IMPACT OF A SCHOOL FEEDING PROGRAMME ON NUTRITIONAL STATUS OF PRIMARY SCHOOL CHILDREN IN ORANGE FARMS

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BTech (Food and Beverage Management)

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June 2009

VANDERBIJLPARK

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature of any degree.

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DEDICATION

This thesis is dedicated to Professor Oldewage-Theron

ABSTRACT

Introduction

Most of the children aged between five and 15 around the world live under difficult circumstances, which lead to a high dropout rate from school before the end of the secondary level. Most of them have poor nutrition, are undernourished and are exposed to a large range of harmful, parasitic and infectious diseases (Shariff *et at,* 2000:265).

Purpose

The purpose of this investigation was to analyze the nutritional status of primary school children in Orange Farms informal settlement in terms of their nutritional needs in order to implement a school feeding programme and assess its impact on the nutritional status of these children.

Methodology

A cross-sectional baseline survey was conducted two weeks before commencing with the school feeding programme. The measurements taken during this phase were socio-demographic and health by means of a questionnaire, as well as dietary intake and food consumption patterns by means of a quantified food frequency questionnaire and 24-hour recall, weight and height measurements. The anthropometric measurements included height and weight and the biochemical measurements included serum ferritin, C-reactive protein, total protein, albumin, vitamin B12, folate, glucose, full blood count, haemoglobin, haematocrit, red blood cell count, mean cell volume, white blood cell count, vitamins A, E and zinc. A single matched "placebo"-controlled, parallel group, clinical trial of ten months followed in a randomly selected sample of 100 participants, 50 forming part of the control group receiving a fruit and 50 forming part of the experimental group receiving corn-soy blend porridge. After the 10-month period, the same

measurements for the baseline survey were repeated, except for the socio-demographic and health measurements.

Results

Malnutrition, including under and over nutrition, remains a major problem among primary school children globally. This was also true in both the experimental and control school groups in this study where 18.6 percent, 34. 9 percent and 4.7 percent were underweight, stunted and wasted respectively in the experimental group compared to 9.1 percent severe underweight, and 9.1 per cent each for severe stunting and wasting in the control group at baseline. A mainly carbohydrate based diet was consumed with limited vegetable and animal protein intakes. The socio demographic data indicated that household food insecurity contributed to the poor dietary intake of the sample, as the majority of the caregivers were unemployed in both groups. This was further confirmed by the limited monthly household income of less than R 1000 for a relatively large family size of up to 5 members in the control group compared to 5-10 household members in the experimental group. The implementation of a school feeding programme that included a nutritious and acceptable meal in the form of enriched corn-soy blend or a fruit as part of the programme, also proved to be a relatively easy and cost-effective way to address hunger in these primary schools. Furthermore, the dietary intake levels for both groups showed statistically significant improvements for various macro- and micro-nutrients when compared to DRIs.

Conclusion

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 both groups, indicating that any food provision may have a positive impact on undernourished children. The results of the intervention indicated an improvement in dietary intake which could result in an improved nutritional status, specifically related to micronutrients. However, the

anthropometric indices and certain biochemical parameters showed significant improvements in both groups after the intervention. School feeding programmes are a good strategy for addressing malnutrition among primary school children if monitored effectively. However, it does not impact directly on household food security. A long-term clinical intervention trial is recommended to measure the impact of a food-based approach to address specific micronutrient deficiencies prevalent among children in these age groups.

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LIST OF ABBREVIATIONS AND SYMBOLS

µg	microgram
BMI	Body Mass Index
EFNEP	Expanded Food and Nutrition Education Programme
FAO	Food and Agricultural Organization of the United Nations
FBDG	Food Based Dietary Guideline
GPA	Gauteng Provincial Administration
H/A	Height-for-age
HSSF	Health Sector Strategic Framework
IDA	Iron Deficiency Anaemia
IDD	Iron Deficiency Disorder
INP	Integrated Nutrition Programme
JAM	Joint Aid Management
KJ	Kilojoules
mg	milligram
MRC	Medical Research Counsel
MTEF	Medium Term Expenditure Framework
NFCS	National Food Consumption Survey
NFP	Nutrition Education Programme
NGO	Non-Governmental Organization
NHNES	National Health and Nutrition Examination Survey
NSFP	National School Feeding Programme
NSLP	National School Lunch Programme
PEM	Protein Energy Malnutrition
PTA	Parent Teacher Association
QFFQ	Quantitative Food Frequency Questionnaires
RDA	Recommended Daily Allowance
SANNSS	South African National Status Survey
SAVACG	South African Vitamin A Consultative Group
SBP	School Breakfast Programme

SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children's Fund
UNHCR	United Nations High Commissioner for Refugees
VAD	Vitamin A Deficiency
W/A	Weight-for-age
WHO	World Food Organization
VUT	Vaal University of Technology
et al	and others
%	Percent
&	and

CHAPTER 1

THE MALNUTRITION PROBLEM AMONGST CHILDREN GLOBALLY AND IN SOUTH AFRICA

1.1 INTRODUCTION

Half (50, percent) of all deaths among children under five are considered to be caused by malnutrition which, because it weakens the immune system which, leads to diseases that are more severe. Poor nutrition is also more prevalent in young girls and women. Children are likely to be born with low birth weight owing to poor maternal health and poor nutrition of pregnant mothers (UNICEF, 2000(b):2).

The immune system of malnourished children become weak, causing their bodies to have lower resistance to infection; they are therefore more likely to die from common childhood disorders like diarrhoeal diseases and respiratory tract infections, and for those who survive, frequent illnesses lowers their nutritional status so that they are prone to recurring illness and faltering growth. Children, with chronic malnutrition, particularly when it occurs at an early age, rarely achieve their full potential of physical, intellectual, or cognitive development (UNICEF, 2000(b):2-4).

Immediate causes of malnutrition include inadequate dietary intake and diseases; underlying causes are related to household food security, adequate maternal and childcare, and adequate access to basic health services and a healthy environment; and basic causes relate to the availability and control of human, economic and organisational resources. Poverty is a basic cause of malnutrition (UNICEF, 2000(a):2-4)

The nutrition situation is worsened by a lack of nutritional information and knowledge, added to this are undesirable dietary habits and nutrition-related practices, attitudes, perceptions and socio-cultural influences that could adversely affect nutritional status. To attain good health and nutritional status, people need sufficient knowledge and skills to grow, purchase, process, prepare, eat and feed their families a variety of foods in the correct quantities and combinations (National Department of Health, 2004:5).

Nutrition programmes are not the only solution to hunger. Basic causes of hunger should be addressed through long-term commitments to improving infrastructure, agricultural productivity and poverty reduction; these longer-term strategies that should be accompanied by direct nutrition interventions with the aim of meeting people's immediate food needs (National Department of Health, 2004:6).

More than two billion people around the world suffer from chronic vitamin and mineral deficiencies. Their health is at risk, as they are not getting the right kinds of food, which can, result in a high rate of death. Six million children under the age of five die each year as a result of malnutrition (National Department of Health, 2004:6-7).

Around the world most of the children aged between five and 15 live under difficult circumstances, leading to high dropout rates from school before the end of the secondary level. Most of the children have poor nutrition, are underfed and are exposed to a large range of harmful, parasitic and infectious diseases (WHO, 2002:2). Deficiencies in micronutrients such as iron, iodine and vitamin A are common around the world (Grantham-McGregor & Ani, 2001:298). Furthermore, the majority of schoolchildren live in material poverty and in substandard or no housing with poor water supply and a little of sanitation. Schools are not only providing education for such children to assure their future, but also trying on a daily basis to help with the provision of resources such as food, clean water, sanitation and shelter (Grantham-McGregor & Ani, 2001:301).

The 1994 Project for Statistics on Living Standards and Development estimated that 39 percent of the population is vulnerable to food insecurity. According to the National Food Consumption Survey (NFCS), only 25 percent of households appeared food secure at a national level and almost 57 percent of the South African population were living in poverty in 1996. The Health Sector Strategic Framework (HSSF) requires the Integrated Nutrition Programme to prevent and manage malnutrition. Malnutrition is a major contributing factor to morbidity and mortality. The Integrated Nutrition Programme (INP) is one of the key strategic health programmes to decrease morbidity and mortality rates. In South Africa, malnutrition is manifested in both under nutrition and over nutrition (National Department of Health, 2004:3).

Severe clinical malnutrition in early childhood, moderate and severe stunting, and underweight and iron-deficiency anaemia are associated with poor cognitive development, as well as poor behaviour and academic attainment in later childhood. Poor nutrition and experience of hunger are inevitably associated with many other socio-economic disadvantages, which are likely to independently affect children's performance at school independently (Badaloo *et al.*, 2002:3).

The most common infectious diseases in South Africa affecting the growth of children and which may lead to malnutrition and death are HIV/AIDS, measles, diarrhoea and acute respiratory infections. Infections and diseases play a major role in loss of productivity through their impact on adult physical performance and work capacity (National Department of Health, 2004:4-5). Many children do not have parents because of the impact of HIV/AIDS and other epidemics or as a result of violence (Grantham-McGregor & Ani, 2001:2).

Many causes of chronic diseases are associated with lifestyle. In the urban areas six percent of children between one and nine years of age are overweight, with a higher prevalence among children of well-educated mothers. Nationally, six percent of children in the one-to-nine-year age group are overweight. Obesity is considered a

major risk factor for diabetes mellitus, hypertension and other chronic diseases. (National Department of Health, 2004:5).

Development of Type 2 diabetes and hypertension rises with increasing body fatness and now affects obese children at an early age. Approximately 85 percent of people with diabetes are type 2; of these, 90 percent are obese or overweight and this is increasingly becoming a problem in the developing world. Raised Body Mass Index (BMI) also increases the risks of cancer of the breast, colon, prostate, endometrium, kidney and gallbladder. Chronic overweight and obesity contribute significantly to degenerative diseases of joint cartilage (osteoarthritis), which is a major, cause of disability in adults (WHO, 2006:2-3).

Effective weight management for individuals and groups at risk of developing obesity involves a range of long-term strategies; these include prevention, weight maintenance, management of co-morbidities and weight loss. They focus chiefly on:

- Creating supportive population-based environments through public policies that promote the availability and accessibility of a variety of low fat, high-fibre foods, and that provide opportunities for physical activity.
- Promoting healthy behaviours through encouraging, motivating and enabling individuals to lose weight by the following methods: eating more fruit and vegetables, as well as nuts and whole grains; engaging in daily moderate physical activity for at least 30 minutes; cutting the amount of fatty, sugary foods in the diet; and moving from saturated animal-based fats to unsaturated vegetable-oil based fats.
- Clinical programmes and staff training to ensure effective support for those affected in their efforts to lose weight or avoid further weight gain (WHO, 2006:2-3).

Malnutrition is acknowledged as an important factor that can have a negative effect on the individual suffering from liver diseases and other sensitive diseases (Tsiaousi

et al., 2008:533). It is also capable of affecting growth, humeral and cellular immunity, bone density and the process of wound healing (Krok & Lichtenstein, 2003: 148).

1.2 DEFINITION OF MALNUTRITION

Malnutrition is defined as the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure normal growth, maintenance, and specific tissue functions. Malnutrition is an imbalance of nutrients. This can result from not eating enough, proper nutritious food or from using up too many nutrients through activities (Hogan & Burstein, 2007:45-47).

There are two forms of malnutrition, which is over nutrition and under nutrition

1.2.1 Over nutrition

1.2.1.1 Obesity

* Definition

Obesity is defined as the excess fat in the body that results in health impairment because fat cells in the body increase in number (Michael & Myers, 2004:1). The main cause of premature death among obese people is heart disease: hypertension, coronary thrombosis and congestive heart failure are all significantly more common among obese people than among those of normal weight control (Garrow *et al.*, 2000:531).

* PrevalenceThe prevalence of overweight and obesity is commonly assessed by using body mass index (BMI), defined as the weight in kilograms divided by the square of the height in metres (kg/m2). A BMI of over 25kg/m^2 is defined as overweight, and a BMI of over 30 kg/m2 as obese (WHO, 2006:2-3).

Childhood obesity is already epidemic in some areas and is rising in others. Globally, 22 million children under five years of age are estimated to be overweight. The number of overweight children and adolescents has increased, while the number of overweight and the prevalence of obese children aged six to11 years have more than doubled since the 1960s. The problem is global and increasingly extends into the developing world (WHO, 2006:3).

Obesity and overweight are affecting both developed and developing countries as the problem appear to be increasing tremendously among children as well as in adults. In many developing countries, obesity co-exists with under nutrition. Obesity is still relatively uncommon in African and Asian countries, but is more prevalent in urban than in rural populations. Women generally have higher rates of obesity than men do, although men may have higher rates of overweight (WHO, 2006:2-3).

Table 1.1 Regional and global prevalence and numbers of overweight children under five years of age (WHO, 2006:3-4).

	CHILDREN (>+2SD ABOVE MEDIAN WT/HT)		ADULTS (BMI>30 KG/M2)	
WHO Regions	Prevalence (%)	Number (million)	Prevalence (%)	Number (million)
Africa	2.7	2.8	2.0	5.1
Americas	4.6	3.6	17.4	82.7
South-East Asia	0.6	1.0	0.8	6.3
Europe	NA	NA	12.4	76.1
Eastern Mediterranean	4.4	3.2	3.5	6.3
Western Pacific	3.7	5.2	2.5	26.4
Global	**3.6**	**21.9**	**6.0**	**203.4**

Not only does obesity in school children approach ten percent in developed countries such as the United States of America (USA), Japan and some of the European countries, but high rates are also evident in developing countries such Algeria, Argentina, Chile, Egypt, Indonesia, Iran, Kiribati, Morocco, Peru, South

Africa, Thailand and many other countries. Overweight and obesity during childhood is one of the major risk factors for the development of obesity in adulthood (WHO, 2006:2-3).

The prevalence of obesity in adults, which varies from country to country, is 10 to 25 percent in most countries of Western Europe, 20 to 25 percent in some countries in the Americas, up to 40 percent in some countries in Eastern Europe, and more than 50 percent in some countries in the Western Pacific (WHO, 2006:3).

* Causes

Obesity is also caused by an imbalance between energy intake and calories expended; more calories are consumed than the amount utilised. Age, gender and activity level have an impact on obesity depending on the body of the individual because everyone has medical differences (Michael & Myers, 2004:1-2).

* Consequences

People who are overweight are at greater risk of the following several disorders: coronary heart disease, strokes, high blood pressure, adult-type diabetes, gallstones and other digestive disorders, back problems and arthritis of the knee and hip (Garrow *et al.*, 2000:531-532). These may result in early death or in disability, which makes it difficult to work and support or care for the family. Obese people are at high risk of accidents and broken bones and they also become tired quickly. Overweight in young children may result in overweight adults. They become unable to run or play games (Garrow *et al.*, 2000:541-542).

Obesity accounts for two to six percent of total health care costs in several developed countries. The true costs are undoubtedly much greater as not all obesity-related conditions are included in the calculations. Overweight and obesity lead to

unfavourable harmful metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance (WHO, 2006:3).

Obesity is a risk factor for increased blood pressure and an unfavourable lipids profile such as cholesterol triglycerol levels, which in turn are risk factors for cardiovascular disease (CVD) (Charlton *et al.*, 2004:801-2).

* Prevention

Obesity can be prevented by following these dietary guidelines:
- Eating meals that contain plenty of fibre and not too much of fat or sugar.
- Eat snacks that are not energy rich.
- Eat foods such as fruit or maize cobs, and avoid foods such as sweets, chips, crisps and cakes.
- Do not drink too much of alcohol.
- Take regular exercises (Garrow *et al.*, 2000:541-542).

1.2.1.2 Hypertension

* Definition

Hypertension means high blood pressure and is a progressive cardiovascular syndrome arising from complex interrelated ecologies (Giles *et al.*, 2005:505).

* Causes

Blood pressure is determined by the amount of blood pumped by the heart, and the size and condition of the arteries. Factors that can affect blood pressure, include volume of water in the body; the salt content of the body; the condition of the kidneys, the nervous system, or blood vessels; and levels of various hormones in the body (Whelton *et al.*, 2002:1882).

* Consequences

Systolic blood pressure is consistently over 140 (systolic is the top number of your blood pressure measurement, which represents the pressure generated when the heart beats) and diastolic blood pressure is consistently over 90. Pre-hypertension is when your systolic blood pressure is between 120 and 139 (Whelton *et al.*, 2002:1882).

* Prevention

The following lifestyle changes may help control high blood pressure:

- Lose weight when overweight. Excess weight adds to strain on the heart. In some cases, weight loss may be the only treatment needed.
- Decrease fat and sodium - salt, mono sodium glutamate (MSG), and baking soda all contain sodium. Increase the intake of fruit, vegetables, and fibre (Whelton *et al.*, 2002:1883-4).

1.2.1.3 Diabetes

* Definition

Diabetes mellitus is a disorder of the metabolism - the way the body uses digested food for energy and growth or a condition resulting in the pancreas not being able to produce enough insulin (Nuble, 2005:1).

In the last 20 years, the incidence of obesity among adults and children has risen nearly 50 percent. Approximately 30 percent of adults and 25 percent of children are considered obese today. Obesity can complicate the treatment and management of diabetes and can even lead to the body developing a resistance to insulin (Charlton *et al.*, 2004:801-2).

* Types of diabetes

There are different types of diabetes in children, namely Type 1 and Type 2 diabetes.

Type 1 (immune-mediated) Diabetes is identified by recent weight loss, a short duration of symptoms like thirst and frequent urination. There is also often a honeymoon period after blood sugars are in control during which the need for insulin diminishes significantly (and sometimes is not needed to control blood sugars) for a while. This type of diabetes leads ultimately to the complete destruction of the insulin-producing cells, which necessitates the use of exogenous insulin for survival and poses an ongoing risk of ketoacidosis. Only about five percent of the patients have a family history (in first- or second-degree relatives) of diabetes (Kenneth *et al.*, 2005:1).

Type 2 (insulin-resistant) Diabetes is identified by overweight, little or no weight loss (obesity is the hallmark of type 2 diabetes) with sugar in the urine, but no ketones, although as many as 30 percent will have some ketones in the urine at diagnosis. These patients will experience little or no thirst and no increased urination. A strong family history of diabetes is usually present with at least 45 – 80 percent having one parent with diabetes. Furthermore, diabetes may span many generations of family members and 74 - 100 percent of patients have a first- or second-degree relative with diabetes. This form of diabetes is typically found in African, Hispanic, Asian, or American Indian people. About 90 percent of children with type 2 diabetes have dark shiny patches on the skin (*acanthosis nigricans*), which are most often found between the fingers and between the toes, on the back of the neck and in the creases of the axillaries. This is known as polycystic ovary syndrome (PCOS) (Kenneth, 2005:1-2).

* Causes

Uncontrolled levels of glucose will lead to millions of patients developing nephropathy, arteriosclerosis, neuropathy, retinopathy and related disability. A growing rate of obesity among children is helping to increase the epidemic rate of diabetes (Charlton *et al.*, 2004:802-3).

* Treatment

Individuals with diabetes mellitus should consume limited amounts of sugar and fats. Exercising regularly and controlling the diet helps to increase the effect of insulin treatment (Nuble, 2005:1).

Eating a diet high in low-glycaemic foods such as nuts, beans and lentils has been found to bring about a greater improvement in diabetes patients as it can help to keep your blood glucose level in the recommended range by monitoring glycaemic index (GI) rating of the food. In the low–glycaemic index diet, the following foods are emphasized: beans, peas, lentils, nuts, pasta and rice (boiled briefly), low–glycaemic index breads (including pumpernickel, rye pita, and quinoa and flaxseed) and breakfast cereals (including large flake oatmeal and oat bran). Another treatment is the high-fibre diet, (whole grain breads; whole grain breakfast cereals; brown rice; potatoes with skins; and whole-wheat bread, crackers, and breakfast cereals). Three servings of fruit and five servings of vegetables were encouraged on both treatments (Jenkins *et al.,* 2008:2742-45).

1.2.1.4 Heart disease / cardiovascular disease

* Definition

Heart disease occurs when blood and oxygen supply fails resulting from the blockage in the vessels supplying the muscular walls of the heart (Barasi, 2003:305). Most of the mortality among obese people is caused by heart disease

that results from hypertension and stroke. Obese people have the problem of abnormalities of blood clotting which further increases the risk of thrombosis and myocardial infection (Garrow *et al.*, 2000: 414). A heart disease also increases with age in men at the age of 55 and women at the age of 64 (Barasi, 2003:307-8).

* Causes

High intake of fat and cholesterol and raised blood pressure elevate the risk of heart disease owing to pressure, stress, smoking, and raised blood lipids; geographical location also has an influence (Barasi, 2003:307-8).

* Consequences

Heart attack may cause sudden death, since the heart no longer functions properly to supply blood to all parts of the body, but most importantly, to the brain (Geissler & Powers, 2005:365-6).

* Dietary treatment

Heart diseases may be addressed through the following dietary guidelines:
- Reduced intake of saturated fatty acids.
- Consumption of raw fruits and vegetables.
- Consumption of processed cereal foods and whole grains.
- Most importantly, consumption of fish, nuts, seeds and vegetable protein sources are good for consumption because they contain vital nutrients.
-Consumption of lean meat should be consumed in small quantities.
- Reduced energy intake to address obesity (Geissler & Powers, 2005: 372-3).

1.2.1.5. Cancer

* Definition

Cancer is a disease in which the normal control of cell division is lost, leading to an individual cell multiplying inappropriately to form a tumour (Geissler & Powers, 2005:416). Cancer is also a group of diseases that begin in the genes, because genes in the body work together to regulate cell division to make sure that each new cell is an exact replica of the main cell (Simin *et al.*, 2006:1).

Cancer is not a single disorder there are different types of cancer with different characteristics (Whitney *et al.*, 2002:849) because cancer can emerge from different tissues and organs in the body (Geissler & Powers, 2005:416). It can also be defined as an uncontrolled growth of abnormal cells in the body (Nanda, 2006:1). Worldwide, there is a significant difference in the rate of cancer from country to country owing to ethnic or racial differences or differences in medical care. Different macro components of diet increase the risk of cancer; too much consumption of red meat and fat and inadequate consumption of complex of carbohydrates increases the risk of cancer (Kaput, Raymond & Rodriguez, 2006:306).

Cancer grows out of normal cells when the cells in the body are not functioning properly which results in the cells dividing rapidly. Cancer grows in any organ or tissue in the body including lung, breast, skin, bones and other organs (American Cancer Society (ACS), 2009:2).

Some cancers are more common in particular geographical areas depending on the food consumed; these include brain, cervical, liver, kidney, skin, thyroid and testicular cancer, as well as cancer of the urinary tract (ACS, 2009:2).

* Causes of cancer

Cancer is caused both by external factors (chemicals, radiation, viruses and diet) and by internal factors (hormones, immune and metabolic conditions and inherited factors). A high consumption of meat may increase the risk of colorectal cancer and high consumption of fat, especially saturated fat, may increase the risk of breast cancer (Lysen, 2006:35). Furthermore, some of the dietary components consumed may accelerate cancers that have already started to develop. Some of the dietary fats eaten in high amounts may promote cancer in part by contributing to obesity (Whitney *et al.*, 2002:849). Certain poisonous mushrooms, radiation, sunlight, tobacco, benzene and other viruses may cause cancer (ACS, 2009:2).

Most cancers tend to run in families from generation to generation because these cancers originate from gene cells. Breast cancer may run in the family when the mother is diagnosed before the age of 40 or after the age of 70, or if a sister is diagnosed with cancer. Colon and lung cancer may run in the family when one's parents or relatives are diagnosed with it and prostate cancer when the brother or father is diagnosed (Simin *et al.*, 2006:2).

Liver cancer can be caused by Aflatoxin which is the food contaminant produced by the fungus Aspergillus; it can occur in high levels in foods such as grains, oilseeds, nuts and dried fruits and most commonly when these foods are stored in hot humid conditions (Geissler & Powers, 2005:425).

* Consequences

The outcome of cancer varies, depending on the type and the stage; some cancers may be cured and some may not be cured but they are treatable (ACS, 2009:4).

* Treatment

The risk of cancer may be reduced by choosing a diet that is rich in fruits and vegetables, by being physically active to maintain body weight; by keeping weight

in check to avoid being underweight or overweight; and by consuming foods low in fat and salt (Whitney *et al.*, 2002:851). Consuming moderate amounts of preserved meat (sausages, salami, bacon and ham) and avoiding consumption of food or drinks at a very hot temperature will also reduce one's risk (Geissler & Powers, 2005:427).

A feasible intermediate target for the dietary prevention of cancer is the reduction of global incidence by 10 percent to 20 percent within 10-25 years (WHO, 2006:5).

Based on the type of cancer and its stage, treatment of cancer varies; if cancer is confined to one location, surgery can be done and it is curable. If it has spread to local lymph nodes it can be removed. If the cancer cannot be treated through surgery, radiation and chemotherapy methods may rather be utilised (ACS, 2009:3).

1.2.2 Under nutrition

Under nutrition is defined mainly as a consequence of inadequate diet and frequent infection, leading to deficiencies in energy, protein, vitamins and minerals (WHO, 2002:7). Brief descriptions of the types of under nutrition follow.

1.2.2.1. Protein Energy Malnutrition

Protein malnutrition is not as easily recognized as protein-energy malnutrition, but is associated with significant increases in the rates of morbidity and mortality. Low consumption of nutrients, malabsorption, drug nutrient interaction and protein loss may contribute to protein energy malnutrition (Tsiaousi, 2008: 527-8).

* Marasmus

Another type of malnutrition is the deprivation of food. It is usually caused by inadequate nutrient intake in conjunction with the stress response. Common causes include chronic diarrhoea, renal dysfunction, infection, haemorrhage, trauma,

burns, and critical illness. Protein malnutrition can result in marked hypoalbuminemia, anaemia, oedema, and muscle atrophy, delayed wound healing and impaired immunocompetence (Armstrong, 2000:8-9). This leads to marasmus due to the shortage of protein, fat, carbohydrates, energy and other important nutrients. The body begins to break down muscle to get protein and it draws on all its stored fat and carbohydrates (Armstrong, 2000:8). The person loses weight with gross loss of muscles especially on the shoulders and buttocks. The skin lies in redundant folds. The child's face will appear like an old man's (Garrow *et al.*, 2000:519).

Once the body goes through all of its stored energy, death is the result. The body can survive for a month or two, as long as it has water. The ability to fight infection is low. The metabolism slows down to save energy. This type of malnutrition is common among children aged six to 18 months in overpopulated areas worldwide (Armstrong, 2000:8).

This is the most common type of malnutrition and occurs when the body does not get enough protein. Not getting enough protein affects the way children grow and develop. In some countries, just-weaned children are fed watery cereal. This diet provides enough calories but not enough protein. This type of malnutrition can be life- threatening because protein helps to build and maintain muscle. Without protein in the diet, muscles such as the heart and respiratory system weaken (Armstrong, 2000:7-8).

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The patient with marasmus is typically emaciated and chronically ill. Long-term nutritional repletion is usually required. Protein-calorie malnutrition usually results in weight loss, reduced basal metabolism, depletion of subcutaneous fat and tissue, bradycardia and hypothermia (WHO, 2006:1-2).

*** Kwashiorkor malnutrition**

Definition

Kwashiorkor is a form of malnutrition caused by inadequate protein intake (Van Voorhees, 2006:1).

Causes

Kwashiorkor occurs mostly in areas of famine, limited food supply, and low levels of education, which may lead to inadequate knowledge of proper diet (Van Voorhees, 2006:2).

Symptoms

The child's hair will be discoloured and the child will also develop a typical skin rash, oedema and severe hepatomegaly, which may lead to growth failure, loss of muscle mass and decreased immune system (Garrow *et al.*, 2000:519).

Kwashiorkor causes a range of conditions, which differ in their signs and severity. A child may fail to grow, be underweight and stunted but still appear normal. Some of the children may look thin, severely wasted with marasmus and oedematous with kwashiorkor (Garrow *et al.*, 2000:519).

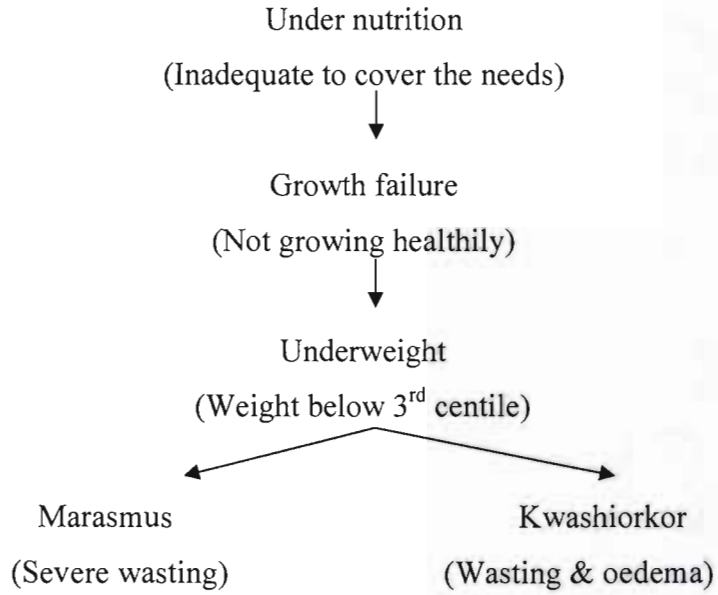

Figure 1.1 Different stages of protein-energy malnutrition (PEM) (King & Burgess, 2000:209).

1.2.2.2 Stunting

Stunting is defined as height-for-age (H/A), and reflects height relative to chronological age (Food Facts Fortification, 2004:3). Children may have growth failure throughout pregnancy if they have a congenital abnormality and some of the children may appear normal but still fall under this group. Children that are born with low birth weight are considered stunted. They are small, but they do not look wasted and also have a normal weight for their length. These children will always be small for their age, even if they have plenty of breastfed milk (King & Burgess, 2000:215-6).

Stunting does not directly cause poor intellectual development in children; the same underlying factors that cause stunting are also likely to impair children's intellectual growth. Among children, stunting can be caused by low birth weight, insufficient

breast-feeding, and nutritionally inadequate food given to complement or replace breast milk, and frequent diarrhoea and respiratory infections. Stunted children tend to enter school later and to be absent from school more often than well-nourished children (UNICEF, 2000(b):1-2).

1.2.2.3 Wasting

Wasting refers to the process by which enervating disease causes muscle and fat tissue to waste away. Wasting is sometimes referred to as acute malnutrition because it has a short duration compared to stunting, which is regarded as chronic malnutrition (Caulfield *et al*, 2006:1)

Wasting can be caused by an extremely low energy intake, nutrient losses due to infection, or a combination of low intake and high loss. Infections associated with wasting include tuberculosis, chronic diarrhoea, and AIDS. Toxic substances can also cause wasting. The mechanism may involve cachectin, also called tumor necrosis factor, a macrophage-secreted cytokine. Caretakers and health providers sometimes contribute to wasting by putting the patient on a very restrictive diet. (Caulfield *et al*, 2006:1).

1.2.2.4. Underweight

Underweight is defined as BMI-for-age (WHO, 2006:3). Underweight remains a spreading problem in developing countries, where poverty is a strong underlying cause contributing to household food insecurity, poor child care, maternal under nutrition, unhealthy environments, and poor health care. All age groups are at risk, but underweight is most prevalent among children under five years of age, especially during and after the weaning period of six to 24 months. WHO has estimated that approximately 27 percent (168 million) of children under five years of age are underweight. Underweight is also common among women of reproductive age, especially in Africa and South Asia, where some prevalence estimates of prevalence of under nutrition are equally high (WHO, 2002:7-8).

Underweight children are at increased risk of mortality from infectious illnesses such as diarrhoea and pneumonia. The effects of under nutrition on the immune system are wide-ranging, and infectious illnesses tend to be more frequent and severe in underweight children. A child's risk of dying from under nutrition is not limited to those children with the most severe under nutrition. There is a risk that even mild under nutrition places a child at increased risk. Since mild and moderate under nutrition are more prevalent than severe under nutrition, many of deaths resulting from under nutrition are associated with less severe under nutrition. Chronic under nutrition in the first two to three years of life can also lead to long-term developmental deficits. Among adolescents and adults, under nutrition is also associated with adverse pregnancy outcomes and reduced work capacity (WHO, 2002:7-8).

Height-for-age (H/A) reflects height relative to chronological age, weight-for-age (W/A) reflects weight relative to chronological age and BMI-for-age reflects body mass relative to height (WHO, 2006:3).

1.2.3 Micronutrient deficiencies

1.2.3.1. Vitamin A deficiency

Vitamin A helps to keep the skin soft and smooth and eyes bright; it also assists in keeping the mucous membranes of the whole body healthy. Vitamin A is also best for vision, especially at night (Insel, 2002:331) and protects the body against infection, depending on the adequate consumption of food containing vitamin A (Sizer and Whitney, 2004:216-17). Vitamin A also enhances healthy growth of bones and teeth, especially in young children. It also helps in prevention of infections and formation of kidney and bladder stones (Keeka & Lasania, 2002:1-2).

Lack of vitamin A in the diet may result in night blindness, roughness and scaling of the skin as well as roughness of mucous membranes. It can also retard bone growth, cause tooth decay and dryness of the eyes (Keeka & Lasania, 2002:1-2). Vitamin A deficiency amongst the children in developing countries remains the leading cause of preventable severe visual impairment and blindness and it is also a (WHO, 2006:1-2).

Globally, 21 percent of all children suffer from vitamin A deficiency (defined as low serum retinol concentrations). Vitamin A deficiency also causes about 16 percent of the worldwide burden resulting from malaria and 18 percent resulting from diarrhoeal diseases (WHO, 2006:1-5).

Vitamin A deficiency (VAD) affects about 285 million children under the age of five worldwide; about 0.5 percent are severely affected by xerophtalmia. VAD affects as many as 265 million children in more than 75 countries in the developing world. Children under five years of age and women of reproductive age are at highest risk of this nutritional deficiency and its adverse health consequences (Shekar *et al.,* 2006:4).

Table1.2 Estimated population of children under 5 years of age affected by vitamin A deficiency in WHO regions (WHO, 2002:3)

Affected population				
WHO Regions	Sub clinical		Clinical	
	Number (million)	Prevalence (%)	Number (million)	Prevalence (%)
Africa	49	45.8	1.08	1.0
The Americas	17	21.5	0.06	0.1
South-East Asia	125	70.2	1.3	0.7
Europe	-	-	-	-
Eastern Mediterranean	23	31.5	0.16	0.3
Western Pacific	42	30.0	0.1	0.1
Total	**256**	**40.3**	**2.7**	**0.1**

1.2.3.2 Iodine deficiency

Iodine is an integral component of the thyroid hormones that regulate body temperature, reproduction, metabolic rate, blood cells production, muscle functioning and growth (Whitney *et al.*, 2002:451). Iodine deficiency disorders (IDD) are the cause of preventable brain damage in the foetus and infant and of retarded psychomotor (mental disorder) development in young children (WHO, 2006:2-4). Iodine deficiency is the most common preventable cause of mental retardation and brain damage: endemic cretinism is the form of profound mental retardation most closely identified with iodine deficiency. It represents the severe end of a broad spectrum of abnormalities collectively referred to as iodine deficiency disorders (Shekar *et al.*, 2006:4). Iodine deficiency also causes lower birth weight and increased infant mortality, hearing impairment, impaired motor skills, and dysfunction of neurons.

Iodine deficiency is controlled through direct supplementation of iodized oil, the addition of iodine to a vehicle such as irrigation water, or, most commonly, iodization of salt. Globally, iodine deficiency disorders were estimated to result in 2.5 million people affected (WHO, 2006:2).

1.2.3.3 Iron deficiency

Iron is the most essential nutrient found in two proteins which are haemoglobin in the red blood cells and myoglobin in the muscle cells that assist with the acceptance, carrying, releasing and delivering of oxygen to the tissues (Whitney, 2002:438-9). Limited supply of oxygen limits the cells energy metabolism, which leads to tiredness; the individual may feel cold and this may cause iron not to be able to make enough haemoglobin to replace new blood cells (Sizer & Whitney, 2006:286).

The main cause of anaemia is iron deficiency. Iron deficiency and anaemia have strong negative effects on human health and development, including increased maternal and newborn mortality, impaired health and development of infants and children, limited learning capacity, impaired immune function, as well as reduced working and productive capacity. Iron deficiency anaemia (IDA) is thus a major impediment to individual and national development (WHO, 2006:2-3).

Iron anaemia affects 2 billion people worldwide. In developed and developing countries, iron deficiency affects nearly twice as many- 3.7 billion. Above 40 percent of this number has clinical iron deficiency (WHO, 2006:2).

IDA is also caused by low dietary intake of iron and poor bioavailability of dietary iron, followed by infections and intestinal parasitic infestations. Several other indirect causes are poverty, poor infant feeding practices, lack of education and ineffective food policies that lead to low intake of iron. Factors such as lack of political commitment to control anaemia, improper planning of control programmes, and absence of community involvement in solving the problem of anaemia are important contributing factors (Ramakrishan, 2001:171).

1.2.3.4 Zinc deficiency

Zinc deficiency is largely related to inadequate intake or absorption of zinc from the diet. Excess losses of zinc during diarrhoea may also contribute, especially among children (UNICEF, 1999:4). In the early 1900s, severe zinc deficiency was defined as a condition characterized by short stature, hypogonadism, impaired immune function, skin disorders, cognitive dysfunction, and anorexia. Zinc deficiency affects about one-third of the world's population, with estimates ranging from 4 percent to 73 percent across sub-regions. Although severe zinc deficiency is rare, mild-to-moderate zinc deficiency is quite common throughout the world (WHO, 2006:2). Globally, zinc deficiency is responsible for approximately 16 percent of

lower respiratory tract infections, 18 percent of malaria and 10 percent of diarrhoeal disease (WHO, 2006:1-2).

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 (Shekar *et al.*, 2006:4).

1.2.3.5 Folate deficiency

Folate deficiency causes widespread megaloblastic anaemia in pregnant women and often exacerbates already existing iron deficiency anaemia, which increases the risk of maternal death (Shekar 2006:4). It is also associated with elevated plasma homocysteine levels and is thereby recognized as an independent risk factor for coronary heart disease and stroke. Folate deficiency is also associated with the occurrence of neural tube defects in high-risk population groups across the world including Europe, middle-eastern countries and China. Low folate status is also associated with cancer, especially of the colon (WHO, 2006:3-5).

1.2.3.6 Calcium deficiency and osteoporosis

Calcium is a major component of mineralized tissues and is required for normal growth and skeletal development. Optimal calcium intake is important for maximizing peak adult bone mass, its maintenance, and for minimizing bone loss among the elderly. Because 99 percent of total body calcium is found in bone tissue, the need for calcium is largely determined by skeletal requirements (WHO, 2006:2-3).

Inadequate dietary calcium has been associated with a number of common, chronic medical disorders worldwide. These disorders include osteoporosis, osteoarthritis, cardiovascular disease (hypertension and stroke), diabetes, dyslipidemias, and

hypertensive disorders of pregnancy, obesity and cancer of the colon (Thacher *et al.*, 2006:1-6).

Calcium deficiency is the major cause of rickets in Africa. It typically manifests after weaning and often after a child's second year. Deficiencies of calcium interact with genetic and/or environmental factors to stimulate the development of rickets in children (Thacher *et al.*, 2006:1-6).

1.2.3.7 Selenium deficiency

Selenium deficiency has been identified in significant population groups in China, Russia and New Zealand. One of its manifestations is Keshan disease (selenium-responsive endemic cardiomyopathy resulting in heart failure), which affects mainly children and women of childbearing age in certain areas of China (Selinus & Alloway, 2005:374).

An increased incidence of Keshan disease has now been associated with low selenium levels in staple cereals and has been detected in samples of human blood, hair and tissue. Selenium deficiency has also been identified as the cause of an endemic osteoarthropathy, Kashin-Beck disease, which primarily affects children between the ages of five and thirteen years (WHO, 2006:3-4).

Selenium deficiency affects neurons and also glial cells in the brain. Microglial cell population is the major one known to increase primary neuronal damage dramatically. Selenium also has anti-inflammatory properties involving the cyclo-oxygenase and lipoxygenase pathways affecting cytokine and chemokine expression (Savaskan et al, 2003:2).

1.2.3.8 Beriberi, Pellagra and Scurvy

Beriberi (thiamine deficiency) is caused by a poor unbalanced diet consisting largely of milled white cereals, including polished rice and white flours, or starchy

staple foods such as cassava and tubers, which are very poor sources of thiamine. This deficiency disease can manifest itself within 12 weeks of deficient intake and can cause disability and death (WHO, 2006:5).

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Pellagra is a lack of the vitamin niacin and its precursor, tryptophan, an essential amino acid. It is common in populations where maize is the principal cereal. When a niacin- and/or tryptophan-deficient diet is consumed, the lead-time for developing signs of pellagra is about two to three months. Pellagra accounted for at least half a million deaths between 1730 and 1930 and caused chronic misery for many more (WHO, 2006:5).

Scurvy is one of the oldest vitamin deficiency diseases. The main symptom of scurvy is hemorrhaging. Hemorrhage marks appear as spots under the skin or bruises, given the medical terms of petechiae and ecchymoses. The gums are swollen and usually become infected. Bleeding can take place in the membranes covering the large bones as well as one of the heart and brain. Wounds heal slowly and the bleeding in or around vital organs can be fatal. The disease develops slowly and is identified early by fatigue, irritability, and depression (University of Califonia Los Angels & Dole Food Company, 2002:2-3)

1.3 GLOBAL PREVALENCE OF MALNUTRITION

The main nutritional problems facing the school-age child include stunting, underweight, anaemia and iodine deficiency. The effects of under nutrition on cognitive ability indicate that chronic under nutrition is associated with lower achievement in schoolchildren (Gibney *et al.*, 2002:5).

1.4 PREVALENCE OF MALNUTRITION IN SOUTH AFRICA

A national survey conducted in 1994 by the South African Vitamin A consultative group (SAVACG) on the micronutrient status of South Africa children, revealed that xerophthalamia (clinical eye lesions leading to nutritional blindness) rates among approximately 11,000 children. Among these the prevalence in, the six to seven months age group was found to be surprisingly high, since clinical Vitamin A deficiency (VAD) was not previously considered a problem. Night blindness was prevalent in 12 percent of the children. Subclinical deficiency was found in an average of 33 percent of the children, ranging from 18 percent in the Northern Cape to 43 percent in the Northern Province. Prevalence of low serum retinol concentrations was higher in the rural areas, at 25 percent than in the urban areas, at 23 percent (Vorster *et al.*, 2001:4).

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In a rural area in Northern Kwazulu Natal, the prevalence of anaemia in a population with ages ranging from six to 47 years was reported to be 42 percent for males and 52.4 percent for females. Iron deficiency anaemia is also common among pregnant women, especially among women of Indian origin who are living in South Africa (Vorster *et al.*, 2001:1-4).

The majority of South African households are living in poverty, with no food or few foods, mainly staples, available in the home. The intake of micronutrients is unacceptably low. The South African National Nutritional Status Survey Group (SANNSS) add that in terms of micronutrients, riboflavin intake was found to be low in black rural and urban areas as well as in the coloured and Indian population. Overall, a similar low pattern of intake was found for vitamin B6, whereas the folic acid intake was low in Indian and rural black women of childbearing age. The vitamin A intake was low in black children younger than 10 years and in urban black women. Only intakes of vitamin B12 seemed to be adequate in all population groups (Vorster *et al.*, 2001:1-4).

Table 1.3 Dietary deficiency micronutrient intakes of South Africans (Vorster *et al.*, 2001:4)

Micronutrients	Groups with lower intake
Iron	Black rural and urban settings Coloured Indian population groups Young children, adolescent girls and women
Thiamine (B1)	Black and Indian population
Riboflavin (B2)	Black rural and urban settings Coloured Indian population
Niacin (B3)	Black and Indian population group
Vitamin (B6)	All population groups of all ages, except white males
Folate	Indians Rural black women of childbearing age
Vitamin A	Black children younger than ten years of age Urban black women Black and Indian men

The National Food Consumption Survey (NFCS) showed that at least 21, 6 percent of children between one and nine years old are stunted, indicating chronic past under nutrition. Underweight affects 10, 3 percent of children (18 percent of children living on commercial farms, rural and tribal). Wasting, an indicator of acute current under nutrition is not common in South Africa, with a prevalence rate of 3, 7 percent of children between one and nine years old (National Department of Health, 2004:3).

Micronutrient deficiencies are prevalent and affect especially vulnerable groups (children and women). Most of the children consume food that is high in energy and poor in protein quality and micronutrient density. Most of the children between

the ages of one and nine years consume approximately less than half the recommended level for vitamin A, vitamin C, riboflavin, niacin, vitamin B6, folate, calcium, iron and zinc (micronutrients as well as macronutrients). Iron deficiency and anaemia are common problems among children in rural communities. Although anaemia could be a result of malaria and parasite infestations, dietary deficiency in iron is also a major concern (National Department of Health, 2004:3).

The National Iodine Deficiency Disorder Survey (IDD), which was conducted in 1998 among primary school children, indicated that that the mandatory iodation of food grade salt in 1995 has dramatically improved the iodine and goitre status of children in the country. It found that learners in 89, 4 percent of primary schools surveyed have a normal iodine status. However learners in 10, 6 percent of the schools, especially in rural areas, were iodine-deficient. According to the Medical Research Council, 62,4 percent of households consume iodised salt (National Department of Health, 2004:3-4).

Infectious diseases constitute one of the major factors contributing to child malnutrition. Conversely, malnutrition makes a child more susceptible to these infectious diseases (National Department of Health, 2004:3-4).

According to the research that was conducted by Vaal University of Technology, the majority of caregivers do not have enough monthly income, which leads to frequent shortages of money with which to buy food. This results in the limitation of nutritious food and correct required portion sizes and in the skipping of meals (Oldewage-Theron *et al.*, 2006: 795-804).

The nutritional status of children has an impact and immediate effect on growth, intellectual capacity, school achievement and immunity. Nutritional status, especially in young children, serves as a general indicator of development, social uplifting and access to resources within the community at large (Napier, 2001:23-4). Poor nutritional status leads to growth failure, anorexia, and susceptibility to

infections, behavioural changes, and learning disabilities. Iron and iodine deficiency during infancy can cause mental retardation or inferior psychomotor function in childhood (Napier, 2001:24).

According to Gary Klugman among South African children as a whole, the average of dietary intake of the energy, calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin niacin, and vitamin B6 was found to be less than 67 percent of the Recommended Dietary Intake (RDI). The consequences of malnutrition include growth stunting, anorexia, and susceptibility to infections, behavioural changes and learning disabilities, depending on the severity of the deficiency. The cause of these problems are multifactoral and include poverty, ignorance, incorrect feeding practices, infections, lack of food, eating food of low nutrient density, and low bio-availability of food nutrients (Klugman, 2005:1-2).

Malnutrition is estimated to affect about 40 percent of the population in South Africa resulting in diseases such as beriberi, rickets, scurvy, goitre, anaemia, kwashiorkor and pellagra. Those affected once have little or no energy to deal with daily life because early symptoms include cramps, diarrhoea, weakness and weight loss; as a result, they become dependent on the wider family, on social welfare organizations and on medical services, hospitals, doctors and clinics for support (Jinabhai *et al.*, 2005: 3-4).

The immediate causes of malnutrition are associated with dietary intake, stress, trauma and disease. These causes are influenced by the underlying causes of malnutrition that are linked to the levels of household food security, maternal and child care, education and information, as well as health services and the environment. In turn, the basic causes of malnutrition such as the availability and control of resources, as well as the political, social, ideological, economic and cultural factors that affect the availability and control of resources, influence the underlying causes (National Department of Health, 2004:1-3).

1.5 NUTRITIONAL NEEDS OF SCHOOL CHILDREN

To understand and know children's needs, it is crucial to understand the meaning of health, which is the physical, mental, spiritual and social wellbeing of every individual (Mathews, 2004:3).

School-aged children are still growing. Growth requirements combined with physical activity play a role in determining children's nutritional needs. Genetic background, gender, and body size and shape are other factors. The nutrients needed by children are the same as for adults but the amounts differ (Boeckner, 2002:2).

The relationship between nutrition, health and the educational achievement of school children in less developed countries has been of interest to many researchers owing to the frequent observation that many of these children did not complete primary school and those who did completed it, did not do well compared to the children in the developed countries. Nutritional and health status directly affects the educational achievement of schoolchildren, while biological, psychological, socioeconomic and cultural factors could directly or indirectly affect nutrition, health status and educational achievement. Poor health and malnutrition in early childhood may affect cognitive abilities, necessary for the learning process and consequently educational achievement (Bundy., 2006:2-3).

The nutritional needs of the children are influenced by beliefs about nutrition and health, cultural beliefs and tradition and religion beliefs (Insel *et al.*, 2002:599).

1.5.1 Nutrition and health beliefs

The biggest influences on nutritional needs, especially of young children, are through television, internet, radio, family and friends, health professionals, print media (newspaper and magazines) and government sources which may lead people

to ignore health information and consume food that may cause health problems (Insel *et al.*, 2002:599-601).

1.5.2 Cultural beliefs and traditions

Food is related to family traditions, social status and health, which results in some cultures not eating certain foods; this could have an impact on nutritional needs (Insel *et al.*, 2002:599-600).

1.5.3 Religion

Food plays an important role in religious rites, symbols, customs and daily activities that are intended to promote an orderly relationship with supernatural forces. Some religious precepts like vegetarianism, which apply to everyday eating, and some that are concerned with special celebration affect the nutritional needs of the children because the food that is consumed may not contain all essential nutrients needed by the body (Insel *et al.*, 2002:599-600).

1.5.4 Meeting children's nutritional needs

Food Based Dietary Guidelines (FBGDs) were developed to help South Africans to choose an adequate, prudent diet; these guidelines are based on the existing consumption of locally available foods with the aim of addressing identified nutrition- related public health problems. FBDGs consist of ten short, clear and simple messages that have been tested for appropriateness and applicability in consumer groups of different ethnic backgrounds in both rural and urban areas (Vorster *et al.*, 2001:53-4).

These are:

- Enjoy a variety of foods.
- Be active.

- Make starchy food the basis of most meals.
- Eat plenty of vegetables and fruit every day.
- Eat dry beans, peas, lentils and soya regularly.
-Chicken, fish, meat, milk or eggs could be eaten everyday.
- Use fats sparingly.
- Use salt sparingly.
- Use food and drinks containing sugar sparingly and not between meals.
- Drink lots of clean, safe water.
- If you drink alcohol, drink it sensibly (Vorster *et al.*, 2001:53-6).

Table 1.4 Nutritional requirements and the role of nutrients in the body (Boeckner, 2002:2-4)

Nutrients	**Recommended daily allowance (RDA)**	**Function**
Carbohydrates	At least 6 servings per day	Provide energy forgrowth
Proteins	2 to 3 servings per day	Build, maintain and repair body tissues
Fruits and vegetables	2 to 3 servings	Maintain healthy skin and fight infections
Milk or dairy products	2 servings per day	Calcium builds strong bones and teeth Iron carries oxygen in the blood

Parents should provide a variety of foods and establish regular meal and snack times. In most cases, nutrient and energy needs will be adequately met. If parents are concerned about their children's poor nutrient intakes, they should consult with a physician or trained nutrition professional, such as a registered dietician. A Pattern for Daily Food Choices (Table 1) provides guidance for planning daily food

intakes for children. Plan meals and snacks that will provide the recommended number of servings each day (Boeckner, 2002:2-4).

Children who are physically active and growing need snacks, but poor snack choices can result in too many calories and not enough nutrients. Children tend to eat what is available so it is the responsibility of parents and other caretakers to assist children to make nutritious snack choices by keeping foods on hand from the first five food groups shown in Table 1.5: Pattern for Daily Food Choices (Boeckner, 2002 2-4).

Table1.5. Pattern for daily food choices for school-aged children (Boeckner & Schledewits, 2006:1-2).

Food Group	Suggested Daily Servings	Serving sizes
Breads, Cereals, and Other Grain Products Whole-grain, enriched Key Nutrients: Carbohydrates, Thiamine, Niacin, Iron	At least 6 servings (Include several servings of whole-grain products daily.)	1 slice of bread 1/2 hamburger bun or English muffin A small roll, biscuit or muffin 3 to 4 small or 2 large crackers 1/2 cup cooked cereal, rice or pasta 1 ounce of ready-to-eat breakfast cereal
Fruits Citrus, melon, berries Other fruits Key Nutrients: Carbohydrates, Vitamins A & C	At least 2 servings	A whole fruit such as a medium apple, banana, or orange Half a grapefruit A melon wedge 3/4 cup of juice 1/2 cup of berries 1/2 cup cooked or canned fruit ¼ cup dried fruit
Vegetables Dark green, leafy Deep yellow Dry beans and peas (legumes) Other starchy vegetables Key Nutrients: Carbohydrates, Vitamins A & C	At least 3 servings (Include all types regularly; use dark green, leafy vegetables and dry beans and peas several times a week.)	1/2 cup of cooked vegetables 1/2 cup of chopped raw vegetables 1 cup of leafy raw vegetables, such as lettuce or spinach
Meat, Poultry, Fish, and Alternates (eggs, dry beans and peas, nuts, and seeds) Key Nutrients: Protein, Thiamine, Niacin, Iron	2-3 servings	Amounts should total 5 to 7 ounces of cooked lean meat, poultry or fish a day. Count 1 egg, 1/2 cup cooked beans or 2 tablespoons peanut butter as 1 ounce of meat.
Milk, Cheese, and Yoghurt Key Nutrients: Protein, Calcium, Riboflavin	2 servings (3 servings for teens)	1 cup of milk 240 grams of yoghurt 45 grams of natural cheese 60 grams of processed cheese
Fats and Sweets	Choose fats and sweets to meet energy needs only after eating recommended servings from the other food groups.	

Safe food handling and preparation is an important part of snacking. School-aged children between five and eight years old should have snacks that are ready-to-eat

or partly prepared (Boeckner, 2002:2-4). Programmes are thus needed to address malnutrition and its consequences in school-aged children.

1.6 RATIONALE AND MOTIVATION FOR THE STUDY

Early childhood severe clinical malnutrition, moderate and severe stunting, and underweight and iron-deficiency anaemia are associated with poor cognitive development, behaviour and academic attainment in later child hood. Poor nutrition and experience of hunger are inevitably associated with many other socioeconomic disadvantages, which are likely to independently affect children's school performance independently (Badaloo *et al.*, 2002:3).

During 2004, Joint Aid Management (JAM), a Christian humanitarian organisation with 21 years of international experience in sustainable development, working in eight African nations, identified Orange Farms as a geographic area with high poverty levels and decided to implement a school feeding programme in two primary schools, supplementary to the governmental school feeding project.

The Vaal University of Technology (VUT) was contacted by the JAM management in November 2004 to assist with the school feeding project in Orange Farms, specifically to determine the impact of the JAM school feeding programme on the nutritional status of these children. This project thus attempted to test the impact of one of the products used in the JAM school feeding programme on the nutritional status of a sample of children in Orange Farms.

1.7 OBJECTIVES

The aim of this study was to measure the impact of a school-feeding programme on the nutritional status of primary school children in Orange Farms.

1.7.1 **Specific objectives**

The specific objectives of this study were to:

- Undertake a cross-sectional baseline survey (socio-demographic and health profile, dietary intake, food consumption patterns, anthropometrics measurements and biochemistry).
- Implement and monitor a ten-month school feeding programme as intervention. and
- Evaluate the impact of the school-feeding programme on the nutritional status of the primary school children.

Figure 1.2 indicates the summary of the study from the onset to data collection, data analyses and final report.

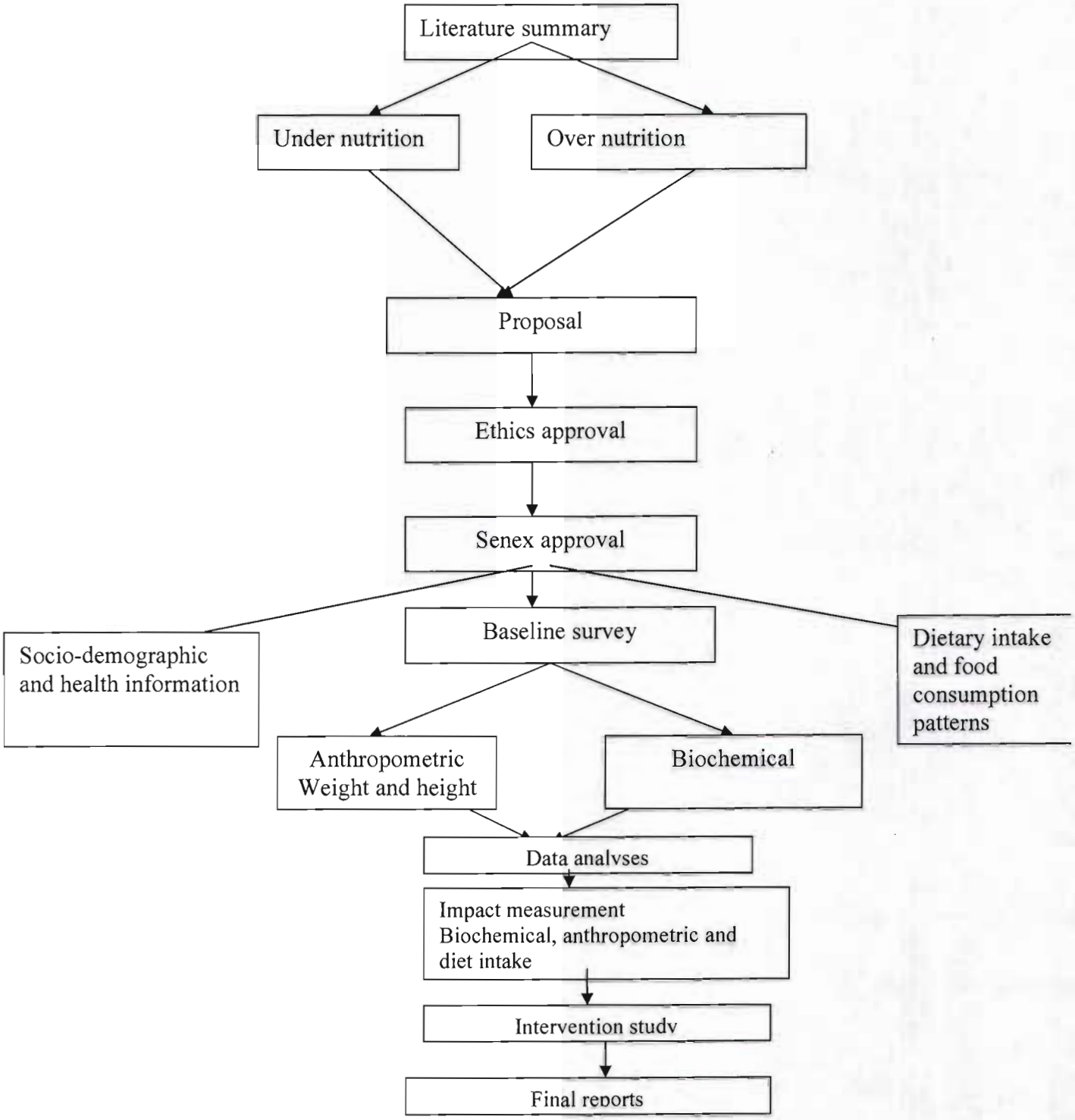

Figure 1.2 Contextual framework of the study

1.8 OUTLINE OF THE DISSERTATION

The dissertation consists of five chapters: chapter one includes the motivation for the study; malnutrition, nutritional needs and strategies for addressing malnutrition. Chapter two includes variables that can have an impact on the nutritional status of the schoolchildren. Chapter three discusses the methods that were used to conduct the study. The results are explained in chapter discussed four. Chapter five consists of the conclusions and recommendations based on the outcome of the study, as well as suggestions for further studies.

CHAPTER 2

LITERATURE REVIEW: CAUSES OF MALNUTRITION AND STRATEGIES TO ADDRESS MALNUTRITION

This chapter includes all possible causes of malnutrition such as immediate, underlying and basic causes as defined by UNICEF as well as the strategies for addressing these causes, namely, food fortification, food supplementation and food diversification, including school feeding programmes.

2 .1 CAUSES OF MALNUTRITION

The factors that cause malnutrition and death in children are illustrated in figure 2.1.

2.1.1 Immediate causes of malnutrition

The immediate causes of malnutrition are disease caused by inadequate food intake which in turn results from food insecurity, a poor public health or social and care environment; or inadequate access to health services at household and community levels (Geissler & Powers, 2005:624).

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2.1.1.1. Inadequate dietary intake

Young children are often at risk of being malnourished as they have very high energy and nutrient requirements for their body size compared to adults. Children need proper care and feeding, which is essential for normal growth, development and activities. Children should be encouraged to eat enough of a variety of food rich in energy, protein, fruit and vegetables for growth and body maintenance (Napier, 2002:9).

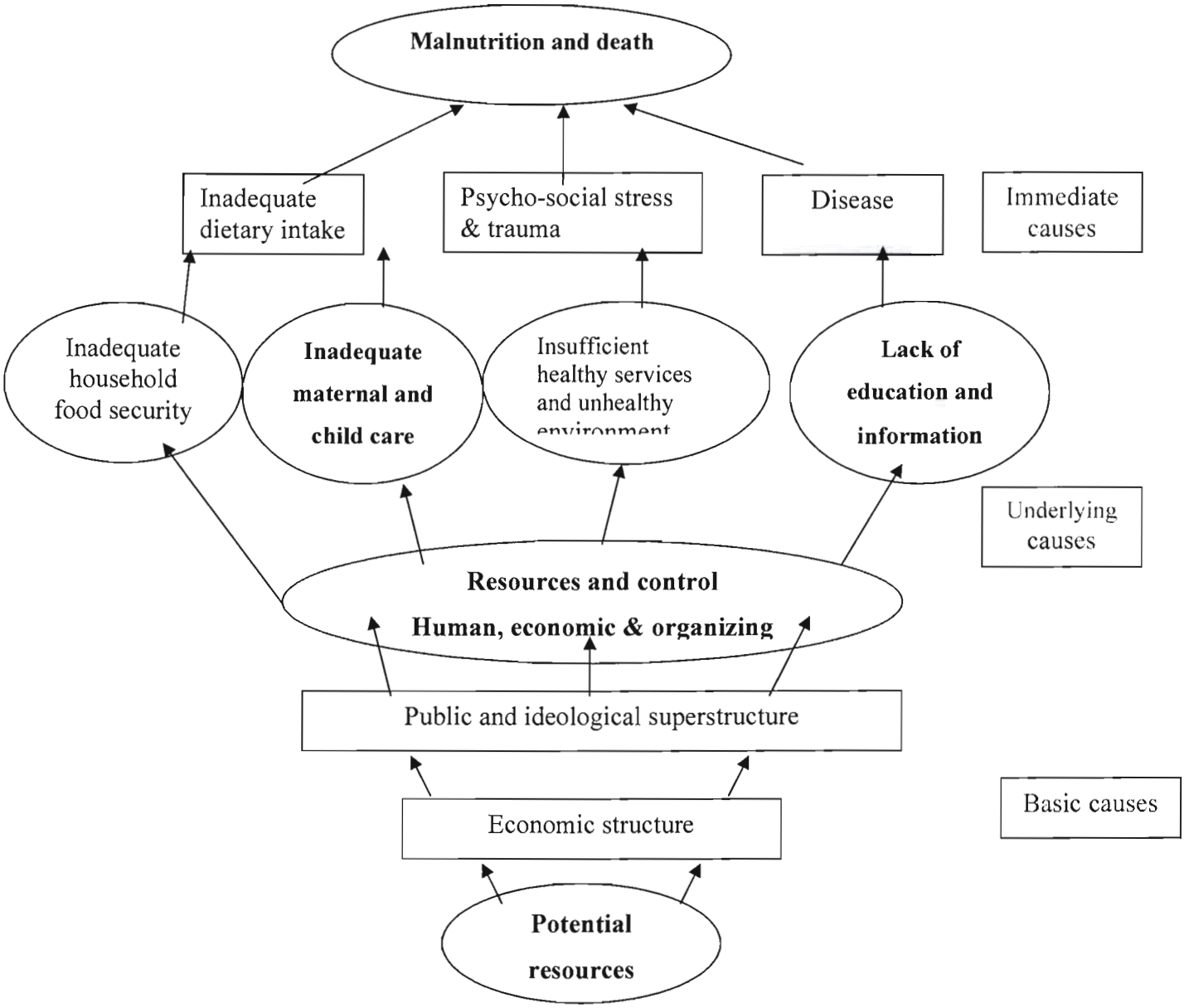

Figure 2.1 Conceptual framework of immediate, underlying and basic causes of malnutrition (UNICEF, 2004).

The main immediate causes of malnutrition in infants are poor diet and infections. If an infant is not able to consume enough food in terms of quantity and quality that can be used for development then malnutrition occurs. Infection reduces nutritional intake by destroying appetite, inhibiting nutrient absorption and increasing nutrient requirements for combating infection. Therefore poor diet reduces the effectiveness of the immune function (Geissler & Powers, 2005:624).

2.1.1.2 Illness

When a child is sick, it experiences eating disorders such as: fatigue, vomiting, nausea, and poor appetite, pain from the disease or treatment, drowsiness from medication, fear and anxiety. Just as with adults, sick children require careful consideration of their emotional, psychological, social and physical needs. Frequent infections, especially measles, diarrhoea and acute respiratory infection, can cause vitamin deficiencies in a community, leading to malnutrition. Nutrition deficits due to insufficient diet and reduced dietary intake cause early growth failure, directing nutrients from physiological growth (Napier, 2001:10).

Good health is as fundamental to healthy well-being, as good nutrition is crucial for maintaining health, growth and development. Access to adequate health care services is essential to ensure priority actions such as immunisation, early diagnosis and management of infectious diseases such as diarrhoea, respiratory disease, measles, malaria and tuberculosis. Health and nutrition education, growth monitoring and the promotion of primary health care is essential (WHO 2000:1-2).

2.1.1.3 Psycho-social stress and trauma

Traumatic Stress Disorder is a natural emotional reaction to a deeply shocking and disturbing experience after which it can be difficult to believe that life can ever be the same again. Trauma and psychiatric injury can be more devastating than physical injury. Traumatic Stress Disorder can be caused by a life-threatening incident or by a prolonged series of events involving bullying, harassment, abuse, a violent partner, or work that entails attending road traffic accidents, fires and disasters (Kinchin, 2005:1-2).

Most deaths during complex humanitarian emergencies are due to preventable causes, especially increased rates of infectious diseases, malnutrition and violent trauma (Brennan & Nandy, 2001:147-156).

The mental and physical changes that accompany inadequate food intakes can have harmful effects on learning, development, productivity, physical and psychological health, and family life (Food Research Action Centre (FRAC), 2005:1-2).

2.1.2 Underlying causes of malnutrition

The underlying causes are household food insecurity, inadequate care for vulnerable groups such as mothers and children, and insufficient essential human services such as health, education, water and environmental sanitation and housing. Underlying causes are influenced by other basic factors including such human, structural, natural and economic resources, politics, culture and the security context. Formal and informal infrastructure, and population movements (forced or unforced) and constraints on movement also have their influence (Oldewage-Theron *et al.*, 2006:795-804).

2.1.2.1 Insufficient household food security

Food security is defined as access by all people at all times to adequate, safe and nutritious food for a healthy and productive life (Olson 1999:1).

Food security is the first and continuing challenge is; how to produce and ensure access to enough food to feed the still-growing population. Food security has been defined in many ways: the Food and Agriculture Organisation's World Food Security Compact states that the ultimate objective of food security is to ensure all people, at all times, are in a position to produce or procure the basic food they need and that this should be an integral objective of economic and social plans (Rattan *et al.*, 2003:340).

Food insecurity may lead to hunger, which is defined as the uneasy or painful sensation in the stomach caused by lack of food. Hunger is described as the recurrent and lack of access to sufficient food owing to poverty or constrained resources, which can lead to malnutrition over time. In some developing nations where famine is widespread, hunger manifests itself as severe and very visible clinical malnutrition. Chronic mild under nutrition does occur when financial resources are low (FRAC, 2005:1-2).

Most of the world's population is chronically undernourished, with the majority in rural areas in the developing world. The 860 million undernourished people comprise mainly illiterate adults (a majority of whom are women) and the 130 million children (mainly girls) who do not go to school. Hunger, malnutrition and food insecurity affect cognitive abilities and reduce school attendance. Illiteracy and lack of education reduce earning capacity and contribute directly to hunger and poverty (Alderman *et al.*, 2004:1-2).

Hunger and malnutrition prevent children from going to school and stunt the learning capacity of those attending classes. Low birth weight, protein energy malnutrition, iron deficiency anaemia and iodine deficiency have all been linked to cognitive deficiencies that hinder children's ability to learn (Alderman *et al.*, 2004:1-2).

2.1.2.2 Causes of food insecurity

- Natural threats

Drought is one of the natural threats to regional food production (Meissner, 2002:3). It is not only drought that can have an impact on the production of agricultural products (raw materials), but extreme weather events such as floods, can also cause damage. Excessive rains and floods, together with reduced and late delivery of agricultural inputs have a severe impact on the production of

agricultural commodities in these countries. Floods can devastate farmland and wash away valuable topsoil that is vital for the production of food which results in many countries becoming reliant on the international food market for their food security needs (Meissner, 2002:3-4).

- Political conditions

Unstable political conditions can make a bad situation even worse. Poverty is more likely to be reduced where the shape of the political system means that the votes of the poor count, obliging politicians to be responsive to the needs of the poor. A useful way of conceptualising these developments and the links between policy processes and poverty reduction, is through the livelihoods framework (Jones & Nelson, 2005:45-46).

In May 2002, the government declared as disaster zones some areas in Angola and the DRC (Democratic Republic of Congo) where 7.8 million people, of which 5.4 million were children, were in need of food aid owing to food shortages made more extreme because of conflict and political crises (Meissner, 2002:3).

- Economic factors

Economic factors, such as the availability of foreign exchange and capital outlay on infrastructure, play a role. When government finances are stretched to the limit by debt and mismanagement, countries can have difficulty implementing infrastructure projects to facilitate the distribution of food within the region. This also implies that agricultural sectors cannot develop to their full potential. For instance, irrigation schemes that could lead to a better food security situation cannot be financed. The implementation of irrigation schemes can make the production of agricultural commodities (raw materials) less dependent on rain. Most farmers, iboth subsistence and commercial farmers, rely on dry land farming to produce food in Southern Africa, both these agricultural sectors are equally important to a country's food security (Meissner, 2002:3-4).

2.1.2.3 Inadequate maternal and childcare

The reason for inadequate maternal and child care include education and ignorance, eating away from home, poor nutrition during pregnancy, and inappropriate breast-feeding and weaning practices (National Department of Health, 2004:1-3).

2.1.2.4 Education and ignorance

In almost all societies a lack of education and literacy tends to result in a lower socioeconomic status. In all countries with an adult literacy rate lower than 95 percent, literacy is less common among rural dwellers than among those who live in urban areas. In large part, lack of education is a problem of developing and underdeveloped countries (Vos, 2005:90).

The nutrition situation is worsening by a lack of nutritional information and knowledge and an unacceptable dietary habits and nutrition-related practices, attitudes, perceptions and socio-cultural influences that could adversely affect nutritional status. To attain good health and nutritional status, people need sufficient knowledge and skills to grow, purchase, process, prepare, eat and feed families a variety of foods in the correct amounts and combinations (National Department of Health, 2004:1-3).

The 1994 Project for Statistics on Living Standards and Development estimated that 39 percent of the population is vulnerable to food insecurity. The HSSF requires the INP to prevent and manage malnutrition. Malnutrition is a major contributing factor to morbidity and mortality. The INP is one of the key strategic health programmes to decrease morbidity and mortality rates. In South Africa, malnutrition is manifested in both under nutrition and over nutrition (National Department of Health, 2004:1-3).

2.1.2.5 Eating away from home

Parents, more specifically mothers, play an important role in shaping young children's eating behaviours through their own dietary behaviours, their attitudes toward food, and the availability of food in the home. Parents can also support more healthful dietary patterns among adolescents, by encouraging family meals. Eating behaviours and dietary quality are influenced by place of consumption, whether at home, school, or away from home in restaurants and fast food establishments. Frequently eating at restaurants or fast food establishments may negatively affect the nutritional quality of the diet because of the large portion sizes of foods served, the preparation methods and the types of foods served (Miller *et al.*, 2006:348).

Schools influence children's eating behaviours by the availability of school nutrition programmes such as the National School Lunch Programme (NSLP) and the School Breakfast Programme (SBP), both of which programmes improve students' nutrient intake (Miller *et al.*, 2006:18).

2.1.2.6 Pregnancy

Under nutrition mostly commences as an ongoing process and it is estimated that the incidence of low birth weight in undeveloped countries is about 20 percent. Although small-for-gestational-age babies experience catch-up growth with adequate nutrition, their ultimate height rarely equals the height of well-fed appropriate-for-gestational-age babies (Napier, 2002:14). Mothers who are stunted or undernourished mothers before or during pregnancy give birth to small babies. Babies are especially likely to be of low birth weight especially if the mother does not gain more than 6 kg during pregnancy (King & Burgess, 2000:249).

Pregnant women should be given extra quantities of food of good quality, be released from hard labour, given adequate time to rest and skilled pre- and post-natal care from trained practitioners in order to ensure a normal weight-for-age

baby. Follow-up checks on breast-feeding which will help a baby at least to have a proper start in life (Napier, 2000:10). Food rich in iron and folate prevents anaemia and can also increase the baby's birth weight, while giving food high in iodine prevents deficiency disorders (King & Burgess, 2000:250).

A pregnant woman needs added calories to grow and maintain the development of the foetus and the placenta as well as to increase breast tissue and store fat and to fuel other metabolic changes. Accordingly, macronutrients are recommended for the provision of energy and micronutrients for increased need of minerals and vitamins (Insel *et al.*, 2002:555).

2.1.2.7 Breast-feeding and weaning practices

Inadequate quantities of breast milk from undernourished mothers and improper weaning practices in infancy contribute to stunting in later childhood. Furthermore, infection as a consequence of both under nutrition and a poor socioeconomic environment slows down the growth and thus aggravate the problem. Breast-feeding provides the best nourishment and protects children from infection (Napier, 2001:14).

Breast-feeding may increase the infants' immunity to disease, which is associated with a decrease in levels of diarrhoea, chronic constipation, gastrointestinal illness and respiratory tract and ear infections. Through promoting improved health in infants, breast-feeding will indirectly benefit intellectual development, as a sick child is less able to explore and learn from the environment. Breast-feeding may benefit the mother-child interaction and facilitate the development of a secure attachment, which is thus likely to benefit the child's development and behaviour. Breast–feeding is associated with a large number of family background characteristics that are related to child development such as parental education level, maternal age, socioeconomic status, family size, crowding and maternal smoking (Charlton, 2004:801-2).

Breast milk provides the infants with optimal nutrition for a growth to infant, with compositional changes that are adapted to the changing needs of the infant. Human milk contains adequate minerals and nutrients for the first six months of life. Breast milk also contains immune components, cellular elements and other host-defence factors that provide various kinds of antibacterial, antiviral and anti-parasitic protection. Breast-milk components stimulate the appropriate development of the infant's own immune system. WHO's public health recommendation is that infants should be exclusively breast-fed during the first six months of life and that they should continue to receive breast milk throughout the remainder of the first year and during the second year of life (Pronczuk *et al.*, 2004:722-723).

For the most breast-fed infants, weaning should start at around six months in order to satisfy their increasing needs for energy and essential nutrients, particularly iron and protein. Infants, especially those from poor families in the developing world, often do not benefit from weaning for many weeks or months because early weaning porridge tends to replace milk but is usually less dense in energy, iron and protein-dense than milk (Garrow *et al.*, 2000:779-80).

2.1.2.8 Insufficient health services and unhealthy environment

A healthy environment should provide shelter, a regular supply of clean water and adequate sanitation along with good access to work, schools and health care should also minimise the chance of injuries or illness and contribute to the physical, social and mental health of the people living in it (Boota *et al.*, 2000:197-8). Failure to remove human waste is one of the most obvious problems in communities, especially in slum communities. It contributes greatly to illness, especially diarrhoea and internal worms in children. Open defecation seriously harms the environment, resulting in unpleasant sights and smells. For the residents the main problem is often the inconvenience and humiliation of having to defecate with no privacy or protection (Boota *et al.*, 2000:246).

Disease caused by poor sanitation can spread in four main ways:

1. Through direct exposure to the contaminated soil.

Intestinal worms are spread when people are exposed to faeces from an infected person. Worm eggs that are shed in faeces remain in the soil and mature over days or weeks into an infective stage. Children are especially at risk because they may play in areas contaminated by faeces (Boota *et al.*, 2000:269).

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2. Through skin contact from contaminated water.

Bilharzias (schistosomiasis) occur when eggs in the faeces or urine of an infected person reach fresh water where certain species of snails live. The eggs develop into infective forms in the snail host and escape back to water. The tiny infectious form called cercaria then passes through the skin when people bath, wash, swim or play in infected water (Boota *et al.*, 2000:269).

3. Through drinking contaminated water or eating food contaminated by water.

Many serious diseases are spread through this route. They include diarrhoeal diseases; cholera and typhoid, giardiasis, amoebiasis and hepatitis A and E. These occur when a person drinks water that has been contaminated with faeces from those who are infectious. Food that have been washed or prepared in contaminated water, especially fruits and vegetables, also spread these diseases (Boota *et al.*, 2000:246).

4. Through eating contaminated water animals or plants.

Eating contaminated plants or animals contaminates people. Most of the diseases caused by these are limited to a certain part of the world (Boota *et al.*, 2000:246).

2.1.3 Basic causes of malnutrition

The basic causes of malnutrition include the number of people in the demographic household, ethnicity, education level of parents, occupation of parents, family

income, housing status, urbanisation, poverty, unemployment, politics, social structures, religion, beliefs and ideological factors and family food expenditure per month (UNICEF, 2000(a):1).

The basic causes of malnutrition are essentially political and economic. Income growth has an impact on reducing under nutrition. Other factors apart from income are those such as level of education, social equity and government behaviour. Good educational levels mean that individuals know how to access, assess and utilize information that is helpful to the attainment of good nutrition (Geissler & Powers, 2005:625).

2.1.3.1 Demographic and family resources

The stability of family and a relationship between a husband and wife in western society has become a central feature of social life, determining new family typologies that deeply affect the life course of individuals. As it often happens for new behaviours, diffusion takes place with a different gradient according to region, culture or social sector. In 2001, divorces and separations involved about 300,000 partners and children in western society. The number of reconstituted families increases, as well as the number of minors living in such families. Instability and the breakdown of family have relevant consequences of a demographic, social and economic nature for the persons involved. Residential and housing conditions change and there modifications of working strategies especially among women. The negative consequences of being separated or divorced affect partners as well as children and the risks of poverty for women with children increases (Urbino *et al.*, 2005:1-2).

2.1.3.2 Poverty

Poverty is defined in relation to lack of services that people in other areas have access to, such as education, health, good housing conditions, water, electricity,

appropriate sewerage, land ownership and sure tenure. In each family, the particular reasons and circumstances that lead to malnutrition vary, but the basic cause is poverty, which can result in young children having inadequate food intake, especially calories, but also protein, vitamins and minerals and then in these children having frequent bouts of other illnesses, especially diarrhoea and acute respiratory illnesses (Jones & Nelson, 2005:10-11).

According to Rattan and co-authors (2003:348), poverty has been viewed mostly as a problem of earning too little income, and consequently consuming too little to attain a socially acceptable standard of living and possessing too few assets to protect themselves against unforeseen problems. Poverty can be alleviated through employment creation, skills development and redistribution of assets from the rich to the poor. Poverty alleviation is an essential component of any successful strategy to achieve food security and essential sustainability. Poverty undermines the development and enhancement of the environment, threatens a steady and reliable food supply, destabilizes communities and regions and ruins lives (Rattan *et al.*, 2003:348-349).

Equally important to the consideration of the environmental sustainability of food security is the extent of the depth of poverty in both the developing and developed world. Nearly a quarter of the world's population, 1.3 billion people, live in absolute poverty. More than 840 million people lack access to sufficient food to lead healthy and productive lives. Being poor may include inadequate access to food, housing, education, meaningful work and health care as well as a general degrading of the quality of life (Rattan *et al.*, 2003:320-21).

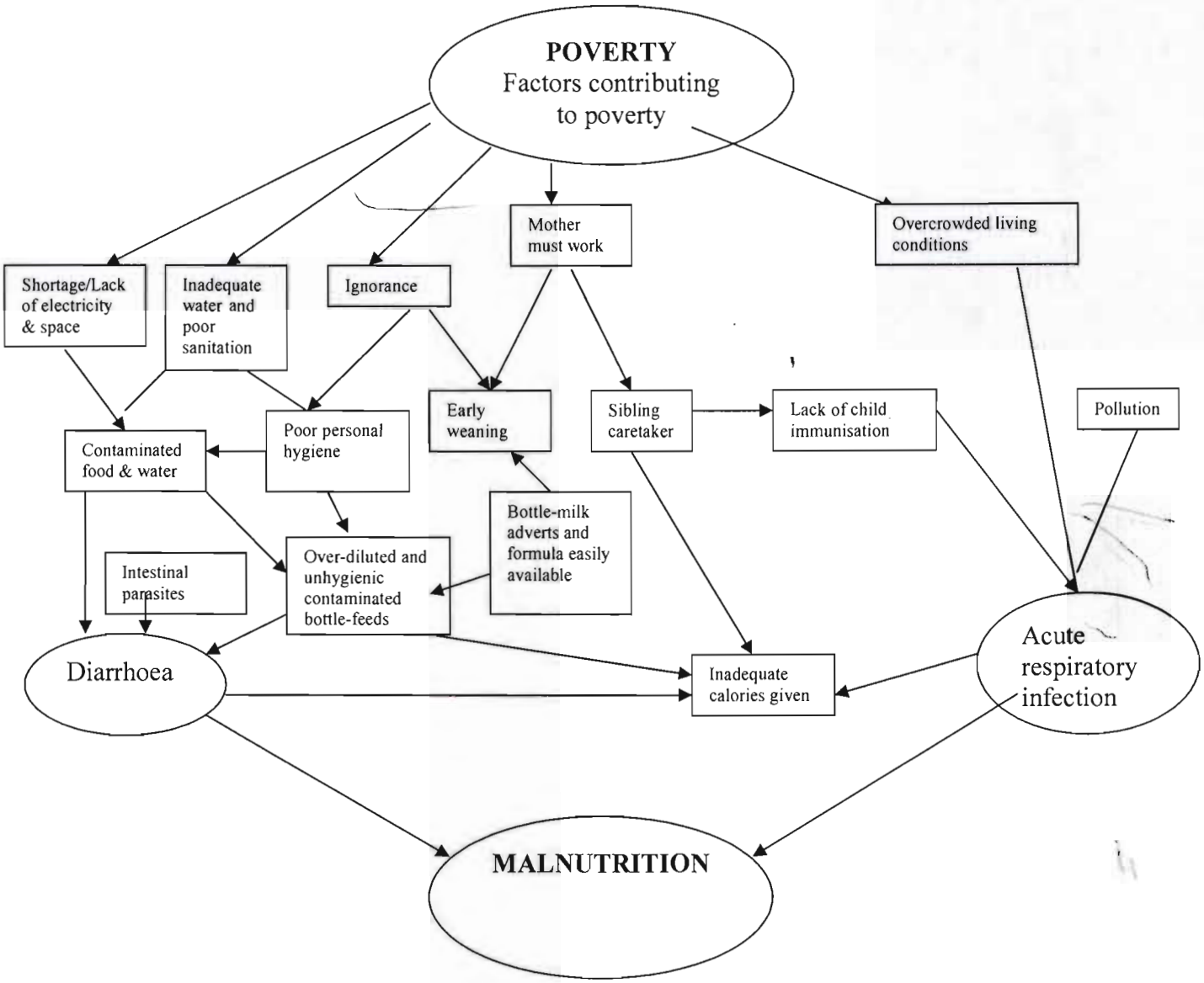

Figure 2.2 Factors contributing to malnutrition in young children based on poverty (Booth *et al.*, 2001:118).

2.1.3.3 Urbanisation

Sustainable development supports a balance between socio-economic development and the environment in the human advancement. High population growth and inadequate infrastructure in urban areas increases pressure on the environment and this may threaten the health and well-being of urban residents. Factors that bring about a natural increase in the population are rural-urban migration, strife and

hunger, leading to the internal displacement (Boadi *et al,* 2005:4). The failure of industries to absorb the increasing labour force has led to massive unemployment and a deepening poverty crisis in urban centres. Inadequate provision of infrastructure and services to accommodate population in urban population growth which has resulted in inefficient development of urban centres, rapid increase of squatter settlements, inadequate basic facilities including pure and clean water, sanitation and waste disposal. Poor environmental sanitation has resulted in the spreading of infectious diseases and deteriorating urban health (Banes, 2000:465).

2.1.3.4 Ideological factors

Ideological factors include habits, beliefs, cultural preferences, and all ideas that legitimise actions in society. The availability and control of human, economic and organisational resources at different levels of society are the results of historical processes in the society (Napier, 2002:21).

At the household level, because men usually control most of the resources, constraints are often placed on the achievement of the necessary conditions of food, care, and health (Urban, 2005:1-2).

2.2 Strategies to address malnutrition

Decision-making at all levels depends on an initial assessment, which is undertaken only when a problem is perceived and a commitment made to do something about it. Perception and commitment are dependent on the availability of information and the ability to understand the information. Analysis of the problem may be facilitated by the collaborative efforts of people most affected by and knowledgeable about the situation, together with people technically trained to undertake analyses of similar problems. Actions taken to improve the situation after this assessment and analysis may not lead to solutions of all aspects of the problem; however, they may contribute to creating a new situation that is more conducive to actions that may not

have been feasible before (Eide & Kracht, 2007:235-6). This cycle is depicted in Figure 2.3.

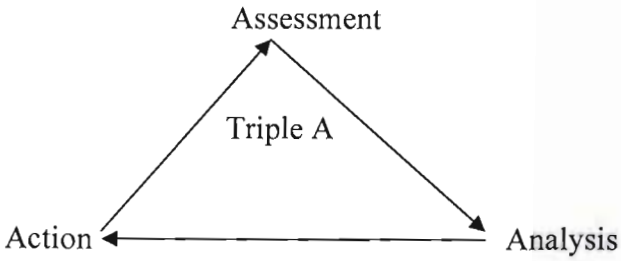

Figure 2.3 Triple A cycle (Eide & Kracht, 2007:235-6).

After this cycle of assessment of the situation of the women and children, analysis of the cause of the problem and action based on the analysis and available resources, the impact of actions is re-assessed and the situation re-analysed. For this process to take place there must be an information system in place that must include information not only about the end result of the situation (malnutrition, for example) but also about its causes (Urban, 2008:2).

Triple-A processes do not function in a vacuum. There are a number of factors that are critical to their success, and which must be present to fuel their operation. These are:

- perception and understanding of the nature of the nutrition problem. This influences, in particular, the choice of what is assessed, how it is analysed, and what actions are regarded as feasible;

-effective demand for nutrition-related information and motivation to act. Decision makers need information for designing actions as well as for convincing others that actions are necessary and feasible (creating coalitions);

-capabilities (primarily technical) to obtain information in assessment (monitoring) and to use information in analysis and design of actions;

-resources for the system, that is, for the establishment and maintenance of the nutrition information system, including human, economic, and organizational resources;

-resources for action. When there are inadequate human, economic, or organizational resources available to implement likely action, the focus of the nutrition information system must be to mobilize these resources (Urban, 2008:2).

Gender strategies are needed to address under and over nutrition especially among teenagers of South Africa to reduce stunting and the development of other chronic diseases (Jinabhai *et al.*, 2000: 944-5).

Table 2.1 Summary on how to address malnutrition (Etcheverry & Abrahams, 2005: 1-2)

Solutions for malnutrition	Problems and barriers towards solutions
Agricultural approach	Requires selective breeding or genetic engineering
Nutrition education for consumers	Cultural norms may interfere, requires educators with knowledge
Food fortification	Forms of chemical substance, choice of food, change in taste and texture, issues of distribution
Supplementation of minerals and vitamins	Limited accessibility, distribution problems and cost

When addressing micronutrient malnutrition in the country, a combination of interventions should be used involving the promotion of breast-feeding, modification of diet, increasing micronutrient bioavailability and consumption and

increasing food availability, food fortification and supplementation (Venktesh *et al.*, 2004:997).

2.2.1 Food fortification

*** Definition of fortification**

Fortification means the addition of one or more micronutrients by means of a fortification mix to a foodstuff, whether or not it is normally contained in a foodstuff, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the general population or specific population group of South Africa as determined by the Department (Department of Health, 2003(a):1).

The types and amounts of micronutrients are determined by the nutritional status which determines the nutritional needs of the population. Both the micronutrients added and food vehicles selected must have a sound scientific basis if the population is truly to benefit from them (Department of Health, 2003(a):2)

The children of Africa suffer much because of a lack of micronutrients such as iodine, vitamin A, and iron, which is especially prevalent in women. A lack of vitamin A, for example, causes leg ulcers and other major skin problems. Many children are born with deficiencies due to the health conditions of the mothers. Objectives are to reduce this lack of micronutrients in the diet (JAM, 2006:2).

*** Advantages of food fortification**

Food fortification plays a major role in substantially reducing vitamin A and iron deficiencies (Venktesh *et al.*, 2004:1997). It is an effective way of increasing nutrient intake and reduces deficiency diseases. Furthermore, fortification programmes are used to increase the intake of nutrients throughout the world (Mary *et al.*, 2006:330).

Food fortification with vitamins and minerals is one of the most effective methods of improving health and is aimed at preventing nutritional deficiencies such as goitre, rickets, beriberi and pellagra in the United States (John, 2005:1).

Food fortification is one of the major strategies to reduce malnutrition diseases in developing countries. It offers a unique opportunity for the industry to simultaneously expand its market and profitability while playing a key role in improving the health and nutritional status of the population. In order to have an effective and sustainable fortification programme, it is vital that the public and private sectors work in close collaboration, understanding and recognizing each other's interests and concerns (Reddy *et al.*, 2007:91).

*** Disadvantages of food fortification**

The disadvantages of fortification are the following:

- Fortification of foods that are targeted for the vulnerable and low-income growth needs high priority (Delange *et al.*, 2001: 437).
- It can result in toxicities and nutrient imbalance because, with the plethora of the products available lately, the risk of exceeding the tolerable intake level of some of the minerals and vitamins increases (Mary *et al.*, 2006:330-1).
- If milled cereals (e.g. wheat flour, maize meal, and ground sorghum) are used, the shelf life of such cereals may be reduced (Horton, 2006:1068).
- Specifically for vitamin C and folate, baking of cereal flour destroys most of the vitamins. Other nutrients, being more stable, would exhibit smaller reductions (Horton, 2006:1068).
- Fortification works well if there are widespread deficiencies (e.g., iron) and/or if the cost of the fortificant is not too high (Horton, 2006:1068-9).
- Fortification requires a suitable food vehicle. There are populations that are hard to reach with commercial fortification, particularly those living in more

remote geographic areas and not utilizing purchased foods (Horton, 2006:1068-9).

*** Fortification legislation in South Africa**

When fortification of a food vehicle is being considered, the following principles apply worldwide:

* There must be evidence that there is a need for the micronutrient to be added.

* The food selected must be consumed by the population who are at risk of developing deficiencies because of a lack of micronutrients in the food they eat.

* The food/s selected for fortification must be eaten regularly.

* The fortified food must have an acceptable shelf life under normal conditions of storage, distribution and use.

* The micronutrient(s) added must be available from the food for use by the body.

* Fortification should not produce undesirable changes to the taste, texture and smell of the food.

* Fortification should not substantially increase the price of the food.

* The process of fortifying food should not be expensive.

* Methods of measuring, controlling and/or enforcing the levels of micronutrients should be in place (Department of Health, 2003(b):1-2).

Although not defined as a micronutrient, many countries add iodine (in the form of iodate) to salt. South Africa is one of the countries that has laws in place for the mandatory iodations of salt and follows a recommendation by the World Health Organisation (Department of Health, 2003(b):2).

Prior to 2003, only salt was required by law to be fortified in South Africa. Many products like bread, maize meal, breakfast cereals and fruit juices, to name just a few, have been, and still are, fortified with various micronutrients on a voluntary basis. There are certain laws that give details on the type of package labelling required for voluntary fortification (Department of Health, 2003(b):2).

A National Food Consumption Survey (NFCS) was carried out by a group of nine South African universities. The results showed serious deficiency problems amongst a large percentage of the South African population and it was recommended that a mandatory food fortification programme be planned (Department of Health, 2003(b):2).

The Department of Health realised that all role players had to be involved from the start and that consensus had to be reached by all parties. This resulted in a series of intense meetings and discussions where the different views of the Department of Health, nutritionists; the milling industry, consumer groups and micronutrient suppliers were heard. In the end, agreement on a National Food Fortification Programme was reached. Legislation was developed covering all aspects, including the levels of fortification, the food vehicles, a fortification logo, a consumer education programme and strict requirements for the manufacture and sale of the micronutrients to be added (Department of Health, 2003(b):2).

On 7 April 2003 the National Minister of Health launched the National Food Fortification Programme for South Africa and the legislation was published (Regulations relating to the Fortification of Certain Foodstuffs). As a result of these regulations, from 7 October 2003 all maize meal and bread flour in South Africa was fortified with the following nutrients: vitamin A; thiamine (vitamin B1); riboflavin (vitamin B2); niacin; folic acid; pyridoxine (vitamin B6) and the minerals iron and zinc.

As a result of the National Food Fortification Programme, a serious health problem was addressed in this country and it is hoped that this will hopefully improve the quality of life of many South Africans.

The Department of Health requires that manufacturers and importers of food vehicles obtain the fortification mix only from companies that have registered with the Department; and that they keep on record a certificate of compliance for every batch of fortification mix in the format specified (Department of Health, 2003(b):2-3).

The formulation of the fortification mix for wheat flour and maize meal, based on the micronutrient requirements specified, are depicted in Table 2.2 and table 2.3 respectively:

Table 2.2 Fortification standards: wheat flour and bread (Department of Health, 2003(b):6)

		WHEAT FLOUR		WHEAT BREAD	
Micronutrient	**Unit**	**White**	**Brown**	**White**	**Brown**
Vitamin A[1]	mcgRE/kg	1610	1415	800	700
Thiamine	Mg/kg	3.91	3.79	2.49	2.54
Riboflavin	Mg/kg	2.05	1.95	1.41	1.39
Niacin	Mg/kg	38.42	54.76	27.91	41.59
Pyridoxine	Mg/kg	2.82	3.07	2.13	2.67
Folic acid	Mg/kg	1.36	1.24	0.74	0.74
Iron	Mg/kg	43.65	47.97	32.26	34.69
Zinc	Mg/kg	20.70	26.73	15.30	20.07

Table 2.3 Fortification standards: maize meal (Department of Health, 2003(b):6-7)

		MAIZE MEAL			
Micronutrient	**Unit**	**Super**	**Special**	**Sifted**	**Un-sifted**
Vitamin A[1]	mcgRE/kg	1877	1877	1877	1877
Thiamine	Mg/kg	3.09	3.86	4.76	5.57
Riboflavin	Mg/kg	1.79	1.88	1.97	2.06
Niacin	Mg/kg	29.70	31.86	34.65	38.25
Pyridoxine	Mg/kg	3.89	4.25	4.79	5.42
Folic acid	Mg/kg	1.89	1.90	1.92	1.94
Iron	Mg/kg	37.35	40.14	44.28	50.40[2]
Zinc	Mg/kg	18.90	22.55	26.60	30.20

The fortification standards referred to in Table 2.3 and Table 2.4 of these regulations are the minimum micronutrient levels in uncooked wheat flour and uncooked maize meal when sampled at the point of manufacturing, importation or sale (Department of Health, 2003(b):6-7).

2.2.2 Food supplementation

* Definition of food supplementation

Supplementation is the addition of nutrients that are not normally present or are present in only minute quantities in the food. More than one nutrient may be added, and they may be added in high quantities (Karim *et al.*, 2005:1).

Dietary supplements are available widely through many commercial sources including health food stores, grocery stores, pharmacies, and by mail. They are provided in many forms including tablets, capsules, powders, gel tabs, extracts, liquids, and others (Karim *et al.*, 2005:1).

* Advantages of supplements

Advantages of supplements are the following:

- Formulations of B vitamins boost energy, a complex of vitamin B and C offers stress reduction, antioxidant mixes protect from cancer and heart diseases and herbal products promote are relaxation and mental well-being.
- Supplementation reduces preparation time of food and it is sustainable.
- Food supplements can improve the educational abilities of children with learning difficulties.
- Supplementation is very specific for treatment.

- The actual cost of many vitamins, especially vitamin C, is quite low relative to that of other relief items such as medicines and food (Karim *et al.*, 2005:2).

*** Disadvantages of supplements**

The disadvantages of supplements are the following:

- Supplements must be chosen with care to ensure that nutrient needs are met and the risk of toxicity is minimal.
- It is important to ensure that the product provides all nutrients needed and that it does not contain ingredients or amounts that could cause ill-effects (Mary *et al.*, 2006:343-44).
- They are more costly than other measures.
- Not all nutrients or minerals can be distributed in tablet form, because overdosing can have dangerous adverse effects. This is especially true in the case of iron, overdoses of which can lead to death from overwhelming infection in severely iron-deficient individuals. Iron-deficient individuals are extremely susceptible to infections, and in their depleted state, a sudden influx of therapeutic iron may provide optimum conditions for replication by the infectious agent and overwhelm the host's resistance to an infection that would otherwise not have been fatal. These restrictions do not apply to iron and vitamin A given in usual daily doses. In addition, massive doses of vitamin A cannot be given to pregnant women. Currently United Nations High Commissioner for Refugees (UNHCR) policy is to give vitamin A to all children under five years old through mass distribution, but this procedure cannot be extended to adult women or girls because of the potential danger of toxicity to the foetus if they should be pregnant.
- Some vitamins need to be distributed frequently because they are not adequately stored in the body. This is especially true for vitamin C.

- Mass distribution is not easy logistically. For example, during an outbreak of scurvy in a large population (among 300,000 refugees in eastern Sudan in 1985), as many as three million vitamin C tablets were required per month. Procurement of such quantities from standard commercial pharmaceutical companies is difficult, and urgent air shipment of consignments is often logistically difficult and expensive.
- Trained personnel are needed to distribute tablets to ensure compliance and to avoid danger of toxicity from overuse of iron and vitamin A. However, outreach personnel are most often urgently required for other essential work such as immunization, oral rehydration, and epidemic control, and tablet distributions can interfere with these other life-saving activities.
- An individual who misses one distribution may have to wait some time for another (e.g. four to six months for vitamin A). Newly arriving refugees may appear just after a tablet distribution and hence be at risk of deficiency before the next campaign.
- Compliance is not ensured among traditional populations who are unfamiliar with tablets and may view them with suspicion. Non-compliance renders the activity cost-inefficient **(University of Saskatchewan, 2006:2).**

2.2.3 Food diversification

Food diversification is a way of sustaining lives by producing food through gardening to maintain good health. It is attributable to plant and animal sources, which often provide significant nutritional security (Wahlqvist, 2005: 52-61).

* Home gardens

In many agricultural communities, people rely on one main staple crop whose seasonality implies a period of food shortage, usually referred to as the lean or the hungry season. Home gardening can often supplement family food supplies during lean periods and can generate added income when other sources of employment and

income may be limited, provided enough water is available. Women, who often water and manure their gardens from domestic wastes and use them to produce early crops such as green maize and the fruits, spices and vegetables needed to prepare relishes, are the ones who mainly maintained home gardens (Economic and social development, 2004:2).

Home gardens are labour intensive, but as they are usually close to the house, the labour required can be combined with home and childcare responsibilities. Children are often responsible for carrying water and for simple maintenance work, and they may also be given a few plants or a small area to tend. Support of home gardening through horticultural training and nutrition education at school, including the establishment and maintenance of a school food production garden, will provide useful training in intensive land management for the next generation (Economic and social development, 2004:2-3).

Important factors to consider in encouraging the expansion of home gardens include security of land tenure to facilitate long-term investment in home gardens and better extension services, including credit, to promote the wider establishment of home gardens and improve their management (Economic and social development, 2004:2).

Traditional home gardens continue to be important sources of micronutrients for rural communities. Poor people obtain most of their nutrients from food plants, which are cheaper and more accessible than animal foods. In humid tropical countries, green leafy plants such as *Amaranthu,, Corchorus, Bidens, pilosa, Gynandropsis, Celosia, Basella, Solanum scabrum, Solanum americanum, Hibiscus sabdariffa and Vigna unguiculata* often grow wild and spontaneously. Traditionally, they have been consumed as leafy vegetables when climatic conditions have made the cultivation of exotic vegetables more difficult. The leaves of these plants tend to be good sources of protein, phosphorus and iron as well as vitamins A and C and in some cases B-group vitamins. In many cases, they are of

higher overall food value than introduced vegetable species, for example cabbage or tomatoes (FAO, 2005:1-2).

Through careful selection, a range of fruit and vegetable crops can be cultivated throughout the year to provide a constant supply of micronutrients For example, yellow and orange perennial fruits (e.g., mango, papaya, cape gooseberry and guava), fruit vegetables (e.g., tomato, pumpkin, squash, gourd and eggplant), some root vegetables (e.g. carrot and yellow-fleshed sweet potato) and most dark-green leafy vegetables are generally moderate to good sources of vitamins A and C. Also, some leaves and fruits produced by local indigenous trees such as guavas and loquats are consumed in rural areas and are rich in micronutrients (FAO, 2005:1).

Some staple foods also have a role as sources of micronutrients. For instance, leaves of roots and tubers are valuable sources. In many countries of the humid African tropics, leaves of cassava are also consumed. Millets are rich sources of iron in comparison with other cereals such as wheat or maize (FAO, 2005:2)

*** School gardens**

School gardens can make a real difference to children's health by

- giving children nutrient-rich fruit and vegetables which are lacking in their diet;
- showing children how to grow, prepare and eat vegetables;
- encouraging families to grow vegetables too;
- helping children to understand what makes a good diet;
- helping children to like nutritious home-grown food;
- showing children the link between what they grow, what they eat and how they feel (FAO, 2005:1-2).

School gardens can add nutritional value and variety to school meals, but they cannot feed the whole school. To produce enough food for that, children would

have to work very long hours. This is not ethical or educational, and would certainly be very unpopular - with both children and their parents (FAO, 2005:2).

School gardens have many roles in the life of the school and community. They should be places where:

- It's good to play, work and study;
- many projects are carried out - e.g., studying bugs, building tables, measuring rainfall;
- people meet people - e.g., community members, parents, children, school teachers, cooks;
- events take place - e.g., selling snacks, staging dramas, holding demonstrations or food fairs;
- Work is displayed - e.g., garden art, photos, drawings, maps, written accounts; everyone learns, including visitors and teachers (FAO, 2005:3).

Gardens are initiated to create a successful, sustainable garden using organic methods, provide a model of a mixed kitchen garden for the community, produce food for the school, improve children's diet with garden produce, improve children's eating habits, sell garden produce to get income for the school, help children survive and prosper in the world and also to bring together school, children, families and community in a common endeavour (FAO, 2005:1).

School gardens are an excellent way to teach children about the food they eat. Children have the opportunity to grow fruits and vegetables, and they learn firsthand about different foods. Many programmes also let children prepare and eat the food they grow (FAO, 2005:2-3).

This is an effective way to educate children, and their parents, about the nutritious advantages of fresh, locally grown food while helping children get balanced meals.

Gardening programmes are also an excellent way to teach about sustainable agriculture and the plight of small farms around the country (FAO, 2005:2-3).

2.2.4 Nutrition education programmes

Nutrition and health behaviours are complex issues because people possess very different combinations of background, culture, and health risks as well as beliefs, motivation, learning styles, environments, goals and expectations (Grosvenor, 2006:518).

The Nebraska's Nutrition Education Programme (NEP) helps families on a limited budget improve the quality of their diet. NEP participants acquire the knowledge, skills, attitudes, and behaviour changes necessary to improve their health. The NEP is free to all participants who meet income guidelines. It has implemented adults and senior classes as well as youth classes in nutrition (University of Nebraska, 2007:1).

NEP is the umbrella term for the Expanded Food and Nutrition Education Program (EFNEP) and Food Stamp Nutrition Education in Nebraska. Both programmes receive federal funding from the United States Department of Agriculture. The University of Nebraska-Lincoln Extension manages the programme and NEP Staff in local Extension Offices deliver it to residents in over 42 counties in Nebraska (University of Nebraska, 2007:2-3).

2.2.4.1 Adult and Senior NEP Classes

Adult and Senior NEP classes are comprised of six nutrition lessons. Each lesson includes hands-on learning activities to help participants apply what they learn in class to their daily lives. All participants learn about meal planning and shopping and budgeting for food. There are also additional topics depending on the needs of the group. The food Pyramid may be included (Healthy Snacking, The Vegetable Group, The Fruit Group, The Milk Group, The Grains Group, The Meat and Beans

Group, and Breakfast). Topics for pregnant women and parents with young children differ, and the topics for Feeding Your Infant, Feeding Your Children, or Prenatal Nutrition may also be covered. The concepts of Food Safety, Food Preparation, Physical Activity and Goal Setting are tied into every lesson. When participants complete six lessons, they receive a certificate and a beautiful cookbook. Classes are taught individually, in small groups at agency or community sites, at home through mail lessons, the Internet or phone visits (University of Nebraska, 2007:1).

2.2.4.2 Youth NEP Classes

The Nebraska Youth NEP classes take place at a variety of community sites including preschools, childcare centres, after school programmes, and summer youth camps. NEP also teaches during the regular school day in qualifying schools (University of Nebraska, 2007:1).

2.2.4.3 Integrated nutrition programme in South Africa

The vision of this programme is optimum nutrition for all South Africans. It is recognised that nutrition is multi-sectoral and complex. Nutrition status is improved through a mix of direct and indirect nutrition interventions implemented at various points of service delivery such as clinics, hospital and communities and aimed at specific target groups (Department of Health, 2008:1).

The aim is to:

- Ensure that 25 percent of all health facilities are baby friendly.
- Increase the proportion of mothers who breast-feed their babies exclusively until at least six months of age and who breast-feed their babies until at least 12 months of age.
- Contribute to the reduction of mortality due to infectious diseases particularly diarrhoea, measles, and acute respiratory infections in children less than five years of age by 50 percent, 70 percent and 30 percent respectively, through nutritional support and counselling.

- Contribute to reducing the prevalence of low birth weight to ten percent of all live births.
- Increase regular growth to reach 85 percent of children less than two years of age.
- Reduce the prevalence of severe underweight (weight-for-age) to one percent among children less than five years of age (Department of Health, 2008:1).

2.2.5 School feeding projects

2.2.5.1 Government school feeding in South Africa

In 1994, government introduced the National School Nutrition (NSNP) Programme, a poverty alleviation strategy, as a part of the reconstruction and development programme of the newly founded democratic Republic of South Africa (Department of Education, 2002:1). Government's objective was to ensure unreserved access to basic quality nutrition as provided by the Government and the Department of Education and aimed to benefit learners from the poorest schools (Department of Education, 2002:1).

The NSNP is funded on a conditional grant with funds from the Medium Term Expenditure Framework (MTEF) and other donors (Department of Education, 2002:1). In order to receive funding for the NSNP, each province is required to submit a business plan duly signed by the Head of Department or Superintendent and approved by the Director General of Education fulfilling all the conditions associated with budgeting and financial management by a public entity as directed in the Public Finance Management (Department of Education, 2002:1-2).

Figure 2.4 Children participating in the primary school nutrition programme (JAM, 2006:2-2)

2.2.5.2 **Joint Aid Management School feeding programmes**

The Joint Aid Management (JAM) school feeding programmes have the main objective of assisting malnourished children to attend school and further their education while receiving good nutritional intake. The 100-150g daily food ration distributed through the nutritional programmes is a porridge- type blend made up of corn, beans, sugar, milk and oil and provides the children with 70-100 percent of their recommended daily allowance, as determined by UNICEF (JAM, 2006:2). The food distributed is manufactured by Joint Aid Management in Beira, Mozambique and in Lobito, Angola. By assisting children to receive education, JAM believes it is helping them to sustain food security in the future.

Through Health and Social Welfare nutritional feeding programmes, JAM provides nutrition to children in hospitals; clinics and orphanages to assist in strengthening their bodies, improving their energy levels and helping them fight disease and infection (JAM, 2006:2-2).

JAM selects the countries and areas for nutritional feeding programmes based on magnitude of need and lack of other aid interventions. It works closely with, and relies on information from, the relevant country's Department of Health and Department of Education as to where the greatest needs are geographically. JAM

conducts surveys assessing hunger, malnutrition and school attendance and achievement in order to determine where the need is greatest (JAM, 2006:2-2).

JAM school feeding beneficiaries are generally between three and 14 years old, attending a pre-school or primary school. Marginal schools in low-income communities are targeted particularly those in rural areas, where protein and energy malnutrition (PEM) are evidently a problem (JAM, 2006:4).

The communities are required to form a Parent Teacher Association (PTA) before the school can be accepted as part of the School Feeding programme. This ensures full community support. The signing of a contract with the PTA, which commits to assist in the implementation of the programme, promotes community ownership. This results in a programme that is accepted by the community and implemented by them in partnership with JAM, and thus ensures long-term sustainability.

2.3 CONCLUSION

Malnutrition is commonly caused by a poor economy, lack of resources, and an inadequate or unhealthy environment that leads to lack of education and food security resulting in a shortage of nutrition intake, social stress and trauma and various diseases that can cause death. However, a number of strategies are adopted to address malnutrition amongst children. These are food fortification, food supplementation and food diversity, of which school feeding programmes form part.

This study formed part of the JAM school feeding programme in Orange Farms. The study methods and results will follow in the next chapters.

CHAPTER 3

STUDY DESIGN AND METHODS

3.1 INTRODUCTION

This chapter includes the methods used when conducting the study. Figure 3.1 illustrates the summary of the methods that were used to accumulate all the data needed to complete the study from the planning, arrangement of meeting, collection of letters of consent, selection of samples from different schools, data capturing, analysis and interpretation, to the writing of the final report.

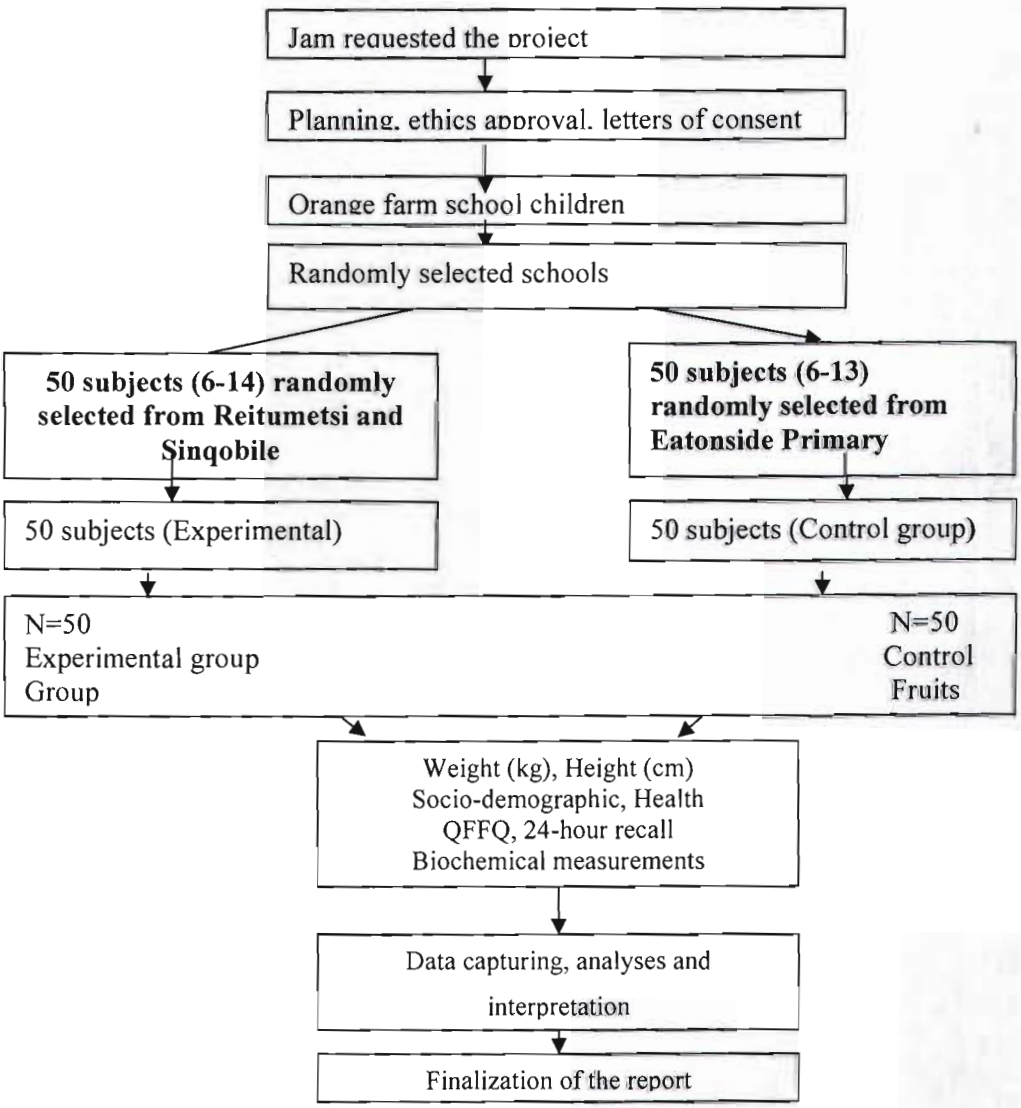

Figure 3.1 Contextual framework of the study

3.2 PLANNING AND ADMINISTRATION

Joint Aid Management (JAM) identified a need for this study and requested Vaal University of Technology (VUT) to undertake the research. The initial step was to visit the schools to meet and explain the project objectives to the teaching staff members. A public meeting followed with the parents to explain the project objectives and to get permission to conduct the study. Letters of consent (including information explaining the purpose of the study as well as the procedure to be followed during the study) were given to the volunteer parents of the primary school children to sign (Annexures A and B).

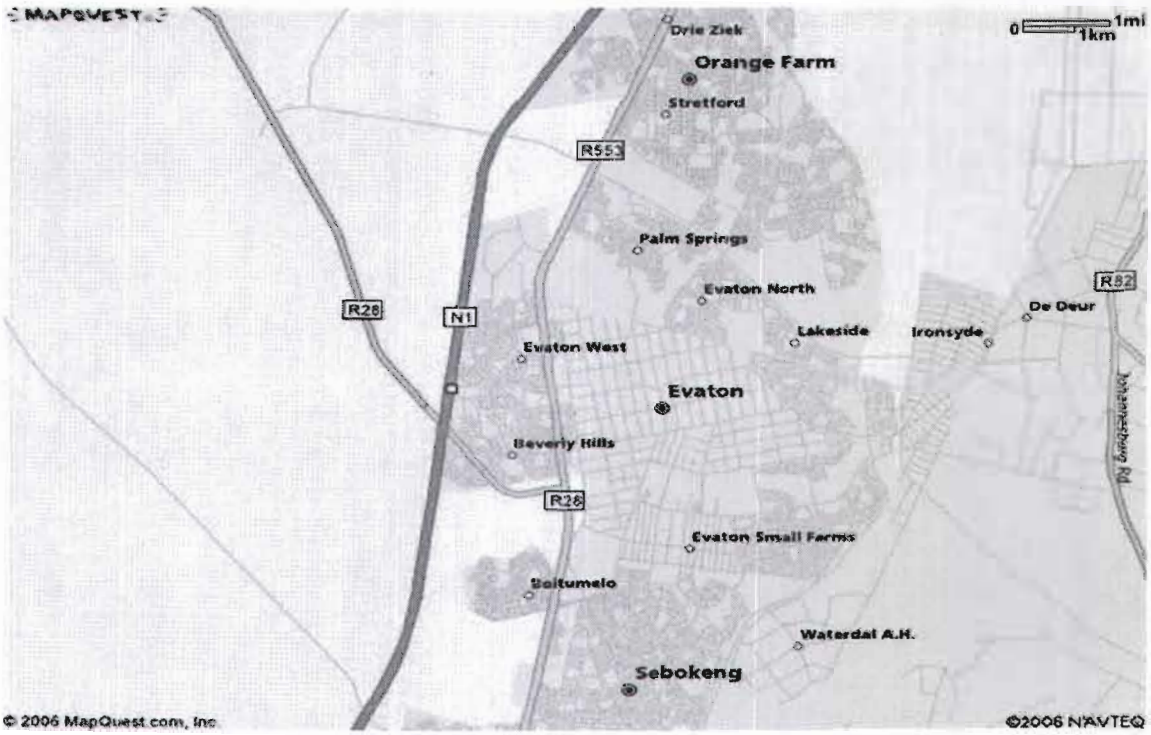

Figure 3.2 Map indicating the location of Orange Farms

3.3 ETHICAL CONSIDERATIONS

The University of Witwatersrand Medical School's Medical Ethics Committees for research on human beings of the approved the study (R14/49) (Annexure C). The protocol was submitted in accordance with the South African Medical Research Council guidelines. Written consent from parents or guardians of subjects younger than 21 years of age was signed during the meeting at the school. A numbers was allocated to each volunteer subject to ensure confidentiality of the information (data collection and the drawing of blood) and the subject's identity. The consent form explained the purpose of the study as well as the procedure to be followed during the study.

3.4. FIELDWORKERS

Ten trained fieldworkers were recruited from the Department of Hospitality and Tourism to assist with data collection. These ten fieldworkers were trained in 2004 and some in 2005 by a qualified dietician to complete socio-demographic, health, quantified food frequency (QFFQ) and 24-hour recall questionnaires and in how to undertake anthropometric measurements. Emphasis was placed on ensuring that the fieldworkers would be aware of the objectives and importance of the project through ongoing training and workshops before they began with data collection. Only third year and BTech level students in Food and Beverage management from Vaal University of Technology who spoke Venda, Xonga, Zulu and Sotho were involved in data collection because they were able to communicate with the schoolchildren in the language that they understood as most of the children spoke those languages. From the onset of this project, training was extensively incorporated. Both training for the initial implementation of the activities and refresher courses throughout the project were included.

Four qualified nursing sisters were incorporated in the fieldworker's team. The nursing sisters were trained by a haematologist on campus on the expected blood sampling and collection methods.

3.5 STUDY POPULATION

The sample consisted of 50 volunteer primary school children attending Sinqobile and Reitumetse primary schools (experimental group) in Orange Farms, and 50 volunteer children attending Setlabotjha primary school (control group) in Eatonside.

The formula that was used to determine the sample size per group is as follows

$$SS = \frac{Z^2 * (p) * (1-p)}{C^2}$$

Where:

Z = Z value (e.g. 1.96 for 95 percent confidence level)

p = percentage picking a choice, expressed as decimal

(.5 used for sample size needed of 50 variables)

c = confidence interval, expressed as decimal

(e.g., $.014)^2$

This is how sample size was calculated using the formula above

$$\frac{1.96^2 \times (0.5)(0.5)}{0.14^2}$$

$$\frac{3.8416 \times 0.25}{0.0196}$$

= 49 (50)

An experimental sample of 50 subjects from the schools in Orange Farms and the control samples of 50 children from Eaton side were randomly selected from among all those schoolchildren from six to 14 years of age with completed and signed letters of consent.

The inclusion criteria were the following:

Only boys and girls aged between six and 14 and attending Reitumetsi and Sinqobile primary schools in Orange Farms and Sethlabotja Primary School in Eatonside were included.

3.6 EMPIRICAL STUDY DESIGN

The study design was experimental and the project was conducted in the following three phases:

3.6.1 Phase 1: Baseline survey

A cross-sectional baseline survey was conducted two weeks before commencing with the school feeding programme. The measurements taken during this phase are summarized in Table 3.1.

Table 3.1 Variables for baseline survey

Variable	Measuring instruments	Statistical analyses
Socio-demographic indicators	Socio-demographic questionnaire	Descriptive statistics
Health indicators	Health and medication questionnaire	Descriptive statistics
Dietary intake patterns	Quantified food frequency questionnaire (QFFQ) and 24-hour recall	Means and standard deviations (SDs)
Food consumption patters	QFFQ and 24-hour recall	Means and standard deviations (SDs)
Anthropometric measurements	Height and weight measurements	BMI-for age
Ferritin, total protein, albumin, iron, transferring	Full blood	Means and standard deviations (SDs)
Full blood count, haemoglobin, haematocrit, red blood cell count, mean cell volume, white blood cell count	E D T A	Means and standard deviations (SDs)

3.6.1.1 Measuring instruments

Questionnaires

Various questionnaires and measurements were used in this study as summarised in Table 1.

*** Socio-demographic questionnaires**

The socio-demographic questionnaire was developed and validated by the research group of the Institute of Sustainable Livelihoods at the Vaal University of Technology. It included questions on role of the family, age, accommodation, number of people who are living at home, age of dwelling, type of the house, description of the dwelling, home language, the number of residents and rooms in the household, employment status, educational level, the residence setting, the person responsible for preparing meals in the household and the number of meals per day (Annexure D).

*** Health and medication questionnaire**

The validated health questionnaire of Gauteng Provincial Administration (GPA) was used. It includes questions on gender, health status, level of physical activities, frequency of smoking, frequency of drinking health facility used, method of travelling to the health facility, number of pregnancies, number of children and description of the child's behaviour (Annexure E).

*** Quantified food frequency questionnaire (QFFQ)**

The validated questionnaire that was used in the Transition and Health during Urbanisation in South Africa (THUSA) study (McIntyre, 1998) was adapted and used in this study to examine usual dietary intake (Annexure F). The questionnaire consisted of two components, namely a list of the food and a set of frequency-of-use response categories. An extensive list of defined foods was included with the aim of estimating usual food intake. To verify the intake all the subjects completed QFFQs in individual interviews with the assistance of fieldworkers at baseline and at the end of the clinical trial. Food models were used simultaneously to determine portion sizes and to explain the food item to subjects.

*** 24-hour recall questionnaire**

The 24-hour recall questionnaire is a retrospective approach and served as reference measure for the QFFQ. It included information about the food and portion sizes consumed the day before the 24-hour recall was administered. The estimation method was used to estimate portion size, as schools did not have utensils or scales. Household measures like cups and tablespoons as well as food models were used (Annexure G).

3.6.1.2 Anthropometric measurements

Height-for-age (H/A) reflects height relative to chronological age, weight-for-age (W/A) reflects weight relative to chronological age and weight-for-height (W/H) reflects body mass relative to height (NHNES, 2003:4).

Height and weight were recorded at the baseline and at the end of the intervention (after ten months).

All subjects were weighed in light clothes without shoes on a portable digital electronic calibrated bathroom scale to ensure that the measurements were accurate. Two measurements for weight were taken, which were not to vary by more than 0,5 kg and then the average of the two measurements was used. Two measurements for height were taken with no more than 0,5 cm variance and then the average of the two measurements was used. Height was measured with an upright stadiometer placed against a perpendicular wall at the primary schools.

3.6.1.3 Biochemical measurements

Using a vacutainer needle with minimal use of tourniquets, blood was drawn from the vena cephalica of the seated subject after an 8-12 h fast. A qualified nursing sister collected the blood samples from the subjects. All the blood samples were drawn between 07h00 and 10h00 with minimal stasis to avoid effects of diurnal variation. Vacutainer blood collecting tubes were labelled in advance with the subject's trial number. Blood sampling and biochemical measurements for baseline were repeated after ten months of the trial.

The following samples were collected from each subject:

- 5 ml in an EDTA (whole blood) for full blood count, haematocrit (Hct), mean cell volume (MCV), red blood cell count (RBC), haemoglobin (Hb) and white blood cell count (WBC).
- 10 ml in silicone-coated tubes for the preparation of serum for the analysis of serum ferritin, iron, albumin, total protein and transferrin.

All blood samples were collected and handled by a haematologist under controlled standardised conditions. Blood samples were separated within 2 hours of blood collection. Separated plasma and serum were aliquoted in marked Eppendorf test

tubes. Two qualified medical technologists continually audited the separating procedure.

Table 3.2 Summary of the methods used for measurement of biochemical variables

Variable	Sample	Method
Haematocrit (Hct)	EDTA_blood	Numeric integration
Haemoglobin (Hb)	EDTA_blood	Cyanomenthaemoglobin-colorimetric method
Mean cell volume (MCV)	EDTA_blood	Impulse generating
Red blood cell count (RBC)	EDTA_blood	Cell counting-auto analyser
White blood cell count (WBC)	EDTA_blood	Cell counting-auto analyser
Ferritin	Serum	Immunoturbidity; Roche Unimate 3 FERR
Total protein	Serum	Colorimetric method
Albumin	Serum	Colorimetric method
Iron	Serum	Colorimetric method
Transferrin	Serum	Immunoturbidity

3.6.2 Phase 2: Intervention study (school-feeding project)

3.6.2.1. Study design

The study design used was a single matched "placebo"-controlled, parallel group, and clinical trial of ten months in subject volunteers.

3.6.2.2 Subjects

The same children participating in the baseline survey were used for the intervention study.

3.6.2.3 Intervention study

The experimental group (n=50) was given 100g of corn soy blend (CSB) porridge each school day for a period of 10 months. The CSB consisted of 65 percent corn,

25 percent soy and ten percent sugar and contributed, as a percentage of the dietary reference intakes for children aged nine to 13 years old, 15 percent of energy, 20 percent of fibre, 68 percent of iron, 32 percent of zinc, 42 percent of vitamin A, 55 percent of thiamine, 24 percent of riboflavin, 35 percent of niacin, 28 percent of vitamin C and 53 percent of vitamin B6 respectively. The control group (n=50) received a fruit each school day for the same period. School holidays, weekends and public holidays were excluded.

3.6.3 Phase 3: Impact measurement

After the ten-month period, the same measurements for the baseline survey were repeated for biochemical, anthropometrics, dietary intake and food consumption, measured by the same fieldworkers and nursing sisters following the same standardised procedures.

3.6.3.1. Data analysis

After completing the fieldwork, questionnaires were checked for completeness and accuracy. The data were captured on Excel spreadsheet by the researcher. Only 45 of from the experimental group and 47 of the control group were used, as five and three children in the experimental and control groups respectively were lost at follow-up after ten months. Data were analysed with the assistance of a qualified statistician on the Statistical Program for Social Sciences, version 12.

3.6.3.2 Socio-demographic and health questionnaires

Descriptive statistics were performed and the data were presented in terms of percentages and frequencies.

3.6.3.3 Dietary intake

The QFFQ (quantitative food framework questionnaire) and 24 hour recall were analysed, with the assistance of a dietician, on the South African Medical Research Council FoodFinder® software program based on the South African food composition tables to establish the nutrient intake and food consumption. The data were analysed for the lowest, mean and the highest intakes of all the nutrients and compared to the dietary reference intakes of children aged nine to 13 years old. The list of top 20 food items most commonly consumed was drawn up from the data. Paired t-tests were done to compare statistically significant differences between the baseline and follow-up data.

3.6.3.4 Anthropometric measurements

The NCHS growth charts were used to make a statistical comparison of the anthropometric indicators. Height and weight measurements were classified according to weight for age, height for age and body mass index (BMI) for age by a qualified statistician who drew scatter plots on the NCHS growth charts. The cut-off points used were the 5^{th}, 25^{th}, 50^{th}, 85^{th} and 95^{th} percentiles of the NCHS median

3.6.3.5 Biochemical analyses

Biochemical data were analyzed by a trained haematologist and captured on the Statistical Package for Social Sciences (SPSS), version 12.0 for both the baseline and follow-up results. Descriptive statistics (frequencies, means, SDs and confidence intervals) were determined. Paired t-tests were done to compare statistically significant differences between the baseline and follow-up data.

Pearson correlation coefficients were used to test for associations between biochemical and haematological variables, as well as between dietary and biochemical and haematological variables.

3.6.4 Compliance

Acceptability of the CSB to primary school children was continually assessed by approaching the children individually, by counting the number of children who ate the CSB on a specific day and by counting the bowls that had been used to serve the children. Another master's student measured compliance as part of her MTech studies.

A key component of the project was the timely reporting and disseminating of dietary data, and was dependent on appropriate mechanisms for thru rapid processing and analysis of data.

3.7. Conclusion

The main objective of nutritional intervention assessments was to determine whether CSB (corn soya blend) would improve the nutritional status of children who required nutritional support to maintain good nutritional status. The main goal was to measure the impact of a school feeding programme on the nutritional status of primary school children after the period of ten months. This chapter described the methods used and the results will be discussed in the next chapter.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

This chapter includes the results and discussion of both the baseline survey and the intervention study described in chapter 3. In tables, the majority category percentage is highlighted.

4.2 BASELINE STUDY RESULTS

4.2.1 Socio- demographic results

Table 4.1 presents control and experimental group results in terms of percentage of age, role in the family, family size, work status, income, education, meals per day, child allowance as well as household equipments.

Table 4.1 Roles of caregivers

	Experimental group (n=45)		**Control group (n=50)**	
Role	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Mother	32	**71.1**	38	**76**
Father	5	11.2	3	6
Grandmother	6	13.3	7	14
Grandfather	0	0	0	0
Care giver	2	4.4	1	2
Other	0	0	1	2

The results in Table 4.1 indicate that the majority of the respondents responsible for children in the family in both the experimental and the control group were mothers (71.1percent of the experimental group, 76 percent of the control group), followed by grandmothers (13 percent of the experimental group and 14 percent of the control group).

Table 4.2 Age of caregivers in years

	Experimental group (n=45)		Control group (n=50)	
Age	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
20-30	5	11	10	20
31-35	6	13	8	16
36-40	7	15	9	18
41-45	14	**31**	11	22
46 and above	13	29	12	**24**

The mean ages of the care givers are summarized in Table 4.2 and the results showed that the majority of care givers in the experimental group were older than 40 years (60 percent) compared to the control group where the majority of the caregivers were younger than 40 years (54 percent).

Table 4.3 Family size and number of rooms per household

	Experimental group (n=45)		Control group (n=50)	
Number of people in the house	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
One to five	24	**53.3**	13	26
Six to ten	20	44.4	19	**38**
Ten and above	1	2.3	18	36
	Experimental group (n=45)		**Control group (n=50)**	
Number of rooms	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Less than two	11	24	18	36
Three to four	27	**60**	23	**46**
More than four	7	15	9	18

As indicated in Table 4.3, the majority of the respondents (53 percent) from the experimental group had a family size of one to five people compared to the control group where a large percentage (38 percent) had a family size of between six and ten people and more than ten people (36 percent). In both groups, the majority of households had three to four rooms (60 percent in the experimental compared to 46 percent in the control group).

Table 4.4 Problems with the house and pests

	Experimental (n=45_)		Control (n=50)	
Problems	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Housing				
None	14	31	7	14
Too small	25	**56**	13	26
Repairs	4	9	0	0
Damp	0	0	22	**44**
Other	2	4.	8	16
Pests				
None	6	13	24	**48**
Mice/rats	19	**43**	1	2
Cockroaches	18	**40**	12	24
Ants	0	0	4	8
Other	2	4	9	18

The results depicted in Table 4.4 indicated that the main problems the experimental group experienced were that houses were too small (56 percent) and had high infestation rates of cockroaches (40 percent) and rodents (43 percent). Only 26 per cent of the control group complained about houses being too small, whereas their main concern was damp houses (44 percent), with cockroaches as pest infestation in only 24 percent of the households. A large percentage of households (48 percent) in the control group reported no pest infestation.

Table 4.5 Work status and income

	Experimental group (n=45)		Control group (n=50)	
Current employment status	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Employed	13	29	23	46
No	32	**71**	27	**54**
	Experimental group (n=45)		**Control group (n=50)**	
Total income	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
< R500	14	31	31	**62**
R501-R1000	20	**44**	17	34
R1001-R1500	5	11	0	0
R1501-R2000	4	9	2	4
R2001-R2500	1	2	0	0
>R2500	0	0	0	0

The economic status is reported in Table 4.5. The results showed that the majority of caregivers in both groups were unemployed (71 percent in the experimental group and 54 percent in the control group) and the majority of households in both groups had an income of less than R1000 per month (75 percent in the experimental and 96 percent in the control groups).

Table 4.6 Food procurement patterns

	Experimental (n=45)		**Control (n=50)**	
Frequency of money shortage	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Always	6	13.3	27	**54**
Often	6	13.3	15	30
Sometimes	29	**64.4**	8	16
Seldom	2	4.4	0	0
Never	2	4.4	0	0
Frequency of food shopping				
Every day	4	9	6	12
Once a week	4	9	7	14
Once a month	36	**80**	29	**58**
Other	1	2	8	16
Where food is bought				
Spaza shop	2	4	31	**62**
Street vendor	4	9	8	16
Supermarket	39	**87**	9	18
Other	0	0	2	4

The food procurement patterns of the households of both groups are reflected in Table 4.6. In both groups, household food insecurity was reported to be a problem as a large percentage (27 percent) of the respondents from the experimental group experienced a chronic money shortage, as did an even more substantial percentage (84 percent) in the control group. Both groups indicated that shopping was done mainly once a month (80 percent in the experimental group and 58 percent in the control group). However, most households in the experimental group bought food from the supermarket (87 percent) whereas in the control group the majority used spaza shops (62 percent).

Table 4.7 Weekly child allowance

	Experimental group (n=45)		Control group(n=50)	
Weekly child allowance	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
0-50c	5	11	27	54
50 c	6	13	15	30
R1-2	20	44	5	10
R2-3	4	9	2	4
R3-4	1	2	1	2
R4-5	4	9	0	0
>R5	5	11	0	0

The results in table 4.7 showed that in both groups the majority of the children received a weekly allowance of less than R 2.00 (68 percent in the experimental and 94 percent in the control groups respectively).

Table 4.8 Educational level of caregivers

	Experimental group (n=45)		Control group (n=50)	
Education level	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
None	1	2.2	11	22
Primary school	1	2.2	25	**51**
Standard 8	12	27	12	24
Standard 10	16	**35.5**	1	2
College	15	33.1	0	0
Other post school	0	0	0	0

Caregivers in the experimental group were more literate in comparison with the control group, as a larger percentage (68.6 percent) in the experimental group had completed school compared to those the in the control group (two percent). The majority (51 percent) of the respondents from the control group had completed only primary school (Table 4.8).

Table 4.9 Number of children under five who have completed immunisation

	Experimental group (n=45)		Control group (n=50)	
Immunisation	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
None	27	**60**	17	34
One to three	16	36	32	**64**
Four to six	2	4	1	2

The results in Table 4.9 indicated that most of the children from the experimental group (60 percent) had not received any immunization, in contrast with the control group where the majority (66 percent) had been immunized.

Table 4.10 Number of meals consumed per day

	Experimental group (n=45)		Control group(n=50)	
No, of meals P/D	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
None	2	4	1	2
One	10	22	11	22
Two	16	**37**	38	**76**
Three	15	33	0	0
Three +	2	4	0	0

According to Table 4.10, the majority of the households in the control group (76 percent) consumed two meals per day in comparison with the experimental group where only 37 percent of the households consumed meals twice daily. However, 37 percent of the households in the experimental group consumed three meals or more daily whereas no households in the control group reported this meal frequency.

Table 4.11 Household assets

	Experimental group (n=45)		Control group (n=50)	
Household equipment	**Number**	**Percentage (%)**	**Number**	**Percentage (%)**
Electrical stove	20	44	5	10
Gas stove	3	7	1	2
Primus/paraffin stove	28	62	37	74
Microwave	4	9	2	4
Hot plate	9	20	10	20
Radio	34	76	30	60
Television	33	73	25	50
Refrigerator	29	64	13	26
Freezer	9	20	5	10
Bed + mattress	37	82	37	74
Mattress only	23	51	22	44
Lounge suite	10	22	7	14
Dining room suite	11	24	9	18

The household assets of both groups are summarized in Table 4.11. The results indicated that the majority of the respondents from the experimental group possessed a

primus/paraffin stove (62 percent), radio (76 percent), television (73 percent), refrigerator (64 percent) and a bed with a mattress (82 percent). The control group possessed mainly the same assets, namely a primus/paraffin stove (74 percent), radio (60 percent), television (50 percent) and a bed with a mattress (82 percent). However, fewer televisions, radios and refrigerators and more primus/paraffin stoves and beds with mattresses are owned in the control group compared to the experimental group.

4.2.2 Health, medical and behavioural results

The health, medical and behavioural results were collected for the experimental group only as these results had previously been obtained and published for the informal settlement of the control group (Oldewage-Theron *et al.*, 2005:317).

Table 4.12 History of diseases in caregivers (Experimental group)

Diseases	**Number**	**Percentage (%)**
Skin diseases	10	**22.2**
Affection of skeleton/joints	6	13.3
Affection of eyes, ears, nose or teeth	6	13.3
Affection of heart or circulation system	0	0
Affection of chest or respiratory system	5	11.1
Affection of urinary system/genital organs	2	4.5
Nervous affection or mental abnormality	1	2.2
Any headaches	9	20.0
Any other illness	6	13.3

The history of health problems reported by the experimental group are summarized in Table 4.12 and were mainly skin diseases (22.2 percent), headaches (20 percent), affections of the skeleton (13.33 percent), as well as eye, nose or teeth problems (13.3 percent). The problems mainly reported by the households of the informal settlement in which the control group was situated, were headaches (50.5 percent), chronic coughing, indicating affection of the chest and respiratory system (65.7 percent), skeletal disease (31.5 percent) and heart disease (21.7 percent) (Oldewage-Theron *et al.*, 2005:313).

Table 4.13 Substance usage of caregivers

Currently smoking	**Number**	**Percentage (%)**
Yes	1	2
No (never smoke)	**39**	**87**
No (stopped)	5	11
Currently using snuff		
Yes	5	11
No (never smoke)	**34**	**76**
No (stopped)	6	13
Spouse or partner smoking		
Yes	6	13
Alcohol		
Alcohol usage		
Yes	3	7
Frequency of alcohol usage		
Every day	0	0
Once a week	0	0
Occasionally	3	**7**
Type of alcohol		
Commercial beer/cider	2	**4**
Home brewed beer	0	0
Strong liquor	1	2
Wine	0	0

Substance abuse was not reported to be a major problem in the experimental group which indicated that only two percent of the respondents smoked, percent consumed alcohol and 11 percent used snuff (Table 4.13). These results compared favourably with those of the control households where it was reported that 15.2 percent smoked, 27.3 percent consumed alcohol and 25.9 percent used snuff (Oldewage-Theron *et al.*, 2005:317).

Table 4.14 Health facilities

Health facility	Number	Percentage (%)
Private doctor	5	11.2
Clinic	38	**84.4**
Hospital	2	4.4
Traditional healer	0	0
Other	0	0
Transport to the facility		
Foot	21	47
Taxi	23	**51**
Bus	0	2
Own transport	1	
Other	0	

The results in Table 4.14 indicate that the majority (84.4 percent) of the caregivers used the clinic when sick and most used a taxi (51 percent) as a means of transport to the health facility. None of the caregivers relied on the traditional healers. Most of the households in the informal settlement where the control group was situated also used the clinic (74.9 percent), but the majority (79.9 percent) walked to the clinic (Oldewage-Theron *et al.*, 2005:317).

4.3 INTERVENTION STUDY RESULTS

4.3.1 Anthropometric measurements

A significant increase in weight and height occurred in both study groups, which may have been due to the normal growth process that took place in the children during the intervention. For this reason, weight-for-age (underweight), height-for-age (stunting) and BMI-for-age (wasting) were evaluated for each child according to the NCHS growth charts. The information was used to indicate underweight, stunting and wasting at the following cut-off points as depicted in Tables 4.15, 4.16 and 4.17: $\leq 5^{th}$ percentile indicating severely malnourished children, $>5^{th}$ and $<25^{th}$ percentile indicating children at risk of being malnourished, and $\geq 25^{th}$ and $\leq 75^{th}$ /85^{th} percentile being normal. Higher than the 75^{th} /85^{th} and $<95^{th}$ percentile

indicates children at risk of being overweight and $\geq 95^{th}$ percentile indicates overweight.

4.3.1.1 Weight-for-age

Table 4.15 Percentile distribution of weight-for-age (underweight)

	Experimental group		**Control group**	
Classification (percentile)	Baseline n = 43 (%)	Follow-up n =43 (%)	Baseline n =22 (%)	Follow-up n =22 (%)
Severely malnourished ($\leq 5^{th}$)	8 (18.6)	2 (4.7)	2 (9.1)	1 (4.5)
At risk of being underweight ($> 5^{th}$ and $<25^{th}$)	11 (25.6)	8 (18.6)	3 (13.6)	2 (9.1)
Normal ($\geq 25^{th}$ and $\leq 75^{th}$)	18 (41.9)	23 (53.4)	10 (45.5)	11 (50)
Risk for overweight ($>75^{th}$ and $<95^{th}$)	5 (11.6)	6 (14)	6 (27.3)	7 (32)
Overweight ($\geq 95^{th}$)	1 (2.3)	4 (9.3)	1 (4.5)	1 (4.5)

Before the intervention, 18.6 percent of the experimental group were severely underweight and 25.6 percent were at risk of being underweight. The follow-up measurements indicated an improvement in underweight to 4.7 percent of the group being underweight and 18.6 percent at risk of being underweight after the intervention. The results showed a similar trend in the control groups where 9.1 per cent were severely underweight, but this improved to 4.5 percent after the eight month-intervention. The children at risk of being underweight in this group decreased from 13.6 percent to 9.1 percent (Table 4.15).

4.3.1.2 Height-for-age

Table 4.16 Percentile distribution of height-for-age (stunting)

	Experimental group		Control group	
Classification (percentile)	Baseline n =43 (%)	Follow-up n =43 (%)	Baseline n =22 (%)	Follow-up n =22 (%)
Stunted ($\leq 5^{th}$)	15 (34.9)	5 (11.6)	2 (9.1)	0
At risk for being stunted ($> 5^{th}$ and $<25^{th}$)	12 (27.9)	9 (20.9)	6 (27.3)	4 (18.2)
Normal ($\geq 25^{th}$ and $\leq 75^{th}$)	10 (23.2)	12 (28)	9 (40.9)	11 (50)
Risk for overweight ($>75^{th}$ and $<95^{th}$)	4 (9.3)	9 (20.9)	5 (22.7)	7 (31)
Overweight ($\geq 95^{th}$)	2 (4.7)	8 (18.6)	0	0

In the experimental group prior to the intervention, 34.9 percent and 27.9 percent were stunted and at risk of being stunted respectively. This indicated a chronic shortage of food experienced in this group. This improved notably after the eight months of the intervention, as 11.9 percent of the experimental group were stunted and 20.9 percent at risk of being stunted at follow-up.

The control group also showed a decrease in the number of children who were seriously stunted after the intervention. The number of stunted respondents decreased from 9.1 percent to none, and the respondents at risk of stunting ($>5^{th}$ percentile and $<25^{th}$ percentile) decreased from 27.3 percent to 18.2 percent as can be seen in Table 4.16.

4.3.1.3 BMI-for-age

Table 4.17 Percentile distribution of BMI-for-age (wasting)

	Experimental group		Control group	
Classification (percentile)	Baseline n =43 (%)	Follow-up n =43 (%)	Baseline n =22 (%)	Follow-up n =22 (%)
Wasting ($\leq 5^{th}$)	2 (4.7)	4 (9.3)	2 (9.1)	0
At risk for wasting ($> 5^{th}$ and $<25^{th}$)	5 (11.6)	6 (14)	14 (18.2)	6 (27.3)
Normal ($\geq 25^{th}$ and $\leq 75^{th}$)	24 (55.8)	28 (65)	12 (54.5)	12 (54.5)
Risk for overweight ($>75^{th}$ and $<95^{th}$)	10(23.3)	3 (7)	1 (4.5)	2 (9.1)
Overweight ($\geq 95^{th}$)	2(4.7)	2 (4.7)	3 (13.5)	2 (9.1)

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. The results summarised in Table 4.17 showed that in the experimental group it was found that 4.7 percent and 11.6 percent of the respondents were severely wasted and at risk of being wasted respectively. After the intervention had been implemented for eight months, the respondents that were severely wasted increased to 9.3 percent and those at risk of being wasted to14 percent.

Table 4.18 Statistically significant improvements in anthropometric measurements between baseline and follow-up for both groups

Variable	Experimental group (n=43)		Control group (n=22)	
	Baseline	Follow-up	Baseline	Followup
Weight	↑	* ↑	↑	* ↑
Height	↑	↑	↑	↑
BMI	↑	* ↑	↑	* ↑

*Significance increase at $p \leq 0.05$

The results in Table 4.18 showed a statistically significant difference ($p \leq 0.05$) observed in the weight and BMI of the respondents in both groups after the intervention. No statistical significance was found for height in both groups. In both the experimental and control groups and between the height-for-age and BMI-for-age categories there is a statistical association between the baseline and follow-up improvement of the children. This association must, however, be interpreted with caution because of the low number of children in each of the five percentile indices of each category. This makes the statistical analysis difficult to interpret.

4.3.2 Dietary intake

Table 4.19 indicates the total dietary intake of the respondents in the experimental group compared to daily recommended intake at baseline (pre-intervention) compared to follow-up (post-intervention) after eight months of implementing the intervention as measured by QFFQ. Only 37 respondents completed the QFFQ at follow-up and in order to do paired t-tests, the follow-up measurements were

matched to the baseline measurements and the baseline group was thus reduced to 37 instead of 50.

Table 4.19 Mean dietary intake compared to DRIs as measured by QFFQ at pre-intervention and post-intervention for the experimental group

	Baseline (n=50)		Follow-up (n=37)		
Nutrients	Corn soya blend (CSB) n =50	% of DRI	Corn soya blend (CSB) n=37	% of DRI	EAR children aged 9-13
Energy kJ	4573	48	9379	98	9572*
Total protein (g)	38	50	72	95	76*
Total fat	49		81		*
Total dietary fibre (g/day)	8	26	21	68	31*
Carbohydrates (g/day)	137	137	280	280	100*
Calcium (mg)	329	25	477	37	1300AI
Iron (mg)	6	101	12	203	5.9*
Magnesium (mg)	146	73	275	138	200*
Phosphorus (mg)	562	53	997	95	1055*
Zinc (mg)	5	71	9	129	7*
Chromium (µg/day)	30	120	46	184	25AI
Selenium (µg/day)	30	86	43	123	35
Iodine (µg/day)	28	38	43	59	73AI
Vit A (RE) (µg/day)	2025	455	646	145	445
Thiamine (mg)	0.7	100	1.2	171	0.7*
Riboflavin (mg)	1.4	175	2	250	0.8*
Niacin (mg)	10	111	17	188	9.0*
Vitamin B6 (mg)	0.9	113	1.5	188	0.8*
Folate (ug/day)	144	58	264	106	250
Vitamin B12 (µg/day)	19	1266	5	333	1.5*
Pantothenate (mg)	2	50	4.6	115	4.0AI*
Biotin (µg/day)	27	135	31	155	20AI
Vitamin C (mg)	77	197	125	321	39*
Vitamin D (µg/day)	4	80	6	120	5AI
Vitamin E (mg)	8	89	11.5	128	9

* = significant increase in the experimental group from baseline to follow-up at $p \leq 0.05$

kJ = kilojoules AI =Average Intake

EAR = Estimated Average Requirements for children aged 9-13 years old (Institute of Medicine, 2004)

The results in Table 4.19 showed significant increase in usual intakes from baseline to follow-up of almost all the nutrients, except for calcium, chromium, selenium, iodine, vitamins A, D and E, pantothenate and biotin. However, the reported intake of vitamin B12 significantly decreased. Although not all the nutrient intakes improved significantly, the majority of the nutrient intakes met the DRIs at follow-up, except for energy (98 percent), total protein (95 percent), total dietary fibre (68 percent), calcium (37 percent), phosphorus (95 percent) and iodine (59 percent). Those nutrients included in the CSB, namely; protein, fat, fibre, vitamin A (1684 i.u), thiamine (0.128 mg), riboflavin (0.448 mg), niacin (4.8 mg), folate (80 mg), vitamin C (48 mg), vitamin B12 (1.2 mg), iron (8 mg), calcium (100 mg) and zinc (5 mg) thus improved the usual nutrient intake significantly.

The results shown in Table 4.20 indicated deficient intakes for the experimental group at baseline (percentage of DRIs) for energy (65 percent), total protein (72 percent), total dietary fibre (35 percent), calcium (15 percent), phosphorus (66), zinc (86 percent), selenium (91 percent), iodine (29 percent), vitamins A (477 percent), B2 (75 percent), B6 (113 percent), B12 (80 percent), D (44 percent), E (115 percent), folate (57 percent) and biotin (80 percent). Similar results were reported in the control group, however, total protein (64 percent) and vitamin B12 (113 percent) intakes were sufficient, although deficient intakes were also reported for chromium (46 percent), pantothenate (75 percent) and vitamin C (46 percent).

Significant differences between the nutrient intakes of the experimental and control groups were reported for total protein, total dietary fibre, iodine, vitamins B1, B3, B12, D, folate, pantothenate and biotin ($p \leq 0.05$).

Table 4.20 Mean dietary intake compared to DRI for 24-hour recall pre-intervention for experimental and control groups.

	Experimental group		Control group		
Nutrients	Corn Soya blend (CSB) n=50	% Of DRI	Fruits n=27	% Of DRI	EAR children aged 9-13
Energy kJ	6214	65	6086	64	9572
Total protein (g)	55	72	42	55	76*
Total fat	47		41		
Total dietary fibre (g/day)	11	35	15	48	31*
Carbohydrates (g/day)	198	198	212	212	100
Calcium (mg)	198	15	316	24	1300AI
Iron (mg)	6	102	6	102	5.9
Magnesium (g)	194	97	243	122	200
Phosphorus (mg)	698	66	630	60	1055
Zinc (mg)	6	86	5.1	73	7
Chromium (µg/day)	29	116	11.5	46	25AI
Selenium (µg/day)	32	91	13	37	35
Iodine (µg/day)	21	29	16.4	22	73
Vitamin A (RE) (µg/day)	210	477	132	300	44AI
Thiamin (mg)	0.7	100	0.8	114	0.7*
Riboflavin (mg)	0.6	75	0.62	78	0.8
Niacin (mg)	15	167	9	100	9*
Vitamin B6 (mg)	0.9	113	0.7	88	0.8
Folate (µg/day)	142	57	129	52	250*
Vitamin B12 (µg/day)	1.2	80	1.7	113	1.5*
Pantothenate (mg)	6.6	165	3	75	4.0AI*
Biotin (µg/day)	16	80	17	85	20AI*
Vitamin C (mg)	45	115	18	46	39
Vitamin D (µg/day)	2.2	44	1.8	36	5AI*

* = significant differences between nutrient intakes at baseline between the experimental and control groups at $p \leq 0.05$

KJ/kj = kilojoules AI =Average Intake

EAR = Estimated Average Requirements for children aged 9-13 years old (Institute of Medicine, 2004)

Table 4.21 Mean dietary intake compared to DRI for 24-hour recall post-intervention for experimental and control group.

	Experimental group		Control group		
Nutrients	Corn Soya Blend (CSB) n=50	% Of DRI	Fruits n=27	% Of DRI	EAR children aged 9-13
Energy kJ	5062	53	8459 [a]	88	9572
Total protein (g)	4.7	6	82 [b]	108	76
Total fat	31 [a]		53		
Total dietary fiber (g/day)	10	32	25 [b]	81	31
Carbohydrates	174	174	301	301	100
Calcium (mg)	167	13	294	23	1300
Iron (mg)	6	102	12 [b]	203	5.9
Magnesium (g)	170	85	320 [b]	160	200
Phosphorus (mg)	593	56	859	81	1055
Zinc (mg)	5	71	9 [a]	129	7
Chromium (ug/day)	25	100	34.6	138	25
Selenium (ug/day)	27	77	41 [b]	117	35
Iodine (ug/day)	16	22	16	22	73
Vit A (RE) (ug/day)	99 [a]		605 [b]	1375	44
Thiamine (mg)	0.7	100	1.1 [b]	157	0.7
Riboflavin (mg)	0.7	88	1 [a]	125	0.8
Niacin (mg)	14	156	18 [b]	200	9
Vitamin B6 (mg)	0.9	113	1.5 [b]	188	0.8
Folate (ug/day)	131	52	442 [b]	177	250
Vitamin B12 (ug/day)	1.2	80	1.2	80	1.5
Pantothenate (mg)	5.1	128	5 [a]	125	4
Biotin (ug/day)	13	65	21	105	20
Vitamin C (mg)	40	103	26 [a]	67	39
Vitamin D (ug/day)	1.5	30	37	740	5
Vitamin E (mg)	6	67	6	67	9

* = significant differences between nutrient intakes at follow-up between the experimental and control groups at $p \leq 0.05$

a = significant differences between nutrient intakes at between baseline and follow-up in the same group (experimental or control) at $p \leq 0.05$

b = significant differences between nutrient intakes at between baseline and follow-up in the same group (experimental or control) at $p \leq 0.05$

kJ = kilojoules AI =Average Intake
EAR = Estimated Average Requirements for children aged 9-13 years old (Institute of Medicine, 2004)

The results in Table 4.21 showed that significantly reduced intakes of total fat and vitamin A were reported in the experimental group before and after the intervention as measured by 24-hour recall. No significantly increased intakes were observed by the experimental group. The control group, however, reported significantly increased intakes of energy, vitamins B2, C ad pantothenate at $p \leq 0.05$ compared to total protein, total dietary fibre, carbohydrates, iron, magnesium, zinc, selenium, vitamins A, B1, B3, B6 and folate at $p \leq 0.01$.

Table 4.22 Top 20 most commonly consumed food items as measured by 24-hour recall for the experimental group at baseline (n=50)

Food items	**Total intake**	**n**	**Mean daily intake**	**SD**
Maize meal, cooked, stiff porridge	38200	50	764	197
Tea, brewed	19660	50	393	283
Rice, white, cooked	14074	50	281	151
Maize meal, cooked, soft porridge	12280	45	272	122
Bread/rolls, brown	9290	50	186	71
Chicken, meat and skin, boiled	5437	50	109	50
Bread/rolls, white	5075	47	107	32
Fruit juice, average	4850	19	255	187
Coffee, brewed/ instant	3725	16	232	76
Milk, full fat / whole, fresh	3560	31	114	91
Cold drink, squash, diluted	2830	16	176	77
Vetkoek, homemade (cake Flour, Water)	2360	17	138	68
Stew, chicken (with skin), tomato and onion	2310	21	110	52
Cold drink, carbonated	2240	11	203	33
Beef, chuck, cooked	1990	14	142	48
Water	1890	8	236	74
Orange juice, fresh	1850	9	205	16
Chicken, meat and skin, roasted	1720	16	107	48
Milk shake, vanilla	1590	7	227	25
Mabella (Sorghum) cooked	1540	5	308	257

Table 4.23 Top 20 most commonly consumed food items as measured by 24-hour recall for experimental group at follow-up (n=37)

Food items	**Total intake**	**n**	**Mean daily intake**	**SD**
Maize meal, cooked, stiff porridge	6667	37	180	171
Tea, brewed	6167	34	181	98
Coffee, brewed/ Instant	5537	34	162	67
Maize meal, cooked, soft porridge	4300	36	119	137
Milk, full fat / whole, fresh	4215	37	114	37
Cold drink, carbonated	3836	37	104	56
Bread/rolls, brown	3459	33	104	60
Mango, raw (peeled)	2909	28	103	68
Fruit Juice, cocktail	2854	36	79	52
Bread/rolls, white	2660	28	96	55
Banana, raw (peeled)	2641	37	71	63
Apple, average, raw	2615	37	71	32
Orange, raw (peeled)	2437	37	66	36
Cold drink, squash, diluted	2149	23	93	57
Egg, fried In sunflower oil	2092	37	57	27
Rice, white, cooked	2075	37	56	21
Mabella (Sorghum), cooked	1892	25	76	36
Vetkoek, Homemade (cake Flour, Water)	1886	35	54	38
Samp and beans	1697	36	47	50
Polony	1616	37	44	12

The results in Tables 4.21 and 4.22 indicate that the experimental group consumed mainly a carbohydrate-rich diet both before and after the intervention. However, the portion sizes were considerably smaller when measured at follow-up, for example 784g of stiff maize meal porridge at baseline compared to 180g at follow-up. More fruit was included in the follow-up measurements, namely mango (8^{th}), fruit juice (9^{th}), banana (11^{th}), apple (12^{th}) and orange (13^{th}) as compared to only orange juice (17^{th}) consumed by only seven respondents at baseline. Furthermore, eggs (15^{th}) were consumed at follow-up by all the respondents whereas eggs were not part of the Top 20 most commonly consumed food items reported at baseline.

Table 4.24 Top 20 most commonly consumed food items as measured by 24-hour recall for the control group at baseline (n=21)

Food items	**Total intake**	**N**	**Mean daily intake**	**SD**
Maize meal, Stiff porridge	21150	21	1007	323
Bread, brown	4330	21	206	72
Tea, brewed	2250	9	250	61
Cold drink, squash	2150	10	215	88
Bread, white	1670	10	186	139
Potato chips	1370	13	105	64
Coffee	1150	4	287	103
Milk, full cream	1065	7	178	196
Tomato and onion stewed	850	10	85	48
Apple, average, raw	760	5	152	4
Cookies, commercial plain	730	13	61	20
Chicken, roasted	685	10	68	49
Rice, white	632.5	5	211	154
Chicken, boiled	627	6	105	90
Boerewors	535	6	89	5
Polony	514	16	32	21
Tea Rooibos, brewed	500	2	250	0
Butternut, boiled	460	1	460	0
Cold drink, carbonated	340	1	340	0
Spinach, boiled	325	4	81	113
Vetkoek	320	4	80	0

Table 4.25 Top 20 most commonly consumed food items as measured by 24-hour recall for control group at follow-up (n=21)

Food items	**Total intake**	**n**	**Mean daily intake**	**SD**
Maize meal, Stiff porridge	6835	20	341	180
Tea, brewed	3770	14	269	143
Bread, Brown	2015	19	106	56
Milk, full cream	1855	7	265	202.46
Cold drink, squash	1200	5	240	155
Bread, White	790	7	112	23
Vetkoek	720	4	180	151
Energy / Power drink	687.5	3	229	61
Orange, juice	400	2	200	0
Potato chips	400	4	100	0
Stew chicken, tomato & onion	380	3	126	64
Apple, raw	300	2	150	0
Apple juice	250	1	250	0
Coffee, brewed	250	1	250	0
Rice, white	250	2	125.	35.36
Cookies, commercial plain	230	4	57	22.17
Butternut, boiled	210	1	210	0
Egg, fried in oil	208	2	104	0
Potato, boiled	200	2	100	113
Chicken, roasted	195	4	48	31

The results in Table 4.26 and 4.27 indicate that the control group also mainly consumed a carbohydrate-rich diet both before and after the intervention. However, some of the portion sizes were considerably smaller when measured at follow-up, for example, 1007 g of stiff maize meal porridge at baseline compared to 341 g at follow-up and the brown bread portion that decreased from 206 g at baseline to 106 g at follow-up. The Top 20 most commonly consumed items were very similar, but the order changed. Boerewors (14th) and chicken (13th) were consumed as protein sources at baseline, but chicken (13th and 20th) and egg (18th) appeared on the list at follow-up.

4.3.3 Biochemical results

The haematological and biochemical data are summarised in Table 4.28. Only the subjects for whom data was available at the end of the study are included as post-intervention results, as the respondents who dropped out were not included in the pre-intervention results.

Table 4.26 Biochemical measurements of the experimental and control groups before and after the intervention

		Experimental group		Control group	
Variables	Normal range (Mahan & Escott-Stump, 2004)	Baseline (mean±SD)	Follow-up (mean±S)	Baseline (mean±SD)	Follow-up (mean±S)
Red blood count	4.0-5.4 X 10^6/mm^3	4.7±0.5 [a]	4.8± 0.4 [a]	4.9±0.3	4.8±0.3
Haemoglobin	12.0-14.0 g/dl	13.1±1.7	13.4±0.9	13.8±0.9	13.2±0.8
Haematocrit	36.0-44.0%	40±43	37±73	41±27	39±24
Mean cell volume	77-91 fl	84.2±5.0 [a]	83.9± 4.0 [a]	84.5±2.2	81.9±2.6
White blood count	4.5-13.5 X 10^3/mm^3	5.4±1.3 [a,b]	6.6±1.6 [a]	6.4±2.1 [b]	6.0±1.7
Total protein	64-83g/l	75.2±6.7[a]	78.4±5.2 [a,b]	78.1±8.2 [c]	74.4±6.3 [b, c]
Albumin	37-52g/l	43.4±4.6 [a]	47.6±5.7 [a,b]	45.5±6.6	44.1±6.0 [b]
Iron	9-31µmol/l	15.2±5.1	14.6±5.0 [b]	34.3±23.1	33.4±15.0 [b]
Ferritin	12-200µg/l	31.2±16.9	36.7±20.7	26.2±13.5 [a]	31.1±15.2 [a]
Transferrin	2-4g/l	2.8±0.58[a,b]	3.1±0.4 [a]	3.2±0.5 [b]	3.1±0.5

a,b,c = significant changes within and between groups in the same line ($p \leq 0.05$).

All the variables were within the normal ranges and thus did not indicate depletion before or after the intervention. In the experimental group, the red blood cell count, total serum protein, albumin and transferrin increased significantly from baseline to follow-up, compared to the mean cell volume, which decreased significantly. The white blood cell count increased significantly in the experimental group, usually indicating infection, but at both baseline and follow-up, the levels were within the normal range. Furthermore, a statistically significant difference was observed between the white blood cell count at baseline between the experimental and control group. In the control group, the only significant changes between baseline and follow-up were increased serum ferritin and decreased total serum protein levels.

Significant differences were observed between the experimental and control groups at follow-up for total serum protein, serum albumin and serum iron. The total serum protein and albumin levels were significantly lower in the control group compared to the experimental group, but the serum iron level in the control group was significantly higher than in the experimental group.

Pearson correlations were conducted in order to determine the association between dietary iron intake and blood levels for serum iron, haemoglobin, hematocrit, ferritin and transferrin. No statistically significant correlations between the blood variable and the 24-hour recall intake was found for either of the experimental (CSB) or the control (fruit) groups at $p \leq 0.05$.

4.4 DISCUSSION

The socio-demographic data indicated that household food insecurity existed in both the experimental and control groups as the majority of households in both the groups had a monthly household income of less than R 1000 and indicated a chronic shortage of food, leading to household food insecurity in both groups. Differences in the groups, however, existed. All the respondents in the experimental group resided in an urban informal settlement, which was close to shopping complexes and shops and food shopping was mostly done at supermarkets in contrast, the respondents in the control group all resided in a smaller, peri-urban smaller informal settlement, with no access to shops and shopping centres and the majority of households in the control group thus purchased food at spaza shops. Monthly food shopping was done by both groups. Two daily meals were consumed in the majority of households of the control group compared to three or more meals per day in the experimental group. Unemployment of the caregivers was prevalent in the majority of households in both groups, and although the mother was the primary child caregiver in both groups, the majority of the caregivers in the experimental group was better educated (secondary school and college) and older (> 40 years of age) than those in the experimental group (primary school and < 40 years of age). Another factor that could have influenced household food insecurity

was the household size, most households in the control group housed families of between one and five people whereas there were more than five people in the majority of households in the experimental group.

The top 20 items consumed by the respondents in both groups indicated that the food consisted mostly of carbohydrates with little animal protein, fruit or vegetables. However, the experimental group consumed more fruit at follow-up and this was consumed by almost all the respondents in the group with daily intakes varying between 103 and 66 g per food item. Food variety, however, was limited in the households of both these groups, but more so in the control group. Furthermore, in the control group, fewer respondents (less than 50 percent) consumed the protein food sources, specifically chicken, with a daily intake of 68 g, compared to the experimental group in which all the respondents in the group consumed chicken at baseline at 109 g per day. However, at follow-up chicken did not form part of the top 20 most commonly consumed list of foods in the experimental group, whereas chicken was consumed by a third of the control group at follow-up in very small quantities (48 g).

The limited food variety was reflected in the poor nutrient intakes of both groups at baseline. The post-intervention dietary intake results showed that both the fruit and CSB contributed significantly to the quality of the diet, as the fruit (control) group consumed 101 percent of energy, 258 percent of protein, 358 percent of iron, 176 percent of zinc, 188 percent of vitamin A, 129 percent of thiamine, 191 percent of riboflavin and 243 percent of niacin (Table 5.9).

Although a significant increase in weight and height occurred in both study groups, these may be have been due to the normal growth process that took place in the children during the intervention. The anthropometric results were not conclusive, as those respondents experiencing severe underweight and stunting, as well as those at risk of being underweight and stunted, showed similar trends and decreased in both groups. Stunting is usually an indication of chronic food insecurity and in this

study both the interventions thus contributed favourably in the case of chronic household food insecurity. The severely wasted in the experimental group and those at risk of being wasted increased, however, and the two interventions thus did not contribute to the reduction of acute household food insecurity.

Considering all the indices (percentiles) of the two groups relative to being severely underweight and at risk of being underweight, severely stunted and at risk of being stunted and severely wasted or at risk of wasting, it can be seen that the fruit group showed a remarkable improvement in the children's nutritional status. These results should be interpreted with caution because of the low number of children in each of the five percentile indices of each category.

Although few statistically significant biochemical changes occurred, there were clinical changes in both groups. Even though more changes occurred from baseline to follow-up in the experimental group, these results are inconclusive as all the biochemical parameters were within the normal ranges in both groups throughout the study period.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

The main aim of this study was to measure the impact of a school feeding programme on the nutritional status of primary school children in Orange Farms.

The specific objectives of this study were to:

- undertake a cross-sectional baseline survey (socio-demographic and health profile, dietary intake, food consumption patterns, anthropometric measurements and biochemistry);
- implement and monitor an eight-month school feeding programme serving corn-soy blend as intervention; and
- evaluate the impact of this school feeding programme on the nutritional status of the primary school children in the selected schools.

The high prevalence of malnutrition and household food insecurity described in the literature motivated this study.

5.1.1 Limitations of this study

The first limitation of this study is related to the type of the biochemical measurements and their cost. Zinc calcium and vitamins A and D are essential micronutrients for growth and well-being during childhood. The most accurate measurement of calcium is bone marrow analysis, which is very invasive and costly. Furthermore, all biochemical blood analyses are costly and for the purpose of this study, only iron was measured. The dietary intake levels, measured by both the 24-hour recall and the QFFQ, indicated low intakes of a variety of micronutrients, including calcium, zinc and vitamin D and it is possible that the sample may be deficient in nutrients not measured in this study.

The second limitation could be attributed to the power of the study as only 37 respondents in the experimental group and 22 in the control group completed the study. Although the experimental group formed part of the Joint Aid Management (JAM) school feeding programme introduced in Orange Farms in 2005, only 50 of the 793 (six percent) children in the experimental school and their parents gave consent to participate in the anthropometric and biochemical measurements. Furthermore, because most of the schools in Orange Farms were included in the JAM programme, a control group outside of Orange Farms, perhaps with a different socio-economic and health status, had to be selected. As a result of the size of Orange Farms and the compromised security in the area, it was difficult to plan and execute the fieldwork and a complete data base for only 37 respondents could be obtained. The control group had a dropout rate of 63 percent, resulting in a complete data set of only 22 respondents. The groups were therefore very small for the post-intervention tests. However, the statistically significant changes in both groups with regard to certain biochemical parameters as well as 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. Eight 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. Furthermore, budgetary constraints and field realities made it difficult to continue with the intervention for longer than eight months.

The fourth limitation was that not all the nutritional status biochemical parameters were tested, owing to financial constraints. This study measured mainly haematological parameters and other deficiencies may have been overlooked in the impact measurements.

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 and it is, therefore, possible that some of the respondents could have been HIV positive with this affecting their nutritional status.

5.1.2 Main findings

The salient findings of this study are discussed in the following paragraphs:

Malnutrition, including under and over nutrition, remains a major problem among primary school children globally. This was also true of both the experimental and control school groups in this study where 18.6 percent, 34.9 percent and 4.7 percent were underweight, stunted and wasted respectively in the experimental group compared to 9.1 percent severe underweight, and 9.1 percent each for severe stunting and wasting in the control group at baseline.

Although various strategies have been adopted to address micronutrient deficiencies, these are still prevalent, especially among school-aged children. Iron was the only micronutrient measured in this study and no deficiencies were observed. The poor dietary intake patterns at baseline, however, indicated that other micronutrient deficiencies, specifically calcium, iodine, selenium, folate and vitamin D, might have co-existed in both these groups of children.

A mainly carbohydrate-based diet was consumed with limited vegetable and animal protein intakes. The socio-demographic data indicated that household food insecurity contributed to the poor dietary intake of the sample, as the majority of the caregivers were unemployed in both groups. This was further confirmed by the limited monthly household income of less than R 1000 for a relatively large family size of up to five members in the control group compared to five to ten household members in the experimental group.

The implementation of a school feeding programme that included a nutritious and acceptable meal in the form of enriched corn-soy blend or a fruit as part of the programme, also proved to be a relatively easy and cost-effective way to address hunger in these primary schools. Furthermore, the dietary intake levels for both groups showed statistically significant improvements for various macro- and micro-nutrients when compared to DRIs.

5.2 CONCLUSIONS

The following conclusions are drawn from the results of this study:

- 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 both groups, indicating that any food provision may have a positive impact on undernourished children.
- One of the objectives of this study was to improve the nutritional status of the primary school children in the selected schools. The results of this study indicated an improvement in dietary intake, which could result in an improved nutritional status, specifically related to iron status. However, the anthropometric indices and certain biochemical parameters showed significant improvements in both groups after the intervention.
- School feeding programmes are a good strategy for addressing malnutrition among primary school children if monitored effectively. However, it does not influence on household food security directly.

5.3 RECOMMENDATIONS FOR FUTURE RESEARCH

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

- A long-term clinical intervention trial needs to be undertaken to measure the impact of a food-based approach to address specific micronutrient deficiencies prevalent among children in these age groups.
- A cost-effective analysis should be done to determine the most cost-effective intervention strategy for SA in poor urban and peri-urban areas. A combination of strategies may be needed to ensure adequate nutrient intakes for all South Africans.
- Because of the high prevalence of HIV/AIDS in SA, future school-based nutrition research should include measuring the presence of HIV/AIDS.
- A long-term nutrition education programme for implementation in primary schools as part of the curriculum needs to be planned so that children are made aware of healthy food choices.
- The sustainability of alternative school feeding programmes should be investigated.

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ANNEXURE A Letter to Orange Farms schools

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

ORANGE FARMS SCHOOL FEEDING PROJECT
INVITATION LETTER TO PARENTS

Subject ID number:.....

Age:.....

Dear Parent

My name is Wilna Oldewage-Theron and I am working at the Vaal University of Technology with four Masters students. We are doing a project to determine the nutritional status of school children in Orange Farms and need your assistance in getting the information for this project. The project was explained to you in the letter of consent. Participation is voluntary and should your child decide to participate, he/she may withdraw at any stage during the project.

We hereby wish to **invite you and your child to come to the school on Saturday, 5 / 12 March 2005 at 07H30** so that we can complete the socio-demographic and health questionnaires and draw blood from the children. Please note that we will **not draw blood from all the children**, but only from **a small sample** that may include your child. We, therefore, want you **not to let your child eat anything** before you come to the school on Saturday. We will **give your child something to eat at the school.**

We will be busy on Saturday from 07H30 to 13H30.

Remember, participation on is **voluntary** and should your child decide to participate, he/she **may withdraw** at any stage during the project.

We hope to see you on Saturday.

Thank you very much.

Wilna Oldewage-Theron (Prof)

Tel: 016 950 9722

MEMORANDUM

DATE : 18 February 2005

TO : Principals
Orange Farms Schools

FROM : Wilna Oldewage-Theron
Associate Professor & Head of Department: Hospitality and Tourism

SUBJECT : **Baseline survey arrangements**

I refer to the feeding project that we are doing in collaboration with JAM.

The students that will be working on this project are:

- Mumsy Chibe
- Angel Malesa
- Tsinikao Nyathela

Thank you very much for meeting with the Masters students to make the arrangements for the baseline survey. I have attached a draft schedule for the baseline survey and I hereby request you to discuss the suitability of these arrangements with the students or advise alternative arrangements.

Thanking you

Wilna Oldewage-Theron (Prof)

DRAFT TIMETABLE

Date	Time	Activity
1 March 2005	After school	Grade 1 – dietary intake questionnaires
2 March 2005	After school	Grade 2 – dietary intake questionnaires
3 March 2005	After school	Grade 3 – dietary intake questionnaires
4 March 2005	After school	Grade 4 – dietary intake questionnaires
5 March 2005	08H00 -	Grade 1-7 pupils and parents – drawing of blood, temperature and blood pressure, weighing and measuring
7 March 2005	After school	Grade 5 – dietary intake questionnaires
8 March 2005	After school	Grade 6 – dietary intake questionnaires
9 March 2005	After school	Grade 7 – dietary intake questionnaires
10 March 2005	After school	Grade 8 – dietary intake questionnaires
11 March 2005	After school	Grade 9 – dietary intake questionnaires
12 March 2005	08h00-	Grade 8-12 pupils and parents – drawing of blood, temperature and blood pressure, weighing and measuring
14 March 2005	After school	Grade 10 – dietary intake questionnaires
15 March 2005	After school	Grade 11 – dietary intake questionnaires
16 March 2005	After school	Grade 12 – dietary intake questionnaires

NB: Letters of consent, socio-demographic and health questionnaires must be given to the parents in advance and collected.

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

ORANGE FARMS SCHOOL FEEDING PROJECT
FIELDWORK CONTROL

Subject ID number:.....

Stations	Activity	Baseline survey (March 2005)	End of trial (Nov/Dec 2005)
Station 1: Check/control	Handing out of file and check consent form and details		
Station 2: Socio-demographic and health data	• Socio-demographic questionnaire • Health questionnaire		
Station 3: Clinical signs, blood	• Oral temperature..... • Blood pressure..... • Clinical signs • Drawing of blood		
Station 4: Café	Handing out of snacks		
Station 5: Anthropometry	• Weight..... • Height..... • Body fat %		
Station 6: Dietary intake	• QFFQ • 24-hour recall • Compliance	X	
Station 7: Nutrition education	Nutrition education information and training session	X	
Station 1: Check/control	Control that all fieldwork is complete		

ANNEXURE B Letter of consent

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

PROJECT INFORMATION AND INFORMED CONSENT:
JAM NUTRITIONAL FEEDING PROGRAMME

Joint Aid Management (JAM), a South African NGO with 20 years of experience in feeding school children throughout Africa, in collaboration with the Vaal University of Technology (VUT), will be starting a School Feeding Programme in Orange Farm at Isikhumbuzo Secondary School, Siyaphambili Secondary School, Reitumetse Primary School, Tshebetso Secondary School and Sinqobile Intermediate School. Every student at these schools will be provided with a Corn Soya Blend (CSB) meal every school day during their first break.

The CSB meal consists of:
- 65% Corn
- 25% Soya
- 10% Sugar
- Fortified mineral and vitamin mix (Vitamin A, Iron, Iodine, Calcium, etc)

Secondary School students will receive 150g of CSB porridge and Primary School students will receive 100g of CSB porridge every school day. These proportions will provide 70-100% of daily recommended dietary allowance for all students, thus assisting them to concentrate and perform better at school.

OBJECTIVES OF THE PROJECT
JAM's School Feeding Programme is primarily designed to provide nutritious food to school children between the ages of 7 and 18 years, in order to:
- Alleviate "short term hunger" in the classroom
- Address micronutrient deficiencies
- Enhance active learning capacities
- Improve school enrolment, attendance, and punctuality, especially for female students
- Reduce absenteeism

BENEFITS OF THE PROJECT
- The project will improve the nutritional status of the students

- The food will provide students with sufficient energy, helping them to keep alert in class
- The project will improve the household food security, because the meal provided at school will replace a meal previously provided at home
- The project will motivate students to attend school regularly

If you have any questions about the project, please do not hesitate to ask any one of the teachers or the principals.

Thank you

.....
Isak Pretorius
Chief Executive Officer

INFORMED CONSENT

I, ...(full name), the parent/legal guardian of _____(child/student), hereby give consent that he/she may participate in the school feeding programme to be administered by Joint Aid Management.

I hereby indemnify Joint Aid Management against any liability that may originate during his/her participation in the school feeding programme. I further undertake that I will not lay any claim against Joint Aid Management for damage or personal disadvantages that he/she may suffer as a result of the school feeding programme.

Signature .....

Relationship to child/student .....

Signed at ..... on .....

Address of parent/legal guardian:
.....
.....
.....

Telephone number : .....

ANNEXURE C Ethics approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Oldewage-Theron

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M050250**
PROJECT	*Impact of a Nutrition Intervention Programme on School Children in Orange Farm*
INVESTIGATORS	Prof W Oldewage-Theron
DEPARTMENT	Hospitality and Tourism
DATE CONSIDERED	05.02.25
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 05.04.20 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 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 report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

ANNEXURE D Socio-demographic questionnaire

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

SOCIO-DEMOGRAPHIC QUESTIONNAIRE: ORANGE FARMS PROJECT

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

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?

Brick	Clay	Grass	Zinc/shack

3.9 How many rooms does your house have?

< 2 rooms	3-4 rooms	> 4 rooms

3.10 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 relatives	
Living with friends	
Hostel accommodation	
Squatter home	
Rented house/flat	
Own house/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 Please specify the monthly income in the household (if willing).....

4.13. 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

4.14 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

4.15 How often do you buy food?

Every day	Once a week	Once a month	Other, specify.....

4.16 Where do you buy food?

Spaza shop	Street vendor	Supermarket	Other, specify.....

4.17. How much money is spent on food PER MONTH? (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

4.18 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

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) have birth certificates?

None	1	2	3	4	5	6	7	8	All

5.4 How many children 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			

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.

Wilna Oldewage-Theron (Prof)
Vaal University of Technology

Ethel Zulu
JAM

Adam Boros
JAM

ANNEXURE E Health and Medical Questionnaire

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

HEALTH, MEDICAL AND BEHAVIOURAL QUESTIONNAIRE – ORANGE FARMS PROJECT

Section A:

1.

Subject number	
Gender	Male ❑ Female ❑

Section B:

HEALTH QUESTIONNAIRE:

2.

ARE YOU SUFFERING OR HAVE YOU SUFFERED FROM	YES	NO	IF ANY ANSWER IS YES, GIVE DETAILS OF THE NATURE, SEVERITY AND DURATION OF ILLNESS
1. Any skin disease?			
2. Any affection of the skeleton and/or joints?			
3. Any affection of the eyes, ears, nose or teeth?			
4. Any affection of the heart or circulatory system?			
5. Any affection of the chest or respiratory system?			
6. Any affection of the digestive system?			
7. Any affection of the urinary system and/or genital organs?			
8. Any nervous affection or mental abnormality?			
9. Any headaches			
10. Any other illness?			

3.

Would you say your usual level of physical activity is:	**Tick the correct block**
1. Heavy/ rigorous (running, playing tennis, swimming, doing heavy gardening, etc., at least three times per week)	
2. Moderate (Taking rigorous exercise once or twice a week, or steady walking, or other moderate activities at least three times per week)	
3. Light (playing golf, taking a stroll, or doing none rigorous activities occasionally)	
4. None (No exercise whatsoever)	

4.

	YES	**NO**
1. Do you suffer from any defect of hearing, speech or sight?		
2. Are you physically disabled and do you use artificial limbs?		
GIVE DETAILS OF THE NATURE AND SEVERITY OF THE DISABILITY		

5.

Do you smoke at this moment?	**Tick the correct block**
1. Yes	
2. No (Never smoked	
3. No (Stopped)	

6.

Do you make use of snuff at this moment?	**Tick the correct block**
1. Yes	
2. No (Never used)	
3. No (Stopped)	

7.

Does you're spouse or partner smoke at this moment?	**Tick the correct block**
1. Yes	
2. No	

3. Not applicable	

8.

Do you use alcohol on a regular basis ?	**Tick the correct block**
1. Yes	
2. No	
3. Not applicable	

9.

If you use alcohol, How often?	**Tick the correct block**
1. Every day	
2. Once a week	
3. Occasionally	

10.

What type of alcoholic drinks do you drink?	**Tick the correct block**
1. Commercial beer / cider	
2. Home brewed beer	
3. Strong liquor ex. Whiskey, brandy, Vodka etc.	
4. Wine	

12.

	YES	**NO**
Have you undergone any operations?		
GIVE DETAILS OF THE NATURE AND DATE OF THE OPERATION/S		

Section C:

MEDICATION QUESTIONNAIRE:

1.

1. Do you use any medication?	**Yes**	**No**
2. If no, go to the next block.		
3. If yes, what for/why?		

.....		
4. What is the name of the medication you are taking?		
5. What is the dosage and how often do you take this medication?.	**Dosage**	**How often?**

2.

Which health facility is commonly used by the household?	**Tick the correct block**
1. Private Doctor	
2. Clinic	
3. Hospital	
4. Traditional Healer	
5. Other (please state)	

3.

How does the household travel to the health facility?	**Tick the correct block**
1. On foot	
2. Taxi	
3. Bus	
4. Own transport	
5. Other (please state)	

4.

How many times have you / your wife / partner been pregnant?	

5.

How many children do you have?	

I declare that the above-mentioned information is true and correct and that I have not withheld any information.
Signature.....Date.....

Section D:

PARENTS CHILD BEHAVIOURAL QUESTIONNAIRE:

Please complete this section by describing the behaviour shown by this child specifically:

A. Statement	Doesn't apply	Applies somewhat	Certainly applies
1. Very restless. Often running about or jumping up and down, hardly ever sits still			
2. Fidgety child			
3. Often destroys own or others belongings			
4. Frequently fights with other children			
5. Not much like by other children			
6. Often worried about things			
7. Tends to be more on his/her own			
8. Irritable, gets irritated quickly by small things			
9. Often appears miserable, unhappy, tearful or distressed			
10. Frequently sucks thumb or finger			
11. Frequently bites fingers or nails			
12. Is often disobedient			
13. Has poor concentration or short attention span			
14. Are afraid of new things and change			
15. Often tells lies			
16. Often complains of pain or aches			
17. Has a stutter or stammer			
18. Bullies other children			
19. Are there any other problems? Please specify:			

B. Please tick the correct answer	Never in the last year	Less often than once per month	At least once per month	At least once per week
1. Wets his or her pants				
2. Loses control of bowels				
3. Has temper tantrums (that is, complete loss of temper with shouting, angry movements, etc.)				
4. Had tears on arrival at school or refused to go into the building				

C. Please tick the correct answer	**No**	**Yes, mildly**	**Yes, severely**
1. Does he/she stummer or stutter?			
2. Has he/she difficulty with speech?			
3. Does he/she ever steal things?			
4. Does he/she any difficulty in eating?			
5. If yes: (please tick) Not eating enough ❑ Eating to much ❑ Specific likes or dislikes ❑ Other ❑……..			
6. Does he/she have any sleeping difficulty?			
7. If yes: (please tick) Falling asleep ❑ Waking during the night ❑ Waking early in the morning ❑ Other ❑ ……			

Adapted from: Rutter M., Tizard J. & Whitmore K. 1970. *Education, Health and Behaviour*. Longman group limited. London.

I declare that the above-mentioned information is true and correct and that I have not withheld any information.
Signature……..Date……

Section E:

TEACHER'S CHILD BEHAVIOURAL QUESTIONNAIRE:

Please complete this section by describing the behaviour shown by this child specifically:

A. Statement	Doesn't apply	Applies somewhat	Certainly applies
1. Very restless. Often running about or jumping up and down, hardly ever sits still			
2. Fidgety child			
3. Often destroys own or others belongings			
4. Frequently fights with other children			
5. Not much like by other children			
6. Often worried about things			
7. Tends to be more on his/her own			
8. Irritable, gets irritated quickly by small things			
9. Often appears miserable, unhappy, tearful or distressed			
10. Frequently sucks thumb or finger			
11. Frequently bites fingers or nails			
12. Tends to absent from school often without valid reason			
13. Is often disobedient			
14. Has poor concentration or short attention span			
15. Are afraid of new things and change			
16. Often tells lies			
17. Has stolen things on one or more occasion			
18. Has wet or soiled him/herself at school this year			
19. Often complains of pain or aches			
20. Has had tears on arrival at school this year			
21. Has a stutter or stammer			
22. Bullies other children			
23. Are there any other problems of behaviour? Please specify: _____ _____ _____			
24. How well do you know this child? Please tick	**Very well**	**Moderate well**	**Not very well**

Adapted from: Rutter M., Tizard J. & Whitmore K. 1970. *Education, Health and Behaviour.* Longman group limited. London.

I declare that the above-mentioned information is true and correct and that I have not withheld any information.
Signature……..Date……

Vaal University of Technology
(Formerly Vaal Triangle Technikon)

JAM
Joint Aid Management

ORANGE FARMS SCHOOL FEEDING PROJECT
SIGNS OF MALNUTRITION

Subject ID number: .....**Completed by**.....

	Signs/symptoms associated with malnutrition	Tick if yes
Hair	• Lack of natural shine, dull and dry	☐
	• Dyspigmented	☐
	• FLAG sign	☐
	• Easily plucked (no pain)	☐
Face	• Scaling of skin around nostrils	☐
	• Swollen face	☐
	• Paleness	☐
Eyes	• Pale conjunctiva	☐
	• Bitot's spots	☐
	• Dryness of the eye	☐
	• Corneal xerosis (dullness)	☐
	• Corneal softening	☐
	• Redness and fissuring of eyelid corners	☐
	• White ring around the eye	☐
	• Small, yellowish lumps around eyes	☐
Lips	• White or pink lesions at corners of mouth	☐
	• Magenta tongue	☐
	• Filiform papillae	☐
	• Atrophy or hypertrophy	☐
	• Red tongue	☐
Teeth	• Mottled enamel	☐
	• Caries/cavities	☐
	• Missing teeth	☐
Gums	• Spongy, bleeding	☐
	• Receding gums	☐
Glands	• Front of neck swollen	☐
	• Swollen cheeks	☐

Nervous system	• Psychomotor changes • Mental confusion • Sensory loss • Motor weakness • Loss of positional sense • Loss of vibration • Loss of ankle and knee jerks • Burning and tingling of hand and feet • Dementia	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

ANNEXURE F Quantified Food Frequency Questionnaire

QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE

SUBJECT DATE OF BIRTH: ..... AGE:.....

SUBJECT NUMBER: .....

NAME: .....

INTERVIEWER: .....

ADDRESS: .....

INTRODUCTION:

Greeting

Thank you for giving up your time to participate in this study. 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 you have 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 you eat the food,
- how the food is prepared,
- how much of the food you eat at a time,
- how many times a day you eat it and if you do not eat it every day, how many times a week or a month do you eat it.

To help you to describe the amount of a food you eat, 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 and where you shop. 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 SUBJECT NUMBER APPEARS ON THE FORM.

IS THERE ANYTHING you WANT TO ASK NOW?
ARE YOU WILLING TO GO ON WITH THE QUESTIONS?

INSTRUCTIONS: Circle the subject's answer. Fill in the amount and times eaten in the appropriate columns.

SUBJECT DATE OF BIRTH: .....

I shall now ask you about the type and the amount of food your child has been eating in the last few months. Please tell me 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 you 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 Employer Slaughter own Gift Other specify: Do not eat chicken								1 2 3 4 5 6
Chicken:	Boiled, nothing added						1521	
	Fried: in butter/crumbs Not coated						1634 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 Employer Slaughter own Gift Other specify: Do not eat red meat								1 2 3 4 5 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						1001	
	Scrambled						1025	
	Fried						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							1
	Employer's farm							2
	Own farm							3
	Shops, supermarket, greengrocer							4
	Hawker							5
	Veld (e.g. morogo)							6
	Gifts							7
	Other specify							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 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 G 24-hour recall

24 – HOUR RECALL

Subject date of birth : _____ Age: _____ Gender: Male/Female

Interviewer: _____

Name: _____ Date: _____ / _____ / 2003

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					

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)					

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 H Language editing certificate

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17 February 2009

To Whom It May Concern

This certifies that the following dissertation has been edited for language accuracy. I trust that all corrections and suggestions made have been applied after due consideration by the author of the document:

IMPACT OF A SCHOOL FEEDING PROGRAMME ON NUTRITIONAL STATUS OF PRIMARY SCHOOL CHILDREN IN ORANGE FARMS

submitted in fulfilment of the requirements for the degree of Magister Technologiae: Food and Beverage Management
in the Department of Hospitality and Tourism,
Faculty of Human Sciences,
Vaal University of Technology

by

Tshinakaho Nyathela

Mary Hoffman
(SATI Registration: 1001632)