare result from a combination of poor education, ignorance, eating away from home, pregnancy, breast feeding and weaning practices.

- Education and ignorance

The causes of growth retardation are deeply rooted in poverty and lack of education (WHO 1993:711). Briley *et al.* (1999) suggested that "educational materials and workshops are needed to help parents plan meals and snacks that complement menus of child-care centers and reinforce the healthy food choices that are modelled in child-care meal patterns". Their study further identifies the special need for education and training targeted at parents to discourage children from eating fats, oils and sweets during the time away from the child-care center.

According to UNICEF (1990:18), all countries should commit themselves to specific measures towards the expansion of early childhood development activities and universal access to basic education. The value of education for human development and improving the quality of life, as well as progress in education and literacy can contribute significantly to the improvement in maternal and child health, protection of the environment and sustainable development. Investment in basic education must therefore be a high priority in order to reduce malnutrition and poverty.

In order to achieve optimal development, children require emotional support and cognitive stimulation from parents and other care-givers (Bellamy 1998:4). It has been proved in several studies that malnourished children who were given the necessary support and stimulation had higher growth rates than those who were not.

Stitt (1996:5) notes that the legislation that was introduced in Spain in 1997 to make nutrition education part of the Spanish National Curriculum that has established more advanced education programmes and policies in order to provide basic food knowledge at school level. A Canadian study of 38 000 Canadians reported that people in the upper-income group are significantly healthier than people in the lower income groups in 11 out of 12 cases. This report concluded that the association could largely be attributed to the link between diet and education. The fact that better health is mostly found in the wealthier group suggests that Canada failed to make nutrition education part of the public education curriculum (Stitt 1996:5).

Adult literacy can play an important role in improving the situation of women in developing countries. Informal education about relevant nutrition-related topics can also greatly improve the malnutrition problem in developing countries (WHO 2000). The more knowledgeable the mother is about issues related to nutrition the better she will be able to feed and care for her children.

According to UNICEF (2004), over 140 million children in developing countries, 13% of those aged seven to eighteen, have never attended school. This rate is 32% among girls in sub-Saharan Africa, where 27% of boys also miss out on schooling, 33% among rural children in the Middle East and North Africa. The gender gap is greatest in the latter region, 34% of girls and 12% of boys there have never attended school. In South Asia these percentages are 25% and 14% respectively, contributing significantly to the overall global disadvantage girls suffer. World-wide, 16% of girls and 10% of boys miss out on school completely.

- Eating away from home

The American Dietetic Association (ADA 2003) reported that there is concern that the increasing popularity of dining out will lessen control over what children eat and how it is prepared, and subsequently the nutritional quality of the diet. In America it was established that foods prepared away from home provided lower levels of cholesterol, fibre, calcium, iron and sodium and higher levels of total fat and saturated fat than foods served at home. It was also established that food prepared at schools during 1989 to 1991 were higher in fat, fibre, and calcium and lower in cholesterol, iron and sodium than home foods. It is therefore essential that day-care centers and schools follow the correct dietary guidelines to ensure that children receive the necessary nutrients to ensure a healthy nutritional status. The portion of the food budget spent away from home has been rising in recent decades and is expected to continue upward in the future. As children get older, they tend to frequent fast food outlets with their peers rather than eat at home with their parents. Children need to learn to select nutritious foods and gain nutritional knowledge at an early age.

- Pregnancy

Undernutrition mostly commences in utero and it is estimated that the incidence of low birth-weight in underdeveloped countries is about 20%. Although small for gestational age or low birth-weight babies experience catch-up growth with adequate nutrition, their ultimate height rarely matches the height of well fed normal birth-weight babies (Rothwell 1994:22).

Bellamy (1998:5) recommends that pregnant women should be given extra quantities of good quality food, released from hard labour, adequate time for rest and skilled pre- and post-natal care from trained practitioners. These recommendations will ensure a normal weight-for-age baby and with follow-up breastfeeding the baby will at least have a good start in life.
Furthermore adequate nutrition for mothers before, during and after birth is vital to reduce infant mortality, usually resulting from maternal malnutrition (UNICEF 2004). Birth intervals should also be increased to benefit both the mother and child (Kibel & Wagstaff 1995:158). Family planning forms an important part of maternal care and contraception should be introduced to women in order to plan family spacing, the major objective of which is to enhance the mothers health status and thus the birth outcomes (UNICEF 2004).

A marked increase in the maternal blood supply during pregnancy greatly increases the demand for iron. It is rare that women enter pregnancy with iron stores sufficient to cover all the needs without compromising maternal well-being (Fagen 2000:178). An anaemic woman is less able to tolerate haemorrhage with delivery and is more prone to develop puerperal infection (Fagen 2000:178).

Women who smoke and use oral contraceptives have ten times greater risk of Coronary Heart Disease (CHD). Risk also increases with the number of cigarettes smoked each day. Studies showed that among races black people smoke more than other races (Krummel 2000:570). Smoking and excessive alcohol consumption is risk factors for developing osteoporosis. Women who smoke about one pack of cigarettes daily will have an average deficit of 5% to 10% in bone density, which increases the risk of fracture. Women who smoke enter menopause one to two years earlier and lose bone more rapidly than non-smokers (Anderson 2000:628). The health of the mother is thus at risk due to smoking habits.

- Breast feeding and weaning practices

According to Rothwell (1994:22) inadequate quantities of breast milk from poorly nourished mothers and inappropriate weaning practices in infancy may contribute to stunting in later childhood. Furthermore, recurrent infections as a consequence of both undernutrition and a poor socio-economic environment slow down growth and aggravate the problem.

Breastfeeding provides the best nourishment and protects children from infection. Children from six months should, however, get complimentary food to meet the all their nutritional needs. From six to eighteen months a child needs frequent feeding and meals that are high in energy and nutrients and also easy to digest (Bellamy 1998:4-5).

According to Brown (1995:323) the caregiver of a child has primary control over the frequency at which foods are offered to the young child, the amount served, the technique with which they are provided (i.e. by spoon, hand and feeding bottle), the composition of these foods and the level of encouragement or forcefulness used to feed the child. It is therefore important that the mother/caregiver use correct feeding practices for the correct age. A study done in Peru conducted in Peru showed that the perceived appropriate age for the introduction of complementary foods is related to the caregiver's notion of when the child is ready to eat. This is generally viewed in terms of the child's development, the presence of teeth, the readiness of the child to receive solid food, the ability to swallow food and the demonstration of an active interest towards food. Recognition of these characteristics varies according to the cultural setting. In certain communities, an infant may be perceived as wanting to eat or needing to begin taking in solid food as early as two to four months of age; in rural highland populations, this is perceived to occur at eight to ten months. In every case, the concept that foods must be introduced gradually is present. The premature introduction of solid foods may result in the child not obtaining enough food to ensure proper nutritional support. This could then result in malnutrition.

Brown (1995:332) reports that studies have shown that the caregiver may misconstrue certain foods as being appropriate for weaning children, which could also result in deficient intake of the essential vitamins and minerals through the diet. Full-term infants with appropriate weight for gestational age should be exclusively breastfed until six months of age.

2.4.2.3 Insufficient health services and unhealthy environment

Affordable and accessible health services, safe water, proper sanitation and absence of unhygienic conditions in and around the house are of utmost importance to ensure an essential element of good health. In South Africa only 27,4% black households had running tap water inside their dwelling, whereas 98,4% white people, 97,7% Asian households and 76% of coloured households had running water in 1994. As far as sanitation is concerned, an estimated 12,6% of the black households had no facilities (Central Statistics Services (CSS) 1995:iii).

It was also reported by Grant (1996:51) that the lack of clean water and safe sanitation is one of the greatest divides between the absolute poor and the rest of humanity. In urban slums in particular, the lack of adequate sanitation devastates the quality of life. Due to heat, flies and smells, disease is dominant and permanent. The World Summit for Children held in 1994 set a goal to provide clean water and safe sanitation for all communities by the year 2000. UNICEF reported during 2004 that 400 million children, an average of one in every five children in developing countries, have no access to safe water. The situation is particularly severe in sub-Saharan Africa. Rates of severe water deprivation are considerably higher in rural areas (27%) than in urban areas (7%). According to the Food and Agricultural Organisation of the United Nations (FAO) (1998:23 & UNICEF 2004:20) fresh and clean foods are important to good nutrition and child survival. Steps should be taken to prevent food from becoming mouldy and contaminated with food poisoning bacteria, which reduce the food's nutrient value and causes disease. Children that are healthy and well nourished are usually not affected by most bacteria that they come into contact with. Eating contaminated, unsafe food can however quickly cause illness. Undernourished or weakened children usually have a lower resistance and increased risk of illness due to disease-causing bacteria. It is thus essential that clean water be used for the preparation of breast milk substitutes and weaning food. Boiling the water used for these purposes and ensuring all utensils are clean reduces the risk of sickness.

According to Brown (1995:320) the frequent occurrence of microbial contamination of non-breast milk foods in many developing countries can substantially increase the risk of diarrhoea and other infectious diseases, possibly resulting in a net negative impact of these foods on nutritional status and other adverse health outcomes.

Over 500 million children, one in every three children in the developing world, have no access whatsoever to sanitation facilities; again, the problem is particularly pronounced in rural areas. Without access to sanitation, children's risk of disease rises dramatically, further jeopardising their chances of survival and often reducing the likelihood that they will be able to take full advantage of schooling. Millions of school-aged children are for example infected by intestinal worms, which have been shown to sap learning ability (UNICEF 2004:22).

According to UNICEF (2004:20) lack of access to clean water and proper sanitation spread disease, aggravates malnutrition and weakens health. The lack of access to decent sanitation facilities is particularly pronounced in rural areas of developing countries. Unless progress accelerates markedly, over half a billion children, one in every three children in the developing world, will continue to be denied access to any sanitation facilities whatsoever.

An essential element of good health is access to affordable health services, currently inadequate facilities and shortages of personnel and basic medicines at primary care centres reduce availability of tertiary care for the poor (Padarath 2004). Grant (1996:50) showed that at the end of the 1970's less than 10% of the children globally were being immunised. Measles, whooping cough, tetanus and diphtheria were claiming the lives of more than 13 000 children every day. Many millions more were left deaf, blind, or crippled by polio and measles and the nutritional health of even larger numbers were undermined by preventable diseases that depress the appetite, burn energy in fevers, inhibit the absorption of food and drain away nutrients through diarrhoea and vomiting. Against this background, the World Health Assembly set the goal of immunisation coverage for 80% of the world's children by the end of 1990.

The public health sector is the main provider of public health care in South Africa and it is important that these services are provided in an effective and efficient manner (Roberts *et al.* 2004).

2.4.2.4 Lack of education and information

Children should have the opportunity to learn about food, food sources, nutrition and the link between nutrition and health. According to Stitt (1996:5) countries such as Belgium have already implemented nutrition education programs in nursery, primary and secondary level schools. The aim is to enhance the nutrition environment in these schools leading to:

- Actual improvement in school children's eating habits.
- Changes in the school nutrition environment, dietetic, material, organisational and educational components.
- Involvement of the various participants in the education system in the long-term maintenance of the quality of the nutritional environment (Stitt 1996:5; Harnack *et al.* 2000:703).

To promote a positive attitude towards good food habits, it is important that parents and caregivers help children understand they are 'good kids". What children do may be unacceptable at times, but they must know who and what they are inside: i.e. normal, healthy children. Hans *et al.* (1995) recommend that if the child refuses to eat or wastes time over a meal longer than half an hour, remove the plate without comment and then limit or omit between meal snacks.

Unfortunately political, legal and cultural factors may defeat the best efforts of households to attain good nutrition. If individuals are to make informed choices about their diet and health, they need to have a good understanding about food and nutrition. For this to happen, all pupils should receive comprehensive food education while at school, beginning at five years of age and continuing throughout their school career. There is a growing realisation that our ability to communicate nutrition concepts and advice has not kept pace with scientific knowledge. More should be known about how to optimise existing food habits (Bellamy 1998:5, Stitt 1996:10 and Caliendo *et al.* 1978:72).

2.4.3 Basic causes of malnutrition

The basic causes of malnutrition include the number of people in the household, ethnicity, education levels of parents, occupation of parents, family income, housing characteristics, urbanisation, poverty, unemployment, politics, social structures, religion, beliefs and ideological factors and family food expenditure per month (UNICEF 1998).

2.4.3.1 Demographic and family resources

According to Kennedy & Goldberg (1995:111) in 1960, 90% of the children in America were living with two parents, less than 1% experienced the divorce of their parents and 18,6% of married woman with children were in the work force. In the 1990's only 70% of American children lived with both parents, almost 50% had experienced the divorce of their parents, and 60% of women with young children were in the labour force. Although it is indicated that the nutritional status of children has improved and infant mortality has decreased since the sixties, it can mostly be accredited to improved health care and better nutrition.

In South Africa 32,8% of employed people usually travel to and from work in the dark (CSS, 1995:37). This must have an influence on household routine and eating patterns. If South Africa adopts a similar growth in single parent households, divorce and working mothers, as found in America, it is likely that less money will be available per household. This may influence the nutritional status of children in SA.

The official unemployment rate of SA in September 2004 was 26.2% (413 000 persons) (Government Communication and Information System (GCIS) 2005). The highest unemployment rate occurs amongst black people, namely 41,1% followed by Asians 17,1%, Coloured people 23,3% and white people 6,4% (CSS, 1995:ii). Black women continue to be the most affected by unemployment, more than seven times the figure of unemployed white males (GCIS 2005). These unemployment figures provide a good indication of the socio-economic situation and similar to malnutrition, unemployment occurs over years and not only in a few days. The amount of people in South Africa that are unemployed could possibly be linked to the nutritional status of the children because of very little or no income coming into households.

UNICEF 2004 reported that 640 million children in developing countries experience severe shelter deprivation, with those in sub-Saharan Africa clearly the most deprived. However, the lack of access to proper shelter is also widespread in both South Asia and the Middle East and North Africa, in the latter region, rural children are more than four times more likely than their urban counterparts to be shelter deprived.

It is alarming to note that 11.8 million of the poorest 23.8 million South Africans lived in households that received no social assistance during 2002 (United Nations Integrated Regional Information Networks (IRIN) 2004).

According to Julian (1989:34) there were 12 million rural people in South Africa in 1989 and by the year 2000 the rural population is estimated to have increased to 20 million. Unless rural areas develop socio-economically to accommodate the majority of their population growth, the flow of people to the cities will amplify, existing problems of unemployment, slums, poverty, malnutrition, disease and escalating crime.

Children living in rural areas in the developing world are, on average, twice as likely to be severely deprived of essential goods and services as their urban peers. They are also twice as likely to suffer severe nutritional deprivation and three times more likely to never attend school. Of course, not all urban children enjoy the same living conditions. For instance, children who live in squatter settlements may fare even worse than their rural counterparts (UNICEF 2004:22-23).

UNICEF (1990:15) recommended that the family should have the primary responsibility for the nurturing and protection of children from infancy to adolescence, and that the family should introduce children to the culture, values and norms of the society. Children should grow up in a family environment in an atmosphere of happiness, love and understanding to ensure that they feel safe and for the full development of their personalities It is furthermore important that all institutions and society support the efforts of parents and care-givers.

Hans *et al.* (1995) found that "when children join the family at meal times he or she learns about the special aspects of food – the sharing of food and pleasant talk of the day's activities". According to Bellamy (1998:4) household food security depends on access to food as well as availability. There might be a variety of foods in the shops, but the family might not be able to afford to buy it. Such a family is also defined as not food secure. The influence that the child has over dietary decisions is well recognised and exploited by food advertising and the media. The influence and interaction of the pre-schooler with those who provide food must also not be overlooked.

Dietary practices are also directly influenced by the family as it provides the child with food and nutrients and indirectly influences dietary practices by transmission of attitudes, preferences and environmental factors which affect the child's lifetime eating patterns (Caliendo *et al.* 1978:69-71).

2.4.3.2 Poverty

As children experience poverty in an environment that is not conducive to their development, rather than merely a lack of income, achieving the income target will make only a moderate contribution to ensuring that every child enjoys a childhood. China an India are on track to meet their income targets, but are falling behind on Millennium Development Goals (MDG's) directly related to children, especially reducing child mortality. Halving hunger will have a pronounced impact, as malnutrition is a contributing factor in over half of under-five deaths in developing countries (UNICEF 2004:9).

UNICEF furthermore reported that poverty is the root cause of high rates of morbidity and mortality in childhood. The rights of over 1 billion children, more than half of the children in the developing countries, are violated because they are impoverished and severely underserved of at least one of the basic goods or services that would allow them to survive, develop and thrive. In the developing world more that one in three children does not have adequate shelter, one in five children do not have access to safe water and one in seven has no access whatsoever to essential health services. Over 16% of children under five lack adequate nutrition and 13% of all children have never been to school.

Estimates show that the proportion of people living in poverty in SA has not changed significantly between 1996 and 2001. However those households living in poverty have sunk deeper into poverty and the gap between the rich and the poor has widened. In 1991, 48,9% of households in South Africa were living below the Minimum Living Level (MLL), this amounted to 17 million people that lived in poverty in 1991. More than a quarter of the population were living on incomes of less than half the MLL. A much higher incidence of poverty was found among households headed by a female and households located in the rural areas, compared with male-headed households and urban households (Whiteford & McGrafh 1991:74). Approximately 57% of individuals in SA were living below the poverty income line in 2001, unchanged from 1996. Gauteng had 42% of the population living below the poverty income line (Human Science Resource Council (HSRC) 2004).

Whiteford & McGrafh (1991:74) suggested that if poverty was to be eliminated through economic growth, the economy would have to grow at a rate of 5% for 24 years or alternatively at 2,5% for 47 years. It can be safely said that SA has not yet been able to grow at these rates and poverty has still not been eliminated and remains a factor in SA.

According to May (1998:38) the essential features of the poor are that they usually are:

- Isolated from the community being unable to mix easily with other people.
- The children are malnourished and the food that is served is of poor quality.
- The homes are crowded and not maintained.
- Nobody in the household is employed.
- Families are split, with fathers not present and children living elsewhere.

Looking at malnourished children as a feature of poverty, Chopra & Ross (as quoted by May 1998:38) indicated that certain household features were perceived by the participants as characterising the poorest homes in their village. These features include:

- female headed households,
- homesteads that were in bad repair,
- crowded,
- little or no food,
- many children and
- not part of the community gardens or creché.

South Africa is characterised by uneven development with extreme poverty in many parts of the country. Basic infrastructure is lacking in the poorer areas of most provinces. In all provinces the spatial distribution of resources is extremely uneven (RSA 1994:20).

In South Africa it is unfortunately true that many communities and families depend almost entirely on the cash from pensions and disability grants. Even though there has been a high level of dependency upon these services, many who are entitled to grants or pensions do not receive them (RSA 1994:35).

UNICEF (1990:22) also stated that the goals set to alleviate problem areas in health, nutrition and education will eventually also alleviate poverty, but much more needs to be done to ensure the establishment of a solid economic basis to meet and sustain the goals of long-term child survival, protection and development.

2.4.3.3 Urbanisation

Caliendo *et al.* (1978:69) found that dietary intake is recognised as being only one of many environmental factors which interact with the generic potential of the young child to affect physical and mental development. A number of environmental factors acting together contribute to malnutrition. According to the Medical Research Council (MRC) (as quoted by Spowart 1998:15) a number of researchers have indicated that urbanisation may have in a negative impact on health, particularly where overcrowding is prevalent and health and sanitation services are lacking. Spowart (1998:15) contends that the social, economic and health status of urban people can improve with more available employment, education and health facilities.

2.4.3.4 Ideological factors

Ideological factors include religion, culture, tradition and beliefs. All of these can influence the production and provision of food in a country or community (UNICEF 1998). Different culture groups have different variations in food patterns, depending on individual and family values and preferences, food cost, availability and the desired foods (Robinson & Weighley 1980:172).

Expenditure on food constitutes the largest single expenditure category for the world at large. Food and drink constitute approximately 21% of total expenditures in Western developed countries, but more than 50% in many of the more densely populated third world countries, notably India and China. In both economic and moral terms, food is more central in the lives of Third World societies than First World societies. Food plays a central role in development; nursing and weaning are major features of early life; there is nothing more important in early life than learning about what is edible and what is not. Food is also a center for parent-child interaction. Such interactions are not always positive, one of the most frequent complaints American parents of toddlers make to their paediatricians is that their toddlers accept only a very narrow range of foods. Food plays a central role in human folk psychology, too. People in traditional cultures typically believe that "you are what you eat". They put forth the very reasonable suggestion, in accordance with most experiences in the world, that when food and food consumer mix, the consumer takes on properties of the ingested food. Thus, eating owls improve night vision, eating lions foster bravery, eating a fast growing plant promotes growth, eating one's friend's food promotes one's well-being, and eating one's enemies foods dims one's prospects. There is evidence suggesting the existence of an implicit belief in "you are what you eat" in educated westerners (Rozin 1998:4-5).

Rozin (1998:5) further states that the social roles of food are particularly clear in immigrant groups, who seem to retain their ethnic identity through food long after they have become assimilated in most other ways. Similarly, food habits and taboos frequently serve as markers for particular culturally defined groups of people. The sharing of food is a major feature of the expression of solidarity, just as avoidance of food sharing is an expression of social distance, especially in Hindu India. Even in the American culture, the sharing of food is an indicator of close relationships.

Food is often central in religious systems: the eating of an apple is the core of the Adam and Eve story. In the Hindu religion, ritual purity is largely maintained by food offerings to the deities and the avoidance of foods that are polluted by virtue of their nature or previous human contact (Robinson & Weighley: 1980:169 & Rozin 1998:5).

Foods are often classed as being suitable for babies, young children or adults (Robinson & Weighley 1980:169). Despite the centrality of food in human life, the types of foods that humans eat, the selection of these foods and their role in daily life have largely escaped the interest of academic psychology. The only food issue that is given serious attention is the quantity that humans eat, but why humans eat this should not be seen as trivial (Rozin 1998:6).

2.5 Factors affecting a child's nutritional status

According to Stanfield (1997:122) and De Onis *et al.* (1993:710) there is overwhelming evidence that chronically undernourished infants and children have depressed cognitive and psychomotor development. This is the consequence of a deprived social environment, that is also predisposed to malnutrition. It is also accepted that undernourished children may compromise play and other physical activity in order to conserve energy for growth.

The WHO 2000 stated that time, attention and behaviour are needed to care for the nutritionally vulnerable and ensure that food, health and love are sufficiently provided to guarantee healthy nutrition. Breast-feeding, and the correct supplementary feeds for infants and young children are vital to achieve optimal nutritional health. Improved education, literacy, social security, employment opportunities and rights of women are needed to ensure that the family reaches and maintains optimal nutritional health.

A number of factors can affect the dietary intake and thus the nutritional status of children. Four of these include food choice, food trends, new foods, early experiences with food and education of the child and care-giver.

2.5.1 Food choice

Food choice in childhood is important for a number of reasons. First it determines nutritional intake which promotes health, growth and development at this early stage in life. Second, food choice is important in the establishment of good eating habits, that will probably be carried through into adulthood. Once established, dietary habits are difficult to change. Third, diseases such as dental caries and obesity which manifest in childhood, have been related to dietary intake. A wide range of complex and often interrelated factors such as social, economical, cultural aspects and psychological patterns influence the choice of food. They may be influenced by interactions with other groups, so that to some extent intermingling of patterns takes place (Stanfield 1997:23). However, the most direct/immediate influence on children's food experiences gained in the early years, is predominated by home, parents and family (Douglas, 1998:22). According to Bronner (1996: 894) children are good targets for heath education messages because their habits are still developing and they are in schools and families that can influence their health behaviour as well as their food choice. Children should form their own opinions on what foods they like and what is good for them. They should have enough knowledge to make food choices that are healthy and good for them.

2.5.2 Food trends and new foods

Martin *et al.* (1992:56) and Greyvensteyn (1996:343) conclude that most pre-schoolers experience food trends and may for a time eat only a few selected foods. When the parent force the child he/she is less likely to try new foods. Parents should set a good example as children often imitate the eating habits of their parents. Fussy food habits are often temporary and will disappear if not reinforced by emotions and unnecessary rules. Food should not become the object of bribes and punishment. Special consideration should be given to providing foods that appeal to the child's senses, like finger foods, crunchy or crackling food and foods with different textures and flavours. The right temperature is also important since foods that are too hot or to cold may be refused. Food should also be presented attractively and in different shapes.

2.5.3 Early experience with food

According to Birch (1998:S36), early experience with food and eating is crucial in the development of food acceptance patterns, both in terms of the acquisition of food preferences and the regulation of food intake. More specifically, the social context and physiological consequences of eating have systematic effects on the development of preferences. Birch (1998:S36) also found that social context seems to influence how children regulate the quantity as well as the variety of food consumed. A deep emotional attachment to food begins from the moment an infant receives his or her first food from a caregiver. Eating is associated with love, caring, attention, and satisfaction. Food is also sometimes used for discipline, punishment, reward for moral virtue and bribery; this could result in frustration, anger and rejection. A child learns the hidden meanings of food very quickly and will use this tool for power and manipulation, for example by refusing to eat to gain power over the parent (Stanfield 1997:23).

2.6 Dietary recommendations for children

Spowart (1998:13) descibed malnutrition as an inclusive term that involves " the lack, imbalance, or excess of one or more of some 50 nutrients that are required by the body".

According to the FAO (1998:14), children are often the most at risk of being malnourished. They have very high energy and nutrient needs for their body size in comparison to adults. Proper care and feeding are essential for normal growth, development and activity. Children and adults can eat the same foods and should be encouraged to eat enough of a variety of energy and protein-rich foods and fruit and vegetables for growth and body maintenance. Children need to maintain their diet of energy-rich and protein-rich foods throughout their growing years until adulthood. They should further be encouraged to exercise and stay active to prevent obesity.

Sick children must be encouraged to eat and drink, even if they have little appetite. They should be offered softer textured foods and the foods they like best. Fluids, milk, fruit juice, soups and clean water are especially important when a child has diarrhoea. Eating patterns are established early on, it is therefore important to teach children at an early age how to get the best from their food. Brown *et al.* (1995:336) indicates in recent studies that the quality of the diet (micro-nutrient content and bioavailability; proportion of energy from animal products) might be an important determinant of energy intake and growth in some settings. This can create a dilemma in some countries as high-quality foods may not be accessible to those children with the greatest need, either because are simply not available locally or because their cost is prohibitive.

According to the FAO (1998:10) vitamins can be added to foods to replace nutrients lost in processing or to enhance the total nutrient content. Foods with added vitamins and minerals are called fortified foods, for example iodine is frequently added to salt to produce iodised salt. In many countries bread, flour and other cereal products are fortified with B vitamins and iron, and vitamins A and D are often added to processed milk and dairy products and to some vegetable oil products.

Dietary Reference Intakes (DRIs) are used as guidelines for nutrition and health professionals in the dietary assessment of groups and individuals. The term "Dietary Reference Intakes refers to a set of four nutrient-based reference values that represent the approach adopted by the Food and Nutrition Board to provide quantitative estimates of nutrient intakes for use in assessing and planning diets. Where adequate information is available, each nutrient has either an Estimated Average Requirement (EAR) and a Recommended Daily Allowance (RDA), or an Adequate Intake (AI). When an EAR for the nutrient cannot be determined (and therefore the RDA can also not be determined), then an AI is set for the nutrient. In addition, many nutrients have a Tolerable Upper Intake Level (UL) (Murphy & Poos 2002:843).

Each DRI is defined as follows:

- Estimated Average Requirement (EAR): a nutrient intake estimated to meet the requirement of half the healthy individuals in a particular life-stage and gender group.
- Recommended Dietary Allowance (RDA): the average daily dietary intake level sufficient to meet the nutrient requirements of nearly all (97-98%) healthy individuals in a particular life-stage and gender group.
- Adequate Intake (AI): a recommended intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of healthy people that are assumed to be adequate AI is used when the RDA cannot be determined.
- Tolerable Upper Intake Level (UL): the highest average daily nutrient intake level likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the risk of adverse effects increases (Murphy & Poos 2002:844).

The RDA is an intake level that meets the requirements of 97-98% of all individuals in a group when requirements in the group have a normal distribution. The RDA should therefore, not be used as a cut-off point for assessing the nutrient intakes of groups because it would seriously overestimate the proportion of the group at risk of inadequacy. Estimated Average Requirement and Average Intake is the appropriate DRI to use when assessing the adequacy of group intakes depicted in Table 2.5 (Murphy & Poos 2002:845-846).

Table 2.5: Uses for dietary intakes for healthy individuals and groups

Type of use	For the individual	For a group
Assessment	EAR: use to examine the probability that usual intake is inadequate. RDA: usual intake at or above this level has a low probability of inadequacy. AI: usual intake at or above this level has a low probability of inadequacy. UL: usual intake above this level has a potential risk of adverse affects.	EAR: use to estimate the prevalence of inadequate intakes within a group. RDA: do not use to assess intakes of groups. AI: mean usual intake at or above this level implies a low prevalence of inadequate intakes. UL: use to estimate the percentage of the population potentially at risk of adverse effects from excessive nutrient intake.

(Trumbo *et al.* 2001:301)

2.6.1 Energy requirements

The body uses glycogen, single sugars, fatty acids, glycerol, and amino acids to supply energy. The rate of breakdown depends upon the total daily energy requirement: the base rate of metabolism, the amount of voluntary activity, the influence of food and the needs for growth (Robinson & Weigley 1980:75). Children cannot eat the same amount of food in one meal as adults. They expend a lot of energy throughout the day and they should sustain energy requirements by eating small meals and snacks spread over the day (FAO 1998:14). Boys aged three to eight years Estimated Energy Requirement (EER) is 7316kj and girls 6896kj, boys nine to thirteen years old require 9572kj and the girls 8698kj (Stanfield 1997:6-7; Evers 2002:1).

2.6.2 Macro-nutrient requirements

The FAO (1998:5) suggests that people, especially children should try and eat a variety of foods throughout the day to meet nutritional needs. Food provides energy to grow and perform basic body functions (breathing, thinking, temperature control, blood circulation and digestion). Food also supplies the body with the materials to build and maintain the body and promote resistance to disease. These different functions are made possible by the nutrients contained in foods. Nutrients in food needed for optimal nutrition include: carbohydrates, protein, fat, iron, vitamin A, B vitamins, vitamin C, vitamin D, calcium, phosphorus, iodine, zinc and water.

2.6.2.1 Carbohydrates

Carbohydrates include sugars, starches and dietary fibre and are the major source of food energy. Foods rich in carbohydrates include: rice, maize, wheat and other cereals, all types of root crops such as potatoes, legumes such as peas and beans, as well as many fruits and vegetables and sugars (FAO 1998:5; Stanfield 1997:53, Food and Nutrition Information center (FNIC) 2002). Natural sugars are found in fruits and juices. Sources of added sugars are soft drinks, sweets, fruit drinks and desserts (FNIC 2002). While no defined intake level at which potential adverse effects of total digestible carbohydrates are identified, the upper end of the Adequate Macronutrient Distribution Range (AMDR) is based on the decreasing risk of chronic disease and providing adequate intake of other nutrients. It is suggested that the maximum intake of added sugars be limited to providing no more than 25% of energy (FNIC) 2002. The EAR requirement for children aged four to thirteen years 100g of carbohydrates per day (FNIC 2002).

2.6.2.2 Protein

Proteins are needed to build and maintain muscle, blood, organs, skin, bones and other tissues of the body. Proteins can also be used to provide energy. Eating more protein than is needed can be wasteful; excess protein will be converted to glucose and used as energy or stored in the body as fat. According to the FAO (1998:6), protein is especially important for growing children. Breast milk contains the perfect combination of amino acids for growth and mothers should be encouraged to breastfeed for at least two years or even longer if possible (De Beer 1995:3). As children are weaned from the breast it is important that their staple foods are supplemented with adequate protein-rich food items.

Sources of proteins are all types of meat, poultry, fish, eggs, milk, cheese and yogurt and provides all nine indispensable amino acids in adequate amounts, and for this reason are considered complete proteins. Proteins from plants, legumes, grains, nut, seeds and vegetables tend to be deficient in one or more of the indispensable amino acids and are called incomplete amino acids. Normal tissue growth in infancy and childhood requires more amino acids than those needed for tissue maintenance. In the absence of adequate dietary protein, growth is slowed down or even stopped (FNIC 2002; Stanfield 1997:75; Moore 1993:3).

Protein serves as the major structural component of all cells in the body and functions as enzymes, in membranes, as transport carriers and as some hormones. During digestion and absorption, dietary proteins are broken down to amino acids, which become the building blocks of these structural and functional compounds. Nine of the amino acids must be provided in the diet; these are termed indispensable amino acids. The body can manufacture the other amino acids needed to synthesise specific structures from other amino acids. While no defined intake level at which potential adverse effects of protein are identified, the upper end of AMDR is based on complementing the AMDR for carbohydrates and fat for the various groups. The lower end of the AMDR is set at approximately the RDA. The total protein needs for children between four and eight years of age, according to the EAR is 15g/day and 27g/day for children aged nine to thirteen years (FNIC 2002; Stanfield 1997:6-7; Evers 2002:2).

2.6.2.3 Fat

Fats and oils provide more than twice the amount of food energy as carbohydrates and proteins (FAO 1998:7). Added fat and oil is a good method to increase the energy intake of young children. When found in foods fats and oils are a source of n-6 and n-3 polyunsaturated fatty acids. Their presence in the diet increases absorption of fat-soluble vitamins and precursors such as vitamin A and pro-vitamin A carotenoids (FNIC 2002). This is important since children are often not able to eat enough bulky foods to meet their energy needs. Young children should receive between thirty and forty percent of their total daily energy intake from fat. Fat is also an important source of the fat-soluble vitamins. Dietary fat includes butter, margarine, vegetable oils, whole milk, visible fat on meat and poultry products, invisible fat in fish, shellfish, some plant products such as seeds and nuts and bakery products (FNIC 2002).

While no defined intake level at which potential adverse effects of total fat are identified, the upper end of AMDR is based on decreasing the risk of chronic disease and providing adequate intake of other nutrients. The lower end of the ADMR is based on concerns related to the increase in plasma triacylglycerol concentrations and decreased HDL cholesterol concentrations seen with every low fat (and often subsequently high carbohydrate) diet (FNIC 2002). The AMDR for total fat for children between four and thirteen years of age is between 25-35g per day (FNIC 2002; Stanfield 1997:6-7).

2.6.2.4 Fibre

Fibre in the diet improves laxation and reduces risk of coronary heart disease, it also assists in maintaining normal blood glucose levels. Dietary fibre is naturally present in grains, such as oats, wheat or unrefined rice. Dietary fibre can have variable compositions and therefore it is difficult to link a specific source of fibre to a particular adverse effect, especially when phytate is also present in the natural fibre source. It is concluded that as part of an overall healthy diet, a high intake of dietary fibre will not produce negative effects in healthy individuals. The AI levels for total fibre needs for children between four and eight years of age is 25g per day, boys aged nine to thirteen years require 31g per day and girls 26g per day. (FNIC 2002; Stanfield 1997:6-7; Evers 2002:3).

2.6.3 Micro-nutrient requirements

Vitamins and minerals are called micro-nutrients and smaller amounts are needed than protein, fat and carbohydrates. Vitamins and minerals assist with all the body functions and form part of the body tissues (FAO 1998:9).

2.6.3.1 Vitamin A

Vitamin A deficiency (VAD) is a major public health concern and the most vulnerable are pre-school children and pregnant women in low-income countries (WHO 2000:15). The function of Vitamin A is building and maintaining healthy tissues, particularly eyes, skin, bones and tissues of the respiratory and digestive tracts. It is also important for the effective functioning of the immune system. According to the FAO (1998:9), VAD can lead to poor night vision, severe eye lesions and in acute and severe cases permanent blindness in children. VAD is the leading cause of preventable severe visual impairment and blindness. This occurs mainly in undernourished children, especially those with measles and other infections that could lead to increased illness and death.

Vitamin A is found naturally in foods of animal origin, notably breast milk, liver, eggs and dairy products. Dark coloured fruit and vegetables contain pigments, called carotenoids, which can be converted to vitamin A (Stanfield 1997:95). According to the EARs children between four and six years of age require 275µg RE and children aged nine to thirteen years require 445µg RE of vitamin A per day (Stanfield 1997:6-7; Institute of Medicine of the National Academies (IOM): 2004).

2.6.3.2 B-vitamins

B-Vitamins are referred to as the vitamin B complex. The B-vitamins assist with converting carbohydrates, fat and protein into energy and for building and repairing the body tissues. Deficiencies of these vitamins can lead to serious effects including muscular weakness, paralysis, mental confusion, nervous system disorders, digestive problems, cracked and scaly skin, severe anaemia and heart failure (FAO 1998:9). Foliate deficiency is a common cause of anaemia among women and young children. Food sources rich in B vitamins are dark green vegetables, nuts, beans, cereals, peas, meat, fish and eggs (Stanfield 1997:89 and Moore 1993:367).

Children need a certain amount of B-vitamins to ensure proper functioning of the body, Table 2.6 shows the EAR for the B vitamins.

Table 2.6: Estimated daily requirements of B-vitamins for children

Water soluble vitamins	Children 4-8 years	Children 9-13 years
Biotin (µg)	12 AI	20 AI
Folate (µg)	160 EAR	250 EAR
Niacin (mg RE)	6 EAR	9 EAR
Pantothenic acid (mg)	3.0 AI	4.0 AI
Riboflavin (mg)	0.5 EAR	0.8 EAR
Thiamin (mg)	0.5 EAR	0.7 EAR
Vitamin B-6 (mg)	0.5 EAR	0.8 EAR
Vitamin B-12 (µg)	1.0 EAR	1.5 EAR

(IOM 2004)

2.6.3.3 Vitamin C

Vitamin C is needed to increase absorption of dietary iron, to make collagen (connective tissue) which binds the body's cells together and to serve as an antioxidant. According to the FAO (1998:9) and Stanfield (1997:84) prolonged vitamin C deficiency can lead to scurvy, failure to thrive in children and low resistance to infection. The symptoms of scurvy are bleeding gums and sore, swollen joints and it can lead to death. Vitamin C assists in bone and teeth formation. Most fruits especially citrus and guava, and many vegetables, including potatoes, are good sources of vitamin C. According to the FAO (1998:9), eating fresh fruit and vegetables is important for both adults and children. A child between four and eight years of age requires 22mg of vitamin C a day and children aged nine to thirteen years require 39mg/day (Stanfield 1997:6-7; IOM 2004).

2.6.3.4 Vitamin D

Vitamin D is important for maintaining blood calcium and phosphorus levels for normal bone calcification. Vitamin D is found in fish, liver oils, eggs and milk and is also produced by the body when the skin is exposed to sunlight (Stanfield 1997:93; Moore 1993:57). According to the FAO (1998:9), a lack of vitamin D can lead to rickets, a disease which causes soft and deformed bones in young children. For children aged between six and thirteen years an adequate intake of 5µg of vitamin D per day is recommended (Ensminger *et al.* 1994: 398; IOM 2004).

2.6.3.5 Iron

Iron deficiency is the world's most widespread nutritional disorder, affecting both industrialised and developing countries. In the former, iron deficiency is the main cause of anaemia in children (WHO 2000:20). Iron is a major component of red blood cells. According to the FAO (1998:9) and WHO (2000:20), iron deficiency is most prevalent in children and woman of childbearing age. It leads to lethargy (low work capacity), learning difficulties, poor growth and development, and increased morbidity (illness) and maternal mortality, especially at childbirth. In infants and young children, functional consequences include impaired psychomotor development, co-ordination and scholastic achievement and decreased physical activity levels (WHO 2000:20). A child between four and eight year old requires 4.1mg of Iron per day and a child of nine to 13 requires 5.9mg (Ensminger *et al.* 1994: 398; IOM 2004).

The major sources of iron include meat, fish, poultry, liver and other organs. Other sources are legumes, dark green leafy vegetables and dried fruits. Vitamin C should be included with iron containing foods to assist with absorption (Stanfield 1997:106). Daily supplementation of iron is likely to have greater impact than weekly supplementation on final haemoglobin and prevalence of anaemia (Beaton & McCabe 1999:ii).

2.6.3.6 Calcium and phosphorus

Calcium and phosphorus are important for body maintenance and healthy bones and teeth. Milk and dairy products are sources of calcium and phosphorus (FAO 1998:9). Calcium is required for the complex process of blood coagulation. Together with other materials calcium regulates the passage of materials into and out of cells, controls the transmission of nerve messages, brings about the normal contraction of muscles, including the heart. Calcium absorption is regulated according to the body's needs for maintenance and growth. A four to eight year old child who is growing rapidly absorbs a greater proportion of the calcium in his diet than an adult who simply needs to maintain the level of calcium in the bones and soft tissue and requires 800mg per day, for a child of nine to thirteen years 1300mg is recommended as adequate intake. Dairy products are a good source of calcium as well as vegetables and fruit that contribute a fair amount to the calcium intake of a child (Moore 1993:369; Stanfield 1997:101; Ensminger *et al.* 1994: 398; IOM 2004).

Phosphorus is essential for building bones and teeth and numerous other functions in the body. If the diet of a child supplies enough calcium and protein, it will then supply enough phosphorus; milk, meat, poultry, egg yolks, legumes and nuts are rich sources (Stanfield 1997:101-102). Children aged between four and eight years require 405mg of phosphorus per day and the EARs guideline is 1055mg for children aged nine to thirteen years (Ensminger *et al.* 1994: 398; IOM 2004).

2.6.3.7 Iodine

According to the FAO (1998:9) and Stanfield (1997:107) iodine is important for proper growth and development, children aged between four and eight years require 65µg per day and 73µg is recommended for children between nine and thirteen years old (Ensminger *et al.* 1994: 398; IOM 2004). The lack of iodine can cause goitre (swollen thyroid gland) and mental retardation. Iodine is found in seafood and foods grown in iodine-rich soils as well as iodised salt. Iodine deficiency disorders (IDD) constitute the single greatest cause of preventable brain damage in the foetus and infant and of retarded psychomotor development in young children. It remains a major threat to the health and development of populations globally, but particularly among pre-school children and pregnant women in low-income countries. IDD results in goitre, stillbirth and miscarriages, but the most devastating toll is mental retardation and deaf-mutism. While cretinism is the most extreme manifestation, of considerably greater significance are the more subtle degrees of mental impairment that can lead to poor school performance, reduced intellectual ability and impaired work capacity (WHO 2000:11).

2.6.3.8 Zinc

Zinc deficiency causes growth retardation or failure, diarrhoea, immune deficiencies, skin and eye lesions, delayed sexual maturation, night blindness and behavioural changes. Zinc supplementation of malnourished infants and growth-retarded young children has resulted in improved growth (WHO 2000: 27). Sources of zinc include animal and plant foods that are good sources of protein: organ meats, muscle meats, poultry, whole-grain breads and cereals, legumes, peanuts and peanut butter. A child aged between four and eight years requires 4mg of zinc per day and for children between nine and thirteen 7mg is the recommended EAR (Ensminger *et al.* 1994: 398; IOM 2004). Children that eat a normal diet that is adequate in protein are not likely to lack zinc (Stanfield 1997:107; Moore 1993:370).

2.6.3.9 Magnesium

Magnesium is a key nutrient in the body and plays a very important role in the processes that generate energy in the body. It is one of the nutrients that tend to be in short supply in the body and there is evidence that children and adolescents do not get enough magnesium from their diet.

Magnesium is important for normal nerve and muscle function and a shortage of it may contribute to cardiovascular disorders and high blood pressure (Briffa 2004:60 &166). Magnesium is found naturally in foods such as leafy vegetables, fish, meat, beans, nuts and seeds. For children four to eight years old the EAR for magnesium is indicated as 110mg/day and for children nine to thirteen years old 200mg per day is indicated (Briffa 2004:60 &166; IOM 2004).

2.6.4 Water

Water has many functions in the body including the formation of cells and body fluids, chemical reactions and urine secretion to carry waste from the body. It is essential to maintain an adequate intake of clean water to replace the water lost by the body, especially in hot weather and during physical activity. Children may also become dehydrated when they have diarrhoea, vomiting and fever (FAO 1998:9). Water requirements depend on many factors, including the amount of solids in the diet, air humidity, environmental temperature, type of clothing worn, respiratory rate, and the state of health.

The body obtains water from:

- beverages;
- foods, including dry ones like crackers;
- metabolic breakdown of food for use by the body

Next to oxygen, water is the most important nutrient for the body (Stanfield 1997:111).

2.7 Measuring nutritional status and growth monitoring

Growth is the best indicator of a child's nutritional status. Anthropometric indices are used as the main criteria for assessing the adequacy of growth in infancy. Careful measurements of height and weight and head circumference for children from birth to three years of age, using appropriate and well-calibrated instruments, are essential. Alternate methods of measuring linear growth in children who can not stand or straighten include sitting height, arm span and knee height (Baer & Bradford 1997:S109; S114, Derrickson *et al.* 1997: 1424; Malima & Bouchard 1991:39).

According to Zemel *et al.* (1997:213) anthropometry is the measurement of body size, weight and proportions and is valuable in monitoring the effects of nutritional interventions for disease or malnutrition anthropometric assessment is a rapid, inexpensive and non-invasive means of determining short- and long-term nutritional status. The nutritional status of children on the anthropometric measurement scale is indicated as underweight, stunting and wasting. Anthropometric indices have the following advantages and are thus important in nutritional assessment:

- the procedures are simple, safe, non-invasive techniques,
- applicable to large sample sizes,
- equipment required is inexpensive, portable and durable,
- measurements can be taken by relatively unskilled personnel,
- the methods are precise and accurate when standardised procedures are used,

- the procedures can assist in the identification of mild to moderate malnutrition, as well as severe cases of malnutrition,
- information is generated on past long-term nutritional history,
- the methods may be used to evaluate changes in nutritional status over a period of time and from one generation to the next and
- screening tests can be devised to identify individuals at high risk (Zemel *et al.* 1997).

The three most commonly used anthropometric indices for children are derived by comparing height and weight measurements with reference curves, namely height-for-age, weight-for-age and body Mass Index (BMI)-for-age (weight-for-height (w/h) could however also be used). Although these indices are related, each has a specific meaning in terms of the process of outcome of growth impairment. Moreover, the ranges of the deficit of physical status based on each index vary significantly across populations (WHO 1995:section 2; Integrated Nutrition Programme (INP) 2000:12) Deficits in one or more of the anthropometric indices are often regarded as evidence of "malnutrition". However, it should not be assumed that such deficits are solely the result of a nutrient or energy deficit (WHO 1995:section 2).

The 2000 Centres for Disease Control (CDC) include reference data for both BMI-for-height and weight-for-height. BMI-for-height reference values are available for children aged two to <20 years. Weight-for-height reference values are available for children with height from 77 to <122cm. Older children are generally taller than 122cm, but for younger children either set of reference data could be used. Both weight-for-height and BMI-for-age could be used to describe a child's weight relative to other similar children. Weight-for-height provides a method of comparing a child's weight with a reference group of children of the same height but not necessarily of the same age. Because BMI is a form of weight adjusted for height, BMI-for-age provides a method to compare a child's weight, adjusted for height, with a reference group of children of the same age but not necessarily of the same height. BMI, calculated as weight (kg)/height (m) squared, is a weight-for-height index that in fact is a method of adjusting weight for height (Flegal 2002:761).

The 1977 NCHS growth charts included weight-for-height but not BMI-for-age. However, because of the increasing use of and acceptance of BMI as an appropriate indicator for children, it was decided to include BMI-for-age charts in the revised version. BMI-for-age is recommended as the appropriate indicator for use in most settings (Flegal 2002:761).

Abnormal anthropometric measurements, including insufficient weight and height gain as well as excess weight gain, have significant short- and long-term health consequences (WHO 1995:section 2).

To some researchers, "malnutrition" implies the severe form of wasting characterised by the clinical conditions of marasmus and kwashiorkor. However, the term also encompasses milder forms of undernutrition, characterised by a significant deficit in one or more of the anthropometric indices. (Dowler 1982:105). As indicated by Sutphen (1985:178), accurate growth assessment demands careful measurement by trained observers. Optimally the same observer and measuring device should be used for interval measurements. In healthy, well-nourished populations, growth is primarily determined by genetic potential. When growth lags behind genetic potential, various factors including nutrition may be the cause. Growth assessment is inexpensive and valuable measure of nutritional assessment that can guide communities in decisions regarding nutritional intervention.

2.7.1 Interpretation of measurements-indices

Indicators of nutritional status, based on anthropometry, can be used as reference indicators that are quick and easy to collect. Weight and size are taken as estimates of body nutrient stores and size at a given age is regarded as a measure of the previous pattern of growth. Anthropometric indicators are most commonly used as a measurement for nutritional status, which could or could not have been caused by a variety of processes including the effects of different nutrient deficiencies or non-nutritional factors such as infection (Dowler 1982: 103).

According to the WHO (1995) anthropometric indices are combinations of measurements and are essential for the interpretation of measurements: It is evident that a value for body weight alone has no meaning unless it is related to an individual's age or height. In children the most commonly used anthropometric indices are weight-for-height, height-for-age (h/a), and weight-for-age (w/a) (Katzenellenbogen *et al.* 1999:243). Other indices are used for different age or physiological groups, such as pregnancy weight gain in pregnant women.

2.7.1.1 The Z – score or standard deviation value system

The Z-score system expresses the anthropometric value as a number of standard deviations (SD) or Z-scores below or above the reference mean or median value and used in research to compare results. A fixed Z-score interval implies a fixed height or weight difference for children of a given age. For population-based uses, a major advantage is that a group of Z-scores can be subjected to summary statistics such as the mean and standard deviation (WHO 1995:section 2).

The anthropometric indices can be expressed in terms of Z-scores, percentiles of median, which can be used to compare a child or group of children with a reference population.

Z-scores (or 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:

$$\text{Z-score or SD score} = \frac{\text{(observed value)} - \text{(median reference value)}}{\text{Standard deviation of reference population}}$$

A fixed Z-score interval implies a fixed height or weight difference for children of a given age. A major advantage of this system is that, for population based applications, it allows the mean and standard deviation to be calculated for a group of Z-scores (WHO 1995: section 2).

2.7.1.2 The percentile system

According to the WHO (1995:section 2) the percentile refers to the position of an individual on a given reference distribution. Percentiles are commonly used in clinical settings because their interpretation is straightforward.

According to the WHO (1995), the 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. Thus a child of a given age whose weight falls in the 10^{th} percentile weighs the same or more than ten percent of the reference population of children of the same age. It is not possible to assign a percentile rank when the child's measurement is below the 5th percentile or above the 95th percentile; but children above 95th percentile of weight-for-height reference data are often considered obese and children less than 5th percentile of weight-for-height are considered to be seriously undernourished (Zemel *et al.* 1997:217; Derrickson 1997:1424-1426).

2.7.2 Indices

The WHO (1995:section 2) and Bronner (1996:891) have shown that indicators are applications of indices to evaluate nutritional status. In this analysis, the percentage of children below a defined cut off point (level) for a particular index (weight-for-age, height -for-age and BMI-for-age), are used to evaluate the extent and magnitude of malnutrition in a particular group of children. The National Centre for Health Statistics (NCHS) median reference is an internationally used indicator system, these standards were derived for use in developing countries to quantify the need for programs of nutritional supplementation (Sutphen 1985:170; Flegal 2002:761). BMI-for-age is more specific than weight-for-age, but less sensitive (Dowler 1983:107; Flegal 2002:761). In agreement with the World Health Organisation's recommendations (WHO 1995: section 2) the anthropometric indices and indicators were used in the analysis as follows:

2.7.2.1 Weight-for-age

According to Schaaf (1992:34) and the WHO (1995: section 2) weight-for-age is still the most common measurement used to indicate the nutritional status of a child, and indicates a complete picture in underweight as it includes short term consequences as well as long term or chronic problems that can cause weight loss.

According to the WHO (1995: section 2) weight-for-age reflects body mass relative to chronological age. It is influenced by both the height of the child (height-for-age) and his/her weight (weight-for-height); and is difficult to interpret. Weight-for-age is an indication of acute malnutrition. Short term change, especially reduction in weight-for-age, reveals change in weight-for-height. Measurement of weight is best performed with a balance-beam scale. The child should be nude and ideally the measurement should be made in the morning before breakfast (Sutphen 1985:170; Frisancho 1990:11).

The proper descriptive term for high weight-for-age is "heaviness", however because few children have high weight-for-age as a result of tallness, high weight-for-age often reflects overweight (WHO 1995: section 2).
Underweight can be indicated by low weight-for-age where the weight is indicated as ≤2SD of the sex-specific reference data relative to age. A child could have a low weight-for-age if it is stunted, wasted or both (Katzenellenbogen *et al.* 1999:244; WHO 1995: 419).

A standard weight-for-age chart is available from the Department of Health to use as a measurement in nutritional studies, namely the Road to Health Chart (RtHC). The RtHC is often the only ongoing link between health workers and a child's parents or caregiver. If used properly it promotes these relationships, improves decisions and helps to focus on those children in need of extra care. The RtHC is based on the reference data from the NCHS, Although the growth reference data provided by the NCHS were not developed from children of various ethnic backgrounds, they currently provide the best means of comparing various populations of children (INP 2000:12, Derrickson 1997:1424-1426; Stuphen 1985:170).

2.7.2.2 Height-for-age

According to WHO (1995: section 2), Sutphen (1985:169) and Frisancho (1990:12) height-for-age reflects achieved linear growth and its deficits indicate long-term, cumulative inadequacies of health or nutrition. Two related terms, length and stature, are also used. Length refers to the measurement in a recumbent position and is often used for children under two to three years of age who cannot stand. Standing height measurement is often referred to as stature and is measured against a wall that does not have a baseboard, a right angle head board should rest on the highest part of the head. Bare feet should be placed with the heels together and in contact with the wall. The buttocks should also be in contact with the wall and the head adjusted so that the child looks straight ahead. "Shortness" is the descriptive definition of low height-for-age. "Stunting" is a frequently used term implying that shortness is pathological. It reflects a process of failure to reach linear growth potential as a result of sub-optimal health and/or nutritional conditions.

A child indicated at ≤2SD on the reference median for height-for-age is stunted and has a history of undernutrition is classified as suffering from chronic undernutrition. If this child has a normal weight-for-height and is currently being fed normally he/she may still be considered to be stunted according to the ≤2SD height-for-age as weight-for-height cannot indicate nutritional stunting (Katzenellenbogen *et al.* 1999:244 , Margetts & Nelson 2000:299; de Onis *et al.* 1993:707).

2.7.2.3 BMI-for-age

BMI-for-age reflects short-term deficits that can indicate a recent, severe shortage of food and nutritional adequacy. BMI-for-age reflects body weight relative to height and is calculated as (kg)/height (m) square (Flegal 2002:761). It is important to note that BMI-for-age does not serve as a substitute for height-for-age or weight-for-age, since each index reflects a different combination of biological processes. Although common determinants are shared, they cannot be used interchangeably. The term "wasting" is widely used to describe a recent and severe process that has led to significant weight loss, usually as a consequence of acute starvation and/or severe disease. "Overweight" is the preferred term for describing high BMI-for-age. Even though there is a strong correlation between high BMI-for-age and obesity as measured by adiposity, greater lean body mass can also contribute to BMI-for-age. On an individual basis, therefore, "fatness" or "obesity" should not be used to describe high BMI-for-age (Schaaf 1992:34; WHO 1995: section 2). According to Zemel *et al.* (1997:218) ideal body weight is defined as the median weight at the age where height matches the median height.

Wasting is indicated where a child ranks below –2SD or ≤5th percentile of the values for the reference median for BMI-for-age (Katzenellenbogen *et al.* 1999:244; Margetts & Nelson 2000:299; de Onis *et al.* 1993:707).

2.7.3 Skinfold thickness

The skinfold thickness measurement is a method for assessing the amount of body fat an individual has. It is practical in clinical settings, although validity depends on the accuracy of the measuring technique and repetition of measurement over time. Changes if they occur will take 3 to 4 weeks. The triceps skinfold (TSF) and subscapular measurements are the most useful because the most complete standards and methods of evaluation are available for these sites (Hammond 2000:372).

2.7.4 Circumference measurements

If more complete information on body composition is needed, additional anthropometric data can be obtained. These include additional skinfold measurements and circumference measurements (Hammond 2004:425).

2.7.4.1 Waist-to-hip circumference ratio

The most frequently used measure of adiposity is the waist-to-hip ratio (WHP), which is mostly used in indicating obesity. Circumferences are easy to measure with either steel or plastic measuring tapes. The smallest circumference between the nipples and the top of the thighs indicates the waist. The hip circumference is defined as the largest circumference between the waist and the knees (Hammond 2004:426).

2.7.4.2 Mid-upper arm circumference

Mid-upper arm circumference (MAC) is measured between the acromion process of the shoulder and tip of the elbow. Combining the MAC with TSF measurements allows indirect determination of the arm muscle area (AMA) and arm fat area (AFA). The AMA is a good indication of lean body mass and, therefore one of the individual's skeletal protein reserves. This is important in growing children and is especially valuable in evaluating possible protein-energy malnutrition as a result of chronic illness, stress, multiple surgeries, or inadequate diet (Hammond 2004:426-427).

2.7.4.3 Head circumference

Head circumference is useful in children younger than 3 years of age, primarily as an indicator of non-nutritional abnormalities. Undernutrition must be very severe to affect head circumference (Hammond 2004:427-428).

2.7.4.4 Calf circumference

Measurements of calf circumference, combined with other anthropometric measurements, can be used to estimate body weight in the elderly (Hammond 2004:427).

2.8 Biochemical analyses

Biochemical tests are the most objective and sensitive measures of nutritional status, but not all are appropriate. Caution must be used when interpreting results, as they can be affected by disease state and therapy (Hammond 2004:430). Compared to medical status, nutritional status generally changes slowly. Deteriorating nutritional status, initially, may not lead to a change in medical status. So when illness occurs, it is not always clear whether nutrition contributed to the illness. However, illness or injury almost always lead to rapid deterioration in nutritional status. Because nutritional status usually changes relatively slowly, the laboratory data used to assess it must be interpreted differently than the laboratory data used to diagnose disease. To obtain an accurate assessment if nutritional status shifts in clinical status, changes in anthropometric indices, dietary history and changes in laboratory indicators of nutritional status should be integrated (Carlson 2004:437).

Carlson (2004:437) indicate that the great advantage of laboratory data, over other kinds of objective data obtained from the body, is that quality control can be stringently maintained inside the laboratory environment.

Several specimen types are used by laboratory personnel to test for nutrients and nutrient-related substances. Traditional specimen types include:

- Serum (the fluid obtained from the blood after the blood has been clotted and then centrifuged to remove the clot and blood cells),
- Plasma (the fluid obtained after centrifugation of blood collected with anticoagulants, like ethylenediaminetetra-acetic acid (EDTA), heparin, trisodium citrate, or potassium oxalate),
- Erythrocytes (red blood cells),
- Leukocytes (white blood cells),
- Other tissue,
- Urine and
- Fecus (Carlson 2004:438).

2.9 Assessment of dietary intake

Diet surveys have been used as a tool for measuring the prevalence of undernutrition and malnutrition in a country. Apart from measuring undernutrition with the help of survey data, it is necessary to obtain data on a more fundamental human feeling, the feeling of hunger. Undoubtedly, it is desirable to have systematic, quantitative data and consumption of kilojoules among individuals in a community and to process such data with the help of different statistical and mathematical methods (Kargel 1988:15-16).

Dietary intake is assessed either by collecting retrospective intake data or by summarising prospective intake data. The choice on which method to use depends on the purpose and the setting in which the assessment is completed. The goal is to determine the nutrient content of the food and the appropriateness of the intake for a particular individual. The prospective method used should record the data at the time the food is consumed or shortly thereafter (Hammond 2000:366).

The first five years of a child's life are crucial to his/her psychological well being. In addition, correct nutrition in a sound socio-economic environment is the foundation of health and well being for the rest of the child's life (Rothwell 1994:22). According to Zemel *et al.* (1997:229) nutrition assessment is an important component providing optimal healthcare for children. It is used in the clinical setting, as well as in nutritional surveillance and research. Assessment of growth and body composition is the primary means of nutritional assessment.

2.9.1 Food Frequency Questionnaire (FFQ)

FFQ are the most frequently used in cohort studies in epidemiology. It is designed to assess usual eating habits, over recent months or years, and comprise of a list of foods and is a retrospective review of intake frequency, that is, food per day, per week, or per month (Margetts & Nelson 2000:134). For ease of evaluation, the food frequency questionnaire organises food into groups that have common nutrients. Since the food frequency interview is concerned with the frequency of usage of food groups, rather than of specific nutrients, it is helpful to focus on the diet in general rather than on specific nutrients (Hammond 2004:418). There are however a few recommendations made by Burley *et al.* (2000:2) on the development of FFQ's that include the following:

- Modification of pre-existing food frequency questionnaires (FFQ) for use in similar populations is useful, however, the purpose of the original and new version should be carefully considered.
- Unless the purpose of the FFQ is very specific a comprehensive food list is desirable.
- Some grouping of foods may need to be considered to prevent excessive questionnaire length.
- FFQ's should not be used for less than 50 people, otherwise the standard deviation will be too big and the study then can not be generalised for the population.
- FFQ's developed in a country should not be used in other countries unless the eating patterns are the same.
- Interviewer-administered FFQ's should be used in preference to self-administered questionnaires to ensure completeness.
- Every questionnaire should be rigorously pre-tested to ensure that the meanings of the food names and the portion size descriptions are clear to the subjects, instructions are clear and that the method of recording responses is unambiguous
- When developing a questionnaire, foods of particular interest should be placed at the beginning of the questionnaire, but group similar food together.
- Reproducibility and validity should always be assessed, in a representative sample of the target population.
- The interval between repeat measurements should be chosen to minimise changes over time and recall of previous answers, and will depend on the reference period of the questionnaire.

The questionnaires should be used with either a picture board of examples or food samples to ensure that the portion sizes are indicated correctly.

The advantages of using FFQs are that it is easy to use, and improve the uniformity of administration limiting interviewer bias, it is low in cost and it is ideal to use with samples. The primary disadvantages are that there is a lot work involved in developing and validating the questionnaires. Incorrect estimating of food consumption and nutrient intake is possible (Margetts & Nelson 2000:136).

2.9.2 24-hour recall

Nutrient intake data depends to a large extent on methods used to obtain information on dietary habits and intakes. The 24-hour recall method tends to measure lower intakes, than diet history and food frequency questionnaires (Vorster *et al.* 1997:3, FAO 1996:2). The 24-hour recall are most appropriate for measuring current diet in groups of subjects, and are therefore suited for studies where differences between groups are being assessed (Margetts & Nelson 2000:140). The 24-hour recall asks the person to list specific foods consumed in the last 24 hours, for use by the person or professional who is assessing the information. Problems that can be experienced in using this method include:

- Inability to recall accurately the kinds and amounts of food eaten,
- over reporting low food intake and
- under reporting high food intakes.

When absolute versus relative estimates of nutrient intakes are required, the food record and 24-hour recall are clearly the methods of choice for estimating mean intakes. These are the only methods that provide data on foods actually eaten, since both the food frequency questionnaire and the diet history are based on long-term subjective perception of a participant's typical eating habits (FAO 1996:5). According to

Hammond (2004:418) using both a FFQ and the 24-hour recall method in combination provides a more accurate estimation of food intake.

The principle disadvantage of using the 24-hour recall method include that it does not provide a reliable estimate of an individual's intake due to day-to-day variation, a single 24-hour recall can not be used to rank subjects reliably. The problem can be overcome by taking repeat 24-hour recalls. The disadvantages include the fact that it is quick and can be repeated easily (Margetts & Nelson 2000:139).

2.9.3 Seven day food record

The Seven-day (7-day) food record documents dietary intake as it occurs, subjects are taught to describe and give an estimate of the weight of food immediately before eating and to record any leftovers. At least seven days data is needed and the time taken for analysis is considerable (Margetts & Nelson 2000:140. A food record is usually more accurate if the food eaten is recorded on the same day. The nutrient intake is calculated and averaged at the end of the seventh day, then compared to the RDA (Hammond 2004:418). Food records are commonly used for surveillance, multicentre cross-sectional investigations, small cohorts and intervention studies (Margetts & Nelson 2000:140).

2.10 Methods of addressing malnutrition

There are four methods available for the control of micro-nutrient malnutrition namely: diet diversification, food fortification, medicinal supplements and disease control the first two are food based.

2.10.1 Micro-nutrient supplementation

Supplements for the prevention of deficiencies are usually given on a time-limited basis during immunisation days and family planning contacts. Supplements do not necessarily fulfil specific nutrient needs, children's vitamin mineral supplements do not contain significant amounts of calcium, which may still not correct a calcium shortage (Lucas 2004:268). Supplementation is rapidly becoming part of treatment plans for measles and pneumonia and is cost-effective for reaching isolated areas with a high prevalence of deficiencies. Vitamin A, iron and iodine are available in concentrated or synthetic form at a relatively low cost and can be administered either orally or by injection (USAID 1993:8). Vitamin A supplementation is a low-cost, reliable and effective way to combat vitamin A deficiency (VAD) and can be rapidly implemented as a programme strategy on a national scale. It should not necessarily be regarded as a short-term measure, as most of the supplementation programmes implemented globally over at least five to ten years. In many developing countries supplementation programmes have been running for decades (VAGI 1997: 3).

Supplementation can be integrated with existing programmes, for example with both routine and campaign-based immunisation programmes (VAGI 1997:6).

In developing countries, a priority intervention is iron supplement distribution for women of reproductive age (USAID 1993:23). The MI in partnership with UNICEF, the World Bank, International Life Sciences Institute (ILSI) and USAID is at present developing a communication strategy to promote effective interventions for iron (MI 1999:1). Although many iron supplementation trials have been proven to be efficacious in carefully controlled circumstances, few have proven to be effective when broadly applied. Low compliance and lack of adequate supply systems have been suggested as reasons for this (Davidsson & Stoltzfus 2000:13).

Iron deficiency is one of the most common nutrient disorders in children. Supplementation can consist of administering iron directly from tablet form. This approach has two draw backs, one it is expensive and secondly supplements irritate the gastric mucosa, inducing adverse events: heartburn, nausea, vomiting, and epigastric pain (Danone 2002: 7). Iron supplementation in children improves the global mental development score, the improvement is greater in children above five years of age (Gera 2004:27).

2.10.2 Fortifying food commodities or products

The food fortification concept was developed during the early part of the 20th century as a means of addressing micro-nutrient deficiencies that were prevalent in Europe and North America at the time. More than 80 years of experience in various developed and developing countries indicated that fortification of commonly consumed foods offers an opportunity to reduce, or even eliminate, the prevalence of these deficiencies safely and cost-effectively (Labadarios *et al.* 2000:883).

In recent years, attention has increasingly turned to finding ways to fortify staple foods consumed by populations who are not only very poor, but also most vulnerable to micro-nutrient deficiency disorders. People in this group are usually found in rural areas and often mainly consume mainly the foods that they grow (MI 1999b:1). Since the early 20th century food fortification has been applied to reduce and eliminate micro-nutrient deficiencies in many countries. Today, food fortification is favoured more than ever (Sloan 1995:24).

Food fortification cannot reach all populations deficient in essential micro-nutrients due to limited access to commercially or centrally processed foods. This can be a result of geography, poverty or cultural preference, public health and welfare approaches to deliver supplements or dietary education. For the large and expanding population that does, however, regularly purchase and consume commercially processed foods, fortification can make a difference (MI 1999:7) At the population level, food fortification is the best option when a suitable food vehicle can be identified (Davidsson & Stoltzfus 2000:13).

2.10.2.1 Fortification in South Africa

In South Africa, the Directorate of Nutrition within the Department of Health (DoH) spearheaded mandatory food fortification by establishing a food fortification task group (FFTG).

Every country has its own government body charged with setting food regulations. The control of micro-nutrient deficiencies, particularly VAD, iodine deficiency disorders (IDD) and iron deficiency, is one of the focus areas of the Integrated Nutrition Programme (INP) of the DoH in SA. The DoH (SA) aims to control micro-nutrient deficiencies through a combination of multi-pronged strategies, of which food fortification is a cost-effective medium to long-term intervention (De Hoop 2000:1).

Weigley *et al.* (1997:29) describes fortification as the addition of nutrients at levels higher than those found or never found in the original food. According to Klem & Ross (1999:52) fortification is the process of adding vitamins and/or minerals to food in microgram or milligram quantities increase the overall nutritional content of the food item (Venkatesh Mannar 1999:24; Lotfi 1997:15; Giese 1995:112). Brady (1996:12) defines fortification as the addition of one or more nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency, of one or more nutrients in the population or specific population groups.

Restoration is a general term for the replacement of nutrients lost during food processing to levels similar to the original levels. For example when "whole wheat" flour is processed to "white" flour, nutrients are unintentionally removed and thus important nutrients would be lost, unless they are returned. Enrichment is the addition of nutrients to achieve concentrations as specified by the standards of identity. An example is when vitamins and minerals are returned to some processed grain products (Weigley *et al.* 1997:28-29). In SA a product may be called "enriched" with a specific nutrient when amounts of more than 15 % of the recommended daily allowance (RDA) for the specific nutrient are present in the product (South Africa (SA) 1972:1214).

According to the Labadarios (2000) more than eighty years of experience in a number of developed and developing countries indicates that fortification of commonly consumed foods offers an opportunity to substantially reduce, or even eliminate, the prevalence of vitamin and mineral deficiencies safely and cost effectively. The food fortification concept was developed in the early part of the 20^{th} century as a means of addressing mineral and vitamin deficiency diseases at the time prevalent in Europe and North America. In order to improve the nutritional status of populations, food fortification is only one of the many strategies necessary to achieve this goal. Teaching the population to eat correctly and increase their consumption of fruits and vegetables, is accepted as being the best long-term solution to micro-nutrient deficiencies and malnutrition in general.

Food fortification is not only for the benefit of populations with a poor dietary intake, but also for the general population (Labadarios *et al.* 2000).

To address the above deficiencies the government implemented mandatory fortification in October 2003, of all maize meal and wheat flour to provide a person 10 years or older with the following percentage RDA (per 200g of raw flour) with vitamin A, 31%; thiamine, 25%; riboflavin, 17% (maize flour) and 20% (wheat flour); iron, 25% (unsifted maize meal) and 50% (maize meal); zinc 20%; niacin, 25% and pyridoxine, 25%; (Labadarios *et al.* 2005:542). Table 2.7 indicates the fortification levels as established by the Department of Health and reflected in the No. R 2003 Foodstuffs, Cosmetics and Disinfectants act, 1972 (act no. 54 of 1972) regulations relating to the fortification of certain foodstuffs (DoH 2003:3).

Table 2.7: Fortification specifications for maize meal (DoH 2003:3).

(Super, special, sifted, unsifted)

Fortificants and diluent	Micro-nutrient requirements (Per 1 kg meal)	Fortificant requirements (Per 1 kg meal)	Fortification mix (g/kg)
Vitamin A palmitate[1] (Activity: 75 000 mcgRE[2]/g)	2085 mcgRE	27.8000 mg	139.0000 g
Thiamine mononitrate (Activity: 78% min.)	2.1875 mg	2.8045 mg	14.0224 g
Riboflavin	1.6875 mg	1.6875 mg	8.4375 g
Nicotinamide/niacinamide	25.000 mg	25.0000 mg	125.0000 g
Pyridoxine HCl (Activity: 81% min.)	3.1250 mg	3.8580 mg	19.2901 g
Folic acid (Activity: 90.5% min.)	2.0000 mg	2.2099 mg	11.0497 g
Electrolytic iron[3] (Activity: 98% min.)	35.0000 mg	35.7143 mg	178.6714 g
Zinc oxide (Activity: 80% min.)	15.00 mg	18.7500 mg	93.7500 g
Diluent	-	To complete 200 mg	To complete 1000 g

1. Protected, stabilized Vitamin A palmitate containing 75 000 mcg RE activity per gram
2. Retinol Equivalents (RE) = 1 mcg retinol = 3.33 IU (International Units) vitamin A
3. Elemental iron powder where more than 95% passes through a 325 mesh (< 45 microns particle size) made by an electrolytic process.

2.10.3 Food diversification

Nutrition can be improved at household level through home gardening, small animal production and aquaculture. Food processing and preservation can be used to raise micro-nutrient levels in the diet (Hussain 2005:1).

According to FAO (2004b:2) as much as 50% of food is lost between harvest and consumption, often because of poor storage facilities that allow moisture, fungus, rodents and insects to take their toll. Improved storage and early processing such as drying can greatly reduce losses. However processing does more than change the eating quality of raw foods. All foods are biological materials that begin decay as soon as they are harvested or slaughtered. Processing slows down or stops this deterioration and thus allows food to be preserved for extended periods (FAO 2004a:1).

The FAO (2004a:2) further notes that food preparation and processing are important to rural communities to ensure their food security, to increase variety in people's diets and as a means of generating diversified income and employment. When successful, processing at village level can create an enhanced quality of life for villagers because of greater prosperity and improved health and nutrition.

Dietary modification is primarily a strategy to improve either the amount of food in the diet or its bio-availability (Venkatesh Mannar 1999:24). Producing or purchasing a greater variety of affordable foods than those usually consumed is considered to be the safest and most sustainable long-term measure in the control of most micro-nutrient deficiencies (USAID 1993:8). It has been suggested that breakfast makes an important contribution to the nutrient intake of children. Concurrent illnesses and poor nutrition interfere with the schooling of children in low-income countries, and that children's health issues need to be addressed as part of educational interventions (Ruxton 1995:419 & Richter 1997:93).

2.10.4 School feeding programmes

Inadequate nutrition can also disrupt cognition. Previously, researchers believed that if a child is malnourished and the brain growth in the first two years of a child's life, when the brain grow to 80% of it's adult size is hampered it could not be corrected, but more recent studies indicated that brain growth in this period is not always terminated irreversibly in undernourished children. Rather it may be put on hold temporarily, if the diet improves at the age of three the brain will continue to grow close to the normal pace. It is also indicates that injury to the brain can occur even when a child suffers malnutrition after the first two years of life, which shows that adequate nutrition through out childhood is important to cognitive development (Brown 1995: 26).

Since the turn of the century, good nutrition has been an accepted part of good education. Every day four million children queue for their school meals in the United Kingdom, over one million school meals served daily are free school meals (Church 1997: 1). Ruxton *et al.* 1995 indicated that the contribution of breakfast to the mean daily energy and nutrient intake of children seven to eight years of age in England is 14% of the energy and 9-36% of the micro-nutrient intake to the overall diet.

Almost all public schools in America participate in the National School Lunch Program (NSLP) and 83% of all private schools participate in the NSLP. Consequently, NSLP is available to 92% of American children and on an average day 56% of the children identified participate in this scheme. The School Breakfast Program in the same country became legislation by 1975 and is available to half of America's children and <20% of the children that have access participate. Several groups are encouraged to participate: children certified to eat for free, reduced price meals and children from low income families, younger children, males, African Americans, and children in rural areas (Burghardt 1995: 252S – 253S).

In a study on the effects of breakfast in rural primary school children in Jamaica the breakfast consisted of a cheese sandwich or a spiced bun and cheese and flavoured milk. The children who received breakfast showed small but significant improvement in attendance and nutritional status (Powell 1998: 874 & 876).

In India primary school children (6-14 years) form about 20% of the total population. Free and compulsory education up to the age of 14 years is the constitutional commitment. It is estimated that 40% of children drop out of primary school. National Nutrition Monitoring Bureau (NNMB) surveys (2000) indicate that about 70% of these children are undernourished and there is a 30% deficit in energy consumption and over 75% of the children have a dietary micro-nutrient deficit of about 50%. Poor enrolment and high school drop out rates are attributed to the poor nutritional status of the children, compounded by poor socio-economic conditions, child labour and lack of motivation (Nutrition Foundation of India 2003:1).

Nutrition support to primary education in India is considered an important method to achieve the objective of providing free and compulsory universal primary education, of satisfactory quality to all children below the age of 14 years. With children from all background and communities eating together, it is also a means of bringing about better social integration (Nutrition Foundation of India 2003:1).

The Nutrition Foundation of India also reported in 2003 that Mid Day Meal programmes (MDM) aimed at improving the nutritional status of poor children and at ensuring better school enrolment have been functioning in various states of the country for over five decades. However, due to various logistical and financial problems these programmes have languished but for a few notable exceptions. The reason for the lack of sustainability of these programmes possibly include that they were not based on an agreed National Policy fully backed by the Central and State Governments and that they were mostly implemented as isolated operations with no meaningful involvement of the community. The failure may also be due to the fact that there was no serious attempt to integrate these programmes as an element of a comprehensive effort towards upgrading the entire school system. The Supreme Court of India sent out a directive on the 28th of November 2001 to State Governments to introduce cooked mid day meals at school and this created a renewed interest in MDM in different states in the country.

The MDM in India seeks to provide each school child roughly one third of the daily nutrients required in the form of a hot fresh cooked meal, the energy content of the meals varies between 350-500 Kcal depending on the age of the child. The quantity of cereal (wheat/rice/millet) may be increased to 125g per child per day. The recipes should include enough vegetables, particularly dark green leafy vegetables, as far as possible, every day. Vegetable gardens in schools should be encouraged with the involvement of the children. Hygiene should also be considered. A system of monitoring the quality of the raw materials should also be in place. Cooking facilities, safe water and clean toilets should be provided (Nutrition Foundation of India 2003:11).

The South African Primary School Nutrition Programme (PSNP) is one of the Presidential Lead projects and its emphasis is on alleviating temporary hunger amongst identified vulnerable primary school children. This programme was introduced in September 1994. Initially only farm schools were targeted but the programme was later extended to urban schools. Gauteng PSNP Project Management Team has defined the PSNP as purely a food based programme, which relieves temporary hunger. Therefore other aspects such as a nutrition promotion and nutrition education are dealt with by the Public Nutrition portfolio through various other strategies (Gauteng Department of Health 1997:4).

Table 2.8:The aims and objectives of the PSNP as set by the Department of Health (Gauteng Department of Health 1997:4).

Aim	Objectives
To alleviate temporary hunger.	• To determine the hungry children per school per grade that are younger than 14 years of age. • To feed children 100% of the feeding days. • Feeding children daily before 10h00. • To increase the concentration span of the children being fed by at least 1%.
To encourage broader initiatives.	• 80% of the suppliers for the new tender period must be SMME's/NGO's. • 100% of the newly appointed suppliers to be trained in basic business & financial principles, project management, basic nutrition, food preparation & hygiene and the claiming procedure of the Department within 4 weeks of the commencement of the contract.
To encourage the self-sustainability of school feeding.	• To have established a project committee per school before the end of the financial year. • 1% of all schools on the programme to have developed a strategy using project management principles which ensures self-sustainability. • To have established one self-sustaining project for each region in a province.
To implement intervention in the most cost-effective and efficient way possible.	• To distribute the allocated funds between the different regions according to a set targeting criteria. • Measure the actual expenditure against the budget.

The Gauteng Department of Health indicated in their policy document that the PSNP only aims at providing 20% (i.e. snack) of the child's daily feeding needs and not a full meal. The snack which is provided at school ensures that children are less hungry while having to learn, thus concentration and learning capacity are increased. The substantial remaining 80% of the child's daily nutritional needs are the responsibility of the parents. To ensure that hunger is effectively alleviated, the snack should be substantial, containing food that takes longer to digest. The menus suggested by the Gauteng Department of Health are depicted in Table 2.9 and 2.10.

Table 2.9: Menu 1: PSNP (Gauteng Department of Health 1997:5-6).

Day	Menu	Quantity/child
Monday	• Fortified biscuits	4x25g
	• Vitamin C enriched cooldrink.	200ml
Tuesday	• Bread	2 slices (80g)
	• Peanut Butter	30g
	• Jam	20g
	• Vitamin C enriched cooldrink	200ml
Wednesday	• Bread	2 slices (80g)
	• Jam	20g
	• Margarine	20g
	• Milk	100ml Fresh full cream
Thursday	• Bread	2 slices (80g)
	• Fish	30g
	• Margarine	20g
	• Vitamin C enriched cooldrink	200ml
Friday	• Bread	2 slices (80g)
	• Maas	200ml
	• Margarine	20g

Table 2.10: Menu 2: PSNP (Gauteng Department of Health 1997:5-6).

Day	Menu	Quantity/child
Monday	• Grain Sorghum	400ml = 80g
	• Sugar	15g
	• Oil	10g
	• Fresh full cream milk or maas	100ml
Tuesday	• Bread	2 slices (80g)
	• Peanut Butter	30g
	• Jam	20g
	• Fruit juice sweetened	200ml
Wednesday	• Maize meal	400ml or 100g
	• Dried legumes	40g
	• Oil	10ml
Thursday	• Bread	2 slices (80g)
	• Margarine	20g
	• Jam	20g
	• Fruit juice sweetened	200ml
Friday	• Maize meal	200ml or 100g
	• Soya mince	40g
	• Oil	10ml

An assessment form developed by the Department of Health must be used to determine which learners qualify for the feeding scheme. The following has to be considered:

- Age – the needy child identified must be between the ages of six and fourteen.
- Number of dependants in household – The teacher should determine the number of children, elderly, disabled and unemployed adults.
- Highest qualification of the care provider, to assess possible earnings.
- Employment status.
- Any food support that the family receives has to be indicated.
- Total income into the household including, salary, pension income, disability grant etc.

At the time of this study only certain children identified by the teachers according to the guidelines above were included in the PSNP programme. It is important that as the children's circumstances improve that they are taken off the programme. Teachers should also encourage parents to still send lunch boxes to address the rest of the daily needs.

The Department of Health makes it clear that the schools should exclude the first and last day of school, this means that feeding commences on the second day of school and ends one day before official closing of school. The feeding must take place during first break and the department provides guidance on how to monitor the programme. Feeding is also monitored by regional/ district or provincial staff. Extra food may be given to the most needy children in the school and the school should keep a feeding register.

The Department of Health does supply as small fee to helpers called a helper's honorarium. Approximately 15 000 schools and 4.9 million learners benefit from school feeding annually in South Africa. In 1999/2000, 15 428 schools and 4.7 million learners participated in school feeding (Louw 2002:1).

A study by Wentzel-Viljoen (2003:286) indicates that out of 10 Gauteng schools making use of the PSNP eight schools served bread and the other two schools made use of menu B. A dairy blend milk powder was served at schools and not fresh full cream as discussed in the policy document. It was also found that out of all the food items on the menu the learners liked the bread most and fish was most disliked at 40% of the group interviewed. Visiting schools in the North West Province of South Africa and collecting food from the PSNP menu, it was found that the PSNP addresses only 20% and not 25%, as indicated in the PSNP policy document, of the children's daily needs according to the RDA/EAR for children aged seven to 10 (Wentzel-Viljoen 2003:186). Allocation of tenders for the delivering of food was a problem in the beginning of the PSNP programme and a lot of learners did not receive the food. At the time of this study no records were kept on the number of children receiving the food and no one new how many children actually received the food.

Wentzel-Viljoen (2003:286) also report that the implementation of the PSNP also met with a shortage of storage space and clean safe facilities was not available at all schools. During this study it was also reported that the schools often received stale bread. The concern regarding the PSNP being implement relates to the children who received food at school did not eat breakfast or lunch at home and did not bring lunch boxes, this could be a cause of the malnutrition not improving as the school food basically replaced the food from home and the children did not get more than normal. The serving time of the food indicated in the policy document also did not happen and children had to wait longer to receive something to eat. The recommendations made by the researcher were that the communication channels between the Department of Health and the Department of Education should be addressed. In the interval since this study was conducted the PSNP has been moved over to the Department of Education for management, who employ persons qualified in nutrition to control the feeding.

According to Wentzel-Viljoen (2003:247) an average of R79.26 for the period 1997/1998 – 1999/2000 was spent per learner per year on the PSNP. Wentzel-Viljoen (2003:47) indicate that it costs the government 90 cents per day per learner, but the researcher advises caution stating that this in itself is not an indication of the cost-effectiveness of the school feeding program, in order to understand the cost-effectiveness it should be expressed in the cost per energy provided. The researcher concludes by noting that not one of the menus served in any of the provinces in South Africa, complied with the national nutritional criteria regarding the energy to be provided.

Results of other South African studies show that 14-19% of school children have nothing to eat before they go to school, due to time constrains, unavailability of food or ignorance. A market survey found that the average frequency of breakfast consumption has declined by 7% since 1997. Most children need a lot of supervision with their overall diet, with caregivers acting as important gatekeepers regarding food choices. Breakfast cereals, with milk and coffee, were eaten most frequently by families from the higher income groups, while tea, bread and porridge were the most popular breakfast item in the lower income groups. A child who misses breakfast is unlikely to make up the shortage in nutrients for the day (Dhansay 2000:116-117).

Results of a study in Johannesburg in South Africa by Richter *et al.* (1997) conducted in a rural farm school in 1997, where no other breakfast feeding schemes were in place at that stage, offered evidence of a beneficial effect on the children in the experimental group associated with (but not necessarily attributed to) the school lunch programme as a nutritional intervention. This report could however not conclude without doubt that there were cognitive and behavioural benefits for children who received breakfast. Teachers did, however, perceive the children to be less hyperactive. The breakfast offered included 30g Kellogg's corn flakes served with 100ml skim milk and a banana.

A school lunch programme was already in operation in this school since 1990 and this study was recorded from children already participating in this scheme.

A summary of school feeding programmes by Kruger *et al.* (2002:5-12) indicates that 14-19% of school children studied skipped breakfast and that the children from low income households that have breakfast eat tea and bread. Children should be encouraged to eat a nutritionally balanced breakfast every morning and this could consist of one of the following:

- high fibre cereal with skimmed milk,
- porridge with skimmed milk and a glass of fruit juice or
- whole-wheat toast spread thinly with butter or margarine, boiled egg or a slice of cheese and fresh fruit or juice (Wardley *et al.* 1997:107).

Table 2.11: Research studies conducted on school feeding programmes (Adapted from Roche 2000:2; Kruger 2002).

South African studies:

Study	Study population	Intervention	Results
Richter *et al.*	55 undernourished rural South African children 7-14 years (test group) 53 well nourished urban children 7-10 years (control).	Test group receive a school breakfast of fortified cereals with milk and banana for 6 months.	The breakfast had a significant beneficial effect on cognitive and behavioural performance.
Van Stuijvenberg *et al.*	115 South African children 6-11 years (test group); 113 children in control group.	Cookies fortified with 60% RDA of beta-carotene, iodine and iron, and a drink with 90mg vitamin C, on school days for a 1 year period (test group); placebo snacks (control).	Improvement in short term memory and attention in test group and fewer illness - related absences from school.

Table 2.11 Continued: Research studies conducted on school feeding programmes (Adapted from Roche 2000:2; Kruger 2002).

Study – International	Study population	Intervention	Results
Benton & Robberts	90 Welsh school children 12-13 years.	Vitamin/mineral supplement for 8 months (30 children) placebo (30 children) no treatment (30 children).	Increase in non-verbal intelligence in supplemented group.
Powell *et al.*	407 undernourished 407 well nourished Jamaican school Children.	Breakfast, every day for 1 year period (test group); one-quarter orange and same attention (controls).	Breakfast improved nutritional status, and school attendance.
Schoenthaler *et al.*	615 US American school children.	Vitamin / Mineral supplements with 50, 100 or 200% RDA for 13 weeks compared with placebo.	Major improvement in nonverbal intelligence by children on 100% RDA supplements.
Sandstead *et al.*	740 Chinese school children 6-9 years from urban, low-income families.	Supplements with 20 mg Zinc, micro- nutrients or both, six days per week for 10 weeks.	Micro-nutrient supplementation with zinc improved neuro- psychological performance and growth significantly.
Jacoby & López de Romaná	500'000 school children of Peruvian Andes 5-10 years.	School Breakfast with 60% RDA of vitamins and minerals, and 100% iron daily for 6 months.	Anemia prevalence fell from 66% to 14%; School attendance improved significantly Improvement in vocabulary test.
Chandler *et al.*	Jamaican schoolchildren	School Breakfast for Undernourished children.	Undernourished children's performance on verbal fluency improved significantly compared with nourished children without breakfast (no improvement)
Cromer *et al.*	Well-nourished US children, grade 9	With a low-energy breakfast, high levels of beta-OH-butyrate were found.	No significant differences in cognitive function were found between the two groups.

2.10.5 Nutrition education

Nutrition education is an instructional method that promotes healthy behaviour by imparting information that individuals can use to make informed decisions about food, dietary habits and health. An effective nutrition intervention program will integrate good instructional design and learning principles and use media that facilitate a high degree of individualisation. Educational research shows that the effect of an intervention on the target population's knowledge and behaviour depends on the interventions application of six basic educational practices: consonance, relevance, individualisation, feedback, reinforcement, and facilitation. A sequential, comprehensive nutrition education curriculum should begin in pre-school and continue through to secondary school (ADA 2003:506 & Boyle 2003:516).

Inadequate food intake and unhygienic dietary practices are often related to poor knowledge of sound nutrition practices. Together with limited resources, deficiencies in knowledge of sound budgeting, food purchasing and food preparation methods can compromise household food security (Walsh *et al.* 2003:89).

Nutrition knowledge for school-aged children has two sets of goals. The first set strive to enhance the child's basic nutrition and food knowledge and to help the child to select a healthy diet. The second set aims to reduce disease risk by forming health promoting eating behaviours. Adequate time and intensity devoted to nutrition education will help to increase the nutrition knowledge of children. Parents and family members serve as role models and influence the child's environment. Parents are often receptive towards participating in the education process. Some strategies that can be used to promote healthy eating among primary school children includes:

- Involve parents in nutrition education through home work or take-home video's,
- provide role models (parents and teachers) for healthy eating,
- use incentives to promote healthy eating,

- identify easy-to-prepare, tasty, and healthy snacks such as fruit and vegetables and
- increase children's confidence in making healthy choices (Boyle 2003:520).

Nutrition education strategies, especially in younger children, are clearly limited by children's cognitive developmental stages. Younger children will not be able to learn the meaning of abstract terms such as energy or nutrients within a few days. While comprehensive nutrition-education projects over several years have been successful in changing dietary intake habits of school children, isolated short-term projects are not likely to change eating behaviour. An important aspect in nutrition education may be to focus on those aspects of nutrition, that are considered important by the children themselves (Westenhoefer 2001:125-129).

A community-based, randomised trial in an urban slum in Delhi, India measured the effect of nutrition education and/or iron supplementation on the iron status of 451 children aged nine to thirty six months. A high prevalence of iron deficiency is common among children less than three years of age. The mothers and children were together in the groups where the nutrition education took place over a period of 4 months. The results showed that in this population group, where the iron and nutritional status was highly compromised, evidence suggests that the nutrition education intervention was effective, the intervention improved the dietary iron intake and prevented the children from suffering the sharp decline in iron status that was noted in the control group. Evaluation of the impact on maternal knowledge indicated an overall improvement in the nutrition score. The attitude data showed that the education intervention was associated with high scores, implying a change in beliefs (Kapur *et al.* 2003:1131-1144).

According to Auld *et al.* (1998:268-280) the critical elements associated with successful school-based nutrition education programs include: school-wide policies that promote healthy eating, school health education curriculum's that involve nutrition and are active, fun and culturally relevant, co-ordination between school food service and nutrition education, training for school staff, family and community involvement and program evaluation.

Educational strategies should communicate the direct perceivable benefits of healthy eating and lifestyle patterns to children, and encourage a positive body image by providing advice and reassurance regarding the range of healthy and acceptable body weights and shapes. Nutrition education requires continuous efforts and year-long programmes, not isolated actions. In this context, the influence of children can be utilised to encourage positive changes in dietary habits within the whole family. Nutrition education needs to have well-defined and achievable goals with documented evaluations, in order to persuade the authorities and sponsors to invest in improved nutrition education programmes (Westenhoefer 2001:125-129).

A nutrition education intervention study in the United Kingdom (UK), conducted to increase the fruit and vegetable consumption of four to eleven year old children by Lowe *et al.* 2004. The study made use of six 6-minute video episodes featuring the heroic 'food dudes' who were a group of 12-13 year olds, two boys and two girls. The results indicate that children who fell in the 0-19% consumption bracket went from eating an average of 2% of their fruit and 3% of their vegetables at lunch time during the baseline study, to 56% and 50%, respectively, of these foods during the intervention, the results were clinically significant. The parental recall data also indicated that the children's fruit and vegetable consumption at home during the intervention also increased. The study also showed that following the intervention, there was an increase in children's reported liking a range of fruit and vegetables (Lowe *et al.* 2004:511,518).

After an intervention study in Finland, aimed at reducing children's intake of saturated fat and cholesterol, it was found that at the inception of the study when, the children were seven years old, the intervention children consumed as much total fat and monounsaturated and polyunsaturated fatty acids and sodium but less energy and saturated fatty acids than the control children. At the age of nine years, after 18 months of nutrition counselling given to the children, by means of 15-20 minute individual sessions with the child (using paper and pencil and plastic model tasks) intakes of total energy, total fat, monounsaturated and polyunsaturated fatty acids did not differ between the groups. The intervention children still consumed less saturated fatty acids and more polyunsaturated fatty acids that the control chiidren. Knowledge regarding the quality of food increased in the intervention children (Räsänen *et al.* 2004:162,164 and 168).

Westenhoefer (2001:129) indicates that the nutritional knowledge of children can be used to encourage positive changes in dietary habits within the whole family. Once off nutrition education session was planned to inform the children of healthy eating based on the Food Based Dietary Guidelines (FBDGs). It was recommended by Vorster *et al.* (2001) that the FBDGs should be used in the Integrated Nutrition Programme that is a countrywide nutrition programme to address malnutrition in the country.

Knowledge gained about school-based nutrition interventions over the past twenty years provides further justification for implementation of comprehensive school based nutrition programmes and services. Current research results provide evidence that school-based nutrition programmes and services will improve the health of beneficiaries and also contribute to the educational achievement of young people now and in the future (American Dietetic Association (ADA) 2003:506). Walsh (2003:95) concludes by recommending that existing skills and good dietary practices in communities be identified and strengthened. Simultaneously, appropriate unconventional methods of nutrition instruction should be given priority in order to encourage community participation in the education process. Community structures such as women's groups, play groups and committees, could be established in the interest of nutrition education.

Improved nutrition education enables children to reduce their risk of becoming overweight; it also influences the eating behaviour of their families (Danone Vitapole Nutritopics 2004:12).

2.11 Food based dietary guidelines

The South African Food Based Dietary Guidelines was published during 2001, with the aim of having a core set of Food Based Dietary Guidelines (FBDG) to promote health for South African's older than five, and was based on locally consumed foods. The aim of the FBDG is to address existing nutrient deficiencies and excesses, and the resulting nutrition related public health problems of a specific country or community. In order to successfully change eating behaviour, a number of specific characteristics for FBDGs have been identified, based on the Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO) recommendations. These include the following: Each guideline should have only one, easily understandable, simple message. Guidelines should be formulated or illustrated in a manner that people from different cultures and literacy backgrounds will grasp their meaning; they should be user friendly and not confusing; they should be formulated in a positive way. No negative messages using words such as avoid, decrease, limit, cut out or eat less, should be used.

The FBDGs should not create guilt feelings about, or negative associations with, food; they should be compatible with the different cultures and eating patterns of the target population; They should be based on affordable, available foods that are widely consumed; they should be sustainable; they should encourage environmentally friendly agriculture; they should lead to a selection of food that are usually eaten together-in groupings that are compatible with existing dietary practices and they should address both over- and under-nutrition. Furthermore FBDGs should help people to choose the most appropriate diet they can afford - encourage undernourished people to choose a more adequate diet and over nourished people to choose a more prudent diet; they should emphasise the joy of eating and they should be formulated and communicated to the target population using marketing skills based on the knowledge, perceptions, attitudes and behaviours of the target population (Voster *et al.* 2001:S3-S6). The FBDGs can form the basis of a nutrition education programmes in schools in South Africa.

The FBDGs developed for South Africa are the following:

- Enjoy a variety of food
- Be active
- Drink lots of clean, safe water
- Make starchy foods the basis of most meals
- Eat plenty of vegetables and fruit every day
- Eat dry beans, split peas, lentils and soya regularly
- Chicken, fish, meat, milk or eggs can be eaten daily
- Eat fats sparingly
- Use salt sparingly
- Use food and drinks containing sugar sparingly and not between meals
- If you drink alcohol, drink it sensibly.

These guidelines were developed for adults and children over the age of seven years (Voster *et al.* 2001:S3-S6). The 11 adopted guidelines not only address existing nutrient deficiencies and excesses and the resulting nutrition related public health initiatives in the country, but also take into account the documented cultural differences and eating patterns. Furthermore, these guidelines are based on affordable and available foods and are widely consumed and encourage environmentally sound agricultural practices (Labadarios *et al.* 2005: 542).

2.12 The hypothesis

The hypothesis developed for this study, namely that the introduction of a cost-effective, culturally acceptable nutrient dense novel product, as part of a school feeding programme, will improve nutritional status of primary school children in an informal settlement, is based on the literature that identification compromised nutritional status amongst this group and the success of other school feeding projects globally and nationally. Figure 2.3, presents a conceptual framework of the study.

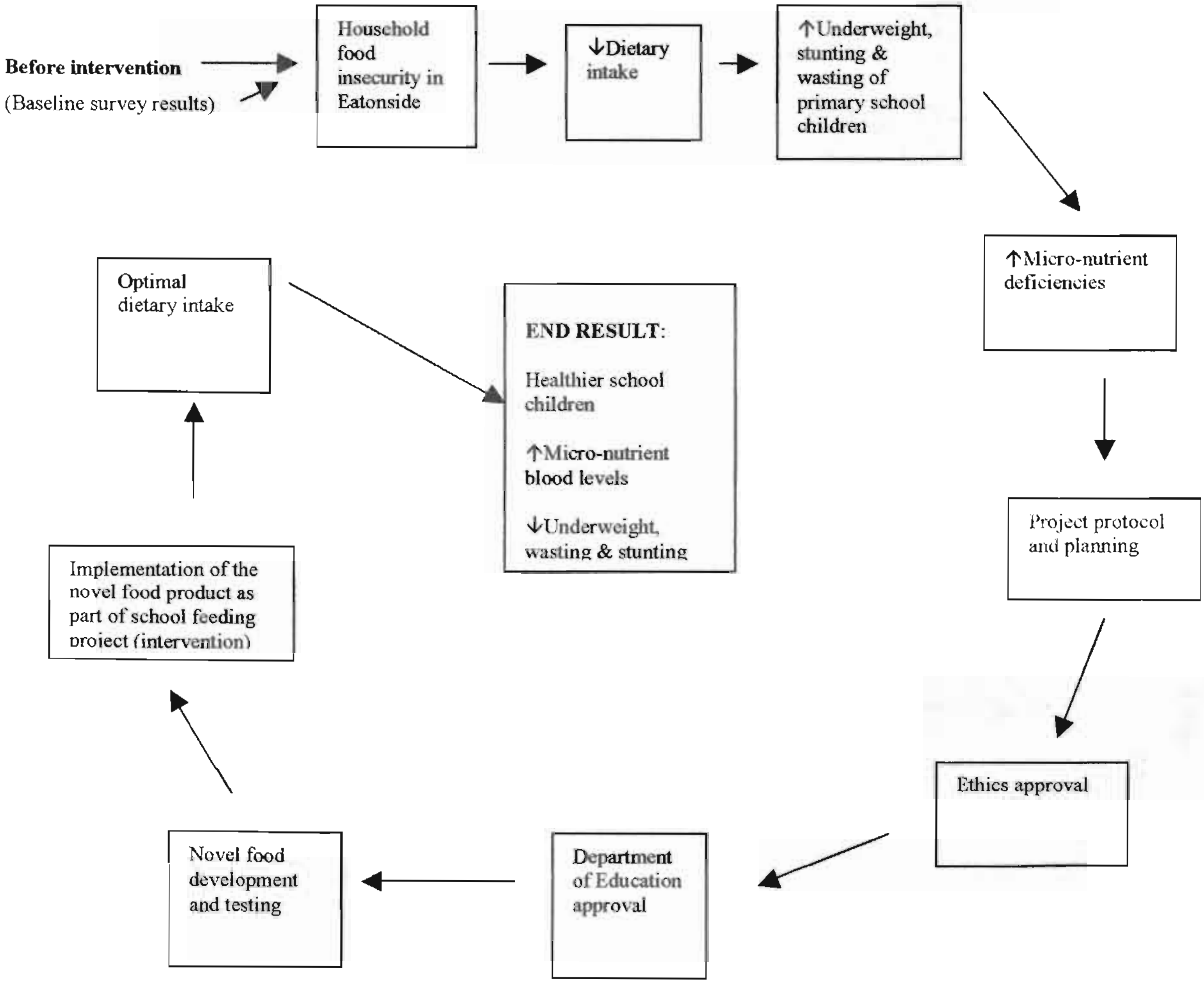

Figure 2.3: Conceptual framework of this study

2.13 Conclusion

The literature review has clearly indicated that malnutrition in primary school children is a global problem. The review also showed that the causes of malnutrition are complex and interrelated and multisectorial strategies and programmes are needed to address these causes. School feeding programmes are one of these strategies as an appropriate diet (at any stage of life) supplies sufficient energy and all the essential nutrients in adequate amounts for health (Stanfield 1997:6).

Children continue to develop new food behaviour patterns while their growth continues at a slow rate. Due to the accepted notion that school children are inquisitive and learn by imitation, they will learn readily from people with whom they are in contact. This is the ideal time to start teaching simple nutrition concepts (Stanfield 1997:148). Schools can play a key role in reversing the trends of obesity, inactivity, food security and poor food choice through school nutrition policies that ensure co-ordination of comprehensive nutrition education programmes, child nutrition programmes, a healthy school environment and community partners (ADA 2003:506).

In South Africa, the integrated nutrition programme implemented by the DoH, aims to improve the nutritional status of South Africans. Furthermore, the PSNP was implemented in schools with the main aim of relieving temporary hunger. However, this literature review has shown that many problems are still being experienced. Various studies also show that many SA children do not eat breakfast before they go to school and this can further impact on the child's school performance. It is, therefore, important to assess the effect of a school feeding programme, not only focusing on alleviation of hunger, but also addressing specific nutrient deficiencies in a community, would improve the nutritional status of primary school children under controlled conditions.

The difficulties experienced by the PSNP and the persistent malnutrition problems among primary school children motivated this study, in which a novel food product was developed to address specific identified nutritional deficiencies. The novel food product was implemented as a school feeding programme to assess the impact on the nutritional status of primary school children in an informal settlement, namely Eatonside, in the Vaal Triangle. The pilot study is discussed in Chapter 3, and Chapters 4 and 5 follow with the development of the product and the intervention respectively.

Each of these chapters will be discussed as an entity with objectives, methods, results and conclusions.

Chapter 3

Assessment survey

3.1 Introduction

The main objective of this part of the project was to determine the socio-demographic background, nutritional status, dietary intake and food consumption patterns of primary school children in an informal settlement. The information gathered was used for the planning of an intervention to address the possible malnutrition in this area. The measurements chosen for this study include Quantitative Food Frequency Questionnaires (QFFQs), 24-hour recall, a socio-demographic questionnaire, anthropometric and biochemical measurements. This chapter will be presented as an entity with methods and results, discussion, conclusion and recommendations.

3.2 Operational definitions of variables

The characteristics that are measured in a study are referred to as variables and include:

3.2.1 Categorical variables (qualitative variables)

Categorical variables specify which category an observation falls into. Such variables are called nominal if categories are in no identifiable order, but are only identified by name. If there is some order amongst the categories, the variable is called ordinal. A categorical variable, which has only two categories, is called a dichotomous or binary variable (Katzenellenbogen 1999:101). Categorical variables may be summarised by the number and percentage of study subjects. The demographic data collected on the demographic questionnaire is referred to as categorical data. The demographic variables in this study include the composition of the population, (age, income and occupation) and the distribution of the population (where the people are in the region).

3.2.2 Numerical values (quantitative variables)

Quantitative variables are called numerical since the allocated numbers have intrinsic quantitative meaning. Numeric variables are discrete if the variable can only take on certain values. Discrete variables are often counts of events, for example the number of patients seen at a clinic per day. Numeric variables need to indicate where the central location of the data lies, as well as what the variability of the data is. Quantitative variables used in this study include the measurement of the children's weight and height as well as their dietary intake.

3.3 Methods

3.3.1 Sample selection

The pilot study was conducted during 2003, the year before the intervention took place. The first contact was made by a visit to the Department of Education to obtain permission to conduct a study in a government school (Annexure A). Ethical clearance for this study were obtained from the University of the Witwatersrand (Wits) by Johannesburg's Medical Ethical Research Committee for research on human beings (Annexure B).

Initially the school was contacted during February 2003. The purpose of this contact was to determine the number of children eligible to be included in the study.

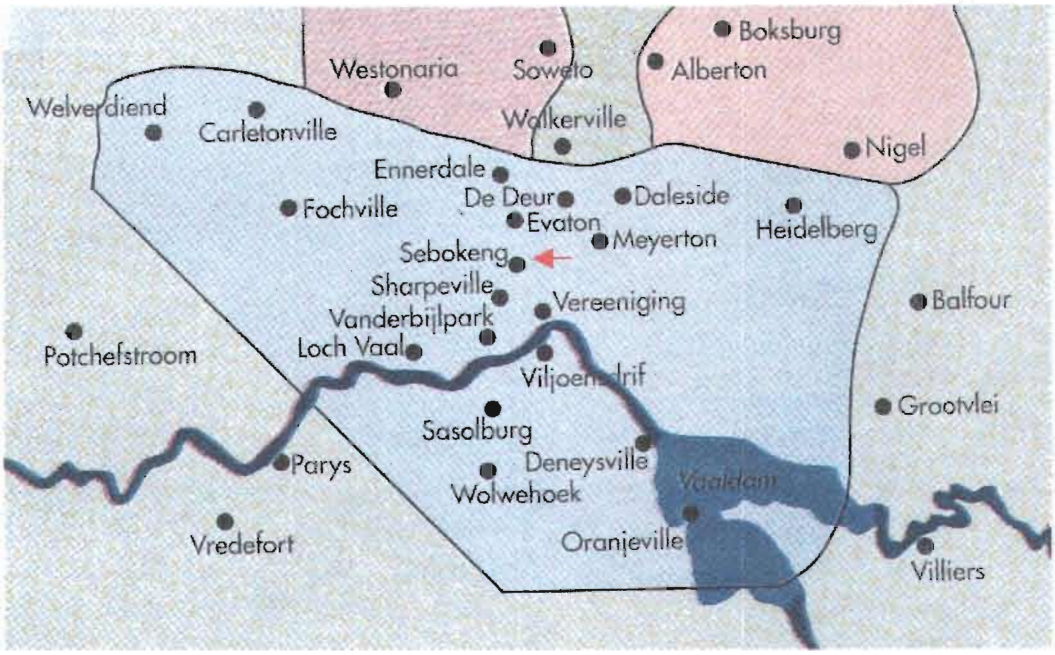

Figure 3.1: Area map of the Vaal Triangle

Initially the school was contacted during February 2003. The purpose of this contact was to determine the number of children eligible to be included in the study.

The inclusion criteria included the following:

- All available girls,
- All available boys,
- aged between six and thirteen year and,
- resident in the Eatonside.

The exclusion criteria were the following:

- children aged younger than six years and older than thirteen years
- resident outside Eatonside.

The parents of all the children meeting the inclusion criteria, in the school (n=519) were asked to participate on a voluntary basis. A total of 80 parents agreed and completed a letter of consent for their child to take part in the study (Annexure C).

The sample consisted of 80 male and female children (15% of the school), aged six to thirteen years in Eatonside in the Vaal Triangle. The school was identified when a strategic roundtable participatory planning workshop with all stakeholders was conducted. The stakeholders included councillors for the region, a Department of Health representative and a Department of Education representative. The stakeholders all identified Eatonside as a community perceived as the "poorest of the poor."

All the children had written parental consent to participate in the study. The study was approved by the ethics committee of the University of the Witwatersrand (WITS), and data was collected in May 2003.

3.4 Fieldworkers

Ten field workers were recruited from the postgraduate Vaal Triangle Technikon students in Food and Nutrition and Food Service Management. All the fieldworkers were Sotho speaking women.

From the onset of this project, extensive training was incorporated. Training for the initial implementation of the activities and refresher courses throughout the project were included. The field workers received detailed instructions regarding anthropometric measurements and administering the QFFQ. Emphasis was placed on ensuring that the field workers were aware of the objectives and importance of the project.

In addition to the initial training sessions, field worker manuals were prepared and printed in English (Annexure D). The instruction manuals were used by all field workers throughout the clinical intervention trial. The purpose of the manual was to ensure standardisation and uniform procedures.

A pilot study, including five volunteer Vaal Triangle students, was conducted in June 2003 to familiarise the field workers with the methodology, to test comprehension and to solve any possible problems that might occur. Aspects addressed in the pilot study included the suitability of the questionnaires, the use and standardisation of all instruments, the willingness of subjects and parents/guardians to allow the drawing of blood, the logistics of the transportation of blood to the analytical laboratory in Vanderbijlpark and Cape Town and the time needed to complete the study for every person. Discussion and solution of the problems encountered during this period equipped the field workers to troubleshoot any possible problems they might have experienced during the pilot study.

The group of researchers developed a fieldwork administration form (Annexure E). The purpose of the form was to ensure that the subjects completed the required activities at each of the stations and to indicate the different activities that took place each time during the intervention trial. The activities at different stations, in order, were:

- Station 1: Handing out of file with forms to recruited respondents
- Station 2: Clinical signs and collection of blood samples
- Station 3: Anthropometry
- Station 4: Handout and/or completion of the different questionnaires
- Station 5: Snacks handed out and handing in of completed forms

3.5 Measuring instruments

The study design for the baseline survey was a cross-sectional, analytical design in which a number of variables were measured.

Factors taken into consideration, when choosing the assessment methods of this study included:

- The objective of this study was to determine nutritional status and to establish this, the sample population had to be interviewed to capture accurate information on their eating patterns and demographic status.
- The completion of questionnaires was not easy and trained fieldworkers had to be used to ensure that the questions were understood correctly and completed correctly.
- The children had to be weighed and measured, to ensure correct measurements. A standardised measuring and weighing method had to be used to ensure uniformity, only fieldworkers could accomplish this.
- Biochemical measurements had to be collected at the same time as the questionnaires being completed and weighing and measuring was conducted.

3.5.1 Socio-demographic information

A socio-demographic questionnaire was used. Data were collected for the following categories: age, gender, number of children per household, dwelling – demographic, number of people in the house, type of house, number of rooms per house, type of dwelling, water supply, toilet facilities, waste removal, pests experienced, employment, job type, household income, frequency of money shortage, frequency of food shopping, type of shops frequented, weekly food expenditure, weekly child allowance, food item most bought, education level, home language, number of children, immunisation, number of school children, how do children get to school?, responsible for food preparation, food decisions, money decisions, number of meals per day, eating place of children, ownership of TV's, stoves etc. Eighty questionnaires were completed (Annexure F), forming an essential part of the socio-demographic data.

3.5.2 Dietary intake

The goals of nutritional assessment are to identify those children who require aggressive nutritional support to restore or maintain nutritional status, to identify appropriate medical nutrition therapies and to monitor their efficacy (Hammond 2000:365). The goal of this assessment was to determine the need for nutritional intervention at this primary school.

The validated QFFQ that was used in the Transition and Health during Urbanisation in South Africa (THUSA) study (Macintyre 1998:200) was adapted for use in this study (Annexure G). A 24-hour recall questionnaire was completed at the same time to measure reliability (Annexure H).

All the QFFQs and the 24-hour recall questionnaires were completed for the subjects by the fieldworkers, during an interview situation with the mother or caregiver and child. Food models were simultaneously used to demonstrate portion sizes to the subjects and to assist the fieldworkers in estimating portion sizes consumed by the respondents. Furthermore, the food models were used to demonstrate unfamiliar food items to the subjects.

3.5.3 Anthropometric measurements

The children were weighed and measured using standardised methods, as discussed in the section on reliability and validity (3.6.4).

3.5.4 Biochemical measurements

A total of 80 blood samples were drawn by qualified nursing sisters in order to determine the serum vitamin A, haemoglobin, Hct, SRBP, zinc, iron, ferritin, transferrin, total iron binding capacity and percentage transferrin saturation and plasma fibrinogen.

Blood was drawn from the *vena cephalica* of the seated subject after an 8-12 hour fast using a Vacutainer needle, with minimal use of tourniquets. A qualified nursing sister collected the blood samples from the subjects. Vacutainer blood collecting tubes were labelled in advance with the subject's trial number as well as the week number.
Blood was collected as follows:

- 5ml Blood in an EDTA tube (purple lid) for full blood counts (Hb, Hct, RBC, MCV, Plt and WBC).
- 10 ml Blood in a silicone-coated tube for preparation of serum for the analysis of ferritin, serum iron, transferrin, total protein, albumin.
- 10 ml Blood in a silicone-coated tube for preparation of serum for the analysis of serum retinol, **vitamin E and Zinc** analysis. This tube was immediately (after collection) protected against UV light, by covering the tube with aluminium foil.

3.6 Reliability and validity

According to Katzenellenbogen (1999:172) and Boyle (2003:454) questionnaires should be designed to have a high reliability and validity. Reliability refers to the degree of consistency found when the same questionnaire is administered to the same respondents at a later stage (test - retest reliability), or the same questionnaire is administered by a different interviewer (inter-rater reliability). Validity presents itself in a number of forms, face validity refers to the extent to which the measure makes sense. Content validity requires that the measure includes or accounts for all the elements of an issue being investigated. Criterion-related validity involves evaluating the results of the index study against the most valid measure available. Predicted validity requires that the measure confirms a known or theoretically hypothesized association. Inconsistent validity may refer to a measure that is valid for one population or group, but might be different in different groups, populations and environments (Katzenellenbogen 1999:92 & Boyle 2003:454).

3.6.1 Socio-demographic questionnaires

The reliability of the demographic questionnaire was tested by having ten adolescents complete one questionnaire each week for four weeks and comparing the answers. Based on the results the questionnaire was accepted to be reliable and valid as a correlation of more than 75% was found for all questions.

3.6.2 Quantitative Food Frequency Questionnaire

The validated QFFQ that was used in the THUSA study (MacIntyre 1998:200) was adapted and used in this study to obtain qualitative, descriptive information about usual food consumption patterns. The questionnaire consisted of two components namely a list of the foods and a set of frequency-of-use response categories. An extensive list of defined foods was included, with the aim of estimating total food intake and thus dietary diversity. All of the subjects completed QFFQs, with the assistance of field workers in individual interviews. Food models were simultaneously used to determine portion sizes and to explain the food item to subjects.

The relative validity of the QFFQ was tested in the THUSA study using 74 volunteers. The reference measurement was a seven-day weighed record and an attempt was made to validate nitrogen intakes against nitrogen excretion in 24-hour urine collections. An additional measure of relative validity was the ratio of reported energy intake to estimated basal metabolic rate (MacIntyre 1998:268). The QFFQ developed for the assessment of dietary intakes of the population of the North West province appeared to provide relatively validated results for energy, macronutrients, calcium, vitamin A and vitamin C (MacIntyre, 1998:347).

The reproducibility of the QFFQ was tested on a sub-sample of 125 volunteers from the THUSA study. The purpose was to obtain the same results when administered at different times to the same subjects. The QFFQ was completed by means of an interview at an interval of six to twelve weeks between repeat administrations. Reproducibility was tested for energy, macronutrients, cholesterol, calcium, iron, vitamin A and vitamin C (MacIntyre 1998:221). Energy and carbohydrates showed satisfactory reproducibility, although the percentages of subjects classified in one quintile were lower. For all the other nutrients, reproducibility was satisfactory on at least two of the analyses. Reproducibility was consistent among all subgroups and it was, therefore, concluded that the QFFQ used in the THUSA study was a relatively reproducible measure of dietary intake (MacIntyre 1998:267).

3.6.3 24-hour recall

A study by Klesges (1987:384) indicates that data obtained by the dietary recall method correlate highly with children's weighed food intake if the parent or primary caretaker providing the child's food responds to the interview. When errors occur, they are errors in portion size, as the parents correctly identified 96% of foods eaten by the children. Parents under-reported only 4% of the time. The researcher concluded by saying that as children become older they appear to be able to recall their own intake both within and outside the home.

The same procedure was followed for testing reliability of the 24-hour recall method. The 24-hour recall was administered before and after the QFFQ on the same day where children had to recall the food that they consumed over the previous 24 hours. Data were analysed and compared to test reliability.

3.6.4 Anthropometric measurements

Two of the fieldworkers were responsible for measuring weight and height and recording these results (Annexure I). The body weight of the respondent (wearing light clothing with shoes removed) was determined to the nearest 0,1 kg. Height was measured to the nearest 0,5cm using a vertical length scale. All measurements were taken twice, and the average of the two measurements, were recorded.

The weight measurements were conducted as follows:

- The scale was placed on an even, uncarpeted area with the spirit level indicator in the middle.
- The scale was switched on and the fieldworker waited until the zero indicator (0.0) appeared and the stable indicator (° in the top left-hand corner of the display panel) appeared.
- The subjects were weighed wearing light clothes, without shoes, after emptying their bladders.
- The subjects were placed on the scale. They had to stand upright in the middle of the platform, facing the fieldworker and looking straight ahead. Their feet had to be flat and slightly apart. They had to stand still until the measurement was recorded in the space provided on the station card.
- The subject had to step down from the scale and wait for the zero reading to appear on the digital display.
- The procedure was then repeated. The readings had to be within 100g of each other, if the difference between the readings were grater than 100g children were weighed again (SAVACG 1995:100-101).

The height measurements were conducted as follows:

- The subject had to remove his/her shoes.
- The subject was positioned as follows:
  - facing the fieldworker
  - shoulders relaxed, with shoulder blades, buttocks and heels touching the measuring board
  - arms relaxed at the sides
  - legs straight and knees together
  - feet flat, heels touching
- The subject had to look straight ahead before the headpiece was slid down onto the head. It just touched the crown of the head.
- The fieldworker recorded the reading in mm on the anthropometric measurement space provided on the demographic questionnaire.
- The procedure was repeated. If the two readings vary by more than 5 mm, then the children were measured again (SAVACG 1995:103).

3.6.5 Biochemical measurements

All the blood samples were collected and handled by a haematologist under controlled, standardised conditions. One of the most important attributes of the project was the importance placed on the quality of the data. For each round of data collection, a monitoring haematologist visited the blood collection points to check and calibrate the equipment in use and to supervise the data collection. Detailed monitoring checklists were maintained to verify whether appropriate techniques were being employed for each point of the data collection. The laboratories involved in the analysis of the full blood count used standard techniques according to existing routine procedures.

3.7 Analyses

3.7.1 Demographic questionnaires

The data on the completed questionnaires were captured on an Excel spreadsheet. After completing the fieldwork, questionnaires were sorted, checked for completeness, accuracy and usability by the researcher. All 80 were usable.

The demographic questionnaires were captured on an Excel spreadsheet and analysed using SPSS computer software with the assistance of a statistician. Tables were drawn up with the percentages of the different variables included on the questionnaire. Only validated questionnaires and standardised methods were used. Data was presented in terms of frequencies and percentages for the following categories:

- age,
- gender.
- number of children per household,
- household income,
- regional dimensions and
- occupation of the breadwinner.

3.7.2 Dietary intake

Data for the QFFQs and 24-hour recalls were captured and analysed using the Food Finder®, South African Medical Research Council computer programme version 3.0 with the assistance of a qualified dietician. On the QFFQ the subjects had three options, indicating frequency of consumption, to choose from. These included per day, per week and per month. If subjects indicated consumption of a food item every day, the portion size was multiplied by 30 to determine estimated monthly intake. Similarly, food items consumed per week, were multiplied by four. The total monthly consumption amount per food item was captured on Food Finder®, analysed and then divided by 30 to determine average daily nutrient intake.

The nutrient intake and foods consumed were established, captured and related in tables and graphs using means and standard deviations for interpretation. The statistical analysis was performed by an independent statistical analyst to determine the adequacy of the nutrient intake and prevalence of deficiencies that could be deducted from the questionnaires. The minimum, median and maximum intake of the children were determined. From the data a top 20 list of foods most often consumed was also drawn up. The association of nutrient intake and nutritional status was compared at <67% of the DRIs.

3.7.3 Anthropometric measurements

The National Centre for Health Statistics (NCHS) growth charts were used to make a statistical comparison of the anthropometric indicators. As recommended by the WHO, the nutritional status of the children in the survey was compared to an international reference population defined by the NCHS. Various norms exist namely, percentiles, z-scores and Standard Deviations. Percentiles were chosen for this study in order to map the data on growth curves for the different age groups and by gender (Hammond 2004:421,423). Height and weight measurements were classified according to these percentiles, which are generally used as an intentional reference population. For this study age was calculated in years from the date of birth to the actual date that each child participated in the survey (Flegal 2002:761).

The anthropometric measurements were analysed with the assistance of a statistician and scatterplots were drawn on the NCHS growth charts. The measurements included the following; BMI-for-age, weight-for-age and height-for-age indicated on the 5^{th}, 50^{th} and 95^{th} percentiles of the NCHS median (Flegal 2002:761).

3.7.4 Biochemical analyses

Blood was separated (centrifuged at 1.500Xg for 20min.) within 2 hours of blood collection. Separated plasma and serum were eliquoted in marked Eppendorf test tubes. Two qualified medical technologists continuously audited the separating procedure. Serum for the analyses of serum iron, transferrin, ferritin, total protein and albumin were stored at -10°C until analysis. Serum for serum retinol, vitamin E and Zinc analysis was covered by aluminium foil and stored at -10°C until it was couriered to the Nutritional Intervension Research Unit of the MRC in Cape Town. Data was captured on Excel spreadsheets and analysed with the assistance of a statistician for means and standard deviations and compared to the normal ranges for the children. Table 3.1 indicates the methods applied and the laboratory used for the tests.

Table 3.1: Summary of methods for serum variable analysis

Variable	Method	Laboratory
Haematocrit (Hct)	Numeric integration, Sysmex SF 300	Vaal University of Technology
Haemoglobin (Hb)	Cyanmethaemoglobin-colorimetric method, Sysmex SF 300	Vaal University of Technology
Mean cell volume (MCV)	Impulse generating Sysmex SF 300	Vaal University of Technology
Red blood cell count (RBC)	Direct current detection, Sysmex SF 300	Vaal University of Technology
White blood cell count (WBC)	Flow cytometry with dual angle light scattering analysis, Sysmex SF 300	Vaal University of Technology
Serum ferritin	Immunoturbidity; Roche	Vaal University of Technology
Total protein	Colorometric method, Konelab 20i	Vaal University of Technology
Albumin	Colorometric method, Konelab 20i	Vaal University of Technology
Serum iron	Colorometric method, Konelab 20i	Vaal University of Technology
Serum transferring	Colorometric method, Konelab 20i	Vaal University of Technology
Zinc	Atomic absorption	Medical Research Council, Cape Town
Vitamin A, E	High performance liquid chromatography	Medical Research Council, Cape Town

3.7.5 Data analysis

Data was screened and captured on Excel spreadsheets, transferred to the SPSS computer software and analysed using the following statistical techniques:

Chi-square: This was used to compare the children with $\leq 5^{th}$ percentile anthropometric status to children with $>5^{th}$ percentile anthropometric status with each other with regard to the nutritional intake <67% of the RDA and >67% RDA. This analysis was used to compare categorical data.

Analysis of variance (ANOVA): This was used to establish the relationship between the children's anthropometrical status ($<5^{th}$ percentile, $=5^{th}$ percentile, $>5^{th}$ percentile, >5 and $<50^{th}$ percentile, $=50^{th}$ percentile, $>50^{th}$ percentile and $<95^{th}$ percentile, $=95^{th}$ percentile and $>95^{th}$ percentile) and the nutrient intake. Probability is indicated as a figure smaller than 0,05 ($p \leq 0,05$).

3.8 Results

3.8.1 Socio-demographic data

The socio-demographic data reflected that 90% of the respondents stayed in a zinc shack with 43.8% having three to four rooms per house (Table 3.2). One hundred percent had access to clean, safe, running water outside their houses and the bucket system toilet facilities were used by 97.3% of the respondents. Waste removal took place at only 6.2% of the houses. Gravel road was existent at 78.9% of houses.

Table 3.2: Demographic data

Type of house	Number N=80	Percentage %
Brick	4	5
Clay	3	3.7
Zinc/shack	72	90
Clay & zinc/shack	1	1.3
Number of rooms		**Percentage %**
< 2 rooms	25	31.2
3-4 rooms	35	43.8
> 4 rooms	20	25

Table 3.3 presents a summary of the demographic characteristics of the sample. Income, educational attainment of parents, and family size are significantly associated with the nutritional status of the school child (Aguillon 1978:10).

Table 3.3: Household data

Employed people per household	Number n=242	Percentage %
None		
One	235	93.3
	17	6.7
Frequency of money shortage	**Number n=242**	**Percentage %**
Always		
Often	85	35.1
Sometimes	46	19
Seldom	74	30.6
Never	21	8.7
	16	6.6
Total household income	**Number n=80**	**Percentage %**
< R500	55	68.7
R 501- R 1000	18	22.5
R 1001-R 1500	3	3.7
R1501- R2000	2	2.5
R 2001- R2500	1	1.3
> R2500	1	1.3

Table 3.3 continue: Household data

Frequency of food shopping	**Number n=80**	**Percentage %**
Every day	7	8.75
Once a week	17	21.25
Once a month	43	53.75
Other	13	16.25
Place of food shopping	**Number n=80**	**Percentage %**
Spaza shop	46	57.5
Street vendor	1	1.25
Supermarket	15	18.75
Other	4	5.00
Spaza shop/street vendor &supermarket	5	6.25
Spaza shop and street vendor	6	7.5
Spaza shop and supermarket	2	2.5
Street vendor and supermarket	1	1.25
Weekly food expenditure	**Number n=80**	**Percentage %**
R0 – R50	32	40
R51-R100	18	22.5
R101-R150	4	5.00
R151-R200	2	2.5
R201-R250	2	2.5
R251-300	1	1.25
> R300	3	3.75
Do not know	18	22.5
Number of meals per day	**n=80**	**Percentage %**
0 - 1	15	18.74
2	46	57.5
3	18	22.5
>3	1	1.25
Place where children consume food	**n=80**	**Percentage %**
Home	62	77.5
Friends	2	2.5
School	5	6.25
Home and school	8	10
Home and buy	1	1.25
Home and family	1	1.25
Family	1	1.25

Table 3.3 continue: Household data

Number of children per household	Number n=80	Percentage %
0 - 1	52	65.00
2 - 3	24	30.00
≥4	4	5
Number of school children per household	**n=80**	**Percentage %**
0 - 1	32	40.00
2 - 3	36	45.00
≥ 4	12	15.00

All of the children that participated in this study were resident in this informal settlement, which is not situated close to a large number of shopping complexes and shops, but the availability of the food was not the problem but rather the availability of resources to acquire the food. Fifteen percent of the households had an average of 3 or more children but 92.5% of the households had a child or children in school. Ninety four percent of the children walked to school everyday. The majority of households had an income of < R500 per month (68.7%). Unemployment was at 93% and most households (40 %) spent less than R50 on food per week. In 2003 a loaf of bread and a litre of milk cost ± R3.00 each. Taking into consideration that the average household size was 4.9 people and R50.00 was spent per household per week, it is calculated that an average of R10.20 per week (R50.00/4.9 people), is spent on food per person in the household. This means that an average of R1.45 (R10.20/7 days) is spent per person per day. This was equivalent to a half loaf of bread or half a litre of milk.

The majority of the households (53.75%) do shopping once a month and 57.5% do their shopping at Spaza shops only. Table 3.4 indicates the list of top 10 food items purchased by the households as measured by the questionnaire. Maize meal, tea, sugar and oil were the top four items purchased comparing well with the food consumption patterns.

Table 3.4: Top 10 food items bought (demographic questionnaire)

Top 10 food items bought regularly (monthly) Food item	Percentage %
Maize meal	96.1
Tea	89.3
Sugar	88.2
Oil	87
Fresh vegetables	72.7
Chicken	64.9
Fresh milk	61.7
Eggs	61
Fresh fruit	45
Butter/margarine	44.4

Fifty eight percent of the households consume two meals a day with 77.5% eating it at home.

3.8.2 Dietary intake

Dietary analysis (Table 3.5) of the micronutrient intake of the respondents indicates that the mean daily energy intake of all the children was below the Recommended Dietary Allowances (RDAs) for children between 7-10 years 8368kj. Comparison of the total protein intake with the RDAs shows that the children consumed more than 100% of the recommendations. The results of this study compare well to findings by Vorster *et al.* 1997, as indicated in Table 3.5.

Table 3.5: The mean dietary intake compared with DRIs (24-hour recall and QFFQs)

Component	Intake (24-hr recall)	Intake (QFFQ)	RDA	%RDA	EAR	%EAR	Compared to other studies in SA. (Vorster *et al.* 1997).
Energy KJ	6115	5990	8368 EER	71.5	-	-	6546kj
Total protein (g)	42.7	39.6	28	141	-	-	55.4g
CA (mg)	195.9	219.9	800 AI	27	-	-	302mg
Fe (mg)	5.3	5.8	10	58	4.1-5.9	116	-

Table 3.5 continue: The mean dietary intake compared with DRIs (24-hour recall and QFFQs)

Component	Intake (24-hr recall)	Intake (QFFQ)	RDA	%RDA	EAR	%EAR	Compared to other studies in SA. (Vorster *et al.* 1997).
Mg (g)	232	212.4	120-170	125	110-200	184.6	270mg
P (mg)	663.7	623	800	78	405-1055	85.3	823mg
Zn (mg)	5.06	4.9	10	49	4.0-7.0	89	9mg
Cu (mg)	0.63	0.69	1.5	46	-	-	-
Cr (μg/day)	21.5	22.4	125 AI	18	-	-	-
Se (μg/day)	20.5	17.8	30	59	23-35	61.3	-
Mn (μg/day)	2030.9	1674	2500	67			-
I (mg/day)	11	17.8	8.10	15	3-4.1mg		13mg
Vit A (RE) (μg/day)	297.2	460	700	66	275-445	127.7	607μg
Thiamin (mg)	0.84	0.77	1	77	0.5-0.7	128	1.3mg
Riboflavin (mg)	1.02	0.8	1.2	67	0.5-0.8	123	0.8mg
Niacin (mg)	9.46	7.47	13	57			11mg
Vitamin B6 (mg)	0.8	0.6	1.4	45	0.5-0.8	92.3	0.5mg
Folate (μg/day)	137.8	131.5	100	132			113μg
Vitamin B12 (μg/day)	2.2	2.17	1.4	155	1.0-1.5	173.6	1.6μg
Pantothenate (mg)	3.2	2.5	4.5	56			
Biotin (μg/day)	17.5	19.9 AI	30	66			
Vitamin C (mg)	44.12	27.7	45	62	22-39	90.8	39mg
Vitamin D (μg/day)	1.3	2.4 AI	10	24			
Vitamin E (mg)	6.4	8	7	116	6-9mg	106.6	

In comparison with the AI, calcium intake of the whole group as well as the intake of iron and zinc were below two thirds (67%) of the DRI and the mean intakes of vitamin A, C, riboflavin were below two thirds (66%) of the EARs.

The NFCS indicates that children, aged 7-9 years old in Gauteng, has a lower intake of nutrients than children in South Africa in general and this is also reflected in the baseline results of this study. Eighty two percent of children in the NFCS take in less than two-thirds of RDA for vitamin A in South Africa.

Table 3.6: Top 20 food items consumed by weight (QFFQ)

Item N=80	Average portion (g)
Maize meal, cooked stiff porridge	403.84
Tea, brewed	203.24
Maize meal, cooked soft porridge	136.83
Milk, full fat/whole fresh	47.22
Bread/ rolls Brown	56.27
Mabella/sorghum cooked	78.92
Cold drink squash, diluted	52.58
Rice, white cooked	39.28
Coffee, brewed instant	80.5
Maize meal cooked, crumbly porridge	87.26
Tea, rooibos, brewed	221.44
Apple average, raw	27.59
Bread/ rolls, white	29.41
Sugar, white granulated	8.8
Samp and beans	42.22
Tomato and onion, stewed	17.83
Egg, fried in sun oil	24.7
Cold drink carbonated, average	66.18
Orange, raw, peeled	30.94
Macaroni, spaghetti cooked	39.74

The top 20 food items consumed indicate that no nutrient dense foods fall in the first 3 items most often consumed namely, stiff maize meal porridge (404g), brewed tea (204ml) and soft maize porridge (137g), milk 4th on the list were more nutrient dense.

The top 20 food items most commonly consumed by the children indicate that the diet is mostly carbohydrate based. Although carbohydrates are seen as energy giving foods (FNIC 2002), it can also be seen that the carbohydrates that are consumed are mainly maize meal, bread and sorghum which are not very nutrient dense and do not greatly contribute to the overall nutritional status of the children.

3.8.3 Nutritional status

Table 3.7 indicates the percentage of children represented in the different percentiles of the NCHS for height-for-age, weight-for-age and BMI-for-age.

Table 3.7: Percentile distribution for weight-for-age, height-for-age and BMI-for-age of children six-thirteen years of age; growth percentiles of the NCHS.

Percentiles	Percentage of children					
	Height-for-age (Stunting)		Weight-for-age (Underweight)		BMI-for-age (Wasting)	
	Boys	Girls	Boys	Girls	Boys	Girls
Below 5th percentile	28.1	28.3	28.1	21.7	9.1	15.2
On 5th percentile	3.1	2.2	3.1	2.2	0	0
Between 5th and 50th percentile	50	54.4	53.1	65.2	59.4	60.9
On 50th percentile	0	0	3.1	0	3.1	2.2
Between 50th and 95th percentile	15.6	10.9	9.4	8.7	28.1	19.6
On 95th percentile	0	2.2	0	0	0	0
Above 95th percentile	3.1	2.2	3.1	2.2	0	2.2

The percentile distribution for height-for-age shows that 83% of the children were under the 50th percentile (28% under the 5th percentile). Further the distribution indicates 86.7% were under the 50th percentile of weight-for-age and 28.1% boys and 21.7% girls were under the 5th percentile. The 72% of the children below the 50th percentile (9.1% boys and 15.2% girls below the 5th percentile) of BMI-for-age indicates slow growth; possibly a result of chronic malnutrition (Table 3.7).

Food items most commonly consumed were maize meal, tea, sugar and oil with eggs 17th on the top 20 foods consumed list as indicated by Table 3.6.

3.8.4 Biochemical measurements

In terms of iron status, 10% of children in South Africa are iron depleted or deficient, one in twenty is severely iron depleted or deficient and one in twenty has iron deficiency anaemia. Anaemia and poor iron status are more prevalent in urban areas (SAVACG 1995). According to Vorster *et al.* 1997b multiple micronutrient deficiencies exist in rural black pre-school children in the form of vitamin A, iron, folate, vitamin E and vitamin B6, this is also true for this study.

Table 3.8: Means (SD) of biochemical variables of primary school children (n=80).

Code	Normal range	Mean	SD	Status	Vorster et al. 1997
Vitamin A	*≥20 (µg/dl)*	25.1	6.2	↑	31.4
Vitamin E	*4.4-thirteen.8 (mg/l)*	10.7	1.8	→	8.2
Zinc	*70-150 µg/dl*	58.5	9.7	↓	
c-reactive protein	**0-10mg/l**	10	5.1	→	
Total Protein	**60-82g/l**	71.9	5.7	→	
Albumin	**37-52g/l**	39	2.5	→	
Ferritin	**20-375ug/l**	24.5	14.1	→	
Vitamin B12	118-716pmol/l	295.5	92.1	→	577.4
Serum folate	3.4-38.3 nmol/l	17	7.3	→	5.4
Red blood cell count	4.0-5.4x106/ul	4.5	0.4	→	
Haemoglobin	**12.0-14.0g/dl**	12.9	1.1	→	10.92
Haematocrit	36.0-44.0%	37.8	3.4	→	
Mean cell volume	77-91fl	84	4.4	→	
White cell count	4.5-13.5 (108/ul)	7	2.5	→	

Table 3.8 indicates that the zinc deficiency is prevalent in this sample. All the other haematological and biochemical status is lower than the normal range for children in this

age group. The levels of white cell count, neutrophils, lymphocites, monocytes, eosinophil and platelet indicates that there was no infections found in this sample at the time of blood collection, confirming that the malnutrition present is not due to infections, but to dietary intake.

3.9 Discussion

The 1999 NFCS indicates that one out of five children, aged one to nine years old, in SA are stunted at national level. Gauteng showed a prevalence of 20% among children under nine years. Nationally, the prevalence of stunting decreased with age from 25,5% in children aged one to three years to 21% in those aged four to six years and 13% in those aged seven to nine years old. A similar pattern emerged for the prevalence of underweight whilst the prevalence of wasting remained constant in all age groups at less than 4% (VIC 2001).

Poverty, household food insecurity and malnutrition are the main problems found in this study. The houses were mainly constructed from zinc (90%), 43.8% of the houses consisted of 3 to 4 rooms and most of the respondents (56%) indicated problems with rat and mice infestation. The socio-economic status of the people in this community was poor with 93% of the caregivers being unemployed and of the 7% that were employed (Table 3.3), 68.7% earned less than R500 per month. Household food insecurity was high as 40% of the household spent less than R50 per week on food and the top 10 items bought indicate that nutrient dense foods were low on the list, animal protein ranked 6th with vegetables featuring 5th on the bought item list (Table 3.4), Food was generally bought from spaza shops (57.5%) that charge higher prices than large supermarkets. Transport to areas where supermarkets are remains expensive when available. The NFCS also found that in one out of five households, the head of the household was unemployed. Unemployment was much higher in the households involved in this study (93%). The NFCS confirmed that in rural, tribal and informal urban areas the unemployment figure was higher overall (Labadarios *et al.* 2001:13), which is consistent with this study as this research area is situated in an informal urban area. The nutritional status of primary school children in an informal settlement was assessed by dietary, anthropometric and biochemical methods. The nutritional status of the children had to be established before the implementation of the intervention to establish the needs to be addressed in the intervention.

Dietary energy must be sufficient to ensure growth and spare protein from being used for energy. Suggested intake proportions of energy are 50% to 60% as carbohydrates, 25% to 35% as fat, and 10% to 15% as protein (Lucas 2004:262). The energy intake of the children in this group only reached 71.5% of the RDA indicating that more energy may be taken from protein which is present at a high level (141%) compared to carbohydrates and fats that do not provide enough protein for muscle development contributing to wasting. Calcium, iron, copper, chromium, selenium, manganese, iodine, vitamin A, thiamine, riboflavin, niacin, vitamin B_6, pantothenate, biotin, vitamin C, vitamin D and zinc intakes were below the DRIs for this age group of the children.

The anthropometric data in this study, when compared with the NCHS standards, indicates that 28% of the children was stunted or chronically malnourished and that 25% of the children fell under the 5^{th} percentile for weight-for-age. Twelve percent of the children fell under the 5^{th} percentile for BMI-for-age and therefore, suffered from acute malnutrition. These results compare well to the data of children between seven and twelve years in Gauteng (Reitsma *et al.* 1994:12), documenting that 12% of the children fell below the 5^{th} percentile of height-for-age, 18% of the children below the 5^{th} percentile of weight-for-age and 6% below the 5^{th} percentile weight-for-height. In this study the anthropometry is supported by the low energy intake.

Iron plays an essential role in many metabolic processes including oxygen transport, oxidative metabolism and cellular growth. The iron present in a person can be divided into essential iron, transport iron and storage iron. The essential iron is found in the red blood cells as Hb (70% of total iron), in muscle as myoglobin (4%) and in enzymes such as cytochromes, catalases and peroxidases (less than 1%). Transport iron is found in small amounts in blood, bond by transferrin. Most of the storage iron is found in the liver (25%) of which two thirds consists of ferritin and haemosiderin. Storage of iron occurs in two forms, namely ferritin and haemosiderin of which ferritin is predominant. Some of the iron is present in the plasma, where it is bound to a specific protein, transferrin. The function of the transferrin is transporting iron (Oldewage-Theron 2001: 135).

In theory, iron depletion is categorised into three stages, ranging from mild to severe. The first stage namely level 1 iron depletion, involves decreased iron stores as measured by decreased serum ferritin. No physiological consequences are present, but an increased vulnerability from long-term marginal iron balance may progress to a more severe deficiency. With low iron stores, a compensatory increase in iron absorption is present preventing progression to the more severe stages (Oldewage-Theron 2001: 135).

In this sample the subjects showed marginal serum ferritin levels that indicate low iron depletion. The dietary intake patterns confirmed low iron intake compared to DRIs. The top 20 foods also indicate low intake of iron-rich foods. Although milk ranks 4th, the portion size is small (47ml).

Although vitamin A deficiency is common among primary school children, the subjects in this community showed a higher than the normal range for vitamin A with similar results reported by Vorster in 1997. Zinc and ferritin levels were lower than the normal range for children in this age group. Comparing the biochemical and dietary intake results, it can be seen that the energy intake is lower and protein higher than the EARs per day. The high protein intake could be utilised as energy and not as much for growth purposes. The low zinc and ferritin levels confirm the low intake of green vegetables, fish and whole grain products as reflected by the top 20. Calcium is needed for adequate mineralisation and maintenance of bone growth in children. Actual needs depend on individual absorption rates and dietary factors such as quantities of protein, vitamin D, and phosphorus. Children who consume no or limited amounts of milk and dairy products are at risk of poor bone mineralisation (Lucas 2004:267). No biochemical measurements were taken for this sample as calcium is extracted from the bone marrow when in short supply and biochemical measurements are not always a viable source for indicating calcium levels, however, the QFFQ indicated a low intake of calcium (219mg).

3.10 Conclusions and recommendations

In 1998, the commission on human rights considered it intolerable that more than 800 million people throughout the world, especially women and children and those living in developing countries, did not have enough food to meet their basic nutritional needs, which infringes on their fundamental rights (FAO 1998). Hunger and malnutrition in their different forms contribute to about half of the deaths of young children. More than 20 million children suffer from severe malnutrition, while 150 million are underweight (UNICEF 1998).

Malnutrition is not a simple matter of whether a child can satisfy his or her appetite. A child that eats enough to satisfy immediate hunger can still be malnourished. Furthermore malnutrition can largely be viewed as an invisible emergency, since three quarters of the children who die worldwide of malnutrition related causes are mildly to moderately malnourished and show no outward sign of problems (UNICEF 1998).

Child malnutrition is not only confined to the developing world. In some industrialised countries, widening income disparities, coupled with reductions in social protection, have worrying effects on the nutritional well-being of children. Another element involved is urbanisation which frequently results in poor dietary intake resulting in under nutrition (UNICEF 1998 & Allen *et al.* 1991).

According to numerous researchers (Allen *at al.* 1991; Martin 1995 and Wardley *et al.* 1997) growth faltering is common in children in developing countries. This is also true for the children in the Eatonside community as 28% were stunted, 25% underweight and 12% wasted. The reasons vary, but the most common reasons are childhood infections and/or inadequate quantity or quality of foods. The foods in the Top 20 most often consumed foods indicated that the diet consisted mainly of carbohydrate-based foods and that the protein foods included were in small portions. The diet quality also proved to be poor as the only nutrients that were sufficiently consumed, when compared to the DRIs were manganese, folate, vitamin B12 and vitamin E. Assisting a child to grow optimally requires that a variety of foods that are high in nutrients should be offered in the diet. No single food can supply all the nutrients in the quantity that the child needs; for example, milk supplies calcium but little iron, meat supplies iron but little calcium. For children to have nutritious diet, a variety of foods must be offered.

Furthermore, many changes occur in a child's life when formal education begins. Lunch eaten at school is different to lunch eaten at home. Getting to school on time and having to walk long distances to school can interfere with breakfast, children might be unwilling to get up in time to have breakfast and busy parents may not have time to provide their children with breakfast (Wardley *et al.* 1997). This pattern of disrupted breakfast is consistent with the results of this study where it can be seen that 88% of the children walk to school. In this study it was found that thirteen.2% of the subjects did not consume breakfast and the majority that did, consumed bread and tea only (86.6%).

Widespread recognition that poor children are unable to properly benefit from school if they are underfed was officially received more than 100 years ago. According to Colquhoun *et al.* (2001:120) school meals cannot make good all the nutritional deficiencies of poor children's diets, but it is recognised that it can make an important contribution, as also proven by Powell *et al.* (1998:875) in a study in Jamaica where breakfast was given to children in a school and resulted in improvement in the children's school attendance. Weight gain was relatively greater than height, leading to a small increase in BMI in the children who received the breakfast. The breakfast consisted of a cheese sandwich or spiced bun with cheese and flavoured milk (2419-2953kj and 27g protein). The children in this school were situated in a mountainous rural area where the children had to walk long distances to get to school. Children from poor households gained more weight than children from better homes. The children in the Jamaican study were not severely malnourished, however their nutritional status improved while receiving breakfast. This suggests that school feeding programmes could be an effective way of improving nutritional status in countries where undernutrition is a serious problem. There is consensus that in large programs sufficient and regular food deliveries are a challenge.

It can therefore be concluded that a chronic shortage of food and lack of nutritious foods, contributed to the relatively large percentage of children suffering from malnutrition in this community.

An intervention study is recommended to address the specific micronutrient deficiencies identified, namely zinc, iron, calcium and vitamin A and to assist in eradicating hunger as a result of the low-socio-economic status and resulting household food insecurity. Although the PSNP is available to children in the school where this study was undertaken, not all the children qualified and some were excluded from the government school-feeding programme. A school feeding programme was thus implemented as the recommended intervention. This will be described in the following three chapters as outlined in Figure 3.3.

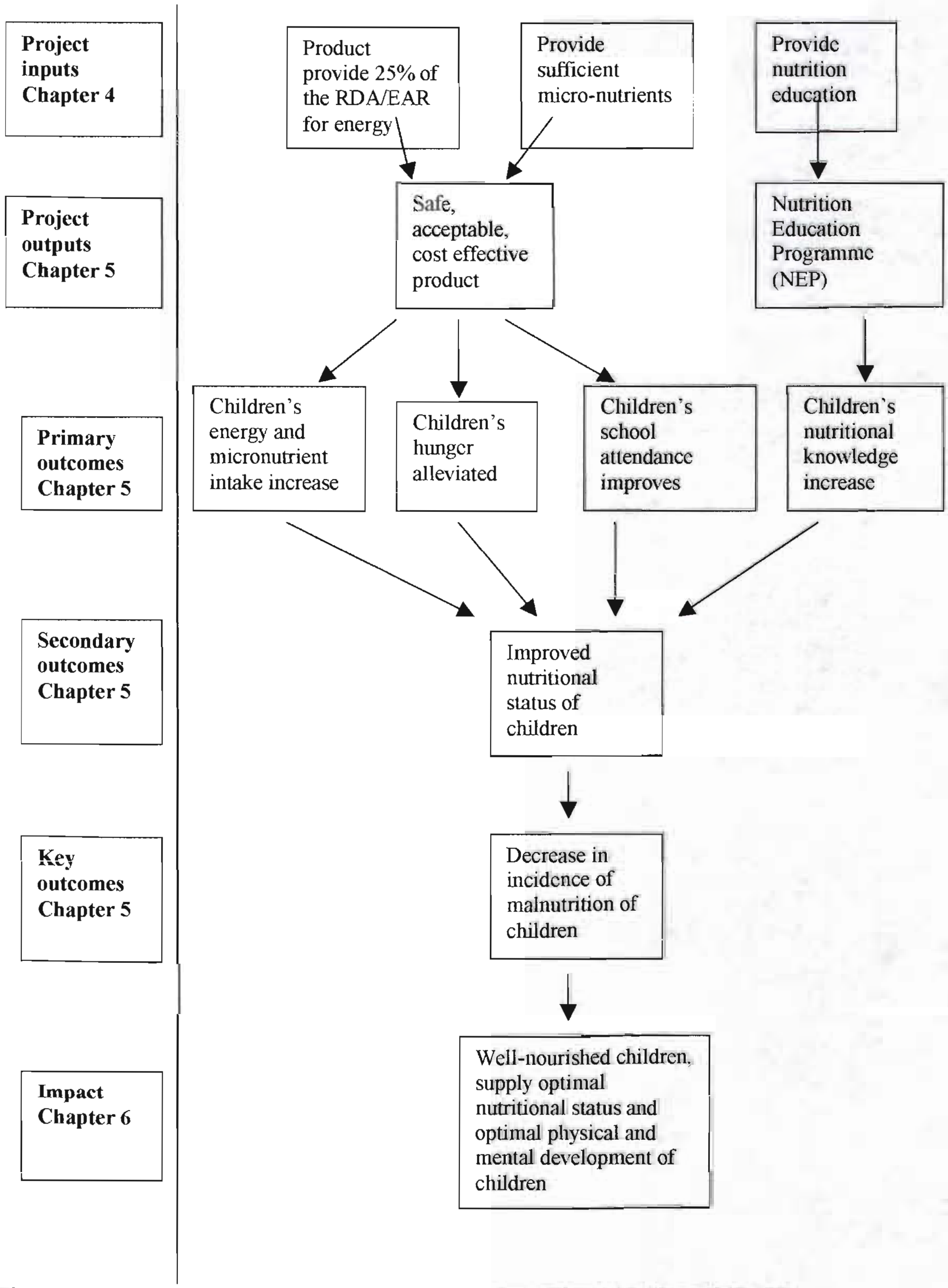

Figure 3.2: Programme theory framework. (Adapted from Wentzel-Viljoen 2003:123).

Chapter 4

Development of the novel food product

4.1 Introduction

The purpose of this chapter is to discuss the development of the novel food product for implementation in the school feeding project in this poor community. The nutritious novel food was developed with the objective to address nutrient deficiencies identified in the baseline study, in order to improve nutritional status of previously disadvantaged primary school children in the Vaal Triangle.

This project was a team effort that was planned, co-ordinated and administered by the researcher, the development of the product was part of the Masters study of J. Kearney (VUT). The researcher was responsible for the assessment survey and intervention including the ethical considerations, training of field workers, making arrangements with the school, random sampling, drawing up and arranging statistical analyses of all questionnaires, co-ordinating biochemical analysis with the laboratories, as well as transport arrangements.

4.2 Objectives

The objective of this part of the study was the development of a novel food product to be used in the intervention study as part of the school feeding programme for primary school children, aged nine to thirteen years to attempt in improving the nutritional status and address food malnutrition in primary school children.

The specific aims of this part of the project were to develop a product, based on the following criteria:

- Balanced nutritional value: rich in energy, rich in proteins and micronutrients, specifically those where deficiencies are present, moderate in fat and sugar.
- Practical: easy to prepare, easy to store, long shelf-life and minimal waste.
- Acceptable to children: attractive appearance and taste acceptable.
- Affordable: local raw materials (Roche 2000:4)

Before the development of a novel food, information is needed regarding the existing specific nutrient deficiencies, as well as the dietary intake and food consumption patterns of the children, subsequently the results from the baseline study that was conducted in the area (see chapter 3), were used as criteria for the development of the product.

This part of the study concentrates on the development of a novel food product for implementation in the school feeding project in this poor community.

This product initiated the involvement of the local communities and the non governmental organisations (NGO's) in the Vaal Triangle for the upliftment of the community by assisting in gathering information, developing a cost effective, nutritious novel food product, easy enough to be prepared by the parents and caregivers. The primary school, situated in this informal settlement, was selected, for the intervention as permission from the Department of Education and the school governing bodies (SGB) had previously been obtained.

4.3 Criteria for the development of the product

The product that was developed was based on the following criteria: affordability, available foods that are widely consumed; sustainability and addressing under-nutrition. The main ingredients were based on the staples mostly used in the community as indicated in the pilot study. The product that was developed was a vetkoek.

The baseline survey showed that both a zinc deficiency and a marginal iron deficiency were prevalent in the primary school children. Furthermore the dietary intake patterns showed low intakes of zinc, calcium, iron, vitamin A and B-vitamins when compared to the DRIs. A study by Wentzel-Viljoen indicates that any product used in school feeding programmes should supply 25% of DRIs for the targeted nutrients. The first criterion that the novel food product was expected to meet was 25% of the DRIs for zinc, iron, calcium, vitamin A and B-vitamins and thus the development of the nutritious novel food product was based on the following criteria:

- Easy to prepare
- Minimal waste
- Acceptable to children (62% of children had bread and tea for breakfast, ingredients form part of food items most commonly consumed, vetkoek is a product that is well known by children in the Eatonside Area)
- Cost effective (<R 2.00 per person per day).

4.3.1 Different recipes identified

Different recipes were evaluated and a specific product, suitable for children, easy to prepare with ingredients readily available was the ideal. Five different vetkoek recipes were chosen, prepared and tested. A vetkoek was chosen as it forms part of the top 20 food items consumed as indicated in the breakfast survey. All ingredients for this recipe are readily available and no stove is required. Basic vetkoek recipes were chosen and adjusted, and three different types of Maize meal and Whole-wheat vetkoek were developed:

A - Maize vetkoek

B - Maize and whole-wheat vetkoek

C - Whole-wheat vetkoek

Vetkoek was identified as a food item that is often consumed by the households in this community, the ingredients for vetkoek is available in the households, as can be seen on the top 10 items bought in Table 3.4 and can be prepared with the equipment available in the households, electrical or outside over an open fire.

Five different vetkoek recipes were identified as possible products. A costing was done on each recipe to determine the three most cost effective recipes with locally available ingredients. Each recipe was nutritionally analysed, and the three that were most suitable were selected.

4.3.2 Preparation and preliminary sensory testing

Five different recipes were initially chosen and analysed from there for the best option.

4.3.2.1 Formulation of the product (Theoretical)

The Dietary Manager® program, based on the SA food consumption tables (Langenhoven 1991) was used to evaluate each of the five recipes for nutritional content. The nutritional content of each recipe was compared to the DRI of children aged nine to thirteen years old. Different ingredients from the top 20 consumed foods as indicated in the baseline survey were added. After inclusion of an ingredient or ingredients the recipe was again theoretically analysed (Dietary Manager Program®) in order to determine the influence of single ingredients on the nutritional value of the recipe. A costing was conducted for each recipe to determine the three recipes meeting the criteria of < R2.00 per portion.

4.3.2.2 Biochemical analyses

The three recipes with nutrition values meeting the criteria closest to 25% of DRIs (for energy, iron, zinc, calcium, and vitamin A) for children nine to thirteen years of age were chosen for nutritional value and cost for the empirical study. The three different recipes were prepared and a preference testing was conducted. The most popular product was chosen and the prepared product was sent to the Agricultural Research centre (ARC) in Irene, for actual analysis.

The ARC is an accredited food analysis laboratory in Irene and did the biochemical food analysis on 100g portions and analysed the vetkoek for the following: Ash, moisture, fat, protein, folic acid, vitamin A, carbohydrates, vitamin B1, vitamin B 2, vitamin B6, vitamin B12, vitamin C, energy, calcium, magnesium, copper, iron and zinc. This was conducted to compare the theoretical and actual nutrient content of the three samples, the first sample was seen as inadequate and needed to be adjusted. The second sample was the one implemented in the school feeding programme (portion size 120g), the third sample was biochemically analysed half-way through the intervention, to compare the product to the actual vetkoek that the children received throughout the intervention and for quality purposes (Table 4.1).

Table 4.1 Nutritional analysis of the product conducted by ARC (100g).

		Dietary Manager® results	Analysis by ARC Vetkoek samples 100g			EARs for children 9-13 years	% of DRIs per 100g of the vetkoek
Analysis	Unit		Sample 1	Sample 2**	Sample 3		
Moisture	%		34.20	29.86	39.5	Not available	
*Protein	%	12.64	7.29	10.32	8.96	Not available	
Fat (ether extraction)	%	33.72	15.42	17.79	8.21	Not available	
Folic acid	µg /100g	57	1002.52	540	820	250µg	216%
Vit A	µg /100g	287 (retinol)	59	69	89	445µg/day	15.50%
Vit B1 –Thiamine	mg/100g	0.24	0.43	0.41	0.40	0.7mg	58.57%
Vit B2- Riboflavin	mg/100g	0.36	0.15	0.21	0.10	0.8mg	26.25%
Vit B6	mg/100g	0.219	1.35	0.36	0.46	0.8mg	45%
Vit B12	µg /100g	0.3	5.31	1.49	1.27	1.5µg	99.3%
Vit C	mg/100g	2	0.81	0.42	1.27	39mg	1.07%
Carbohydrates (calculated)	µg /100g	34.15	40.66	39.82	41.45	100g/day	39.82%
Energy (calculated)	kj/100g	2065	1386	1511	1161	8368kj/day	18.05%
Calcium	mg/100g	198	140.49	156.03	117.23	1300mg	12%

Table 4.1 continued: Nutritional analysis of the product conducted by ARC (100g).

		Dietary Manager® results	Analysis by ARC Vetkoek samples 100g			EARs for children 9-13 years	% of DRIs per 100g of the vetkoek
Analysis	**Unit**		**Sample 1**	**Sample 2****	**Sample 3**		
Magnesium	mg/100g	85	73.42	72.13	72.24	200mg	36.06%
Copper	mg/100g	0.24	0.08	0.17	0.14	1.5mg	11.33%
Iron	mg/100g	3.09	9.8	6.94	4.02	5.9mg	117.6%
Zinc	mg/100g	1.82	3.96	3.60	3.45	7mg	51.42%

*For the conversion of nitrogen content to protein content the factor 6.25 was used ARC.
**Sample two was the sample agreed on and implemented as part of the intervention and the comparison with EARs were made with 100g of this sample's results.

Table 4.1 indicates the EARs compared to 100g of the vetkoek, the portion the children received was 120g and addressed at least 25% of the DRIs of the children's needs for iron, magnesium, zinc, vitamin B12, folic acid, thiamine, vitamin B6 and vitamin B12. The nutrients that did not reach 25% included vitamin A, vitamin C, calcium and copper (see also Table 5.10).

The recipe was then finalised. The product was prepared and the target group took part in a sensory analysis.

The biochemical analysis used were as follows:

- Dry matter / total solids

The dry matter content is the residue expressed in percent by weight, which remains after the drying process described. Dry matter is the sample without water. The moisture from a sample is driven off by use of heat. Weight loss is used to calculate dry matter content. This method is suitable for the determination of dry matter in plant tissue samples and food products (Swart 2004).

- Determination of total Vitamin C as dehydro ascorbic acid

The method specifies a high performance liquid chromatographic technique for the determination of vitamin C. Mass fraction of the vitamin determined by the method specified. The vitamin concentration was expressed as mg/100g. Extraction of vitamin C was done by using acetic acid and *meta*-phosphoric acid. Oxidation of ascorbic acid changed to dehydro ascorbic acid (DHAA). Derivatisation of DHAA was done and determination with HPLC was done to conclude the fluorescence detection (Swart 2004).

- Determination of fat through hydrolysis the Soxtec method

Fat is defined as organic chemical compounds made up of components known as fatty acids and glycerol and most fat is soluble in petroleum ether (PE). The fat in the sample were dissolved in the ether at boiling temperature. The ether was evaporated at 90°C. The fat was left in the beaker. Weight gain was used to calculate fat content. Bounded fat is not soluble in PE and had to be broken down by hydrolysis (Swart 2004).

- Total non structural carbohydrates

Non structural carbohydrates were analysed as reducing sugars after complete enzymatic hydrolysis to monosaccharide. This method entailed the gelatinisation of all the starch to glucose and determined the glucose content by spectrophotometer (Swart 2004).

- Minerals

These analyses were performed in a sub-contracted laboratory. A suitable mass (0.5g to 1g) of sample was digested with 7ml HNO_3 (concentrated nitric acid) and 3ml $HClO_4$

(perchloric acid) at temperatures up to 200°C and brought to volume in a 100ml volume flask (Swart 2004).

K and Na: An aliquot of the digest solution was used for determination of K and Na by flame emission spectroscopy (flame photometer) in a LPG-air flame, using Li ($LiNO_3$) as an internal standard. The method has been automated by means of a flow system (Swart 2004).

Calcium, iron and zinc by atomic absorption: The digest solution were analysed with flame atomic absorption spectrophotometry (AAS) for iron and zinc using an Air-Acetylene Flame with wavelengths of 248.3nm and 213.9nm for iron and zinc respectively. An aliquot of the solution was diluted for determination of calcium by AAS in a Nitrous Oxide-Acetylene Flame, using a wavelength of 422.7 nm for calcium (Swart 2004).

- B-carotene

The test material was alkaline saponified and the unsaponifiable matter was extracted with ether. An aliquot of the ether extract were evaporated and dissolved in hexane. The analysis was performed on a HPLC with a silica column and hexane as the mobile phase. The carotene was detected with an Ultra Violet (UV) detector at 453 nm. Regression analysis was performed and the carotene calculated (Swart 2004).

- Metabolisable energy by gas production

The procedure for determining metabolisable energy is a two-phase technique involving 72-hour fermentation by rumen micro-organisms in a buffer solution, followed by a 48 hour pepsin digestion after acidification. Cumulative gas production was measured during the fermentation period. The reduction in the organic matter content was ascribed to digestion of the sample. Rate of gas production were used to determine fermentation rate. The results obtained include *in vitro* organic matter digestibility, fermentation time and metabolisable energy (Swart 2004).

4.3.3 Optimisation

After evaluation of the products selected the recipes were adapted in order to identify a suitable product. Different ingredients were added to the vetkoek to test the influence on the taste, texture, and cooking process. From the original five recipes the three most suitable recipes were chosen. The three recipes with nutrition values meeting the criteria closest to 25% of DRIs (for energy, iron, zinc, calcium, and vitamin A) for children nine to thirteen years of age were chosen for nutritional value and cost for the empirical study. The three different recipes were prepared and a preference testing was conducted. The general appearance, taste and overall acceptability of the three products were evaluated. The most popular vetkoek was chosen and the prepared product was sent to the Agricultural Research centre in Irene, for actual analysis. The results from the ARC indicated a shortfall in energy - 429 kJ, Ca- 156.4 mg and vitamin A - 40 RE. The final adjustments were made to reach an average of 25% of DRIs for energy, iron, zinc, calcium, and vitamin A for children nine to thirteen years of age. The recipe was theoretically analysed by using the Dietary Manager® Computer program, based on the South African food composition tables. From the theoretical calculations on Dietary Manager the shortages could be addressed by adding 20g of milk powder. The different recipes were adjusted to be maize based (staple) and by adding different ingredients to contribute to the nutrient content. The most popular recipe was chosen and the following shortfall was identified by the biochemical analysis:

- Energy - 429 kJ
- Ca- 156.4 mg
- Vit A - 40 retinol equivalents (RE)

Spinach was added to improve the iron content, pilchard fish was added for zinc, calcium and protein. The product was fried in vegetable oil to enhance the energy value of the vetkoek. The recipe was adjusted and sent to the ARC for a second nutritional analysis.

These adjustments to the final recipe were made to address 25% of the DRIs for children aged nine to thirteen years.

The final vetkoek contains the following ingredients: maize meal, whole wheat, yeast, spinach, and milk powder, egg, sugar, salt and pilchard fish (Figure 4.1). The vetkoek is fried in vegetable oil. The different recipes were prepared and tested in the cooking laboratories of the Hospitality and Tourism department of the Vaal University of Technology. Recipes for the maize meal and whole-wheat vetkoek were theoretically analysed by using the Dietary Manager® Computer program, based on the South African food composition tables.

Figure 4.1: Ingredients used in the product

4.4 Shelf-life analysis of the nutritious novel food product

The researcher had to contract the shelf-life studies out, as this is not her field of expertise. Shelf-life studies were carried out under a range of controlled test conditions by the ARC. Microbiological tests were done to evaluate the growth of harmful bacteria and micro-organisms after special time periods to determine shelf-life. During shelf-life testing the food was periodically examined for changes in appearance, aroma, texture and taste until it became unacceptable. The sensory changes at first were subtle, but they eventually made the food unacceptable. High numbers of micro-organisms are normal in certain foods, but indicate deterioration in other foods. The prepared vetkoek was couriered just after preparation to the laboratory for the shelf-life testing. The vetkoek was delivered to the ARC-Microbiology in a cool box without any cooling blocks. The vetkoek was packed in a foil tray with a carton lid. One tray was kept at 4°C and the other tray at room temperature (±25°C). The vetkoek was plated out on day 0 (day of arrival), day 2, 4 and day 7 (Annexure M).

4.5 Microbiological analysis

A 10g sample was removed aseptically from the inside of the vetkoek. The samples were homogenised in a Stomacher 400 (DHK Pty Ltd) with 90 ml of diluted buffered peptone water. The sample were plated out for a total aerobic plate count on Tryptone soy agar and incubated at 25°C for 72 hours and for yeast and moulds on Rose Bengal agar and incubated at 25°C for 72 hours.

4.6 Sensory evaluation

A paired preference testing was conducted to determine the most popular of the three products. In the second sensory evaluation an acceptance test was done to determine how well the product was liked by consumers. A hedonic scale was used to indicate the degrees of dislike to like (Annexure M).

4.6.1 Paired preference testing

In the first sensory evaluation a paired preference test (Annexure J) was performed. The preference test forces a choice of one item over another. A sensory panel of 60 children aged nine to thirteen years was constituted by random selection from the Primary School and evaluated the three types of vetkoek. Two sessions were held in two different classrooms with 30 children in each classroom. The sensory panel was seated in three rows of ten children; the children were not allowed to communicate with each other during the sensory evaluation session. An example of the sensory evaluation form was drawn on the black board in the class and a lecture in the children's own language was given before the sensory evaluation took place. Sensory evaluation forms and pencils were handed out to all the children. For serving, each vetkoek were placed on a white paper plate and numbered A, B and C, the children then evaluated sample A first, then sample C and last sample B. A glass of water was given to the children between tasting to clear their taste buds and mouth before they tried the next sample. Personal assistance was offered to the children during evaluation.

4.6.2 Acceptance testing

In the second sensory evaluation an acceptance test (Annexure K) was conducted and the objective was to test the acceptability of the product. A smiling face scale /hedonic scale was used, this method is suitable to use for measuring children's response to products. This test is relatively simple and the aim was to determine whether the children liked or disliked the vetkoek. The target group included 30 children aged nine to thirteen years, currently attending the primary school in Eatonside. An example of the sensory evaluation form was drawn on the black board in the class and explained to the children's in their own language and in English to make sure that they understood exactly what is expected from them. Sensory evaluation forms and pencils were handed out to all the children.

For serving, the vetkoek was placed on a white paper plate and a glass of water was given to the children after tasting. As a reward for helping with the assessment the children got fruit and a sweet, they were also allowed to keep the pencils.

4.7 Developing of a recipe pamphlet

A recipe pamphlet (Annexure L), containing different vetkoek recipes was developed and printed for illiterate people and was used to train the mothers and caregivers who were responsible for preparing the maize meal and whole wheat vetkoek, for the school children. The recipe pamphlet contains the recipe for the vetkoek and other similar recipes that can be prepared with available ingredients in the households, according to the baseline study done. The same recipe pamphlet will be used in future in basic training of caregivers in this and other communities.

4.8 Results and findings

4.8.1 Criteria

The criteria for the development of the product were the following:

- The vetkoek should consist of at least 25% of the DRIs for children aged nine to 13 years old for zinc, iron, calcium, vitamin A and B-vitamins. To address the nutrient deficiencies as indicated in the baseline study namely, zinc, iron and low energy intake
- The product should be easy to prepare
- Acceptable by children

- Produced with locally available ingredients
- Affordable at <R2.00 per person per day

Figure 4.2: Vetkoek portion of 120 g

4.8.2 Recipes

Figure 4.4 is the original recipe before it was adapted and used as the basis for the developed vetkoek in Figure 4.5.

Recipe name: Whole-wheat and Maize meal vetkoek (Yield 20)

Quantity		
Grams	**Millilitres / units**	**Ingredients**
10g	1 x small packet	Yeast, dry instant
185g	200ml	Lukewarm water
210g	200ml	Lukewarm milk, full cream
60g	1 each	Egg, large beaten
20g	30ml	Oil, sunflower
15g	15ml	Sugar, white
15g	15ml	Salt, fine
440g	750ml	Whole-wheat flour
310g	500ml	Maize meal

Raw weight: 1.190kg Cooked weight: 1.155kg

Method:
Mix milk, water and eggs and mix well.
Mix all dry ingredients with instant yeast.
Add milk mixture to dry ingredients and blend well.
Knead well for 5 minutes, to make a soft dough.
Put dough into a clean bowl, cover with a clean kitchen towel.
Leave in a warm place to rise for 2 hours.
Lightly roll out and cut with portioning frame.
Fry for 4 minutes in pre-heated oil (160°C) on each side.

Figure 4.4: Original Vetkoek Recipe (before optimisation).

The recipe indicated in figure 4.5 was adapted after the nutritional analysis showed that it did not address the children's needs.

Recipe name: Whole-wheat and Maize meal vetkoek (Yield 20)

Method:

Quantity		
Grams	**Millilitres / units**	**Ingredients**
20g	2 x small packets	Yeast, dry instant
400g	400ml	Lukewarm water
300g	3 cups	Milk powder, full cream
120g	2 each	Egg, large beaten
20g	30ml	Oil, sunflower
20g	20ml	Sugar, white
20g	20ml	Salt, fine
900g	7 cups	Whole-wheat flour
500g	3 cups	Maize meal
500g	6 cups	Spinach, chopped, raw
420g	1 can	Pilchards in tomato sauce, mashed

Mix milk powder with water
Add eggs and oil to milk and mix well, chop spinach.
Mix all dry ingredients with instant yeast.
Add milk mixture to dry ingredients and blend well.
Add chopped spinach and pilchards to the mixture.
Knead well for 5 minutes, to make a soft dough.
Put dough into a clean bowl, cover with a clean kitchen towel.
Leave in a warm place to rise for 2 hours.
Lightly roll out and cut with portioning frame, fry for 4 minutes in pre-heated oil (160°C) on each side.

Figure 4.5: Whole-wheat and maize vetkoek – adjusted

The vetkoek was analysed for cost and had to be affordable to this specific community, the cost analysis applies to 2004 (Table 4.2).

Table 4.2: Cost analysis of the vetkoek in 2004

Ingredients	Cost
Maize meal (fortified)	R2.91
Whole-wheat flour	R7.34
Yeast, instant	R1.29
Salt	R0.45
Sugar, white	R0.89
Eggs, large	R1.06
Oil, sunflower	R5.28
Milk powder, full cream	R3.99

Table 4.2 continue: Cost analysis of the vetkoek in 2004

Ingredients	Cost
Pilchards in tomato sauce	R5.00
Spinach raw	R2.04
Total price	**R30.25**

The standardised recipe yielded 20 vetkoek and worked out to R1.51 per vetkoek(120g). The children received 1 vetkoek per day. The product development was completed by April 2004, the intervention started in May 2004.

4.8.3 Evaluation of the product

The results showed that the majority (65%) of the consumers liked the product very much, and 90% found it to be acceptable for inclusion in a school feeding program.

4.8.4 Shelf-life testing

Shelf-life testing indicated that the vetkoek stored at 4°C had a seven-day shelf-life period as seen in Table 4.3.

Table 4.3: Shelf-life results of the vetkoek stored at 4°C

Sample	Total Aerobic Plate Count Cfu/g	Yeast and Moulds Cfu/g
Day 0	2,0 x 10	<10
Day 2	1,0 x 10	<10
Day 4	5,0 x 10	<10
Day 7	1,6 x 10	<10

Cfu/g = Colony forming units per gram of sample.

The vetkoek stored at 25°C had a two-day shelf-life. Although moulds were visible, thus not acceptable to eat, on the vetkoek stored at 25°C on day 4, the counts were very low throughout the trial (Table 4.4). This could be due to the fact that the 10g aliquot of sample was taken from the middle of the vetkoek each time, and the visible mould growth was on the upper crust of the vetkoek.

Table 4.4: Shelf-life results of the vetkoek stored at 25°C

Sample	Total Aerobic Plate Count Cfu/g	Yeast and Moulds Cfu/g
Day 0	1,9 x 10	<10
Day 2	1,3 x 10	<10
Day 4	2,4 x 10	<10
Day 7	>3 x 10	1

Cfu/g = Colony forming units per gram of sample.

The total bacterial count and the yeast and mould counts for the vetkoek stored at 4°C remained low throughout the seven day trail. The total bacterial count as well as the yeast and moulds counts for the vetkoek stored at 25°C increased from log 2 to log 6 on the second day and increased to more than log 7 on the last day of the self life trial. Although the yeast and mould counts remained very low throughout the 7 days, moulds were visibly detected on day 4 of the trial (Figure 4.3).

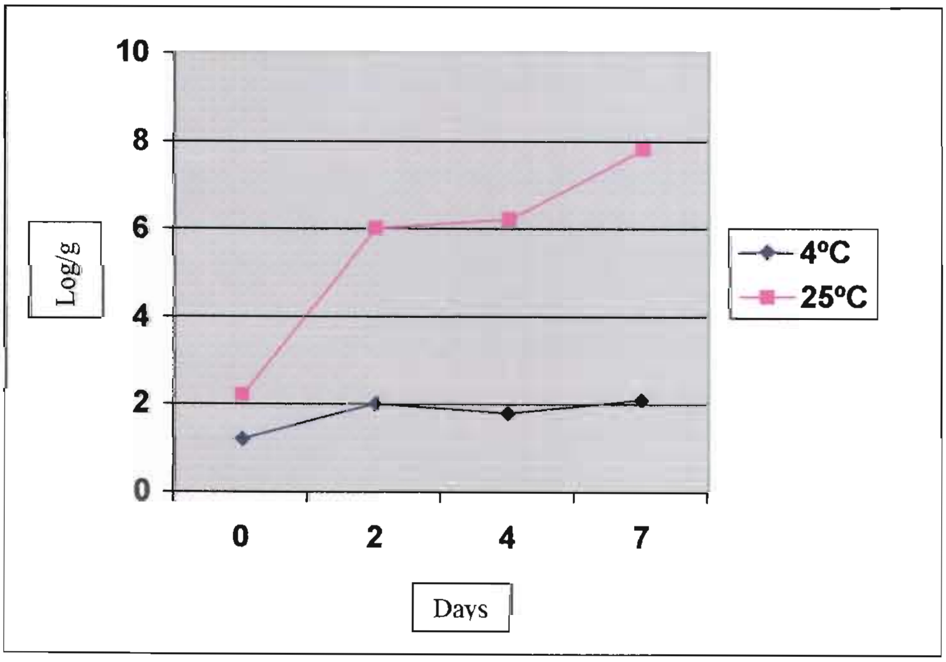

Figure 4.3: Total bacterial count over 7 day period stored at 4°C and 25°C.

4.8.5 Sensory analysis - preference testing

A paired preference test was performed to determine which of the three products the subjects preferred. Of the subjects 80% preferred sample B, the maize meal and whole-wheat vetkoek. This vetkoek was therefore used in the intervention study. The method of consumer sensory evaluation was used. The goal was to determine which of the three products was the most popular. In the sensory analysis it was determined that 65% of the consumers liked the product very much and said it was tasty, 18% liked the product moderately and 17% found it acceptable. All subjects (n=60) in the evaluation were part of the target consumer group, age nine to 13 years old.

Table 4.5: Results: Sensory analysis – preference testing

Sample A Maize vetkoek					**Sample B** Maize and whole-wheat vetkoek					**Sample C** Maize, whole-wheat and cake flour vetkoek				
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3%	1%	5%	0	0	43%	37%	1%	0	0	3%	7%	0	0	0

1. Like a lot
2. Like
3. Neither like / dislike
4. Dislike a little
5. Dislike a lot

Table 4.5 indicates that 43% of the respondents liked the taste of sample B a lot, 37% liked the taste of sample B and 1% neither liked nor disliked the taste of sample B. A total of 10% of the respondents found product C within their liking. Only 4% found sample A to be acceptable. The total of the three samples makes up 100% of the children.

4.8.6 Sensory analysis - acceptance testing

The preference testing was done to establish a liking between the three products, the second testing (acceptance testing) was done to establish the sensory values of the products, in terms of taste, appearance and general acceptability. The children's degree of like / dislike of the vetkoek was determined. A smiley face evaluation sheet was developed for the sensory analysis (Annexure M). The sensory panel consisted of randomly selected representatives from the target group (n=30), they tested the developed vetkoek and completed the evaluation sheets. The sensory panel received training and guidelines before the product was tasted. The sensory evaluation process was discussed with the representatives, and an explanation of what was expected from them was done in Sotho, to ensure that all the children understood the process. The most popular product was evaluated. Eighty percent (80%) of the subjects preferred sample B, the maize meal and whole-wheat vetkoek. Fifty eight percent (58%) of the children liked the taste of the developed vetkoek, with 37% rating the taste as "like", 5% rated the taste as "neither like nor dislike". Where the appearance of the product was concerned 35% of the children rated it as "like it a lot" and 41% liked it. Forty two percent (42%) of the children rated the overall acceptability as "liked a lot" the vetkoek with 41% liking it.

A second acceptance testing was conducted towards the end of the intervention in October 2004 to test the children's (n=30) reaction to the product after having it as part of their breakfast for as period of seven months. The same smiley face evaluation sheet was used. In this sensory evaluation 78% of the children still liked the product very much.

The product eventually used was the most popular vetkoek as chosen by the children's preference testing and even after seven months of consumption the children still enjoyed the taste of it.

4.9 Conclusion

The criteria for developing the novel food product were; to meet a minimum of 25% of DRIs for energy, iron, zinc, calcium, and vitamin A for children nine to thirteen years of age, to be easy to prepare by illiterate mothers (18.9%) and with ingredients available in the households. The results showed that only 17% of the households had access to electrical stoves, 8.8% used coal and 75.6% had access to paraffin stoves. The preparation method thus had to take this into consideration. The product should furthermore be cost effective (<R2.00 per person per day) and acceptable to children, in order to ensure compliance during the school feeding programme. Vetkoek was found to be consumed by the majority of households in this study as it was easy to prepare. For this reason it was decided to develop a "vetkoek" that met all the criteria.

This study showed that it is possible to develop an acceptable novel food product meeting specific criteria. Wentzel-Viljoen (2003:224) recommend that at least 25% of DRIs should be met for micronutrients in a food product to be implemented in school feeding programmes. This criterion was met in the vetkoek recipe for iron, magnesium, zinc, vitamin B12, folic acid, thiamine, vitamin B6 and vitamin B12. It is, however, important not only to use theoretical calculations for nutrients as the biochemical results indicated variances from the theoretical calculations.

The sensory evaluation of the vetkoek also showed that the vetkoek was acceptable to the majority of the intended consumers, namely the primary school children, as it received a high score for taste, appearance and general acceptability.

The vetkoek developed was also tested for shelf-life and the results showed a recommended shelf-life of two days at room temperature (24%) and seven days when refrigerated.

The vetkoek developed in this project, met all the criteria for the intended use in a school feeding programme for this community in the Vaal Triangle. The next chapter will discuss the implementation of the vetkoek in a school feeding programme as part of an intervention study.

Chapter 5
Intervention

5.1 Introduction

There is a high prevalence of malnutrition among South African children (Labadarios *et al.* 2005:536 & Reitsma *et al.* 1994:10). Improving nutritional status of children in any community is one of the principal goals of feeding and development programmes. Nutrition intervention through school feeding schemes may be a solution to the problem of malnutrition among school going children. However, to be affective, feeding schemes should not only be well planned but should also be evaluated in pilot studies before and regularly after implementation. It seems that the benefit of supplementary food programmes in children with moderate or less-than-severe malnutrition is far from clear. For success, a more holistic approach is advised where food intervention should form part of the total primary health care delivery system. Nutrition and health education should be included in such intervention programmes (Reitsma *et al.* 1994:10).

A vetkoek was developed and met the criteria required for a school feeding item, it addressed 25% of the RDA/EAR for children aged six to thirteen for energy, iron, zinc, calcium and vitamin A. The product also consisted of food items that are available in the household and known to the children. The product is cost effective at R1.97 per child per day and proved to be sensory acceptable by learners.

This chapter describes the inclusion of this developed vetkoek as part of a school feeding programme to measure the impact of this vetkoek on the nutritional status of the learners.

5.2 Methods

The intervention study was undertaken in the same school, but was completely separate from the needs assessment survey. Consent forms were completed once again for the randomly selected children in the sample. The sample may have included some of the children in the needs assessment survey, but the data were not compared. Socio-demographic data were not collected again as this informal settlement was identified.

5.2.1 Sample selection

The study was conducted during 2004. The sample consisted of 160, newly selected, male and female children (31% of the school), aged six to thirteen years old in a primary school in Eatonside in the Vaal Triangle.

The children participating in the PSNP, meeting the criteria as stipulated, were identified (n=40) and the rest of the group were randomly divided into the vetkoek and fruit groups with 60 children per group. The intervention group, the control group and the group receiving the PSNP formed part of the government school feeding scheme, numbering 160 participating children.

5.2.2 Building and equipping of cooking facilities

The school in Eatonside had no cooking facilities and a production kitchen had to be erected on the school premises (Figure 5.1). A wooden hut measuring 4x4 m^2 with a veranda and corrugated iron roof was erected. Insulation panels were installed inside on the walls and the ceiling and walls were painted white. The kitchen had one door and one window opening to the outside that could be used as a serving hatch. A burglar door was installed to provide safety. A cement square was laid in front of this kitchen, to keep children from standing in the mud during rainy seasons and to keep dust out of the kitchen. Water and electricity was installed from the adjacent building. A double basin stainless steel sink was installed. Shelves were mounted against the wall for the ingredients, small utensils and small equipment items. The kitchen hut was equipped with a variety of equipment and utensils as indicated in Table 5.1.

An existing gas stove was installed in compliance with the SABS 0157 and the Vessels Under Pressure Act. A separate storage area was constructed outside the wooden kitchen for the safe storage of the gas bottles used for the gas stove.

Table 5.1: Equipment and utensils in cooking facility

Equipment/utensil	Quantity	Capacity
Deep fat fryer	2	5l
Fry baskets	2	5l
Electrical urn	1	20l
Tea trolley, stainless steel	1	2 tier
Counter top scale	1	1g/10kg
Can opener	1	Table mounted
Work table, stainless steel	1	1.2m, splash back and under shelve
Portioning frame, stainless steel	1	12 portions
Bain-marie pan with lid	1	Full size, 200mm
Chopping boards PVC	3	
Chef's knives	3	
Mixing bowls, stainless steel	3	20l
Mixing bowls, plastic	3	20l
Spatulas, plastic	2	
Food tongs	2	
Strainers, plastic	2	
Measuring cups, spoons and jugs, plastic	3 sets	1l
Spoons, perforated, stainless steel	3	
Spoons, solid, stainless steel	3	
Storage bins with lids	5	20l
Cleaning bucket with lid, galvanized	1	20l
Dustbin, black		
Mop	1	
Broom	1	

Storage shelves were installed against one of the walls for storage of the ingredients and utensils (Figure 5.2).

The kitchen was reserved for the sole use of the project, for the duration of the intervention, but will become the property of the school, for use as a tuck shop in future. The cost for the kitchen to be erected and equipped amounted to R30 020.00.

Figure 5.1: The kiosk erected for the school feeding intervention from outside

Figure 5.2: Inside of the kitchen erected for the school feeding intervention

5.2.3 Training of community workers

The school principal identified five caregivers from the community and training was provided on personal hygiene, basic kitchen hygiene and safety, basic food preparation, cooking methods and the use of electrical equipment (Annexure N). Training also included the preparation of the vetkoek recipe. These trained community workers, were responsible for the preparation and portioning of the ''vetkoek'' on a daily basis. A portioning frame was designed and made of stainless steel to be used by the community workers to portion each batch of vetkoek into 20x 120g portions. The frame was 2cm high, 40cm long and 25cm wide. When the dough was prepared, the ladies were trained to roll it out to the same size as the portioning frame. The frame was then placed on the dough and pressed down, this resulted in 20 vetkoek portions of 120g each.

Initial training was presented in the student-training restaurant at Vaal University of Technology (VUT) and all demonstrations were done in the kitchen. Video sessions on personal and kitchen hygiene were presented in the Goldfields Library at VUT. Thereafter training was provided in the wooden kitchen that was built on the school premises. The kitchen was equipped with stainless steel tables, a double washbasin and deep fat fryer and all small utensils required to prepare the product. Training on hygiene and safety was given on a continued basis to maintain the standards and to make sure that a good quality product was prepared daily. After the initial training, visits to the school were conducted every day for the first two weeks and thereafter twice a week to ensure that the product was prepared according to the recipe and specific requirements and that the portion size administered to the school children were correct. These visits were done randomly and no appointments were made beforehand. During these visits the availability of stock was monitored and orders were given to the supplier every second Friday for delivery on the following Monday, all fresh ingredients were delivered on a daily basis by a local supplier.

The volunteer food service workers were issued with two over-coats, safety shoes, disposable gloves as well as aprons and disposable hats (Figure 5.3).

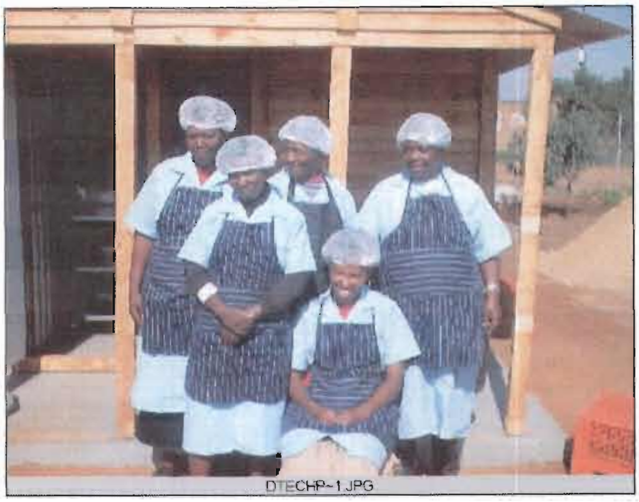

Figure 5.3: Photograph of trained volunteer food service workers from the community

5.2.4 Provision of supplies

A local supplier that was able to deliver the ingredients at the school in the informal settlement was identified. The supplier was able to deliver spinach and fruit on a daily basis and the other dry ingredients on a weekly basis. The VUT opened an account with the supplier. Trained community workers with the assistance of teachers were responsible for receiving delivered goods. Ingredients delivered were checked according to the standard order provided by the researcher. The researcher checked the quality of the ingredients on every visit. Invoices were kept in a file in the kitchen and the researcher collected all invoices during visits to the school.

5.3 Data collection prior to and after the intervention

Written parental consent was obtained for all the children participating in the study. The pre-intervention data was collected in May 2004 on the Saturday prior to the commencing of the feeding scheme on the Monday. The post-intervention data was also collected on a Saturday at the end of November 2004.

The researcher developed a fieldwork administration form. The purpose of the form was to ensure that the subjects completed the activities at each of the stations, and to indicate the different activities that took place during the intervention trial. The activities at different stations for all three groups (PSNP, experimental and control) in order were:

- Station 1: Handing out of file with forms to recruited sample
- Station 2: Clinical signs and collection of blood samples
- Station 3: Anthropometry
- Station 4: Handout and/or completion of the different questionnaires
- Station 5: Snacks handed out and handing in of completed forms

The same trained fieldworkers that assisted in the baseline survey assisted with data collection in the intervention study. The fieldworkers obtained dietary data from each child and his/her mother or caregiver by means of a quantity food frequency questionnaire (QFFQ) and a 24-hour recall form. Both the questionnaires were completed in an interview situation combined with weighing, measuring and blood samples of the children collected (n=160).

5.4 Measuring instruments

The effect of a nutritional vetkoek was compared to the effect of a single fruit per day and the existing PSNP already in place in the school. Children six to thirteen years (n=160) were randomly assigned, except for the PSNP group, to one of two groups: (1) vetkoek (n=60); (2) fruit (n=60). The vetkoek, PSNP and fruit were distributed daily during the school week and compliance was closely monitored and recorded. Children were assessed at baseline and after 7 months of the intervention. The measurements chosen for this intervention included 24-hour recall, anthropometric, biochemical measurements and school attendance records for all three groups.

Table 5.2: Children participating in the study categorised by age.

Age	Group 1 – Vetkoek N=60	Group 2 – Fruit N=60	Group 3 – PSNP N=40
6 years	1	0	0
7 years	12	4	10
8 years	18	13	14
9 years	19	24	10
10 years	9	15	6
11 years	1	4	0

5.4.1 Anthropometric measurements indicating nutritional status

All the children in all three groups were assessed for anthropometric measurements included age, height and weight indicating stunting, wasting and underweight measured against reference standards that reflect the growth and the development of the individual by making use of weight-for-age, height-for-age and BMI-for-age measurements. The information was used to indicate underweight, stunting and wasting at the following cut-off points, $\leq 5^{th}$ percentile indicating severely malnourished children, $>5^{th}$ and $<25^{th}$ percentile being at risk of being malnourished and $\geq 25^{th}$ and $\leq 75^{th}$ /85^{th} percentile as normal. Higher than the 75^{th} /85^{th} and $<95^{th}$ percentile the risk of being overweight and $\geq 95^{th}$ percentile being overweight.

5.4.2 Dietary intake

The QFFQ and 24-hour recall were used to gather data, the same methods were applied as in the needs assessment survey, in the vetkoek group (n=60), PSNP group (n=40) and fruit group (n=60). Children were questioned on their dietary intake by the trained fieldworkers, by means of QFFQ and 24-hour recall, however for the follow-up only 24-hour recall was measured and used for comparisons. Figure 5.4 shows the fieldworkers busy completing the questionnaires. A study by Klesges (1987:384) indicates that data obtained by the dietary recall method correlate highly with children's weighed food intake if a parent or the primary caretaker providing the child's food responds to the interview. When errors occurred they were largely errors in portion size, as the parents correctly identified 96% of foods eaten by the children. Parents under-reported only 4% of the time. Klesges 1987: 384) concludes by saying that as children become older they appear to be able to recall their own intake both within and outside the home.

Figure 5.4: Fieldworkers completing questionnaires.

5.4.3 Biochemical measurements

The same methods were applied for biochemical measurements as in the needs assessment survey. Figure 5.5 shows the nursing sister collecting blood samples from the children. A total of 160 blood samples were drawn for the determining of serum vitamin A, haemoglobin, Hct, SRBP, zinc, iron, ferritin, transferrin and plasma fibrinogen by qualified nursing sisters, with methods summarised in Table 3.1.

Blood was drawn from the *vena cephalica* of seated subject after an 8-12 h fast using a Vacutainer needle with minimal use of tourniquets. A qualified nursing sister collected the blood samples from the subjects. Vacutainer blood collecting tubes were labeled in advance with the subject's trial number as well as the week number.

Blood was collected as follows:

- 5ml Blood in an EDTA tube (purple lid) for full blood counts (Hb, Hct, RBC, MCV, Plt and WBC).
- 10 ml Blood in a silicone-coated tube for preparation of serum for the analysis of ferritin, serum iron, transferrin, total protein, albumin.
- 10 ml Blood in a silicone-coated tube for preparation of serum for the analysis of serum retinol, vitamin E and Zinc analysis. Immediately after collection this tube was protected against UV light, by covering it with aluminium foil.

Figure 5.5: Blood collection

All the blood samples were drawn with minimal stasis and between 07H00 and 10H00 to avoid effects of diurnal variation.

5.4.4 School attendance

School attendance was recorded for all the children in the study by the teachers on a daily basis in a school attendance register, divided into the four terms of the year 2004.

5.5 Analyses

5.5.1 Dietary intake

Data were captured and analysed using the Food Finder® version 3.0 computer software package by a qualified dietician. The Food Finder® software was updated to address the new enriched maize meal which were implemented during the duration of the intervention, to give a correct analysis of the 24-hour recall questionnaires. The vetkoek recipe was also updated to accommodate the enriched maize meal for the post-intervention results.

The QFFQs were analysed on the computer package Food finder® and the nutrient intake and foods consumed were established. The data from the QFFQs was captured and related in tables and graphs for interpretation. The statistical analysis was conducted by an independent statistical analyst to determine the adequacy of the nutrient intake and prevalence of deficiencies that could be concluded from the QFFQs and 24-hour recalls. The minimum, mean and maximum intakes of the children were analysed and compared to 100% of the EAR/RDA. From the data, a top 20 list of foods most often consumed was also drawn up.

5.5.2 Anthropometric measurements

The NCHS growth charts were used to make a statistical comparison of the anthropometric indicators. As recommended by the WHO, the nutritional status of the children in the survey was compared with an international reference population defined by the NCHS. Height and weight measurements were classified according to these percentiles, that are generally used as an intentional reference population. For this study age was calculated in years from the date of birth to the actual date that each child participated in the survey (Flegal 2002:761).

The anthropometric measurements were sent to a statistician, analysed and scatterplots was drawn on the NCHS growth charts. The measurements included the following; BMI-for-age, weight-for-age and height-for-age indicated on the 5^{th}, 25^{th}, 50^{th}, 85^{th} and 95^{th} percentile of the NCHS median (Flegal 2002:761).

5.5.3 Biochemical measurements

Blood was separated (centrifuged at 1.500Xg for 20min.) within 2 hours of blood collection. Separated plasma and serum were eliquoted in marked Eppendorf test tubes. Two qualified medical technologists continuously audited the separating procedure. Serum for the analyses of serum iron, transferrin, ferritin, total protein, albumin were stored at -10°C until analysis. Serum for serum retinol, vitamin E and Zinc analysis was covered by aluminum foil and stored at -10°C until it was couriered to the Nutritional Intervention Research Unit of the MRC in Cape Town. Data was captured on Excel spreadsheets and analysed with the assistance of a statistician for means and standard deviations and compared to the normal ranges for the children. Table 3.1 indicates the methods applied and the laboratory used for the tests.

5.5.4 Statistical analyses used in the study

Data were screened and captured on Excel spreadsheets, transferred to the SPSS computer software and analysed using the following statistical techniques:

Chi-square: This was used to compare children on the 5^{th} percentile for anthropometric status to children with > 5^{th} percentile for anthropometric status with regard to the nutritional intake below the recommended DRIs. Chi-square analysis is used to compare categorical data.

Analysis of variance (ANOVA): This was used to establish the relationship between the children's anthropometrical status (5^{th}, 25^{th}, 50^{th}, 85^{th} and 95^{th} percentile) and the nutrient intake. Probability is indicated as a figure smaller than 0,05 ($p \leq 0,05$).

Pearson correlation: This was used to compare numerical data for pre-intervention and post-intervention data.

Pair t-test: This test was used to compare pre-intervention and post-intervention data within the groups.

5.6 Management of the intervention

The intervention started on the 17^{th} of May 2004 and the follow-up data were collected during November 2004 (7 months) for post-intervention results. The feeding scheme continued during 2005 and measurements taken in November 2005 will serve as postdoctoral data to determine the long-term effect on nutritional status.

The vetkoek was the product developed as part of the school feeding scheme used in the intervention study as discussed in Chapter 4. The five voluntary female caregivers that were trained prepared the vetkoek daily according to the recipe given to them. The process started at 6h00 every morning preparing the yeast product, which had to stand approximately one hour in order to rise. It sometimes took longer depending on the weather. At approximately 7h00 the volunteer ladies portioned the vetkoek dough into 120g portions by making use of a portioning frame (Figure 5.6) designed specifically for this project. The oil was then heated and the vetkoek deep fat fried until golden brown. The vetkoek was still warm when the children received it at break time (9h30).

5.6.1 Quality, portion control and compliance

The researchers visited the school on a daily basis for the first month, there after a visit took place once a week to do quality control. If any portion sizes did not correspond to the original plan, the discrepancy was addressed immediately and corrected. The school appointed a teacher to control the ladies and check the quality and progress of the feeding. She also checked that feeding took place every day in the correct manner and could contact the researchers immediately if any problems occurred.

5.6.1.1 Vetkoek group

The vetkoek group consisted of 60 children randomly selected from the children who had parental permission to participate in the study and had completed all the questionnaires and blood sample collection. Their names were listed on a register and the community ladies had to check the names daily to ensure that the correct children received the vetkoek. The children lined up in front of the kiosk at 9h30 (the grade one to four group) and 14h00 (the grade five to seven group started school at 12h00 daily) daily to receive the vetkoek (Figure 5.7 and 5.8), water was made available for them drink while eating the vetkoek. The children were not allowed to leave the kiosk area until they finished their portion of the vetkoek. Children received the same whole wheat-maize vetkoek for the duration of the study with the exception of weekends, public holidays and school holidays.

Figure 5.6: Photograph of vetkoek and portioning frame

Figure 5.7: Photograph of experimental group children queuing for vetkoek

Figure 5.8: Photograph of experimental group children eating the vetkoek.

5.6.1.2 Fruit group

The fruit group consisted of 60 children randomly selected from the children who's parents gave permission for participation in the study and who completed all the questionnaires and blood sample collection. The names were listed on a register and the community ladies had to check the names daily to ensure that the correct children received the fruit. The children lined up next to the ablusion building at 9h30 (the grade one to four group) and 14h00 (the grade five to seven group) daily to receive the fruit (Figure 5.9 and 5.10), the type of fruit depended on the availability and cost and included fruit like apples, oranges, bananas and pears. Children received fruit for the duration of the study with the exception of weekends, public holidays and school holidays.

Figure 5.9: Photograph of control group children queuing for fruit

Figure 5.10: Control group children eating the fruit given to them.

5.6.1.3 Primary School Nutrition Programme group

The PSNP food was prepared by community ladies and teachers sometimes assisted (Figure 5.11). The PSNP food group consisted of 40 children selected from the PSNP programme who's parents gave permission for participation in the study and who completed all the questionnaires and blood sample collection. The names were listed on a register and the community ladies had to check the names daily to ensure that the correct children received the food. The children lined up in front of a classroom at 9h30 (the grade one to four group) and 14h00 (the grade five to seven group) daily to receive the food as discussed in chapter 2 as part of the PSNP programme (Figure 5.12 and 5.13). The children received the menu items for the duration of the study with the exception of weekends, public holidays and school holidays.

Figure 5.11: Teacher and community mothers preparing the food for the PSNP group.

Figure 5.12: Children queuing for the cooldrink as part of the PSNP.

Figure 5.13: Children eating and drinking as part of the PSNP.

5.7 Results

5.7.1 Drop-outs

During the study there were minimal drop-outs (children that did not partake in the final measurements) in the experimental group (n=4), from the control group more drop-outs were experienced. In the fruit group, five children dropped out, most of the children that dropped out were from the PSNP group (n=20), possibly because they did not benefit from this intervention. The main purpose of this study was to determine the effect of added zinc, iron and calcium intake on nutritional status of primary school children in an informal settlement. This was also compared to the PSNP and control group, due to normal growth patterns of primary school children, which could be confounding the anthropometric results, it was decided to compare the biochemical measurements of the group with those of the drop-outs. There was no statistical significance observed between the biochemical measurements and the weight, height or BMI variables of the groups and the drop-outs. At baseline, it can therefore be assumed that the subjects that dropped out, would not have influenced the results differently (Table 5.3).

Table 5.3: Baseline measurements of drop-outs compared to participants

Variable	Normal range	Participants n= 131			Drop-outs n= 29
		Mean	Standard deviation	Mean	Standard deviation
Vitamin A	20µg/dl	31	19.95	30.63	9.7
Zinc	70-150µg/dl	86.14	12.56	83.74	14.56
Total protein	64-83g/l	74.21	12.19	75.04	7.93
Iron	9-31µmol/l	30.51	19.48	33.36	22.69
Transferin	2-4g/l	3.13	0.59	3.04	0.49
Ferritin	12-200µg/l	30.10	18.21	29.58	15.67
Albumin	37-52g/l	43.46	6.37	42.48	5.28
Red blood cell count	4.0-5.4x106/µl	4.62	0.46	4.63	0.42
Haemoglobin	12.0-14.0g/dl	13.35	0.81	13.20	0.93
Haematocrit	36.0-44.0%	39.61	3.61	39.52	2.97
Mean red cell volume	77-91fl	85.91	3.97	85.51	3.91
White cell count	4.5-13.5	6.74	2.32	6.54	1.7
Triglycerides (TRIG)	<1.80mmol/l	0.75	0.47	0.76	0.33
Total serum cholesterol (CHOL)	<5.2µmol/l	3.63	0.87	3.71	0.79
HDL cholesterol	>0.9µmol/l	1.04	0.26	1.07	0.31

5.7.2 Nutritional status

The nutritional status of all 160 children in the vetkoek, fruit and PSNP group will be discussed. The data was categorised according to the percentile system in accordance with the NCHS/WHO indicators. The following anthropometric indicators were used: weight-for-age, height-for-age and BMI-for-age. The information was used to indicate underweight, stunting and wasting at the following cut-off points, $\leq 5^{th}$ percentile indicating severely malnourished children, $>5^{th}$ and $<25^{th}$ percentile being at risk of being malnourished and $\geq 25^{th}$ and $\leq 75^{th}/85^{th}$ percentile as normal. Higher than the $75^{th}/85^{th}$ and $<95^{th}$ percentile indicates the risk of being overweight and $\geq 95^{th}$ percentile being overweight.

5.7.2.1 Underweight

Before the intervention 13.6% of the vetkoek group boys were severely underweight, this figure increased to 15.8% after the first seven months, The results showed that 13.5% of the girls were severely underweight but this improved to 13.3% after the seven months. The children at risk of being underweight in this group increased in the boys from 40.9% to 42.1% and decreased in the girls from 35.2% to 33.4% (Table 5.4).

The PSNP group also showed an increase in severely underweight boys and girls, boys from 7.4% to 10% and girls from 34.4% to 38.1%. The at risk of being underweight boys decreased from 48.2 to 40%. The girls showed a decrease in the at risk group from 31.2% to 19.1% as depicted in Table 5.4.

Table 5.4 indicates that for the fruit group the boys and girls being severely underweight declined from 4.8% for boys and 16.7% for girls to 0 and 7.6% respectively. The boys showed a large decrease in at risk cases at 23.8% to 0% and the girls increased from 5.6% to 15.4%.

Table 5.4: Comparison of the weight-for-age (underweight) of the primary school children pre-and post intervention

Vetkoek				
Weight-for-age	Boys n=22	n=19	Girls n=37	nN=30
Underweight	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	13.6	15.8	13.5	13.3
$>5^{th}$ and $<25^{th}$	40.9	42.1	35.2	33.4
$\geq 25^{th}$ and $\leq 75^{th}$	40.9	31.6	40.5	40
$>75^{th}$ and $<95^{th}$	4.6	10.5	10.8	13.3
$\geq 95^{th}$	0	0	0	0
PSNP				
Weight-for-age	Boys n=27	n=20	Girls n=32	n=21
Underweight	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	7.4	10	34.4	38.1
$>5^{th}$ and $<25^{th}$	48.2	40	31.2	19.1
$\geq 25^{th}$ and $\leq 75^{th}$	40.7	45	28.1	33.3
$>75^{th}$ and $<95^{th}$	3.7	5	6.3	9.5
$\geq 95^{th}$	0	0	0	0
Fruit				
Weight-for-age	Boys n=21	n=9	Girls n=18	n=13
Underweight	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	4.8	0	16.7	7.6
$>5^{th}$ and $<25^{th}$	23.8	0	5.6	15.4
$\geq 25^{th}$ and $\leq 75^{th}$	52.4	88.9	50	23.1
$>75^{th}$ and $<95^{th}$	19	11.1	22.2	46.2
$\geq 95^{th}$	0	0	5.6	7.7

5.7.2.2 Stunting

In the vetkoek group prior to the intervention 18.2% of the boys and 16.3% of the girls were seriously stunted as shown in the height-for-age at or below the 5th percentile on the NCHS median. This indicates a chronic shortage of food experienced. It did not improve notably and after seven months of the intervention the boy's results indicated 21% and the girls 16.7% being severely malnourished (Table 5.5).

The PSNP group also showed a decrease in the number of children being seriously stunted after the intervention. The number of stunted boys decreased from 22.2% to 15% and stunted girls from 25% to 33.3% as can be seen in Table 5.5.

Table 5.5 shows that the fruit group indicated a total decline in the numbers of seriously stunted children with 4.8% boys and 5.6% girls dropping to 0 in both groups. The number of boys in the at risk (>5th percentile and <25th percentile) of being stunted group decreased from 28.6% to 22.2%, and the girls from 33.3% to 15.4%.

In all groups (except for the boys in the PSNP group) the number children at risk of being stunted (>5 and <25th percentile) declined.

Table 5.5: Comparison of the height-for-age (stunting) of the primary school children pre-and post intervention

Vetkoek				
Height-for-age	Boys n=22	n=19	Girls n=37	n=30
Stunting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	18.2	21.1	16.3	16.7
$>5^{th}$ and $<25^{th}$	40.9	21.1	29.7	23.4
$\geq 25^{th}$ and $\leq 75^{th}$	31.8	47.3	40.5	43.3
$>75^{th}$ and $<95^{th}$	9.1	10.5	13.5	13.3
$\geq 95^{th}$	0	0	0	3.3
PSNP				
Height-for-age	Boys n=27	n=20	Girls n=32	n=21
Stunting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	22.2	15	25	33.3
$>5^{th}$ and $<25^{th}$	33.3	35	43.7	14.3
$\geq 25^{th}$ and $\leq 75^{th}$	40.7	35	25	38.1
$>75^{th}$ and $<95^{th}$	3.8	10	6.3	9.5
$\geq 95^{th}$	0	5	0	4.8
Fruit				
Height-for-age	Boys n=21	n=9	Girls n=18	n=13
Stunting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
$\leq 5^{th}$	4.8	0	5.6	0
$>5^{th}$ and $<25^{th}$	28.6	22.2	33.3	15.4
$\geq 25^{th}$ and $\leq 75^{th}$	52.4	55.6	38.9	46.2
$>75^{th}$ and $<95^{th}$	9.5	22.2	16.7	38.4
$\geq 95^{th}$	4.8	0	5.6	0

5.7.2.3 Wasting

Wasting occurs when an acute shortage of food has been experienced and is indicated where the weight-for-age is at, or below $\leq 5^{th}$ percentile of the NCHS median. In the vetkoek sample it was found that 9.1% of the boys and 16.2% of the girls were severely wasted. After the intervention was implemented for 7 months the children that were severely wasted were 11% of the boys and 10.4% of the girls. The risk of being wasted has declined from 36.4% to 33.3% for the boys and the girls indicated a decline from 32.4% to 31% (Table 5.6).

The PSNP group presented similar results to the vetkoek group for wasting, the boys who were severely malnourished formed 3.7% of the sample, before the intervention, increased to 5.3% after seven months. Seventeen percent (17%) of the girls fell at, or below 5^{th} percentile before the intervention and all of them moved out of this category after seven months of participating in the government school feeding programme. The boys also showed a growth in the group at risk (>5^{th} percentile and <25^{th} percentile) of being malnourished (29.6% before and 31.5% after) with the girls showing a decline in this category (43.8% and after 38.1%) as can be seen in Table 5.6.

The fruit group indicated a 9.5% malnourished status for boys and 5.6% for the girls before the intervention period, after receiving only a variety of fruit for the seven month period the boys and girls underweight status declined to 0%. The at risk group (>5^{th} percentile and <25^{th} percentile) however went up from 9.5% for the boys and 22.2% for the girls to 12.5% for the boys and 30.8% for the girls (Table 5.6).

The significant increase in weight, height and BMI can be due to the normal growth process that took place in the children during the intervention.

Table 5.6: Comparison of the BMI-for-age (wasting) of the primary school children pre-and post-intervention

Vetkoek				
BMI-for-age	Boys n=22	n=18	Girls n=37	n=29
Wasting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
≤ 5^{th}	9.1	11.1	16.2	10.4
>5^{th} and <25^{th}	36.4	33.3	32.4	31
≥25^{th} and ≤85^{th}	54.5	50	51.4	58.6
>85^{th} and <95^{th}	0	5.6	0	0
≥95^{th}	0	0	0	0

Table 5.6 continue: Comparison of the BMI-for-age (wasting) of the primary school children pre- and post-intervention

PSNP				
BMI-for-age	Boys n=27	n=19	Girls n=32	n=21
Wasting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
<5th	3.7	5.3	16.6	14.3
>5th and <25th	29.6	31.5	43.8	38.1
>25th and <85th	66.7	63.2	40.6	47.6
>85th and <95th	0	0	0	0
>95th	0	0	0	0
Fruit				
BMI-for-age	Boys n=21	n=9	Girls n=18	n=13
Wasting	% Pre-intervention	% Post-intervention	% Pre-intervention	% Post-intervention
<5th	9.5	0	5.6	0
>5th and <25th	9.5	12.5	22.2	30.8
>25th and <85th	66.7	87.5	61.1	38.4
>85th and <95th	9.5	0	0	15.4
>95th	4.8	0	11.1	15.4

A statistically significant difference ($p \leq 0.05$) was observed in the boy's weight and height in the vetkoek group after the intervention. The girls in this group showed a statistically significant difference ($p \leq 0.05$) in their weight, height and BMI from the pre-intervention measurements and the post-intervention measurements (Table 5.7).

In the PSNP group a statistically significant increase ($p \leq 0.05$) was observed in the boy's weight and height after the intervention. The girls in this group showed a significant increase ($p \leq 0.05$) in their weight, height and BMI from the pre-intervention measurements and the post-intervention measurements (Table 5.7).

In the fruit group a statistically significant increase ($p \leq 0.05$) was observed in the boy's height. The girls in this group showed a significant increase ($p \leq 0.05$) in their weight, height and BMI from the pre- intervention measurements and the post-intervention measurements (Table 5.7).

No statistical significance was found between the growth that took place in the different three groups where weight, height and BMI are concerned. Table 5.7 indicates that significant growth for weight, height and BMI took place within all the groups.

Table 5.7: Statistically significant improvement in anthropometric measurements per age and gender (post-intervention).

Variable	Vetkoek		PSNP		Fruit	
	Boys n=18	Girls n=29	Boys n=20	Girls n=21	Boys n=9	Girls N=13
Weight	* ↑	* ↑	* ↑	* ↑	↑	* ↑
Height	* ↑	* ↑	* ↑	* ↑	* ↑	* ↑
BMI	↑	* ↑	↑	* ↑	↑	* ↑

↑ Increase

*Significance at $p \leq 0.05$

In all the groups and between all the categories (except for weight-for-age in the fruit group), there is a statistical association between the pre-intervention and post-intervention improvement of the children. This association must however be interpreted with caution because of the five categories in each group, the number of children in each category was low which makes the statistical analysis difficult to interpret.

5.7.3 Dietary intake

A 24-hour recall and QFFQ were completed for each child (n=160) and food models were used to assist in the quantification of portion sizes. The intake of 28 different macro- and micro-nutrients were determined. The nutrients discussed in this chapter include energy, protein, fat, cholesterol, carbohydrate, fibre, calcium, iron, magnesium, potassium, vitamin C and vitamin A, because of the relevance to malnutrition. Table 5.8 depicts the mean intake compared with the DRI levels.

On the basis of the 24-hour recall questionnaire, it would appear, that generally, the overall intake of the children was poor before the intervention. The intake is on average less than the DRI for the specific age of the child. The majority of the children consumed a diet deficient in energy and poor nutrient density to meet their nutritional requirements. Energy, zinc, iron, calcium, vitamin A, vitamin C, vitamin D, vitamin E, phosphorus, selenium, folate, pantothenate, riboflavin, chromium and copper did not meet the RDI's as can be seen in Table 5.8.

Table 5.8: Mean dietary intake compared to the DRIs (24-hour recall) – Pre-intervention

Nutrients	Vetkoek n=52	% of DRI	PSNP n=35	% of DRI	Fruit n=27	% of DRI	EAR children aged 9-13
Energy KJ	4927	59	4815.2	58	5948.7	71	8368
Cholesterol (mg)	157.6	53	71.64	24	119.34	40	<300mg/day
Total protein (g)	37.5	134	36.7	131	40.5	145	28
Total Fat (g/day)	36.04	103	30.62	87	40.06	114	25-35
Total Dietary Fiber (g/day)	12.81	51	12.94	52	14.56	58	25-31
Calcium (mg)	209.4	16	240	18	307.5	24	1300 AI
Iron (mg)	4.88	83	4.86	82	5.5	93	5.9
Magnesium (g)	188.7	94	206.9	103	230.3	115	200
Phosphorus (mg)	608.9	58	606	57	710.9	67	1055
Zinc (mg)	4.5	64	4.8	69	4.8	69	7
Copper (mg)	0.54	36	0.54	36	0.62	41	1.5
Chromium (µg/day)	11.2	45	19.9	80	12.11	48	25 AI
Selenium (µg/day)	15.8	45	11.03	3	11.9	34	35
Manganese (µg/day)	2106.12	84	2030.8	81	2255.2	90	2500
Iodine(µg/day)	14.9	20	11.3	15	14.6	20	73
Vit A (RE) (µg/day)	273.2	61	149.8	34	133.3	30	445
Thiamin (mg)	0.65	93	0.7	100	0.73	104	0.7
Riboflavin (mg)	0.5	63	0.45	56	0.59	74	0.8
Niacin (mg)	8.72	97	7.6	84	8.4	93	9
Vitamin B6 (mg)	0.55	69	0.56	70	0.6	75	0.8

Table 5.8: Mean dietary intake compared to the DRIs (24-hour recall) – Pre-intervention

Nutrients	Vetkoek n=52	% of DRI	PSNP n=35	% of DRI	Fruit n=27	% of DRI	EAR children aged 9-13
Folate (µg/day)	131.6	53	100.6	40	123	49	250
Vitamin B12 (µg/day)	1.95	130	1.26	83	1.51	101	1.5
Pantothenate (mg)	2.92	73	2.3	58	2.7	68	4.0 AI
Biotin (µg/day)	21.68	108	14.5	73	15.8	79	20 AI
Vitamin C (mg)	11.7	30	22.7	58	16.8	43	39
Vitamin D (µg/day)	2.15	43	1.28	26	1.85	37	5 AI
Vitamin E (mg)	5.68	63	3.54	39	6.4	71	9

g =gram
µg =microgram
mg =milligram
DRI =Dietary reference Intakes
KJ/kj =kilojoules
AI =Average Intake

When comparing the intake of the children as measured by the 24-hour recall after the seven month intervention it can be seen that less nutrients were found to be below the DRIs for iodine, vitamin D, calcium, phosphorus in the PSNP group only, chromium and copper did not reach the DRIs as can be seen in Table 5.9.

Table 5.9: Mean dietary intake compared to the DRIs (24-hour recall) – Post intervention

Nutrient	Vetkoek n=55	%DRIs	PSNP n=38	%DRIs	Fruit n=35	%DRIs	Estimated Average Requirement children aged 9-13
Energy KJ	8415.33*	101	6388.3*	76	8444.22*	101	8368
Cholesterol (mg)	224.33	75	84.71	28	99.86	33	<300mg/day
Total protein (g)	72.12*	258	48.5*	173	59.81*	214	28
Total Fat (g/day)	51.42	146	44.06	126	39.41	113	25-35
Total dietary fiber (g/day)	17.18	69	17.16	69	14.95	60	25-31
Calcium (mg)	427.01*#	33	198.5**	15	283.36	22	1300 AI

Table 5.9 continue: Mean dietary intake compared to the DRIs (24-hour recall) – Post intervention

Nutrient	Vetkoek n=55	%DRIs	PSNP n=38	%DRIs	Fruit n=35	%DRIs	Estimated Average Requirement children aged 9-13
Iron (mg)	21.09*#	358	9.85*	167	11.78*	200	5.9
Magnesium (g)	339.07*	170	265.9*	133	314.06*	157	200
Phosphorus (mg)	928.6	88	723.7	69	898.26	85	1055
Zinc (mg)	12.31*#	176	6.93*	99	8.38*	120	7
Copper (mg)	1.01*#	67	0.6	40	0.9*	60	1.5
Chromium (µg/day)	21.33*	17	15**	12	29.83*	23.9	125 AI
Se (µg/day)	42.05*	120	24.72**	71	40.71*	116	35
Manganese (µg/day)	2560.1	102	2587.1	104	2962.5	119	2500
Iodine(µg/day)	21.1	29	10**	14	16.09	22	73
Vit A (RE) (µg/day)	836.19**	188	390.5*	88	472.72*	106	445
Thiamin (mg)	0.9*	129	0.88*	126	1.1*	157	0.7
Riboflavin (mg)	1.53*	191	1.01*	126	1.03*	129	0.8
Niacin (mg)	21.87*	243	14.57*	162	17.7*	221	9
Vitamin B6 (mg)	3.05*#	381	1.2*	150	1.56*	195	0.8
Folate (µg/day)	1510.88*#	604	348.83*	140	435.31*	174	250
Vitamin B12 (µg/day)	12.92*#	861	1.52	101	1.59	106	1.5
Pantothenate (mg)	8.4*	210	3.9**	98	4.59*	115	4.0 AI
Biotin (µg/day)	23.7	119	16.6**	83	20.51**	103	20 AI
Vitamin C (mg)	22.2*	57	17.8	46	40.01*	103	39
Vitamin D (µg/day)	2.7	54	0.9*	18	0.79*	16	5 AI
Vitamin E (mg)	10.9*	121	6.3*	70	6.18	69	9

g = gram
mg = milligram
µg = microgram
DRI = Dietary Reference Intake
KJ/kj = kilojoules
= significant increase in vetkoek group compared to the other two groups at $p \leq 0.05$

* = significant increase from pre- to post intervention each group at $p \leq 0.05$
** = significant increase from pre- to post intervention each group at $p \leq 0.1$
AI =Average Intake

From Table 5.8 and 5.9 it can be seen that the energy intake of the vetkoek, PSNP and fruit groups increased substantially ($p<0.05$), from 58.8% for the vetkoek group, 57.7% for the PSNP group and 71% for the fruit group to 100.6%, 76.3% and 100.9% respectively.

The zinc intake increased in all three groups after the intervention, the vetkoek group took in 64.2% compared to the PSNP and fruit groups 68.5% before the intervention, after the intervention the vetkoek group took in 175.8% compared to the PSNP and fruit groups 99% and 119.7%, this indicated an increase at a significant level of $p \leq 0.05$ between the vetkoek and PSNP and fruit groups.. It is clear that the vetkoek group, from the lowest intake group increased to the highest intake group, but all three groups showed a significant increase at $p \leq 0.05$.

The iron intake of the groups show a similar growth in the groups, the vetkoek group increased from 82.7% to 357.5%, the PSNP group increased from 82.3% to 166.9% and the fruit group increased from 68.5% to 199.7% ($p \leq 0.05$). A significant difference was also experienced between the groups, the vetkoek group took significantly more iron ($p \leq 0.05$) in than the PSNP and fruit groups.

The total protein intake of the children was substantially increased after the intervention compared to before the intervention ($p \leq 0.05$). Although the calcium intake increased after the intervention in the vetkoek and fruit groups, the PSNP group showed a lower intake of calcium after the intervention (18% to 15.3%) all the groups still indicated below 67% calcium intake on the EAR for calcium. The vetkoek group consumed the lowest amount of calcium of the 3 groups before the intervention (16%). After the intervention the vetkoek group reported an intake of 42.8% that was the highest of the three groups. A significant increase at $p \leq 0.05$ was noted between the vetkoek and PSNP, as well as between the vetkoek and fruit groups.

Vitamin B6, B12, copper and folate intake also showed a significant increase between the vetkoek and the PSNP and fruit groups at $p \leq 0.05$. There was also a significant increase in vitamin E intake between the vetkoek and the fruit group at $p \leq 0.1$. Magnesium intake increased significantly more in the vetkoek than PSNP group ($p \leq 0.1$).

Table 5.10: Nutrient intake percentages contributed by the vetkoek

Nutrient	Vetkoek group daily intake n=55	%DRIs	Nutrient contibution by 120g of vetkoek per day	% Contribution made by the vetkoek (DRI)	Estimated Average Requirement children aged 9-13
Energy KJ	8415.33	101	1813.20	21.66	8368
Calcium (mg)	427.01	33	187.23	14.4	1300 AI
Iron (mg)	21.09	358	8.32	141	5.9
Magnesium (g)	339.07	170	86.55	43.27	200
Zinc (mg)	12.31	176	4.37	62.42	7
Copper (mg)	1.01	67	0.20	13.3	1.5
Vit A (RE) (µg/day)	836.19	188	79	17.75	445
Vitamin B12 (µg/day)	12.92	861	1.78	118.6	1.5
Vitamin C (mg)	22.2	57	0.50	1.28	39

The vetkoek contributed considerably to the daily intake of the children, Table 5.10 indicates that 21.66% of the daily energy intake of the children was supplied by the 120g vetkoek consumed by the children. Zinc (62.42%) and Iron (141%) were some of the major nutrients contributed by the intake of the vetkoek.

5.7.4 Food intake

The following section presents a summary of food intake divided into the 10 most consumed foods, for each of the three groups, Table 5.11 presents the pre-intervention intake and Table 5.12 presents the post-intervention intake. The analysis of nutrient intakes provides the nutritionist with valuable information. For non-nutritionists, however, the expression of intakes in terms of foods or food groups is far more meaningful and easier to interpret.

The average intake per month was established and calculated back to an average per day. The two foods consumed in the largest amount between the groups, before the intervention, were maize meal and tea for the vetkoek and PSNP groups and maize meal and full cream milk for the fruit group. After the intervention the vetkoek and PSNP groups consumed maize meal and brown bread most often and the fruit group maize meal and tea. In the vetkoek group, the consumption of vetkoek moved up from being number eight to being number four on the top 10 food items.

Chicken, as the first animal protein, appears prior to pre-intervention at number 9 on the top 10 list for the vetkoek group. In the PSNP group chicken appeared 9th in the pre- and 10th on the post-intervention list. Apart from milk, protein rich foods appeared low on the list of foods consumed before and after the intervention. Red meat, except for boerewors/ beef sausage was not even on the top 10 list.

Table 5.11: Top ten Foods most consumed per person per day - Pre-intervention.

	Vetkoek group (n=52)		PSNP group (n=36)		Fruit group (n=27)	
Rank	Food Item	Mean g/ml	Food item	Mean g/ml	Food item	Mean g/ml
1	Maize meal, Stiff	323	Maize meal, Stiff	447	Maize meal, Stiff	437
2	Tea, brewed	232	Tea, brewed	256	Milk, full cream	240
3	Bread, brown	145	Milk, full cream	221	Tea, brewed	238
4	Milk, full cream	203	Bread, brown	115	Bread, brown	138
5	Cold drink, squash	196	Cold drink, squash	210	Cold drink, squash	222
6	Potato chips	209	Potato, mashed	170	Potato chips	216

Table 5.11 continue: Top ten Foods most consumed per person per day - Pre-intervention.

	Vetkoek group (n=52)		**PSNP group (n=36)**		**Fruit group (n=27)**	
Rank	Food Item	Mean g/ml	Food item	Mean g/ml	Food item	Mean g/ml
7	Maize meal, soft	329	Rice, white	165	Vetkoek, plain	277
8	Vetkoek, plain	40	Boerewors/beef sausage	118	Cold drink, carbonated	340
9	Chicken, boiled	64	Chicken, boiled	87	Rice, white	103
10	Rice, white	103	Maize meal, soft	248	Cookies, commercial, plain	49

Tables 5.11 and 5.12 shows the foods that were most frequently consumed during the day in terms of weight(g) and volume(ml). No fruit appeared on the top 10 list for the vetkoek and PSNP group, apples were eighth on the list for the fruit group, bananas and oranges appeared further down on the list for this group. Except for a potato that is consumed in reasonable portions, other vegetables in the form of tomato and onion stew appeared low on the list.

Table 5.12: Top ten Foods most consumed per person per day - Post-intervention

	Vetkoek group (n=55)		**PSNP group (n=38)**		**Fruit group (n=35)**	
Rank	Food item	Mean g/ml	Food item	Mean g/ml	Food item	Mean g/ml
1	Maize meal, Stiff	380	Maize meal, Stiff	426	Maize meal, Stiff	342
2	Bread, brown	164	Bread, brown	15	Tea, brewed	269
3	Tea, brewed	239	Milk, full cream	279	Bread, brown	106
4	Vetkoek, developed for intervention	120	Tea, brewed	264	Milk, full cream	265
5	Milk, full cream	171	Cold drink, squash	236	Cold drink, squash	240
6	Cold drink, squash	234	Rice, white	172	Bread, white	113
7	Coffee	210	Vetkoek, plain	83	Vetkoek, plain	80
8	Potato chips	100	Coffee	275	Apples	229

Table 5.12: Top ten Foods most consumed per person per day - Post-intervention

	Vetkoek group (n=55)		PSNP group (n=38)		Fruit group (n=35)	
Rank	Food item	Mean g/ml	Food item	Mean g/ml	Food item	Mean g/ml
9	Bread, white	125	Energy/Power drink	193	Orange juice	200
10	Rice, white	185	Chicken, roasted	83	Potato chips	100

Table 5.13 indicates that however the maize meal fortification came into place during the intervention and impacted on the results, the vetkoek group still showed a higher increase in iron, zinc, vitamin A, thiamin, riboflavin and niacin.

Table 5.13: Percentage Daily Recommended Intake per group compared (24-hour recall).

Enriched nutrient s in Maize meal	%DRIs for post intervention intake in the vetkoek group	%DRIs of Post-intervention intake in the PSNP group	%DRIs for post intervention intake in the fruit group
Iron (mg)	358%	167%	200%
Zinc (mg)	176%	99%	120%
Vit A (RE) (µg/day)	188%	88%	106%
Thiamin (mg)	129%	126%	157%
Riboflavin (mg)	191%	126%	129%
Niacin (mg)	243%	162%	221%

These nutrients were targeted when the vetkoek was developed and the results showed that the vetkoek group had sufficient intakes for the most nutrients compared to the PSNP and fruit groups.

5.8 Biochemical measurements

The haematological and biochemical data are summarised in Table 5.14, only the subjects for whom data was available at the end of the study are included, as post-intervention results, as the drop-outs could not be included. The mean haematological and biochemical measurements for the subjects were similar for all three groups.

Table 5.14 shows that in all three groups, most of the variables were within the normal ranges, except for the mean ferritin levels that were marginal in all three groups, indicating a risk for iron depletion.

Zinc deficiency may occur as the result of malabsorption, starvation, or increased losses via urinary, pancreatic or other exocrine secretions. Zinc deficiency results in various immunologic defects and some of the symptoms include growth retardation, delayed wound healing, skin lesions, impaired appetite and immune deficiencies (Mahan and Escott-Stump 2004:146). To obtain laboratory confirmation of iron deficiency anaemia after screening, the serum ferritin level is often measured as indicator of iron stores. Ferritin is the storage protein that binds the iron normally gathered in the liver, spleen and marrow. As the iron supply increases, the intracellular level of ferritin increases to accommodate iron storage. The increased ferritin levels of the children may indicate an increased intake of iron during this period.

Although the baseline survey (needs assessment survey described in chapter 3) found zinc levels to be marginal, in these subjects the zinc levels were normal in all three groups, but were closer to the minimum than the maximum parameter.

The only statistically significant changes observed in the vetkoek group, were for total protein, tryglicerydes and HDL-cholesterol compared to vitamin A, serum iron, RBC and HDL-cholesterol in the PSNP group. The fruit group showed statistically significant changes in zinc, total protein, ferritin, RBC, hemoglobin and hematocrit, MRCV, and HDL-cholesterol compared to zinc, Hb, mean RCV and HDL-cholesterol. The fruit group showed improved clinical levels for zinc, transferrin, ferritin, albumin, RBC, mean RCV and HDL-cholesterol.

All three groups showed clinical changes and it is difficult to determine which one of the groups had the best results, however, all three groups showed statistical significant improvements in HDL-cholesterol.

The levels of white cell count, neutrophils, lymphocites, monocytes, eosinoplil and platelet indicate that there was no infections found in this sample at the time of blood collection, confirming that the malnutrition present is not due to infections but dietary intake.

Pearson correlations were conducted in order to determine the association between dietary intake and blood levels for iron, haemoglobin, hematocrit, protein, cholesterol, zinc, HDL and transferin.

No statistical significance between the significant blood variable and the 24-hour recall intake was found for the vetkoek and fruit groups, however at $p \leq 0.05$ the HDL in the blood and the cholesterol in the 24-hour recall questionnaire for the PSNP group were significant.

Table 5.14: Biochemical measurements of primary school children - Pre-and post intervention

		Vetkoek group				PSNP group				Fruit group			
		Pre-intervention n=53		Post-intervention n=45		Pre-intervention n=50		Post-intervention n=35		Pre-intervention n=32		Post- intervention n=21	
Variable	Normal range	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Vitamin A	20 (µg/dl)	**28.74**	6.16	**27.23**	7.19	**28.71**	7.66	**29.21***	7.58	**37.54**	34.44	**30.25**	7.41
Zinc	70-150 µg/dl	**88.56**	14.78	**86.04**	17.35	**83.17**	12.39	**83.12**	14.93	**85.44**	10.67	**90.87***	19.37
Total Proteien	64-83g/l	**72.45**	11.62	**76.10****	6.77	**75.05**	12.15	77.71	7.41	**76.13**	10.24	**75.41***	6.46
Iron	9-31µmol/l	**31.08**	21.93	**31.78**	15.50	**28.01**	15.51	**33.30***	19.12	**34.25**	23.06	**33.88**	14.56
Transferin	2-4g/l	**2.99**	0.60	**3.09**	0.51	**3.17**	0.51	3.17	0.51	**3.21**	0.61	**3.25***	0.54
Ferritin	12-200µg/l	**31.62**	17.87	**37.44**	29.57	**29.90**	17.99	**30.71**	20.76	**27.78**	17.38	**32.73***	15.80
Albumin	37-52g/l	**42.48**	6.16	**44.41**	6.97	**43.21**	5.10	**44.31**	5.34	**44.58**	7.54	**44.64**	5.95
Red blood cell count	4.0-5.4x106/µl	**4.62**	0.58	**4.67**	0.32	**4.55**	0.33	**4.67***	0.32	**4.73**	0.39	**4.78****	0.34
Haemoglobin	12.0-14.0g/dl	**13.45**	1.69	**12.93**	0.73	**13.16**	0.74	**12.64**	2.16	**13.37**	1.00	**13.12***	0.85
Haematocrit	36.0-44.0%	**39.83**	4.69	**38.55**	1.97	39.12	2.25	**39.18**	2.28	**39.95**	2.77	**39.05**	2.59
Mean red cell volume	77-91fl	86.29	3.91	**83.16**	3.92	86.19	3.92	**84.28**	3.88	**84.53**	3.93	**81.65**	2.59
White cell count	4.5-13.5	**6.85**	2.57	**6.63**	2.1	**6.73**	2.04	**6.13**	2.14	**6.43**	1.90	**6.22**	1.70
Triglycerides (TRIG)	<1.80mmol/l	**0.70**	0.24	**0.80****	0.31	**0.74**	0.38	**0.98***	0.47	**0.83**	0.72	**0.88**	0.36
Total serum cholesterol(CHOL)	<5.2µmol/l	**3.50**	0.79	**3.59**	0.81	**3.69**	0.83	**3.52**	0.73	**3.80**	1.00	**4.07**	0.91
HDL cholesterol	> 0.9µmol/l	**1.09**	0.26	**1.41***	0.41	**1.03**	0.28	**1.36***	0.36	**1.00**	0.26	**1.35***	0.28

* = significant increase from pre- to post intervention each group at $p \leq 0.05$ ** = significant increase from pre- to post intervention each group at $p \leq 0.1$

5.9 School attendance

The school register reflected the rate of absenteeism over the intervention period. Overall the school attendance of the children taking part in the intervention initially decreased it can be seen that during the second term the absenteeism dropped by 37.9% for the vetkoek group, 21.3% for the PSNP group and 40.7% in the fruit group. This was the term during which the intervention started as depicted in Table 5.15.

Table 5.15: Number of days absent per group over the four school terms.

Category	Term 1	Term 2	%	Term 3	%	Term 4	%
Vetkoek group	79	49	37.9 ↓	53	8.2 ↑	62	17 ↑
PSNP group	94	74	21.3 ↓	63	14.9 ↓	63	0 ↔
Fruit group	54	32	40.7 ↓	32	0 ↔	32	0 ↔

The third term showed a slight increase in absent children, this could be due to the winter period. However during the last term the children in the vetkoek group that were absent from school increased by another 17% while the absenteeism for the PSNP and fruit group stayed the same as the third term. The absenteeism did not further increase every term, a lot less children were absent during the last three terms than was the case during the first term. No significance was found between the attendance ratios of the three groups.

A study by Wentzel-Viljoen (2003:192), indicates that no statistics were kept at schools, during a 1999 study, to record whether the PSNP influenced school attendance. A study by Powell *et al.* (1998:4) showed a significant improved attendance in a group of school children in Jamaica receiving breakfast compared to the control group. Although the results were not very clear, the educators did indicate that they experienced better school attendance and that learners were more alert in the classroom.

5.10 Confounding factors

Mandatory fortification of maize meal became law in South Africa October 2003, the maize meal fortification legislation came into place while the intervention took place. Table 5.16, 5.17 and 5.18 indicates the differences made to the nutritional intake of the children by the fortified maize meal in the different groups.

Table 5.16: Contribution of fortified maize meal to nutrient intake of the children in the vetkoek group.

Enriched nutrients in Maize meal	Mean intake (24-hour recall) Pre-intervention	Mean intake (24-hour recall) Post-intervention	DRIs for children 9-13	%DRIs for post - intervention intake	Contribution to nutrient intake made by unfortified maize meal before intervention (158g)	Fortification as per DoH per kg of maize meal (DoH 2003:3)	Contribution to nutrient intake made by the fortified Porridge after the intervention (162g)	Contribution made by the vetkoek to DRIs	Contribution made by the vetkoek % DRIs
Iron (mg)	4.88	21.09	5.9	358%	1.90	35	5.67	8.32	141
Zinc (mg)	4.5	12.31	7	176%	2.21	15	2.43	4.37	62.2
Vit A (RE) (µg/day)	273.2	836.19	445	188%	0.00	2085	333.6	79	17.75
Thiamine (mg)	0.65	0.9	0.7	129%	0.62	2.18	0.35	Not available	-
Riboflavin (mg)	0.5	1.53	0.8	191%	0.09	1.69	0.27	Not available	-
Niacin (mg)	8.72	21.87	9	243%	1.90	25	4.05	Not available	-

Table 5.16 indicates that the nutrient intake for iron, zinc, vitamin A, thiamin, riboflavin and niacin was higher after the intervention than before. The maize meal that the children consumed in the form of maize meal porridge before the intervention contributed 1.9mg iron, 2.21mg zinc, 0µg vitamin A, 0.62mg thiamine, 0.09mg riboflavin and 1.9mg niacin to their daily intake of these nutrients. After the intervention it was indicated that their intake increased to 5.67mg for iron, 2.43mg for zinc, 333.6µg

for vitamin A, 0.35mg thiamine, 0.27mg riboflavin and 4.05mg niacin. The maize meal used in the vetkoek contributed 0.87mg iron, 0.37mg zinc, 52µg vitamin A, 0.05mg thiamine, 0.04mg riboflavin and 0.62mg niacin to the nutritional intake of the children. The vetkoek contributed more to the zinc and iron than the fortified maize meal.

Table 5.17: Contribution of fortified maize meal to nutrient intake of the children in the PSNP group.

Enriched nutrient s in Maize meal	Mean intake (24-hour recall) Pre-intervention	Mean intake (24-hour recall) Post-intervention	DRIs for children 9-13	%DRIs of Post-intervention intake	Contribution to nutrient intake made by unfortified maize meal before intervention (160g)	Fortification as per DoH per kg of maize meal (DoH 2003:3)	Contribution to nutrient intake made by the fortified Porridge after the intervention (162g)
Iron (mg)	4.86	9.85	5.9	167%	1.92	35	5.67
Zinc (mg)	4.8	6.93	7	99%	2.24	15	2.43
Vit A (RE) (µg/day)	149.8	390.5	445	88%	0.00	2085	333.6
Thiamine (mg)	0.7	0.88	0.7	126%	0.62	2.18	0.35
Riboflavin (mg)	0.45	1.01	0.8	126%	0.10	1.69	0.27
Niacin (mg)	7.6	14.57	9	162%	1.90	25	4.05

Table 5.17 indicates that the maize meal that the children in the PSNP group consumed in the form of maize meal porridge before the intervention contributed 7.92mg iron, 2.24mg zinc, 0µg vitamin A, 0.62mg thiamine, 0.10mg riboflavin and 1.9mg niacin to their daily intake of these nutrients. After the intervention it was indicated that their intake increased to 5.67mg for iron, 2.43mg for zinc, 333.6µg for vitamin A, 0.35mg thiamine, 0.27mg riboflavin and 4.05mg niacin. The PSNP and vetkoek group consumed almost the same portion sizes of maize meal porridge, the pre-intervention portion for the vetkoek group was 158g and the PSNP group 160g and after the intervention the portion size for both the groups was 162g.

Table 5.18: Contribution of fortified maize meal to nutrient intake of the children in the fruit group.

Enriched nutrients in Maize meal	Mean intake (24-hour recall) Pre-intervention	Mean intake (24-hour recall) Post-intervention	DRIs for children 9-13	%DRIs for post intervention intake	Contribution to nutrient intake made by unfortified maize meal before intervention (101g)	Fortification as per DoH per kg of maize meal (DoH 2003:3)	Contribution to nutrient intake made by the fortified Porridge after the intervention (79g)
Iron (mg)	5.5	21.09	5.9	200%	1.21	35	2.76
Zinc (mg)	4.8	12.31	7	120%	1.41	15	1.18
Vit A (RE) (µg/day)	133.3	836.19	445	106%	0.00	2085	164.82
Thiamine (mg)	0.73	0.9	0.7	157%	0.39	2.18	0.17
Riboflavin (mg)	0.59	1.53	0.8	129%	0.06	1.69	0.13
Niacin (mg)	8.4	21.87	9	221%	1.20	25	1.97

Table 5.18 indicates that the maize meal that the children in the fruit group consumed in the form of maize meal porridge before the intervention contributed 1.21mg iron, 1.41mg zinc, 0µg vitamin A, 0.39mg thiamine, 0.06mg riboflavin and 1.20mg niacin to their daily intake of these nutrients. After the intervention it was indicated that their intake increased to 2.76mg for iron, 1.18mg for zinc, 164.82µg for vitamin A, 0.17mg thiamine, 0.13mg riboflavin and 1.97mg niacin. Their intake was less than the other two groups because the portion size consumed was less than the other two groups (79g).

The effect of the fortification of the maize meal on the nutritional intake on the children is clearly one of the reasons for the large increase in these specific nutrients that took place as indicated in the above tables.

5.11 Discussion

The socio-demographic questionnaires completed during the pilot study indicated that all the children that partook in this study resided in an informal settlement, which was far away from shopping complexes and shops and shopping was mostly done at informal community shops (Spaza shops) (57.5%). The availability of good quality food was as much a problem as was the availability of resources to acquire the food. Although the households had a limited income, 57% of the children still came to school once a week with 50c to spend on food, 19% had R1-R2 and 10% had R2-R3 per week. The food items most commonly purchased in the household were maize meal (96%), tea (89.3%), sugar (88%), oil (87%), fresh vegetables were bought by 72.7% of the households and chicken only by 64.9%. This purchasing behaviour is in line with the top 20 foods consumed by the children with maize meal, tea, sugar and oil as the first four items on the list.

Unemployment and large families could be the cause of unavailability of food. The low income (R500 amongst 68.7% households) of the families per month indicated that very little money is available for food. As financial status improves and income increases, the families will probably have more money available for food and thus improve their eating habits and improve the nutritional status of the children if the correct foods are brought into the households. By improving the nutritional knowledge of the children whereby they can then possible influence the caregiver to buy the correct foods for optimal nutritional growth.

The top 10 items consumed by the children indicates that the food consisted mostly of carbohydrates with no animal protein under the first ten; very little variety is available in the households. This can explain the little knowledge that the children had about legumes, beans and soya as can be seen in the results of the pre- and post-tests.

The post-intervention dietary intake results show that the product contributed significantly to the quality of the diet as the vetkoek group consumed 101% of energy, 258% of protein, 358% of iron, 176% of zinc, 188% of vitamin A, 129% of thiamin, 191% of riboflavin and 243% of niacin (Table 5.9).

The vetkoek contributed to the nutrient intake of that group of children by 21.6% for energy, 14.4% for calcium, 141% for iron, 43.27% for magnesium, 62.42% for zinc, 13.3% for copper, 17.75% for vitamin A, 118.6% for vitamin B12 and 1.28% for vitamin C (Table 5.10).

The severely underweight children in the vetkoek group increased by an average of 1% with the PSNP group showing an average increase of 3.75%. The fruit groups showed a significant decrease from 21.5% to 7.6%.

Although the severely stunted children in the vetkoek group on average increased by 1% the children at risk dropped from an average of 35.5% to 22.25%, moving a bigger number of children into the normal range (9.15%). The PSNP indicated an average decrease in numbers for severely stunted children by 0.5% with a 13.85% decrease in the at risk groups and moving 3.65% of the children into the normal range.

The severely wasted children in the vetkoek group decreased by an average of 1.9%, the children in the at risk group also decreased by 2.25%, increasing the children in the normal range ($\geq 25^{th}$ and $\leq 85^{th}$) by an average of 1.3%. The PSNP group indicated a decrease of 0.35% of severely wasted children and 1.9% decrease of at risk children. The fruit group indicated that all the severely wasted children moved on to the at risk group.

Considering all the figures of the three groups where severely and at risk of being underweight, stunted and wasted was concerned; it can be seen that the vetkoek group fared significantly better than the PSNP group, the fruit group however showed a remarkable improvement in the children's nutritional status.

Although few statistically significant changes occurred biochemically, clinical changes occurred in all groups. This study proved that the nutritional intake and nutritional status of children can be improved in a controlled school feeding programme.

5.12 Conclusion

Growth and nutritional status should be monitored frequently and nutrition interventions modified as needed. The medical, social, and environmental concerns related to the growth retardation should be addressed and resolved (Lucas 2004: 261). This study aimed to improve the nutritional status of the children attending primary school in this informal settlement.

The causes of malnutrition in the community were first identified and actions undertaken to address the problems relevant to the local setting and needs by developing a product designed to meet the specific identified nutrient deficiencies. This was implemented as a school feeding programme and the children, participating in the study were monitored and the impact of school feeding was measured.

The current study contributes to the literature because this is one of the first studies using a deep fried yeast product to address malnutrition among children aged six to thirteen years.

As children grow, they acquire knowledge and assimilate concepts by leaps and bounds. The early years are ideal for providing nutrition information and promoting positive attitudes about food. More formal nutrition education should be provided in schools (Lucas 2004: 274). At the end of this intervention it was decided to implement a nutrition education programme to enforce knowledge of basic nutrition and healthy eating habits, so that children are informed when making food choices in future and this will be discussed in the following chapter.

Chapter 6
Nutrition-education

6.1 Introduction

Hunger and malnutrition remain one of the most devastating problems facing the majority of the world's poor and needy and will continue to dominate the health of the world's poorest nations. Nearly 30% of humanity, including infants, children, adolescents, adults and the elderly in the developing world, are currently suffering from one or more of the multiple forms of malnutrition. The tragic consequences of malnutrition include death, disability, stunted mental and physical growth that can result in a retarded national socio-economic development (WHO 2000).

Bellamy (1998) indicates that the nutritional status of South African children is below the average, when compared to the rest of the world. In Africa, a third of all children are underweight, with black and coloured children having the highest prevalence (25% and 17% respectively). Rural black children are the most vulnerable group (Schaaf *et al.* 1992: 24-36 & Vorster *et al.* 1998: 169-176).

In South Africa (SA), under-nutrition continues to be the major problem facing children. This form of malnutrition is caused by poor food intake and increased infections in young children (Schaaf *et al.* 1992:24-36 & FAO 1998:2).

The 1999 National Food Consumption Survey (NFCS) furthermore indicate that one out of five children, aged one to nine years old, in SA are stunted at national level. Gauteng showed a prevalence of 20%. Nationally the prevalence of stunting decreased with age from 25,5% in children aged one to three years to 21%, in those aged four to six years to 13% and in those aged seven to nine years old. A similar pattern emerged for the prevalence of underweight whilst the prevalence of wasting remained constant in all age groups at less than 4% (VIC 2001:3).

Inadequate food intake and unhygienic dietary practices are often related to poor knowledge of sound nutrition practices. Together with limited resources, deficiencies in knowledge of sound budgeting, food purchasing and food preparation methods can compromise household food security. Poor knowledge of nutrition plays a role in most of the multi-sectoral factors involved in the development of malnutrition (Walsh *et al.* 2003: 89-95).

Income, educational attainment of parents and family size are significantly associated with the nutritional status of the school child (Agguilon *et al.* 1978:4). The basic causes of malnutrition include number in the household, ethnicity, occupation of parents, family income and housing characteristics, compared to the underlying causes including family food expenditure per month, eating away from home, health services, safe water and sanitation (Caliendo & Sanjur 1978: 2; UNICEF 2004). The immediate causes include inadequate dietary intake, psycho-social stress and trauma as well as disease (UNICEF 2004).

Nutrition-education strategies, especially in younger children, are clearly limited by children's cognitive developmental stages. Younger children will not be able to learn the meaning of abstract terms such as energy or nutrients within a few days. While comprehensive nutrition-education projects over several years have been successful in changing dietary intake habits of school children, isolated short-term projects are not likely to change eating behaviour. An important aspect in nutrition-education may be to focus on those aspects of nutrition, that are considered important by children themselves (Westenhoefer 2001:125-129).

According to Auld *et al.* (1998:268-280), the critical elements associated with successful school based nutrition-education programs include; school-wide policies that include healthy eating, a school health education curriculum that includes nutrition and that is active, fun and culturally relevant, co-ordination between school food service and nutrition-education, training for school staff, family and community involvement and program evaluation.

Educational strategies should communicate the direct perceivable benefits of healthy eating and lifestyle patterns to children and encourage a positive body image by providing advice and reassurance regarding the range of healthy and acceptable body weights and shapes. Nutrition-education needs continuous effort and year-long programmes, not isolated actions. In this context, the influence of children can be utilised to encourage positive changes in dietary habits within the whole family. Nutrition-education needs well-defined and achievable goals with documented evaluations, in order to convince the authorities and sponsors to invest in improved nutrition-education programmes (Westenhoefer 2001:125-129).

A cross-sectional baseline survey, undertaken in an informal settlement amongst primary schoolchildren (n=160) to determine the demographic and health profile, as well as dietary intake and food consumption patterns showed that poverty was prevalent in these households. This was confirmed by the fact that 89.9% of the households resided in a non-permanent structure zinc shack and had been staying like this for more than five years (88.8%). Furthermore, the socio-economic status of these people was also poor and inclined towards poverty. This was demonstrated by the fact that only 7% of the caregivers were employed. The majority of the households (69%) had an income of less than R500 per month, which also indicated that they lived in poverty. Household food security was also a problem in this community. Most of the respondents indicated that they bought food only once a month (54%) and food was procured mostly from the local spaza/tuck shop in the area (57.8%).

Schools can play a key role in reversing the trend of childhood obesity, inactivity, food insecurity and poor food choices through school nutrition policies that ensure co-ordination of comprehensive nutrition-education programmes, child nutrition programmes and a healthy school environment (American Dietetic Association (ADA) 2003:103). The ADA concludes by saying that knowledge gained about school based nutrition interventions over the past 20 years provides further justification for implementation of comprehensive school based nutrition programmes and services.

6.2 Nutritional status and dietary intake

The micronutrient intake gathered from the QFFQ indicates that the mean daily energy intake of all the children was below the Estimated Energy Requirements (EER) namely children between 7-10 years 6930-13869kJ, boys between 11-12 years 8400-15540 kJ; and girls between 11-12 years 6300-12600kJ respectively. Comparison of the total protein intake with the RDA shows that the children consumed more than 100 percent of the recommendations for protein. The results of this study compare well to findings by Vorster *et al.* (1997).

In comparison with the AI, calcium intake of the whole group as well as the intake of iron and zinc were below two-thirds (67%) of the RDA and the mean intakes of vitamin A, C, riboflavin were below two-thirds (67%) of the Estimated Average Requirement (EAR).

Eighty two percent (82%) of children in the NFCS take in less than two-thirds of RDA for vitamin A in South Africa. In terms of iron status, 10% of children in South Africa are iron depleted or deficient, one in twenty is severely iron depleted or deficient and one in twenty has iron deficiency anaemia. Anaemia and poor iron status are more prevalent in urban areas (South African Vitamin A Consultative Group (SAVACG) 1995:335). According to Vorster *et al.* (1997:125), multiple micronutrient deficiencies exist in rural black pre-school children in the form of vitamin A, iron, folate, vitamin E and vitamin B6.

Dietary intake and nutritional status was also compromised as these children consumed mainly a carbohydrate-based diet. It was found that 17.4% of the children were severely underweight (weight-for-age <5th percentile) and 58.4% of the children were at risk of malnutrition. Eighteen percent (18%) of the children were seriously stunted as shown in the height-for-age <5th percentile of the NCHS median. This indicates a chronic shortage of food possibly experienced as a result of the low-income level and unemployment. The percentage risk cases for stunting (BMI-for-age <5th percentile) is 53.7% and only 23.5% of the children had a normal height. The WHO (2000) estimated that 43% of children under five years old in developing countries have a low-height-for-age.

In this study 12.8% of the sample population had low weight-for-height, presenting wasting indicated at <5th percentile from the NCHS median (weight-for-height was subsequently replaced by BMI-for-age). Sixty four percent (64%) of the children are however at risk of being wasted (>5th and <25th percentile). These results are similar to other studies completed in South Africa. Labadarios *et al.* (2000) indicates that 2% of children aged one to nine years are wasted.

The global prevalence of malnutrition and the findings of the baseline survey conducted in this community indicate the need for a nutrition-education programme.

6.3 Objectives

The objective of this study was to determine nutrition knowledge among the same children where the baseline survey was conducted and to develop a nutrition-education programme, specifically aimed at these primary school children to ensure nutrition awareness that may lead to healthier food choices.

Westenhoefer 2001(125-129) indicates that the nutritional knowledge of children can be used to encourage positive changes in dietary habits within the whole family, Voster *et al.* (2001: S3-S6), recommends that the South African Good Based Dietary Guidelines (FBDG) should be used in the Integrated Nutrition Programme that is a country-wide nutrition programme to address malnutrition in South Africa. This study used the FBDG as a basis for knowledge determination and providing information.

The FBDG developed for South Africa (and adopted by the Department of Health in 2001), have the aim of addressing existing nutrient deficiencies and excesses and the resulting nutrition related public health problems of a specific country or community, the eleven guidelines of the FBDG are:

- Enjoy a variety of food
- Be active
- Drink lots of clean, safe water
- Make starchy foods the basis of most meals
- Eat plenty of vegetables and fruit every day
- Eat dry beans, split peas, lentils and soya regularly
- Chicken, fish, meat, milk or eggs can be eaten daily
- Eat fats sparingly
- Use salt sparingly
- Use food and drinks containing sugar sparingly and not between meals
- If you drink alcohol, drink it sensibly.

These guidelines were developed for adults and children over the age of seven years (Voster *et al.* 2001:S3-S6).

6.4 Methodology

The purposive sample included a primary school in an informal settlement in the Vaal Triangle of which 60 male and female children aged 6-13 years old, were randomly selected to participate in this study.

The nutrition-education questionnaire used was developed by the Medical Research Council (MRC) in SA (Annexure O) for the purpose of testing the nutritional knowledge of urban South African adolescents (Whati *et al.* 2004:12). The questionnaire is based on the 11 South African Food Based Dietary Guidelines with some questions on pregnancy added.

The questionnaire was used as pre-test and post-test. The children completed the questionnaire on the day that the education session was conducted. The post-test took place the following day. A registered dietician presented the training session based on the 11 FBDG. The data were captured on Microsoft Excel® as correct or incorrect answers and the pre- and post-test results were compared and presented in percentages with the significance of the differences indicated at ($p \leq 0,05$) level. The questionnaire consisted of 60 questions and, for the purpose of the report, the questions were grouped into the 11 FBDG and will be reported as such. The education session included the use of pictures of food items that were grouped within the 11 guidelines. Each guideline was presented and discussed individually.

6.5 Results

6.5.1 Nutrition-education

The results of the pre-and post-test indicated that the nutrition-education session that the children attended improved their nutritional knowledge of the FBDGs, as indicated in Table 6.1.

Table 6.1: Impact of nutrition-education programme on knowledge (% correct answers)

Nutrition knowledge analysis - according to FBDG (N=60)			
FBDG guideline:	**Before %**	**After %**	**Increase %**
Enjoy a variety of food	**24.18**	**37.08**	**12.9%**
Be active	**27.43**	**50.00**	**22.8%**
Drink lots of clean, safe water	**40.87**	**54.17**	**13.3%**
Make starchy food the basis of most meals	**19.35**	**27.92**	**8.6%**
Eat plenty of vegetables and fruit every day	**29.03**	**40.42**	**11.4%**
Eat dry beans, split peas, lentils and soya regularly	**43.58**	**41.88**	**0%**
Chicken, fish, meat, milk or eggs can be eaten daily	**20.74**	**33.21**	**12.5%**
Eat fats sparingly	**14.84**	**36.00**	**21.2%**
Use salt sparingly	**34.68**	**42.50**	**7.8%**
Use food and drinks containing sugar sparingly and not between meals	**43.26**	**64.50**	**21.2%**
If you drink alcohol drink it sparingly	**38.70**	**35.00**	**0%**
Pregnancy	**28.23**	**44.06**	**15.8%**

The children's knowledge increased in most of the FBDG guidelines, an average of 11.8% increase in their nutritional knowledge was experienced when asked questions about eating a variety of foods. As indicated in Table 6.1, a 22.8% increase in correct answers was indicated when asked about activity as part of healthy eating. The guidelines of "eat dry beans, split peas, lentils and soya regularly and "If you drink alcohol drink it sparingly" no increase in knowledge were indicated, this could be because the children were between six and thirteen years and might not be exposed to alcohol, the low increase in correct answers on "eat dry beans, split peas, lentils and soy" might be because these items were not previously seen as a source of protein.

When asked where the children got their nutrition information from on a daily basis it was concluded from a multiple answer question that 64.5% of the children got their information from school, 19.4% said that their parents informed them and 16% indicated that they received information from peers/friends and radio/television and magazines respectively.

6.6 Discussion

The nutrition-education provided through this project was aimed at informing children of healthy eating habits and encouraging more healthy food choices. The researcher concedes that comparing the income into the household to the food intake that it is not always possible to make the correct choices. Nutrition-education is aimed at giving children the advantage of knowing what the better options are when making food choices so that they grow up with a good knowledge of nutrition that might be used in their purchasing patterns as grown ups. As these the children (aged six to thirteen years) already had money in hand to buy food items when away from home, it is important that they are equipped to make the correct choices.

Schools have been identified as a major venue for health programs because a very high percentage of children in South Africa attend school, schools are nested in neighbourhoods and have existing connections with family- and community-based institutions (Blom-Hoffman *et al.* 2004:65).

Improving the nutritional knowledge of children may result in these children influencing their caregivers to buy the correct foods for optimal nutritional growth.

6.7 Conclusion

This study has highlighted the importance of implementing nutrition-education programmes that include knowledge and behaviour change components. This study further demonstrates the importance of systematic programming to promote consistent levels of intervention implementation. It can be seen that a single 45-minute nutrition education session increased the nutrition knowledge of the children of at least ten of the Food based dietary guidelines. The two guidelines that showed no increase in knowledge is items that does not appear on the top 20 food consumed list, namely dry beans, dry peas, lentils and soya as well as alcohol, and the children has only limited knowledge of this it in general.

Nutrition-education in schools has to be planned and implemented carefully and over a longer period to establish a good understanding of healthy eating based on the FBDG. Basing the nutrition-education on the FBDG, which was created for the South African public, it can be seen that nutrition education session increased the nutritional knowledge of the children in this community over a short term. More research, will however, have to be done to test the actual behaviour change that took place.

The current study contributes to the literature because this is one of the first studies using the MRC questionnaire and the FBDG to examine and document knowledge change with children as young as six to thirteen years old. Although the children made large knowledge gains after receiving the program, the effect of the programme on behaviour still needs to be tested.

Published: NAPIER C.E. AND OLDEWAGE-THERON W.H. 2005. Knowledge of food based dietary guidelines and nutritional status of primary school children in an informal settlement. *In* Annals of Nutrition and Metabolism. 18th International Congress of Nutrition, Durban. London: Karger ISBN: 3-8055-8015-0.

Chapter 7

Discussion, conclusions and recommendations

7.1 Discussion

7.1.1 Introduction

The major objectives of this study were to:

- Determine the socio-demographic status, nutritional status, dietary intake and food consumption patterns of children in an informal settlement in the Vaal Triangle to gather information for planning an intervention to address possible malnutrition.
- Develop a novel food product to address the nutritional needs identified, for implementation in an intervention study in a primary school in the informal settlement.
- Implement the novel food product in an intervention study as a school feeding programme and to establish the impact on the nutritional status of the children.
- Determine the nutritional knowledge amongst the primary school children, develop and implement a nutrition education programme to increase the nutritional knowledge of the children.

The high prevalence of malnutrition and household insecurity motivated this study.

7.1.2 Limitations of this study

The first limitation of this study is related to the type and costs involved of the biochemical measurements. Calcium and vitamin D are critical micronutrients during childhood, but the most accurate measurement of calcium, is bone marrow analysis, which is too invasive and costly. The dietary intake levels, measured by both the 24-

hour recall and the QFFQ, indicated low calcium and vitamin D intakes and it is possible that the sample may also be calcium deficient.

The second limitation may lie in the power of the study. Only 160 of the 519 (30.8%) children in the school and their parents gave consent to participate in the intervention trial. Dividing the volunteer subjects into groups, namely the experimental, control (fruit) and PSNP groups, the group size was reduced to 60, 60 and 40 respectively. With a further 18% dropping out of the study, (with the majority in the control group), the groups were therefore very small for the post-intervention tests with only 13 girls remaining in the control group. However, the statistically significant changes in all three groups of certain biochemical measurements and weight and height, suggest that the power of the study may have been sufficient, despite the fact that few statistically significant clinical results were obtained.

The third limitation may be associated with the time period over which the school-feeding programme was implemented. Seven months with two holidays in-between (with no feeding), may have been too short to have a statistically significant impact on the nutritional status of the children. However, budgetary constraints made it impossible to continue with the intervention for longer than seven months.

The fourth limitation could be the legislation that was ratified halfway through the study regarding the compulsory fortification of maize meal. The extra micronutrients that were contributed to the diet by the fortified maize meal, may have had a confounding effect on the results, despite the fact that the vetkoek contributed more to the total dietary intake of zinc and iron than the fortified maize meal. This may be the reason why there were no statistically significant improvements in the zinc, iron and vitamin A levels before and after the intervention; and between the groups.

The fifth limitation is the absence of HIV/AIDS tests. The children's HIV status was not determined, as this was not the focus of the study. But it is possible that some of the children could be HIV positive and that it had an impact on their nutritional status.

7.1.3 Main findings

The salient findings of this study are:

Malnutrition remains a persistent problem among primary school children globally. This was also found in this sample of children in the assessment survey where 28% stunting, 25% wasting and 12% underweight were found indicating a chronic food shortage. Although various strategies have been adopted to address micronutrient deficiencies, these difficulties are still prevalent, especially among this group of children.

Zinc deficiencies were the most profound problem as the mean zinc intake for the sample was 83.5% of the minimum levels of the DRIs. A concomitant iron deficiency was also found in this group of children as a large percentage of the sample had marginal ferritin levels (Mean intake of 24.5μg).

The dietary intake patterns reflected poor nutritional status of the children in this community as a mainly carbohydrate based diet was followed with limited vegetable and protein intakes. The socio demographic data indicated that household food insecurity contributed to the poor dietary intake of the sample as 93% of the caregivers were unemployed. This was further confirmed by the limited amount of money spent for food purchases (R50) per week. The underlying cause of the poor nutritional status of the children was poverty as 68.7% of the households had an income of less than R500 per month. This contributed to the household food insecurity that resulted in a malnourished sample.

Developing a novel food product meeting 25% of DRIs for identified micronutrients, prepared with low-cost ingredients, available in the majority of the households in this sample and being acceptable by 81% of the subjects, is possible. This was proved by the vetkoek that was developed for this project. The vetkoek can be prepared without specialised equipment or electricity and also met the low cost criteria of <R2.00 per portion. The implementation of a school feeding programme that included a tasty, acceptable product as part of the programme, also proved to improve school attendance as the vetkoek group showed the best school attendance compared to the PSNP and fruit groups, however, no statistically significant differences were found or among the three groups.

The dietary intake levels in all three groups showed statistically significant improvements for various macro- and micro-nutrients when compared to DRIs. School feeding programmes are a good strategy for addressing malnutrition among primary school children if they are monitored regularly. Commitment from the community and volunteer workers can assist in executing a well run and managed school feeding programme. The infrastructure, however, will have to be provided with financial resources available to ensure a constant flow of ingredients or food items, in order to provide a consistent supply of food to the school children.

Children at primary school level start making their own food choices, however little food choices were available in this community as the food consumption patterns showed that a total of 39 different food items were consumed by the sample during one month, indicating a medium dietary diversity. The top 10 food items purchased reflected mostly carbohydrate based foods and the children in this community had limited knowledge related to healthy eating patterns as can be seen in the nutrition education knowledge questionnaire. The nutrition education programme forming part of this study indicated that: in order to ensure that children make healthy choices they have to be educated on the subject on an ongoing basis.

Although the study did not aim to measure the impact of the food fortification on nutritional status, it can be concluded that the fortification of maize meal contributed to the improved nutritional status of all three groups. Although no statistically significant changes occurred in micronutrient status between the three groups, the dietary zinc intake increased in all three groups; although this may have been the result of the added micronutrients contributed by the fortified maize.

7.2 Conclusions

The following conclusions can be drawn from the results of this study:

- Compliance to the intake of the vetkoek was good and this indicates that this vetkoek, developed to meet certain criteria, can be successfully implemented in a school-feeding programme based on its result of its acceptability by the subjects.
- Although few statistically significant differences were observed between the groups with regard to dietary intake patterns, biochemical changes and nutritional status indices; positive changes were observed in each of the groups, indicating that any food provision may have a positive impact on a malnourished child population. Any effect, no matter how small, may be beneficial to a malnourished child.
- This research project provided the opportunity to develop a novel food item that is nutrient-dense, acceptable to children and affordable. Furthermore, it is easy to prepare and no special ingredients are needed. To sustain this project, the female caregivers can be trained to prepare the vetkoek for the children to take to school.
- This was the first time that an intervention study was conducted among primary school children in the Vaal Triangle. The Vaal Triangle is usually included in the Gauteng results for national census and other surveys. This was the first

intervention study in the Vaal Triangle and the first where socio-demographic results for children in the area will be made known.

- The community involvement in this project by means of community members assisting in preparing the vetkoek for school children, receiving training in food preparation methods and being involved in the overall management of the project gave them a feeling of contributing to the well-being of the children in their community. Their commitment to the study was shown by always being on duty and not one day went by where the children did not get their food because of a person not arriving for duty. This was the first time that an intervention took place in this community on such a far- reaching scale.
- One of the objectives of this study was to improve the nutritional status of the primary school children in this poor community. The results of the clinical intervention trial clearly indicated that the vetkoek alone would not be sufficient, but that the fortification of the maize meal played a synergistic role in improving the nutritional status of the total group of children in this sample. Strategies can thus be implemented simultaneously in the fight against child malnutrition.
- The nutrition-education provided to the children showed a lack of basic nutrition knowledge. The Food Based Dietary Guidelines were developed specifically for South Africans older than seven years old, but this sample commonly did not know anything about the guidelines. Many opportunities exist to improve the public's knowledge about nutrition and nutrition professionals should be more involved in nutrition education. The primary school child is at an age where he/she is susceptible to ideas and imparting nutrition knowledge to children at this age by means of nutrition education, may lead to a healthier SA population in future.

7.3 Recommendations for future research

The results of this study indicate that further research is needed as follows:

- A long-term clinical intervention trial to measure the impact of a food-based approach to address malnutrition among primary school children.
- A cost-effective analysis should be done to determine the most cost-effective intervention strategy for SA in urban poor areas. A combination of strategies may be needed to ensure adequate nutrient intakes for all South Africans.
- As a result of the high prevalence of HIV/AIDS in South Africa, future school based nutrition research should include measuring the presence of HIV/AIDS.
- A long-term FBDG based nutrition education programme for implementation in primary schools as part of the curriculum needs to be planned and presented as part of nutritional awareness of children in South Africa.
- Training of caregivers in communities in the preparation of healthy food prepared in a hygienic manner to address malnutrition in children should be investigated.
- The sustainability of a product similar to the one developed in this study implemented as part of the daily household food intake, to assist children in their nutritional needs, should be investigated.

RESEARCH OUTPUTS

Articles published in accredited Journals:

- **NAPIER C.E.** & OLDEWAGE-THERON W.H. 2005. Knowledge of food based dietary guidelines and nutritional status of primary school children in an informal settlement. *Annals of Nutrition and Metabolism,* London: Karger ISBN: 3-8055-8015-0.

- OLDEWAGE-THERON W.H., DICKS E. G., **NAPIER C.E.**, & RUTENGWE R. 2005. Situation analysis of an informal settlement in the Vaal Triangle. *Development Southern Africa,* 22(1): 13-26. March.

- OLDEWAGE-THERON W.H., DICKS E. G., **NAPIER C.E.**, & RUTENGWE R. 2005. A community-based integrated nutrition research programme to alleviate poverty: baseline survey. *Public Health,* 119(4): 312-320. Apr.

Abstracts published in accredited Journals:

- NAPIER C.E., OLDEWAGE-THERON W.H. 2003. Prevalence of malnutrition in primary school children living in an informal settlement. *Annals of Nutrition and Metabolism*, 47:529.
- NAPIER C.E.& OLDEWAGE-THERON W.H. 2004. Biochemical measurements and anthropometry as indicators of nutritional status measuring the prevalence of malnutrition in primary school children living in an informal settlement. *Asia Pacific Journal of clinical Nutrition*, 13, Supplement: S122.
- KEARNEY J. & NAPIER C. 2004 Breakfast patterns of primary school children in an informal settlement. *Asia Pacific Journal of clinical Nutrition*, 13, Supplement: S121.
- C NAPIER & W OLDEWAGE-THERON. 2005. Nutritional status and eating patterns of primary school children in an informal settlement as determinant for a nutrition education programme. *Journal of Nutrition Education and Behaviour*, vol. 37 (S1), Jul 2005: 75.

Particulars of congress presentation:

Poverty Food & Health in Welfare International conference – Lisbon Portugal	1-4 July 2003	Food consumption patterns and anthropometric indices of primary school children in an informal settlement
9th European Nutrition Conference – Rome	1-4 October 2003	Prevalence of malnutrition in primary school children living in an informal settlement.
7th National Conference of the South African Association of Family Ecology and Consumer Science (SAAFECS) – Cape Town	September 2003	Poverty and Nutritional Status of primary school children in an informal settlement.
Oral presentation: Goudini Western Cape, Nutrition Congress 2004 - Diversity in Nutrition	23-27 August 2004	Biochemical, dietary and anthropometric measurements as indicators of nutritional status measuring the prevalence of malnutrition in primary school children living in an informal settlement.
Poster presentation: International Congress of Clinical Nutrition in Brisbane, Australia	11-13 August 2004	Biochemical measurements and anthropometry as indicators of nutritional status measuring the prevalence of malnutrition in primary school children living in an informal settlement
Oral presentation: 18th International Nutrition Congress, Durban	19-23 September 2005	Knowledge of food based dietary guidelines and nutritional status of primary school children in an informal settlement.

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ANNEXURE A

DEPARTMENT OF EDUCATION

GAUTENG DEPARTMENT OF EDUCATION
OFFICE OF THE MANAGER: CURRICULUM DELIVERY & SUPPORT.
SEDIBENG EAST (D7)

TO: Ms. C. NAPIER (For action)

FROM: Ms. M Miller (FES ECD/FP)

DATE: 1 MARCH 2002

RE: Visits to Primary Schools

Dear Ms Napier

The District hereby grants your research team permission to visit the Primary Schools in the Sedibeng East District to enable them to do a study on the nutritional status, eating patterns and effect of a snack on the Primary School children.

I would just like to indicate that the research must not interfere with the educational time of the learners. All visits to schools must be by appointment with the principal.

In reply to the information you need for your project: Currently the Department of Health is running a Primary School Nutrition programme in the schools (PSNP).

I will supply you with the following regarding the PSNP programme:
1. Nutrition programme Policy
2. List of schools that is on the (PSNP programme)
3. Name list of schools in Sedibeng East and the principals to contact at each school.

AD Strydom

DR AD STRYDOM
MANAGER: CURRICULUM DELIVERY AND SUPPORT

LWC HENDERSON
DISTRICT SENIOR MANAGER

Enquiries: M MILLER

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Private Bag X05, Vereeniging, 1930

ANNEXURE B Ethical approval for study.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

COMMITTEE FOR RESEARCH ON HUMAN SUBJECTS (MEDICAL)
Ref: R14/49 Napier

CLEARANCE CERTIFICATE **PROTOCOL NUMBER** M03-05-66

PROJECT Evaluation of a Feeding Programme in Addressing Malnutrition in Primary Schools

INVESTIGATORS Ms C Napier

DEPARTMENT Hospitality & Tourism, Vaal Triangle Technikon

DATE CONSIDERED 03-05-30

DECISION OF THE COMMITTEE Approved unconditionally

Unless otherwise specified the ethical clearance is valid for 5 years out may be renewed upon application
This ethical clearance will expire on 1 January 2008.

DATE 03-08-26 CHAIRMAN.............................(Professor P E Cleaton-Jones)

* Guidelines for written "informed consent" attached where applicable.

c c Supervisor: Prof W Oldewage-Theron
Dept of Hospitality & Tourism' Vaal Triangle Technikon
Works2\lain0015\HumEth97.wdb\M 03-05-66

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DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10001, 10th Floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. I agree to a completion of a yearly progress form. I/we agree to inform the Committee once the study is completed.

DATE ....SIGNATURE ....

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

ANNEXURE C

INFORMED CONSENT : IMPLEMENTING AND EVALUATION OF A SCHOOL FEEDING PROGRAMME

I, the undersigned..(full names in print) have read the details of the project, or have listened to the oral explanation thereof, and declare that I understand it. I have had the opportunity to discuss relevant aspects with the researcher and declare that I voluntarily participate in the project. I hereby give consent to participate in the project and that blood samples may be taken from my child.

I the parent/legal guardian of...(full names of child), grade..............., hereby consent that he/she may participate in this research project and that blood samples may be taken from my child .

Signature .... Relationship..

Signed at .... on ....

Witnesses

Name .... Name ....

Signature .... Signature ....

Signed at .... on ....

For subjects under the age of 21 years, signed consent of a parent or legal guardian is essential.

Address of volunteer: ....
....
....

Telephone number : ....

Community-based integrated nutrition research project

Dear Parent,

Welcome and thank you for taking the time to read through this document. My name is Carin Napier and I work at the Vaal University of Technology we are starting a community-based integrated nutrition research project in your community. We require your voluntary participation to make this project work. This project is planned to establish nutritional needs in the community and develop maize based products to address any needs that might be identified.

Nurses, Dietitians and members from the Department of Health will be assisting me and they will explain to you in your own language the content of this letter.

WHAT IS THIS PROJECT?

The major objective of this project is to perform a clinical intervention trial under controlled conditions to examine the effect of maize-based breakfast food in primary school children in order to:

- To contribute to the community in giving a possible solution in addressing school feeding in primary schools in South Africa.

- To improve the knowledge and products available to the schools and communities that can improve the nutritional health status of primary school children in the Vaal Triangle area within three years of project duration.

WHY IS THIS PROJECT IMPORTANT?

In children three micronutrient deficiencies, namely vitamin A, iron and iodine, are considered to be a major health problem in developing countries. These are presently receiving high priority globally. Communities that are affected the most are those in situations where poverty, unemployment, civil unrest, war and exploitation remain endemic (SAVACG, 1995: 39; USAID, 1993: 2). Growth retardation, brain damage, diminished cognitive function and diminished working capacity in children and adults, as well as increased susceptibility to and severity of infections, and mortality are the collective result of these micronutrient deficiencies (SAVACG, 1995: 39; USAID, 1993: 2).

PROCEDURE

The project will take place over a period of 1 year. You will be requested to report to us during the 1 year period. During this time your child will be supplied with breakfast at school, the dates for the start of the feeding programme will be given to you as well as the date for the measurements.

WHAT WILL BE MEASURED IN THE PROJECT?

- Eating and drinking habits will be measured and used to establish nutritional intake through Questionnaires
- Weight and height will be measured to establish anthropometric status these measurements will indicate your child's nutritional status

- Blood samples will be taken as markers of nutritional status. PLEASE NOTE, **NO HIV OR AIDS** testing. One 5ml EDTA blood and 2x7ml clotted blood will be collected by drawing blood from your child's arm.

WHO MAY PARTICIPATE?

Primary school children 9-10 years old, resident in Eatonside.

WHAT ARE THE BENEFITS FOR YOU?

Many healthy and nutritional status indicators of your children will be measured. You will receive feedback during which a member of the investigation team will explain your health risk to you. You will receive dietary advice and will be referred to your clinic or doctor if necessary. A doctor will be supervising the research project and it involves a low risk.

Your child will be receiving weeks before the time a colouring in book illustrating the process that will be followed when drawing blood. This book will assist you in explaining to your child what the process is going to be.

WHAT DO WE EXPECT OF YOU?

- **To come to the Setlabotsha Primary school on the 15th of May 2004 - Saturday at 8h00.**
- Please bring your child's birth certificate or clinic card, we need to know his/her birth date.
- We will appreciate it if your child will report fasting on the day of his/her participation. **It means that for 5-6 hours before your child's blood sample is taken, he/she must not eat or drink anything but pure water.**
- You will be asked to sign a form giving consent to participate in the project if you have not signed one already.
- Then you will receive a **reference number** for the project.
- Your child will be weighed and measured.
- Your child's temperature will be taken orally.
- You will be questioned in detail about your child's eating habits.
- Blood will be taken from your child 2 times in a period of 12 months by a registered nursing sister.
- You and your child will receive a sandwich and fruit juice after blood has been taken.
- Please inform your child priot to the day of drawing of blood that a needle will be used for this procedure so that the child does not get a fright when he/she sees the instruments to be used. The colouring in book issued to your child will assist you with this.
- Please assure your child at this stage that this will not be painful, but a little prick sensation will be experienced.
- Please keep in mind that you do not have to take part in this study it is strictly on a voluntary basis.
- You are also allowed to withdraw from the project at any time without penalty or loss of benefits.

If you have any questions about the project, please do not hesitate to ask any one of the field workers at any time.

Thank you for your participation.

Carin Napier
Researcher

ANNEXURE D

FIELD WORKER MANUAL

Why am I here?

Carin Napier has started a research project to evaluate the effect of a feeding practice on the nutritional status of previously disadvantaged primary school children in the Vaal Triangle not receiving breakfast.

The main aims of the project are as follows:

a. A survey of school feeding in SA and the structures and resources needed to implement such a scheme.
b. Measuring of the dietary intake and collecting child development history of primary school children in the Vaal Triangle by a quantitative food frequency questionnaire (QFFQ) and 24-hour recall method.
c. Developing a nutritionally balanced meal/snack to administer to the children and testing it for consumer acceptability.
d. Socio-demographic measurements by using questionnaires and in-depth, semi-structured interviews to explore the family life and well being of the families.
e. In a cluster controlled randomised trial, evaluating the effect of the meal/snack on the children by nutritional status.
f. Analysing the data, interpretations and conclusion and recommendations.

What is a Field Worker?

The field worker is an extremely important person in this project. In fact, this research would not be possible without the field workers. The field workers are the people who must interview the subjects (the people chosen to take part in the research) and get correct and accurate information from them. The subjects must feel at ease with the field worker so that they will not feel threatened or intimidated and will willingly answer the questions to the best of his or her ability.

How should I behave?

In order to be a successful interviewer, a field worker must have (or develop) the following characteristics:

1. **Friendliness:** the field worker must be able to make each subject feel relaxed and not threatened in any way. The subject must feel that the field worker sees him or her as a person, not just another number that must be dealt with.

2. **Respect:** the subject must be treated with respect at all times. For example, he must be greeted politely, thanked for his time and co-operation; he must not be forced to answer a question that he is not willing to answer. The field worker must never show if she disagrees with something the subject has said.

3. **Patience:** each subject has to be asked the same questions in the same way. This means that the field worker must ask the same questions over and over, which can be very tiring and irritating. However, the field worker may never show that she is impatient or irritated even when the subjects are slow to answer or when they do not understand the questions. She must be able to control her own feelings and hide them when necessary.

4. **Reliability:** the field worker must be reliable, she must pay attention to detail, record all answers accurately, not skip over questions or make up answers herself.

5. **Enthusiastic and Motivated**: the field worker must be enthusiastic about the research. She should be doing it because she really wants to and not just because it's just a job.

6. **Flexible:** a good field worker is able to adapt to circumstances. She is aware that things do not always work out as planned and sometimes she will have to work under difficult and uncomfortable conditions.

8. **Neat Appearance:** the field worker must always look neat and well groomed, but never overdressed. The following guidelines for dress should be followed:
- wear neat, simple and comfortable clothes
- do not wear badges or emblems of organisations, churches, etc. as these may influence the way subjects answer.
- dress so that the subject will concentrate on the interview and not on the way you are dressed.

How do I interview the subject?

Due to the subjects in this project being children, the parents and/or caregivers will need to be involved in the interview process to verify information that is needed for the questionnaires. Therefore the "subject" in this project is the child and parent or caregiver.

1. How do I begin?

- ✗ Greet the subject politely and introduce yourself.
- ✗ Ask what language the subject would prefer to speak.
- ✗ Explain what the interview is about. Let the subject ask questions about the research. Reassure the subject that the answers are confidential and that neither the subject nor his or her address will be identified.
- ✗ Put the subject at ease. Be flexible and sensitive to the subject. Some subjects may be tense or apprehensive. In such cases, talking about something general, e.g. the weather may put the subject at ease.

2. How do I conduct the interview?

- ✗ During the interview direct the questions to the child, but if the child cannot answer, ask the parent/caregiver for the information needed.
- ✗ Ask the questions exactly as they are written on the questionnaire. Try even to keep your tone of voice the same for each subject so as not to lead the subject or to give him an idea of how you want him to answer. You may have to explain a question or use different wording if the subject cannot understand it.
- ✗ Ask the questions in the order that they appear on the questionnaire. If the subject refuses to answer the question, record the lack of response and go on to the next question.
- ✗ Follow the instructions on the questionnaire. Sometimes it may seem that a subject has already answered a question when he answered a previous one, but the interviewer must still answer the question. For example, the questions about polony and atchaar. Start the question: "We have already mentioned this, but...".
- ✗ Do not lead the respondents. Do not try to influence the way the subject answers. Keep your facial expression friendly, but neutral. Never show surprise or shock or approval to the subject's answers. Try to avoid unconscious reactions such as nodding the head, frowning, raising the eyebrows. Never give your own opinions.
- ✗ Keep the tone of the interview conversational. Be friendly and courteous. Do not make the subject feel as if he or she is taking an examination or is on trial Be familiar with the questionnaire so that you can ask questions conversationally rather than reading them stiffly.

The questionnaire is designed to keep the amount of writing to a minimum. However, if a subject gives a long response to an 'other' question, say, 'excuse me while I write that down'. Don't make the subject feel as though you have forgotten he is there.

- Keep control of the interview. Do not let the subject go off into irrelevant conversation. If he or she does, bring him or her gently back to the interview.
- Allow the subject time to think; do not hurry him to answer. However, if he is silent for too long, repeat the question, or 'prompt' him. For example, say ' you have told me how you cook cabbage; now please tell me how you cook pumpkin.
- Follow the instructions on the questionnaire for recording the responses. Record all responses, including negative responses or refusals to answer.
- Make sure that you have written in the subject's number.

3. How do I end the interview?

- Tell the subject that you have finished the interview.
- Reassure him that everything he has told you is confidential.
- Thank him for his time and cooperation. Direct him to the next stage. Greet him.

Interview for the Quantitative Food Frequency Questionnaire.

Quantitative = amounts of food
Frequency = number of times food is eaten

1. Part I

Part I of the QFFQ is aimed at finding out the eating pattern of the subject, that is, how many times a day he eats, at about what times he eats, where he eats and does he consume snacks or drinks between his main meals (and also what does he think of as a snack). We need this information to be able to compare the eating habits of people in different areas and to be able to give people relevant advice.

We start by asking the number of meals the subject ate 'yesterday' because it is easy to remember what you ate yesterday. ('What is a meal? Discuss this with field workers). Put a circle around the day, which was 'yesterday'. Then ask at about the times at which he ate each meal. The number of questions to ask next will depend on the subject's answer to question 1. So, if the subject answered that he ate 2 meals yesterday ask questions 2.1.1-2.2.2.

We then ask if this is the number of meals he usually eats (2.5). If the answer is YES do not ask questions 2.5.1. We also ask if he eats at these times usually. If the answer is YES do not ask questions 2.6.1-2.6.7.

2. Part 2

We now come to the main part of the QFFQ. It is very important that this information be filled in as accurately as possible. All that the subject tells us will be put onto a computer and analysed to tell use how much energy, protein, fat, vitamins and minerals the subject is eating and whether it is too little or too much to be healthy or whether it is the correct amount.

The subject must answer about what he has eaten or drunk in the last few months. Anything, which he has not eaten in this time, must be marked with an X under 'Seldom/Never'.

2.1 Filling in the amounts and frequencies.

For the direct questions, e.g. "Do you eat maize-meal?", circle the number next to the subject's answer.

To fill in the amount: estimate the portion size of the food using the food samples or crockery and utensils available, i.e. cups, spoons, bowls, etc. Write this amount in the column under 'AMOUNT'. If the subject describes the amount as spoons or teaspoons, ask him which size of spoon and whether it is level or heaped. Use L for level and H for heaped. For example: If a subject takes one small, heaped teaspoon of sugar in a cup of tea write *1 x small heaped tsp* under 'AMOUNT' or if he takes 2 level 5 ml teaspoons of sugar per cup of tea write *2 x level tsp* under 'AMOUNT'. Use the sizes of the cups and glasses in the sample pack for amounts of drinks, or the sizes of cans or bottles.

Remember that amount of most foods should be the cooked amount and not the raw amount.

To fill in the frequency: ask the subject how many times he has the food per day; how many times he has it per week or how many times per month. Write the number under the column 'Per day' 'per week' or 'Per month' For example, a subject has 500g stiff porridge in the morning and evening every day. It will be filled in as follows:

Example 1: The subject eats a medium size dish of maize-meal porridge once every day, except on Sundays.

FOOD	DESCRIPTION	Amount	TIMES EATEN Per day	Per week	Per month	Seldom Never	CODE	AMOUNT/DAY
Maize-meal porridge	Stiff	*2 cups*	2	7				

Interviewer: How do you like your maize-meal porridge?
Subject: I eat it stiff
Interviewer:(*Circle 'Stiff'*) How much do you eat at a time? (*Show the cup and let the subject tell you how many at a time))*
Subject: About 1 of those cups.
Interviewer: How many times a day do you eat this amount of stiff porridge?
Subject: I eat it once every day.
Interviewer: (*Write 1 under the column Per Day).*
Do you eat stiff porridge every day?
Subject: No, I do not eat it on Sunday.
Interviewer: So you eat stiff maize-meal porridge six times a week (*Write 6 under the column Per Week*)

FOOD	DESCRIPTION	Amount	TIMES EATEN Per day	Per week	Per month	Seldom Never	CODE	AMOUNT/DAY
Maize-meal porridge	Stiff	*1 cup*	1	6				

Example 2.The subject eats a large dish of ting twice a month

I: Do you eat ting?
S: Yes
I: How much do you eat (*Show the cup and let the subject tell you how much would fit in the cup*)
S: About 2 of those cups.
I: How many times a day do you eat ting?
S: I don't eat ting every day.
I: How many times a week do you eat ting?
S: I eat it less than once a week
I: How many times a month do you eat it?
S: I eat it twice a month.
I: (*Write 2 under the 'per month' column*)

FOOD	DESCRIPTION	Amount	TIMES EATEN Per day	Per week	Per month	Seldom Never	CODE	AMOUNT/DAY
Ting		*2 cups*	1		2			

2.2 Brand names.

In some sections, the subject is asked what brand he uses. This is so that we can be sure to use the correct item for nutrient analyses. For example, some maize-meals have vitamins added, others do not. The subject may not know whether the maize-meal he uses has added vitamins or not, but he should know the brand name. We can then check if that brand has added vitamins or not. The same applies to margarines, milk powders, fruit juices, and breakfast cereals.

2.3 Preparation methods (meat and vegetables).

Do not read out the list of all the possible preparation methods to the subject. Ask 'How do you prepare your beef?' Then circle the option closest to the subject's answer. If the answer does not fit one of the options, circle 'other' and write in the description.

Also, check if the subject cooks the food in more than one way.

If the subject does not know the preparation method (men or if eaten away from home), help him by reading the list. If he still does not know, circle 'Don't know' and fill in the amounts and frequency next to 'Don't know'.

Example: The subject sometimes cooks cabbage with potato and onions and sometimes fries it.

I: How do you cook cabbage?
S: I cook it with potato and onion.
I: *(Circle boiled with potato, onion and fat).*
Do you cook it any other way?
S: Sometimes I fry it.
I: (*circle Fried, nothing added)*
What is the amount you eat if it is cooked with potato and onion? (*Show the samples, cutlery or crockery available*)

S: This one (*Subject points to ladle*)
I: (*Write 1 ladle under 'Amount' next to boiled, potato, onions and fat).*
How often do you eat it?
S: About three times a week.
I: (*Write 3 under 'per week'*)
What is the amount you eat when you fry cabbage?
(*Show the samples, cutlery or crockery available*)
S: This one (*Subject points to ladle*)
I: (*Write 1 ladle under 'Amount' next to fried, nothing added).*
How often do you eat it?
S: I only fry it if I haven't got any potatoes?
I: How many times per month is that?
S: Usually at month end, when the potatoes are finished.
I: So, how may times a month?
S: Say twice a month.
I: (*Write 2 under 'per month')* Can I check that I have got this right? You eat cabbage with potato and onion three times a week and fried cabbage with nothing added twice a month.
S: That is right.

FOOD	DESCRIPTION	Amount	TIMES EATEN Per day	Per week	Per month	Seldom Never	CODE	AMOUNT/DAY
Cabbage	**How do you cook cabbage?**							
	Boiled nothing added							
	Boiled with potato, onion and fat	30	1	3				
	Fried nothing added	30	1		2			
	Boiled then fried with potato onion							
	Other describe Don't know							

2.4 Other foods.

- **Vegetables and fruit:** Ask the subject which vegetables and fruits he eats and mark them on the questionnaire, then go back to each answer and ask about the preparation, amount and frequency. Do not read the list to the subject.

- **Tomato and onion gravy:** Use the ladle to help the subject judge the amount of gravy used with the porridge.

- **Canned fruit with custard:** Custard is included under fruit as it is usually eaten with canned fruit. This is also a control question, as canned fruit and custard is also included under puddings. The answers to both questions must be the same. If not, make sure the subject has understood the question.

- **Bread and spreads:** Ask the subject if he spreads anything on his bread. If he answers **YES** ask him what he spreads and mark them on the questionnaire, then go back to each answer and ask about the amount and frequency. Do not read the list to the subject. (Remember not to ask how much is put on per slice of bread, but how much is used every day or every week or every month).

- **Atchar:** Atchar is included here as a spread on bread, it is also asked about later under 'condiments' for when it is used as sesebo.

- **Polony:** Polony is asked about here again (it was included with cold meat) as something put on bread, whereas previously it was asked about as cold meat. Make sure with the subject whether he uses polony only on bread (e.g. with atchar) or if he also eats it on its own.

- **Margarine:** There is a difference between the type of fat in soft (tub) margarines and hard (brick) margarines. When you ask about the brand also ask whether it is the hard or soft type and write the answer with the brand e.g. *' Rama - soft'* or *'Rama - hard'*.

- **Fats, drinks and snacks:** As for vegetables, fruit and spreads. Ask the subject what he uses and mark them on the questionnaire, then go back to each answer and ask about the preparation, amount and frequency. Do not read the list to the subject.

- **Fats:** Most people will add fat to vegetables or other food while it is being cooked. So to try to find out how much fat one person is getting, we need to ask how much fat is used for the whole amount of food and then how many people will eat the food. These are also checking questions for the cooking methods of vegetables.

- **Alcoholic drinks:** Some questions are asked in the first general questionnaire about the use of alcohol. The subject may want to know why he is being asked again. The first questionnaire is to assess the general state of health of the subject and alcohol is a part of this. In our questionnaire we want to find out the amounts used as alcoholic drinks are 'food' and contribute energy and some nutrients to the diet.

- **Repetition:** Some questions are repeated e.g. custard, atchar, polony. This has been done as a double check to make sure that everything is included. For example, atchar may be spread on bread or eaten as 'sesebo'. The subject may only think of it as sesebo, if it was not also included under spreads.

- **Storing food:** Keeping food can affect its nutritional value and other properties of the food. If food is regularly stored, it could have an important effect on the quality of the diet.

- **Salt:** Separate questions are asked about the use of salt, as it is very difficult to estimate the amount of salt used.

Interview for the 24-Hour Recall Questionnaire.

The 24-hour recall is a questionnaire on what the subject has eaten the day before over a 24 hour period. Often the 24-hour recall is used to establish whether the QFFQ is valid or not. It is important to think of the 24-hour recall questionnaire as being a totally separate questionnaire and not a cross-reference to the QFFQ. Therefore, the answers to the questionnaire need to be very detailed. You will need to ask what is eaten and drunk, what type of food or drink is consumed, the brand name, the preparation method and the quantity consumed. Remember to include spreads, sugar and milk to tea / coffee, snacks, sweets, juices, sauces, salts and other condiments.

Example: The subject is asked what she has in the morning on waking up.

I: What do you have in the morning when you wake up?
S: I drink tea and then have porridge.
I: How do you take your tea?
S: With 2 sugars and a little milk.
I: How big is the spoon and is it level or heaped? (*Showing the teaspoon*).
S: It is like that spoon and I also have it heaped.
I: What type of porridge did you eat and how much did you have? (*Showing a bowl or cup*).
S: I had soft mealie meal porridge and I had about 2 of those cups to the fill in a bowl.
I: Do you put anything else in the porridge?
S: Yes, 2 spoons of sugar, like my tea, and a little margarine about 1 spoon.
I: At about what time was this meal?
S: At 6 am.
I: Where did you have this meal?
S: At home.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
6 am	**Home**	**Tea**	**1x**		
		With milk	**little milk**		
		And sugar	**2 heaped tsp**		
		Soft mealie meal porridge	**2 cups**		
		With sugar	**2 heaped tsp**		
		And margarine	**1 tsp**		

ANNEXURE E

Data collection route

Fieldwork – 15 May Setlabotjha Primary School

Table 1

Registration Check consent form, if not completed – parent must complete Indicate grade of child on file Confirm the address of the child Hand file over to parent for next point **C. Napier**

Table 2

Weigh child Measure each child's height Take each child's age Take each child's temperature Drawing of blood (Indicate readings in file on form provided) **Nursing sisters and C. Grobler**

Table 3

Collection of Bread roll and fruit juice, parent and child, collect snack tickets from file **J. Kearney**

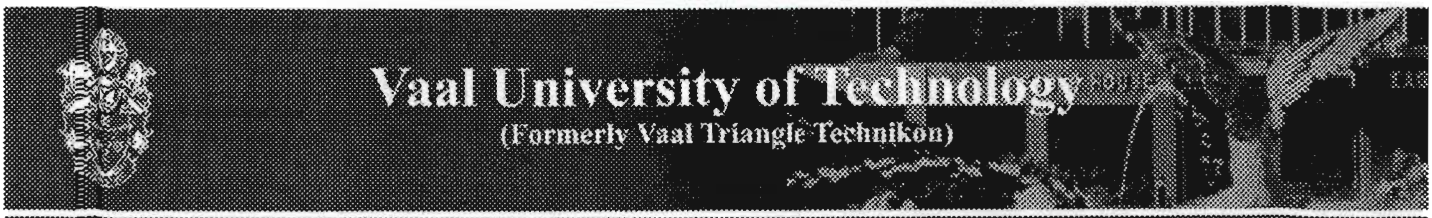
Table 4

Completion of QFFQ and 24 hour recall (Mark it in the file as completed) **Fieldworkers**

Table 5

Hand in file Final check to ensure that all data has been collected Serving of soup and bread- take meal ticket **J. Kearney & C. Napier & students**

ANNEXURE F



SOCIO-DEMOGRAPHIC QUESTIONNAIRE:

This questionnaire covers certain aspects of your life, including work and personal details, health and illness, lifestyle and social life that is relevant to health. The answers to these questions will be kept strictly confidential and the information will not be identifiable from any reports or publications.

1. GENERAL INFORMATION

Subject ID number:..

Please answer all questions by marking the correct answer with **X,** except where otherwise indicated.

Example: In what town do you live?

Johannesburg	Bloemfontein	Cape Town	Vanderbijlpark	Durban

2. PERSONAL INFORMATION

2.1 Your role in the family

Mother	Grandmother	Caregiver	Other, specify.........................

2.2 When were you born? Year: ______ Month: ______ Day: ____

2.3 How old are you?__________________years

2.4 Gender:

Male	Female

Electrical iron			
Kettle, electrical			

6.10 What type of fuel do you usually use for food preparation?

Food fire	Paraffin	Electricity	Gas	Coal	Other, specify...............

6.11 What type/s of pots do you use to cook your food (tick all relevant options)?

Cast iron	Aluminium	Stainless steel	Clay	Other, specify...............

Thank you very much for your co-operation. We appreciate the time.

Carin Napier
Researcher
Vaal University of Technology

Wilna Oldewage-Theron (Prof)
Supervisor

3. ACCOMMODATION AND FAMILY COMPOSITION

3.1 Where do you live?

Town/City	Farm	Informal settlement	Rural village	Hostel	Other, specify...............

3.2 Do other people live in your house?

Yes
No

3.3 How many people are living in your house?

1	2	3	4	5	6	7	8	9	10	10+

3.4. Please **complete** the table below on all members of the household

Name of household member	Age (yrs)	Gender M / F	Family relationship	Does this person eat and sleep in this house at least 4 days a week?

3.5 Are all members permanent residents in this house?

Yes	No

3.6 If yes, how long have you been staying permanent in this house?

< 1 year	1-5 years	>5 years

3.7 Do you have another home outside the Vaal Triangle?

Yes	No

3.8 In what type of house are you staying and indicate the number of rooms?

Brick	Clay	Grass	Zinc/shack	< 2 rooms	3-4 rooms	> 4 rooms

3.9. Are there other houses/shacks within the same yard of the main house?

Yes	No

3.10 How would you describe the place where you are currently living?

Homeless	
Living with parents	
Living with relatives	
Living with friends	
Hostel accommodation	
Squatter home	
Rented house	
Rented flat	
Own house	
Own flat	
Other, specify............................	

3.11 Do you have the following facilities at home?

3.11.1 Water

Tap in the house	
Tap outside the house (in yard)	
Borehole	
Spring / river / dam water	
Fetch water from elsewhere	

3.11.2 Toilet facilities

None	
Pit latrine	
Flush / sewage	
Bucket system	
Other, specify.............................	

3.11.3	Waste removal	Yes	No

3.11.4	Tarred road in front of house	Yes	No
	Gravel road in front of house	Yes	No

3.12 To what extent do you have problems with your housing (e.g. too small, repairs, damp, etc.)?

....

....

3.13. Do you have problems with the following?

Mice / Rats	Cockroaches	Ants	Other pests, specify................................

4. WORK STATUS AND INCOME

4.1. Are you currently employed?

Yes	No

If YES, go to Question 4.5.

4.2. If NO, how would you describe your current status (tick one box only)?

Unemployed	Retired	Housewife	Student	Other, specify....................

4.3. Are you actively looking for paid employment at the moment?

Yes	No

4.4. How long have you been unemployed?

< 6 months	6-12 months	1-3 years	> 3 years

4.5. If YES (question 4.1) is your current job a:

Permanent position	Temporary position	Fixed term contract	Other, specify......................

4.6. Is your job?

Full time	< 25 hours per week

4.7 What is the exact title of your current job?
(Including self-employed)

4.8 Do you have a second job for extra cash?

Yes	No

If YES, go to Question 4.10.

4.9 If NO, is your spouse (partner) in paid employment at present?

Yes, full time, permanent	
Yes, part-time, permanent (< 25 hours p w)	
Yes, temporary	
No, unemployed	
No, retired	
No, other, specify.............................	

4.10. If YES, what is your spouse (partner)'s occupation or job?

4.11. What is the total income in the household per month?

< R500	R501-R1000	R1001-R1500	R1501-R2000	R2001-R2500	> R2500

4.12. How often does it happen that you do not have enough money to buy food or clothing for you or your family?

Always	Often	Sometimes	Seldom	Never

4.13 How many people e.g. partner, relatives & others (including yourself) contributed to your household income from any source, (including wages/salary from paid employment, money from second or odd jobs income from savings investments, pension, rent or property, benefits and or maintenance etc.) in the last 12 months?

People	0	1	2	3	4	5	6	7	8	9

4.14 How often do you buy food?

Every day	Once a week	Once a month	Other, specify....................

4.15 Where do you buy food?

Spaza shop	Street vendor	Supermarket	Other, specify....................

4.16. How much money is spent on food PER WEEK? (Tick only one box)

R 0 – R 50	R 51 – R 100	R 101 – R 150	R 151 – R 200	R 201 – R 250	R 251 – R 300	> R 300	I do not know

4.17 How much money do you give to each child to take to school for buying food / snacks PER WEEK?

50 c	R 1 – 2	R 2- 3	R 3 - 4	R 4 - 5	> R 5

4.18 Do you buy the following regularly (per month)?

Food item	**Yes**	**No**	**Food item**	**Yes**	**No**
Chicken			Cheese		
Beef			Eggs		
Mutton			Fresh milk		
Tripe			Powdered milk		
Fish			Condensed / Ideal milk		
Canned fish eg pilchards			Cremora		
Polony and other processed meat			Frozen vegetables		
Canned meat eg bully beef			Fresh vegetables		
Cold drink			Canned vegetables		
Sugar			Fresh fruit		
Maize meal			Canned fruit		
Oil			Fruit juice		
Butter / margarine			Coffee, instant		
Peanut butter			Tea		
Fish paste			Cheese curls		
Jam			Sweets		

5 EDUCATION AND LANGUAGE

5.1. What is the highest education you have?

None	Primary School	Standard 8	Standard 10	College	Other post school

5.2 What language is spoken mostly in the house?

Sotho	Xhosa	Zulu	Pedi	Other, specify....................................

5.3 How many children (in the household) 5 years and under have birth certificates?

None	1	2	3	4	5	6	7	8	All

5.4 How many children 5 years and under have completed their immunisation schedule?

None	1	2	3	4	5	6	7	8	All

5.5 Number of children attending school

None	1	2	3	4	5	6	7	8	All

5.6 How do the children get to school?

Walk	Bus	Taxi	Lift	Other, specify.................................

6 ASSETS

Tick one block for every question:	Father	Mother	Sibling	Grandma	Grandpa	Aunt	Uncle	Cousin	Friend	Other
6.1 Who is mainly responsible for food preparation in the house?										
6.2 Who decides on what types of food are bought for the household?										
6.3 Who is mainly responsible for feeding/serving the child?										
6.4 Who is the head of this household?										
6.5 Who decides how much is spent on food?										

6.6 How many meals do you eat at per day?

0	1	2	3	> 3

6.7 Where do you eat most of your meals?

Home	Friends	Work	Buy	Other, specify........................

6.8 Where do your children eat most of their meals?

Home	Friends	School	Buy	Other, specify........................

6.9 Does your home have the following and how many?

	Yes	No	Quantity
Electrical stove			
Gas stove			
Primus or paraffin stove			
Microwave			
Hot plate			
Radio			
Television			
Refrigerator			
Freezer			
Bed with mattress			
Mattress only			
Lounge suite			
Dining room suite			

ANNEXURE G

VAAL UNIVERSITY OF TECHNOLOGY

DIETARY INTAKE INTERVIEW SCHEDULE

SUBJECT DATE OF BIRTH: .... AGE:..............

NAME: ....

INTERVIEWER: ....

ADDRESS: ....

INTRODUCTION:

Greeting

Thank you for giving up your time to participate in this study. I hope you are enjoying it so far. Here we want to find out what people living in this area eat and drink. This information is important to know as it will tell us if people are eating enough and if they are healthy.

Please think carefully about the food and drink your child has consumed during the past few months. I will now go through a list of foods and drinks with you and I would like you to tell me

- if your child eats the food,
- how the food is prepared,
- how much of the food the child eats at a time,
- how many times a day he/she eats it and if he/she does not eat it every day, how many times a week or a month he/she eats it.

To help you to describe the amount of a food your child eats, I will show you pictures/examples of different amounts of the food. Please say which picture/example is the closest to the amount that is eaten, or if it is smaller, between sizes or bigger than the pictures.

I will also ask some questions about where you get your food, where you shop, whether your child eats away from home and so on. This information is important because it will tell us which foods are easy to obtain and which are not and how the food is prepared and served.

THERE ARE NO RIGHT OR WRONG ANSWERS

EVERYTHING YOU TELL ME IS CONFIDENTIAL. ONLY YOUR CHILDS SUBJECT NUMBER APPEARS ON THE FORM.

IS THERE ANYTHING HE/SHE WANT TO ASK NOW?
ARE YOU WILLING TO GO ON WITH THE QUESTIONS?

PART I

INSTRUCTIONS: Circle the number next to the subject's answer **OR write the time in the columns.**

SUBJECT ID NO: ....

EXAMPLE:

1.	**How many meals did you eat yesterday?** **Yesterday = Mon1 Tues2 Wed3 Thurs4 Fri5 Sat6 Sun7**				
2.1.1	**At about what time did you eat your first meal?**				
2.1.2	Where did you eat this meal? Home Work Other specify: Not applicable				**1** **2** **3** **4**

Please answer the following questions:

1.	How many meals did you eat yesterday? Yesterday = Mon1 Tues2 Wed3 Thurs4 Fri5 Sat6 Sun7				
2.1.1	At about what time did you eat your first meal?				
2.1.2	Where did you eat this meal? Home Work Other Not applicable				1 2 3 4
2.2.1	At about what time did you eat your second meal?				
2.2.2	Where did you eat this meal? Home Work Other Not applicable				1 2 3 4
2.3.1	At about what time did you eat your third meal?				
2.3.2	Where did you eat this meal? Home Work Other Not applicable				1 2 3 4
2.4.1	At about what time did you eat your other meals?				
2.4.2	Where did you eat these meals? Home Work Other Not applicable				1 2 3 4
2.5	Do you eat this number of meals on most week days?	Yes 1		No 2	
IF NO: 2.5.1	How many meals do you usually eat a day? Not applicable = 99				
2.6	Do you eat your meals at about the same times as above on most days?	Yes 1		No 2	

PART II

INSTRUCTIONS: Circle the subject's answer. Fill in the amount and times eaten in the appropriate columns.

SUBJECT ID NO: ....

I shall now ask you about the type and the amount of food you have been eating in the last few months. Please tell if you eat the food, how much you eat and how often you eat it. We shall start with maize meal porridge.

Do you eat maize meal porridge? YES 1 NO 2
If YES, what type do you have at home now?

Brand name: ....
Don't know 2
Grind self 3

If brand name given, do you usually use this brand?
YES 1 NO 2 DON'T KNOW 3
Where do you get your maize meal from? (May answer more than one)

Shop	1
Employer	2
Harvest and grind self	3
Other – specify	4
Don't know	5

FOR OFFICE USE

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Maize meal porridge	Stiff ('pap')						e4225 4250	
Maize meal porridge	Soft ('slap pap')						e4225 4250	
Do you pour milk on your soft porridge? YES 1 NO 2 If YES, what type of milk (whole fresh, sour, 2 %, fat free, milk blend)? .... INSTRUCTION: Show subject examples.								
If YES, how much milk?								
Do you pour sugar on your soft porridge? YES 1 NO 2								
If YES, how much sugar?							9012	
Maize meal porridge	Crumbly (phutu)						e4225 4250	
Ting	Maize/mabela							
Mabella Coarse Fine Rice	Stiff						4082	
Mabella Coarse Fine Rice	Soft						4082	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Do you pour milk on your mabella porridge? YES 1 NO 2 If YES, what type of milk (whole fresh, sour, 2 %, fat free, milk blend)? .... INSTRUCTION: Show subject examples.								
If YES, how much milk?								
Do you pour sugar on your mabella? YES 1 NO 2								
If YES, how much sugar?							9012	
Oats							4032	
Do you pour milk on your oats? YES 1 NO 2 If YES, what type of milk (whole fresh, sour, 2 %, fat free, milk blend)? .... INSTRUCTION: Show subject examples.								
If YES, how much milk?								
Do you pour sugar on your oats? YES 1 NO 2								
If YES, how much sugar?							9012	
Breakfast Cereals	Brand names of cereals at home now: Don't know						4036	
Do you pour milk on your cereal? YES 1 NO 2 If YES, what type of milk (whole fresh, sour, 2 %, fat free, milk blend)? .... INSTRUCTION: Show subject examples.								
If YES, how much milk?								
Do you pour sugar on your cereal? YES 1 NO 2								
If YES, how much sugar?							9012	
Samp	Bought Self ground with fat without fat						4043	
Samp and Beans								
	Are the amounts of samp and beans the same as in the picture? YES NO If NO, do you use more beans than in the picture or less? MORE LESS							
Samp and Peanuts								
	Are the amount of samp and peanuts the same as in the picture? YES NO If NO, do you use more peanuts than in the picture or less? MORE LESS							
Rice	White Brown Maize rice						4040 4134 4043	
Pastas	Macaroni Spaghetti Other						4062	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
You are being very helpful. Can I now ask you about meat?								
CHICKEN, MEAT, FISH								
Where do you get your chicken from? (May answer more than 1). How many times per week do you eat chicken? ……….								
	Shop, supermarket, spaza							1
	Employer							2
	Slaughter own							3
	Gift							4
	Other specify:							5
	Do not eat chicken							6
Chicken:	Boiled, nothing added						1521	
	Fried: in butter/crumbs						1634	
	Not coated						1520	
	Roasted, grilled						1520	
	Stewed						1520	
	What vegetables are in the stew?							
	Don't know							
Do you eat chicken skin? ALWAYS 1 SOMETIMES 2 NEVER 3								
Chicken bones stew								
Chicken feet	How do you cook it?						1609	
Chicken offal	How do you cook it?						1610	
Where do you get your MEAT from? (May answer more than 1). How many times per week do you eat meat? ……………								
	Shop, supermarket, spaza							1
	Employer							2
	Slaughter own							3
	Gift							4
	Other specify:							5
	Do not eat red meat							6
Red meat:	How do you like meat? With fat Fat trimmed							
Beef	Fried – with bone							
	Fried – without bone							
	Stewed – with bone							
	Stewed – without bone							
	Grilled – with bone							
	Grilled – without bone							
	Minced						1585	
Mutton	Fried – with bone						1522	
	Fried – without bone						1571	
	Stewed – with bone						1511	
	Stewed – without bone						1511	
	Grilled – with bone							
	Grilled – without bone							
	Minced						1662	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Pork	Fried – with bone							
	Fried – without bone							
	Stewed – with bone							
	Stewed – without bone							
	Grilled – with bone							
	Grilled – without bone							
Beef Offal	Intestines: boiled, nothing added						161	
	Stewed with vegetables							
	Tripe						1546	
	Heart						1565	
	Lungs							
	Liver						1515	
	Kidneys						1518	
	Other specify:							
What vegetables are usually put into meat stews?								
Wors sausage	Fried Grilled						1526	
Bacon							1501	
Cold meats	Polony						1514	
	Ham						1564	
	Viennas						1531	
	Other specify:							
Canned meat	Bully beef						1535	
	Other specify:							
Meat pie	Home made Bought						1548	
Hamburger	Home made Bought							
Dried beans, peas, lentils (10)	How do you prepare them?							
Soya products e.g. Toppers	Brands at home now Don't know........ Show examples						3527	
Pilchards in tomato chilli brine	Whole						2557	
	Mashed with fried onion							
Fried fish	With batter/ crumbs						2523	
	Without batter/crumbs						2509	
Other canned fish	Tuna							
	Pickled fish Other:						2562	
Fish cakes	Home made (describe) Frozen Bought						2531	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Eggs	Boiled poached Scrambled Fried						1001 1025 1003	
WE NOW COME TO VEGETABLES AND FRUIT How many times per week do you eat vegetables? …………………………………………………………………… Where do you get your vegetables from? (May answer more than 1) Own vegetable garden Employer's farm Own farm Shops, supermarket, greengrocer Hawker Veld (e.g. morogo) Gifts Other specify								 1 2 3 4 5 6 7 8
Cabbage	How do you cook cabbage?							
	Boiled, nothing added						8066	
	Boiled with potato and onion and fat							
	Fried, nothing added							
	Boiled, then fried with potato, onion							
	Other:							
	Don't know							
Spinach / morogo / other green leafy	How do you cook spinach?							
	Boiled, nothing added						8071	
	Boiled fat added						8209	
	Boiled with – onion, tomato & fat							
	-onion, tomato & potato						8212	
	- with peanuts							
	Other:							
	Don't know							
Tomato and onion 'gravy'	Home made - with fat - without fat							
	Canned (Is this the amount of pap you eat? How much more or less?)						8221	
Pumpkin	How do you cook pumpkin?							
	Cooked in fat & sugar							
	Boiled, little sugar and fat							
	Other:							
	Don't know							

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Carrots	How do you cook carrots?							
	Boiled, sugar & fat						8129	
	With potato/ onion							
	Raw, salad Chakalaka						8015	
	Other:							
	Don't know							
Mealies / Sweet corn	How do you eat mealies? On cob –with fat -without fat						8033	
	Off cob –with fat -without fat						8261	
Beetroot salad	Home made Bought						8005	
Potatoes	How do you cook potatoes?							
	Boiled/baked - with skin						8046	
	- without skin						8045	
	Mashed						8187	
	Roasted						8189	
	French fries						8048	
	Salad						8236	
	Other:							
Sweet potatoes	How do you cook sweet potatoes?							
	Boiled/baked - with skin						8057	
	- without skin						8214	
	Mashed						8058	
	Other:							
	Don/t know							
Salad vegetables	Raw tomato						8059	
	Lettuce						8031	
	Cucumber						8025	
Other vegetables specify:								

FRUIT:

Do you like fruit? YES NO How many times per week do you eat fruit in winter? ………/ in summer? ………

Where do you get your fruit from?

Own fruit trees	1
Farm – employer	2
Farm – own	3
Supermarket/greengrocer	4
Hawker	5
Veld	6
Gifts	7
Other	8

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Apples/Pears	Fresh						7001	
Pears	Fresh Canned						7053 7054	
Bananas							7009	
Oranges / naartjies							7031	
Grapes							7020	
Peaches	Fresh Canned						7036 7038	
Apricots	Fresh Canned						7003 7004	
Mangoes	Fresh						7026	
Guavas	Fresh Canned						7021 7023	
If subject eats canned fruit: Do you have custard with canned fruit? YES 1 NO 2								
Custard	Home made Ultramel						0004	
Wild fruit / berries	Stamvrugte Noen-noem Klappers Maroelas Nastergals Other – specify						7070	
Dried fruit:	Types:							
Other fruit:								
BREAD AND BREAD SPREADS								
Bread Bread rolls	White						4001	
	Brown						4002	
	Whole wheat						4003	
Do you spread anything on the bread? ALWAYS 1 SOMETIMES 2 NEVER 3 If YES, what do you spread?								
Margarine	What brand do you have at home now? …………………… Don't know Show examples						6508 6521	
Butter	What brand do you have at home now? ………………… Home made Don't know						6502	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
Peanut butter							6509	
Jam/syrup/ honey							9008	
Marmite/Fray Bentos etc.							9501	
Fish/meat paste							1512	
Cheese	Type:						0010	
Atchar							3004	
Polony							1514	
Other spreads: specify								
Dumpling							4001	
Vetkoek							4057	
Provita, crackers etc.								
FATS: What fats do you use and where do you use them?								
Margarine	Where used: on bread							
	with vegetables** Number of spoons .... /number in family							
Butter	on bread with vegetables** Number of spoons .... /number in family							
Holsum / vegetable fat	Where used: Number of spoons .... /number in family						6508	
Oil	Where used: Number of spoons .... /number in family						6510	
Dripping	Where used: Number of spoons .... /number in family							
Mixed fat (makhuru)	Where used: Number of spoons .... /number in family							

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	**Per week**	**Per month**	**Seldom Never**		
Lard	Where used: Number of spoons .... /number in family						6520	
Mayonnaise/ salad dressing	Number of spoons .... /number in family						6573	
Cream	Fresh/Long life /canned Orley whip						6503	
DRINKS:								
Tea							9514	
Sugar/cup tea							9012	
Milk / cup tea	What type of milk do you use in tea?							
	Fresh / long life whole						0006	
	Fresh / long life 2%							
	Fresh / long life fat free						0072	
	Whole milk powder Brand						0009	
	Skimmed milk powder Brand						0008	
	Milk blend Brand						0068	
	Whitener Brand						0039	
	Condensed milk						0002	
	Evaporated milk						0003	
	None							
Coffee								
Sugar / cup coffee							9012	
Milk / cup coffee	What type of milk do you use in coffee?							
	Fresh / long life whole						0006	
	Fresh / long life 2 %							
	Fresh / long life fat free						0072	
	Whole milk powder Brand						0009	
	Skimmed milk powder Brand						0008	
	Milk blend Brand						0068	
	Whitener Brand						0039	

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	**Per week**	**Per month**	**Seldom Never**		
	Condensed milk						0002	
	Evaporated milk						0003	
	None							
Milk as such	What type of milk do you drink as such?							
	Fresh / long life whole						0006	
	Fresh / long life 2 %							
	Fresh / long life fat free						0072	
	Sour / Maas						0006	
	Buttermilk						0001	
	Whole milk powder Brand …………						0006	
	Skimmed milk powder Brand ……….						0072	
	Milk blend Brand …………						0068	
Milk drinks Brand ……….	Nestle Milo Other						0023	
Yoghurt	Drinking yoghurt Thick yoghurt						0044 0020	
Squash	Sweeto SixO Oros/Lecol - with sugar - artificial sweetner Kool Aid Other						9013 9013 9002 9013 9002	
Fruit juice	Fresh/Liquifruit/Ceres Tropica Concentrates e.g. Halls Nectars Flavour							
Fizzy drinks Coke, Fanta	Sweetened Diet						9001 9013	
Mageu/Motogo							9562	
Home brew							9516	
Tlokwe							9516	
Beer							9506	
Spirits							9510	
Wine red							9508	
Wine white							9518	
Liqueur							9517	
Other: specify								

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
SNACKS AND SWEETS:								
Potato crisps							4275	
Cheese curls Niknaks etc.							4067	
Peanuts	Raw Roasted						6001 6007	
Raisins							7022	
Peanuts and raisins								
Chocolates	Name						9024	
Candies	Sugars, gums, hard sweets						9009	
Sweets	Toffees, fudge, caramels						9014	
Biscuits	Type							
Cakes & tarts	Type							
Scones							4029	
Rusks							4160	
Savouries	Sausage rolls Samoosas Biscuits e.g. Bacon kips Other						1534 4196 4162	
PUDDINGS:								
Canned fruit	Type							
Jelly							9004	
Custard	Homemade Ultramel						0004	
Baked pudding							4181	
Instant pudding							4066	
Ice cream Sorbet							6507 6516	
Other: specify								
SAUCES / GRAVIES / CONDIMENTS:								
Atchar							3004	
Tomato sauce Worcester sauce							3027	
Chutney							9524	
Pickles							8176	
Packet soups							3046	
Others:								
INSECTS:								
Locusts								
Mopani worms								
Others:								

FOOD	DESCRIPTION	Amount	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom Never		
WILD BIRDS OR ANIMALS (hunted in rural areas or on farms)								
MISCELLANEOUS: Please mention any other foods used more than once/two weeks which we have not talked about:								

SALT USE:

The next few questions are to find out if you use salt, where you use it and how much you use.

Do you add salt to food while it is being cooked?

Always	Sometimes	Never	Don't know
1	2	3	4

Do you add salt to your food after it has been cooked?

Always	Sometimes	Never	Don't know
1	2	3	4

Do you like salty foods e.g. salted peanuts, crisps?

Very much	Like	Not at all
1	2	3

KEEPING FOOD:

Do you keep food from one meal to eat at the next meal?

Always	Sometimes	Never	Don't know
1	2	3	4

If ALWAYS OR SOMETIMES, what foods do you keep?
Do you eat kept food cold or do you reheat it?

FOOD	Reheated	Eaten cold

Do you use any of the following?

	Name of product	Amount/day
Vitamins/vitamins & minerals		
Tonics		
Health foods		
Body building preparations		
Dietary fibre supplement		
Other: specify		

THANK YOU FOR YOUR COOPERATION AND PATIENCE

GOOD-BYE!

ANNEXURE H

24 – HOURS RECALL

Subject ID number: ____________________ Interviewer: ____________________

Name: ____________________________ Date: ______ / _______ / 200 ___

Address: ____

Tick what the day was yesterday:

Monday	Tuesday	Wednesday	Thursday	Friday

Would you describe the food that you ate yesterday as typical of your habitual food intake?

Yes	1	No	2

If not, why? ____

I want to find out about everything you ate or drank yesterday, including food you pick from the veld. Please tell me everything you ate from the time you woke up to the time you went to sleep. I will also ask you where you ate the food and how much you ate.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
During the morning at work or at home					

ANNEXURE H

Time (approximately	Place (Home, school, etc)	Description of food and Preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
Middle of the day (Lunch time)					
During the afternoon					
At night (dinner time)					

ANNEXURE H

Time (approximately	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
After dinner, before going to sleep					

* Do you take any vitamins (tablets or syrup)	Yes	1	No	2
Give the brand name and dose of the vitamin/tonic:				
* Do you receive a mealie meal mix (PVM) at the clinic?	Yes	1	No	2
How often do you eat this?		Daily	Weekly	Monthly
How much do you eat at a time?				
* Do you receive PVM drink mix at the clinic?	Yes	1	No	2
How often do you eat this?		Daily	Weekly	Monthly
How much do you eat at a time?				

ANNEXURE I

Community-based integrated nutrition research project

Assessment of the nutritional status of Primary school children in an informal settlement in the Vaal Triangle

Section A:

1. Name of school: Setlabotiha Primary School 2. Name of the teacher.........................

3. Name of the child..4. Age:............. 5. Grade: ....

6. Name of the parent /caregiver...

7. Address of the child:..

8. Date of birth of the child	Year	Month	Day

9. Gender of the child	Male	Female

Section B:

1. Body weight (kg)	2. Height/Length (cm)
kg	cm

ANNEXURE J

Sensory evaluation
Preference testing

Name: ____________________ **Surname:** ______________________________

Grade: _______________

Date: ________________

1. Please mark with a cross (**X**) under the face which best describes how you feel about the **taste** of product **A.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

2. Please mark with a cross (**X**) under the face which best describes how you feel about the **taste** of product **C.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

3. Please mark with a cross (**X**) under the face which best describes how you feel about the **taste** of product **B.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

4. Please mark with a cross (X) under the face which best describes how you feel about the **texture** of product **A.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

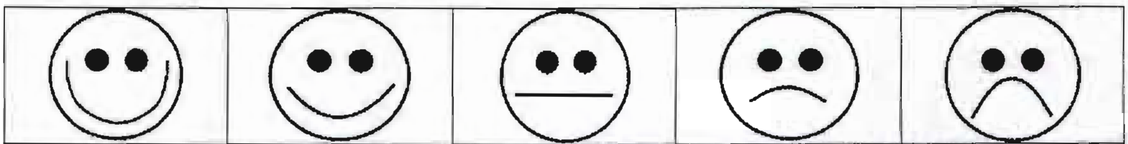
5. Please mark with a cross (**X**) under the face which best describes how you feel about the **texture** of product **C.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

6. Please mark with a cross (**X**) under the face which best describes how you feel about the **texture** of product **B.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

7. Please mark with a cross (**X**) under the face which best describes how you feel about the **color** of product **A.**



Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

8. Please mark with a cross (**X**) under the face which best describes how you feel about the **color** of product **C.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

9. Please mark with a cross (**X**) under the face which best describes how you feel about the **color** of product **B.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

Thank you for your assistance

ANNEXURE K

Sensory evaluation Acceptance testing

Name: ____________________ **Surname:** ______________________________

Grade: _______________ **Date:** ________________

1. Please mark with a cross (X) under the face which best describes how you feel about the **taste** of the product.

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

2. Please mark with a cross (X) under the face which best describes how you feel about the **texture** of the product.

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

3. Please mark with a cross (X) under the face which best describes how you feel about the **color** of the product.

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

4. Please mark with a cross (X) under the face which best describes how you feel about the **smell** of the product.

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

5. Please mark with a cross (X) under the face which best describes how you feel about the **portion size** of the product.

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

6. Please mark with a cross (X) under the face which best describes how you feel about **receiving this product as part of the school feeding program.**

Like a lot	Like a little	Neither like or dislike	Dislike a little	Dislike a lot

Thank you for your assistance

ANNEXURE L

Vaal University of Technology

Caregiver training: Eatonside

Recipe 1 Basic Vetkoek

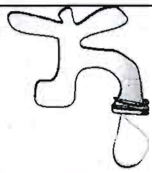
1 x small packet 10g		Yeast
1 cup 200ml 		Lukewarm water
1 cup 200ml 		Fresh milk or milk powder
1		Egg, large beaten
30ml 		Oil, sunflower
15ml 		Sugar, white

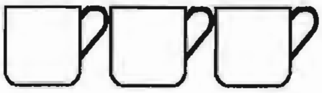
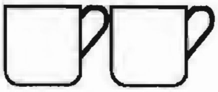
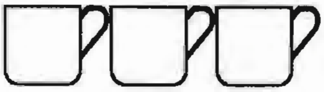
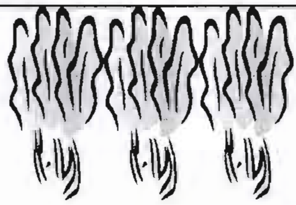
5ml 		Salt
3 cups 		Whole-wheat flour
2 cups 		Maize meal

METHOD:

1. Mix egg, oil, milk and water
2. Mix all dry ingredients with instant yeast
3. Add egg mixture to dry ingredients
4. Knead well for 5 minutes, to make a soft dough
5. Put dough into a clean bowl, cover with a clean kitchen towel
6. Leave in a warm place to rise for 2 hours
7. Lightly roll out and cut
8. Fry 4 minutes on each side
9. Oil temperature 160°C

Recipe 2 Wholewheat and Maize meal " vetkoek"

1 x small packet 10g		Yeast
1 cup 		Lukewarm water
1 cup 		Fresh milk or milk powder
1		Egg, large beaten
15ml 		Oil, sunflower
10ml 		Sugar, white
10ml 		Salt

3 cups 		Whole-wheat flour
2 cups 		Maize meal
3 cups 		Spinach chopped raw
1 small can		Pilchards in tomato sauce, mashed

METHOD

1. Mix eggs, oil, milk (milk powder) and water
2. Mask pilchards
3. Chop spinach
4. Mix all dry ingredients with instant yeast
5. Add milk mixture to dry ingredients
6. Add chopped spinach and pilchards
7. Knead well for 5 minutes, to make a soft dough
8. Put dough into a clean bowl, cover with a clean kitchen towel
9. Leave in a warm place to rise for 2 hours
10. Lightly roll out and cut with portioning frame
11. Fry 4 minutes on each side
12. Oil temperature 160°C

ANNEXURE M

Shelf life analysis of Nutritional Vetkoek

Introduction

The Vetkoek was delivered to ARC-Microbiology on Monday afternoon the 12th of September 2005 in a cool box without any cooling blocks. The vetkoek was packed in a foil tray with a carton lid.

Shelf life study

One tray was kept at 4°C and the other tray at room temperature (±25°C). The vetkoek was plated out on day 0 (12 September 2005, day of arrival) day 2 (14 September 2005), 4 (16 September 2005) and day 7 (19 September 2005).

Microbiological analysis

A 10g sample was removed aseptically from the inside of the vetkoek. The samples were homogenized in a Stomacher 400 (DHK Pty Ltd) with 90 ml of diluent (Buffered peptone water). The samples were plated out for a total aerobic plate count on Tryptone soy agar and incubated at 25°C for 72 hours and for yeast and moulds on Rose Bengal agar and incubated at 25°C for 72 hours.

Results

Table1. Result of Vetkoek stored at 4°C

Sample	Total Aerobic Plate count Cfu/g	*Yeast and Moulds* Cfu/g
Day 0	$2{,}0 \times 10^1$	<10
Day 2	$1{,}0 \times 10^2$	<10
Day 4	$5{,}0 \times 10^1$	<10
Day 7	$1{,}6 \times 10^2$	<10

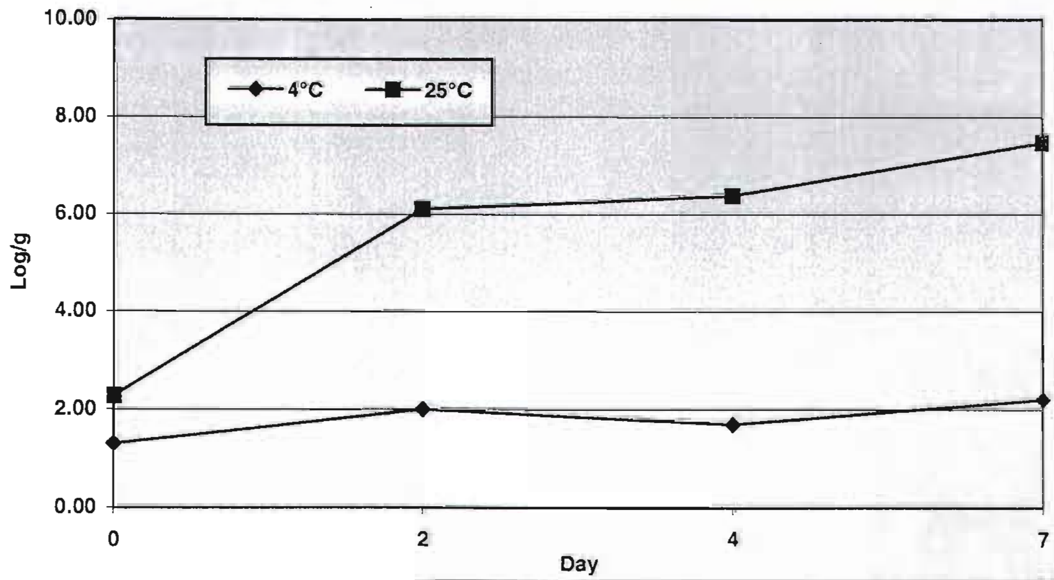
Cfu/g = Colony Forming units per gram of sample

Table 2. Result of Vetkoek stored at 25°C

Sample	Total Aerobic Plate count Cfu/g	Yeast and Moulds Cfu/g
Day 0	1,9 X 10^2	<10
Day 2	1,3 X 10^6	<10
Day 4	2,4 X 10^6	<10
Day 7	>3,0 X 10^7	1

Cfu/g = Colony Forming units per gram of sample

Figure 1. Total bacterial count of Vetkoek over a 7day period stored at 4°C and 25°C



The total bacterial count as well as the yeast and mould counts for the vetkoek stored at 4°C remained low throughout the seven day trial.

The total bacterial count for the vetkoek stored at 25°C increased from log 2 to log 6 on the second day and increased to more than log 7 on the last day of the shelf life trial. Although the yeast and mould count remained very low throughout the 7 days, moulds were visually detected on day 4 of the trial.

Conclusion

The vetkoek stored at 4°C do have a seven-day shelf life period. The vetkoek stored at 25°C only have a two-day shelf life.

Although moulds were visible on the vetkoek stored at 25°C on day 4, the counts were very low throughout the trial. This could be due to the fact that the 10g aliquot of sample was taken from the middle of the vetkoek each time, and the visible mould growth was on the upper crust of the vetkoek.

ANNEXURE N

TRAINING OF SETHLABOTJA COMMUNITY WORKERS

Basic training on personal, kitchen hygiene and handling of equipment and the preparation of the vetkoek will be conducted in three sessions.
The dates will be as follows:
Session 1.Thursday 04-03-2004 from 09H00-15H00
Session 2. Friday 05-03-2004 from 09H00-12H00
Session 3. Thursday 11-03-2004 from 09H00-14H00.

1. An attendance register must be completed with every training session.
2. Training sessions will be conducted in Afrikaans, because this is the language understood by all the identified community workers.
3. Training sessions will take place on the premises of the Vaal Triangle Technikon, in the Training restaurant and in the library video room.
4. With every training session the trainees will be collected from the Sethlabotja School in Eatonside and will be dropped of at the school after the training session.
5. Tea and lunch will be provided on the days when training will take place.
6. Trainees will be required to wear appropriate headgear and aprons with every training session.

Session1. Personal Hygiene

1.1 Why do we wash hands?
1.2 Correct way to wash your hands.
1.3 Dress requirements when working with food.
1.4 What you are not allowed to do when you work with food.
1.5 Discussion.
1.6 Tea break.

1.6 Tea break.
1.7 Video session on personal hygiene.
1.8 Questions and discussion.
1.9 Lunch break.
1.10 Discussion on kitchen hygiene.
1.11 Video session.

Session 2. Correct use of kitchen equipment

2.1 Names and description of basic kitchen equipment.
2.2 Names and description of basic kitchen utensils. (demonstration).
2.3 Group discussion.
2.4 Tea break.
2.5 Demonstration on correct use of the deep fat fryer.
2.6 Cleaning of the deep fat fryer.
2.7 Lunch

Session 3. Preparation of the 'vetkoek'

3.1 Introduction to different ingredients.
3.2 Discussion of the recipe.
3.3 Demonstration of the mixing process.
3.4 Demonstration of the kneading process.
3.5 Tea break.
3.6 Trainees mix and knee own dough.
3.7 Demonstration on portioning and baking of the vetkoek.
3.8 Questions and discussion.
3.9 Lunch.
3.10 Trainees do portioning of their vetkoek.
3.11 Trainees do baking of their vetkoek.
3.12 Cleaning of the kitchen and equipment.
3.13 Tasting and evaluation of the vetkoek.
3.14 Final questions and discussions.

Please note that ongoing training and assistance will be provided when the intervention study start after the school holidays.

Regards
Jeanette Kearney
Restaurant Manager
Vaal Triangle Technikon

Hygiene and Safety in the kitchen

Index

Hygiene

WHEN

To wash your hands

1. After going
   to the toilet

2. Before touching
   and eating food

3. If your hands
   look or feel dirty

4. After touching pets

5. After coughing, sneezing or
   blowing your nose

HOW

To wash your hands

1. Use **soap** and **warm water**

2. Rub the soap over **both sides** of your hands

3. ...between **every finger** and around the **thumbs** and **nails**

4. Rinse off with **clean** warm water

5. **Dry hands** thoroughly with a clean dry towel, paper towel or under a hot air dryer

Personal hygiene:

- Wear clean clothes at all times
- Take a bath daily
- Do not scratch your hair or body while preparing food
- Keep your hair covered with a hairnet, cap or scarf
- Do not pick your nose while handling food
- Do not cough or sneeze over food – cover your mouth
- After coughing or sneezing wash your hands with soap and water
- Do not smoke in the food preparation area
- Do not wear nail polish while preparing food
- Do not wear jewellery while preparing food

When you handle food:

1. Wear a clean apron or overall
2. Wear a chef's hat, hairnet, scarf or cap
3. Do not wear open shoes, e.g. sandals , wear hard closed shoes
4. Use clean cloths to wipe work surfaces
5. Do not wear nail polish while preparing food
6. Do not wear jewellery while preparing food

Kitchen Hygiene:

1. Do not allow refuse to accumulate in the kitchen area
2. Make sure all refuse is placed in a bin with a lid on top
3. Remove refuse on a daily basis
4. Floors must be cleaned as required
5. Floors must be kept clean at all times
6. All working surfaces must be cleaned regularly
7. All food storage must be protected against infiltration of insects and rodents
8. Food must always be covered
9. All utensils must be washed with hot soapy water
10. Storerooms and cupboards must be cleaned regularly

Safety

In the kitchen

1. Remove all obstructions to passageways, paths and working areas such as
   * equipment
   * boxes and rubbish

2. Clean up spillages immediately after they occur especially:
   * chemicals
   * fat and grease
   * water

3. Work in good lighting

4. Do not store food with non-food items

5. Make sure the shelves you use can hold what you put on them

6. Use the correct bending technique – bend the knees not the waist and keep your back straight.
   Use a trolley for heavy items

Storage guidelines:

7. Use separate storerooms / Cupboards for food items and non-food items
8. Must be a well ventilated room
9. Food must be placed on platforms or must be stored in bins

Basic food preparation:

Cooking:

- ~~Deep fry~~
- Boil
- Steam
- Bake

Session 1 Personal hygiene:

- Always wash hands before and after handling of food
- Wash hands with soap and water up to the elbows
- Always work in a clean area
- Clean as you go
- Always wash your hands after using the toilet
- Do not mix raw food with cooked food
- Wash the utensils thoroughly with soap and water, after preparing uncooked meat
- Always wash hands after handling dirty articles such as money rubbish bins
- Wear clean clothes at all times
- Take a bath daily
- Do not scratch your hair or body while preparing food
- Keep your hair covered with a hairnet, cap or scarf
- Do not pick your nose while handling food
- Do not cough or sneeze over food – cover your mouth
- After coughing or sneezing wash your hands with soap and water
- Do not smoke in the food preparation area
- Do not wear nail polish while preparing food
- Do not wear jewellery while preparing food

When you handle food: Wear an apron

Session 2 Preparation Area:

- Do not allow refuse to accumulate in the kitchen area
- Make sure all refuse is placed in a bin with a lid on top
- Remove refuse on a daily basis
- Floors must be cleaned as required
- Floors must be kept clean at all times
- All working surfaces must be cleaned regularly
- All food storage must be protected against infiltration of insects and rodents
- Food must be covered
- All utensils must be washed with hot soapy water
- Storerooms and cupboards must be cleaned regularly
- Do not store food with non-food items

Storage guidelines:

- Separate storerooms / Cupboards to be used for food items and non-food items
- Must be a well ventilated room
- Food must be placed on platforms or must be stored in bins

Session 3& 4 Practical demonstration

ANNEXURE O

Office Use Only

NUTRITION KNOWLEDGE QUESTIONAIRE

INSTRUCTIONS

THE FOLLOWING QUESTIONNIRE CONTAINS TWO TYPES OF QUESTIONS,

MULTIPLE CHOICE AND TRUE/ FALSE

1. MULTIPLE CHOICE: CHOOSE **ONE** THAT YOU THINK IS THE CORRECT ANSWER AND TICK THE CORRESPONDING NUMBER THAT IS NEXT TO THE ANSWER

2. TRUE/ FALSE: CHOOSE THE **TRUE** OR THE **FALSE** AND TICK THE ONE THAT YOU THINK IS THE CORRECT ANSWER

THE QUESTIONS REFER TO TO A HEALTH PERSON WHO IS NOT ON ANY MEDICATIOON OR SPECIAL DIET

Please answer all the questions before moving on to the next ones.

Do not page back!

	YY	MM	DD	
DATE				
SUBJECT NUMBER				
AGE				
	YY	MM	DD	
DATE OF BIRTH				
GENDER	Male	Female		
SCHOOL/ INSTITUTION				
GRADE/ DEGREE				

1 You should eat a lot of sugar to have enough energy

TRUE	FALSE	11A

2 Cooked meat/ fish/ chicken sold on the street may not always be safe to eat

It may have been undercooked	1	
The cook may not have used fresh meat	2	
It may have been kept for a long time before being	3	
All of the above	4	6D

3 What a pregnant woman eats during pregnancy has no effect on her health and the health of her unborn baby

TRUE	FALSE	12

4 You should not have starches at most meals because

They are not important for your health	1	
Even eating small amounts can cause weight gain	2	
They cause diseases	3	
None of the above	4	3B

5 How much water should you drink a day

You don't have to drink water everyday	1	
1 to 3 glasses	2	
4 to 6 glasses	3	
7 to 9 glasses	4	9A

6 You should add extra salt to your cooked food before you even eat it

TRUE	FALSE	8A

7 What is a portion of cooked vegetables?

I Tablespoon	1	
Half a cup	2	
I Cup	3	
2 Cups	4	4A

8 Which of the following is a low fat snack

"Simba" Chips	1	
Popcorn	2	
Fried chips	3	
"Niknaks"	4	7A

9 From which group of foods should you eat the most every day?

Bread, samp, rice, porridge	1	
Apples, bananas, spinach, carrots	2	
Milk, yogurt, cheese	3	
Chicken, fish, beans, eggs	4	3A

10 Drinking a lot of wine, beer, cider can cause weight gain

TRUE	FALSE	10B

11 Which one of the following is not healthy for a pregnant woman to do

Be physically active	1	
Eat different kinds of foods	2	
Sleep most of the day	3	
Drink lots of water	4	12

12 Women must try not to gain weight when they are pregnant

TRUE	FALSE	12

13 It is not healthy for a pregnant woman to eat foods like milk, cheese, yoghurt

TRUE	FALSE	12

14 People who are overweight should not be physically active

TRUE	FALSE	2B

15 It is usually not necessary to wash vegetables before you cook them

TRUE	FALSE	4D

16 The key to a healthy way of eating is to

Eat many different kinds of foods	1	
Eat some foods more than other foods	2	
Eat certain kinds of foods in moderate or small amounts	3	
All of the above	4	1A

17 The following foods must not be eaten at all when one is trying to lose weight

Bread and rice	1	
Meat and fish	2	
Margarine	3	
None of the above	4	1A

18 Which foods contain a lot of calcium?

Chicken and eggs	1	
Milk, yoghurt	2	
Pilchards	3	
2 and 3	4	6C

19 The healthiest snack is:

A glass of milkshake	1	
A tub of unbuttered popcorn	2	
A slab of chocolate	3	
2 and 3 above	4	7A

20 To which of the following foods has iodine been added?

Bread	1	
Maize meal	2	
Table salt	3	
Powdered milk	4	8C

21 If you were trying to increase the amount of fiber in your diet, which one of the following foods should you eat more of?

Cakes and biscuits	1	
Apples and carrots	2	
Chips and pies	3	
Chicken and fresh fish	4	4C

22 Being physically active means

Going to the gym	1	
Walking a lot	2	
Playing sports like soccer or netball	3	
All of the above	4	2A

23 Which of the following choice of foods prevent certain diseases

Fish, Chicken without skin, and lean meat	1	
Beef sausage, bacon, and lean mince	2	
Fried fish, fried chicken, and regular mince	3	
All of the above	4	6A

24 Which foods contain a lot of fibre?

Oats, apples, beans	1	
Milk, yogurt, cheese	2	
Beef, chicken, mutton	3	
Butter, margarine	4	1C

25 How many fruits and vegetables should be eaten

1 fruit and vegetable a day	1	
3-4 fruits and vegetables a day	2	
5 or more fruits and vegetables everyday	3	
There is no need to eat fruits and vegetables	4	4A

26 If you are eating a healthy diet there is no need for you to be physically active — TRUE | FALSE 2A

27 Drinking boiled water is a good way to lose weight — TRUE | FALSE 9B

28 Salt should be added to all foods except fruits — TRUE | FALSE 8A

29 If one wants to lose weight there is no need to be physically active, it is better that one simply diets — TRUE | FALSE 2B

30 All water is safe to drink — TRUE | FALSE 9A

31 You can drink as much wine, beer, ciders as you want provided you have eaten first — TRUE | FALSE 10A

32 A little sugar can be eaten when one is trying to lose weight — TRUE | FALSE 11B

33 How much milk or maas should you have a day?

None	1
Half a cup	2
One cup	3
Two cups	4

6A

34 Your body only needs a little bit of salt to be healthy

TRUE	FALSE

8A

35 A well- balanced diet

Consists mostly of meat, with smaller amounts of starch, fruits, vegetables, and dairy products	1
Consists mostly of vegetables, and smaller amounts of meat and dairy products	2
Consists mostly of starches, vegetables and fruits, with smaller amounts of meat and dairy products	3
None of the above	4

3A

36 Sugar and foods that contain sugar should be eaten in small amounts

TRUE	FALSE

11A

37 Eating a lot of different kinds of foods is healthier than eating only a few kinds foods

TRUE	FALSE

1A

38 Overweight women should try to lose weight when they are pregnant

TRUE	FALSE

12

39 Sugar contains a lot of vitamins and minerals

TRUE	FALSE

11A

40 It is impossible to get all the vitamins and minerals you need from food, you need to a vitamin and mineral pill

TRUE	FALSE

1A

41 It is not healthy for a pregnant woman to drink a lot of wine, beer, cider

TRUE	FALSE

12

42 Which one of the following groups of nutrients are found in large amounts in fruits and vegetables?

Fibre, Vitamin A	1
Starches, fat, Vitamin D	2
Fats, Iron, Calcium	3
None of the above	4

4C

43 Which of the following breakfast menus contain little fat

Whole-wheat toast with thinly spread margarine	1
Weet-Bix with 2% fat milk	2
Bacon and egg	3
1 and 2	4

7A

44 It is important for a pregnant women to avoid eating different kinds of foods

TRUE	FALSE

12

45 Which food has the most fibre?

White rolls	1
Brown bread	2
White bread	3
Whole wheat bread	4

3C

46 The best place to defrost meat from a frozen state is to

leave it at room temperature	1
leave it in the fridge	2
leave it in sunlight	3
Meat should never be defrosted	4

6D

47 Starchy foods should not be eaten when one is trying to lose weight

TRUE	FALSE

3B

48 To make sure that you stay healthy you should eat

Lean meat, fruits and vegetables, low fat dairy products, and breads and cereals	1
Fruit and vegetables only	2
Bread, cereals, fruit and vegetables only	3
Low fat dairy products and lean meat only	4

7A

49 Eating bread always causes weight gain | TRUE | FALSE | 3B

50 Which of the following foods are the lowest in fat:

Corn flakes and full cream milk	1	
Grilled lean steak and boiled carrots	2	
Pizza and milkshake	3	
Fried lamb chops and creamed spinach	4	7A

51 To protect yourself from disease you should avoid eating many different kinds of foods | TRUE | FALSE | 1B

52 It is healthy to snack on foods that contain a lot of sugar | TRUE | FALSE | 11B

53 Which of the following should a pregnant woman eat more of?

Milk, cheese, maas	1	
Meat, chicken, fish	2	
Fruits and vegetables	3	
All of the above	4	12

54 Dry beans, peas, and lentils should be eaten often | TRUE | FALSE | 5A

55 Soya mince is as healthy as meat | TRUE | FALSE | 5A

56 You can eat as much meat as you want everyday | TRUE | FALSE | 5A

57 Which group of foods has the most Vitamin A?

Oats, whole wheat bread, rice	1	
Carrots, spinach, sweet potatoes	2	
Pies, cakes, pudding	3	
None of the above	4	4C

58 Dry beans, peas, lentils are a healthy choice to eat in place of meat | TRUE | FALSE | 5A

59 Meat/ fish/ chicken will not spoil if you store them

In the cupboard for a few days	1	
In the fridge for 2 days only	2	
In the freezer for 3-4 months	3	
In 2 and 3 above	4	6D

60 The reason why beans, peas and lentils are good for you is that

They contain only small amounts of fat	1	
They contain a lot of fibre	2	
They can protect you from some diseases	3	
All of the above	4	5B,C

SELECT YES OR NO FOR ALL THE CHOICES

1. From where do you get your information about nutrition?

	YES	NO	
School	1	2	13F
Peers/ Friends	1	2	13F
Parents	1	2	13F
Radio/ TV/ Magazines	1	2	13F
Other (Specify)			
	1	2	13F

SELECT 1 OR 2 OR 3 OR 4 FOR ALL THE CHOICES THAT YOU CHOSE YES TO IN QUESTION 1

2. Of the choices you have selected above, how would you rate them as
1= very unreliable
2= unreliable
3= reliable
4= very reliable

	very unreliable	unreliable	reliable	very reliable	
School	1	2	3	4	13G
Peers/ Friends	1	2	3	4	13G
Parents	1	2	3	4	13G
Radio/ TV/ Magazines	1	2	3	4	13G
Other (Specify)					
	1	2	3	4	13G

ANSWERS

NUTRITION KNOWLEDGE QUESTIONAIRE

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THEFOLLOWING QUESTIONNIRE CONTAINS TWO TYPES OF QUESTIONS,

MULTIPLE CHOICE AND TRUE/ FALSE

1 . MULTIPLE CHOICE: CHOOSE **ONE** THAT YOU THINK IS THE CORRECT ANSWER AND TICK THE CORRESPONDING NUMBER THAT IS NEXT TO THE ANSWER

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THEQUESTIONS REFER TO TO A HEALTH PERSON WHO IS NOT ON ANY MEDICATIOON OR SPECIAL DIET

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DATE	YY / MM / DD	
SUBJECT NUMBER		
AGE		
DATE OF BIRTH	YY / MM / DD	
GENDER	Male / Female	
SCHOOL/ INSTITUTION		
GRADE/ DEGREE		

1 You should eat a lot of sugar to have enough energy

TRUE	FALSE	11A	FALSE

2 Cooked meat/ fish/ chicken sold on the street may not always be safe to eat

It may have been undercooked	1		
The cook may not have used fresh meat	2		
It may have been kept for a long time before being	3		
All of the above	4	6D	4

3 What a pregnant woman eats during pregnancy has no effect on her health and the health of her unborn baby

TRUE	FALSE	12	FALSE

4 You should not have starches at most meals because

They are not important for your health	1		
Even eating small amounts can cause weight gain	2		
They cause diseases	3		
None of the above	4	3B	4

5 How much water should you drink a day

You don't have to drink water everyday	1		
1 to 3 glasses	2		
4 to 6 glasses	3		
7 to 9 glasses	4	9A	4

6 You should add extra salt to your cooked food before you even eat it

TRUE	FALSE	8A	FALSE

7 What is a portion of cooked vegetables?

I Tablespoon	1		
Half a cup	2		
I Cup	3		
2 Cups	4	4A	2

8 Which of the following is a low fat snack

"Simba" Chips	1		
Popcorn	2		
Fried chips	3		
"Niknaks"	4	7A	2

9 From which group of foods should you eat the most every day?

Bread, samp, rice, porridge	1		
Apples, bananas, spinach, carrots	2		
Milk, yogurt, cheese	3		
Chicken, fish, beans, eggs	4	3A	1

10 Drinking a lot of wine, beer, cider can cause weight gain

TRUE	FALSE	10B	TRUE

11 Which one of the following is not healthy for a pregnant woman to do

Be physically active	1		
Eat different kinds of foods	2		
Sleep most of the day	3		
Drink lots of water	4	12	3

12 Women must try not to gain weight when they are pregnant

TRUE	FALSE	12	FALSE

13 It is not healthy for a pregnant woman to eat foods like milk, cheese, yoghurt

TRUE	FALSE	12	FALSE

14 People who are overweight should not be physically active

TRUE	FALSE	2B	FALSE

15 It is usually not necessary to wash vegetables before you cook them

TRUE	FALSE	4D	FALSE

16 The key to a healthy way of eating is to

Eat many different kinds of foods	1		
Eat some foods more than other foods	2		
Eat certain kinds of foods in moderate or small amounts	3		
All of the above	4	1A	4

17 The following foods must not be eaten at all when one is trying to lose weight

Bread and rice	1		
Meat and fish	2		
Margarine	3		
None of the above	4	1A	4

18 Which foods contain a lot of calcium?

Chicken and eggs	1		
Milk, yoghurt	2		
Pilchards	3		
2 and 3	4	6C	4

19 The healthiest snack is:

A glass of milkshake	1		
A tub of unbuttered popcorn	2		
A slab of chocolate	3		
2 and 3 above	4	7A	2

20 To which of the following foods has iodine been added?

Bread	1		
Maize meal	2		
Table salt	3		
Powdered milk	4	8C	3

21 If you were trying to increase the amount of fiber in your diet, which one of the following foods should you eat more of?

Cakes and biscuits	1		
Apples and carrots	2		
Chips and pies	3		
Chicken and fresh fish	4	4C	2

22 Being physically active means

Going to the gym	1		
Walking a lot	2		
Playing sports like soccer or netball	3		
All of the above	4	2A	4

23 Which of the following choice of foods prevent certain diseases

Fish, Chicken without skin, and lean meat	1		
Beef sausage, bacon, and lean mince	2		
Fried fish, fried chicken, and regular mince	3		
All of the above	4	6A	1

24 Which foods contain a lot of fibre?

Oats, apples, beans	1		
Milk, yogurt, cheese	2		
Beef, chicken, mutton	3		
Butter, margarine	4	1C	1

25 How many fruits and vegetables should be eaten

1 fruit and vegetable a day	1		
3-4 fruits and vegetables a day	2		
5 or more fruits and vegetables everyday	3		
There is no need to eat fruits and vegetables	4	4A	3

26	If you are eating a healthy diet there is no need for you to be physically active	TRUE	FALSE	2A	FALSE
27	Drinking boiled water is a good way to lose weight	TRUE	FALSE	9B	FALSE
28	Salt should be added to all foods except fruits	TRUE	FALSE	8A	FALSE
29	If one wants to lose weight there is no need to be physically active, it is better that one simply diets	TRUE	FALSE	2B	FALSE
30	All water is safe to drink	TRUE	FALSE	9A	FALSE
31	You can drink as much wine, beer, ciders as you want provided you have eaten first	TRUE	FALSE	10A	FALSE
32	A little sugar can be eaten when one is trying to lose weight	TRUE	FALSE	11B	TRUE

33 How much milk or maas should you have a day?

None	1		
Half a cup	2		
One cup	3		
Two cups	4	6A	4

34 Your body only needs a little bit of salt to be healthy | TRUE | FALSE | 8A | TRUE

35 A well- balanced diet

Consists mostly of meat, with smaller amounts of starch, fruits, vegetables, and dairy products	1		
Consists mostly of vegetables, and smaller amounts of meat and dairy products	2		
Consists mostly of starches, vegetables and fruits, with smaller amounts of meat and dairy products	3		
None of the above	4	3A	3

36 Sugar and foods that contain sugar should be eaten in small amounts | TRUE | FALSE | 11A | TRUE

37 Eating a lot of different kinds of foods is healthier than eating only a few kinds foods | TRUE | FALSE | 1A | TRUE

38 Overweight women should try to lose weight when they are pregnant | TRUE | FALSE | 12 | FALSE

39 Sugar contains a lot of vitamins and minerals | TRUE | FALSE | 11A | FALSE

40 It is impossible to get all the vitamins and minerals you need from food, you need to a vitamin and mineral pill | TRUE | FALSE | 1A | FALSE

41 It is not healthy for a pregnant woman to drink a lot of wine, beer, cider | TRUE | FALSE | 12 | TRUE

42 Which one of the following groups of nutrients are found in large amounts in fruits and vegetables?

Fibre, Vitamin A	1		
Starches, fat, Vitamin D	2		
Fats, Iron, Calcium	3		
None of the above	4	4C	1

43 Which of the following breakfast menus contain little fat

Whole-wheat toast with thinly spread margarine	1		
Weet-Bix with 2% fat milk	2		
Bacon and egg	3		
1 and 2	4	7A	4

44 It is important for a pregnant women to avoid eating different kinds of foods | TRUE | FALSE | 12 | FALSE

45 Which food has the most fibre?

White rolls	1		
Brown bread	2		
White bread	3		
Whole wheat bread	4	3C	4

46 The best place to defrost meat from a frozen state is to

leave it at room temperature	1		
leave it in the fridge	2		
leave it in sunlight	3		
Meat should never be defrosted	4	6D	2

47 Starchy foods should not be eaten when one is trying to lose weight | TRUE | FALSE | 3B | FALSE

48 To make sure that you stay healthy you should eat

Lean meat, fruits and vegetables, low fat dairy products, and breads and cereals	1		
Fruit and vegetables only	2		
Bread, cereals, fruit and vegetables only	3		
Low fat dairy products and lean meat only	4	7A	1

49 Eating bread always causes weight gain | TRUE | FALSE | 3B | FALSE

50 Which of the following foods are the lowest in fat:

Corn flakes and full cream milk	1		
Grilled lean steak and boiled carrots	2		
Pizza and milkshake	3		
Fried lamb chops and creamed spinach	4	7A	2

51 To protect yourself from disease you should avoid eating many different kinds of foods | TRUE | FALSE | 1B | FALSE

52 It is healthy to snack on foods that contain a lot of sugar | TRUE | FALSE | 11B | FALSE

53 Which of the following should a pregnant woman eat more of?

Milk, cheese, maas	1		
Meat, chicken, fish	2		
Fruits and vegetables	3		
All of the above	4	12	4

54 Dry beans, peas, and lentils should be eaten often | TRUE | FALSE | 5A | TRUE

55 Soya mince is as healthy as meat | TRUE | FALSE | 5A | TRUE

56 You can eat as much meat as you want everyday | TRUE | FALSE | 5A | FALSE

57 Which group of foods has the most Vitamin A?

Oats, whole wheat bread, rice	1		
Carrots, spinach, sweet potatoes	2		
Pies, cakes, pudding	3		
None of the above	4	4C	2

58 Dry beans, peas, lentils are a healthy choice to eat in place of meat | TRUE | FALSE | 5A | TRUE

59 Meat/ fish/ chicken will not spoil if you store them

In the cupboard for a few days	1		
In the fridge for 2 days only	2		
In the freezer for 3-4 months	3		
In 2 and 3 above	4	6D	4

60 The reason why beans, peas and lentils are good for you is that

They contain only small amounts of fat	1		
They contain a lot of fibre	2		
They can protect you from some diseases	3		
All of the above	4	5B,C	4

SELECT YES OR NO FOR ALL THE CHOICES

1. From where do you get your information about nutrition?

	YES	NO		
School	1	2	13F	
Peers/ Friends	1	2	13F	
Parents	1	2	13F	
Radio/ TV/ Magazines	1	2	13F	
Other (Specify)				
	1	2	13F	

SELECT 1 OR 2 OR 3 OR 4 FOR ALL THE CHOICES THAT YOU CHOSE YES TO IN QUESTION 1

2. Of the choices you have selected above, how would you rate them as
   1= very unreliable
   2= unreliable
   3= reliable
   4= very reliable

	very unreliable	unreliable	reliable	very reliable		
School	1	2	3	4	13G	
Peers/ Friends	1	2	3	4	13G	
Parents	1	2	3	4	13G	
Radio/ TV/ Magazines	1	2	3	4	13G	
Other (Specify)						
	1	2	3	4	13G	

ANNEXURE P

A E RESEARCH SERVICES

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27 June 2006

To Whom It May Concern,

This is to certify that I have acted as language editor for the thesis titled "Evaluation of a Feeding Programme in Addressing Malnutrition in a Primary School" submitted by C. E. Napier in fulfillment of the requirements for the degree of DTech: Food Service Management in the Department of Hospitality and Tourism, Faculty of Human Sciences, Vaal University of Technology. I have reviewed the printed manuscript and made the necessary corrections; I trust that these changes have been effected on the final document.

Yours sincerely

AEngelbrecht

Antoinette Engelbrecht