THE EFFECT OF SEASONAL FOOD VARIETY AND DIETARY DIVERSITY ON THE NUTRITIONAL STATUS OF A RURAL COMMUNITY IN KZN

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DECLARATION

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

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ABSTRACT

Introduction: Dietary diversity is an indicator of access and measurement of household food security as it relates to income, location and seasonality. Dietary diversity is measured by physically counting the number of individual foods as well as food groups consumed over a given reference period. When dietary diversity is accurately measured, nutrient adequacy will be easily predicted. In order to measure dietary diversity accurately, it is important to determine household food security. Insufficient food and resources often result in food insecurity which leads to little or no dietary diversity. Poor populations suffer most from achieving dietary diversity because they consume a standard diet based on starchy staple food with limited fruits and vegetables resulting in multiple nutrient deficiencies. Rural communities rely on seasonal food variety in order to obtain fruits and vegetables needed by the body to limit nutrient deficiencies. Some seasons are more productive than others. Rural communities also use various coping strategies to deal with food insecurity in all four seasons. High levels of unemployment as well as a lack of nutrition education results in most rural households unable to cater for dietary diversity.

Aim: The aim of the study is to determine the effect of seasonal food variety, dietary diversity and nutrient adequacy on the nutritional status of women in rural areas.

Method: A hundred women in this community were weighed and measured and BMI determined and classified according to the WHO cut-off points for BMI. Waist circumference was measured in order to determine the waist-to-height ratio indication risk of metabolic syndrome. Twenty four hour recall questionnaires were used to determine actual intake compared to dietary reference intake (DRIs). Food Frequency Questionnaires for a period of seven days were completed captured and analysed using the SPSS version for descriptive statistics in order to determine food diversity. Coping strategies were determined by Focus Group interviews with community members in order to identify the various strategies used in time of food shortages. The severity of these strategies was determined by the community. Seasonal food consumption patterns and dietary intake behaviour were assessed over the four seasons. The highest frequency score (7) x severity weight (1-4) x10 strategies = maximum score of 140. Thus the higher the score the more food insecure the community is.

Results: Food production from crops differs in different seasons. Food insecurity is high in summer and autumn due to a low number of food items harvested from crops. The community cope less in summer and autumn due to less crops available. The community is more food insecure in spring and winter due to the high number of food items harvested from crops. The community cope better in winter and spring due to the high level of available crops. Anthropometric measurements indicated that 41.2% of women between 31 and 50 and 49% of women between 51 and 70 years of age had a BMI of 30 and above. About 44% of total women are obese and 29% are pre obese. Only 26% had a normal weight. The 24 hour recall analysis indicates that the high level of obesity is due to the fact that a high number of participants consume large amount of carbohydrates every day.

Conclusion: Overall results in this study indicated that this rural community is food insecure, on a higher level during summer and autumn, which leads to the consumption of undiversified diets. The women are malnourished and obese with a risk of metabolic syndrome. The information obtained in this study can be used to formulate strategies to develop interventions that can be used to access sufficient food in rural area in order to improve food insecurity, dietary diversity and, therefore, nutrient adequacy.

TABLE OF CONTENTS

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

LIST OF FIGURES

LIST OF ANNEXURES

ACRONYMS AND ABBREVIATIONS LIST

AD   -   Alzheimer disease

ADEQ   -   Adult equivalent

AHA   -   American Heart Association

AJCN   -   American Journal of Clinical Nutrition

ANM   -   Annuals of Nutrition Metabolism

BJN   -   British Journal of Nutrition

BMI   -   Body Mass Index

BMJ   -   British Medical Journal

CASA   -   Comprehensive Agricultural Support Programme

CBNP   -   Community Based Nutrition Programmes

CDC   -   Centre for Disease Control

CNP   -   Community Nutrition Programmes

CPEG   -   Centre for Poverty, Employment and Growth

CS   -   Coping strategies

CSI   -   Coping Strategy Index

CVD   -   Cardio Vascular Disease

DDS   -   Dietary Diversity Score

DOA   -   Department of Agriculture

DOH   -   Department of Health

DOSD   -   Department of Social Development

DRI   -   Dietary Reference Intake

DUT   -   Durban University of Technology

EAMJ   -   East African Medical Journal

EER   -   Estimated Energy Requirements

EFNEP	-	Expanded Food and Nutrition Education Programmes
EJM	-	English Journal of Medicine
ESCFNSEP	-	Expanded School and Community Food and Nutrition Surveillance and Education Programme
FANTA	-	Nutrition Technical Assistance Project
FAO	-	Food and Agricultural Organisation of the United Nations
FBDG	-	Food Based Dietary Guidelines
FDA	-	Food and Drug Administration
FFQ	-	Food Frequency Questionnaire
FGDS	-	Food Group Diversity Score
FRC	-	Faculty Research Committee
FVS	-	Food Variety Score
g	-	grams
GDP	-	Gross Domestic Product
GHI	-	Global Hunger Index
GHS	-	General Household Survey
GI	-	Glycaemic index
GMF	-	Genetically Modified Food
HDDS	-	Household Dietary Diversity Score
HDL	-	High Density Lipoprotein
HFBSN	-	Health Facility-Based Services and Nutrition
HFSA	-	Heart Foundation of South Africa
HIV/AIDS	-	Human Immunodeficiency Virus /Acquired Immune Deficiency Syndrome
HS	-	Household survey
HSRC	-	Human Sciences Research Council
IDD	-	Iodine Deficiency Disorders
IDS	-	Individual Diversity Score

IES	-	Income and Expenditure Survey
IFPRI	-	International Food Policy Research Institute
IFSNP	-	Integrated Food security Nutrition Programme
IFSS	-	Integrated Food Security Strategy for South Africa
INP	-	Integrated Nutrition Programme
IOM	-	Institute of Medicine
IU	-	International Units
JFSN	-	Journal of Food Science Nutrition
JN	-	Journal of Nutrition
JNHA	-	Journal Nutrition Health Aging
Kg	-	Kilogram
kJ	-	Kilojoules
KZN	-	KwaZulu-Natal
LDL	-	Low Density Lipoprotein
LFS	-	Labour Force Survey
MAFISA	-	Micro Agricultural Initiative of South Africa
MDG	-	Millennium Development Goals
mg	-	microgram
MRFE	-	Minimum Recommended Food Expenditure
MUAC	-	Mid-Upper Arm Circumference
MUAMA	-	Mid-Upper Arm Circumference Muscle Area
MUAMC	-	Mid-Upper Arm Muscle Circumference
n	-	number
NAR	-	Nutrient Adequacy Ratio
NBPEP	-	National Blood Pressure Education Programme
NCHS	-	National Centre of Health Statistics
NDA	-	National Department of Agriculture

NFCS	-	National Food Consumption Survey
NFCS-FB	-	National Food Consumption Survey- Fortification Baseline
NFES	-	National Food Emergency Scheme
NGO	-	Non-Governmental Organisation
NICE	-	National Institutes of Clinical Excellence
NICUS	-	Nutrition Information Centre University of Stellenbosch
NIH	-	National Institute of Health
NPFS	-	National Programme for Food Security
NSP	-	nutrition supplementation programme
NSSA	-	Nutrition Society of South Africa
NUS	-	Neglected and Underutilized Species
OHS	-	October Household Survey
PEM	-	Protein energy malnutrition
PHN	-	Public Health Nutrition
PLWHA	-	People living with HIV and AIDS
PM	-	Preventative Medicine
PPM	-	Parts Per Million
PUFA	-	Polyunsaturated fatty acids
QFFQ	-	Quantified Food Frequency Questionnaires
RBC	-	Red Blood Cell
RDA	-	recommended dietary allowances
RNI	-	Recommended nutrient intake
RPFS	-	Regional Program for Food Security
SA FBDG	-	South African Food Based Dietary Guidelines
SADAFF	-	South Africa Department of Agriculture, Forestry and Fishery
SADC	-	Southern African Development Community
SADHS	-	South Africa Department of Health Services

SAJCN	-	South African Journal of Clinical Nutrition
SAMJ	-	South African Medical Journal
SAMRC	-	South African Medical Research Council
SCN	-	Standing Committee on Nutrition
SD	-	Standard Deviation
SFT	-	Skin fold thickness
SPFS	-	Special Programme for Food Security SPFS
SPSS	-	Statistic Package for Social Sciences
STATSSA	-	Statistics South Africa
UHI	-	Unilever Health Institute
UL	-	Tolerable Upper Intake Level
UNAIDS	-	Joint United Nations Programme on HIV/AIDS
UNDP	-	United Nations Development Programme
UNICEF	-	United Nations Children's Fund
USDA	-	United States Department of Agriculture
VAT	-	Value Added Tax
WFP	-	World Food Programme
WHO	-	World Health Organisation
WTHR	-	Waist-To-Height Ratio
WTO	-	World Trade Organisation
RIACSO	-	Regional Inter-Agency Co-ordination Support Office

CHAPTER 1 – THE PROBLEM AND ITS SETTING

1.1 INTRODUCTION

A diversified diet is an important aspect of human wellbeing. The human body requires a fine balance of protein, carbohydrates, vitamins, minerals and fats to maintain an optimal level of functionality. The intake of a variety of foods especially fruits, vegetables and grains is encouraged by the World Health Organisation (WHO). Obtaining all these nutrients requires the consumption of a large variety of food items some of which are not affordable to indigent rural communities; hence the inability to achieve dietary diversity. At least 55% of nutrients consumed daily should be carbohydrates. These carbohydrates should be consumed from a variety of food items. The nutritional quality of the diet improves as a higher diversity of food items or food groups is consumed (Kennedy, Berardo, Papavero, Horjus and Ballard 2010; Mann and Truswell, 2007; Clausen, 2005; Steyn, 2006; FAO, 2009b; 2012).

Most of the breadwinners in rural areas are migrant labourers who spend most of the time in cities and are, therefore, unable to cater for the diverse dietary requirements of unemployed dependents. Poor populations mostly experience a lack of dietary diversity due to the high consumption of a normal diet based on starchy staple food containing little or no animal or dairy products and a few fruits and vegetables leading to numerous nutrient deficiencies (Ruel, 2003; Mann et al., 2007; FAO, 2009b).

Diversified diets are thus a necessity for the achievement of balanced nutrient intake for optimal nutrition. Optimal nutrition is essential for functional health status and mental wellbeing of humans. Dietary diversity (increasing a variety of foods across and within the food groups) has been identified by nutritionists as a key element in ensuring high quality diets (Clausen, 2005; Ruel, 2003).

In order to ensure the consumption of highly diversified diets, the problem of food insecurity should be attended to initially and dealt with accordingly; since food security remains a fundamental problem for the developing world. About two billion people globally face severe food insecurity while at least 900 million face hunger every day. China and India escaped the poverty trap 20 to 30 years after dealing with food security issues by means of Green Revolution technical solutions

together with suitable guidelines and politics to administer changed food production capacity. The poor people of Asia, however, remain food insecure even if the number of residents is decreasing. The number of people facing food insecurity in Africa is increasing (Laing, 2011; Malnutrition Matters, 2009; World Food Programme (WFP), 2006; FAO, 2010).

1.1.1Background to the problem

In most rural areas in developing countries the majority of the people do not receive nutritional advice. Barker and Barker, 2004 have emphasized the importance of nutrition education as part of an integrated programme of health services. The people who are most responsible for food production and preparation in developing countries are women; hence programmes aimed at improving household food security should target women. About 70% of the South Africa's poorest households live in rural areas. A very small percentage of households, even in rural areas, are food producers in South Africa (Labadarios, Swart, Maunder, Kruger, Gericke, Kuzwayo, Ntsie, Steyn, Schloss, Dhansay, Jooste and Dannhauser, 2008; Labadarios, Davids, Mchiza and Weir-Smith, 2009;Barker et al.; 2004; Maliwichi, Oni and Obadire, 2012).

Throughout the world, the nutritional status of people has been affected by the four seasons defined on the basis of climatic and activity patterns. In the harvest period (September to November) maize, red sorghum and rice is harvested. This will result in people in rural areas obtaining almost 85% of the daily food intake from maize and rice (Clausen, 2005).

More than 20% of women in Sub-Saharan Africa have a low body mass index (Black, Allen, Bhuta, Caulfield, De Onis, Ezzati, Mathers and Rivera, 2008). In many of these countries, women also have low social status. Women are often the last in the household to eat, and do not receive nutritional care needed, especially in the childbearing years. Poor nutrition in women throughout the life cycle thus extends through the generations. Malnourished girls turn out to be short women, and short women give birth to smaller babies. This brutal cycle is maintained by the low social status of women (Ruel, Grebmer, Nestorova, Olofinbiyi, Fritschel and Yohannes, 2010; Black et al. 2008).

Studies have been conducted to assess seasonal dietary diversity and food variety on the African continent. Droughts, storms, insects (caterpillar), floods, negligence and lack of irrigation have been proven as the main reasons for the poor vegetable and fruit production in South Africa (Ruel, 2003; Clausen, 2005; FAO, 2009c).

According to the FAO (2009c), the price increase of maize and wheat as staple food of the poor in South Africa has led to serious problems for the urban and rural poor since the majority is net food buyers. FAO (2009c) supported by Heady and Fan (2008) and Evans (2009), stated that food prices will increase gradually over the next decade even if there are some fluctuations and irregular drop in prices. Given strongly escalating connections between the local, national and international level, product chains and economic networks, even remote rural households of South Africa are affected by changes in these networks. Poor households will always be forced to allocate a greater proportion of the expenditure to food unless there are new policy directions. As people try to cope with these situations, diets will become less diverse, poor in quality and lower in energy (FAO, 2009c; Heady and Fan, 2008; Evans, 2009).

South Africa ranks among the countries with the highest rate of income inequality worldwide. South Africa has extremely high levels of poverty compared to other middle income countries. The South African government has pledged to decrease the poverty rate by 50% between 2004 and 2014. Achieving household food security is an essential component in achieving that goal. Access to food and water is possible unlike other areas of delivery, since food and water are essential to well-being and human growth (Altman, Hart and Jacobs, 2009; De Klerk et al., 2004).

Maize meal has been identified as the main staple food of the population in KZN rural areas. It is eaten in many forms i.e. stiff porridge (bogobe) with a relish such as tomato gravy, soft porridge as well as mealie meal bread causing high carbohydrate intake, more than other nutrients which may result in obesity and other nutrient deficiency disorders. The most popular fruit in rural areas is banana and the most popular vegetable is spinach (morogo). Morogo and bananas are, therefore, available in all seasons unlike other fruits and vegetables which are grown in specific seasons (Labadarios and Steyn, 2002; Browne, Love and Vorster, 2001).

Excessive fat intake has long been recognized as a risk factor for the development of heart and other degenerative disease. The excessive intake of carbohydrates and insufficient intake of fruits, vegetables and proteins has been recognized as a risk factor for kwashiorkor and malnutrition in general. More than 20 million children in the world are affected by malnutrition due to the lack of consuming a diversified diet (FAO, 2009a:14, 22; UNICEF, 1990:15; Elmadfa and Kornsteiner, 2009).

Women in rural areas have a significantly higher intake of energy, protein, fat, fibre, riboflavin, niacin and vitamin B6 in summer. It has been speculated that this higher nutritional intake may be due to spending more time working in the fields during summer and therefore higher level of physical activity resulting in increased hunger and greater food intake (Abercrombie, Labadarios and Steyn, 2002; Ladzani, Nel and Steyn, 2008).

1.1.2 Rational and Motivation

In rural areas the low intake of protein, fruits and vegetables as well as a higher intake of carbohydrates has been identified as the main reasons for the high rate of nutrient deficient disease. Beans, maize meal and potatoes are consumed 3 times a day and very few protein rich food items are easily accessibility and affordable by rural dwellers (Steyn, 2005; MacIntyre, Kruger, Venter and Vorster, 2002).

Several studies have indicated that the lack of certain nutrients have affected the IQ and learning abilities of rural children. Rural children do not consume an adequate breakfast which results in poor learning ability and malnutrition (UNICEF, 1990; Abrahamson, Lennernas, Risvik and Sepp, 2001).

According to Clausen and Steyn (2005), low income results in a low dietary diversity. Most people in rural areas are unemployed and are, therefore, unable to cater for dietary diversity. This poor dietary diversity has resulted in impaired immunity. According to Abercrombie et al. (2002), seasonal food items that are harvested may supply the rural poor with certain nutrient rich food items that are not affordable to them. During winter higher production of oranges and berries is evident on most continents. Mangos and plums are produced in summer. This will increase the intake of fruits by rural communities during these seasons thus increasing nutrient intake. Lack of cold storage facilities prevents the most rural households from buying highly perishable foods e.g. fish, poultry, meat, seafood and dairy products. This has an impact on the nutrient deficiency rate in rural areas because these highly perishables are high in protein mostly needed for the prevention of kwashiorkor and malnutrition (Abercrombie et al., 2002; Labodarios et al., 2008; Alberts, Burger, Monyeki, Nthangeni and Steyn, 2001).

Summer has been identified as a season with a high food consumption rate and high activity rate in rural areas since rural populations engage themselves in working activities more in summer than in winter which result in higher food intake (Abercrombie et al., 2002; Labodarios et al., 2008).

1.2 FOOD SECURITY

Food security is identified by the FAO (2008:19-20) as the attainment of physical, social and economic access to safe, adequate and nutritious food by all people at all times in order to achieve the dietary needs and preferences of the body essential for a nourishing lifestyle (FAO, 2009b; Laing, 2011).

Household food insecurity exists whenever there is a limited availability of sufficient safe and nutritious food or means to obtain sufficient food at all times for a sustainable and healthy life in a manner that is socially tolerable. The unavailability of nutritious food and inability of households to access enough food indicates the level of poverty that exists in households that are food insecure. Household food insecurity is, therefore, an important element of the individual's health within a household (De klerk, Drimie, Aliber, Mini, Mokoena, Randela, Modiselle, Roberts, Vogel, Swardt and Kirsten, 2004; FAO, 2008; 2012; Laing, 2011; Kirkland, Kem and Lori, 2011).

According to the Heads of State and Governments, during the World Food Summit in 1996, having access to adequate, safe and nutritious food is a fundamental right of all citizens. Food security is very complex and, therefore, cannot be measured and captured by a single indicator. It requires valid and reliable ways in order to be measured and captured appropriately. The main causes of food insecurity are the lack of purchasing power; inaccessibility of food and inappropriate food distribution and utilization both at national and household level. Food insecurity may be long-lasting, seasonal or fleeting. Other contributing factors towards food insecurity in most rural settlements include over-reliance on naturally irrigated agriculture, low productivity, low incomes, poor road infrastructure, poor running of markets and poor modernization. Ecological factors such drought, floods and pests may threaten food security in rural areas by causing a decline in agriculture. The inappropriate implementation of food security policies adds to failing food production and productivity activities (FAO, 2008, De Klerk et al., 2004; Bouis, 2008; Laing, 2011).

Food security cannot be understood and properly addressed if it is isolated from other developmental issues such as social protection, income sources, urban and rural development, transformed household structures, health, access to land, water accessibility, retail markets, education and nutritional awareness programmes (De Klerk et al., 2004; Hendricks and Lyne, 2009; Kirkland et al., 2011).

Expanded employment opportunities have improved household income. Though expanded employment has contributed to increased household food security status, employment opportunities are not sufficient to address poverty meaningfully for all citizens as income security is an important constituent in addressing food insecurity (Aliber, 2009; STATSSA, 2006a; 2007; Altman, Hart et al., 2009; Laing, 2011).

Aliber (2009) analysed the Income and Expenditure Survey (IES) of 2005/2006 and explained that poor rural households spend a larger portion of the total household expenditure on food more than the urban households. The possible reason for this interpretation is that rural households spend more money trying to acquire an equivalent food basket. However, rural households spend 15% less on each household member in terms of Rand than urban households. Higher prices of food usually point to the direct overheads on food. However, this excludes transport costs that rural households need to cover if shopping in supermarkets of nearby towns where food prices are much lower (Aliber, 2009; STATSSA, 2006a; 2007; Altman, Hart et al., 2009; Cloete, Lenka, Marais and Venter, 2009).

1.2.1 Food security the global perspective

Estimates of the FAO confirmed that the number of undernourished people globally increased from 848 million to 923 million from 2003/2005 to 2007, mainly due to the food price increase (FAO, 2008). The number of undernourished people increased even more in 2008 as prices persistently increased and the financial crisis struck higher levels owing to the global economic reduction. Food price increases have also raised micronutrient deficiencies, with negative results for nutrition and health, such as impaired cognitive development, lower resistance to disease, and increased risks for both mothers and children during childbirth (Oni, Maliwichi and Obadire, 2011; FAO, 2008; Labadarios, Steyn and Nel, 2011; Kirkland et al., 2011).

The Global Hunger Index (GHI) as a tool developed by the International Food Policy Research Institute (IFPRI) to measure and track broadly global hunger has proposed a helpful and multi-dimensional outline of global hunger. The hunger index in the world remains at a level illustrated as serious. This result is expected given that the overall number of hungry people exceeded 1 billion people in 2009 (Von Grebmer, Ruel, Menon, Nestorova, Olofinbiyi, Heidi Fritschel and Yohannes, 2010).

During the last three years, the global prices of basic food products have increased rapidly. The food price index increased by 9% in 2006 and by 23% in 2007. As from 2008, wheat and maize prices were 130% and 30% higher respectively in comparison to 2007. This situation posed danger to food and nutrition security in developing countries, mostly for children, pregnant and lactating women and required quick and organised action by the international society (UNICEF, 2008; Oni et al., 2011).

The increase of food prices could lead to a decrease in access to quantity and quality of food for households, which can possible lead to undeviating consequences for the nutritional status of children and women. In addition, susceptible households may alter for certain coping strategies which have harmful consequences on children (UNICEF, 2008; Heady et al., 2008).

Food insecurity can lead to conflict and with increasing food prices and common living cost, people have turned to the streets in objection. Social and political conflict has taken place in 61 countries since 2007, with some experiencing multiple incidences and a high level of violence (Von Braun, 2008). Even though this disorder has taken place mostly in countries with low performance in governance, another3655countries have also been affected. In Bangladesh, a 50% increase in the price of food is estimated to elevate the incidence of iron deficiency among women and children by 25% (Bouis, 2008; Oni et al., 2011; Kirkland et al., 2011).

According to Kgaphola and Boshoff (2002: 65), in some countries when food security is met at national level, food may be exported to other countries while its own citizens are still experiencing food insecurity, malnutrition and hunger. Food insecurity should be addressed both at national and household level differently in a broad perspective (Kirkland et al., 2011; Kgaphola et al., 2002: 65).

Small scale production has been successfully supported by several countries in Europe, Japan and Indonesia for its contribution to household food baskets. The dietary guidelines given to the US public by The US Department of Health aim to improve the nutrient intake of the population so that illness due to chronic diseases can be reduced. The US Department of Health introduced a dietary diversity score (DDS) which makes it clear that all food groups i.e. dairy, grain, fruits, vegetables and meat should be consumed daily (FAO, 2009c; 2010; Labadarios et al., 2011).

1.2.2 Food security the African perspective

Food and nutrition security continues to be one of Africa's most serious challenges. The persistence of the challenge is consequential of intricate political, social, and economic factors as well as environmental stressors (USDA, 2009; Altman et al., 2009; Labadarios et al., 2011).

Food insecurity, malnutrition and hunger are the results of poverty more particularly in Southern African countries where poverty is still one of the major challenges. The level of poverty varies from country to country ranging from 15% in Botswana to 85% in Zambia. In most countries in Southern Africa, poverty is a rural pandemic and about 75% of poverty sufferers are rural dwellers who attain their living from agriculture and other non-farming activities. In Zimbabwe alone, 7 million people are considered to be in danger of starvation (Sayed, 2002:3; Derrickson, Sakai and Anderson, 2001:155; Lado, 2001:4; De Klerk et al., 2004; SADC FANR Vulnerability Assessment Committee, 2003; Maliwich et al., 2012).

Increasing household agricultural production may definitely be a highly suitable strategy to decrease food insecurity in countries including some in the Southern African Development Community (SADC) in which agriculture is still one of the foremost contributors to gross domestic product (GDP). Agricultural production might have a great input towards income and/or savings and might have the potential to promote food diversity. Opportunities and threats need to be understood better and suitable interventions developed to support production at household-level (Altman et al., 2009; Aliber, 2009; Van der Berg, 2006; SADC Vulnerability Assessment Committee, 2003).

The HIV and AIDS pandemic have a great impact on food insecurity in African countries. The argument that the existing Southern African food crisis is closely related to the prevalent HIV outbreak, which has expanded the disaster, is supported greatly by the food security issue and present thoughts. This claim is strengthened by the truth that the region has the highest prevalence rate in the world (Lesotho 31%; Malawi 16%; Mozambique 13%; Swaziland 33%; Zambia 22% and Zimbabwe 34%), with infection levels approximately 25% of the world's population (Matshe, 2009; UNAIDS, 2002). All elements of food security which are availability, stability, access and use of food are affected where the incidence of HIV and AIDS is high (UNAIDS, 2002; WHO, 2007; De Klerk et al., 2004; Devereux and Maxwell, 2003; Matshe, 2009; Fawzie, Msimanga, Urassa, Hertzmark, Petrato, Willet and Spiegelman, 2007).

A key review meeting in response to the food crisis in Southern Africa, arranged by UNAIDS and the Regional Inter-Agency Co-ordination Support Office (RIACSO) re-iterated this position and concluded that HIV and AIDS must be essential to all responses to the food crisis facing the region (RIACSO, 2002). It was argued that the shocking impact of HIV and AIDS, especially in the badly affected areas of Southern Africa, caused complications in the task of combating starvation and strengthening the livelihoods of the poor. The pandemicproduced many new susceptible people and was quickly eroding food and livelihood security (UNAIDS, 2002; WHO, 2007; De Klerk et al., 2004; RIACSO, 2002).

The Millennium village project (MVP) was put into operation in Malawi, Kenya and Uganda where food insecurity rate is high with an aim of improving food security and nutrition interventions through a set of interventions recommended by the United Nations Millennium Project Hunger (Sanchez, Palm, Sachs, Denning and Flor, 2007; Millennium Village Project, 2010; Nzinguheba, Palm, Berhe, Denning and Dicko, 2010; United Nations Millennium Project, 2005).

1.2.3 Food security the South African perspective

South Africa has been classified as a food secure country for more than 20 years since it has sufficient foreign currency to import other food items in order to meet the needs of the populations. Despite the country's ability to produce 100% of the staple food requirements, poverty still exists in about 43% of households (DOA, 2002; De Klerk et al., 2004; Heady et al., 2008; Evans, 2009).

More than 14 million people, or about 35% of the population in South Africa, are estimated to be victims of food insecurity, whilst the increase of as many as 1.5 million, or 25% of children under the age of 6 are considered to have been stunted by malnutrition. The constitution, if not the values of society and/ or the total economic cost of decline production potential, dictates the need to reduce susceptibility of South Africans to possible harmful outcomes of food insecurity (De Klerk et al., 2004; Mbaya, 2003; Berry, 2007).

A number of studies indicated that food insecurity, hunger and poverty is a crisis in South Africa (May and Woolard, 2007; De Klerk et al., 2004; Pauw and Mncube, 2007; Maliwichi et al., 2012). Agricultural growth offers a potential for reducing risks of food scarcity at all levels, increasing general distribution of food, creating economic opportunities for susceptible people and improving dietary diversity and the quality of food consumed by rural households (Lyne et al., 2009). In South

Africa, food security is not a failure of agriculture to produce adequate food at the national level, but a failure of households to access sufficient food (Barker and Barker, 2004; May et al., 2007; De Klerk et al., 2004; Pauw et al., 2007; Mjonono, Ngidi and Hendriks, 2012).

In 2010 household access to food improved according to two measures. The percentage of South African households with reduced or severely reduced access to food decreased from 21, 9% in 2010 to19, and 4% in 2011 using the Household Food Insecurity Access Scale which aimed at determining households' access to food. For that period of time, the percentage of individuals that were at risk decreased from 27.1% to 23.3%. The percentage of households that experienced hunger between 2002 and 2011 decreased from 23.8% to 11.5% whereas the percentage of individuals who suffer from hunger decreased from 29.9% to13% (STATSSA, 2011).

According to the National Food Consumption Survey (NFCS) 2005, approximately 80% of households in South Africa cannot afford to buy a simple nutritional food basket costing an average of R262 per person per month which means only 20% of South Africa can be regarded as food secure (Labadarios et al., 2008). South Africa may be food secure at national level while food insecurity is still a crisis at household level, more so in rural areas. Meeting food security at national level does not mean food security is automatically met at household level. Household food insecurity in most rural areas is due to the lack of buying power, lack of production, inconsistent food supply, improper and inadequate food storage facilities and poor food hygiene (Labadarios et al., 2008, FAO, 1998:11; Altman, Hart et al., 2009; Cloete, Lenka, Marais, Venter, 2009; Mjonono et al., 2012).

In 2005, South Africa exported $5.4 billion of agricultural food and seafood. Agricultural products contributed 8% of South Africa's total exports. South Africa is the world's top exporter of avocado, tangerine, and ostrich products. It is also positioned as the world's second major exporter of grapefruit, third for plums and pears, and fourth for grapes. Other main export commodities include wine, citrus, sugar, grapes, maize, fruit juice, wool and deciduous fruit (Berry, 2007). Projections shows that should present production inclinations hold, domestic wheat production would be exceeded by domestic consumption by at least 60% in 2010 and by above 100% in 2020 (Limpopo Department of Agriculture, 2002). Maize and beef is expected to increase by about 130% if production tendencies persist. The need for poultry products has already exceeded domestic production by an approximate 22% in 2000, and is likely to increase to 92% in 2010 and to 192% in 2020 (Limpopo Department of Agriculture, 2002; Berry, 2007).

The target goal of the Integrated Food Security Strategy (IFSS) is to decrease the number of food insecure households by 50% by 2015. The tactical objective to reach this target is to increase domestic food production by offering support services to vulnerable households. The Department of Agriculture (DOA) has the duty to provide each and every citizen access to available food on a continuous basis. The aim of the DOA is to support the 244,000 food parcel beneficiaries to make use of basic food given for own benefit and that of dependents (DOA, 2006; 2007).

Social grants showed to have contributed much in reducing food insecurity in the poorest households that were introduced in 2001 with 4 million beneficiaries but by 2007, there were about 12 million beneficiaries. According to Statistics South Africa STATSSA (2011), 44.8% of the households in South Africa are dependent on any form of grant while only 62.2% of the population are financially dependent on salaries. Social grants are not a long term strategy used in eradicating poverty since beneficiaries do not participate in economic development of the country and are, therefore, vulnerable to politics and national policy choices. According to Aliber's 2007 general household survey (GHS), 51% of absolutely starving households seem to be eligible for social grants that they do not get. Child support grants have been raised to 18 years and further 13% of hungry households are receiving grants for which they are entitled to (Aliber, 2009; Evans, 2009; STATSSA, 2011).

The South African Food Based Dietary Guidelines advise the South African public to consume a variety of foods from all the food groups, including 5 fruit and vegetables a day (Vorster et al., 2001; DOH, 2004)

1.3 FOOD EXPENDITURE PATTERNS

Aliber (2009) utilizes the income and expenditure survey (IES) 2005/2006 to make a detailed analysis of food expenditure patterns and ask whether current household food expenditure allows paying for the cost of nutritionally satisfactory food baskets. This is done by calculating the average and below average dietary energy costs. About 1 in 5 households in the country spend sufficient money on food to purchase nutritionally adequate food baskets. Significantly smaller numbers of rural households can afford such food baskets when a rural-urban breakdown is made i.e. 1 in 10 households in rural areas compared to 1 in 4 households in urban areas (STATSSA, 2006a; 2007; Aliber, 2009; Jacobs, 2009).

There are numerous ways of explaining the reason why rural households in the similar expenditure group with urban households spend less on food per adult equivalent (ADEQ). The clearest reason is that there are more people in the average rural household compared to urban households. Furthermore, it is likely that own-production partially explains lower ADEQ expenditure in rural areas (Altman et al., 2009). According to Palmer and Sender (2006), the best methods to acknowledge the importance of production for own use in South Africa may be to measure the difference in ADEQ expenditure between farming and non-farming households. The distinction between rural and urban households serves as a kind of substitute since the IES 2005/2006 does not distinguished between farming and non-farming households. If two households were involved in own production and a quarter of this value was consumed by the groups of higher incomes, it would imply that poor households saved an average of R750 per annum considering an in-kind input to the budget (Altman et al., 2009; STATSSA, 2005; 2006a; 2007).

The difference between urban and rural food expenditure guides can be traced to specific food kinds as rural households spend a larger portion of money allocated to food on grain products and lower share on meat which is a total opposite of urban households in the similar deciles (Altman et al., 2009; STATSSA, 2007; 2011).

Statistics from the 2007 General household survey (GHS) reveal that severe hunger is prevalent and is found in similar sections in rural districts and metros as 10% of children and 12.2% of adults are sometimes and always hungry (Altman, Hart and Jacobs, 2009). The National Food Consumption Survey (NFCS) of 2005 revealed that 52% of households experience hunger daily (Labadarios et al., 2008; Labadarios, Davids, Mchiza and Weir-Smith, 2009). It further reports that an additional 33% ofhouseholds are at risk of hunger, which means that food price increase and the loss of income might shove 33% of households into starvation. (Labadarios et al., 2008; Labadarios et al., 2009).

Women are key role players in achieving household food security in rural areas. Participation in small-scale agriculture in rural areas is imperative to food security, with women taking responsibility for it as one feature of a diverse livelihood strategy. However, women also have other roles and responsibilities; namely food selection, food preparation, care and feeding of children, fetching of water for cleaning and firewood for fuel. These activities reduce the time available for household agricultural production. Any assistance that enables women to increase the productivity during the time spent on agricultural activities, and to spend less time on regular household duties could be more

helpful in increasing agricultural productivity for the benefit of the entire household (Labodarios et al., 2008, Ladzani et al., 2008).

1.4 DIETARY DIVERSITY

Dietary diversity is defined by Ruel (2003) as a number of individual different foods or food groups consumed over a given period of time. Nutritionists have long recognized dietary diversity as a chief constituent of high quality diets. Dietary diversity seems to indicate potential as a means of measuring food security and monitoring variations and effect (Hoddinott and Yohannes, 2001: 7; Ruel, 2003).

The Food and Nutrition Technical Assistance Project (FANTA) has stated that dietary diversity is a good measure for household food security and the level of poverty in all settings which includes urban and rural areas, poor, middle and low income countries and all seasons of the year. In order to reflect the quality of a diet better, the number of different food groups consumed is calculated instead of the number of different food items consumed. Knowing that households consume, for instance, an average of four different food groups is an indication that the diets offer some diversity in both macro and micronutrients. This is a more meaningful indicator than knowing that households consume four different individual foods, which might all be from one food group (Swindale and Bilinsky, 2006, Hoddinott et al., 2001: 7).

The Household Dietary Diversity Score is used as measures for the socio-economic level of the household whereas the individual dietary diversity scores (IDDS) is used as measure for the nutritional quality of an individual's diet. An increase in the average number of different food groups consumed gives a countable measure of improved household food access. Any increase in household dietary diversity indicates an improvement in the household's diet. The changes in HDDS must be compared to some significant goal level of diversity in order to use this indicator to assess improvements in food security in an enactment reporting situation. However, normative data on ultimate or target levels of diversity are commonly unavailable (FAO, 2007b; Kennedy, Ballard and Dop, 2011).

The dietary diversity patterns of more affluent households can be used as a target, assuming that poorer households will diversify the food expenditures as revenues increase, and thus reflecting the consumption patterns of these households. Baseline surveys usually gather some income or economic

status information over and above the dietary data since projects using the HDDS indicator generally include interventions aimed at increasing household income (FAO, 2007b; Kennedy et al., 2011).

1.5 SOUTH AFRICAN STUDIES CONDUCTED

TABLE 1.1: South African studies on dietary diversity, food security and coping strategies in rural areas over the past 10 years.

Title of the study	Author	Measuring tools	Summary of results
How diverse is the diet of adult South Africans? (2011) (n = 3287)	Labadarios, D., Steyn, N.P and Nel, J.	24 hour recall which was not quantified was used. A dietary diversity score (DDS) was calculated by counting each of 9 food groups. Food frequency questionnaires were also used in the study.	The provinces with the highest incidence of poor dietary diversity (DDS <4) were Limpopo (61.8%) and the Eastern Cape (59.6%). By difference, only 15.7% of participants in Western Cape had a low score. Participants in tribal areas (63.9%) and informal urban areas (55.7%) were extremely affected. Significant differences were found in DDS by Living Standards Mean (LSM) analysis ($p<0.05$) with the lowest LSM group having the lowest mean DDS (2.93).The most commonly consumed food groups were cereals/roots; meat/fish; dairy and vegetables other than vitamin A rich. Eggs, legumes, and vitamin A rich fruit and vegetables were the least consumed.
Toward Improved Understanding of Food Security: A Methodological	Kirkland, T.M., Kemp, R and Lori M. R	The Coping Strategies indicators were measured in 7-days. Food	The results revealed that about 86% of the coping strategies and 67% of the experience of hunger measures resulted in statistically significance $p<0.01$, suggesting many measures are similarly identifying food insecure

		frequency questionnaires (FFQ) were used in the study.	households. About 91% of households that indicated that the respondent skipped an entire day of food also reported reducing the amount of food served to men. About 3% of households that reported running out of food also reported not having enough food in the last 30 days.
Examination Based in Rural South Africa. May 2011 (290 households)			
An investigation into the factors affecting food availability, choices and nutritional adequacy of smallholder farming households under irrigation and dry farming in Vhembe district of Limpopo, province, South Africa (2012) (n=3,236 small-scale irrigators)	Maliwichi1, L. L., Oni2, S. A and Obadire, O. S.	The data collection tool was the questionnaire which was designed and used to obtain the required data needs of the study. The questionnaire included both open-ended and close-ended questions.	About 52% of the irrigators were males whereas 48% were females and 49% of the dry-land farmers were males while 51% were females. Households obtained utility from the intake of foods through the satisfaction found in a set of taste characteristics with the health results of the nutrients consumed. Vegetables contributed about 35.6% of total income in irrigation farming as compared to 46.3% in dry-land farming. Livestock income was very low as farmers sold the livestock only in time of pressing financial requirement and animals were not frequently kept for profit-making reasons by farmers in the study area.
Investigating household food	Mjonono, M.,	Socio-demographic	The study revealed that households utilized coping strategies to lessen food shortages

insecurity coping strategies and the impact of crop production on food security using coping strategy index (CSI). (2012) (n=200 respondents from 176 households)	Ngidi, M and Hendriks,S.	questionnaires, coping strategy index (CSI) were used in the study.	which resulted from inadequate crop production. The results indicated that as CSI scores increased, households relied more on the consumption coping strategies. Households with low CSI scores applied these consumption coping strategies less frequently than households with high CSI scores. The frequency to apply coping strategies was reduced through income from sales of produce and consumption of food from production. As a result, income from sales of produce and consumption of food from own production shielded households who are food insecure.
Food Variety and Dietary Diversity as Indicators of the Dietary Adequacy and Health Status of an Elderly Population in Sharpeville, South Africa. 2008. (153women and 16 men)	Oldewage-Theron, W.H and Kruger, R.	Socio-demographic, health food frequency questionnaire,24 h-recall questionnaires, and anthropometric and biochemical measurements were measuring instruments used in the study.	The mean calcium intake of women was low (226.3mg) compared to 1,200mg AI for calcium. The nutrient adequacy ratio for calcium was (19%) when measured against the required value of 100%\ for all nutrients. Men had fewer deficient nutrient intakes compared to women. This was proved by the mean adequacy ratio of 0.69 women and 1.04 for men. The nutrient analysis of the diets of both men and women indicated deficient intakes for a number of nutrients when compared with the EAR even though the majority of households indicated eating three or two meals per day. . Thiamine was the only nutrient that had a mean

			nutrient adequacy ratio of 90% <100% which is slightly lower than recommended 100%). Vitamins A, B2, B6, C, biotin, and pantothenate had a mean nutrient adequacy ratio of 60%. Calcium, iodine, folate, vitamins D and E, and selenium had a very low mean NAR of less than 60%
The contribution of food access strategies to dietary diversity of farm worker households in Orange farm in the Fouriesburg district (RSA). (2008) (21 adult women)	Moratswa Tsholofelo Hope Matla	Anthropometric measurements. Body Mass Index (BMI) was the only measure of body weight included in the study. Food frequency questionnaires (FFQs) were used.	The results revealed that food purchasing; food gathering and food production are the main food accessing strategies used by households. Food gathering and food purchasing are the two most commonly used food accessing strategies since gathering of food items such as wild leaves, vegetables and fruits plays an important role in increasing dietary diversity of farm workers.
Dietary Diversity as a Food Security Indicator (2006)	Hoddinott, J and Yohannes, Y.	24-hour individual intake data. Quantified food frequency questionnaires (QFFQs) were used in the study.	The results showed that for every 1 percent increase in dietary diversity there was an associated 1 percent increase in per capita intake. A 0.7 percent increase in total per capita caloric accessibility, a 0.5 percent increase in household per capita daily caloric availability from staples, and a 1.4 percent increase in household per capita daily caloric availability

			from non-staple food items.
Assessing nutritional diversity of cropping systems in African villages. (2011) (170 households from three cities)	Remans, R., Flynn, D.F.B., De Clerck, F., Diru, W., Fanzo, J., Gaynor, K., Lambrecht, I., Mudiope, J., Mutuo, P.K., Nkhoma, P., Siriri, D., Sullivan, C and Palm, C.A.	Data collection on edible plant species diversity, food security and diet diversity were collected. Blood samples were collected from 90 adult women to determine iron and vitamin A deficiency level.	The results showed that adding or removing individual species can give different outcomes for nutritional diversity. Farm species richness was found to be independent from farm landholding size (r^2=-0.0017, p=0.366). The five most commonly grown crops in all three cities were banana (93%), maize (91%), beans (75%), cassava (75%) and mango (69%).

1.6 AIMS AND OBJECTIVES

1.6.1 Study Aim

The aim of this study was to establish the seasonal food group dietary diversity, food variety and coping strategies as a measurement for diet adequacy of a community in rural KZN.

1.6.2 Objectives

To determine:

- The food consumption patterns and dietary intake behaviour during the four seasons by using a Quantified Food Frequency Questionnaire (QFFQ).

- Using a 24 hour recall method as reference measurement.
- The food coping strategies used by the Malangeni community in times of hunger.
- The nutritional status of the caregivers in the households in the Malangeni community by using anthropometric measurements.
- Household food cupboard survey.
- The socio-demographic status of the community.

1.6.3 Figure 1.1 Plan of research activities

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                    │     Literature review     │
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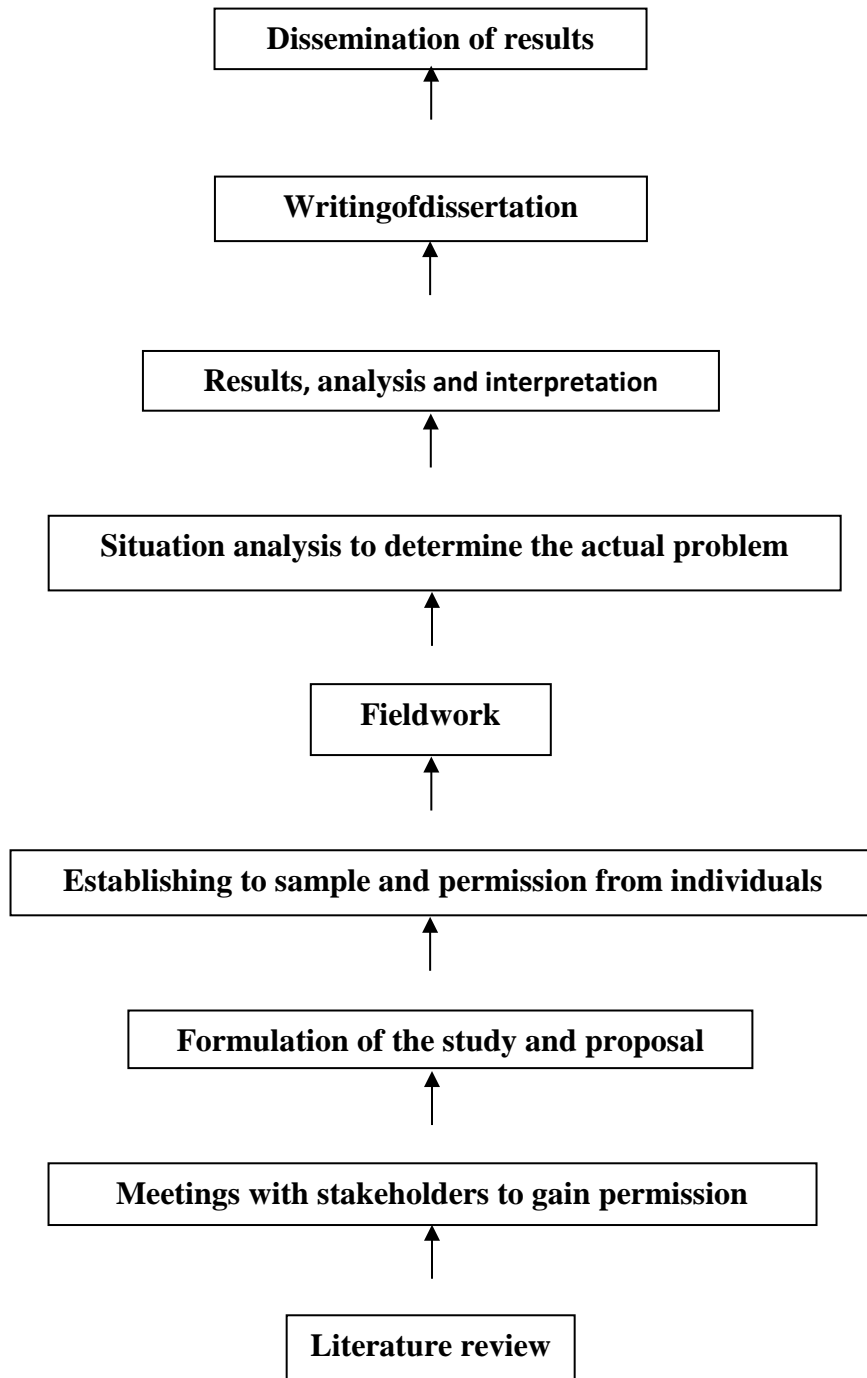
1.6.4 Structure of dissertation chapters

Chapter 1:   Introduction and motivation for the study

Chapter 2:   Literature Review

Chapter 3:   Methodology

Chapter 4:   Results

Chapter 5:   Conclusions and Recommendations

1.7 CONCLUSION

Eradication of global hunger is a major challenge and the number of people suffering from continuous malnutrition remains very high. However, the renewed efforts of decreasing hunger level globally during the past 20 years may assist in reaching the global Millennium Development Goal (MDG) hunger target by 2015. The rapid growth of economy is essential but not sufficient to speed up hunger and malnutrition reduction. Sustainable agricultural development is normally helpful in reaching the poor since the majority of the poor and starving people live in rural areas and are dependent on agriculture for a substantial part of life. However, agricultural development will not automatically result in improved nutrition for all. Policies and programmes that will warrant "nutrition-sensitive" growth comprise of encouraging and supporting improved dietary diversity and educating consumers concerning sufficient nutrition and healthy eating habits (FAO, 2012).

CHAPTER 2: LITERATURE SYNTHESIS

2.1 INTRODUCTION

A healthy, wholesome life and sound nutrition that is unrestricted by diseases and nutrient deficiencies is a basic need for every citizen and, therefore, the state of a human's physical, social and mental wellbeing should be as healthy as possible. The World Health Organization (WHO) aims at attaining the highest achievable levels of health and promoting the healthy lifestyle for all people by eradicating and preventing health risks that may be found within the physical and social environments. In 2007, the 7th of April was declared as the World Health Day with an intention of increasing the awareness of the people on world health issues important for productive and happy lives as well as to encourage governments to invest in health and building a safer future (Mann et al., 2007; WHO, 2007).

The United Nations Children's Fund (UNICEF) has a Nutrition Strategy that aims at empowering families, organisations, communities, individuals and governments at improving the nutritional status, health, growth, survival and development of infants, young children and women by means of adequate dietary intake and nutrient adequacy being the determents of good nutrition (UNICEF, 2004; 2008; Chopra and Darnton-Hil, 2006).

One of the major objectives of the Department of Health (DOH) is to ensure that nutrition is promoted, protected, prized and provided to all South Africans with food security and nutrient adequacy being the top priorities that entail having sufficient food and good nutrition on a continuous basis. The DOH implemented an Integrated Nutrition Programme (INP) in 1994 to assist in developing a Nutrition Strategy for South Africa. The aim of the INP was to identify, address and solve problems associated with nutrition by using the conceptual framework that describes malnutrition as a result of interrelated causes at different levels and nutrition planning as an endless process of assessment, analysis and action which is also known as the Triple A cycle of UNICEF. When introducing the Triple A cycle by means of the INP, the DOH had a belief that in order to combat malnutrition, the causal factors that are basic, immediate and underlying must be known first and then addressed (Faber and Wenhold, 2009; UNICEF, 1990; 2004a; DOH, 2002a; b; 2004).

2.2 WHAT IS MALNUTRITION?

Malnutrition is the inconsistency that is found between nutrients needed by the body for healthy living and the amount that the body constantly receives. It is one of the major contributing factors towards morbidity and mortality. Malnutrition is not only an urgent worldwide health problem. It is also a barrier to productivity, economic development and poverty eradication. One of the broad tasks that has been identified by the governments of most developing countries is to improve the nutritional status of all citizens. The understanding of the term malnutrition during the past years has been limited and most people associated it with under-nutrition. Malnutrition needs to be redefined and its outcomes need to be well known and understood within different societies in order to deal with disease prevention and tendency better (United Nations Systems, 2004; Norman, Pichard, Lochs and Pirlich, 2008; UN Millennium Project, 2005).

Malnutrition causes may be social, physical and psychological which include nutrient deficiency diseases, mental disorder, social isolation and poverty; therefore, the level of risk related to nutrition deficiencies significantly differs within individuals. In Europe, the estimation of the cost of malnutrition related diseases is £7.3 billion a year which surpasses even the cost of obesity. The most noticeable victims of malnutrition are women and children due to lack of nutrition knowledge and illiteracy, lack of development and poverty (European Nutrition for Health Alliance, 2006; Norman et al., 2008).

According to Magdoff (2008), one billion people of the total population of 6 billion world population are starving continuously. It is predictable that 32% of the global burden of disease would be reduced by eradicating malnutrition, including micronutrient deficiency (UN Millennium Project, 2005). Malnutrition does not only result from hunger and poverty, it also affects people who have sufficient food but lack knowledge on the consumption of nutrient rich food needed by the body in order to prevent malnutrition. The Food and Agricultural Organisation (FAO) has recommended the 9 essential food groups essential for a healthy life which are 1) Cereals roots and tubers; 2) Dairy; 3) Eggs, 4) Fats and oils; 5) Legumes and nuts; 6) Other vegetables; 7) Other fruits; 8) Vitamin A rich fruits and vegetables, 9) Flesh products (meat, poultry, fish and offal (FAO, 2009c).The strategies used by the WHO to combat malnutrition are to facilitate health education programmes to limit unhealthy diets, expand accessibility of healthy food to the poor in adequate amount and ensure

agricultural developments and water supply (FAO, 2009c; 2008; Magdoff, 2008; UN Millennium Project, 2005).

One of the major contributing factors towards malnutrition especially in children is infectious diseases. Malnutrition makes the body more vulnerable to infectious diseases. Human Immunodeficiency Virus (HIV) /Acquired Immune Deficiency Syndrome (AIDS), measles, diarrhoea and respiratory infections are major child infectious diseases in South Africa that are worsened by malnutrition. Malnutrition may also cause the adult body to be more vulnerable to diseases such as coronary heart diseases, diabetes, hypertension and anemia. The most important nutrients needed by the body in order to prevent malnutrition are proteins, carbohydrates, fats, vitamins and minerals. The imbalance between nutrients required and the proportion that the body receives leads to over-nutrition or under-nutrition. Malnutrition technically refers to both under-nutrition and over-nutrition but it is commonly used as a synonym for under-nutrition (Du Plessis, Labuschagne and Naude, 2008; FAO, 2009b; UNICEF, 2004; Steyn, 2006; NICUS, 2005b).

The results of child malnutrition is extreme in nations, communities and families concerned with perceptible symptoms such as anaemia, muscle twitches, disorientation, lack of muscular coordination and loss of reflexes. Causes of malnutrition are anticipated and avoidable and can be alleviated through affordable means which include increasing the capability of direct community action along with formulation, implementation and strengthening of the nation's nutrition policies and programmes. There is sufficient knowledge to address the issue of malnutrition significantly. However, it seems as if there is a huge gap between knowledge and application and between theory and practice (Bradshaw, Groenewald, Laubscher, Nannan, Nojilana, Norman, Pieterse and Schneider, 2003; World Food Programme (WFP), 2006; Bhutta, Ahmed, Black, Cousens, Dewey, Giugliani, Haider, Kirkwood, Morris, Sachdev and Shekar, 2008; WHO, 2000d).

Figure 2.1: Classification of Malnutrition
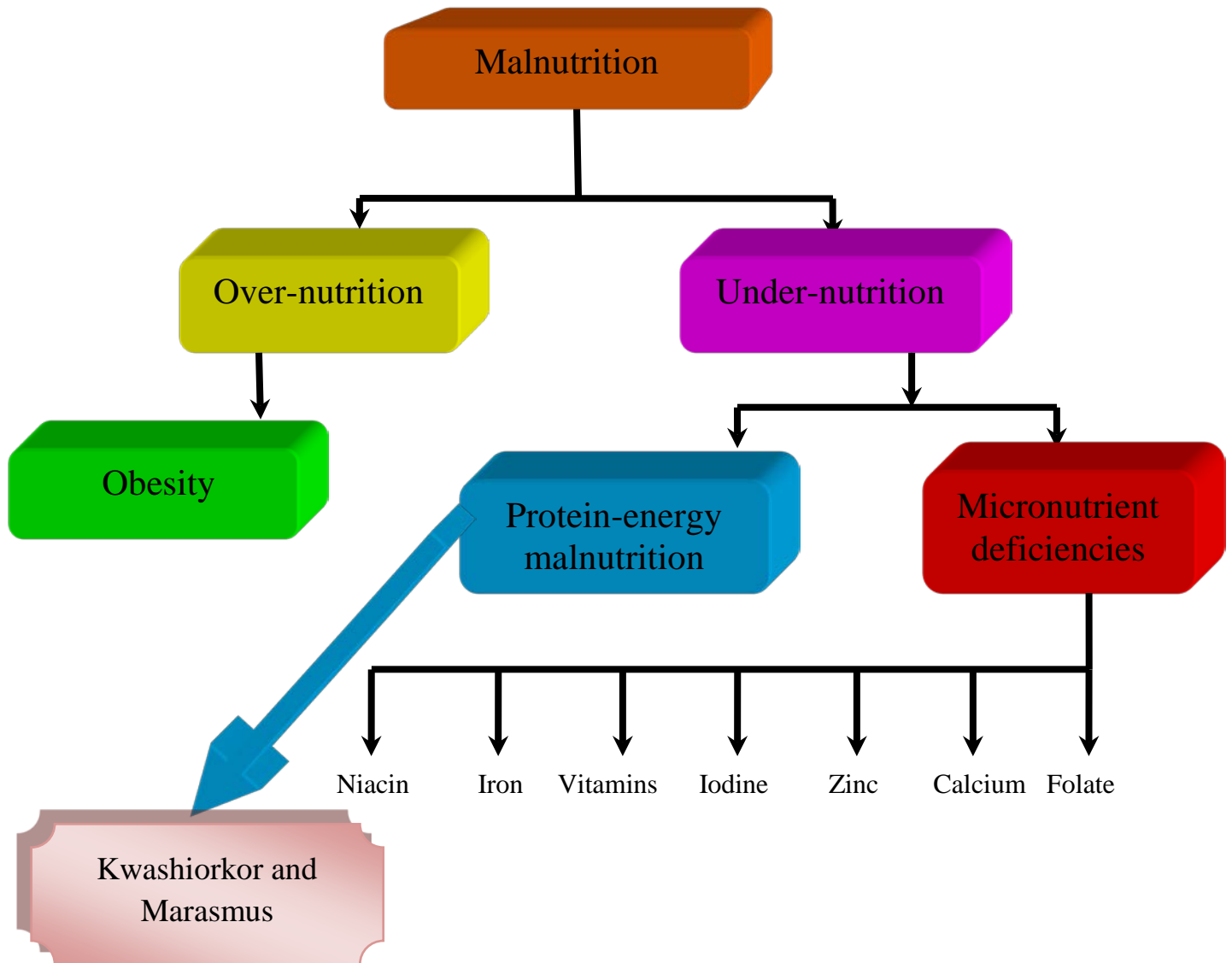
Figure 2.1: Classification of Malnutrition (Faber et al., 2007)

2.2.1 Over nutrition

    a) Obesity

Obesity is the abundance of body fats caused by the consumption of certain energy high nutrients coupled with the lack of physical activity. The imbalance between the amount of energy consumed from energy dense food and the amount of energy used up by the body may lead to health

impairments including obesity. The prevalence of obesity in one's body may increase the risk of health problems such as coronary heart disease, diabetes, kidney failure, osteoarthritis, back pain and psychological damage. According to WHO (2007), over one billion adults in the world are obese (Rankinen, Zubeni, Chagnon, Weisnagel, Argyropoulus, Walts, Perusse and Bouchard, 2006; DOH, 2004a; 2007; Senekal, Mchiza and Boolet, 2008; WHO, 2000a; 2007; Faber et al., 2007; Olsson and Karlstrom, 2003).

According to the WHO (2009), the reduction of nutrients such as trans-fat by 63%, saturated fat by 40%, sugars by 36% together with increase in beneficial nutrients such as dietary fibre by 28%, calcium by 17%, iron by 13% and folic acid by 5% in the diet can assist in eliminating access fat in the body. According to the study conducted by Kruger, Venter, Vorster and Margetts (2002: 422), women with higher income and lower physical activities were at the utmost risk of increased BMI (WHO, 2009; Kruger et al., 2002: 422).

The absence of practical cookery lessons has led to children and young people growing up without the necessary skills to prepare healthy meals resulting in the high consumption of convenience foods which are mostly energy dense. The advertising and promotion of high energy dense food as well as high prices of healthy food have made unhealthy food more economical and appealing than healthy ones. Food labelling that helps consumers in choosing healthy food is often absent in some food packages. Behr and Ntsie (2008) have emphasised the significance of nutrition education campaigns to educate the public on the dangers of obesity and the importance of healthy eating in daily life (Behr et al., 2008; Latham, 1997; Florencio, 2001).

According to the WHO (2008a), non-communicable diseases are linked to obesity. These non-communicable diseases are grouped together and called metabolic syndrome which is the combination of the most hazardous heart attack risk factors that include stroke, hypertension, osteoporosis, osteoarthritis and gallbladder disease. The blood glucose is the basic fuel of all biological processes which is raised by digestion. Excess fat may, therefore, disturb the secretion of insulin needed for the appropriate use of blood glucose in the body which may result in insulin resistance. The insulin is the body hormone that is responsible for controlling the blood sugar level (WHO, 2008a; Khuzwayo, 2008: 167).

Soqele, Smith and Bruyns (2007:62-74) and the National Institute of Health (NIH) (2000) stated that the most common measure for body fat is the Body Mass Index (BMI) which is calculated by dividing the weight of a person by height squared and the cut off points for BMI are stated. The BMI of 30 or more indicates obesity. The BMI of between 25.0 -29.9 indicated overweight. The BMI of between 18.5 –24.9 indicates normal weight and the BMI <18.4 indicate underweight. Overweight individuals are at 2-6 times risk of developing increased blood pressure as compared to healthy individuals as obesity increases the chances of death by 250 % (Soqele et al., 2007; WHO, 2003a; NIH, 2000; Presidency, 2007).

The Heart Foundation of South Africa (HFSA) (2009:2) has given some guidelines to be followed by people who want to lose weight which includes eating 3 times a day or 5-6 smaller meals with snacks like fruits in between, having breakfast every day as it has been proven that people who skip breakfast are more likely to be overweight because of eating large amounts of food later in the day which increase energy intake, fat intake should be reduced especially saturated fat which is animal fat, hidden fat from food items such as ice cream, pastries, cookies and processed food should be avoided at all times, healthier methods of cooking such as grilling, steaming, boiling and baking should be used instead of frying, fibre intake should be increased as fibre makes one to feel fuller for longer, eating a least 5 portions of fruits and vegetables every day, drinking at least 6-8 glasses of water a day along with regular exercise of at least 3 times per week for at least 30 minutes at a time (HFSA, 2009, Soqele et al., 2007; American Heart Foundation, 2008; 2009).

According to The American Heart Association (AHA) 2009, aerobic exercises such as swimming, jogging, cycling and walking have benefits of building muscle fibres, increasing metabolism, reducing body fat and increased benefits of energy used by the body. Close to a quarter of children in South Africa are overweight due to the fact that about 90% of food manufactured for children is junk food with high levels of sugar sodium and fat sold in cartoon wrappings featuring toys, puzzles and games. The AHA has emphasised the importance of giving children healthy food for nutritional value not for the sake of calorie intake even when refusing to eat it. Children's favourite foods such as pizzas should be made nutrient rich. Parents should make children part of the mealtime process by teaching them how to prepare nutritious meals (AHA, 2008; 2009; WHO, 2003a).

The Department of Education should assist in decreasing the rate of obesity in children by introducing and promoting physical education for all children at schools and monitor school tuck shops in order to reduce the selling of high energy snacks and sweetened cold drinks to children. The Medical Research Council has emphasised that children have got many nutritional needs to meet during school years and, therefore, need to eat healthily. The fruit tuck shops may help in preventing overweight and obesity in children by developing a good eating pattern that can be carried throughout the life cycle. Fruits intake instead of sugary foods can help children in limiting the potential of heart disease and promoting healthy teeth (Budd and Vople, 2006; Senekal et al., 2008; DOH, 2004a).

2.2.2 Under-nutrition

Under-nutrition is the outcome that is encountered by the body due to insufficient consumption of the required nutrients and micronutrients essential to meet the basic requirements for growth and development which results from hunger (DOH, 2003). According to Black, Morris and Bryce (2003), more than five million children under the age of five years which is about 50% of children die of malnutrition each year in low and middle income countries. The SA Medical Research Council (MRC) stated that people who are undernourished cannot keep the capabilities of the body such as growth, recovering from diseases, resisting infections, lactation and pregnancy in women. The absence of breastfeeding and complementary feeding practices of infants and children may contribute to illnesses such as diarrhoea, malaria and pneumonia (Black, Morris and Bryce, 2003; DOH, 2003; 2007a).

Bryce, Coitinho, Darnton-Hill, Pelletier and Pinstrup-Andersen (2008:2) promote challenges for addressing under-nutrition in children at a national level. According to the WHO (2003a), under-nutrition in children as a clinical form of hunger can be measured with indicators such as BMI-for-age (underweight); height-for-age (stunting); weight for age which is wasting and other conditions that are not clinically registered but impair physical and mental activities. BMI is used to establish underweight, overweight and obesity in adults. According to the MRC, children have the right to a standard of living adequate for the physical, spiritual, mental and social development. The nutritional status of undernourished individuals may be worsened from time to time due to absorption problems resulting from loss of nutrients during illness conditions such as vomiting and diarrhoea (Black et al.; WHO, 2003a; DOH 2003; 2007b).

2.3 CAUSES OF MALNUTRITION

2.3.1 Household food insecurity

Household food security is defined as having access to safe and nutritious food both in quality and quantity in order to meet the dietary requirements for a healthy life. It is important that a household has enough food to fulfill the nutritional needs of all members and equally distribute that food amongst all its members in order to prevent malnutrition. Food insecurity can lead to nutrient insecurity but not all food secure people are nutrient secure. Food secure people may have adequate food with inadequate intake of micronutrients and diversified diets essential for a healthy and active life (FAO, 2009b, WHO, 2003; Labadarios et al., 2011; USDA, 2009; Labadarios, Mchinza, Steyn, Gericke, Maunder, Davidsa and Whadi-ah Parker, 2011).

Food security is divided into four different categories i.e. food availability, food accessibility, food utilization and food system and stability. Food availability concentrates on food production whereas food accessibility looks at the ability of households to access food whether through purchasing and bartering or production. Food utilization concentrates on the nutritional value along with the safety of food, whereas food systems and stability focus on adequate supply of nutritious food and responding to food emergencies at national level (FAO, 2009b; Labadarios et al., 2011; Laing, 2011; Kirkland et al., 2011).

The State of Food Insecurity Report of 2008 by the FAO (2008) indicated that nearly one billion people in the world are malnourished with 30% of the African population suffering from malnutrition. The food chains at all levels should be taken into consideration in order to decrease food insecurity. The food chain includes production, harvesting, storage, distribution, marketing and preparation. Food preparation in most households is taken as the women's responsibility and, therefore, women should be given a lower load of household duties in order to ensure food security. When addressing food security, much emphasis should be placed on staple food and fruit or vegetables. In urban areas household income and food variety available from wholesalers will determine the level of household food security. In rural areas, the availability of land for fruit and vegetable plantation as well as sustainable agriculture, availability of agricultural resources and rural development helps to reduce food insecurity since about 70% of food insecure people are from rural areas. Grain commodity crops have a great impact on diet diversity and limitation of monotonous

diets in rural areas with legumes plantation having a great impact on increased household food security. Rural households that are involved in cultivation and harvesting are said to have greater impact on diversified and nutritious food intake (FAO, 2010; Anderson, Pasapuleti, 2008:57).

Poverty is a contributing factor towards food insecurity in South Africa. The rising food prices and transportation cost have contributed towards poverty which results in food insecurity. In 2007, the Government reported on measures to eradicate poverty. Social grants as a government initiative to decrease food insecurity increased from 10 billion in 1994 to 37.1 billion in 2004 with beneficiaries increasing from 2.6 million in 1994 to 7, 9 million in 2004. Goal one, target 1A of the Millennium Development Goals is to halve the number of people who earn less than $1,25 a day by the year 2015 (STATSSA, 2011). The World Food Programme (WFP) is rapidly increasing the number of young children, pregnant women and nursing mothers receiving nutritionally improved foods (WFP, 2006; Bickel, Nord, Price and Cook, 2000; Nord, Coleman-Jensen, Andrews and Carlson, 2009).

The FAO (2009b and c) has a concern that if the World Trade Organisation (WTO) allows the liberalization of crucial markets and economic globalization, food security and poverty of the whole community with special emphasis on rural areas may be threatened by reduction in the agricultural employment levels. Liberalization and globalization can increase food insecurity as the government is imposing to reduce the export taxes of agricultural products especially staple food such as wheat, rice, beef, fruits, vegetables and dairy products in order to reduce the number of people who are living under the poverty line. Liberalization may also lead to improper distribution of food with rural areas becoming the first victims. According to Martin, Carolina and Diaz-Bollina (2008), food is sufficient to feed the whole world but the problem is improper distribution. The government should make food distribution easier ensuring efficient infrastructure such as roads, bridges and railways. The reduction of export costs of some non-consumables such as fuel may also help in the drop of household food insecurity rate. Quality and safety of imported food may reduce as a result of liberalization of trade markets (Martin et al., 2008:6-7).

When combating food insecurity, it is important to first measure the level of household food insecurity and monitors the changes constantly. The process of measuring food insecurity status is complicated, costly and time consuming but the results are a good measure as a starting point for making means of decreasing household food insecurity. Several food insecurity measuring tools are used across the globe. The household measuring tool used should be fast and easy to manage and

analyze. The US Food Security Measure as a household measuring tool focuses on research that involves qualitative interviews with rural women, low income households and children that are victims of food insecurity. The previous research results of this tool were that, 1) Households experience household food insecurity differently. There are children's and adult's food insecurity levels. 2) Hunger is the most common cause of food insecurity. 3) Children are most at risk of food insecurity with at least five million children per year in the world dying of food insecurity. The Coping Strategy Index (CSI) is another tool for measuring household food security that can be used to measures the effect of food aid programmes. It is a straightforward, easy, fast and practical measuring tool that can also be used to measure the degree and severity of household coping behaviours. The (CSI) measure the range of behaviours applied by households in times of food scarcity. The 24 hour recall of food consumption for individual household members is another food security measuring tool that may give reliable consumption data to be used for measuring food insecurity levels. This method is often not carried out for every member of the household but it is only applied to certain individual household members hence it does not reflect the food accessibility of the whole household (Maxwell, Watkins, Wheeler and Collins, 2003:1;Refiel, Nord, Sudeghizadeh and Mohammed, 2009; WHO, 2000d).

According to Maxwell et al. (2003), implementing several strategies together would assist in alleviating food insecurity. These strategies may be enabling market access, capacity building, and gender development, facilitating, creation of off-farm opportunities and implementation of food distribution programme. The FOA (2009b) stated that the people who are most vulnerable to food security should be protected. The first step in doing so is to know the identity, location and situation of the people suffering from food insecurity (Maxwell et al., 2003; Maxwell, 1996; Mjonono et al., 2012).

According to Mbhenyane, Makuse, Ntuli, Mbhatsani (2008: 220-224), South Africa is rich in indigenous plant species especially in rural areas. Urbanization has been associated with developing more western eating practice as compared to rural areas where the intake of indigenous plants from traditional crops has become an option. These indigenous plants are excellent sources of vitamins and minerals such as zinc, riboflavin, niacin and folate. Wild edible plants have contributed much in increasing food security in rural areas. Indigenous plants have improved the quality of life, impacted on job creation and community development. Wild edible plants especially green leafy vegetables

and roots may be the only source of micronutrients available during times of food scarcity in rural areas. Indigenous plants may supplement the staple food and contribute protein content of up to 36%. Indigenous plants can be easily preserved by cooking, drying and storing. Indigenous plants are also known for making food more palatable and digestible (Mbhenyane et al., 2008; PePinstrup and Andersen, 2008).

In rural areas, some indigenous vegetables mainly the green leafy ones are sources of traditional medicine and have health benefits that include treatment of diabetes, hypertension, nausea, diarrhea; controlling blood pressure and prevention of constipation. This is of great benefit in rural areas where community health centres are insufficient (Nel and Steyn, 2002; Mbhenyane et al., 2008).

The use of indigenous plants in South Africa may decline in future due to various reasons such as:

- Urbanization, morbidity or migration may cause dietary transition.
- Land related issues may have a great impact on agriculture.
- Socio-economic development has brought in lifestyle modification of many people.
- Stigma that has been associated with most indigenous food.
- Globalization and western systems have affected the indigenous consumption rate.
- Inadequate programmes to transfer inter-generational knowledge to communities.
- Associating the consumption of indigenous plants with low class people (Mbhenyane et al., 2008: 223).

According to Mbhenyane et al. (2008:224), knowledge of issues such as biological diversity, cultural diversity and ecology conservation are important factors in promoting traditional food.

Nel et al, (2002) stated that 7% of the urban population and 25% of rural population consume green leafy vegetables; 12% of urban population and 22% of the rural population consume wild leaves such as morogo.

2.3.2 Lack of nutrition education

Nutrition education is acquiring knowledge on food varieties with the essential nutrients needed by the body for a healthy life as well as good eating habits that helps in improving the health status of people in order to prevent nutrition related health problems. It assists the participants in

understanding the relationship between proper nutrition and good health as well as the importance of nutrient rich food daily consumption to prevent malnutrition. The nutrition situation of people throughout the world is worsened by lack of nutrition information and knowledge (Contento, 2007:2; WHO 2010; DOH, 2005; 2007d).

A study was conducted by Andresen, Wandel, Barth, Eide, Herselman and Iversev (2009) to evaluate the level of nutrition supplementation programme's (NSP) experience of mothers of Cape Town in relation to South Africa's emphasis on human rights. The results showed that women in South Africa receive little or no education and lacked information and necessary skills on how to help children gain weight.

According to the FAO (2005b), nutrition education involves a series of different activities that are interrelated such as giving knowledge, empowering people in personal skills development such as child feeding practices, encouraging people to ensure healthy eating habits, providing important information to the people and encouraging them to develop a culture of eating a variety of macro and micro nutrient rich food. Linking nutrition education activities as interrelated practices may adopt and give birth to new practices for example, when giving the nutrition advice of eating plenty of vegetables, additional information on how to preserve nutrients in vegetables by applying proper cooking methods should be provided. Nutrition information should be reinforced to different target groups in various forms such as group discussion, role play, drama, demonstration, newsletter, posters, practical sessions, videos and radios in order to be effective and quickly conveyed (FAO, 2005b).

The USAID (2003) stated that the implementation of Expanded Food and Nutrition Education Programmes (EFNEP) within communities may help individuals and families to acquire knowledge and skills necessary for the development of nutritionally sound diets. The EFNEP is a process whereby the Consumer Science professionals engage themselves in ongoing-job-training and supervision of peer educators and volunteers in community nutrition education. The Consumer Scientists get referrals from current and former participants in nutrition education programmes. The referrals may be local schools, health and wellness centres, non-profit based organisations, community organisations and faith based organizations. The main focus of EFNED is the improvement of the individual health status. The total number of households that have benefited from the EFNEP is 150,270 with 86,827 coming from the cities. Nutrition is not only meant for people

with food scarcity crisis but also for people with adequate food as some of them lack information on food combinations necessary for a balanced diet. In 2009, Nestle together with other nutrition experts implemented a Healthy Kid Programmes for children in South Africa between the ages of one to twelve along with the Nutrition Education Programs for girls in rural areas between thirteen and seventeen years of age with an aim of assessing community needs, education on balanced food eating, preventing childhood obesity and ensuring understanding of the value of good nutrition (WHO, 2010; USAID, 2003).

The fourth goal in the MGD by the United Nations Development Programme (UNDP) is to ensure that women and girls have access to health services and education in primary and secondary schools. Children that mostly suffer from malnutrition are those that are born to mothers without formal education. According Swart and Dhansay (2008: 394-398), educating mothers and caregivers on the importance of exclusive breastfeeding up to six months is the key component of nutrition education. The lack of nutrition education among women in combination with ignorance has had much impact on reducing the nutritional status of children. Nutrient rich food items are sometimes readily available in some households but are underutilized due to the ignorance of mothers on the nutritive value of these items (Swart et al., 2008: 394-398).

The FAO and WHO convened a summit in Cyprus in 1995 with an aim of building up and discussing Food Based Dietary Guidelines (FBDGs) that are consumer tested and evidence based as an effective tool for nutrition education and an applicable strategy for unrestricted health nutrition for the reason that consumers concentrate more on food rather than on nutrients that most people are unfamiliar with. FBDGs also assist individuals in the consumption of nutrient rich food by linking certain food consumption patterns with low frequency of certain diseases. The most evident benefit of using the FBDGs as a means of ensuring sufficient consumption of micro-nutrient rich food sources among individuals is that these guidelines are action oriented and are a practical approach to achieve nutritional goals with positive and non-dictatorial outcomes since it considers the cultural and socio-economic factors together with the physical environment in which people live in (Berh et al., 2008:338-339).

2.3.3 Inadequate dietary intake

Adequate nutritional intake is important to the wellbeing of each person and it is a prerequisite for a successful and healthy life of individuals. A diet that is inadequate in nutrients both in quality and in quantity is more likely to cause malnutrition. According to IOM (1997; 1998; 2000; 2001 and 2002), every person between the ages of 19-50 should have a daily dietary intake of 210g carbohydrates because carbohydrates provide 55-75% of total energy, 30g total fat (which is between 15-30% of total energy intake) with 13g being poly-unsaturated fat (which is 6-10% of the total energy intake) and the total absence or less than 10% of the total energy intake of saturated fat, 71g protein and 29g fibre to ensure optimal level of nutrition. Steyn (2006:3) stated that woman in urban areas consume higher amounts of animal protein, fat, saturated fats, added sugar, cholesterol, sodium, selenium, potassium and zinc compared to rural women who have higher intake of only carbohydrates, plant protein, fibre and magnesium along with a relatively low intake of niacin, thiamine and riboflavin (Institute of Medicine (IOM), 1997; 1998; 2001; 2002; Steyn 2006).

According to Mbhenyane et al. (2008:225), several strategies are used to address food diversification which include agricultural intervention that seeks to improve the accessibility and availability of micro-nutrient rich food sources, implementation of food and economic policies that increase the demand and lower the prices of micro-nutrient rich food, development of technological food preservation methods and plant breeding as well as sponsorship and promotion of nutrition education to advance the consumption level of micro-nutrient rich food sources amongst ignorant individuals. Strategies used to address food diversification should consider the issues of bioavailability of food, food preparation techniques and food preferences. Several tools are used to measure the dietary intake for the household and individuals.

2.3.4 High rate of unemployment

Poverty is continuously becoming the main influence in household food insecurity particularly in rural areas where sustainable livelihood strategies are limited. Most households that are poverty stricken are greatly dependent on wage income. Poverty inclinations are, therefore, highly impacted by unemployment level hence food insecurity (FAO, 2009b; Presidency, 2007; WHO, 2000c).

According to the unemployment labour survey of 2012, in 2008, there were 3.9 million unemployed persons in South Africa and this rate increased rapidly reaching 4.4 million in 2010. The rate of unemployment further rose to 4.5 million in 2012. Women have been more likely to be unemployed than men. In 2008 the unemployment rate of women reached 27.1% while the rate of men reached only 6.6%. This gap has been narrowed to a difference of 4.7% in 2011 and 1.7% in 2012 (STATSSA, 2011).

The Centre for Poverty, Employment and Growth (CPEG) at the Human Sciences Research Council (HSRC) was established to discover approaches to halving unemployment and poverty between 2004 and 2014 on a maintainable basis. Unemployment rate has increased from 25.0 % in 2011 to 25.2% in 2012 with the rate reaching 45.5 % in the North West province which is the highest in South Africa, 45.2% in Mpumalanga, 44, 2 in Limpopo, 43, 1% in the Eastern Cape, 39.3% in KwaZulu Natal, 38.9% in the Free State, 33.8% in the Northern Cape, 30.33% in Gauteng and 24.5 % in the Western Cape which is the lowest in South Africa. According to the unemployment labour survey of 2012, livelihood strategies are limited which cause increased dependence in wage income. The survey also divulged that wages contribute 39-48% of income in former homelands. About 73% (6.9 million) of households in South Africa received an income less than R2500 in the 2000 and 46% of all households receive R1000 per month or less. This has contributed to implications for the standard of living and more significantly in food security status of many households (STATSSA, 2011; Altman et al., 2009).

According to STATSSA (2011), the most vulnerable groups to unemployment are rural citizens. The income and expenditure survey of 2011 revealed that 84% of rural households had a monthly income of less than R2500 per month while 62% of rural households received less than R1000 per month whereas only 21% of urban population earn less than R1000 per month. This indicates a close relationship between location and poverty. Provinces with more rural settlements are more susceptible to unemployment which in turn may lead to poverty than provinces with less rural settlements e.g. the population that earn less than R2500 per month in Gauteng is 45% as compared to 83% in the Eastern Cape. This may be due to less rural settlements in Gauteng than in the Eastern Cape (Altman et al., 2009).

Household income is dependent on household size. Households receiving less than R2500 per month may decrease if the size of all households increases to four members and will further increase if households' sizes increase to more than four members. Members receiving income less than R2500 per month are 40% and usually consist of five or more members (STATSSA, 2011).

The average monthly income of South African households is R2786 which is much lower than the average household expenditure which is R4518. This indicates a gap of R1732 between the average monthly income and the average monthly expenditure taking into consideration that about 73% of all households in South Africa earn income that is less than R2500 which is far less than the average monthly expenditure. This means that 62% of the rural households who earn less than R1000 per month cannot meet the basic food requirements which have a major contribution to malnutrition (STATSSA, 2011; Altman et al., 2009).

The monthly household income should be enough to cater for the Minimum Recommended Food Expenditure (MRFE). The MRFE is the amount of money needed to purchase sufficient food to satisfy the nutrient amount recommended which is estimated on the basis of the Recommended Dietary Allowances (RDA), mostly consumed food items in South Africa and the selling prices of food items. The difference between the actual food expenditure for the household and the recommended food expenditure is called the expenditure gap which is a good measure for the additional amount of money needed for meeting the dietary requirements of the household (DOA, 2002; STATSSA, 2007; 2011).

According to STATSSA (2011), household income is low amongst the black South African households. One in every four black South African households which is approximately 29.0% earn income that falls within the lowest quintile (less than R11 378 per annum) compared to white households where only 6.7% of households earn income that falls within the lowest quintile.

TABLE 2.3 shows the distribution of South African households by income quintiles in **PERCENTAGES** and population group of household heads according to STATSSA (2011).

Class	Black African	Coloured	Indian/Asian	White
Upper quintile (R90 467+)	8.6	19.5	46.0	78.8
4th quintile (R36 043 - R90 466)	9.5	7.3	28.2	1.4
3rd quintile (R20 203 - R36 042)	23.0	20.2	13.6	3.6
2nd quintile (R11 378 - R20 202)	27.7	22.6	11.7	5.9
Lower quintile (Less than R11 378)	29.0	21.1	8.5	6.7

According to STATSSA (2011), rural households spend an average of R6 334 per annum of food and non-alcoholic beverages as compared to an average of R9 054 per annum spent by urban households. This contributes to a low food insecurity status of rural households (STATSSA, 2011).

2.3.5 Lack of nutrition programmes

a) Integrated Nutrition Programmes (INP)

The INPs were formulated by the nutrition committee that was appointed by the Minister of Health in August 1994 to develop nutrition strategies for all South Africans. The main aim of the INP is to combine direct nutrition interventions such as nutrition education and promotion; micronutrient supplementation; food fortification; and nutrition support and counseling that is disease related and indirect nutrition interventions such as steps to improve food accessibility; provision of health care facilities; provision of clean and safe water; and parasite control. The nutrition committee formulated an Integrated Nutrition Strategy which consists of three components namely: Community Based Nutrition Programmes (CBNP), Health Facility-Based Services and Nutrition promotion (DOH, 2002b; 2004c; 2005).

The INP is another nutrition intervention programme in South Africa with the main objectives that include facilitating an approach to solving nutrition problems, contributing to the alleviation of hunger and malnutrition, ensuring integration of nutrition intervention into primary health care and

community health services as well as ensuring the proper inclusion of nutrition education into household food security interventions within the Integrated Food Security Nutrition Programme (IFSNP) through the promotion of community gardening of micronutrient rich vegetables, promotion, protection, support of safe infant feeding and the provision of nutritional advice to sectors that deal with the uplifting of food security levels (DOH, 2005; 2007; Labadarios, Steyn, Mgijima and Dladla, 2005).

c) Community based nutrition programmes

Community based community programmes have common goals which are reducing the prevalence of malnutrition that results in the fast growing epidemic of diet related chronic diseases; encouraging healthy lifestyles as well as healthy food consumption and providing facilities that can improve nutrition and alleviate poverty amongst poor communities (DOA, 2002; Javier and Baez, 2007).

Community based nutrition programmes that had an impact on reducing malnutrition include supporting, protection and promotion of breastfeeding; home, school and clinic gardens; food security projects and programmes. In 2002, the Department of Agriculture elaborated on the Integrated Food Security and Nutrition programme (IFSNP) since food security is part of section 21 of the constitutional Bill of Rights of South Africa which states that all South African citizens have the right to have access to sufficient food and water. The IFSNP has a vision of attaining universal social, physical and economic access to sufficient safe and nutritious food by all South Africans in order for them to meet their dietary preferences essential for an active and healthy lifestyle and improving nutrition and food safety (DOA, 2002).

The ability of community based nutrition programmes (CBNPs) to achieve its objectives determines its success. Active participation of community members and team work when conducting the CBNPs is important and ensures success. All stakeholders that are involved in facilitating CBNPs should create supportive macro-environments through strong and developing public and political campaigns. CBNPs should not only focus on meeting the nutritional needs of the community but should also educate and assist in skills development so that income generation can be improved to meet the adequate food and nutrition needs of families which is a basic human right (Ismail, Immink and Mazar, 2003).

Community based nutrition monitoring programmes are an easy, quick and efficient method with workable solutions to address the prevalence of malnutrition since they are carried out at community level where practical instances of malnutrition are seen and experienced on a daily basis. According to Baez (2007: 4), Community Nutrition Programmes (CNPs) improve and support the corrective actions used to assist low income communities to be able to reinforce the nutritional and health status of all the household members especially children. Active participation of community members in CNPs is important because members will be more concerned if involved in the implementation process rather than being spoon fed. Great emphasis should be placed on growth monitoring of children below three or two years of age where cases of malnutrition and associated illnesses resulting in growth faltering and weight loss are commonly experienced. The leaders of the CNP should be trained members of the community because community members are well familiar with the existing local resources and constraints of the local framework. The CNPs may add complementary actions such as the distribution of micronutrients through food supplements and fortified food as a strategy to limit nutrient inadequate diets of low income household members especially children and pregnant women (Baez, 2007:4-5; 2005).

The DOH (2005) stated that there are several programmes that have been implemented with a positive effect on reducing malnutrition levels worldwide. One of the most effective ones is the Expanded School and Community Food and Nutrition Surveillance and Education Programme (ESCFNSEP) which is a community-based nutrition initiative that started in 1999 with activities that are mostly targeted at children up to three years old which is the most critical age where irreversible and harmful impacts of malnutrition occur, pregnant and lactating mothers. The success of the ESCFNSEP is dependent on the active involvement of community members, schools, health centres and NGO's and training on how to sustain nutrition based development should be given. The activities of the ESCFNSEP include growth monitoring of children one to three years old on a monthly basis, micronutrient and food supplementation, frequent training sessions to empower community members with nutrition education, provide community health care and immunization services as well as holding several meetings to discuss nutritional problems that may lead to malnutrition with possible solutions (Baez, 2007:4-5; DOH, 2004a; 2005; Sun, Sangweni, Chen and Cheung, 1999).

2.4 STRATEGIES TO ADDRESS MALNUTRITION

2.4.1 Food fortification

Food fortification is a cost effective, sustainable and a long term strategy of improving the nutritional quality of food by adding more nutrients in food as a mean of improving the micronutrient consumption level of vulnerable populations at a level higher than the nutrients found in original food. Food fortification programmes are effective when all members of the targeted populations consume fortified food in suitable quantities and when the essential properties of original food such as colour, taste and appearance is unchanged. The government and the food industries should work together and agree on the most affordable and viable food fortification strategy to be implemented for the specific target groups. All food fortification strategies should be monitored for micronutrient level and quality assurance in order to ensure that fortified products contain the correct quantities of micronutrients needed by the body (Kruger, Hendricks and Puone, 2008:683-684; Van Stuijvenberg, Smuts, Lombard and Dhansay, 2008; Gericke, Labadarios and Ntsie, 2008).

According to Kruger et al. (2008: 684), common food types that are often fortified include fats and oils, milk, tea, cereals, instant noodles, rice and infant formulas since they are frequently eaten by most people and affordable and, therefore, can improve vitamin intake of a larger section of population. Approximately six million women of productive ages and 2.3 million children under six years of age have benefited from eating fortified bread which was part of the flour and maize meal fortification project of South Africa in 2006. The fortification flour and maize meal has been able to supply a child of 10 years and older with 31% vitamin A, 25% thiamine, 25% niacin, 25% pyridoxine, 50% folate, 17% riboflavin from maize and 20% riboflavin from wheat flour, 20% zinc, 25% iron from unsifted maize and 50% iron from wheat flour (Micronutrient Forum, 2007; Kruger et al., 2008: 684)

Averting and controlling iodine deficiency disorders are mostly achieved by iodization of salt. The iodine fortification of food eaten by farm animals may help in increasing the iodine status of animal products such as meat, milk and eggs when consumed. Iron and vitamin A fortified food products such as sugar, margarine and wheat flour may improve vitamin A and iron intake and meet about one

third of the daily recommended allowance (DRA) of most people thus lowering the risk of anemia and night blindness (Jooste, 2004; Van Stuijvenberg, Smuts, Lombard and Dhansay, 2008).

2.4.2 Food Supplementation

Food supplements are non-food substances that are used to boost the dietary intake of micronutrients, vitamins, minerals and amino acids. Food supplements are available in a form of tablets, powders, liquid capsules and pills to replace all the nutrients found in nutritious food. Food supplementation as part of the INP is a programme that aims at enriching staple food products with the essential micronutrients. Food supplements are provided for nutritionally vulnerable groups especially those that are underweight due to malnutrition, HIV/AIDS infected, tuberculosis infected and those with other debilitating diseases such as cancer (Charlton, Ferreira and Du Plessis, 2008:576; Berry, Hall, Hendricks, 2010; Key, 2005, NICUS, 2005a; DOH, 2002a).

According to the DOH (2008), food supplementation is seen as a good strategy of reducing micro-nutrient deficiencies in most people and recommends that every person living with HIV should consume multivitamin and mineral supplements that contribute to the RDA of micronutrients daily or adequate intake (AI), but they should not replace a balanced diet and the whole food since there are other compounds that cannot be replaced by supplements. Supplements should be consumed according to the recommended dose. Some marketers mislead the consumers by selling the belief that herbal supplements are safe even if overdosed because they are natural. This is not correct, as some herbs and vitamins are toxic and hazardous as they may have potent pharmacological action and may change the blood vessels of connected medications (DOH, 2008; Berry, Hall, Hendricks, 2010).

The American Heart Association (2009) recommends that all adults should use multivitamin supplements daily to prevent chronic diseases especially people who are at high risk such as pregnant and lactating mothers, those that are food insecure, those who are alcohol dependent, those that suffer from tuberculosis and other chronic illness (AHA, 2009, Kruger et al., 2008:685).

Iron supplementation is an effective strategy used in the treatment of anemia as an iron deficiency disease. The recommended basic dose of iron in adults is 60mg/day and 30mg/day in children. Iron

supplementation should be taken as intended i.e. in the morning between meals and with water or juice in the evening. When used in conjunction with vitamin A, iron supplementation is more effective than when taken alone. In pregnant women, iron supplements taken together with folate supplements may cause an increase in birth weight and length. Poor compliance which may be related to side effects such as nausea, constipation and diarrhoea is a major problem of iron supplementation (Kruger et al., 2008:685; The World Bank, 2006).

2.4.3 Food based dietary guidelines

Food based dietary guidelines (FBDG) are principles that have been developed by the WHO and FAO in conjunction with other stakeholders in an international consultation in Cyprus in 1995 to improve healthy eating habits for all adults of the world and children of seven years and over. FBDG are used to address challenges in nutrition such as nutritional disorders that result from poverty and malnutrition. FBDG as an effective nutrition education tool have been used to reduce the prevailing nutrition related public health problems globally. FBDG as qualitative and action oriented statements have been used to set dietary goals in terms of food, not nutrients, because consumers think in terms of food rather than nutrients. The proper knowledge of nutrient composition of food together with the relationship to health and disease has assisted in the formulation of FBDG. There is much evidence that there is a strong relationship between fat intake and the prevalence of cardiovascular disease (Mbhexane et al., 2008:226; Behr et al., 2008:338; Hendricks, Goeiman and Dhansay, 2008).

According to the WHO (1998) and FAO (1998), FBDG as a strategy of reducing the level of chronic malnutrition, micronutrient deficiencies and diet related diseases possesses the following characteristics:

- They are evidence based.
- They ensure consumer understanding as they are consumer tested.
- They are practical rules used to meet the nutritional needs of the population.
- They are non-regulatory and are phrase positively.
- They are action oriented.

- They are food based, written in simple language that can be understood by any man in the street.
- They consider the cultural dietary patterns of consumers.
- They take into account the socio-economic factors of consumers as well as the physical environment in which people live in.

The WHO and FAO developed the FBDG according to the 10 recommended process steps which are outlined below:

- Formation of a representative working group which could be agriculture, health or food and nutritional science industries.
- Set nutritional goals based on the information on nutrition related disease, food accessibility and dietary diversification of the country.
- Formulation of the set of FBDGs that will address the already set nutritional goals through full discussion.
- Pilot-test understanding of FBDG with consumers and their revision if necessary.
- Compiling a procedural support document for each FBDG so that they are evidence based.
- Submission of procedural support document to the national and international interest groups for assessment, comments and corrections where necessary.
- Finish, adopt, publish and distribute the final report.
- Put into practice the FBDGs at national level.
- Assess the impact of FBDGs on eating patterns of the people.

In May 1997, the Nutrition Society of South Africa (NSSA) initiated the formation of South African Food Based Dietary Guidelines (SA FBDG) working group after following the publication of the WHO/FAO consultation report. The SA FBDGs were to addresses the nutrition transition faced by many South Africans which results in over and under-nutrition. One of the greatest nutrition transitions that has challenged South Africa is a large increase of animal food consumption and a decline in fibre and cereal intake. In 2003, the South African Department of Health Services (SADHS) developed the SA FBDGs. These FBDGs were non-quantitative in nature and allow flexibility for other nutrition educators to adjust messages according to customer needs. The SA

FBDGs were tested across all socio-economic aspects of South Africa which are rural, informal urban dwellers as well as in all cultural group representatives. The results of consumer testing helped in adapting the draft SA FBDGs. For SA FBDGs to be effective, it was important that all nutrition educators understood the necessity of applying these guidelines, knowing the eating habits of individuals or groups, knowing the barriers that could fail the application of these guidelines as well as advice on solutions to those barriers. The nutrition educators should also be familiar with the type of food which the community consumes mostly, their preparation methods, and knowledge of food items that are not available, not affordable or culturally unacceptable (Mbhexane et al., 2008:226; Behr et al., 2008:338; Hendricks et al. 2008).

The eleven SA FBDGs used as reference standard are discussed in detail below:

a) **Make starchy foods the basis of most meals**

The consumption of unrefined and fortified food essential for the increase of B vitamins, Vitamin E, magnesium and zinc level in the body is recommended by the FAO. According to Steyn (2006), starchy foods are the most commonly consumed food items in South Africa. Starchy food is the staple food for most communities with wheat and maize being at the top of the list. Carbohydrates, therefore, contribute 44% to 64% of the energy intake in the diet of urban dwellers and contribute 62% to 71% of energy intake in the diet of rural dwellers. Urban dwellers are gradually changing from more maize diets to an intake of wheat and much more intake of rice. Urbanization has also contributed in the decrease of brown bread consumption and an increase in white bread consumption (Steyn, 2006b; Mann et al., 2007).

b) **Use food products and drinks containing sugar sparingly**

The population of South Africa that is using high sugar products is 84% of the total population. Seventy seven percent of the population is uses white sugar and 34% of the population of urban areas takes high sugar containing products such as cookies, puddings, carbonated drinks, pancakes and tarts at a higher level. These products are low in micro-nutrients; high in fat, energy dense, thus

contributing to weight gain and compromised dental health especially in individuals with inadequate dental care (Senekal et al., 2008:499).

c) Eat plenty of fruits and vegetables daily

The majority of South Africans do not meet the minimum number of five fruits and vegetables to be eaten a day as stated by the FAO, 2009c. According to Schneider, Norman, Parry, Bradshaw and Puddemann (2007a), 40% of the adults of South Africa do not eat vegetables while 64% do not eat tubers and approximately 70% do not eat fruit. This may result in seeing South Africans at a risk of low fibre intake, weak immunity which may lead to increased development of infectious and cardiovascular diseases and an increase of micro-nutrient deficiencies especially vitamin A, C and E which are important anti-oxidants. Low fruit and vegetable intake of South Africans has been a risk factor and has contributed 3.2% of all deaths in 2000 and 60% IHD in males and 52% in females; 17.8% ischemic stroke in males and 32.7% in females; 9.8% oesophageal cancer in males and 7% in females and 7.8% lung cancer in males and 4.7% in females, meaning that the public health should take initiatives of increasing the level of fruit and vegetable intake in all sectors of the population (Schneider et al., 2007; FAO, 2009c).

d) Eat dry beans, peas, lentils and soy regularly

Dry beans, peas, lentils and soy products are significant because they are low in fat and are good sources of proteins, fibre, energy and minerals. The photo-chemicals such as isoflavones that are present in these food products, their highly soluble fibre content that contributes to reduced cholesterol levels, their affordability and their low glycemic index add to their health benefits. Legumes consumption in urban areas is slightly higher than in rural areas (Stipanuk, 2006).

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

In South Africa meat is consumed by 67%, milk and its products by 48%, eggs by 18% and fish by 12% of the total population daily. The consumption of these food products is beneficial because they are excellent sources of biological value protein responsible for the promotion of growth and

repairing of worn out tissues in the body, B vitamins and minerals such as iron, zinc, calcium and magnesium. Care should, however, be taken when consuming animal products since they are energy dense thus they increase the risk of obesity and are associated with the risk of cardiovascular diseases (CVD). The intake of animal products such as milk, chicken and eggs is high in urban areas than in rural areas and, therefore, high animal fat consumption is high in urban area. According to Steyn (2006), the minimum recommendation of 10% of total energy should come from protein. The consumption of animal products with high fat content such as viennas, pies, bacon, sausages, ham and russians are eaten more in urban areas than in rural areas. The cooking methods that require a lot of oil is used mostly in urban areas. The results from SADH (2004) revealed that 74% of South Africans used full cream milk, 51% eat red meat, 75% eat chicken with its skin and 34% eat processed meat on a daily basis (Senekal et al., 2008:501; Steyn, 2006b).

f)   Use fat sparingly

The intake of fat is essential for the absorption of fat soluble vitamins, provision of essential fatty acids and is good in providing the body with energy. However, high intake of fat contributes to nutrition related health outcomes such as obesity and CVD. High consumption of fat in South Africa is associated with urbanization. About 20% of urban area dwellers use added animal fat that is 3% greater than that normally used by rural area dwellers. About 72% of urban area dwellers are using vegetable fat oil. A mean of 30.6% of energy of individuals living in urban areas is provided by fat compared to a mean of 22.9% in people living in rural areas. The most commonly consumed high fat products in urban areas which are high in saturated fats and trans fatty acids are brick margarine, fatty snacks and deep fried fast and takeout food. Urbanization is, however, associated with a positive trend of the decrease of consumption of highly saturated plant fats in the form of non-dairy creamers (Senekal et al., 2008:502-503; MacIntyre et al., 2002).

According to Chen, Milbury, Lapsley and Blumberg (2005), certain food rich in saturated fat may have multiple benefits. Nuts are rich in saturated fats but it has a benefit of lowering the risk for gallstones. Sebate (2003) stated that the American Food and Drug Administration (FDA) approved the health claim that eating 45g of most nuts may improve low density lipoprotein (LDL): high density lipoprotein (HDL) ratio.

g) Use salt sparingly

Among the most commonly consumed food items, salt is not reported as such because it is always grouped with other condiments. Results from the DOH (2003; 2004a; 2007a) revealed that 12% of the adult sample usually eats very salty, 83% eat lightly salted and 5% eat unsalted food. About 7% of the sample indicated that they add salt to food before tasting, 56% add salt to food after tasting and 37% do not add salt to food at all. About 35% of the sample indicated that they eat highly salted snacks (Senekal et al., 2008:504).

According to the National Blood Pressure Education Programme (NBPEP) of 2003, the amount of 5g and less per day is recommended for the prevention of hypertension and to decrease the risk of osteoporosis since chronic excessive salt intake is associated with increased urinary calcium loses. In western populations, the daily mean salt intake is 10 to 12 g (Clemens, Slawson and Klesges, 1999). Salt, however, should not be completely excluded in the diet since all salt intended for human use in South Africa is iodized and, therefore, serves as a good source of iodine which helps to prevent goiter disease and cretinism in children of women with goiter (Jooste, 2004; Steyn, 2006).

h) If you drink alcohol, drink sensibly

The burden of death of 7.1% in South Africa is associated with alcohol intake outcomes such as excessive intake which results in addiction, behavioral change, interpersonal violence, drunken driving and negative health outcomes such as liver diseases, under-nutrition in general and micro nutrient deficiencies, especially thiamine deficiencies. The daily intake of one to two alcoholic drinks per day is health beneficial in terms of the prevention of CVD (Schneider at al., 2007a; DOH, 2004b; Mahan and Scott-Stump, 2008).

The study conducted by SADHS (DOH 2004b; 2007a), revealed that only 10% of the South African population consume alcohol. Alcohol consumption in urban areas is three times higher than in rural areas. According to the results of the study, an average of men living in South Africa drink alcohol i.e. 70% of Whites, 52% of Coloureds, 52% of Indians and 35% of Black Africans. The study also

revealed that15% of women in South Africa drink alcohol i.e. 51% of White, 28% of Coloureds, 28% of Indians and 11% of Black Africans.

i) Drink lots of clean safe water

Water plays a vital role in the human body as it contributes to 50-60% of body weight. Water is responsible for regulating body processes, dissolving all the water soluble vitamins and minerals and removing the waste products out of the body. Water needs to be replaced in the body continuously since the body loses much water through sweating (Senekal et al., 2008:504).

Water contributes the total dietary intake of selected trace elements and electrolytes that are between 1 and 20%. The micronutrients with the largest proportion of intake from drinking water as compared to that provided by food are calcium and magnesium. Water may provide up to 20% of the required total daily intake for calcium and magnesium. Drinking water provides less than 5 % of total intake for the majority of other elements (WHO, 2005).

j) Enjoy a variety of food everyday

The consumption of a variety of food in most food groups is higher in urban areas compared to rural areas. The nutrient density of the diet increases with high consumption of nutrient rich food from all the food groups such as unrefined cereals, fruit and vegetables. The increase in consumption of unhealthy food with high fat and sugar content may increase the energy density and decrease the micronutrient intake level of the body, thus increasing the risk of malnutrition (Kruger, Puoline, Senekal and Van der Merwe; Mann and Truswell, 2007; Barker et al., 2004).

According to Steyn et al. (2007), urbanization is associated with areas that have a high dietary intake of protein, fruit and vegetables and other nutrient rich food products than adults from rural areas. Rural dwellers consume insufficient calcium, iron, folate, vitamin B_6 and vitamin E and they are, therefore, at a high risk of developing micronutrient deficiency. Rural dwellers should, therefore, focus on eating a variety of food in their diet especially fortified starches, fruits and vegetables; plant based products as well as animal/fish based products because over and above supplying the

recognized essential nutrients, they also include biologically active compounds that provide health benefits (Steyn et al., 2006c).

2.4.4 Millennium Development Goals (MDGs)

The MDGs were endorsed by the Millennium Summit which was held in New York in 2000 with an aim of entering the new millennium with a strengthened set of fundamental values that are essential in the 21st century. The Member States adopted these values as Millennium Declarations. Out of the Millennium Declarations, seven areas that the United Nations needs to put emphasis on were identified before entering the new millennium namely:

- Security, harmony, peace and disarmament.
- Development of strategies essential for poverty eradication.
- Promotion and protection of a healthy environment.
- Human rights, social equality and good governance.
- Protection of the susceptible.
- Fulfilment of special needs of Africa.
- Strengthening the UN.

There were specific objectives given for each of these areas and all these areas were understood as an integrated system. Later on, these seven areas were presented as MDGs offered in various contexts. There are eight MDGs that were formulated with 18 targets and 48 indicators. For the MDGs to be effective, the data reported on the achievement of those goals should show changes and progress in vulnerable groups. The MDGs should also focus on reducing inequality amongst the people of all socio-economic class. The eight MDGs and their nutrition effects are presented in a table below:

TABLE 2.5: The seven MDG and the nutrition effects

GOAL	NUTRITION EFFECT
Goal 1: Eradicate extreme poverty by halving the proportion of people who suffer from hunger by the year 2015.	People who live on less than one dollar a day are likely to be malnourished. The consequences of malnutrition may be irreversible and pass through from one generation to the next which affects human cognitive and physical development.
Goal 2: Achieve universal primary education by ensuring that all boys and girls complete a full primary education course.	Malnutrition may have a negative impact on a child's school performance and on the school attendance status of a child.
Goal 3: Promote gender equality and empower women	Gender disparity affects the malnutrition status of women since they have limited access to assets that will enable them to purchase food, access health and care resources
Goal 4: Reduce child mortality by two-thirds among children less than five years of age.	Most child deaths are associated with malnutrition as it contributes a lot in reducing the burden of disease
Goal 5: Improve maternal health ensuring progress amongst the poor and marginalized groups.	Malnutrition affects maternal health which in turn increases the risk of maternal mortality.
Goal 6: Combat HIV/AIDS, malaria and other disease	The risk of HIV transmission is worsened by malnutrition. Malnutrition may compromise antiretroviral intake which may speed up the level of full blown AIDS.
Goal 7: Ensure environmental sustainability by reducing the proportion of people without sustainable access to safe water	Contaminated drinking water may affect the immune system and lead to illnesses such as cholera

(Mauder, Khoza, Kuzwayo and Barth Eide, 2008: 9; United National Development Programmers (USDP), 2010)

2.4.5 Food parcels

The food bank programme under South Africa Social Security Agency (SASSA) has been able to supply food to 1,900 people per month in KwaZulu-Natal since 2006 from donated food parcels (SASSA, 2008). The National Food Emergency Scheme (NFES) of the Department of Social Development (DOSD) as part of IFSNP was introduced by Cabinet in 2002 with an aim of distributing food parcels to people living in hunger in all the sectors of the population. The primary beneficiaries of the NFES are the households who spend less than R300 per month on food from both urban and rural areas. The NFES is a temporary measure to assist the vulnerable groups to obtain essential micronutrients. The non-governmental organisations (NGOs) and Community–based organisations are responsible for identifying the vulnerable groups to qualify to benefit from the scheme. The vulnerable groups identified are:

- Orphaned children.
- Child headed households.
- Disabled people.
- Women headed households.
- HIV/AIDS sufferers.

According to STATSSA (2007), 2.2 million households estimated at 14 million people which are 30% of the total population of South Africa live on a monthly income of R600 per month of which R300 or less is usually spent on food. This insufficient amount is classified by the poverty indicators as below the average per capita monthly expenditure and, therefore, makes it difficult to purchase nutrient rich food from all the food groups. The agencies used to implement the NFES, were selected according to certain criteria which included experience, existing relationship with the DOSD at provincial and national level, suitable equipment to package food parcels, ability to distribute food parcels and willingness to add value to the programme. The food parcels distributed by the DOSD include the following:

• 10 kg maize meal	• 1 bar green soap	• 5 kg dry beans
• 250 g tinned pilchards	• 3 bars bath soap	• 10 kg dry beans
• 2 kg sugar	• 500 g rooibos tea	• 500 g peanut butter

• 2 kg soya mince   • 750 ml cooking oil   • 500 g coffee

Food parcels played an important role in combating malnutrition regardless of the short term of the implementation process (Moeng and Hoop, 2008:290-291; DOA, 2006; 2007).

2.4.6 Genetically Modified Food (GMF)

Genetic modification involves obtaining genes from the cell of a plant, animal or microbe and introducing them into another cell to provide preferred characteristics. The process of genetic modification of food produced products known as genetically modified food. Cross-breeding is a technique that is used by farmers to modify and improve the quality, yield and taste characteristics as well as distinguishing and transferring particular characteristics of plants and animals. The farmers should ensure that information needed by consumers in regard to GMF is given. This could be achieved by means of proper labeling so that consumers can make informed decisions. The aims of genetic modification of food are to improve macro and micronutrient content of food; reduce allergy-causing properties in food; include of properties that prevent chronic diseases such as cancer and heart disease; and preserve the quality of food (Oldewage-Theron and Fuller, 2008: 653; Soqele et al., 2007:253-254).

According to Soqele et al. (2007:253-254), Some consumers are concerned about the side effects of GMF on human health and the impact that genetically modified crops may have on the environment since GMF products are grown with artificial fertilizers, pesticides and herbicides. GMF animal products may also be treated with vaccines and can be fed with growth related hormones, drugs, steroids and antibiotics since there is no guaranteed evidence from specific data that GMF products are harmless. Food products that are usually modified and the reasons for their genetic modification are presented in a table below:

TABLE 2.6: Food products that are usually modified and the reasons for their genetic modification.

FOOD SOURCES	REASON FOR GENETIC MODIFICATION
Soy bean	Assist farmers in spraying weeds without damaging the crops by increasing resistance to herbicides.
Legumes	Increase the nutritional value of food and provide the plants with natural protection for fungal and bacteria diseases.

Oil seeds such as canola and sunflower	Increase mono-saturated (omega 3) fatty acids in food products such as margarine and cooking oil to improve cardiovascular or heart heath.
Sugar	Increase the amount of sucrose produced by plants and enhance resistant to disease.
Wine grapes	Enhance resistance of food to pests and diseases and improves the ability of plants to absorb nutrients from soil as well as improving, colour, flavor and sweetness.
Barley	Increase production by improving resistance to pests and diseases.
Wheat	Increases the amount of fiber thus improving health.
Apples and pears	Limiting the use of pesticides by increasing the natural resistance to insects.
Grapes and citrus fruits	Increase the production of seedless varieties to meet consumer demands.
Potatoes	Prevent disclouration and decrease the use of pesticides.
Poultry	Enables infectious diseases to be discovered thus increasing the health of poultry
Pigs	Improves the health of pigs by increasing the pig's natural immunity.
Salmon	Boost the growth rate and size of salmon.

(Oldewage-Theron et al., 2008: 653).

2.5 FOOD SECURITY

2.5.1 The role of sustainable agriculture and rural development in increasing household food security.

In remote areas where employment opportunities are limited, people are highly dependent on crops and livestock for livelihoods; hence the promotion of agriculture should be one of the priority strategies used in order to increase food security (FAO, 2009c; DOA, 2002; Maliwichi et al., 2012).

The USAID (2003) addressed food security by identifying the three critical elements of a food system which are: 1) the ability to produce, supply, issue and deliver enough food to meet the basic needs of the people. 2) Achieve the highest level of healthiness so as to reduce susceptibility to market escalations and political pressures. 3) Ensure the limited seasonal and cyclical accessibility to food varieties. According to FAO (2009c), there are certain challenges to food security that have

been identified and addressed by various stakeholders through research such as ensuring sufficient and food availability to all people presently and in future, adjusting the food prices to match the people's income in order to ensure the affordability of adequate and nutritious food, encouraging people to make nutritious, healthy and safe food choices all the time as well as to monitor, evaluate and report on the impact of food security programmes on susceptible populations through gathering, analysing and communicating complete and relevant information (USAID, 2003, FAO, 2009c; Maliwichi et al., 2012).

In South Africa, the Comprehensive Agricultural Support Programme (CASA) of 2005 involved various government departments in incorporating the Household Food Security Program for every household that does not have access to surplus food. The sum of R22 million was spent on 273 projects with over 17 000 recipients benefiting from assistance through surplus food. The CASP also aimed at promoting wealth and improving household food security through agriculture by focusing on the skills and knowledge transfer along with marketing and financial advice. The Micro Agricultural Initiative of South Africa (MAFISA) was launched by the National Department of Agriculture (NDA) which used a budget of R150-R200 million in training black farmers and the working poor with an objective of improving livelihoods, increasing household security and eradicating poverty. In 1996, the worldwide food security summit that consists of 185 countries was held in Rome by the Department of Agriculture and the Integrated Food Security Strategy (IFSS) that was established and, thereafter, the South African government fabricated it by partnering with experienced community based and NGO members in trying to escalate the trading and production power of households, improve food and nutrient security, create job opportunities and provide capacity building (DOA, 2002).

According to the FAO (2005a), most people believe that the immediate solution to food insecurity lies on the activeness of agriculture through a number of measures that may be implemented through new technologies. The most important contributions that agriculture could make in decreasing the food insecurity level are to lower the prices of available food and increase the availability of affordable food so that all people are able to afford nutrient dense food. When the production of food grains at country level increases, a remarkable reduction in prices is expected which will highly benefit the poor in both rural and urban areas where most people plant and buy own food. Accelerating agricultural development may increase agricultural productivity by increasing job

opportunities in communities where unemployment and underemployment are a setback hence increase the wage rate off and on farm production. The on-farm agricultural production may increase the need for labour required for planting, weeding, harvesting and preparing thus creating more jobs for the unemployed. The linkages between agriculture and other sectors may have a strong effect on rural labour markets and, therefore, extra jobs may be created (FAO, 2005a; Berry, Hall, Hendricks, 2010).

2.5.2 The role of seasonal food plantation in increasing household food security.

The importance of seasonal food crop production as an essential dietary component is the greatest in critical periods when many people especially in poorer communities encounter food shortage problems. The availability of land together with enough resources for plantation and manpower provides sufficient food in some seasons in the form of leaves, fruit, vegetables, wildlife and roots that are edible. According to the FAO (2006), seasonal food is most consumed in food shortage seasons which may serve two functions; increasing the household food security and ensuring nutrient adequacy. Seasonal nutrient rich and fresh food varieties gathered from crops consumed as a result of lack of money to buy certain unhealthy food may serve as a diet supplement and, therefore, lack of money to purchase food from shops can have a positive effect on the nutritional status of the community members (FAO, 2006; Maliwichi et al., 2012;).

The FAO (2006) stated that seasonal food cultivation is important in times where the supply of some nutrient rich food items is acute. Home gardens have played a significant role in increasing the food security status of some households and nutritional studies have shown that home gardens may supply nutritious food to food insecure families throughout the year. Some seasons have more cultivation than others and dry seasons are, therefore, associated with increased nutrition problems. The administrative seasonal issues may also create and worsen food shortages, for example, if there is insufficient money to purchase seed to be planted during the dry season and a lack of crop monitoring procedures such as weeding, there will be no harvesting in the wet season. Plantation of emergency food that provides calories and that persists in droughts such as roots and tubers should be highly encouraged over low energy dense food. The trees and forests have great potential in providing food resources such as forest fruits and nuts especially during food scarcity periods and, therefore, appropriate management of food resources in terms of protection and development is essential. The

nutritive value of forest foods need to be understood in order to plan and manage its continuous utilization (FAO, 2006).

Table 2.4: Seasonal crop varieties in South Africa

Month	Crop food available
January	**Vegetables:** asparagus, baby butternut, baby corn, green beans, mange tout, beetroot, sweet peppers, baby corn, carrots, chives, courgettes, cucumber, brinjal, endive (limited supply), garlic, lettuce, mushrooms, onion, parsley, potatoes, pumpkin, radishes, radicchio, spinach, squash, Italian tomatoes, table celery **Fruit:** all berries, apricots, figs, granadillas, nectarines, peaches, plums, bananas, lemons, litchis, mangoes, nectarines, pears, pineapples, prickly pears, grapes, watermelons, honeydew melons, kiwi fruit
February	**Vegetables:** asparagus, green beans, beetroot, sweet peppers, carrots, cabbage, chives, courgettes, cucumber, brinjal, endive (limited supply), garlic, lettuce, mealies, mushrooms, onion, parsley, potatoes, pumpkin, radishes, spinach, squash, sweet potatoes, tomatoes, turnips **Fruit:** apples (top red, starking, golden delicious - end of Feb.) (Royal Gala - mid Feb.), figs, nectarines, peaches, pears, plums, pomegranates, bananas, lemons, mangoes, melons, pineapples, prickly pears, grapes, spanspek, watermelon, granadillas, all berries
March	**Vegetables:** green beans, beetroot, cabbage, sweet peppers, carrots, celery, chives, courgettes, cucumber, brinjal, endive (limited supply), leeks, garlic, lettuce, mealies, mushrooms, onion, potatoes, pumpkin, radishes, spinach, squash, sweet potatoes, tomatoes, turnips. Avocados starting **Fruit:** apples (Granny Smith, Royal Gala), bananas, avocados, figs, peaches, pears, plums, pomegranates, quince, lemons, mangoes, pineapples, grapes, spanspek, watermelon
April	**Vegetables:** artichokes (Jerusalem), green beans, beetroot, broccoli, cabbage, cauliflower, sweet peppers, carrots, celery, chives, courgettes, cucumber, brinjal, endive (limited supply), leeks, garlic (scarce), lettuce, mealies, mushrooms, onion, parsley, parsnips, potatoes, pumpkin, radishes, spinach, squash, sweet potatoes, tomatoes, turnips

	Fruit: Apples (Granny Smith), Fuji (mid April), pears, avocados, bananas, lemons, grapes, gooseberries, pineapples, winter melons, pomegranates
May	**Vegetables:** artichokes (Jerusalem), green beans, beetroot, broccoli, brussels sprouts, cabbage, sweet peppers, carrots, cauliflower, celery, chives, courgettes, cucumber, endive (limited), horseradish, kale, leeks, garlic (scarce), lettuce, mushrooms, onion, parsnips, potatoes, pumpkin, radishes, spinach, gem squash, sweet potatoes, tomatoes, turnips, peas **Fruit:** avocados, bananas, oranges, lemons, grapefruit (imported), guavas, paw-paw, pineapples, cape gooseberry, pecan nuts
June	**Vegetables:** artichokes (Jerusalem), beetroot, broccoli, brussels sprouts, cabbage, carrots, cauliflower, celery, chives, cucumber, endive, horseradish, kale, leeks, garlic (scarce), lettuce, mushrooms, onion, parsnips, potatoes, pumpkin, radishes, spinach, squash, sweet potatoes, turnips, peas **Fruit:** avocado, bananas, orange, lemons, grapefruit, naartjies, limes, guavas, paw-paw, pineapples, cape gooseberries, granadillas, kiwi (limited), rhubarb, apples
July	**Vegetables:** beetroot, broad beans, broccoli, black radish, Japanese white radish i.e. daikon, Brussels sprouts, cabbage, carrots, cauliflower, celery, celeriac, endive, horseradish, red Russia kale, black kavolonero kale, kohlrabi, leeks, garlic (scarce), lettuce, mushrooms, onion, parsnips, peppers, potatoes, pumpkin, radishes, Swiss chard, spring onion, gem squash, sweet potatoes, tomatoes, tarsoi, pachoi, turnips, peas **Fruit:** avocado, bananas, oranges, lemons, grapefruit, naartjies, kumquats, guavas, paw-paw, pineapples, cape gooseberries, granadillas, kiwi, apples
August	**Vegetables:** asparagus, beetroot, broad beans, broccoli, black radish, Japanese white radish i.e. daikon, Brussels sprouts, cabbage, carrots, cauliflower, celery, celeriac, cucumber, endive (limited), horseradish, kale, leeks, garlic (scarce), lettuce, mushrooms, new potatoes, onion, parsnips, peas, potatoes, pumpkin, radishes, spring onion, Swiss Chard, squash, sweet potatoes, tomatoes, tarsoi, pachoi, turnips **Fruit:** avocado, bananas, oranges, lemons, grapefruit, naartjies, limes, tangelo (limited), kumquat, guava, loquats, paw-paw,

	pineapples, cape gooseberries, granadillas, kiwi
September	**Vegetables:** asparagus, artichokes, beetroot, broad beans, broccoli, black radish, Japanese white radish i.e. daikon, cabbage, carrots, cauliflower, celery, cucumber, endive (limited), leeks, garlic, lettuce, mushrooms, new potato, onion, parsnips, peas, potato, pumpkin, radishes, rhubarb, Swiss Chard, squash, spring onion, sweet potatoes, tarsoi, pachoi, tomatoes, turnips, waterblommetjies **Fruit:** mulberries, avocados, bananas, cape gooseberries, oranges, lemons, grapefruit, naartjies, limes, tangelo (limited), kumquats, guava, paw-paw, pineapple, kiwi, rhubarb
October	**Vegetables:** artichoke (globe), beetroot, green beans, broccoli, cabbage, carrots, cauliflower, celery, chives, courgettes, cucumber, endive (limited), leeks, garlic, lettuce, mealies, mushrooms, onion, parsnips, peas, potatoes, pumpkin, radishes, spinach, squash, sweet potatoes, tomatoes, turnips, waterblommetjies **Fruit:** apricots, mulberries, bananas, oranges, lemons, grapefruit, naartjies, guava, paw-paw, pineapples, kiwi, rhubarb, strawberries
November	**Vegetables:** asparagus, baby marrows, beans, carrots, cauliflower, cucumbers, globe artichokes, leeks, peas, spinach **Fruit:** almonds, apricots, avocados, cherries, guavas, paw-paw, peaches, pineapples, plums, spanspek, strawberries, watermelons, melons
December	**Vegetables:** artichokes (globe), green beans, sweet peppers, carrots, chives, courgettes, cucumber, brinjal, endive (limited), garlic, lettuce, mealies, mushrooms, onion, potato, pumpkin, radishes, spinach, squash, sweet potatoes, tomatoes **Fruit:** cherries (one or two weeks only), figs, nectarines, peaches, plums, bananas, lemons, litchis, mango, paw-paw, pineapples, spanspek, water, melons, rhubarb

(Rice, 2012)

The seasonal food varieties available in each month in South Africa are reflected in Table 4.2 and it indicate the most as well as less productive seasons. Winter season i.e. June, July and August has more crop food than other months which means households that rely on crop food for living are more food secure in winter (Rice, 2012).

According to USAID (2003), some countries due to ignorance may plant crop food that contains the same nutrients such as in Northern Sudan where people plant more sorghum, wheat and millet which are all rich in carbohydrates. This may increase the food security status but the over consumption of certain nutrients coupled with shortages of others may lead to micro nutrient deficiencies, diseases and obesity.

The South Africa Department of Agriculture, Forestry and Fishery (SADAFF) stated that climatic conditions may affect the crop food production which may in turn affect the whole country's food security status especially in rural areas where crop foods are mostly consumed. In 2010, winter crops, livestock as well as grassland were in poor condition due to low rainfall as part of the country was affected by droughts. During dry seasons such as summer more food should be planted in the interior part of the country as the coastal areas are dryer than the interior areas. The SADAFF advised famers to plant in accordance with the climatic conditions associated with that particular area and should strictly follow all the planting dates. Unforeseen circumstances that could affect crops plantation such as fire should be known and alternative measures should be maintained and prepared in advance (USAID, 2003; SADAFF, 2010).

2.5.3 The role of the government in ensuring sustainable agriculture and food security.

The high increase in food insecurity globally has commanded and urgently required agriculture that is sustainable, often large scale and export oriented. The government has a significant role to play in sustaining agriculture which is often overlooked in order to decrease food insecurity, especially in rural areas where almost 70% of the world's poor citizens live in. The FAO (2005a) has a Special Program for Food Security (SPFS) that involves 106 countries which concentrates on boosting food production, uplifting food security within the poor households through the National Programme for Food Security (NPFS) and the Regional Programme for Food Security (RPFS). The FAO together with other engaged partners and donors facilitates these programs and assist in their successful formulation and implementation at national and regional level (FAO, 2009c; 2005b).

According to the FAO (2009c), many governments have promoted the system of agricultural production that depend on poisonous pesticides that might have a undesirable effect on the health of farm workers with an aim of limiting crop losses and obtaining food self-sufficiency, nevertheless, the dismissal of state enterprise has led to the high cost of importation and distribution of fertilizers, seed insecticides, machinery and agricultural implementation. The role of the South African Department of Agriculture (SADA) is to provide infrastructure such as fencing, irrigation and agro logistics as well as to get involved in skills development since the country is in great need of a skilled and trained workforce in the agriculture industry and together with the Ministry of Police, ensure the safety of farm owners and workers at all times. The challenge that the SADA is facing is to ensure an effective service that can address all the needs of commercial and smallholder farmers along with ensuring the ownership of the land to embark on the important task which is food production. In October 2010, the SADA developed an integrated growth and development plan aimed at creating a link between three sectors which are agriculture, forestry and fishery as a technique of improving the food security status of the country (USAID, 2003; FAO, 2009c).

The Department of Agriculture as part of the world's economy is trying to find markets in other parts of the world for surplus products such as maize which will generate income needed for the plantation of the next season's scarce food as well as for the training and establishment of lively, reasonable and sustainable communities that will contribute towards food security for all (USAID, 2003; FAO, 2009c).

2.6 DIETARY DIVERSITY
2.6.1 Definition of dietary diversity

Dietary diversity is a measure of a number of individual foods consumed that is often referred to as the Food Variety Score (FVS) and the number of food groups consumed that is referred to as the Food Group Diversity Score (FGDS) calculated over a certain period of time as a Dietary Diversity Score (DDS) in order to determine the nutrient adequacy of the diets referred to as the Nutrient Adequacy Ratio (NAR) (USAID 2003). Eating a variety of foods is the first of the ten Food Based Dietary Guidelines (FBDG) which aims at limiting the health problems arising from lack of dietary variety and encouraging people to increase the variety of food eaten daily; as the National Food Consumption Survey of 1999 revealed that low income households consume food with low dietary

variety. The USAID has implemented a programme as a strategy to increase the DDS amongst the households which entails the education about the nutrient rich food and the promotion of diversified diets that includes nutrient micro nutrient rich food. The questions on dietary diversity may be asked to know the nutritional status at household level which is stated as the Household Dietary Diversity Score (HDDS) and the Individual Diversity Score (IDDS) as a measure for the nutritional quality of an individual's diet. The nutritional quality of food advances with increased consumption of greater food diversity (Mauder, Matji and Hlatshwayo-Molea, 2001:1; Labadarios et al., 2011).

According to Ruel (2003), dietary diversity measure is a key element for good quality diets which ensures adequate intake of essential nutrients for the improvement of nutritional status of undernourished individuals thus promoting good health. The undiversified diets have led to the fast growing problem of chronic diseases of lifestyle (Mauder et al., 2001:3; Labadarios et al., 2011; Ruel, 2003).

Ruel (2003) stated that the dietary diversity of vegetables and fruit is associated with reduced risk of stomach cancer and degenerative diseases (Ruel, 2003).

2.7 FACTORS CONTRIBUTING TO POOR DIETARY DIVERSITY IN RURAL AREAS.
2.7.1 Cultural beliefs on food

According to Mbenyane et al. (2008), food intake is highly influenced by cultural processes. Cultural influence on food habits, therefore, moves throughout generations. Culture can lead the people concerned to resist change which might negatively influence production and consumption of food.

The cultural wisdom characteristic in traditional systems together with plant and animal resources may contribute towards increasing food security, decreasing the problem of under-nutrition, contribute towards agricultural diversification and assist populations to meet socio-cultural and nutritive needs. According to Magbagbeola, Adetoso and Owolabi (2010), there has been a major decrease in the consumption of fruits and vegetables because of cultural changes and urbanization since many traditional foods are now being associated with being recessive and irrationalized. In some countries, nutritional rich planted products with an undoubted effect towards the improvement

of nutritional status such as roots and tubers, pulses and oil seeds, leafy vegetables and tropical fruits are neglected and underutilized. These neglected plant products are known as Neglected and Underutilized Species (NUS). The potential of the NUS is usually known for its nutritional contribution to some communities but neglected because of certain cultural reason for example, Muslims do not eat pork because of the belief that it is dirty whereas pork is rich in B complex vitamins (Magbagbeola et al., 2010; Steve, Farre, Fringola and Pilamunga, 2001:1).

2.7.2 Food purchasing power.

Most food eaten nationally is bought, but livestock and crop production still takes place in rural areas as subsistence farming (Mauder and Meaker, 2007).

Decreasing the cost of food should enable households to consume more diverse and nutritionally sufficient diets. Households purchase 70–90% of food supplies from supermarkets and major retailers. Some of the practices of supermarkets might be to sustain high food prices more than ensuring that food is affordable although dominating agro-food value chains. An understanding of food value chains and other structural limitations is required in order to formulate suitable interventions. This could engage a political-economic analysis of the systems involved in ensuring food access at numerous levels. Extending social grants to qualifying households can significantly improve the food security status of hungry adults and children. This might decrease suffering in the medium term, but the fundamental issues can only be addressed through longer term maintainable solutions based on developing the hopes of employment and supporting livelihoods. The current situation of economic decline and doubts about the future may decrease the possible impact of market-based solutions (Altman et al., 2009; Mauder and Meaker, 2007).

2.7.3 Lack of food storage facilities.

Crop food may be damaged and deteriorate easily. Cold chain technology is highly necessary in order to preserve the quality of crop food. Cold chain technology refers to packaging methods, transportation and storage of thermal and temperature sensitive and perishable products essential for maintaining their quality (FAO' 2009c; 2012).

According to the FAO (1998), there is a shortage of cold storage facilities and the cost of renting storage facilities is high. This affects the availability of produce over a longer period of time. Due to the high amount of money spent on renting storage facilities, the price of food increases while the product is still in storage in order to cover the storage costs.

Indigenous foods are harvested only when in season and surplus food is preserved for later use. Methods of preserving plants and animal products that are used may include sun drying. Other food products such as Mopani worms are prepared by drying (Mbhenyane et al., 2008).

2.8   DIETARY REQUIREMENTS FOR WOMEN BETWEEN THE AGES OF 31-50 AND BETWEEN 51-70 YEARS OF AGE: MACRO NUTRIENTS

2.8.1 The role of dietary reference intakes (DRI's) and other dietary requirements

The DRI represents the goal of maximizing health and improving the quality of life. DRI's were formulated on the basis of a larger concept that provides indicators for good health and prevention of the burden of diseases as well as the potential undesirable effects of over consumption. DRI's were formulated using a variety of materials such as controlled and clinical case studies. Benefits of DRI's include promotion of health to enhance the quality of life and providing guidelines to assist individuals and groups in minimizing risk factors for illnesses (Nutrition Information Centre University of Stellenbosch (NICUS, 2003).

The term DRI is a collective one which includes four nutrient-based reference values of which RDA is one of them. The other three nutrient-based reference values are discussed further below:

a) **Estimated Average Requirement (EAR)**

EAR is the estimated intake that meets the nutritional requirements of at least 50% of individuals of the same gender and age in a given life time and is the basis for the multiple nutrient-based reference levels used in several countries. EAR is used as a tool to set RDA and, therefore, for RDA to be formulated, adequate scientific evidence to create an EAR should be available (NICUS, 2003; Soqele and Bruyns, 2006: 61; Gibson 2005;198).

b) Adequate Intake (AI)

AI is used instead of RDA's when the scientific evidence to set an EAR is insufficient. The AI is estimated through experimentation of intake levels and through observing average nutrient intake of healthy individuals and groups who seem to have efficient health indicators, normal growth and normal nutrient blood circulation. More scientifically proven research is required to establish EAR (NICUS, 2003; Soqele et al., 2006: 61).

c) Tolerable Upper Intake Level (UL)

UL is the utmost nutrient intake by a person who is unlikely to cause risks of an unpleasant health outcome in at least 97-98% of people within a specific group (NICUS 2003; Soqele et al., 2006: 61).

d) Recommended dietary intake (DRA)

RDA was established in 1989 in the USA with an aim of providing standards which could be used as a target for good nutrition by recommending food intake that meets at least 97% of individuals of the same gender and age in a given life time. Nutrient adequacy in individuals can be assessed by means of RDA (Soqele et al., 2006: 61).

2.8.2 Energy

The global food supplies are presently enough to meet the energy/calorie needs of the world's population if equally distributed among and within all nations (International Food Policy Research Institute (IFPRI) and FAO (2008). The age, gender and energy expenditure of a person defines the amount of energy required by the body. A variety of food should provide adequate energy to ensure the maintenance of an anticipated body weight. The energy requirements of a person decrease with age due to reduced physical activities and lowered basal metabolic rate as a person grows. The estimated energy requirements (EER) for a moderate active woman between the ages of 31-50 and between 51-70 years are 10.093kJ/day. Physical inactiveness and lowered basal metabolism results in lower energy requirements. A moderately active man or woman aged 70 years and over has the

estimated energy requirements (DRI) of 10.68 and 8.55 MJ/day (2 557 and 2 046 kcal/day) (Charlton et al., 2008:558; Hammond, 2008a: 720; NICUS,2003).

The WHO (2003a) stated that the energy requirements of an adult who is asymptomatically HIV infected are expected to increase by 10% and by 20%-30% during symptomatic HIV and AIDS to sustain the body weight and physical activity. The interventions to meet the energy needs of individuals should address its significance; consider the dynamics of energy expenditure which is striking a balance between energy intake and expenditure (Schoeller, 2009; WHO, 2003a; Lamberg, 2006; Fox, Danavey and Jankowskie, 2004).

2.8.3 Dietary fiber

Whole grain is defined by the Food and Drug Administration (FDA) as that which consists of an unbroken and grounded fruit of the grain with its main components which are germ, endosperm and bran. The germ and bran are present in the same relative quantity as it is present in the whole grain. The whole grain is an important source of certain vitamins and minerals as well as phyto chemicals which contain anticancer properties. A dietary fibre requirement (RDA) for a moderate active woman between the ages of 31-50 is 25g/day and between 51-70 years are 21g/day (Anderson, Baird, Davis, Ferreri, Knudston, Koraym, Waters and Withers, 2009; Aune, Chan, Lau, Vieira, Greenwood, Kampman and Norat, 2011:343; NICUS, 2003; WHO, 2003a).

The intake of germ and bran in required amounts can assist reducing cardio vascular disease. Increased consumption of dietary fibre can significantly lower the development of the risk of the disease trends such as hypertension, obesity, diabetes, stroke, gastro-intestinal disease and coronary heart disease. Dietary fibre also assists individuals in lowering high blood pressure, reducing glycaemia and insulin insensitivity as well as in enhancing weight loss (CVD) (De Moura, Lewis and Falk, 2009; Anderson et al., 2009; WHO, 2003a).

According to Anderson et al. (2009), increasing dietary fibre in the diet reduces gastro-intestinal disorders such as constipation, duodenal ulcers, and hemorrhoids, gastro-esophageal reflux and diverticulitis by means of roughage present in most indigestible cellulose of fruits and vegetables. Dietary fibre also boosts the functioning of the digestive system and keeps it healthy (Anderson et al., 2009; WHO, 2003a).

2.8.4 Carbohydrates

Carbohydrates are a group or compound that consists of starch, sugar, dextrin and cellulose. Carbohydrates are principal sources of energy and during digestion, are converted to glucose which is utilized for energy. Carbohydrate requirements (RDA) for a moderately active woman between the ages of 31-50 and between 51-70 years are 100g/day. A South African study has revealed that carbohydrates as the main contributor to total energy, contribute 62% to 71% of the energy to rural African dwellers and 44% to 64% to urban dwellers of all ethnic groups. This shows that rural dwellers consume more carbohydrates than urban dwellers (Steyn, 2006b; Vorster, Venter, Wissing and Margetts, 2005; Soqele et al., 2006:43; NICUS, 2003; Steyn, 2005; Dewey and Brown, 2003).

Carbohydrates are classified by glycaemic index (GI) which ranks food according to its impact on speeding the rate at which blood sugar levels raise after consumption. The concept glycaemic means supplying carbohydrate for metabolism. The GI is an essential component for sustaining good health especially for people who are diabetic and over-weight. Food items with high GI contain carbohydrates that are converted to blood glucose immediately after eating. Food items with low GI contain carbohydrates that are converted to blood glucose at a slower rate after eating. A GI which is less than 55 is considered low, between 56 and 69 is considered medium and greater than 70 is considered high. Food items high in GI include potatoes, white bread, rice crispies, jelly beans, cornflakes, white rice, dates and rye bread. Food items low in GI include lentils, milk, split peas, soy-beans and low fat unsweetened yoghurt (Steenkamp and Delport, 2005; Pieters and Jerling, 2005; Slabber; 2005; Steyn, Blaaw, Lombard and Wolmarans, 2008).

The amount of GI in food is not dependent on quantity of carbohydrate consumed but on its quality. The measurement of glycaemic index in food is, therefore, not reliant on the portion size since making reasonable comparison tests of the GI of food commonly uses 50 grams of accessible carbohydrate in each food. This should be clearly explained by health professionals to individuals who use GI as a healthy eating guide. A person can thus eat twice as much carbohydrate in a food item and have the same blood glucose response as a person who had one (Anderson andPasapuleti, 2008; Brand-Miller, 2003: 2261-2267; Pieters et al., 2005; Mann, 2006).

Steyn (2006) reported that the rural African diet is usually high in carbohydrates, low in fibre, protein and fats as compared to African urban diets which usually consists of more sugar, confectionary,

meat, wheat products, oils/fats, fruits and beverages. According to Steyn (2006b), a typical example of an African rural diet for adults includes leftover maize meal stiff porridge with vegetables or meat for breakfast, maize meal stiff porridge or samp with relish for lunch and maize meal stiff porridge or samp with relish, red meat, chicken or vegetables for supper (Steyn, 2006b:33-41; Steyn et al., 2008).

2.8.5 Protein

Protein is a nutrient that is essential for growth and maintenance of worn out tissues and muscles in the body whose building blocks are amino acids. Some amino acids are essential at all times and some are essential under special occasions. The absence of any of the nine essential amino acids in the body may result in stunted growth. Protein may be obtained from both animal sources and plant sources. The daily intake of protein in adults should be approximately 46g/day and should contribute 10-20% of the total energy as well as 0.8g of protein per kilogram body weight to meet the RDA. Protein requirements (RDA) for a moderately active woman between the ages of 31-50 and between 51-70 years are 46g/day (WHO, 2003b; Steyn et al., 2008:725; Anderson et al., 2004).

According to NICUS (2005) and the WHO (2003b), increase in protein intake for people living with HIV/AIDS (PLWHA) to 1.2-1.5g per kilogram body weight is recommended but the data to support this increase are insufficient. The intake of animal originated food by African South Africans is gradually increasing as it was very low in the past compared to other population groups who have high intake of meat and, therefore, increased risk of chronic disease. This has been impacted by urbanization. The intake of other animal sources such as milk amongst all the population groups and fish in some population groups is low (DOH, 2004b; 2007b; NICUS, 2003; WHO, 2003b).

According to Scholtz, Vorster and Matshego (2001: 39-46), a balanced diet and healthy eating routine is possible without the consumption of animal food sources. The use of soy protein has many benefits over animal source protein which includes lowering the level of lipoprotein by 5.4% and cholesterol by 4% in the body which decreases the risk of chronic diseases. Numerous studies support the consumption of soy protein to reduce blood cholesterol and the present health claim has recommended the intake of 25g of soy protein by the entire world's population (Allen, 2007; Azadbakht, 2008; Liao, 2007; NICUS, 2003; Scholtz et al., 2001).

2.8.6 Fats

Fats include all the lipids derived from plant and animal sources that are consumed as food. It is essential that the minimum fat intake (which is 15% of total energy intake) is attained by the body in order to ensure adequate consumption of total energy, fat soluble vitamins and essential fatty acids. Adults with BMI a of <18.5 and women of reproductive age should consume fats that contribute 20% of the daily energy requirements for metabolic and structural activities.(FAO 2009a: 14, 22; Vorster et al., 2008; Hammond, 2008b; Arab and Steck-Scott, 2004).

The composition of food should be analyzed in order to determine the quality of fat and the nutritive value. There are some foods that contain better quality fat and, therefore, have good nutritive value. Foods that have more unsaturated fats have better quality in terms of nutritive value than saturated ones and are high in essential fats such as omega-3 and-6 and polyunsaturated fatty acids (PUFA) (Zevenbergen, Brea, Zeeleberg, Laitinen, Duijin and Flotter, 2009; Kris-Etherton, Eckel, Haward and Appel, 2003; Cunnane, Drevon, Harris, Sinclair, Spector and Salem, 2004; Gallagher, 2008).

A global viewpoint study on fat intake which was conducted in 28 countries revealed that the mean daily total fat intake which contributes to energy ranges from 11.1 to 50.7%. Africa had the highest score ranging from 13.1 to 50.7% then Europe which ranged from 28.5 to 46.2%, America ranged from 25.7% to 37.2% and Asia ranged from 11.1 to 35.6%. It has, however, been hypothesized that high intake of mono-unsaturated fats intake may reduce the risk of breast cancer (Elmadfa et al., 2009; Arab et al., 2004; Steyn et al., 2008).

According to the FAO (2005b), in 2005 with the world population of 6 billion people, the average fat intake was estimated to be almost 20kg per person per year. Maritz (2006) stated that an estimation of 5.5 million South Africans who are 30 years and older are at a risk of developing cardiovascular diseases (CVD) due to the total cholesterol level (TC) (FAOc, 2005; Maritz, 2006; Charlton, Wolmarans, Marais and Lombard, 1997).

2.9 THE ROLE OF MICRO NUTRIENTS IN THE NUTRITIONAL STATUS OF ADULTS

2.9.1 Dietary Requirement Intakes (DRIs) for macro and micro nutrients in women.

Table: 2.1: Dietary Requirement Intakes (DRIs) for macro and micro nutrients in women between 31-50 years old and 51-70 years old.

MACRO-NUTRIENTS	REQUIREMENTS PER DAY 31-50 YEARS	REQUIREMENTS PER DAY 51-70 YEARS
Energy (EER kJ/day) • Carbohydrates (EAR) Fibre (AI) Protein (RDA)	10093 KJ 100g/day 25g/day 46g/day	10093 KJ 100g/day 21g/day 46g/day
MICRO-NUTRIENTS		
Calcium (AI)	1000mg/day	1200mg/day
Zinc (EAR)	6.8mg/day	6.8mg/day
Iron (EAR)	8.1mg/day	5.0mg/day
Iodine (EAR)	95mcg/day	95mcg/day
Phosphorus (EAR)	580mg/day	580mg/day
Magnesium (EAR)	265mg/day	265mg/day
Fluoride (AI)	3.1mg/day	3.1mg/day
Selenium (EAR)	45mcg/day	45mcg/day
Chromium (AI)	25mcg/day	20mcg/day
Vitamin A (EAR)	500mcg/day	500mcg/day
Vitamin C (EAR)	60mg/day	60mg/day
Thiamin (EAR)	0.9mg/day	0.9mg/day
Riboflavin (EAR)	0.9mg/day	0.9mg/day
Vitamin D (AI)	5mg/day	10mg/day
Vitamin B_6 (EAR)	1.1mg/day	1.3mg/day
Vitamin B_{12} (EAR)	2.0mcg/day	2.0mcg/day
Vitamin E (EAR)	12mg/day	12mg/day
Vitamin K (AI)	90mcg/day	90mcg/day
Folic acid (EAR)	320mcg dietary FE/day	320mcg dietary FE/day
Nicotinic acid (EAR)	11mg NE/day	11mg NE/day
Biotin (AI)	30mcg/day	30mcg/day

a) Vitamin A

Vitamin A is a fat soluble compound that is formed in small amounts by a group of antioxidant compounds that performs a number of functions in the body. Vitamin A sources are colourful fruits, vegetables and animal food. Vitamin A derived from animal food is called retinol and is easily absorbed and efficiently used in the body. The main sources of retinol vitamin A are beef, chicken livers, whole milk and cheese. The vitamin A obtained from colourful fruit and vegetables is in the form of carotenoids such as beta carotene that is converted into retinol within the intestines after consumption and it is not as easily absorbed as vitamin A from animal products. The national food consumption survey 2005 revealed that 64% of women living in rural areas and children between the ages 1-9 years in South Africa have inadequate vitamin A levels with 14% who are vitamin A deficient (Swart et al., 2008:407-408; DOH, 2007c; Soqele et al., 2006).

According to the Institute of Medicine (IOM) (2001), the Dietary Reference intake (DRI) provides recommendations for vitamin A which are 1,000 International Units (IU) for children aged 1-3, 3,000 (IU) for boys, 3.3310 (IU) for girls, 2,265 (IU) for pregnant women and 1,300 for lactating women over nineteen years of age. Rice (2007:1) stated that vitamin A deficiency may lead to increased pregnancy related deficiencies. Pregnant and lactating mothers who are lacking vitamin A may pass the deficiency to the child which may result in death within the first six months of life. About 250 000 to 500 000 vitamin A deficient children become blind in each year and most of the deficiencies are transferred from vitamin A deficient mothers to the fetus. A randomized placebo controlled field trial that includes 2000 pregnant women revealed an empirical result of 40% reduction in pregnancy related deaths among women who were given vitamin A supplements weekly during, after and before pregnancy (Rice 2007:1).

The overdose of vitamin A may lead to risk factors such as osteoporosis which mostly results in hip fractures and capability impairment of other nutrients especially vitamin D that promotes calcium absorption. Diets with excess alcohol may drain vitamin A in the body since alcohol rich diets do not provide adequate amounts of vitamin A. According to Paoane, Sanders and Mason (2008:920), the home gardens have made a significant difference in decreasing the vitamin A deficiency level in South Africa. Households with home gardens have children with higher vitamin A intake than children from households with no home gardens (IOM, 2001; WHO, 2000b, c and d; Rice, 2007;

Paoane et al., 2008; Labadarios, Moodieand and Van Rensburg, 2007; DOH, 2004b, 2007; Schneider, Norman, Parry, Bradshaw and Puddemann, 2007b).

Table 2.2: The functions, sources, deficiency diseases and symptoms of vitamin A (National Institutes of Clinical Excellence (NICE), (2006).

FUNCTION	SOURCES	DEFICIENCY DISEASES AND SYMPTOMS
• Assist in bone development, cell differentiation, cell division and reduce respiratory problems along with diarrheal infections and measles in children. • Reduce the risks of eye infections such as night blindness by making the cornea very dry enabling viruses and bacteria to enter the eye easily and helps in clear vision expansion in dim light. • Regulate the immune system to help fight and prevent diseases by making more white blood cells. • It helps the white blood cells especially lymphocytes to fight infections. • Assist the functioning of the skin and mucous membrane as protectors against harmful viruses and bacteria.	• Liver • Green fruits and vegetables • Yellow fruits and vegetables • Dairy products • Beef • Poultry • Seafood	• Night blindness • Exophthalmia • Bibot's spots • Corneal xerosis • Diarrhoea • Measles • Pruritus • Broken fingernails • Keratomalacia • Lack of appetite • Defective teeth and gums • Retarded growth in children • Dry and dull hair • Dandruff • Rough and dry skin • Excessive hair loss

• Assist in reducing risks of certain types of cancers		• Poor wound healing • Poor sense of taste and smell • Weakened immune system

b) Vitamin D

Vitamin D as a fat-soluble vitamin is apro-hormone that is stored and absorbed by the body when skin is exposed to sunlight and when vitamin D rich food is consumed. It plays a vital role in calcium and phosphorus levels regulation in the blood as well as bone and teeth formation. Vitamin D may be classified into two forms called ergocalciferol (Vitamin D2) and cholecalciferol (Vitamin D 3). Cholecalciferol which is produced by the action of the sunlight is much better at raising vitamin D levels in the blood than ergocalciferol which is obtained from plants and fungal sources (Alexander 2009; Swart et al., 2008:408; Charlton et al., 2008: 558.)

According to Soqele et al. (2006), vitamin D may cause certain deficiencies such as rickets which is the impairment of bone mineralization in children and osteomalacia that may lead to osteoporosis in adults. The main cause of vitamin D deficiency includes inadequate exposure to sunlight which may lead to clinical disorders. The elderly especially those that are housebound, institutionalized and hospitalized are commonly affected by Vitamin D deficiency because of their little or no exposure to sunlight which may result in hip fractures. Reduced mal-absorption and reduced metabolism may also result in vitamin D deficiency illness. The most common symptoms of vitamin D deficiency are muscle aches, muscle weakness, and bone pain at any age (Soqele et al., 2006; Daly, Bass and Nowson, 2006; Charlton et al., 2008).

c) Vitamin C

The intake of vitamin C is significant particularly for lactating and breastfeeding women since the vitamin C status of a mother determines the content of vitamin C of breast milk. The consumption of vitamin C in many women is very low due to low consumption of fruit and vegetables. Vitamin C plays a major role in bone development and collagen formation. The shortage of vitamin C in the body results in defective connective tissue especially collagen. Vitamin C as an antioxidant plays a therapeutic role in protecting brain cells from free radical damage. The gastrointestinal tract needs the presence of vitamin C to improve absorption of non-heama iron while reducing gastric pH and slows down the change from nitrates to nitrites and prevents gastric cancer (Styne et al., 2008:36; Soqele et al., 2006; Key, 2005; Riboli, 2003).

d) Iron

The effect of iron deficiencies globally is worsened by poor socio-economic factors.. The most common iron deficiency disease is anaemia. Anaemia is the result of the reduction of the number red blood cells and the amount of heamoglobin which leads to the reduction of oxygen-carrying capacity of blood cells. The common symptoms of anaemia are headache, weakness, fatigue, decreased work capacity, cardiovascular implications, impaired cognitive function and paleness of the tongue, nail beds and tongue (Lee and Niemen, 2003; WHO, 2001a; Nojilana, Norman, Dhansay, Labadarios, Van Stuijvenberg and Braadshaw, 2007; Vijayaranghavan, 2004).

According to Swart et al. (2008: 394-398), anaemia in pregnant women of South Africa has been found to range from approximately 16% to 26%. The study conducted by Kesa and Oldewage-Theron (2005) in Gauteng (Sharpville) revealed that low income pregnant women consume diets that are low in iron and the mean total intake is far below the Dietary Reference Intake (DRI). The diets of low income pregnant women consist mostly of plant-base products with little or no animal food, with the exception of milk (Swart et al., 2008:394-398; Vijayaranghavan, 2004; Kesa and Oldewage-Theron, 2005).

Factors that contribute to low iron level in most communities include poverty, alcoholism, inadequate dietary intake, chronic diseases, multiple medication use, inflammation and physical inability to prepare food (Swart et al., 2008:394).

Iron fortification of staple and complementary food in places where commercial complementary food products are used is one of the strategies of FAO to fight iron deficiency diseases. Fortification of staple food with iron may have more technical difficulties than with other food and is a very expensive option. These difficulties include the instability of certain forms of iron which can change the colour and taste of fortified food. Iron fortified food products include wheat, milk powder, cereals, infant formula and sugar (Kruger et al., 2008:684; Micronutrient Forum, 2007; Van Stuijvenberg, Smuts, Lombard and Dhansay, 2008).

e) **Calcium**

Calcium plays an important role in the body since it is responsible for the formation of strong bones and teeth especially in children due to rapid skeletal growth. Milk is an excellent source of calcium and it is therefore an important constituent of the infants' diet. Economic challenges have decreased the consumption of milk despite the fact that milk is value added tax (VAT) exempted. Calcium is not included as part of the multi-mix of micronutrients used to fortify bread, bread flour and maize meal. In health promotion, the intake of calcium rich food products that are affordable such as tinned pilchards and dairy products is vitally important. People who are on diet and want to exclude milk in the diet in an attempt to lose weight may rather consume low fat milk products (Swart et al., 2008:410; White, 2006).

The milk consumption in South Africa varies between urban and rural communities. Urban communities consume more milk (72%), of which 57% consume full cream milk, 10% processed milk products such as maas, 3% consume low fat processed milk and 18% consume high fat cheeses. Only 20% of rural communities consume milk, of which 9% consume full cream milk, 3% consume processed milk products such a maas, 4.5% consume low fat processed milk products and 3% consume high fat cheeses (Nel and Steyn, 2002).

f) **Zinc**

The zinc content of many food sources is not included in the South African food composition tables. The RDA for zinc used in the diet analyses of the NFCS was previously based on the 1998 RDA of

10 mg/day and was further adjusted down to 5 mg/day in 2001 (Earl and Borra, 2000; Swart et al., 2008; Dhansay, Marais and Labadarios, 2007).

Zinc is essential for normal growth through protein synthesis processes, skeletal development, and neuropsychological function. Zinc deficiency may cause poor growth in children and poor wound healing. The zinc status of individuals may be increased by the intake of wholegrain cereals, milk, cheese, yoghurt and red meat. Zinc is also necessary for the individual's clinical management. The zinc status of populations and communities is necessary for public health policies and programmes. Plasma or serum concentrations are mostly used as zinc status indicators but these concentrations change during malnutrition. The cut off points of plasma or serum zinc concentration of $<10.7\mu mol/L$ ($<70\mu g/dL$) for blood samples of individuals who are fasting is an indication of zinc deficiency. The most common symptoms of zinc deficiency are diarrhoea, infection, skin lesions, anorexia and alopecia (Wenhold, Kruger and Muehlhoff, 2008:448; Kruger et al., 2008:672; International Zinc Nutrition Consultative Group (IZiNCG), 2004; Dhansay et al., 2007).

In April 2003, the enrichment of maize meal with zinc as a nutrient that will benefit the community was legislated (DOH, 2003).

g) Vitamin E

Vitamin E plays an anti-oxidant role, keeps cell membranes healthy, retards ageing, protects brain cells and prevents blood clotting. The main sources of vitamin E are vegetable oils, wheat-germ, sunflower seeds, pumpkin seeds, sesame seeds, milk, green leafy vegetables, nuts and eggs (Plassman, Langa and Fisher, 2007). According to Steyn et al (2008: 738), vitamin E rich food products should be included in the diet as it plays a major role in the prevention of prostate cancer and gastric cancer. All women including pregnant and lactating ones have higher vitamin E needs as compared to men due to estrogen loss after menopause (Steyn et al. 2008:738; Plassman, Langa and Fisher, 2007; Peterson, Thomas, Grundman, Bennet, Doody, Ferris, Galasko, Kaye, Levey, Pfeiffer, and Sano. 2005).

h) Iodine

Iodine is a vital part of the thyroid hormones which help to regulate growth and metabolic rate. Areas that solely rely on locally produced food that is sown in soil that is low in iodine comprise a high rate of iodine deficiency. Iodine deficiency may cause the enlargement of the thyroid gland and goiter. The main sources of iodine are fish, shellfish, fruits, vegetables, cereals, milk and milk products (Soqele et al., 2007). In 2005, the NFCS evaluated salt and urine samples of iodine and the results indicated an adequate iodine intake and a more than adequate iodine status (Jooste, Labadarios, Nel and Strydom, 2007).

About 97% of households in South Africa contains, a significant amount of iodine which is more than two parts per million (PPM). Eight of the nine provinces in South Africa have a remarkable high percentage (95%) of the amount of iodated salt consumed. About 76.9% of households in the country use salt that contains more than 15 PPM and these percentages differ from 45.3% I Limpopo to 87.7% in the Western Cape. The urinary iodine (UI) defined the percentage distribution of iodine status and the outcome was that less than 20% of women had values below 100µglL. There is an insignificant pattern of median IU values of urban women and rural women. In the Northern Cape, rural women tend to have a higher median IU values as compared to urban women whereas in other provinces, urban women have a higher median IU values than rural women. This may be due to consumption of food products grown in soil that is low in iodine in rural areas thus increasing chances of Iodine Deficiency Disorders (IDD) (Jooste et al., 2007).

The iodization of salt has practically eliminated IDD in the country. Most consumers lack knowledge on iodine rich food products. In 2002, the South African Medical Research Council (SAMRC) conducted a study on women of sixteen years of age and older to assess the knowledge on IDD. The results revealed that only 15% of the respondents identified iodated salt as the key source of iodine. The DOH strengthened communication on the role of iodine based on these results (Jooste et al., 2007).

i) Thiamine

Frequent intake of thiamine is vital as the storage capacity for thiamine in the human body is very low. Thiamine deficiency is associated with beriberi, nervous disorders, poor muscle control, poor appetite, disorientation, paraesthesia of legs, painful calves and slow growth (Heymsfield and Williams, 1998). Severe thiamine deficiency may result in thiamine-responsive megaloblastic anaemia syndrome, diabetes mellitus and neuro sensorial deafness which may all be treated with increased thiamine intake. Food sources that are thiamine rich include lean pork, legumes, yeast extract, wholegrain cereals and nuts. Thiamine plays a significant role in respiratory sequence activity more especially in cells and tissues. Healthy adults of all age groups are rarely victimized by thiamine deficiency (Tinsa, BenAmor, Kaabachi, Ben Lasound, Bousseta and Bousnina, 2009; NICUS, 2005b).

j) Riboflavin

An experimental study in KwaZulu Natal has revealed that home gardens have had a great emphasis in increasing dietary consumption of riboflavin rich food items such as dark green leafy and yellow/orange vegetables. Home gardens have also made an impact on improving the serum retinol levels of children (Faber, Venter and Benade, 2002a; Faber, Venter, Dhansay and Benade, 2002b). Dairy products and meat as the main sources of riboflavin are consumed irregularly country wide which may increase the possibility of riboflavin deficiency disorders such as slow growth, skin and eye problems (Zimmermann, 2007). Researchers have recommended fortification of maize with riboflavin by 17% and wheat flour by 20% per 200 g for persons that are 10 years and older at the level of intake (Steyn, Bradshaw, Norman, Joubert, Schneider and Steyn, 2006; Labadarios, 2007; Zimmermann, 2007).

k) Niacin

Niacin status level presently can be assessed through urine. A more reliable technique to calculate the amount of ingested niacin in the human body is still being investigated. The major sources of niacin are legumes, fish, peanuts, poultry, lean meat, wholegrain cereals, dried fruits and green vegetables. Niacin facilitates and improves circulation, reduces cholesterol and blood pressure and promotes

healthy skin and digestion. Severe deficiency of niacin may cause pallegra. Niacin content may be destroyed by over-cooking food and therefore precautionary measures for preserving nutrients when cooking food should be taken (Soqele et al., 2006)

l) Vitamin B6

Numerous tests have been done and succeeded in determining the impact of vitamin B6 in reducing the risk of coronary heart disease, myocardial infarction and atherosclerosis. Most results were from surveillance studies, without any definite evidence (Ramakrishnan and Huffman, 2001; Wachs, 1995). In a study conducted by Ladzani (2008) to probe the digestibility of vitamin B6, it was found that the digestibility of vitamin B6 from all food sources ranged from 51 to 91%. The vitamin B6 rich food items that were tested included white cabbage, fish, corn, bananas, brown rice, soybeans milk powder, barley and eggs. Animal products were found to be 10% higher than plant products in vitamin B6 digestibility.

The role that vitamin B6 plays is vital as it assists in neurotransmitter systems of learning and memory; maintains the nervous system; controls muscles; and promotes growth, development and healthy skin (Wach, 1995, Soqele et al., 2006). To prevent peripheral neuropathy, all HIV-positive patients receiving a TB drug regimen containing ionized ingredients should receive 10 mg of vitamin B6 a day. The intake of about 20 mg/day of vitamin B6 and other nutrient supplements by HIV infected pregnant women has been reported to decrease the relative risk of disease progression of the virus to AIDS, increase CD4+ and CD8+ cell count, decrease the viral load when compared with placebo thus delaying the inevitability in the absence of Anti-retro viral (ARV) therapy (WHO, 2007; Wach, 1995, Soqele et al., 2006).

m) Vitamin B12

The main sources of vitamin B12 that are frequently consumed in South Africa are animal protein sources such as eggs, milk products and meat. There are no vitamin B12 rich products from plant food source which is a major challenge of vegetarianism since vitamin B12 is necessary in the formation of red blood cells; promotes growth; impairs cognitive function and improves calcium absorption for healthy bones and teeth. Almost 50% of children in South Africa consume inadequate quantities of vitamin B12. There is an extensive incidence of vitamin B12 deficiency even though

most vitamin B12 rich diets have quantities that exceed the RDA for vitamin B12 (Steyn and Labadarios, 2000; Scott, 2007; Soqele et al., 2006).

n) Vitamin K

Vitamin K as a fat soluble vitamin can be destroyed by extended exposure to sunlight and is not affected by normal cooking temperatures. The main functions of vitamin K are to prevent blood clotting, increase bone mineral density and decrease the risk of bone fracture. The elderly have greater vitamin K needs than younger people since bone minerals could gradually be lost with age. There are very rare incidents of vitamin K deficiency even in developing countries where most people cannot afford to diversify the diets. Liver, green leafy vegetables, soy-beans and wheat-germ are excellent sources of vitamin K (Kennedy, Nantel and Shetty, 2003:8; Tsugawa , Shiraki, Suhare, Kamao, Tanaka and Okano, 2006; Soqele et al., 2006).

o) Folate

Folate is necessary during pregnancy to help prevent neural tube defects (NTD) in newborns, megaloblastic anaemia and colorectal cancer. The 20th century research showed that the major contributor to the incident of serious birth defects of the spine and brain is insufficient availability of folate between 21 and 37 days after conception (Moeng and de Hoop, 2008:310). Inadequate folate intake during conception may lead to anaemia and slow growth of the fetus. The most common cause of anaemia in rural black South African pregnant and lactating women was found to be folate deficiency (Labadarios, 2007; Baynes, Meriwether, Bothwell, Fernandes Costa, Bezwoda and MacPhail, 1986). In a study conducted in Gauteng, 32% of women were folate deficient during pregnancy and lactation. In a study conducted in Limpopo, 48% of pregnant women were folate deficient in the last trimester and the recent prevalence of a further 10% was found. The authors associated this decline with folate supplements given to pregnant women at clinics. In 2005, the mean red blood cell (RBC) folate concentration in women was lower in respondents living in rural areas than in respondents living in urban areas. Lack of diversified diets in rural areas might be a cause for lower RBC folate concentrations in women in rural areas (Mamabolo, Alberts, Styne, Delemarre-Van de Waal, Nthangeni and Levitt, 2004; Baynes et al., 1986; Mayet, 1985; Labadarios, 2007).

The centre for disease control (CDC) and prevention recommended that all women intending to become pregnant should consume at least 400µg folic acid per day. The CDC also proposed that all women with a history of a previous NTD- affected pregnancy should consume at least 4 mg folic acid per day when planning pregnancy. The three approaches that are recommended by the CDC to increase folate intake are consumption of folate rich food products, use folic acid supplements and fortification of food with sufficient levels of folic acid (Moeng et al., 2008:310).

According to Tsugawa et al. (2006), countries who desire to use folate in fortification schemes should be careful not to overdose since some people may react negatively towards high folate intake. The drugs used to fight malaria, rheumatoid arthritis, psoriasis and cancer are anti-folate, therefore, high amount of concentrated folate in the blood may result in drug resistance syndrome due to cytotoxicity destroyer cells that decline when the level of folate concentration is high. High folate level combined with low vitamin B12 levels in the blood may increase the risk of anaemia and cognitive impairment. Folate can be lost during cooking and can be partially lost during processing and canning (Soqele et al., 2006).

p) Biotin

Biotin deficiency is very rare in healthy and active adults who consume a normal diet except if treated with broad spectrum antibiotics. A combination of certain factors may possibly lead to biotin associated deficiency. The most important biotin that is found in food and that is protein bound should be converted to free biotin in the intestine prior to being absorbed (American Heart Association, 2007).

Biotin plays a distinctive role in chromatin arrangement and cell gesturing. Biotin partakes in many processes excluding classic carboxylation reactions (Zeppelin, 2005).

q) Magnesium

As a mineral that most people are rarely deficient in, magnesium is mainly involved in mineralization and transmission of nerve impulses. Magnesium is necessary for the action of some enzymes. The most common symptoms of magnesium deficiency are tiredness and major depression. Magnesium

may be found in a diversity of foods such as cereals, bread, meat, potatoes, fruits, vegetables and milk (Soqele et al., 2006).

2.3.2. Protein energy malnutrition

Protein energy malnutrition (PEM) is the most common nutrient deficiency in Africa which is the range of medical conditions with different characteristics that are caused by the lack or inadequate intake of varying proportions of calories from protein (Smith and Haddad, 2000). Protein is vital in providing the body with amino acids that promote growth and repair all worn out tissues, minerals as well as vitamins. It is the leading cause of death among children in developing countries with reduction or failure of growth being the most obvious symptom. According to Smith and Haddad, 2000(2000), kwashiorkor which is also called wet-PEM or primary PEM and marasmus which is secondary malnutrition are two main types of PEM that affect the body differently throughout the same dietary deficiencies. According to the WHO (2003) and UNICEF (2008), kwashiorkor which is the most prevalent form of PEM is a clinical condition whose victims are children who have been weaned from breastfeeding in the first 12 months of life due to either the birth of a second child or the illness of the mother. The symptoms of kwashiorkor may include swollen stomach, burns on the skin, diarrhea and hair breakage. Kwashiorkor can be treated by the addition of protein in the diet typically in the form of dried milk. Marasmus is the severe emaciation of a child which results from the total lack of nutrients in the diet. The most noticeable symptoms of marasmus are rapid weight loss, dry skin, muscle wasting and growth retardation (WHO, WFP and UNICEF, 2005; UNICEF, 2008; WHO, 2003; Smith and Haddad, 2000).

UNICEF (2008) stated that the distribution of high protein porridge and protein bars may help in a government's struggle to fight against PEM in young children. PEM in the elderly increases with age as 4-10% of protein energy malnourished people are living at home, 15-38% living in institutional care and 70% are hospitalised patients. Some protein deficiencies may be observed in elderly people that are in good health. The risk factors of PEM are cancer, chronic infectious diseases, factors that cause food intake reduction such as swallowing disorders along with oral and dental disorders, mal-absorption and increase in energy requirements. Nutritional support should be provided to the elderly in order to fight PEM such as human assistance during meals, dental and oral care and treatment of any basic illnesses (WHO, 2003b; UNICEF, 2008).

Severe PEM may be treated by nutritious food such as breast milk, cereal with milk, oil and sugar, soft ripe fruits and cooked vegetables. Protein intake of 3-4 grams (g) per body kilogram (kg) and 200 kcal of energy intake per body kg should be established daily (West, 2006:13).

2.10 METHODS FOR COLLECTING DATA

2.10.1 Socio demographic survey

Socio demographic questionnaires are used to collect data concerning the social status of individual respondents and/or groups. It is an essential measuring tool that is used to measure the socio-economic status of individuals and communities. Different socio-demographic factors such as age, gender, level of education and level of income must be known in order to measure the level of poverty as well as the impact that such factors have on socio-economic wellbeing of individual households and communities. A socio-demographic questionnaire that is tested for validity and reliability is used as a measuring tool (Napier, 2006).

2.10.2 Dietary assessment methods

Various types of questionnaires can be used to collect dietary intake data. Some questionnaires may be open-ended, some may be closed ended and some may be the combination of the two. Different types of dietary assessment methods may be used simultaneously to improve accuracy and efficiency as well as to facilitate the interpretation of data (Gibson, 2005; Wolmarans and Wentzel-Viljoen, 2008). Dietary assessment methods are discussed below.

a) 24 hour recall data sheet.

The 24 hour dietary recall data sheet, like the dietary intake record, is an open ended type of questionnaire without any leading information about the type of food or portion size of the specific food consumed given to the respondents. It is used to collect quantitative dietary intake data of individuals or a group of individuals and to describe consistent dietary intake. The 24 hour recalls of groups >50 should be collected in order to report on an average intake of a group. Certain specific formulas may be used to calculate the exact number of respondents needed for a study (Gibson, 2005; Langenhoven, Kruger, Gouw and Faber, 1991).

The 24 hour dietary assessment method determines the food and quantity consumed by the respondent 24 hours prior to being interviewed. This method is useful only if the food consumed 24 hours prior to the interview is the usual dietary intake of the respondent and if the respondent is able to recall all food consumed as well as quantities. The 24 hour recall assessment method may not be an appropriate tool for collecting information on the dietary intake of children less than seven years of age but could be used for the classification of dietary intake of respondents older than seven years e.g. calculating the mean energy intake of respondents between 31 and 50 years of age. The 24 hour recalls cannot be used to correlate dietary intake with biochemical markers (Gibson, 2005; Langenhoven et al., 1991).

The 24 hour dietary assessment method can also be used to classify individuals into categories of those meeting or those that are not meeting reference values such as EERs and AIs. Extensive training of interviewers is required in order to administer 24 hour recall interviews correctly (Gibson, 2005).

b) Food frequency questionnaires (FFQ)

Food frequency questionnaires (FFQ) may consist of a structured record of individual foods or food groupings intended to collect information on the type of food consumed within a specific time frame e.g. a period of seven days; as well as the frequency of consumption based on specified frequency categories. FFQs rank individuals according to the intake of selected nutrients. FFQs may be more accurate than other dietary assessment methods for estimating mean intake of nutrients with large daily variability for which there are reasonably little considerable food sources even though FFQ are not designed to estimate complete nutrient intake. FFQs may focus on one or several specific nutrients. Absolute FFQs intended to estimate a large number of nutrients generally include between 50 and 150 food items. FFQs may either be un-quantified, semi-quantified or completely quantified. Un-quantified food frequency questionnaires do not specify serving sizes (Oldewage-Theron and Kruger, 2008; Steyn, 1988; Wolmarans et al., 2008; MacIntyre, 2001a,b,c).

c) Quantified food frequency questionnaires (QFFQ)

In South Africa, validated and reliable QFFQ have been developed to collect dietary intake data from individuals of various racial, age and gender groups. Unlike un-quantified FFQs, QFFQs allow respondents to indicate any amount of food usually consumed. QFFQs may be used to classify

individuals into high or low consumers and whether meeting or not meeting some reference values. (Steyn, 1988, Chalton, Wolmarans, Marais and Lombard, 1997, Lombard and Burger, 2007; McIntryre, 2001a,b,c ; Wolmarans et al., 2008).

The major shortfalls for QFFQs are that its success is solely dependent on the memory of the respondent and, therefore, could not be useful in the elderly where memory is a concern. QFFQs do not provide information on food intake at various meal times of the day. It can be very time consuming to develop QFFQs since after it has been developed; it has to be tested for validity and reliability (Wolmarans et al., 2008).

d) Diet histories

The meal-based diet history is designed with an intention to assess the usual individual total food intake. It consists of a recorded list of food and beverage items commonly consumed by an individual at each eating incident within a specific period of time. It determines the typical meal pattern of food combinations eaten by individuals. A highly trained interviewer conducts a survey on the respondent's habitual food intake pattern in a given time. During a meal-based diet history assessment method, a respondent needs to be very co-operative in order to be able to recall the typical required diet and to avoid over estimation of nutrients. The main benefit of a diet history is that it is able to correlate dietary intake with other markers such as anthropometric and biochemical (Wolmarans et al., 2008).

e) Food records

To conduct food records, the respondents should be literate. Using this method, the respondents describe the usual dietary intake and estimate the quantity of the diet. The questionnaires are designed for a diversity of respondents, therefore, questionnaires that are validated for different gender, age and cultural groups are generally available. The food record method correlates dietary intake with other makers such as anthropometry. This method can be time consuming especially when estimated measures reported in the household have to be converted to grams of food. Food records can be regularly used as a standard when other dietary intake methods need to be validated (Wolmarans et al., 2008; Margetts and Nelson, 2006).

f) Household survey

In a household survey, any food item that is available for consumption in the household whether raw or cooked is weighed or estimated into household measures. Any food consumed by visitors; preparation waste such as outer leaves and trimmed fat as well as food waste which is food that is prepared but not consumed should be subtracted from the total. An estimated 15% of the total or any estimated proportion of food that is believed to be wasted is usually subtracted (Gibson, 2005: 34-35; Margetts et al., 2006:130).

2.10.3 Anthropometric data collection methods

Anthropometric data collection involves attaining the physical measurements of an individual and comparing these to already set standard values for health and nutritional status. Anthropometric measurements taken on a regular basis provide useful information concerning fluctuations in nutritional status ultimately and permits early discovery of malnutrition (Charlton et al., 2008).

Through anthropometry, the human body can be measured in terms of the dimensions of bone, muscle, and fat tissue,malnutrition can be categorized and the impact that body mass has on malnutrition and human growth can be determined. Anthropometric measurements such as BMI can be used as an indicator for negative nutrition related health results such as obesity and CVD (Gibson, 2005; Lee et al., 2003; WHO, 2000e).

Anthropometric measurements can be compared to a dietary diversity score of individuals to create a relationship, if any. The essential attributes of anthropometry are simplicity and fastness. Weight, height and waist circumference measurements are the most commonly used anthropometric measurements in epidemiological studies. Correct techniques must be applied when administering anthropometric measurements in order to ensure that accurate, precise and reliable results are obtained. Various methods such as calculating the weight-to-height ratio using reference standards such as National Centre of Health Statistics (NCHS) medians and BMI as well as the WHO cut off-points can be used to interpret the body weight of adults (Gibson, 2005; Lee et al., 2003).

a) Height

Height measurements are useful in determining the nutritional status of adults especially when used together with other anthropometric and experimental assessments. Height can be used in conjunction with weight to calculate the BMI of individuals. Height can be measured using different methods. Direct and indirect height approaches can be used to obtain height measurements. In the direct height approach, a stadiometer or rod is used with the back placed to the vertical backboard of the stadiometer. The participant must be able to stand or recline flat and the weight should be evenly distributed on both feet during the direct measuring method. Indirect methods includes arm span, recumbent length (using a measuring tape) and knee height (only measured on adults that are 60 years of age and older) measurements. Indirect methods are used for individuals who are restricted due to physical disability i.e., scoliosis, muscular dystrophy, missing or emaciated limb and those who have curvature of the spine (Oram and Moley, 2000).

The arm span assessment may be used instead of height since it reflects the true length of body frame. Knee height measurement is a good height predictor as compared to arm span since it tends to overestimate height. The knee height measurement is defined by WHO (1998) as the knee joint space-to-heel measurement (cm), measured from the sole of the foot to the fore surface of the thigh with the foot and knee each curved at 90°. Approximation height can be calculated if it is impossible to measure height due to severe kyposis by using the following knee height equation:

- Women: Stature (cm) = [1.91 x knee height (cm)] – [0.17 x age (y) + 75.
- Men: Stature (cm) = [2.08 x knee height (cm) + 59.01 (Oram and Moley, 2000; Marias, Marias and Labadarios, 2007; WHO, 1998; Charlton et al., 2008).

b) Weight

Weight measurement is easily attained but needs to be administered properly to be effective in providing a basic assessment of total fat and muscle stores. Various methods used to interpret and simplify body weight measurements include BMI, actual weight and normal weight. Actual body weight is obtained the moment measurements are taken. The amount of fluid an individual takes may influence actual body weight. Decrease in body weight may be associated with dehydration, illness and/or under-nutrition (Centre for Disease Control (CDC), 2002).

Total fat may be estimated by means of calf circumference, knee height, mid-upper arm circumference (MUAC) and sub scapular skin fold measurements if it is impossible to weigh a person on a scale normally due to certain reasons such as being bedridden. Equations developed in the United States of America may be used for the above mentioned alternatives to weighing using a scale (CDC, 2002).

c) BMI

The most broadly used BMI calculation formula is weight in kilograms (kg) divided by height in metres squared (W/H^2) using various cut-off-points. BMI is used as an indicator of nutritional status including over and under-nutrition as well under and over-weight. The uniqueness of BMI over other nutritional status indicators is that it is responsible for revealing differences in body composition (fat mass to lean body mass ratio) by measuring the degree of adiposity as well as muscle mass and relates it to height; hence reducing reliance on frame size index (Lee et al., 2003; 2010; Gibson, 2005).

Low and high BMIs are highly associated with increased risk of diseases. There has been a reported correlation between BMI and handgrip strength (sign of upper body strength and physical function) in adults of rural areas of Malawi and Tanzania (Lee et al., 2003; Eleventh, Chumlea, Eiben, Harries, Heymsfield, Launer, Rosenburg, Solomon, Svanborg, Van Staveren and Wellas, 1998).

Death related to low BMI in adults is usually due to tuberculosis, disruptive lung disease, and lung and stomach cancer while death related to high BMI relates to the presence of diabetes, colon cancer in men, post-menopausal and breast cancer in women, cardiovascular and cerebrovascular disease (Charlton et al., 2008; Key, 2005).

BMI values are gender and age independent; however, the degree of fatness in different populations may interpret BMI differently due to deviating body proportions. BMI categories regarding health risk may vary in different populations (WHO, 2004b).

BMI values are presented in different classification categories ranging from underweight to obese (Refer to Table 2.7).

Table 2.7: The worldwide categorization of adult underweight, overweight and obesity according to BMI (WHO, 1995; 2000; 2004a).

Classification	BMI(kg/m^2)	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	**25.00 - 29.99**	**25.00 - 27.49**
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34-99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.9	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

The cut-off points of (23), (27.5), (32.50 and (37.5) kg/m^2 are to be included as points for public health action. A WHO working group was formed by the WHO Expert Consultation and is presently responsible for an advanced appraisal and assessment of available information on the association between BMI, waist circumference, and health risk and the relations between waist circumference and morbidity (WHO, 2004a).

d) Waist-to-height ratio (WHTR)

WHTR is more detailed, critical, cheaper and convenient in assessing health risk than BMI and waist circumference and, therefore, can be used as an early predictor of health risk. WHTR is calculated by simply dividing weight (kg) by height (m). Moderate range of BMI does not guarantee lower metabolic risk whereas WHTR signifies a constituent of authentic obesity which relates to metabolic risk. WHTR has a negative correlation of height to some metabolic aspects (Hseih, Yoshinanga and Muto, 2003; Hendricksson, Lindblad, Agren, Nilson-Enhle and Rastam, 2001; WHO, 2000e).

The most important components of WHTR are height and waist. What makes WHTR more effective is that self-measurement is more stable and reliable with height than with weight when using a standard measuring tape and that waist circumference measurement needs a measuring tape as it is more convenient than using weight scales (Hsieh and Moto, 2004; Ashwell and Hseish, 2005).

A study was conducted by Hsieh and Muto (2004) to determine the superiority of WHTR as an anthropometric index to evaluate clustering of coronary risk factors among non-obese men and women. The BMI, waist circumference and WHTR as indices were compared for assessment of grouping of coronary risk factors. The results showed that the total of coronary risk factors correlated positively with all anthropometric indices, with the closest correlation found for WHTR; and that WHTR is more responsive than BMI or waist circumference only to assess grouping of coronary risk factors in non-obese men and women (Hsieh et al., 2004).

The mean WHTR values for both genders are closer than the values of waist circumference since waist circumferences are not the same for men and women because men are taller with lager waists than women. WHTR, therefore, has modification for height and makes use of the same boundary value for both genders. The anticipated boundary value of WHTR = 0.5 and above indicates greater risk for both men and women (Hseih et al., 2003; Hsieh et al., 2004; Hsieh, Muto, Yoshinaga, Tsuji, Arimoto, Miyagawa, Hoshihara and Hara, 2006).

The foremost benefits of WHTR calculations for more accurate tracking of fat distribution and accumulation by age include the following:

- It is used to identify potential signs of excess fat deposition in individuals especially those that are HIV- infected (Hammond, 2008b).
- It is nearer to the ratio of 1 for the anthropometric standards among men and women at different age gaps.
- It tracks fat distribution and accumulation by age more precisely.
- It has a closer connection with metabolic risk.
- It makes classification of overweight individuals and those of normal weight facing higher risks more broad.

- It is highly stable sensitive and more specific in identifying individuals with higher risk at an index of WHTR of 0.5 and above.
- Displays greatest simplicity (Hsieh et al., 2006; Hsieh et al., 2004).

There are supportive records for WHTR as an efficient interpreter of metabolic risk from reports of other researchers in Japan, Taiwan, Hong Kong, Bangladesh, United Kingdom, Greece and United States; even though the efficiency of different anthropometric indices for the prediction of metabolic risks is, however, debatable. Keeping waist circumference below half the height measurement should be the health message for the public to prevent metabolic disorder (Hsiehet al., 2006; Hsieh et al., 2004).

e) Waist circumference

Waist circumference is a good predictor of intra-abdominal fat mass which is an excellent predictor of cardiovascular risk diabetes and other abnormalities than BMI. A non-stretchable tape measure is usually used to measure the distance around the smaller area under the rib cage and on top of the umbilicus where the waist circumference is positioned. Cut-off point values for an increased risk in adults was recommend by the WHO (1997); however, up until now these values have not been permitted for used in adults of African populations and are unreliable when used in individuals with a BMI that is less than 35 (Gibson, 2005). According to CDC (2002), a measurement of 102 cm (40 inches) and above for men and 88 cm (35 inches) and above for women is a high risk factor for disease. These measurements may be ineffective for those with BMI of 30 and over and for those that are more than 152.4cm tall (CDC, 2002).

f) Calf circumference

As a sensitive measure of muscle mass in adults, calf circumference is not dependent on changes in stores of body fat (Charlton et al., 2008). The main circumference of the calf is measured with the knee and ankle curved at $90^{\circ}C$ (Eveleth et al., 1998).

g) Skin fold thickness (SFT) measurement

Triceps SFT gives a measure of subcutaneous fat. Calibrated calipers are used to measure triceps SFT which is measured on the posterior surface of the arm, half way between the acromion process and the elbow (i.e. mid-upper arm) with the arm slacking by the side, while the subject is in a standing position. A value of <4mm for men or <9mm indicates under-nutrition (Woodward, 2002).

h) Mid-Upper Arm Circumference (MUAC)

Changes in body composition and kyphosis may cause BMI reference values to be inappropriate for identifying poor nutritional status of adults. MUAC only requires a tape measure and is easy to carry out measurement without any obstacles. It is taken with the arm relaxed and hanging on the side; at the medium point between the acromion process and the radial point. In developing countries, MUAC is commonly used as a sensible and consistent indicator of body fat. Ismail and Manandhar (1999) instigated reference values for adults that are shown in Table 2.8.

Table 2.8: MUAC reference values for adults in developing countries

Mid-Upper Arm Circumference (cm)			Nutritional status
African adults (men and women)	Asian/Caucasian adults		
	Men	Women	
>24.0	>22.0	>22.0	Normal malnutrition
23.1-24.0	22.1-23.0	20.1-22.0	Mild malnutrition
22.1-23.0	21.1-22.0	19.1-20.0	Moderate malnutrition
<22.1	<21.1	<19.1	Severe malnutrition

i) Mid-Upper Arm Muscle Circumference (MUAMC) and Mid-Upper Arm Circumference Muscle Area (MUAMA)

MUAMC is derived from the MUAC and SFT combined together and can be used to evaluate protein-energy malnutrition since the size of the muscle mass is a guide of protein quantity. MUAMC is used for people who cannot be weighed and for people with high edema in whom BMI cannot be administered. The change in MUAMC will be proportionately smaller than the change in MUAMA if the volume of the mid-upper-arm muscle declines during protein-energy malnutrition or enlarges following nutrition intervention. The use of MUAMA may be, therefore, be more suitable since arm muscle circumference is insensitive to small changes (Charlton et al., 2008).

j) Biochemical indices

Biochemical indices may reflect changes in nutritional status earlier than anthropometric and clinical measurements since it is more sensitive than these measures. Indicators of animal protein status and immune function are helpful in assessing compromised nutritional status. Measures of levels of

circulating proteins (albumin, pre-albumin, transferring and retinol-binding protein) can be indicators of protein insufficiency (Charlton et al., 2008).

2.11 CONCLUSION

The literature reviewed in   this chapter focused on determining the effect of seasonal food variety and coping strategies on dietary diversity, nutritional status, food security and nutrient adequacy of women in rural areas. It clearly shows that the prevailing lack of dietary diversity, low nutritional status and nutrient inadequacy of women living in rural areas can be improved by seasonal food intake obtained from crops and coping strategies used by the communities in times of food scarcity. Certain highly nutritious food products such as fruit, vegetables, and cereal grains are unaffordable and unavailable to indigent rural communities due to unequal distribution of food and inaccessible food purchasing outlets. Seasonal food variety has played a major role in increasing food security status of rural dwellers. Some seasons are more productive than others and, therefore, the nutritional and food security status of an individual rural dweller can differ in various seasons. Socio-economic status has an adverse effect on the human's nutritional status and dietary diversity.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

This chapter explains how data were collected in order to determine the socio–economic profile, seasonal food variety, nutrient intake, nutritional status, coping strategies, household survey and dietary diversity of women in a rural community of KwaZulu-Natal (KZN). Good quality data were gathered with an aid of proper planning research design and measuring instruments being the critical components in data gathering. Research methods were properly selected so that all the research objectives will be met. The following factors were taken into consideration when selecting the research methods.

- Population characteristics (gender, age, level of education, cultural diversity)
- Estimated time
- Resources that are available.

According to Clausen (2005), low income results in low dietary diversity. Most people in rural areas are unemployed and are unable to cater for dietary diversity. Rural communities are, therefore, more vulnerable to seasonal fluctuations regarding food supply as most food is supplied by agricultural activities. This study was essential and a key factor in knowing the effect of seasonal food variety and food security of the women in rural areas. The correct sampling, data collection methods and instruments were essential in an attempt to answer a research problem.

3.2 Permission and Consent

The research proposal was submitted and approved in 2009 by the Faculty of Applied Sciences Research Committee (FRC) at the Durban University of Technology (DUT) prior to the commencement of the study (Annexure A). Ethical clearance was obtained from the FRC as part of the proposal approval and was not approved by the Institutional Research Ethics Committee (IREC) as this committee was only constituted during 2011. All Faculty ethics applications were dealt with at FRC level prior to this date. Therefore, from 2011 all DUT research had to adhere to the ethical guidelines as per the DUT website.

Permission to conduct this study in this community was requested and obtained from the chief of Malangeni area through a letter and permission was granted. The researcher and fieldworkers stood at

the local supermarket and selected women randomly and requested participation. The women that agreed to participate were given full information and the information letter outlining the purpose and expectations of the study as well as consent forms to sign as an acknowledgement to participate on a voluntary basis. The information letter and the consent forms were written in isiZulu to allow every respondent to understand everything written clearly (Annexure A). The respondents were ensured that participation was voluntary and that they could withdraw at any stage without any penalties. The house numbers of everyone that agreed to participate were recorded and an appointment made for the following day. The following day, the researcher and the fieldworkers conducted the research in the households of every randomly selected respondent. Each participant was issued with a participant number in order to ensure confidentiality. Respondents were assured that personal information would be kept confidential and be locked away in the Department of Food and Nutrition cupboards for the period of five years and thereafter it will be disposed of by shredding. Only the researcher and the supervisor would have access to this information.

It is important that when the researcher is conducting research he or she should take ethical considerations seriously. In this study the researcher considered the research ethics as recommended by Human Sciences Research Council (HSRC).

3.3 EMPIRICAL STUDY DESIGN

An empirical study design was used to collect primary data about the community living in rural areas. The study was designed as a survey using quantitative measures complementing with qualitative techniques.

3.3.1 Developmental Study Design

Stage 1- Literature review

This stage involves a scrutiny of scientific literature significant to the study.

↓

Stage 2- Planning the study

The planning procedure consisted of these steps.

- Writing a research proposal.

- Setting appointments with relevant stakeholders.

- Visiting the chief of the community to obtain information to do the study in his community.

Stage 3-Rolling out of study

The rolling out of study was done over a period of one year in four seasons which were autumn (April 2009), winter (July 2009), spring (September 2009) and summer (January 2010)

Stage 4–Reporting on results

The result will be discussed in details in chapter 4

3.4 STUDY TYPE

The study was exploratory and descriptive in nature and, therefore, various measuring instruments were used to collect relevant data. A quantitative research approach with a small qualitative component was implemented with an aim of identifying important variables in an area and to provide an answer to a research problem, during personal face-to face interviews. Interviews of 20 minutes per household were conducted. Anthropometric measurements were also collected at the same time and data were recorded accordingly. Data were collected from 100 women 18 years and older one in each household.

3.5 STUDY VARIABLES

Various questionnaires were used to measure a variety of variables. The socio-demographic questionnaire determined household indicators like age, employment status, number of dependents living conditions and assets. Anthropometric measurements that were conducted included height and weight. The coping strategies in the households were determined for the period of food insecurity. Dietary intake, food cupboard content and number of meals respondents consumed were also established. These variables were used to describe the community.

3.10   SAMPLING STRATEGY

The sample was calculated using a power calculation and was 114 subjects out of a population base of 270 households. Hundred and fourteen were randomly selected from the 270 but 14 were lost to

follow up by refusing to participate in the study because of suspected political agenda, some were ill and others had bad memory. One Hundred respondents made up the final sample over the four seasons (Cole, 1997). Twenty five were randomly selected from the final sample to be included per season.

Sample Size

$$Ss= \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)
p = percentage picking a choice, expressed as decimal

(.5 used for sample size needed)
c = confidence interval, expressed as decimal = .07 (three units on both sides of the normal).

The sample was described as women of 18 years and above in Malangeni rural community. The respondents had to be permanent residents of the area. The following people were excluded from the study.

- Women living in the area on a temporary basis e.g. living in the areadue to work.
- Underage individuals who are below 18 years old.

Random sampling was conducted in the study. Door to door interviews took place between 8am and 4pm for five consecutive days in each season.

3.11   RESPONSIBILITY OF FIELDWORKERS

Three fieldworkers were conscripted from amongst the 3rd year students in the Food and Nutrition Department at the Durban University of Technology (DUT). The fieldworkers attended a fieldworker training workshop and the training manuals were handed out to refer to at a later stage if necessary (Annexure B). English was the medium of instruction for the training sessions. Fieldworkers were, however, allowed to use the local language (isiZulu) during the interviews in order to avoid any language barriers. The fieldworkers were comprehensively trained on how to complete the 24 hour

recall questionnaires, food frequency questionnaire, coping strategies questionnaires and how to take the anthropometric measurements during the interviews. Food samples, books and posters were used to help the respondents to recognise the food easily and also to help the fieldworker in measuring portion sizes. Two fieldworkers worked together for safety reasons as the fieldwork was conducted in the households. The fieldworkers were told to be patient, respectful and friendly as those are important components when dealing with this community. Punctuality and reliability on duty on a daily basis was highly emphasized by the researcher to the fieldworkers. The fieldworkers encouraged the respondents to be as honest as possible. The researcher was available during the data collection phase in case any questions or concerns arose.

3.12   ADMINISTRATION OF MEASURING INSTRUMENTS

Different types of questionnaires were used as measuring instruments for all the variables of the study. Dietary, socio-economic, nutrient intake, nutritional status, coping strategies, household survey and anthropometric data were collected during the fieldwork stage. The researcher checked all the questionnaires for accuracy and completeness every day after the fieldwork was completed in case any questions had to be repeated the next day. The details of the gathering of data will be discussed in more details in the next section.

3.8.1 Socio demographic survey

The socio demographic questionnaire was pre-tested and validated in the study (Oldewage-Theron et al., 2005). This survey was compiled in English and its purpose was to determine the socio economic profile of all respondents. The main categories of this survey were personal information, level of education, employment status, household's family income, number of household members end household assets. The researcher completed the socio demographic questionnaire in the first season in all 100 households as it was lengthy and requires speed and patience (Annexure C).

3.8.2 Dietary assessment

One of the main aims of the study was to determine the food variety and dietary intake behaviour of the rural community over all four seasons. Four 24 hour recall questionnaires, one per season, food frequency questionnaire and a cupboard survey per season were completed for this section.

a) 24 hour recall

A structured 24 hour recall questionnaire was used in all four seasons (Annexure D). This is a dietary assessment questionnaire that is used to determine the food consumed by the respondent 24 hours prior to the interview and the respondent's actual dietary intake. This was done through face to face interviews by the fieldworkers who had been trained in using methods for imploring dietary information and in using food models simultaneously to determine portion sizes and identifying certain food items which helped in yielding sufficient reliable data.

b) Food frequency questionnaire –FFQ

The FFQ was conducted to determine food group diversity score (FGDS), dietary intake behaviour over the four seasons (Annexure E). The FFQ consist of a structured listing of individual foods adapted in the community over a period of seven days in the nine food groups recommended by FAO which are:1) Cereals roots and tubers (including rice. Pap, samp, maize meal, bread); 2) Dairy(including milk, maas, cheese, yoghurt, ice-cream); 3) Eggs, 4) Fats and oils (including butter, sunflower oil, margarine, lard); 5) Legumes and nuts; 6) Other vegetables(including onion, cabbage, beetroot, rhubarb, turnips, tomatoes, cauliflower); 7) Other fruits (including apples, peaches, pears grapes, plums); 8) Vitamin A rich fruits and vegetables (including pumpkin, spinach, butternut, mango, carrots, apricots, 9) Flesh products (meat, poultry, fish and offal (FAO 2009). The respondents were asked to indicate the food items consumed in the last seven days as listed on the questionnaire. The FFQ as an instrument was used to validate the 24 hour recall. The FFQ used were un-quantified as it did not specify serving sizes (Oldewage-Theron and Kruger, 2008).

c) Household survey

The household survey method that was used was the household food record method. During the interviews, the researcher requested 25 respondents per season in each household to show all food available for consumption in the household whether raw or processed. The food available was then estimated in household measures allowing for preparation waste such as discarded outer leaves, peel and trimmed fat as well as allowing for food that could be eaten by visitors. The preparation waste and food to be eaten by visitors were estimated to be 15% of the estimated measure. The total estimated food items in 25 households were then added up and the mean was calculated. The pictures of food in the cupboards of households were taken to show as evidence. The researcher recorded the

top 10 food items in each household according to the estimated measures. When the top 10 food items for every household were recorded, the researcher compiled top 10 food items for all 25 households for all seasons. This technique was well suited for this community since the large proportion of the diet is home-produced rather than pre-processed (Gibson, 2005:34-35; Margetts and Nelson, 2006:130).

3.8.3 Coping strategies (CS)

An adapted food coping strategy questionnaire developed by Maxwell et al. (2003) was used for this study (Annexure F). The coping strategies used by the community in times of food scarcity were adapted for this community by means of Focus Group discussions with 10 caregivers from this community. One hundred community members who were not part of the pilot study were then divided into groups of four and one Focus Group was held per season. During the Focus Group, the group discussed whether in the past 30 days there had been times when food and money to buy food was not enough and what strategies were used to ensure that household members had food to eat. The group had to rank strategies identified according to severity, least severe score a one (1) and most severe score a four (4). The options were: 0 never (zero times per week); 0.5 hardly at all (once or few times per week); 1.5 once in a while (1 to 2 times per week) and 7 (all the time or everyday). The highest frequency score which was 7 multiplied by the severity weight which was 1-4 multiplied by 10 strategies = maximum score of 140 thus the higher the score the more food insecure the community is. The randomly selected 25 households then completed the adapted coping strategy questionnaire in the selected seasons with the assistance from the fieldworkers.

Table 3.1: Coping strategies and frequency scores.

COPING STRATEGY	FREQUENCY SCORE
• Borrow food from neighbours?	1
• Rely on less expensive food?	2

• Buy food on credit?	1
• Visit neighbours to eat?	3
• Gather food from crops?	3
• Limit portion sizes?	2
• Reduce the number of meals eaten in a day?	3
• Bartering (exchange food from their crops)?	2
• Restrict consumption by adults in order for small children to eat?	3
• Sell some of their belongings in order to get money for food?	4

3.8.4   Anthropometric questionnaire

The height, weight and waist circumference of 100 participants during the first season were determined by the trained fieldworker to calculate BMI. Precise standard measuring techniques were applied for the anthropometric measurements to be valid. The measurements were recorded on anthropometric data sheet (Annexure G). The measures were then compared and evaluated to reference standards to assess weight status, BMI and the risk of various diseases.

3.9 PROCEDURE FOR COLLECTING ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements included waist, weight, height and circumference.

3.9.1   Height

The height of all respondents was measured in metres (m) and rounded off to the nearest (mm). The respondents had to remove shoes and hats prior to being measured. In respondents with hairstyles that may have added height, the crown of the head was used to indicate the margin where the

measuring should start. A stadiometre was used to determine height (scales 2000). The respondent had to stand up straight with shoulders and arms relaxed while the heels and buttocks were touching the wall and the respondent facing the fieldworker. The fieldworker had to record the respondent's height twice in the space provided on the anthropometric data collection sheet and the average was calculated. The procedure was repeated twice and the two readings varied by less than 5mm. The measurement was taken to the nearest 5 mm and then taken to the nearest 0.5cm. The same procedure was repeated in all the respondents (WHO, 2011; Lee and Nieman, 2010).

3.9.2 Weight

Weight was measured in kilograms (kg) and rounded off to the nearest gram (g) using a good quality, accurately calibrated electronic scale (CPPS- physician scale, scales 2000). The scale was placed in a hard and uncarpeted surface. The scale was then switched on and waited until zero indication and a stable indicator appeared.

The respondent had to step on the scale without shoes, bulky clothing such as jackets and heavy objects in pockets such as keys removed before being weighed. The respondents had to stand up straight facing the fieldworker with feet slightly apart so that weight was be equally distributed in each leg until the measurement was recorded twice in a space provided on the form and the average was calculated. At the end of the measuring and recording of the weight, the respondent would step down the scale and the scale would be returned to zero position to ensure the privacy of each respondent before the next respondent was weighed (WHO, 2011).

3.9.3 Waist circumference

Waist circumference was measured by a fieldworker in all respondents preferable directly on the skin, however, due to cultural reasons some respondents were measured with lighter outer garments. Measurements were recorded on the anthropometric data collection sheet. Waist circumference was measured at the midpoint between lower margin of the last palpable rib and the top of the ilea crest (hip) (WHO, 2008). The respondents were asked to stand up straight with their feet fairly close together (about 12-15 cm) so that the weight will be equally distributed in both legs. The measuring tape was held firmly and its horizontal position was ensured to be in line with the belly button. The tape was made loose enough to allow the fieldworker to place the finger between the tape and the respondent's body without squeezing the skin. The respondents were asked to breath and

measurements were taken after exhalation to prevent contraction of the abdominal muscles when holding their breath. Measurements were recorded to the nearest centimeter and rounded off to the nearest 0.1 cm. The procedure was repeated twice in each respondent and the average was calculated. The changes in waist circumference indicated changes in risk factors for cardiovascular diseases. The measure for the increased risk was ≤88cm in women and ≤102 cm in men (WHO, 1997; 2008, CDC, 2002; Katzenettengogan and Joubert, 2008).

3.10   STATISTICAL ANALYSIS OF DATA

3.10.1 Socio demographic questionnaire

The socio demographic questionnaires were sorted and checked for completeness and accuracy by the researcher after completion. The researcher then captured the data from the questionnaires onto an Excel spreadsheet. The statistician analyzed the data using statistic package for social sciences (SPSS) windows version 17 and the descriptive statistics were determined. Data are presented in tables, frequencies and percentages.

3.10.2 Dietary assessment questionnaires

The seasonal food consumption patterns and dietary intake behaviour were assessed during each of the four seasons. The 24 hour recall questionnaires were analysed using the food finder version 3 of 2002 computer software program by a food and nutrition specialist. The results of the 24 hour recalls were then used to determine the actual intake with means, standard deviation and nutrient intake calculated and compared to DRIs. Estimated average Requirements (EARs) were used as the references measure and if not available adequate intake (AI) as Recommended Daily Allowances (RDAs) are indicated for use in individuals and not groups of people (NICUS 2003). The top 20 food items consumed per season were determined and presented in total intake, mean intake and frequency. The data of FFQs over the past seven days in all four seasons as a measure for dietary diversity (DD) namely; food group diversity score (FGDS) and food variety score (FVS) were captured on an excel spreadsheet and analysed by a statistician using SPSS version 17 for descriptive statistics. The captured data were then used to find out whether there is any relationship between FVS and FGDS. The FVS and FGDS of all the seasons were then compared and the most frequently consumed food items in all seasons were listed. Furthermore, the data were used find the food items

consumed in all seasons so that the dietary diversity and nutrient adequacy of the community is assessed.

The household survey data were captured and analyzed using an excel spreadsheet and presented in mean scores. The top 20 food items in the household were identified per season.

3.10.3 Anthropometric measurements

The weight and height of all the respondents (n=100) were captured on an excel spreadsheet and used to classify and determine the body mass index (BMI) and waist to height ratio (WHtR). The BMI was calculated by dividing weight in kilograms (kg) by height in m^2. The results were between these groups [moderate weight (BMI 18.5-24.9) which is low risk, overweight (BMI=25-29.9) which is an average risk, obese 1>30, obese 2>35 and obese 3>40 which is high risk]. BMI was used to estimate and predict the prevalence of overweight and obesity within the population and the risks associated with it. The waist circumference measures for an increased risk was ≥88 cm in the women. Changes in waist circumference indicated changes in risk factors for cardiovascular disease. The waist to height ratio was measured by dividing waist by height. If the WHTR is ≥0.5, there is a risk for CVD (CDC, 2002; Hseih et al., 2003:610-616; WHO, 1997; 2000e).

3.10.4 Correlations

Bivariate correlations (Pearson correlations – 2 tailed) were drawn between some of the variables to establish a relationship. Household income and BMI, money spent on food and BMI, household food security score and BMI, household income per month and food security, money spent on food and food security score, household income and money spent on food per month was used. A $p<0.05$ were used as an indication of statistical significance.

3.11 CONCLUSION

This chapter discussed all the instruments used to determine the socio-economic and nutritional status o women in rural areas. All the instruments used in this study were suitable for data gathering and to answer a research problem. The aim of this study was to know the effect of seasonal food variety, dietary diversity and nutrient adequacy in rural areas. The results will be discussed in Chapter 4.

CHAPTER 4: RESULTS AND FINDINGS

4. 1 INTRODUCTION

The purpose of the study was to determine the interaction between the socio-economic conditions, seasonal food variety, dietary diversity, nutrition adequacy, health status, coping strategies and food consumption patterns of women in a rural community in Kwa-Zulu Natal (Malangeni).

This chapter will focus on reporting the results obtained in this study. The findings include socio-economic factors, dietary intake, food frequency scores, anthropometric results and coping strategies used by the community in times of food scarcity. A total of 100 women (n=51 over 50 years of age and n=49 under 50 years of age) participated in the study during the four seasons with a mean age of 48.1 years (SD ±17.1). The results will be presented in percentages which will also reflect the numbers (n) as 100 community members participated unless otherwise stated.

4.2 SOCIO-DEMOGRAPHIC RESULTS

TABLE 4.1: Accommodation and family composition

Variable	Number (n=100) and %
Type of house	
Brick	4
Clay	62
Grass	1
Wood	12
Zinc	21
Total	100
Number of rooms per household	
≤ 2rooms	4
3-4 rooms	38
≥ 4 rooms	58
Total	100

Duration of residence	
1-5 years	06
>5 years	94
Total	100
Water facilities available per home	
Tap inside the house	13
Tap outside the house	36
Borehole	0
Spring/ river/ dam	51
Fetch water elsewhere	0
Total	100
Toilet facilities available per home	
Pit latrine	99
Flush/ sewerage	00
Bucket system	01
Total	100
Operational waste removal system:	
No	100
Total	100
Electricity available in the household	
Yes	28
No	72
Total	100
Number of people living in the household	
>10	73
<10	27
Total	100
Mean & SD of people living per household	**Mean** 7.3±3.1

Children per household:	
Children	100
No children	00
Total	100
Grandchildren	86
No grandchildren	14
Total	100
Great grandchildren	56
No great grandchildren	44
Total	100

The information in Table 4.1 indicates that the majority of the respondents lived in clay houses (62%) which are at a risk of collapsing in times of poor weather conditions. The majority of houses (58%) contain four rooms and more. About 51% of the respondents do not have access to water facilities inside the house but fetch water from nearby rivers and dams whilst only 13% of households have taps inside the house. The majority of respondents (99%) use pit latrine toilets whilst only one household used the bucket system. All the households do not have access to a waste removal system. Table 4.1 also indicates that all respondents have children and the majority (86%) also live with grandchildren. Most respondents (56%) live with great grandchildren. The majority (73%) live with more than ten people in their households with a mean of 7.3 and SD ±3.1 whilst only 3% of households have 3 people in the household. A large percentage of respondents (94%) are permanent residents and have been living in the area for more than five years.

Figure 4.1: Pest infestation in households.
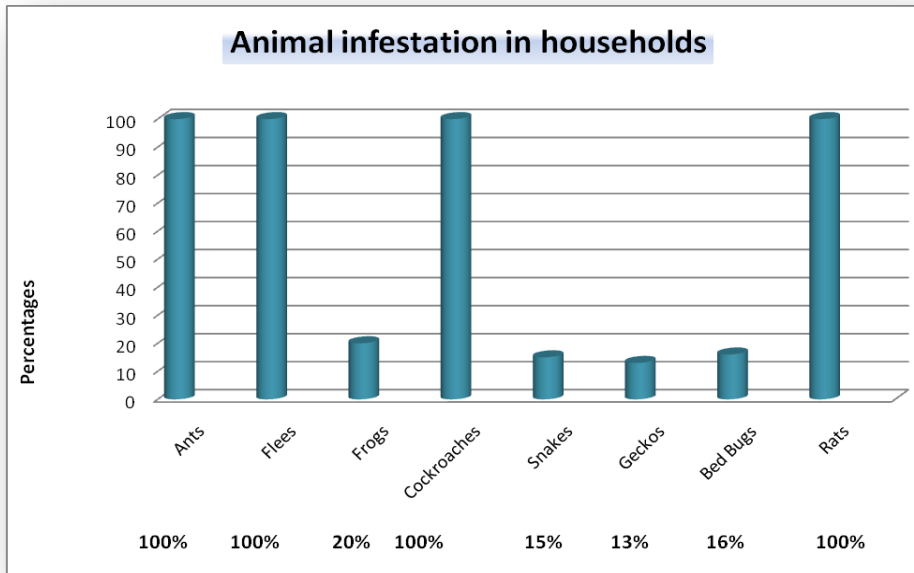
Problems that are faced by the respondents included pest infestation in households which could contribute to poor food safety and hygiene. Cockroaches, ants, flee and rats were reported by all the respondents (n=100). Snakes were reported by 15% of the respondents, frogs by 20%, bed bugs by 16% and geckos by 13%.

Table 4.2: Work and income status of respondents

Variable	Number (n=100) and %
Women employed in the households	
Yes	02
No	98
Total	100
Type of employment	**(n=02)**
Fulltime, permanent	01
Part time , permanent	00

Temporary	01
Total	02
Duration of unemployment	**(n=98)**
<6 months	00
6-12 months	00
1-3 months	00
>3years	98
Total	98
Looking for employment	
Yes	14
No	86
Total	100
Highest level of education:	
None	36
Primary school (grade 7)	59
Standard 8 (grade 10)	04
Standard 10 (matric)	01
Total	100
Total household income per month	
<R500	01
R500-R1000	17
R1001-R1500	07
R1501-R2000	70
R2001-R2500	03
R2501-R3000	02
Total	100
Money spent on Food per month	
R0-R50	00
R51-R100	09

R101-R150	04
R151-R200	07
R201-R250	07
R251-R300	08
>R300	65
Total	100
How often food is purchased	
Everyday	11
Once a month	89
Total	100
Number of meals per day	
<3	08
=3	90
>3	02
Total	100
Other people contributing to household income	
Yes	02
No	98
Total	
Grant beneficiaries (old age and/or child support grant)	
Yes	94
No	06
Total	100
Spouse employed	
Yes	52
No	48
Total	**100**

Table 4.2 indicates that the majority of respondents (98%) is unemployed and has been unemployed for more than 3 years. Only 1 respondent is a fulltime permanent employee. Most respondents (86%) are not looking for employment due to other family responsibilities such as babysitting and care-giving. The highest level of education of most respondents (59%) is primary school (grade 7) whilst only one respondent had a Matric qualification. None of the respondents have tertiary education qualifications. Seven percent of the households had an income of R1001-R1500 per month; R1501-R2000 was the monthly income of 70% of the households whereas only 2% of the households receive a monthly income of R2501-R3000 which indicates a very low monthly income in most households. About R300 and more in most households (65%) is spent on food every month whilst 04% of households spend R101-R150 on food monthly. The majority of respondents (89%) buy food once a month and 90% of households eat 3 meals per day. Two of the households had other people living with them who contributed to the monthly income, while 98% of the households did not have people who assist in contributing to the monthly income. The majority of respondents (94%) were beneficiaries from either old age pension or child support grants. Fifty two percent of respondents have husbands who are working in the cities and may contribute to the monthly income of households.

Table 4.3: Household assets and appliances

Variables	Number (n=100)
	Yes
Electrical assets	
Television	18
Electric stove	02
Microwave	01
Hot plate	26
Refrigerator	13
Freezer	07
Electric radio	28

Non electrical assets	
Gas stove	27
Paraffin/primus stove	55
Mattress and bed	89
Lounge suite	33
Dining room suite	12
Battery radio	69

Although the income status of the households is said to be poor as shown in previous tables, some respondents (n=28) have access to electricity and the majority of respondents (n=72) do not have access to electricity. Non electric assets are used by most respondents which include a mattress and bed (89%), battery powered radio (69%), lounge suite (33%) and dining room suite (12%). The high usage of non-electrical assets as compared to electric ones might be due to high cost of electricity. The majority (n=55) of respondents use paraffin stoves to cook which might be a strategy of saving electricity followed by 27% who use gas stoves, a hot plate is used by 26% and an electrical stove is used by 2 of the respondents.

4.3 ANTHROPOMETRIC HEALTH INDICATORS

4.3.1 Anthropometric findings

Table 4.4 below describes the mean age, weight and BMI of the total group and then for women < 50 years of age and women > 50 years of age separately.

Table 4.4: Mean and standard deviation for age, weight and BMI (n=100)

Variable	Mean age ±SD	Mean height ±SD	Mean weight ±SD	Mean BMI ±SD	Mean waist ±SD
Whole group	48.25±17.12	1.55m±0.07	69.78kg±17.30	28.99±6.83	93.91±13.95
Women<50 years (n=51)	36.71±9.04	1.57m±0.07	69.73kg±15.19	28.33±6.24	91.68±14.03
Women>50 years (n=49)	64.26±13.08	1.53m±0.06	70.40kg±15.62	29.87±7.10	99.19±13.13

The mean age of the whole group was 48 years with a SD of ±17.12. The mean height of the whole group was 1.55m±0.07. The mean weight of the whole group was 69.78kg±17.30kg. The mean BMI of the whole group was 28.99. Women <50 years (n=51) displayed a mean weight of 69.73kg with a mean height of 1.57m and a mean BMI of 28.33. Women >50 years (n=49) displayed a mean weight of 70.40 kg with a mean height of 1.53m and a mean BMI of 29.87. The mean BMI of both groups are relatively high above >25 and <30 which means that both groups are in the overweight category.

Table 4.5: BMI classification table for women < 50 years and > 50 years

Parameter	Classification	% of women <50 years (n=51)	% of women >50 years (n=49)
Body Mass Index (kg/m^2)	Underweight (<18.50)	4.0%	2.0%
	Normal weight (18.50 - 24.99)	21.5%	26.5%
	Overweight (25.00 - 29.99)	33.3%	22.5%
	Obese 1 (30.00-34.99) Obese 2 (35.00-39.99) Obese 3 (≥40)	23.5% 7.8% } 41.2% 9.9%	22.5% 18.3% } 49% 8.2%
	TOTAL	100%	100%

The results in Table 4.5 indicated that 41.2% of women <50 years are obese (BMI = obese 1 ≥30 and <34.99, obese 2 ≥35 and <39.99 and obese 3 ≥40) and 49% of women >50 years are obese. The BMI scores for women <50 years showed that only 21.5% is of moderate weight (BMI ≥18.50 - ≥24.99) and the BMI of women >50 years showed that only 26.5% is of moderate weight.

4.3.2 Waist circumference scores

The majority of respondents (76%) were above the cut off points for waist circumference (≥88cm) while only 24% were within normal values (<88cm) as shown in Figure 4.2 below.

Figure 4.2: Cut off points for waist circumference
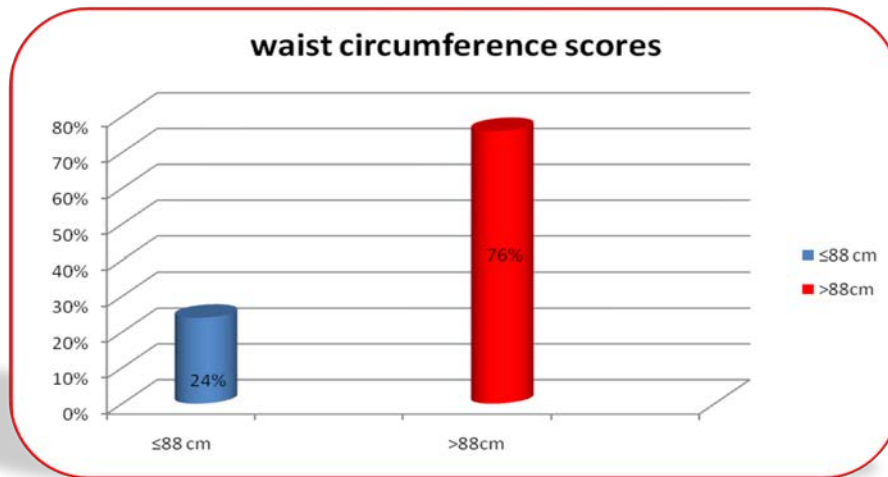
The results in Figure 4.2 correlate with the results in Figure 4.3 as it clearly shows cut off points for WHtR had been exceeded by the majority of respondents (83%) and that the waist circumference cut off points had been exceeded by the majority of respondents (76%).

Figure 4.3: Waist-to-height-ratio scores (WHtR) of the total group (n=100)
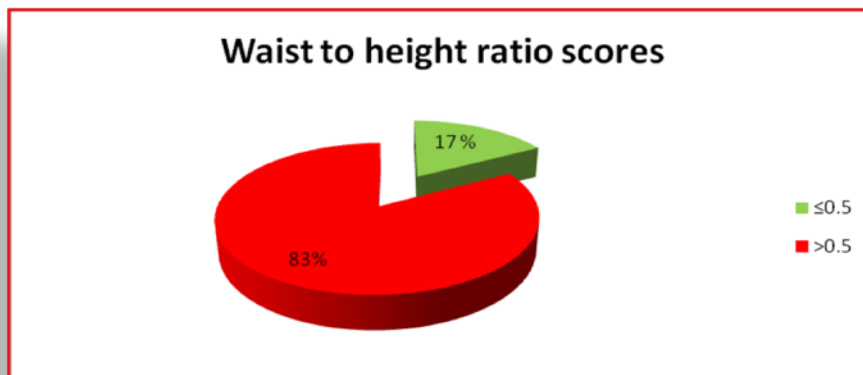
The scores of waist-to-height-ratio (WHtR) in Figure 4.3 are determined by dividing the waist circumference by height measurements in centimeters. The WHtR was used as apredictor for coronary risk factors and metabolic syndrome. The results revealed that the majority (83%) of respondents are at a risk of metabolic syndrome and coronary factors as the WHtR scores were ≥0.5 while only 17% of the respondents has a WHtR that is <0.5 which indicates normal values.

4.3.3 Health indicators

The data collected through the health questionnaire is self-reported data and not diagnosed by a health practitioner. The majority of respondents (63%) in the under 50 age range reported to be on chronic medication and 27% were not on chronic medication (Refer Figure 4.4).

Figure 4.4: Self-reported chronic medication users aged <50 (n=51)
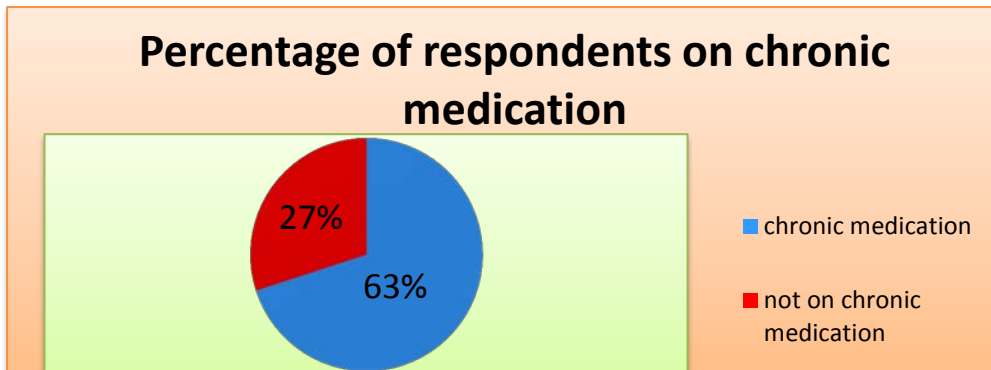
In the older than 50 age group more than two thirds of the group (76%) reported to be on chronic medicine (refer Figure 4.5).

Figure 4.5: Self-reported chronic medication users aged >50 (n=49)
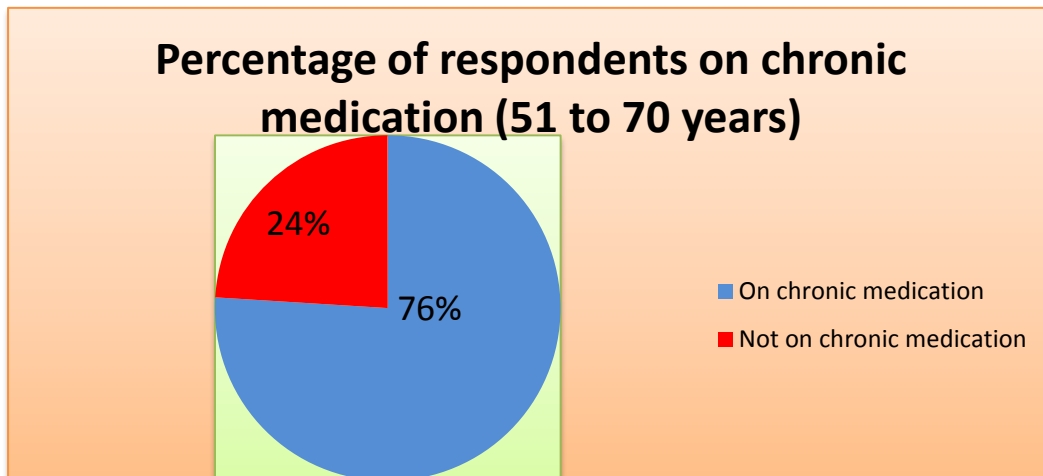
4.4 DIETARY INTAKE AND FOOD CONSUMPTION PATTERNS

4.4.1 Nutrient consumption

This section presents the macro and micro nutrient intake of the women separately for the less than 50 years (n=51) and over 50 years (n=49) age group as measured by the 24 hour recall questionnaire. The DRIs of the group is compared to the DRIs as presented by the Nutrition Information Centre of the University of Stellenbosch (NICUS 2003).

Table 4.6 indicates the mean macronutrient intake for respondents over 50 years of age. The mean energy intake in all seasons was less than the estimated requirement of 10.093kJ for the women. In autumn, 83% of the women, winter 51.02%, spring 63.34% and in summer 91.83% of respondents consumed diets that supplied <100% of EAR's for energy.

Table 4.6: Analysis of 24 hour recall: mean daily macronutrient intake (n=49) (_women51-70 years_) (NICUS, 2003).

Nutrient Per day	AUTUMN		WINTER		SPRING		SUMMER		DRI's
	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	
Energy (kJ)	7427.42 ±4502.69	83.67	9478.84 ±2305.06	51.02	7683.76 ±2656.47	67.34	7546.12 ±2300.35	91.83	10 093kJ EER
Total protein (g)	38.13 ±22.76	61.22	52.29 ±23.99	44.89	51.08 ±24.62	46.93	55.15 ±28.20	63.26	46g/day EAR
Total fat (g)	24.39 ±28.37	-	60.73 ±30.52	-	37.68 ±27.14	-	28.23 ±21.43	-	-
Carbohydrates (g)	326.36 ±205.58	10.20	340.08 ±93.90	00	302.94 ±109.92	00	305.41 ±85.97	00	100g/day EAR
Total Dietary Fiber (g)	19.45 ±14.07	63.26	38.62 ±18.80	14.28	27.71 ±18.46	38.77	31.87 ±21.76	55.10	21g/day AI

The protein contribution showed that in autumn, the mean intake was 38.13g/day which is less than the recommended dietary allowance of 46g/day for protein. Autumn and summer had the highest

percentage of respondents consuming protein compared to the DRIs with 61.22% in autumn and 63.26% in summer consuming <100% of the daily needs for protein for this age group. This correlates with the top 20 food items since only two food items that are protein rich were represented on the top 20 food list for summer and no food item from the top 20 food items for summer was protein rich.

In autumn 10.20% of respondents consumed <100% of EAR's for carbohydrates, no respondent consumed <100% of the EARs for carbohydrates in any of the other seasons. The mean carbohydrate consumption in all seasons is much higher than the estimated adequate requirement for carbohydrate which is 100g/day. The mean intake for carbohydrate in all seasons is 326.36g/day in autumn, 340.08g/day in winter, 302.94g/day in spring and 305.41g/day in summer. This correlates with the top 20 food list for all seasons since 9 food items in autumn and winter, 12 food items in spring and 10 food items in summer are carbohydrate based.

Dietary fibre consumption indicated that the mean intake for dietary fibre during autumn was less than the adequate intake of 21g/day and 63.26% of respondents during autumn consumed diets that supplied <100% of EAR's for fibre.

Table 4.7: Mean micronutrient intake (women 51-70 years): (n=49) (Institute of Medicine 2003).

Nutrient Per/day	AUTUMN		WINTER		SPRING		SUMMER		DRI's
	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	
Vitamin A	199.91 ±259.73	89.79	690.21 ±2201.69	81.63	536.63 ±527.43	75.51	669.42 ±713.60	46.93	500.00mcg/day EAR

Vitamin C	189.48 ±371.64	65.30	162.00 ±102.28	14.28	78.34 ±111.82	18.36	51.49 ±43.76	77.55	60.00mg/day EAR
Vitamin E	6.81 ±11.21	83.67	9.33 ±5.60	75.51	8.68 ±8.38	81.63	6.33 ±4.78	95.91	12.00mg/day EAR
Vitamin D	1.63 ±3.42	93.87	1.67 ±2.99	97.95	2.87 ±5.74	91.83	2.06 ±3.47	97.95	10.00mg/day AI
Vitamin B6	0.89 ±0.64	77.55	1.58 ±1.12	48.97	1.33 ±0.87	53.06	1.43 ±0.98	69.38	1.3mg/day EAR
Vitamin B12	1.18 ±3.34	91.83	1.31 ±3.30	85.71	3.45 ±7.94	89.79	2.97 ±5.14	97.95	2.00mµ/day EAR
Vitamin K	262.69 ±540.57	77.55	166.66 ±402.19	42.85	362.41 ±701.80	51.20	432.01 ±654.85	67.34	90.00mcg/day AI

Thiamine	0.85 ±0.50	46.93	404.02 ±235.32	18.36	1.35 ±0.83	32.65	1.61 ±1.08	48.97	0.90 mg/day EAR
Riboflavin	0.65 ±1.78	97.95	0.77 ±0.36	48.97	0.79 ±0.47	51.20	0.94 ±0.79	69.38	0.90 mg/day EAR
Niacin	7.21	87.75	13.09	38.77	13.42	36.73	14.16	53.06	11.00

	±4.68		±6.44		±7.30		±7.52		mg/day EAR
Folate	338.84 ±258.70	85.71	447.33 ±425.14	61.22	448.92 ±443.99	65.30	508.55 ±456.89	57.14	320.00 µg/day EAR
Pantothenate	2.84 ±1.96	89.79	4.87 ±2.59	69.38	3.23 ±1.49	75.51	3.08 ±1.65	97.95	5.00mg/day AI

Table 4.7 indicates the mean vitamin intake for respondents over 50 years of age. The results should be read with caution due to high Standard Deviations (±SD) reported. The mean vitamin A intake was 199.91mcg/day which is less than the Estimated Adequate Requirement (EAR) of 500mcg/day. In autumn 89.79%, in winter 81.63%, in spring 75.51% and in summer 46.93% of the respondents consumed diets that supplied <100% of EAR for vitamin A respectively.

In autumn 77.55% of the respondents consumed diets that supplied <100% of EAR'sfor vitamin B6. In autumn, the mean vitamin B6 intake was 0.89mg/day which is less than the estimated adequate requirement of 1.3mg/day. In other seasons, the vitamin B6 intake was adequate as it was more than the estimated adequate requirement. The vitamin B12 consumption of the majority of the respondents was <100% of EAR's in autumn (91.83%), winter (85.71%), spring (89.79%) and summer (97.95%). In autumn and winter the group consumed less (autumn 1.13µg/day) compared to the EARs of 2.00mcg/day.

 The folate consumption in all seasons was above the EARs of 320.00µg/day but 85.71% of respondents in autumn, 61.22% in winter, 65.30% in spring and 57.14% in summer consumed diets that supplied < 100% of EAR's.

Table 4.8: Mean micronutrient (mineral) intake (women 51-70 years) (NICUS 2003).

Nutrient	AUTUMN		WINTER		SPRING		SUMMER		DRIs
P/day	Mean ±SD (n=49)	(%) <100 % of EAR	Mean ±SD (n=49)	(%)< 100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%)<100 % of EAR	
Calcium	207.94 ±158.52	100	404.02 ±235.32	97.95	464.14 ±271.60	89.79	428.66 ±243.62	97.95	1200 mg/day EAR
Iron	6.91 ±4.44	32.65	10.97 ±4.37	4.08	8.07 ±4.14	19.36	12.08 ±5.50	8.16	5.00 mg/day EAR
Zinc (mg)	5.94 ±5.48	59.18	8.14 ±4.07	40.81	8.07 ±4.14	40.85	8.91 ±4.90	55.10	6.80 mg/day EAR
Magnesium (mg)	327.10 ±276.83	51.02	413.91 ±189.81	18.38	361.91 ±192.86	32.65	415.86 ±208.82	22.44	265 mg/day EAR
Phosphorus (mg)	708.90 ±307.04	34.69	1040.00 ±328.40	6.12	935.61 ±375.65	16.32	1005.39 ±407.61	10.20	265 mg/day EAR
Chlorine (mg)	486.27 ±738.24	69.38	462.21 ±548.67	57.14	612.40 ±970.26	44.89	446.70 ±615.85	81.63	425 mg/day AI

Table 4.8: Mean micronutrient (mineral) intake(women 51-70 years) continued.

Nutrient Per day	AUTUMN		WINTER		SPRING		SUMMER		
	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	DRI'S
Chromium (mg)	53.32 ±83.12	30.61	60.63 ±93.28	38.77	37.42 ±65.01	53.06	15.54 ±16.89	63.26	20 mg/day
Selenium (mg)	12.86 ±18.45	100	12.08 ±14.09	97.95	13.76 ±20.04	81.62	17.81 ±24.78	77.75	45 mg/day
Biotin (mg)	16.67 ±12.14	71.42	38.57 ±17.19	30.61	23.23 ±10.75	59.14	22.80 ±12.31	61.22	30 mμ/day

Table 4.8 indicates the mean mineral intake for respondents over 50 years of age. The mean calcium consumption throughout all the seasons was very low as it was less than the EARs of 800.00mg/day. The mean calcium intake was 207.94mg in autumn, 404.02mg in winter, 464.14mg in spring and 428.66mg in summer. The majority of the respondents in all seasons, autumn (100%), winter (97.95%), spring (89.96%) and in summer (97.95%), consumed diets that supplied <100% of EARs.

The majority of respondents in all seasons consumed diets with iron that is above the EARs of 5.00mg/day. The intake of iron was adequate in most of the respondents as only 32.65% in autumn, 4.08% in winter, 9.36% in spring and 8.16% in summer consumed diets that supplied <100% of EARs for iron.

The mean zinc intake in winter, spring and summer was above the EARs of 6.80mg/day. Autumn is the only season with a mean zinc intake that was less that the EAR at 5.94mg/day. The majority of respondents in winter (40.81%), spring (4.85%) and summer (55.10%) consumed diets that supplied <100% of EAR. In all seasons, the mean intake of magnesium was > the estimated adequate requirement of 265mg/day.

Table 4.9: Mean macronutrient intake _(women 31-50 years)_: (n=51) (NICUS, 2003)

Nutrient Per day	AUTUMN		WINTER		SPRING		SUMMER		DRI's
	Mean ±SD	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	
Energy (KJ)	6433.99 ±3587.08	98.03	8295.95 ±2879.63	94.11	8478.85 ±2459.00	80.39	8318.53 ±2703.21	98.03	10093KJ EER*
Total protein (g)	35.73 ±18.31	86.27	43.91 ±18.66	66.66	51.08 ±20.48	54.90	54.99 ±25.65	78.43	46g/day EAR
Total Fat	21.90 ±23.23	-	53.92 ±30.48	-	40.04 ±21.25	-	31.40 ±19.65	-	-
Carbohydrates (g)	277.76 ±164.28	9.80	301.63 ±113.71	00	337.35 ±100.53	00	340.30 ±115.22	1.96	100g/day EAR
Total Dietary Fiber (g)	17.28 ±11.52	86.27	31.00 ±18.00	54.90	32.82 ±22.57	60.78	38.41 ±19.65	68.62	25g/day AI

Table 4.9 indicates the mean macronutrient intake for respondents less than 50 years of age. The energy contribution showed that the mean intake of energy in all seasons was less than the EARs of 10093kJ. In autumn, 98.03%; winter 94.11%, spring 80.39% and summer 98.03% of respondents consumed diets that supplied <100% of EARs. The protein contribution showed that in autumn the mean intake was 38.13g/day and in winter was 43.91g/day which is less than the recommended dietary allowance of 46g/day. Autumn (86.26%) and summer (78.43%)had the highest percentage of

respondents with protein in the diet that supplied <100% of DRI. This correlates with the top 20 food items since only two food items that are protein rich were from the top 20 food items consumed list for summer and no food item from the top 20 food items for summer was protein rich.

The carbohydrate contribution in 9.80% (autumn) and 1.96% (summer) of the respondents were <100% of EARs and none of the respondents consumed diets that supplied <100% of EARs in winter and spring. The mean carbohydrate consumption in all seasons is much higher than the EARs of 100g/day. The mean intake for carbohydrates in all seasons is 277.76g/day in autumn, 302.63g/day in winter, 377.35g/day in spring and 340.30g/day in summer. This correlates with the top 20 most consumed food list for all seasons since 9 food items in autumn and winter, 12 food items in spring and 10 food items in summer are carbohydrate based.

The dietary fibre consumption during autumn was 17.28g/day which is less than the adequate intake of 25g/day and the majority of respondents in all seasons consumed diets that supplied <100% of the EARs.

Table 4.10 indicates the mean vitamin intake for respondents <50 years of age. The mean intake for vitamin A was 185.69mcg/day in autumn, 452.53mcg/day and 414.63mcg/day in spring which is less than the estimated adequate requirement of 500.00mcg/day. Summer is the only season that had a mean intake that is above 500.00mcg/day. In autumn, 90.19%, in winter 80.39%, in spring 64.70% and in summer 70.58% of respondents consumed diets that supplied <100% of EAR for vitamin A. The vitamin B6 contribution showed that 98.03% of respondents in autumn consumed diets that supplied <100% of EARs. In autumn, the mean vitamin B6 intake was 0.77mg/day which is less than the EAR of 1.1mg/day. In the other three seasons, the vitamin B6 intake was adequate. A poor intake of vitamin B12 was experienced in the majority of the respondents consuming diets that supplied <100% of the EARs with autumn (98.03%), winter (90.19%), 88.23% in spring (88.23%) and in summer (82.35%). In all seasons the vitamin B12 intake was less than the estimated adequate requirement of 2.00µg/day, autumn (0.77µg day) in winter (1.77µg/day), spring (1.32µg/day) and summer (1.20µg/day). Folate consumption was <EAR of 320.00µg/day and 94.11% of respondents in autumn consumed diets that supplied <100% of the EARs.

Table 4.10: Mean micronutrient intake (women31-50 years) (IOM 2003).

Nutrient Per/day	AUTUMN		WINTER		SPRING		SUMMER		DRI's
	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	
Vitamin A	185.69 ±327.34	90.19	452.53 ±553.72	80.39	414.63 ±452.12	64.70	841.16 ±642.17	70.58	500.00 mcg/day EAR
Vitamin C	119.23 ±317.92	86.27	146.08 ±151.59	19.60	86.14 ±86.80	70.58	62.11 ±40.57	39.21	60.00mg/day EAR
Vitamin E	4.55 ±6.28	86.27	7.66 ±7.39	78.43	9.40 ±6.47	80.39	8.12 ±6.68	90.19	12.00mg/day EAR
Vitamin D	0.60 ±1.28	98.03	1.54 ±3.72	90.19	1.61 ±2.42	96.07	1.54 ±4.31	94.11	5.00 mg/day AI
Vitamin B6	0.77 ±0.54	74.50	1.23 ±0.97	68.62	1.44 ±0.98	60.78	1.64 ±0.62	82.35	1.1mg/day EAR
Vitamin B12	0.44 ±1.44	98.03	1.77 ±5.54	90.19	1.32 ±3.13	88.23	1.20 ±1.04	94.11	2.00mg/day EAR
Vitamin K	200.77 ±468.30	76.47	111.98 ±185.33	70.58	339.15 ±711.32	60.78	520.68 ±793.47	80.39	90.00mg/day AI

Nutrient per day	AUTUMN		WINTER		SPRING		SUMMER		
	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	DRI's
Calcium	150.06 ±102.20	100	367.30 ±224.09	98.03	438.82 ±215.10	92.15	430.31 ±276.27	100	1000mg/day
Iron	6.11 ±3.37	84.31	9.32 ±5.16	60.78	11.11 ±5.15	58.82	12.74 ±5.73	88.23	8.10mg/day EAR
Zinc (mg)	4.48 ±2.45	80.39	6.94 ±3.50	68.62	7.85 ±4.21	76.47	9.80 ±4.98	90.19	6.80mg/day EAR
Magnesium (mg)	228.46 ±117.93	54.90	353.63 ±170.92	43.13	391.95 ±210.45	49.01	489.22 ±235.84	60.78	265mg/day EAR
Phosphorus (mg)	602.50 ±280.03	35.29	880.87 ±331.49	19.60	1017.89 ±351.17	25.49	1058.92 ±450.29	43.13	265mg/day EAR
Chlorine (mg)	524.52 ±700.73	90.19	453.46 ±651.16	78.43	671.69 ±619.13	60.78	523.16 ±660.66	64.70	425mg/day AI
Chromium (mcg)	42.82 ±56.26	64.70	21.02 ±27.53	68.62	69.13 ±101.00	58.82	20.14 ±25.10	72.54	25.00mg/day AI

Table 4.11: Mean micronutrient (mineral) intake (women 31-51) NICUS 2003.

Nutrient P/day	AUTUMN		WINTER		SPRING		SUMMER		DRI's
	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	Mean ±SD (n=49)	(%)<100% of EAR	DRI's
Thiamine	0.73 ±0.38	80.39	1.27 ±0.79	74.50	1.45 ±0.82	62.74	1.89 ±1.05	88.23	0.90mg/dayEAR
Riboflavin	0.30 ±0.19	100	0.65 ±0.31	68.62	0.82 ±0.52	52.94	0.96 ±0.62	74.50	0.90mg/dayEAR
Niacin	6.61 ±4.21	92.15	11.99 ±5.70	64.70	11.64 ±5.72	66.66	14.57 ±6.86	86.27	11.00mg/day EAR
Folate	200.08 ±172.48	90.19	389.45 ±391.45	82.35	492.30 ±473.74	78.43	600.54 ±568.75	94.11	320.00µg/day EAR
Pantothenate	2.89 ±2.54	94.11	3.83 ±2.18	80.39	3.66 ±2.21	74.50	4.00 ±2.51	90.19	5.00mg/dayAI

Table 4.11: Mean micronutrient (mineral) intake (women 31-50 years) continued.

Nutrient Per day	AUTUMN		WINTER		SPRING		SUMMER		
	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	Mean ±SD (n=49)	(%) <100% of EAR	DRI'S
Selenium (mg)	14.28 ±18.72	92.15	11.65 ±14.69	46.07	15.67 ±15.04	49.11	15.96 ±4.98	94.11	45 mg/day
Biotin (mg)	12.53 ±8.39	96.07	32.79 ±19.92	62.74	24.46 ±11.83	58.8	27.79 ±3.48	52.94	30 mµ/day

Table 4.11 indicates the mean mineral intake for respondents less than 50 years of age. The mean calcium intake in all seasons was lower than the estimated adequate requirement of 1000mg/day. The mean calcium intake was 150.06mg in autumn, 367.30mg in winter, 438.82mg in spring and 430.31mg in summer. The majority of the respondents in all 4 the seasons consumed diets that supplied <100% of EARs for calcium. Autumn (100%), winter (98.03%), spring (92.15%) and 100% in summer.

In autumn the respondents consumed diets with iron that is less than the EARs of 8.10mg/day. In other seasons, respondents consumed diets with iron that is above the EARS of 8.10mg/day. The majority of the respondents, 84.31% in autumn, 60.78% in winter, 58.72% in spring and 88.32% in summer, consumed diets that supplied <100% of EAR for iron.

The mean zinc intake in winter, spring and summer was above the estimated adequate requirement of 6.80mg/day. Autumn is the only season with a mean zinc intake that was less that the estimated adequate requirement. The majority of respondents in winter and spring seasons consumed diets that supplied <100% of EAR except for autumn where 80.38% and summer where 90.19% of respondents consumed diets that supplied < 100% of EAR.

In all seasons, the mean intake of magnesium was higher than the estimated adequate requirement of 265mg/day.

4.4.2 Top 20 food items consumed per season

The tables in this section show the mean top 20 food products ranked by total consumption (portion size x number of respondents) for all four seasons as measured by 24 hour recalls (n=100). The tables indicate the frequency that the group consumed of each food item, the per capita intake is also reflected, indicating the mean intake if the whole group (n=100) consumed the food item.

Table 4.12: Top 20 food items consumed measured by 24 hour recall (n=100): *winter* season

No	Food product	Total intake (g)	Mean intake (g)	Frequency	Per capita Intake/ day
1	Maize Meal Porridge	28670	392.73	73	286.70
2	Tea, Brewed	26600	443.33	60	266.00
3	Amahewu (maize meal fermented drink)	19650	561.42	35	196.50
4	Oranges	13780	218.73	63	137.80
5	Rice, White	9900	309.37	32	99.00
6	Avocado	9120	182.40	50	91.20
7	Cold Drink	6400	336.84	19	64.00
8	Bread rolls,	6080	114.72	53	60.80
9	Isigwaqane (mixture of maize meal and boiled sugar beans 1:1)	5900	368.75	16	59.00
10	Mulberry	4600	170.37	27	46.00
11	Potatoes	3780	210.00	18	37.80
12	Isijingi (mixture of maize meal and boiled pumpkin 1:1)	3200	400.00	8	32.00
13	Sugar, White	2695	47.28	57	26.95
14	Amadumbe	2620	374.28	7	26.20
15	Pawpaw	2550	283.33	9	25.50
16	Bean Stew	2280	175.38	13	22.80
17	Maas (sour milk)	1950	278.57	7	19.50
18	Coffee	1500	375.00	4	15.00

| 19 | Mabella porridge | 1450 | 362.50 | 4 | 14.50 |
| 20 | Tomato and onion stew | 1350 | 225.00 | 6 | 13.50 |

Table 4.12 reflects that carbohydrate based food items were consumed in higher amounts than any other macro nutrients as nine food items amongst the top 20 food items are carbohydrate based. The total intake for carbohydrates was extremely high ranging from 28670g with a mean intake of 392.73g consumed 73 times during the 24 hours to 1450g for mabella porridge with a mean intake of 362.50g which was consumed 4 times. The large mean and per capita intake of carbohydrates in this group is above the recommended intake of 100g/day (NICUS 2003).

Fruit and vegetables were consumed in a medium variety but small amounts during the winter as six types of fruit and vegetables appear on the top 20 food items (n=6). Oranges were consumed with a total intake of 13780g and a mean intake of 218.73g consumed 63 times, mulberry with a total intake of 4600g and a mean intake of 170.37g were consumed 27 times. The total consumption of pawpaw was 2550g with a mean intake of 370g consumed 9 times, pumpkin was consumed 8 times with a total intake of 3200g and mean intake of 400g as well as tomatoes with a total intake of 1350g and mean intake of 225g. The portion sizes for fruit and vegetable were small and did meet the WHO recommended intake of >400g/day (Mann et al., 2007; Lee et al., 2003).

The consumption of protein during autumn was low as only one (sugar beans) food item out of the top 20 food items are protein based. Very few respondents consumed any protein rich food. Sugar beans and isigwaqane was the only consumed protein food items consumed 13 and 16 times respectively with a per capita intake of 22.80g for bean stew and 59.00g respectively, this does not reflect well when compared to the recommended daily intake for protein of 46g/day for women in this age group.

Table 4.13: Top 20 food items consumed measured by 24 hour recall (n=100): *spring* season

No	Food product	Total intake(g)	Mean intake	Number	Per capita Intake/ day
1	Amahewu (maize meal fermented drink)	28200	552.94	51	282.00
2	Tea, Brewed	25050	511.22	49	250.50
3	Maize Meal	20850	325.78	64	208.50
4	Rice, White, Cooked	10720	268.00	40	107.20
5	Isigwaqane (mixture of maize meal boiled sugar beans cooked together 1:1)	8800	352.00	25	88.00
6	Coffee	6425	356.94	18	64.25
7	Amadumbe	5000	333.33	15	50.00
8	Bread/rolls, Brown	4820	102.55	47	48.20
9	Cold Drink	4350	362.50	12	43.50
10	Maas (sour milk)	4250	283.33	15	42.50
11	Isijingi (mixture of maize meal and boiled pumpkin cooked together 1:1)	4220	383.63	11	42.20
12	Sweet potatoes	3800	292.30	13	38.00
13	Mabella porridge	2800	400.00	7	28.00
14	Isigwamba (mixture of maize meal and boiled wild herbs cooked together 1:1)	2800	466.66	6	28.00
15	Sugar	2700	38.57	70	27.00
16	Cabbage Stew	2650	56.38	47	26.50
17	Oranges	2610	100.38	26	26.10
18	Wild Herb Stew	2500	208.33	12	25.00
19	Vetkoek, Homemade	2370	182.30	13	23.70
20	Potatoes	2168	197.09	11	21.68

During spring carbohydrate based food products were consumed in higher amounts than any other macro nutrients as twelve food items of the top 20 food items are carbohydrate based. The total

intake for carbohydrates was extremely high ranging from 28200g for amahewu with a mean intake of 552.94g consumed 51 times during the 24 hours to 2168g for potatoes with a mean intake of 197.09g consumed 11 times during 24 hours. The average and per capita carbohydrate consumption of the groups was above the recommended intake of 100g/day (NICUS 2003) (refer Table 4.13).

Vegetables and fruit were also consumed in small amounts during spring as only four fruits and vegetables appear on the top 20 food items which is amadumbe consumed by 15% of the respondents with a mean intake of 333.33g and per capita intake of 50.00g, sweet potatoes were consumed 13 times with a mean intake of 292.30g and per capita intake of 38.00g, cabbage stew which was consumed 47 times with a mean intake of 56.38g and a per capita intake of 26.50g as well as herb stew which was consumed 12 times with a mean intake of 208.33g and a per capita income of 25.00g. The portion sizes for fruit and vegetable was small and did meet the WHO recommended intake of >400g/day (Mann et al., 2007; Lee et al., 2003).

The consumption of protein during spring was low as no protein rich food item was on the top 20 food items with the exception of some sugar beans at number 5.

Table 4.14: Top 20 food items consumed measured by 24 hour recall (n=100): *summer* **season**

No	Food product	Total intake	Mean intake	Num ber	Per capita Intake/ day
1	Amahewu (maize meal fermented drink)	19500	500.00	39	195.00
2	Tea	18800	458.53	41	188.00
3	Maize Meal, Porridge	17600	314.28	56	176.00
4	Isigwaqane(mixture of maize meal boiled sugar beans cooked together 1:1)	9470	378.80	25	94.70
5	Mango, raw with skin	7990	194.87	41	79.90
6	Rice, White, Cooked	7500	227.27	33	75.00
7	Isigwamba (mixture of maize meal and boiled wild herbs cooked together 1:1)	7100	394.44	18	71.00

8	Cold drink, Carbonated, Average	5750	302.63	19	57.50
9	Mealie, Sweetcorn, Boiled	5618	200.64	28	56.18
10	Coffee (brewed)	5250	437.50	12	52.50
11	Isijingi (mixture of maize meal and boiled pumpkin cooked together 1:1)	5100	425.00	12	51.00
12	Plum, Raw	4470	171.92	26	44.70
13	Bread/Rolls, Brown	4250	114.86	37	42.50
14	Peach, Raw	4010	167.08	24	40.10
15	Maas (sour milk)	3000	375.00	8	30.00
16	Mabellacornrice/ Sorghum, Cooked	2900	414.28	7	29.00
17	Spinach leaves, Boiled	2220	185.00	12	22.20
18	Sugar, White, Granulated	1815	26.69	68	18.15
19	Vetkoek, Homemade	1800	180.00	10	18.00
20	Cabbage Stew	1450	207.14	7	14.50

Table 4.14 indicates that during summer carbohydrate based food items were consumed in higher amounts than any other macro nutrients 10 food items of the top 20 food items are carbohydrate based. The total intake for carbohydrates was extremely high ranging from 19500g for amahewu with a mean intake of 500.00g consumed 39 times during the 24 hours to vetkoek with a mean intake of 180.00g consumed 10 times. The large portion sizes brought the carbohydrate intake to exceed the recommended intake of 100g/day (NICUS 2003). The per-capita intake of the carbohydrate in this group is also above the DRIs (Amahewu195.00g).

Vegetables and fruit were also consumed in small amounts during summer as only six fruits and vegetables appear on the top 20 food items which is mango consumed by 41% of the respondents with a mean intake of 194.87g and per capita intake of 79.90g, sweetcorn was consumed 28 times with a mean intake of 200.64g and per capita intake of 56.18g, plums 26 times with a mean intake of 171.92g and a per capita intake of 44.70g, peaches 24 times with a mean intake of 167.08g and a per capita intake of 40.10g, spinach 12 times with a mean intake of 185.00g and a per capita intake of 22.20g as well as cabbage which was consumed 7 times with a mean intake of 207.14g and a per capita income of 14.50g. The portion sizes for fruits and vegetable were inadequate when the per

capita intake was used as comparison anddid not meet the WHO recommended intake of >400g/day (Mann et al., 2007; Lee et al., 2003). The consumption of proteins during spring was low as no protein rich food item was on the top 20 food items consumed list.

Table 4.15: Top 20 food items consumed measured by 24 hour recall (n=100): *autumn* season.

No	Food product	Total intake (g)	Mean intake	Frequency	Per capita Intake /day
1	Maize Meal Porridge	31820	345.86	92	318.20
2	Rice, White	23290	337.53	69	232.90
3	Tea	19890	272.46	73	198.90
4	Bread/rolls, Brown	8820	149.49	59	88.20
5	Potatoes	5840	139.04	42	58.40
6	Fruit Juice (diluted)	5260	375.71	14	52.60
7	Samp And Beans (1:1)	5250	375.00	14	52.50
8	Beans, Sugar(stew)	4870	139.14	35	48.70
9	Coffee	3050	338.88	9	30.50
10	Spinach	2900	152.63	19	29.00
11	Sugar, White	2715	24.90	109	27.15
12	Amadumbe	2200	314.28	7	22.00
13	Vetkoek (Homemade)	1785	255.00	7	17.85
14	Tomato And Onion stew	1468	69.90	21	14.68
15	Cabbage, Cooked With Potato	1390	173.75	8	13.90
16	Orange Juice, Sweetened	1250	416.66	3	12.50
17	Curry, Chicken	1040	173.33	6	10.40
18	Cold Drink	1030	343.33	3	10.30
19	Maize rice	900	450.00	2	9.00
20	Pumpkin	870	174.00	5	8.70

During autumn carbohydrate based food items were consumed in higher amounts than any other macro nutrients as ten of the top 20 food items are carbohydrate based. The total intake for

carbohydrates were extremely big ranging from 31820g for maize meal porridge with a mean intake of 345.86g consumed 92 times during the 24 hours to 900g for maize rice with a mean intake 450g which was consumed twice. The per-capita and mean intake of the carbohydrate in this group is also above the DRIs of 100g/day (NICUS 2003; 2005b).

Vegetables were consumed in small amounts during the autumn season as only 4 types of fruits and vegetables appear on the top 20 with spinach consumed by 19% of the respondents with a mean intake of 152.63g and per capita intake of 29g, tomatoes were consumed 21 times by the respondents with a mean intake of 69.90g and per capita intake of 14.68g, cabbage was consumed 8 times by the group with a mean intake of 173.75g and pumpkin consumed 5 times with a mean intake of 174g. The portion sizes for fruit and vegetables were small and did meet the WHO recommended intake of >400g/day (Mann et al., 2007; Lee et al., 2003).

The protein consumption during autumn was low as only two (chicken curry at number 17 and sugar beans at number 8) food items out of the top 20 food items are protein based. Very few respondents consumed any of the protein rich food items as sugar beans was the most consumed protein food item which was consumed 35 times with a mean and per capita intake of 139.14g and 48.70g respectively. Chicken which is the second source of protein on the top 20 food items was consumed only 6 times with a total intake of 1 040g and a mean and per capita intake of 173.33g and 10.40g respectively. This does not reflect well when compared to the daily recommended intake of 46g/day for women.

4.4.3 Household survey (HS)

A household survey conducted in each household (n=100) indicated food items present in the household at the time of the survey.

Table 4.16: Top 10 most common ingredients available in households for autumn and winter (n=100).

No	Autumn			Winter		
	Food item	Total (g)	Mean (g) (±SD)	Food item	Total (g)	Mean (g) (±SD)
1	Rice	115600	1156 (±5064)	Potatoes	102 000	1020 (±2549)

2	Sugar	107525	1075(±4942)	Sugar beans	96 050	960.50(±3015)
3	Potatoes	100300	1003 (±3116)	Oranges	91 800	918 (±2839)
4	Sugar beans	79050	790.50 (±2731)	Maize meal	89 250	892.50(±3068)
5	Samp	69700	697(±2669)	Pumpkin	85 850	858.50(±3541)
6	Amadumbe	68850	688.50 (±2846)	Amadumbe	77 350	773.50 (±2913)
7	Maize meal	65875	658.75 (±2367)	Pawpaw	72 250	722.50 (±1632)
8	Cabbage	57800	578 (±2653)	Rice	69 700	697 (±4218)
9	Spinach	6630	66.3 (±263)	Avocado	61 200	612 (±2880)
10	Brown bread	5695	56.95 (±249)	Brown bread	5 992	59.92 (±260)

In autumn, most food products available in the cupboards of most households are carbohydrate based such as rice, potatoes, sugar beans, maize meal, brown bread and samp with few crop harvested food items which are spinach, amadumbe and cabbage as shown in Table 4.16. About five items among the top 10 food ingredients found in household cupboards in winter are crop harvested products which are amadumbe, pawpaw, avocado, oranges and pumpkin. Sugar beans were found in all seasons as it can be harvested and stored for a long time. Amadumbe were found to be among the top 10 food products in three seasons i.e. autumn, winter and spring. In spring five food items among the top 10 food items found in household cupboards were seasonal crops harvested items i.e. oranges, cabbage, pumpkin, amadumbe and sweet potatoes as shown in Table 4.17. In summer as well, six food items among the top 10 food items found in household cupboards were seasonal crops harvested items i.e. sweet corn, mangos, plums, pumpkin, amadumbe and avocado.

In all seasons, the only protein rich food item found among the top 10 food items found in household cupboards was sugar beans. No flesh and dairy products were found to be among the top 10 food items available in households in all seasons.

Table 4.17: Top 10 most common food ingredients available in households for spring and summer (n=100).

No	Spring			Summer		
	Food item	Total (g)	Mean (g) (±SD)	Food item	Total (g)	Mean (g) (±SD)
1	Potatoes	117 300	1173 (±3254)	Sweet corn	160 650	1606.50 (±4831)
2	Oranges	109 650	1096.50 (±4543)	Mango	107 950	1079.50 (±3226)
3	Rice	79 050	790.50 (±2933)	Pawpaw	101 150	1011.50 (±3550)
4	Cabbage	85 850	858.50 (±2879)	Plums	90 950	909.50 (±5240)
5	Sugar beans	84 150	841.50 (±3003)	Maize meal	82 875	828.75 (±3747)
6	Maize meal	90 950	909.50 (±4420)	Sugar	73 100	731 (±3330)
7	Pumpkin	59 500	595 (±3212)	Pumpkin	62 050	620.50(±2548)
8	Amadumbe	56 950	569.50(±2657)	Rice	68 850	688.50 (±3099)
9	Sweet potatoes	50 150	501.50 (±2580)	Sugar beans	61 200	612 (±4323)
10	Brown bread	3 782	37.82 (±215)	Potatoes	5 482	54.82 (±286)

4.4.4 Food Group Diversity Score and Dietary Diversity

The Food variety score (FVS) consisted of a count of single foods within the nine nutritional food groups. The Food Group Diversity Score (FGDS) indicated the number of food groups consumed over a period of 7 days as measured by the FFQ.

Table 4.18: Household food access as measured by food variety within the food groups consumed in _winter_ over the period of seven days (n=100).

Flesh Group (n=3)	Eggs Group (n=1)	Dairy Group (n=2)	Cereals Group (n=8)	Legumes Group (n=2)	Vitamin A Group (n=4)	Fruit Group (n=5)	Vegetable Group (n=8)	Fats Group (n=3)	Total FG Individual food (n= 26)
0=22	0=88	0=61	1=0	0=53	1=4	1=10	1=0	1=1	<16=0
1=46	1=12	1=33	2=0	1=33	2=55	2=37	2=4	2=31	16=1
2=25		2=6	3=0	2=14	3=35	3=28	3=9	3=68	17=5
3=7			4=2		4=6	4=19	4=32		18=7
			5=19			5=6	5=41		19=13
			6=61				6=9		20=19
			7=14				7=4		21=24
			8=4				8=1		22=13
									23=7
									24=4
									25=5
									26=2

Low =0-3 food groups or <30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High =6-9 food groups or > 60 individual foods.

During the winter season, a total of 79 different individual food items were consumed in seven days by all respondents (Refer to Tables 4.18 and 4.23).However, the total range of individual food items consumed by an individual during the seven-day data collection period was only 16–26 foods. The majority of respondents (76%) consumed 19-23 individual food items in seven days and the highest consumption was 21 food items by 24% of the respondents. The cereal group was consumed the most and was consumed by all respondents. Nineteen percent of the respondents consumed 5 types and 61% consumed 6 types of cereals in seven days. Fats were also consumed in large amounts since a large number 69% of respondents consumed 3 types of fats in seven days. Eggs, dairy products and legumes were consumed in small amounts since a large number 88% of respondents did not consume any eggs, a large number of respondents 61% did not consume any dairy products and 53% did not

consume any legumes in seven days. The food groups with most variety were cereals, (maize porridge, bread, rice, and potatoes, amahewu, mabella porridge, isijingi, isigwaqane and amadumbe; vegetables (pumpkin, tomatoes, cabbage and wild herbs) and fruits (oranges, pawpaw, avocado, banana, apples and mulberries). The largest number of foods consumed by any person was 26 food items, and this was achieved by only two respondents. The mean FVS ($\pm$SD) for all the food consumed in this community from all the food groups during winter in a period of seven days was 20.7 (SD$\pm$2.1), which revealed poor dietary diversity scoring. The cereal group had the highest mean variety score of 5.9 (SD$\pm$0.75) followed by vegetables 4.5 (SD$\pm$1.1), fruit 2.7 (SD$\pm$1.0), vitamin A rich fruits and vegetable group 2.4 (SD$\pm$0.6).

Table 4.19: Household food access as measured by food variety within the food groups consumed in _spring_ over the period of seven days (n=100).

Flesh Group (n=3)	Eggs Group (n=1)	Dairy Group (n=2)	Cereals Group (n=8)	Legumes Group (n=2)	Vitamin A Group (n=4)	Fruit Group (n=5)	Vegetable Group (n=8)	Fats Group (n=3)	Total FG Individual food (n= 25)
0=25	0=89	0=61	1=0	0=55	1=6	1=11	1=0	1=1	<14=0
1=44	1=11	1=33	2=0	1=3 3	2=60	2=41	2=4	2=30	14=1
2=25		2=6	3=0	2=12	3=29	3=31	3=12	3=69	15=0
3=6			4=2		4=5	4=13	4=38		16=1
			5=20			5=4	5=35		17=9
			6=62				6=8		18=8
			7=13				7=2		19=16
			8=3				8=1		20=24
									21=18
									22=6
									23=12
									24=2
									25=3

Low =0-3 food groups or <30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High =6-9 food groups or > 60 individual foods

Table 4.19 and 4.23 indicates that during spring, a total of 76 individual food items was consumed by all respondents in seven days. However, the total range of individual food items consumed by an individual during the seven-day data collection period was only 14–25 foods. The majority of respondents 93% consumed 17-23 individual food items in seven days and the highest consumption was 20 food items by 24% of the respondents. The cereal group was consumed the most since 62% of respondents consumed 6 types of cereal in seven days. Other food groups that were consumed by all respondents were vitamin A rich food as 60% of the respondents consumed 2 types of vitamin A rich food items and vegetables where 38% of respondents consumed at least 4 types of vegetables. Eggs were the least consumed food group since 89% of respondents did not consume any eggs, followed by the dairy group where 61% did not consume any dairy product, legumes where 55% of the respondents did not consume any legumes and meat group where 25% of the respondents did not consume any flesh products in seven days. Although certain food groups such as vitamin A rich food group, fruits and vegetables were consumed by all respondents, very few varieties of food items were consumed from these groups i.e. 60% of the respondents consumed only two types of vitamin A rich food items, 41% of the respondents consumed only two food items from fruit group and 38% of the respondents consumed only four types of vegetables in seven days.

For the community, the mean FVS (±SD) for all the foods consumed in summer from all the food groups in a period of seven days was 20.20 (SD±2.09). This revealed poor dietary diversity. The cereal group has the highest mean food variety score (±SD) of 5.95 (SD±0.73) followed by vegetables, fats, fruit and vitamin A rich food items with 4.41 (SD±1.06), 2.68 (SD±0.49), 2.58 (SD±0.98) and 2.33 (SD±0.66).

Table 4.20: Household food access as measured by food variety within the food groups consumed in _summer_ over the period of seven days (n=100).

Flesh Group (n=3)	Eggs Group (n=1)	Dairy Group (n=3)	Cereals Group (n=8)	Legumes Group (n=1)	Vitamin A Group (n=4)	Fruit Group (n=2)	Vegetable Group (n=7)	Fats Group (n=3)	Total FG Individual food (n=25)
0=2	0=88	0=84	1=0	0=91	1=5	0=57	1=0	1=1	<15=0
1=62	1=12	1=7	2=0	1=9	2=66	1=28	2=2	2=25	15=3
2=29		2=3	3=0		3=25	2=15	3=9	3=74	16=15
3=7		3=6	4=0		4=4		4=41		17=21
			5=8				5=37		18=25
			6=62				6=8		19=9
			7=28				7=3		20=16
			8=2						21=4
									22=5
									23=1
									24=0
									25=1

Low =0-3 food groups or <30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High =6-9 food groups or > 60 individual foods

In summer, only 25 different individual food items were consumed in seven days by all the respondents (refer to Tables 4.20 and 4.24). However, the total range of individual food items consumed by an individual during the seven-day data collection period was only 15–25 foods. The majority of the respondents (86%) consumed 16 to 20 individual food items in seven days. Of these, the highest consumption was 18 food items by 25% of the respondents. The cereal group was consumed by most respondents as 62% of the respondents consumed 6 types of cereals in seven days. Legumes, dairy, fruits, eggs and flesh food groups were poorly consumed in summer since 91% did not consume any legumes, 88% did not consume any eggs, 84% did not consume any dairy products,

57% did not consume any fruit and 2% did not consume any flesh product in seven days. Very few varieties of vegetables and meat products were consumed since 41% of respondents consumed only 4 types of fruits and 62% consumed only one type of meat item.

For this community, the mean FVS (±SD) for all the foods consumed in summer from all the food groups in a period of seven days was 18.25 (±1.919). This revealed poor dietary diversity. The cereal group has the highest mean food variety score (±SD) of 6.24 (SD±.0.62), followed by vegetables, fats, vitamin A rich food and dairy products with 4.49 (SD±0.94), 2.73 (SD±0.46), 2.28 (SD±0.62) and 1.94 (SD±0.92).

Table 4.21: Household food access as measured by food variety within the food groups consumed in _autumn_ over the period of seven days (n=100).

Flesh Group (n=3)	Eggs Group (n=1)	Dairy Group (n=3)	Cereals Group (n=8)	Legumes Group (n=1)	Vitamin A Group (n=4)	Fruit Group (n=2)	Vegetable Group (n=7)	Fats Group (n=3)	Total FG Individual food (n=25)
0=1	0=88	0=84	1=0	0=91	1=5	0=57	1=0	1=1	<15=0
1=66	1=12	1=7	2=0	1=9	2=66	1=28	2=2	2=25	15=2
2=28		2=3	3=0		3=25	2=15	3=9	3=74	16=17
3=5		3=6	4=0		4=4		4=41		17=21
			5=8				5=37		18=23
			6=62				6=8		19=11
			7=28				7=3		20=16
			8=2						21=4
									22=5
									23=0
									24=0
									25=1

Low =0-3 food groups or <30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High =6-9 food groups or > 60 individual foods

Tables 4.21 and 4.24 indicate that in autumn, a total of 75 individual food items was consumed by all respondents in seven days. However, the total range of individual food items consumed by an individual during the seven day data collection period was only 15-25. The majority of respondents 88% consumed 16-20 individual food items in seven days. Out of these the highest consumption was 18 food items by 23% of the respondents. When assessing the number of food items within the various food groups, the cereal group, vitamin A rich fruit and vegetables, fats and vegetables were consumed by all respondents. A large number of respondents 62% consumed six types of cereals in seven days. The majority of the respondents 66% consumed 2 types of vitamin A rich food items in seven days. A total of 41% of respondents consumed 4 types of vegetables and 74% consumed 3 types of fats in seven days. Although the vitamin A rich food items and vegetables were consumed by all the respondents, it was a low variety.

For this community, the mean FVS (±SD) for all the foods consumed in summer from all the food groups in a period of seven days was 18.21 (SD±1.86). This revealed poor dietary diversity. The cereal group has the highest mean food variety score (±SD) of 6.24 (SD±0.62) followed by vegetables, fats and vitamin A rich food items and dairy with 4.49 (SD±0.94), 2.73 (SD±0.46), 2.28 (SD±0.62) and 1.94 (SD±0.92).

Table 4.22: Comparison of the FVS with the number of participants over the four seasons.

FVS	14	15	16	17	18	19	20	21	22	23	24	25	26
Autumn	-	2	17	21	23	11	16	4	5	-	-	1	-
Spring	1	-	1	9	8	16	24	18	6	12	2	3	-
Summer	-	3	15	21	25	9	16	4	5	1	-	1	-
Winter	-	-	1	5	7	13	19	24	13	7	4	5	2

Low FVS =<30 individual foods, Medium FVS = 30-60 individual foods, High FVS = > 60 individual foods

Table 4.22 presents the number of different foods consumed by the participants over the four seasons. Spring and winter reflect as the seasons with the higher food variety consumed.

Table 4.23: Summary of food variety within the food groups for winter and spring seasons.

	WINTER			SPRING		
Food Group	Mean	±SD	Range of Scores	Mean	±SD	Range of Scores
Flesh	1.50	0.66	1-3	1.49	0.64	1-3
Eggs	1.00	0.00	1-1	1.00	0.00	1-1
Dairy	1.15	0.36	1-2	1.15	0.36	1-2
Cereals	5.99	0.75	4-8	5.95	0.73	4-8
Legumes	1.30	0.46	1-2	1.27	0.44	1-2
Vitamin A	2.43	0.67	1-4	2.33	0.66	1-4
Fruits	2.74	1.07	1-5	2.58	0.98	1-5
Vegetables	4.58	1.10	2-8	4.41	1.06	2-8
Fats	2.67	0.49	1-3	2.68	0.49	1-3
Total food items	23.36	5.58	1-26	22.86	5.39	1-25

Table 4.23 shows the summary of food variety within food groups during *winter* and *spring*. The mean FVS (±SD) for all foods consumed from all the food groups in a period of seven days during *winter* is 23.36 (±5.58) for and 22.86 (±5.39) for *spring*. This also reveals poor dietary diversity.

Table 4.24: Summary of food variety within the food groups for autumn and summer seasons.

	AUTUMN			SUMMER		
Food Group	Mean	±SD	Range of Scores_	Mean	±SD	Range of Scores_
Flesh	1.38	0.58	1-3	1.44	0.62	1-3
Eggs	1.00	0.00	1-1	1.00	0.00	1-1
Dairy	1.94	0.92	1-3	1.94	0.92	1-3
Cereals	6.24	0.62	5-8	6.24	062	5-8
Legumes	1.00	0.00	1-1	1.00	0.00	1-1
Vitamin A	2.28	0.62	1-4	2.28	0.62	1-4
Fruits	1.35	0.48	1-2	1.35	0.48	1-2
Vegetables	4.49	0.94	2-7	4.49	0.94	2-7
Fats	2.73	0.46	1-3	2.73	0.46	1-3
Total food items	21.664	4.65	1-25	22.47	4.69	1-25

Table 4.24 shows the summary of food variety within food groups during *autumn* and *summer*. The mean FVS (±SD) for all foods consumed from all the food groups in a period of seven days is 21.66 (±4.65) for autumn and 22.47 (±4.697) for summer. This also reveals poor dietary diversity.

Table 4.25: Comparison of the Food Group Diversity Score (FGDS) with the number of participants over the four seasons.

FGDS	4	5	6	7	8	9
Autumn	1	38	43	17	1	--
Spring	--	5	37	42	15	1
Summer	--	40	43	16	1	--
Winter	--	5	33	43	17	2

Low FGDS=0-3, Medium FGDS=4-5, High FGDS=6-9

In Table 4.19 the food group variety score consumed by the number of participants over the four seasons is presented, here winter and spring also reflect as the seasons with the highest food group variety consumption that is also reflected in Figure 4.6.

Figure 4.6 Comparison of FGDS between the four seasons
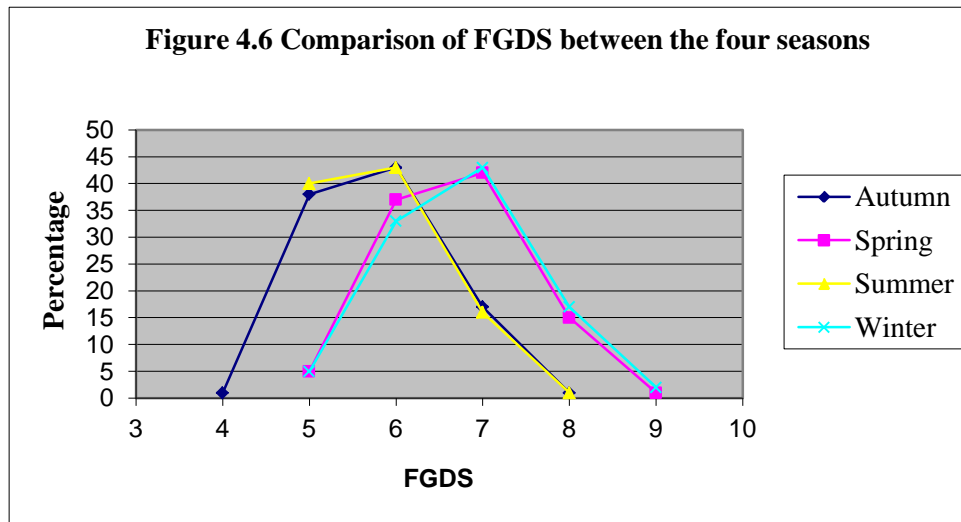
Table 4.26: Summary of Food Group Diversity for all seasons (n =100)

Number of Food Groups Consumed (n =9)	Winter		Spring		Autumn		Summer	
	Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
1	0	0.0	0	0.0	0	0.0	0	0.0
2	0	0.0	0	0.0	0	0.0	0	0.0
3	0	0.0	0	0.0	0	0.0	0	0.0
4	0	0.0	0	0.0	1	1.0	0	0.0
5	5	5.0	5	5.0	38	38.0	40	40.0
6	33	33.0	37	37.0	43	43.0	43	43.0
7	43	43.0	42	42.0	17	17.0	16	16.0
8	17	17.0	15	15.0	1	1.0	1	1.0
9	2	2.0	1	1.0	0	0.0	0	0.0
TOTAL	100	100	100	100	100	100	100	100

In Table 4.26, the majority of respondents (95%) during winter and spring could be classified with a high dietary diversity (consuming between6-9 food groups). During autumn 61% of the respondents could be classified with high dietary diversity while 39% could be classified with medium dietary diversity (using 4-5 food groups). During summer 60% of the respondents could be classified with a high dietary diversity (6-9 food groups) while 40% could be classified with medium dietary diversity (4-5 food groups). In spring only two respondents and in winter one person consumed food from all the nine nutrition food groups during the seven day data collection period.

There is a statistical significant difference (p=0.000) between the FGDS in autumn and spring, autumn and winter, spring and summer, spring and winter as well as summer and winter. There is, however, no statistical significant difference between autumn and summer. The season with the highest food group diversity was winter followed by spring.

4.4.5 Food security and coping strategies

This section reports on the food security and coping strategies implemented by the community in order to gain access to food (n=100).The maximum food insecurity score that could have been generated is 140, indicating severe food insecurity, with the minimum as 0, indicating food security. The higher the score the greater the prevalence of food insecurity, and the lower the score the less

food insecure the households are. The individual coping strategies and the mean cumulative food security index was determined, and the results are expressed in Tables 4.27 and 4.28. The cumulative scores ranged from 28.00 to 87.50with the mean score of 53.83, 40.05, 54.34 and 43.78 for autumn, winter, spring and summer respectively. The questionnaire developed through the Focus Group discussion with 10 ladies from the community is reflected in Figure 4.6.

Figure 4.14: <u>**COPING STRATEGY INDEX FOR MALANGENI COMMUNITY**</u>

Subject number_____ Interviewer_____ Date_____

In the past 30 days, if there have been times where you did not have enough food or money to buy food, how often has your household has to:	All the time? Everyday	Pretty often? 3-6 */week	Once in a while? 1-2 */week	Hardly at all? <1 */week	Never	Raw score	Severity score	Score= Relative Frequency x weight
Relative frequency score	7	4.5	1.5	0.5	0			
a) Borrow food from neighbours?							1	
b) Rely on less expensive food?							1	
c) Buy food on credit?							2	
d) Visit neighbours to eat?							1	
e) Gather food from crops?							2	
f) Limit portion sizes?							1	
g) Reduce the number of meals eaten in a day?							2	
h) Bartering (exchange food from crops)?							3	
i) Restrict consumption by adults in order for small children to eat?							3	
j) Sell some of their belongings in order get money to buy food?							4	
Total household score								

Severity weight: 1= least severe, 4= more severe

Figure 4.6: Coping strategy questionnaire developed for the community.

Table 4.27: Number of households applying individual coping strategies per income group per season (n=25 per season)

Season / Income group	Borrow food Mean score	Less expensive food Mean score	Buy food on credit Mean score	Eat at neighbours Mean score	Gather food from crops Mean score	Limit portion sizes Mean score	Reduce no. of meals per day Mean score	Exchange food from crops Mean score	Restrict adults for children to eat Mean score	Sell belongings to buy food Mean score	Cumulative score Mean score
Autumn (n=25)											
M (n=2)	6.00	2.25	7.00	6.75	2.25	3.50	0.00	3.00	3.00	0.00	33.75
LM (n=14)	3.96	2.35	10.00	6.75	5.14	4.00	2.4	5.39	1.82	1.93	43.87 [b]
L (n=3)	6.00	5.00	7.00	10.5	6.25	9.33	7.00	4.00	4.00	0.00	63.33
VL (n=6)	4.75	5.5	14	10.2	5.2	9.33	10.5	4.25	5.75	0.00	74.42
Winter (n=25)											
M (n=3)	5.00	3.00	7.00	6.00	6.00	0.00	4.67	1.50	2.50	0.00	32.67
LM (n=16)	3.09	2.34	4.38	4.22	7.63	3.43	3.94	2.56	2.25	0.00	35.38 [ab]
L (n=2)	6.00	5.25	7.00	11.3	11.3	7.00	10.5	2.25	9.00	0.00	72.50
VL (n=4)	3.75	5.62	7.00	12.4	10.5	14.00	8.75	6.00	6.75	6.75	74.75
Spring (n=25)											
M (n=3)	2.00	2.00	9.30	4.50	7.00	7.00	2.33	4.66	1.50	0.00	36.33
LM (n=17)	2.38	2.29	5.35	6.35	6.62	4.53	4.12	4.05	2.39	3.18	41.26
L (n=1)	6.00	4.50	7.00	7.00	9.00	14.00	7.00	4.50	6.00	0.00	79.00
VL (n=4)	5.25	4.87	8.75	11.3	10.5	10.5	8.75	4.87	5.62	4.50	74.88
Summer (n=25)											
M (n=4)	3.00	3.75	7.00	5.63	5.63	3.50	5.25	2.25	1.87	0.00	37.88
LM (n=13)	3.34	4.96	9.15	5.19	5.54	3.23	5.38	4.46	1.96	2.08	46.31 [a]
L (n=3)	4.00	4.00	11.50	4.00	4.50	11.70	9.30	3.50	2.00	3.00	64.17
VL (n=5)	5.80	8.1.	8.40	4.30	9.90	9.80	11.2	5.10	2.70	5.40	70.60

[a] Significant differences in mean cumulative scores between winter and summer were found based on LM at $p=0.003$.

[b] Significant differences in mean cumulative scores between autumn and winter were found based on LM at $p=0.047$.

The coping strategy that seems to be highly used within the community in all seasons among all income groups is buying food on credit as shown in Table 4.27.

Table 4.28: Individual coping strategies (mean) and the cumulative foods security index per season

	Borrow food	Less expensive food	Buy food on credit	Eat at neighbours	Gather food from crops	Limit portion sizes	Reduce no. of meals per day	Exchange food from crops	Restrict adults for children to eat	Sell belongings to buy food	Cumulative index
	Frequency x severity										
	$(0-7)\sim x1°$	$(0-7)\sim x2°$	$(0-7)\sim x1°$	$(0-7)\sim x3°$	$(0-7)\sim x3°$	$(0-7)\sim x2°$	$(0-7)\sim x3°$	$(0-7)\sim x2°$	$(0-7)\sim x3°$	$(0-7)\sim x4°$	**Mean (Min-Max)**
Autumn	4.43	3.52	10.65	8.13	7.15	6.08	5.17	4.91	3.13	1.95	53.83 (32.5-87.5)
Winter	3.66	3.18	5.32	6.3	6.54	5.32	5.32	3.58	2.94	2.80	40.05 (28-80)
Spring	3.40	3.17	6.46	7.96	6.09	7.00	5.56	4.38	3.46	3.46	54.34 (28-73.5)
Summer	3.84	5.28	8.96	5.00	7.02	5.60	7.00	4.64	2.10	5.52	43.78 (36-84)

Middle income (M) R2001-R3000, Low middle (LM) R1501-R2000, Low (L) R1001 – R1500, Very low (VL) R501 – R1000**.**

~ **Frequency scoring**: 0 never (zero times per week); 0.5 hardly at all (once or fewer times per week); 1.5 once in a while (1 to 2 times per week); 4.5 Pretty often (3-6 times per week); 7 (All the time/every day).

° **Severity weight**: Based on ordinal ranking by focus group respondents (1 least severe and 4 most severe).

There is no statistical significance between the cumulative scores of respondents based on the season for the full group.

Exchanging food from crops as a coping strategy is mostly used in winter as the mean score for

middle income group is 6.00, 7.63 for low middle group, 11.30 for low income group and 12.4 for

very low income group. The mean score for low and very low income groups that use gathering food from crops as a coping strategy is higher in winter and spring is than in autumn and summer. The low and very low income groups in all seasons had higher mean scores in most coping strategies than middle and low middle income groups.

Table 4.29: Statistical significance difference between the cumulative scores of respondents based on season per income group.

Income group		Cumulative score	p-values
Autumn (n=25)			
LM	M (n=2)	33.75	0.568
	LM (n=14)	43.87	-
	L (n=3)	63.33	0.001
	VL (n=6)	74.42	0.000
M	VL (n=6)	74.42	0.000
	L (n=3)	63.33	0.001
VL	L (n=3)	63.33	0.317
Winter (n=25)			
LM	M (n=3)	32.67	1.000
	LM (n=16)	35.38	-
	L (n=2)	72.50	0.000
	VL (n=4)	74.75	0.000
M	VL (n=4)	74.75	0.000
	L (n=2)	72.50	0.000
L	VL (n=4)	74.75	1.000
Income group		Cumulative score	p-values
Spring (n=25)			
LM	M (n=3)	36.33	0.37
	LM (n=17)	41.26	-
	VL (n=4)	74.88	0.005

M	VL (n=4)	74.88	0.008
Summer (n=25)			
LM	M (n=4)	37.88	0.166
	LM (n=13)	46.31	-
	L (n=3)	64.17	0.004
	VL (n=5)	70.60	0.000
M	L (n=3)	64.17	0.000
	VL (n=5)	70.60	0.000
L	VL (n=5)	70.60	0.510
VL			

Middle income (M) R2001-R3000, Low middle (LM) R1501-R2000, Low (L) R1001 – R1500, Very low (VL) R501 – R1000.

Although there is no statistical significance between the cumulative scores of respondents based on the season for the full group, when groups are divided according to income groups there is a statistical significance at $p \leq 0.05$.

The mean food security scores for autumn and summer is mostly higher than in winter and spring as shown in Table 4.28. The mean food security score for gathering food from crops as a coping strategy is higher in winter and spring than in autumn and summer. Buying food on credit is a mostly used coping strategy especially in autumn and summer. Autumn and summer had higher maximum cumulative score which is 87.5 in autumn and 84 in summer as compared to winter with maximum cumulative score of 80 and spring with cumulative index score of 73.5. Winter and spring had the lowest minimum cumulative index score which is 28 as compared to autumn with minimum cumulative index score of 32.5 and summer with minimum cumulative index score of 36.

4.5 CORRELATIONS

Data was not statistically adjusted for variances, full databases was used to draw correlations. Mean nutrient adequacy ratio (expressed as %) of energy, nutrients and vitamins at different levels of FGDS

<u>**AUTUMN**</u>

Figure 4.7: Mean NAR (%) of energy and nutrients at different levels of FGDS (Autumn)

Figure 4.8: Mean NAR (%) of vitamins at different levels of FDGS (Autumn)
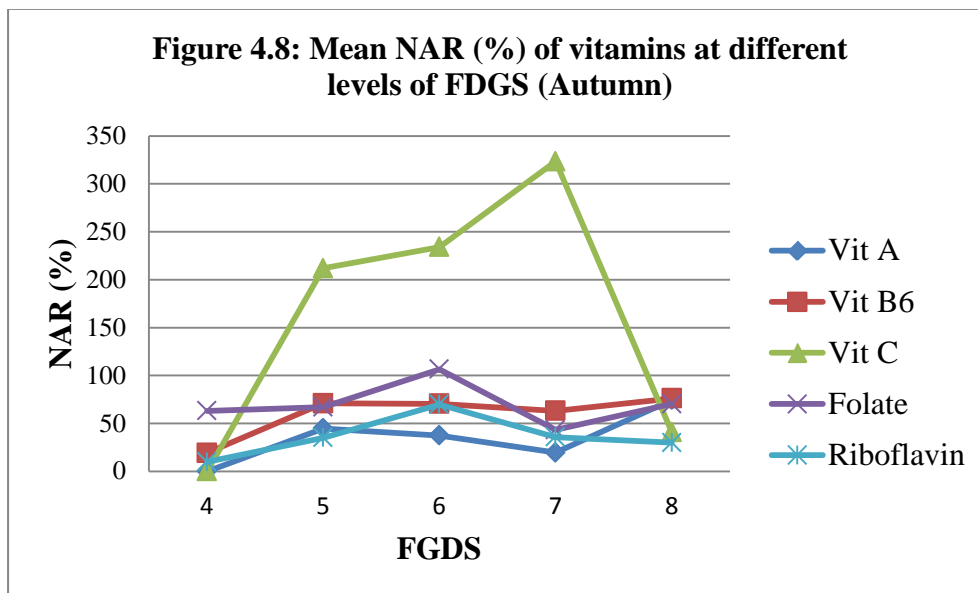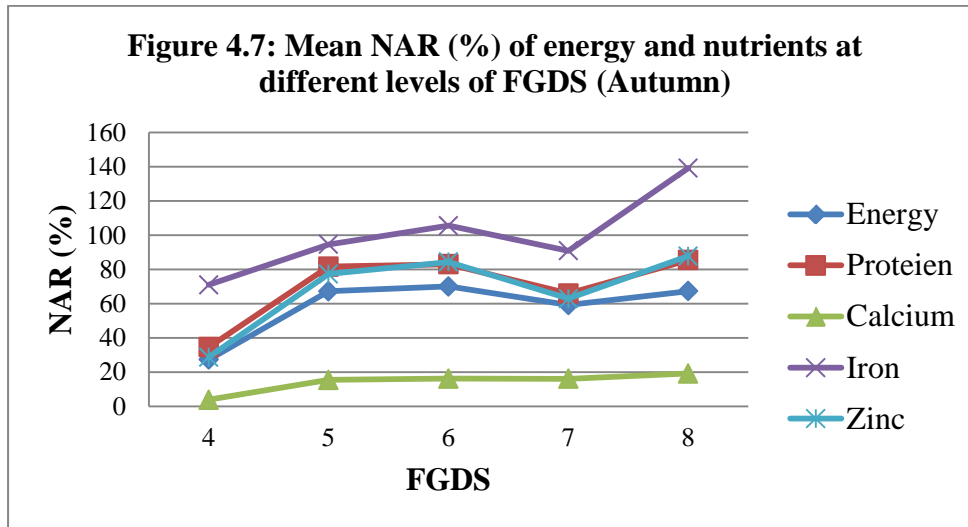
Figures 4.7 and 4.8 indicates the relationship between the FGDS and Mean nutrient adequacy ratio of Macro and Micro nutrients. Although there is an upward trend in the Nutrient Adequacy ratio throughout the number of food groups consumed, a larger increase can be observed between participants consuming food from 7 food groups and participants consuming food from 8 different food groups.

SPRING

Figure 4.9: Mean NAR (%) of energy and nutrients at different levels of FGDS (Spring)

Figure 4.10: Mean NAR (%) of vitamins at different levels of FGDS (Spring)
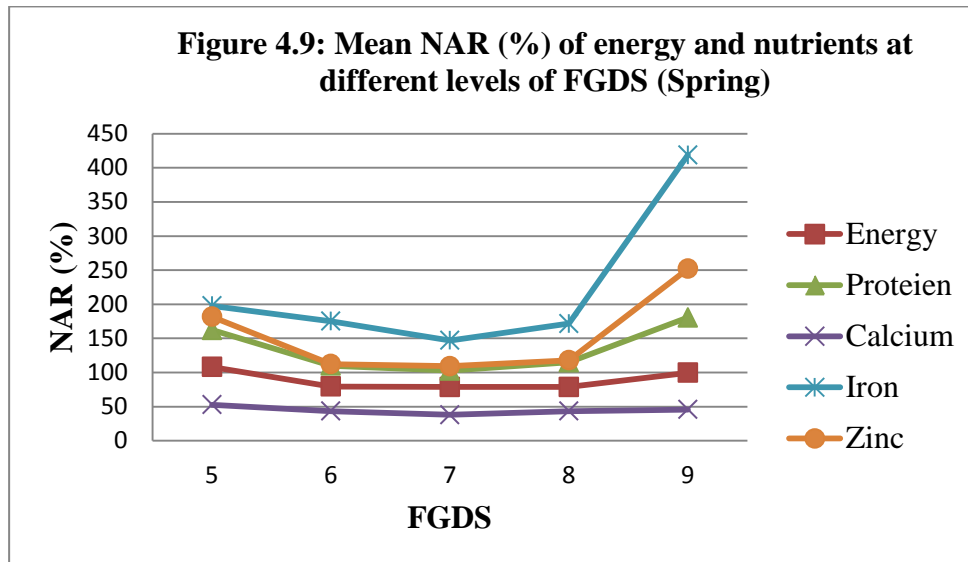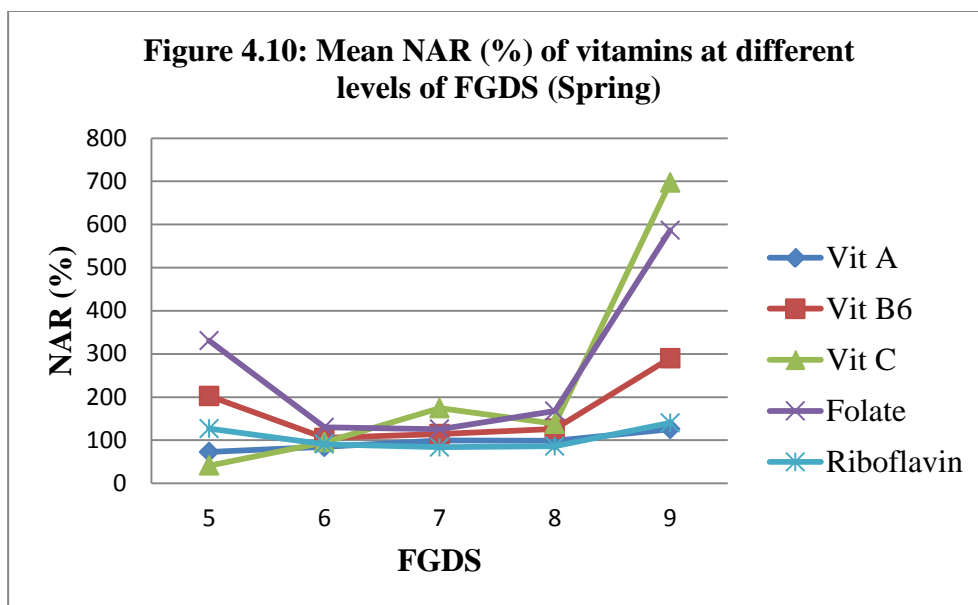
The relationship between dietary diversity score and nutrient adequacy ratio of energy, protein and other minerals showed an increase in nutrient adequacy ratio for all the nutrients as dietary diversity score increases (refer to Figures 4.9 and 4.10).

Table 4.30: Relations hip between variables.

Relationships	R-values	P-values
BMI and household income	-0.081	0.425
BMI and money spent on food	-0.914	0.053
BMI and food security score	-0.128	0.204
Household income and food security score	-0.528	0.000
Money spent on food and food security score	-0.451	0.000
Household income and money spent on food	0.825	0.000

Significant relationships existed between household income and food security score (r=-0.528, p=0.000) and money spent on food as well as between household income and money spent on food (r=0.825, p=0.000). It is clear as shown in Table 4.30that the more money spent on food the lower the food security score, meaning more food in the household. A strong positive relationship exists between household income and money spent on food. No other significant relationships were observed.
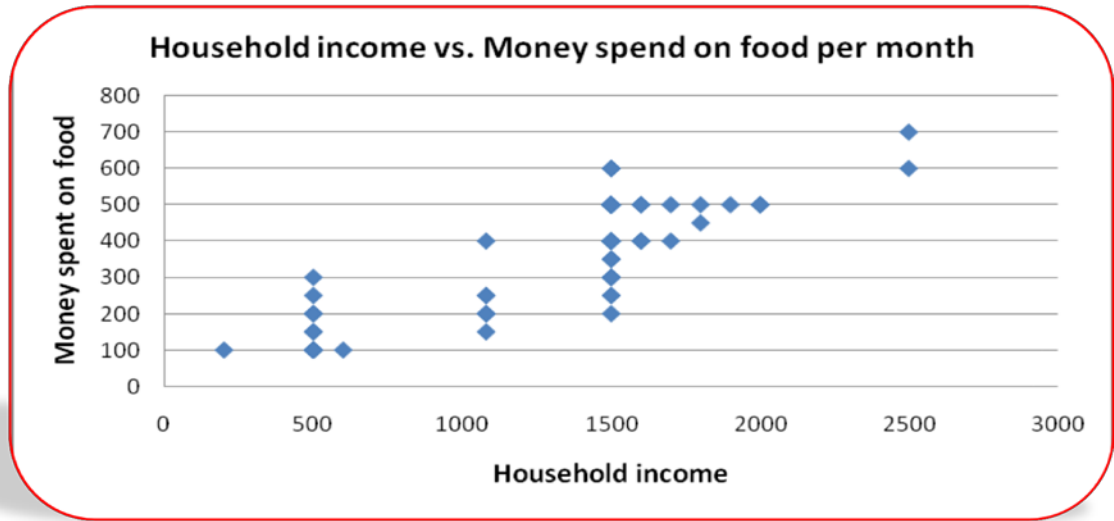
Figure 4.11: The relationship between household income and money spent on food per month.

The relationship between the household income and food spent on food is significant at *p*=0.000 level. There is thus a highly significant relationship between household income and money spent on food per month.
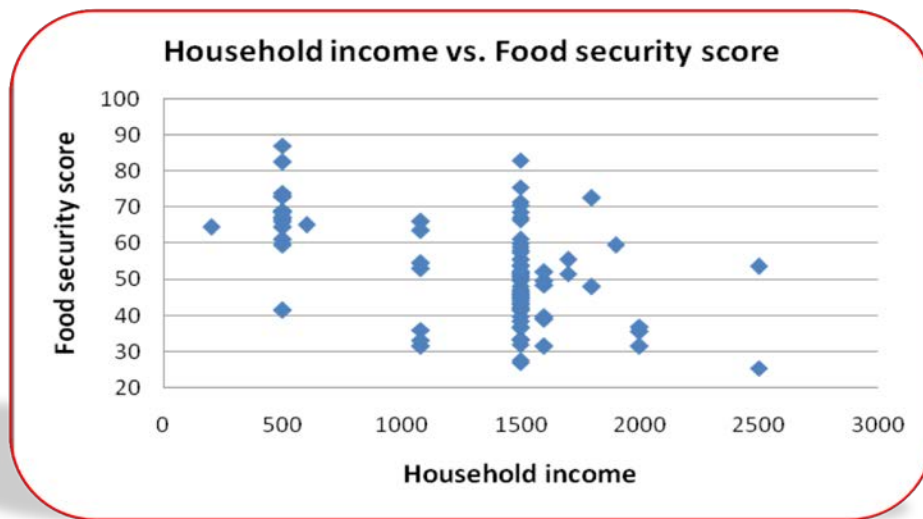
Figure 4.12: Household income and food security score correlations

The relationship between household income and food security scoreis significant at *p*=0.000 level. There is thus a highly significant relationship between household income and food security score.

Figure 4.13: Money spent on food and food security score correlations

The relationship between money spent on food and food security score is significant at *p*=0.000 level. It can thus be concluded that money spent on food and food security score are highly correlated and that people who spend more money on food are more likely to be food secure.

4.6 DISCUSSION OF RESULTS

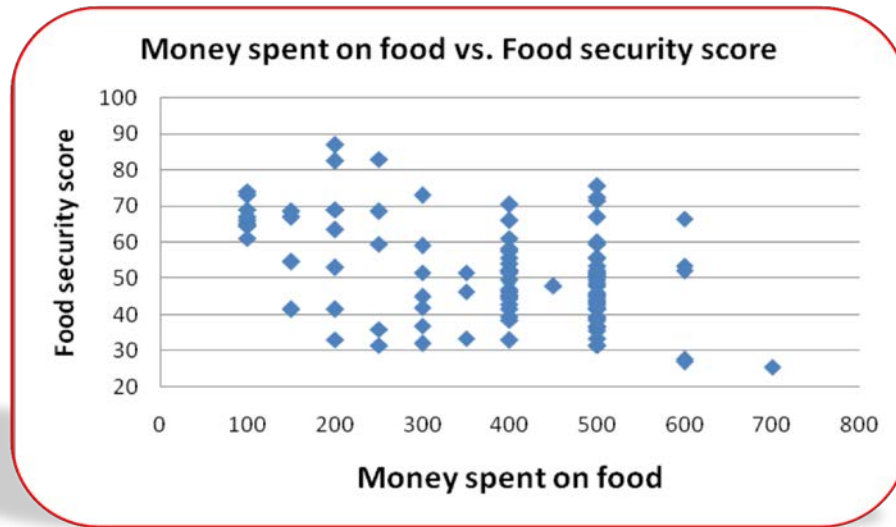The results analysed in this chapter clearly indicate high levels of food insecurity, nutrient inadequacy and poor nutritional status of women living in this rural area. Women were chosen when conducting the study because women are the ones that prepare food and buy groceries. The results analysed from the study regarding the socio-economic status of this community is that there are high levels of illiteracy and unemployment in most households. There are many members living in each households and the number of rooms are not sufficient for all the members. Grandchildren, great-grandchildren and other extended family members may increase the number of household members which puts a huge strain on the limited financial resources of rural women and which in turn has an impact on household security level. Most household are female headed and the spouses are either working in the cities or late. Some spouses are also unemployed and the households end up solely dependent on social grant if there is any qualifying member in the household. There is a correlation

in these results with a study that observed food accessing strategies used by farm worker households in a rural area where most women are unemployed and, therefore, dependent on either spouses who work in the cities to cater to the dietary needs of the households and/or other food accessing strategies to obtain food and/or dependent on state's social grant.

Most respondents (n=52%) have husbands who work in the cities and are able to contribute to the dietary needs of the dependents; even though some husbands who are working in the cities are not supportive to the families left in rural areas and/or the money given to families in rural areas is insufficient to carter for all the members of the household. Most employed spouses earn lower salaries and only a small percentage of the income can be used to buy food.

Most respondents in this community are not educated and, therefore, lack sufficient knowledge on nutrition. It was clear that women need nutrition education or skills on nutrition when observing the food purchasing patterns used by most households which is seen to be the same. This was seen when observing food that is commonly available in the cupboards of most households during household/cupboard survey. Therefore, by improving the nutrition knowledge of this rural community, the women can improve the nutrition quality of life of households. Investing in the education of women increases the capability, empowers women to make healthier food choices and expands opportunities available to them. Lack of nutrition education in this study correlates with the findings in a study by Steyn (1988: 28) which states that the literacy level of a mother has a straight relationship with a nutritional status of a child.

Dietary intake and food consumption patterns indicate that the top 20 food consumption list for all seasons in this study indicated that the majority of food items consumed were carbohydrate-based with a low regularity of small portions of vegetables and fruit, not meeting the recommended intake of >400 g per day (Mann et al., 2007; Lee et al., 2003; Swindale and Ohri-Vachaspati, 2004). Most respondents consumed much starch in the diets with little or no animal products. This was further confirmed by the FVS for each of the food groups, indicating that the cereal group showed the most variety with eight food items each; whereas, the percentage of respondents consuming vegetables and fruit was very low compared with those consuming cereals. In winter, spring and summer, there are no respondents consumed less than 100% of EARs for carbohydrates as compared to other macro-nutrients such as protein, energy and dietary fibre where most respondents consumed less than 100% of EARs. This is de due to high cost of animal and dairy products as compared to starch products

157

since most households spend a very small amount of money on food. Fruits and vegetables consumed by the households are seasonal ones. Some seasons such as autumn and summer have little seasonal fruit and vegetables which results in lower micronutrient intake of the community. Some seasons such as winter and spring have a wide variety of seasonal fruits and vegetables intake which resulted in better micronutrient intake compared to summer and autumn. In summer and winter, there was a lower percentage of respondents with less than 100% of EARs in most nutrients.

Only two dairy food items, in small portions, were consumed by this group of rural respondents in winter and autumn and three in summer and spring, resulting in the low dietary calcium and riboflavin intakes. The low zinc and iron intakes could be the result of the low food variety scores of the flesh and legume groups in all four seasons. Vitamin A, B6, B12, folate and iron are important nutrients in women especially those in child bearing age saw consumed insufficiently in autumn and summer as compared to other seasons. This could be addressed by including cheaper options such as legumes in the diet as these showed to be good sources of zinc and iron. A 100g portion of cooked sugar beans will supply 1.06mg of zinc, 2.1mg of iron, 140mg of folate, and 8.2g of fibre compared with 4.88mg of zinc, 2.3mg of iron, 5mg of folate, and 0g of fibre particularly in braised beef rib with fat (Langenhoven et al., 1991).It was clearly seen that autumn lacked dietary diversity due to the lower number of seasonal crop food available. It can, therefore, be concluded that seasonal food variety has a direct effect on dietary diversity, nutrient adequacy and nutritional status of rural households who can not afford to cater for dietary diversity requirements of all household members although seasonal food products are not sufficient to provide the households with all the nutrients the body requires. The findings in this study confirm those of STATSSA 2011 which clearly indicate that rural households are most affected by poverty. The reason for this is the inability of rural households to access sufficient resources to meet the basic needs consistently leading to poor dietary diversity.

The nutrient intake of women between 31 and 50 years of age is better than nutrient intake of women between 51-70 years, however, vitamin A and iron were consumed by women between 31-50 years of age better than women between 31-50 years of age. Folate as a nutrient that is important for women of child bearing age was consumed better by women between 51-70 years of age compared to women between the ages of 31 to 50 who have greater needs for folate in child bearing years.

The overall nutrient intake of this community is poor since most respondents consumed less that 100% of EARs in most nutrients.

When comparing the food variety score amongst all season, it clearly shows that respondents are more food secure in winter and spring compared to summer and autumn. In autumn and summer, a large number of respondents (n=44 in autumn and n=46 in summer) consumed between 17 and 18 individual food types whereas in winter and spring, a large number of respondents (n=52 in spring and n=53 in winter) consumed between 20 and 21 individual food types. Food group diversity score also proves that respondents had more dietary diversity in winter and spring compared to summer and autumn since in winter and spring, all 9 food groups were consumed whereas in autumn and spring, only 8 food groups were consumed and only one respondent consumed eight food groups in autumn and summer compared to winter and spring where 15 respondents consumed 8 food groups in spring and 17 respondents consumed 8 food groups in winter. A large number of respondents (n=43) consumed only 6 food groups in autumn and summer compared to spring where a large number of respondents (n=42) consumed 7 food groups and winter where a large number of respondents (n=43) consumed 7 food groups. This reveals that respondents have poor dietary diversity in autumn and summer compared to winter and spring. Seasonal food variety plays a major role in increasing dietary diversity of this community during winter and spring. In this community, the period of food plantation is autumn to winter and the harvest period is, therefore, during winter and spring which makes the community more food secure in winter and spring compared to autumn and summer which in turn increases the nutritional status and nutrient adequacy of the community in winter and spring compared to autumn and summer.

These results confirm those of the study by Matla, (2008) that revealed that the farm workers consumed 81 individual food types in winter which was the highest food variety score and 54 individual food types in autumn and summer which was the lowest food variety score which means better nutrient intake in winter. The food group diversity score in this study was also high in winter (between 8 and 9) and the month with the lowest food group diversity score (between 4 and 9) was summer.

Vegetable intake was better in winter and spring (between 2 and 8 types) compared to autumn and summer (between 2 and 7 types). Fruit intake was also better in winter and spring (between 1 and 5

types) as compared to autumn and summer (between 1 and 2 types). This also reveals that during winter and spring, the community has better nutritional status and nutrient adequacy compared to autumn and summer. This poor intake of fruit and vegetables is confirmed by the results of the top 20 food items consumed where fruit and vegetables were very few i.e. 4 types of fruit and vegetables in autumn, 6 in winter, 5 in spring and 5 summer.

The food variety score (FVS) consisted of a simple count of single food within the 11 nutritional food groups. Seventy nine individual food items were consumed by all respondents in seven days over four seasons. The total range of individual food items consumed by an individual respondent during the seven days data collection period were between 15 and 25 in summer, 14 and 25 in spring, 16 and 26 in winter15 and 25 in autumn. During the winter season, a large number of respondents consumed five (19%) and six (61%) types of cereal in seven days. Maize meal was commonly consumed in two forms during the winter season i.e. amahewu (maize meal fermented drink) and maize meal crumbly porridge. A large number of respondents (69%) consumed 20 to 22 food items in seven days. The highest number of individual food items consumed was 21 in 24 of the respondents.

The results in Tables 4.14-4.17 indicates that only 8 vegetable types of the total of 20were consumed in winter and spring; and 7 types of vegetables were consumed during summer and autumn. The intake of vegetables in this community is poor especially in summer and autumn. Between 5-7 cereal food varieties were consumed by a large percentage of the sample (98%) in all four seasons which links up with the top 20 results of the 24 hour recall questionnaire of all seasons where cereals were amongst the highest groups consumed. The meat consumption (Flesh group) indicates that a mean of 1-2 items were consumed by the majority of the respondents in all seasons. During winter and spring, five types of fruit were consumed as compared to summer and autumn where only two types of fruit were consumed. A large percentage (85%) of the participants in winter and spring consumed 2-4 types of fruit and 57% did not consume any fruit in summer and autumn. This indicates poor intake of fruit in this community especially in summer and autumn which links up with the Top 20 results of the 24 hour food recall questionnaires of all four seasons where there were no fruit varieties in autumn and 4 fruit varieties in winter. Mulberry, pawpaw, avocado and oranges were only available during winter and spring and are planted within the community. The plantation of these fruits in the community increases the intake of fruit during the seasons when they are available.

The household survey that inspected food that is available for consumption in households revealed that most food items are seasonally harvested not purchased and there are more seasonally harvested food items among the top 10 food items compared to purchased food items. This clearly indicates that the seasonal food variety has an effect on dietary diversity, nutritional status and nutrient adequacy of this rural community.

Anthropometric measurements – More should be known about the underlying causes of obesity in order to prevent obesity among the black women in order to develop suitable and culturally acknowledged means. Most women in this rural community were unemployed with low incomes and physical inactivity, therefore, had high risk of increased BMI. These results correlate with the results of the study by Eleventh et al., 1998 that women with high physical inactivity have greatest risk of increased BMI. The BMI of a large number of respondents in this study was high i.e. 30 and above. About 41.2% of women between 31 and 50 years and 49% of women between 51 and 70 years of age had the BMI of 30 and above. This clearly shows that elderly women have increased BMI compared to women between 31 and 50 years of age. This can increase the risk of elderly women to diseases of lifestyle. These results may be due to the fact that elderly women are physically inactive since younger women are the ones that are responsible for crop plantation and other household duties. These results are confirmed by the study by Mkhize (2011) that revealed that the elderly are more vulnerable to diseases of lifestyle due to physical inactivity as well as the study by Oldewage-Theron and Kruger (2008) that indicated that 83.7% of elderly women in Sharpville were above the BMI of 30 which is obese. The large portion sizes of thecereal food items, combined with the cereal group being the most diverse and most commonly consumed group, could contribute to this occurrence described by Ruel (2003) (Oldewage-Theron, Salami, Zotor, Matiwane, and Venter, 2005a).

Waist to height ratio and waist circumference scores revealed that 83% of respondents are at a risk of coronary factors and metabolic syndrome (≥0.5) and 76% of respondents are above cut off points for waist circumference. This may lead to increased risk of disease of lifestyle including heart disease. High consumption of starchy food products may contribute to increased BMI WHtR as well as waist circumference of respondents since the top 20 food products consumed by respondents in all seasons, food variety within the food groups as well as food group diversity score indicates high consumption of starchy food products which may result in obesity. The results in this study are confirmed by the results of the study by Mkhize (2011) that revealed that elderly black women consume higher

amounts of starch than any other nutrients. The mean daily macro-nutrient results of this study also indicated that carbohydrates intake for all seasons were far above the estimated adequate requirement of 100g/day.

Health indicators revealed that 63% of respondents are on chronic medication. This might be caused by increased BMI, WHtR scores and waist circumference scores.Again, the large portion sizes of the cereal food items, combined with the cereal group being the most diverse and most consumed group, could contribute much to this incident described by Ruel (2003).

The number of households applying individual coping strategies was high among low and very low income categories. This is confirmed by results of correlations made between variables where it showed that there is a relationship between household income and food security score; money spent on food and food security score and household income and money spent on food. The mean score for all coping strategies used by the community in times of food scarcity was higher in autumn and summer than in winter and spring. These results clearly show that the community is more food secure in winter and spring compared to autumn and summer. Gathering food from crops as a coping strategy in times of hunger was used more in winter and spring which means there is more food from crops in winter and spring compared to other seasons. This means that coping strategies used by rural communities in times of food shortages have a great impact on increasing the food security status of poor households.

According to the study by Eleventth (1998) there is a high risk of increased BMI in women with higher income and lower physical activity. There is a strong association between lack of physical activity and BMI measures. This information is evidenced by the findings in this study 98% of women in rural areas are unemployed with lower income levels and lower levels of physical activities which exposes them at a higher risk of increased BMI.

4.7 CONCLUSION

The results of the study clearly show that the rural community of Malangeni is food insecure and lacks diversity and, therefore, nutrient inadequate. Seasonal food has played a major role in increasing dietary diversity, food security and nutrient adequacy of the rural community.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

In Chapter 4 the results of the data were presented, analysed and discussed and are equivalent to the literature review chapter. Unequal distribution of food and resources throughout the whole world has led to high level of food insecurity and poor dietary diversity in the most vulnerable communities in rural areas. There are various determinants of malnutrition globally. Inadequate dietary intake is one of the key determinants leading to malnutrition. Other determinants that lead to malnutrition include poverty that is mostly caused by high levels of unemployment, drought, lack of nutrition education, inadequate health services as well as the HIV/AIDS pandemic.

The aim of this research was to describe the effect of seasonal food variety and dietary diversity on the nutritional status of women in rural areas with the aim of identifying the contribution of coping strategies and dietary diversity to household food security. The interpreted results of this study will help in formulating practical recommendations for a sustainable reliable intervention strategy to improve the nutritional status of women in this community.

5.2 LIMITATIONS OF THE STUDY

- The first limitation was getting access to see the community chief to obtain permission to do research in his area. It took about a month for the chief secretary to set a date for the researcher to see the chief after handing over the letter asking for permission. That caused a delay in the implementation of the project.

- The second limitation was politically related as the study was conducted close to ward councilor's elections. The reigning political party thought the study was one of the opposition's party strategies to coup power from them and for that reason, some community members refused to participate.

- The third limitation was the long distance between houses where respondents live. In rural areas, houses are very far apart and there are no roads in between the houses suitable for a

vehicle. The researcher and the fieldworkers, therefore, had to walk a long distance from one house to another in rocky pathways while carrying heavy research instruments. This resulted in the addition of more days of fieldwork than expected.

- The forth limitation that some of the respondents that were previously available in some seasons were no longer available in other seasons due to death, immigration, work related matters, hospital admission and social visitation. The respondents that were no longer available had to be replaced by any female household member that was available.

- The fifth limitation was that some of the community members refused to participate in the study due to tiredness and or illness, associating the study with political schema, fear of giving confidential information to strangers, fear of theft, feeling uncomfortable to disclose information about their socio-economic status and lack of time.

- The sixth limitation was that most respondents complained that recalling food consumed over the past seven days was difficult since it was a too long period. Therefore, extra time had to be allocated to the dietary intake data in order for the fieldworkers to give the respondents enough time to think back and to ask pertinent questions to assist with memory.

- The seasons are very long as each season is about three months and the findings may not be true if interviews are carried out in under-producing parts of the season. It is, therefore, recommended that respondents should be interviewed twice in each season which will be early in the season and late in the season.

5.3 MAIN FINDINGS

5.3.1 Literature

The literature in this study clearly illustrates that rural populations suffer most from malnutrition (over and under nutrition). The key factors that contribute to malnutrition in rural areas are food insecurity which is highly caused by unequal distribution of food at national level, high levels of unemployment, lack of nutrition education especially amongst women whore are care givers and

164

food preparers, Lack of nutrition programmes such as INP and community based nutrition programmes as well as inadequate dietary intake resulting in high consumption of undiversified diets. Factors that contribute to a high consumption of undiversified diets in rural areas included lack of storage facilities especially meat products, dairy products and vegetables that deteriorate easily. Due to insufficient storage facilities for food products that deteriorate easily, rural communities opt for purchasing large amounts of starchy food items since they do not deteriorate easily. Improper storage facility to store exported food products is a country's serious issue that has led to lack of diversified diets.

The literature further reveals that certain strategies are used to address malnutrition at both national and international level.

5.3.2 Socio demographic

Essential socio demographic variables that were identified in the study included socio-economic status, accommodation and family composition. There is a very high rate of unemployment in this communityand therefore the total household income low resulting in little money spend on food. Most members of this community are grant beneficiaries and entirely rely on grant which is not sufficient for a healthy living. The level of education of most community members is very low which results in unemployment. Low level of education also contributes to poor nutritional knowledge.This clearly shows that this is a poor community that can contribute to food insecurity.

5.3.3 Anthropometric indicators

The results of this chapter show that obesity was high amongst women between 31 and 50 as well women between 51 and 70 years of age. This was confirmed by the high waist-to-height ratio, waist circumference and BMI. High levels of obesity in this community are due to the high consumption of starchy foods with little or no meat, dairy products as well fruit and vegetables.

5.3.4 Health status

The majority of respondents in this community are on chronic medication. Obesity and the risk of CVD are the main health problems identified in this community. The large portion sizes of the cereal

food items and low intake of micronutrients is likely to contribute to the health status in this group of people.

5.3.5 Dietary intake and Nutrient Adequacy

The results of this study confirmed that the total range of individual food items consumed by all respondents during the seven-day data collection period over four seasons was 14-79 foods. The results clearly show low consumption of fruit and vegetables in all seasons especially in summer and autumn. This contributes to the poor nutritional status of the community. Seasonal fruit and vegetables intake which were mostly available in winter and spring resulted in better micronutrient intake compared to summer and autumn, indicating a higher food variety in winter and spring. The results have indicated that the diet of this community is largely carbohydrate-based containing primarily starchy staple foods, though there is an insufficient intake of animal products and dairy foods conceivably resulting in the detected deficiencies.

The findings have indicated that the mean score for all coping strategies used by the community in times of food scarcity was higher in autumn and summer than in winter and spring. These results clearly show that the community is more food secure in winter and spring compared to autumn and summer.

The results from this study confirm that a lower income resulted in a low dietary diversity, which led to poor dietary intake and micronutrient deficiencies in this rural community. Seasonal food variety and coping strategies used by the community in times of food scarcity, however, played a major role in increasing the nutritional status and nutrient adequacy of the community even though it was not enough to ensure household food security at all times.

Poor dietary intake, especially protein, zinc, vitamin A and calcium has shown to be a problem in this black community and may result in impaired immunity, which can lead to an increased risk of infectious diseases. Limited research has been done to explore the consequences of low dietary variety on the nutritional status in other population groups.

In this study the results from the 24 hour recall (nutrient adequacy ratio) confirmed the findings of the FFQ (food variety and dietary diversity), and food variety and dietary diversity are, therefore,

confirmed as good indicators of dietary adequacy and proved that dietary variety is a significant, but simple tool to identify the poor communities at risk of food and nutrition insecurity and its resultant effects on health, which can thus effectively replace the habitual dietary assessment tools in monitoring dietary outlines. This is very useful especially in rural illiterate communities in which food assessing strategies are limited. This will assist in quick nutritional assessments for immediate carrying out of food and nutrition interferences.

5.4 CONCLUSION

This study attempted to define dietary variety amongst a rural community of a black population in South Africa and its effect on the quality of the total diet and ensuing nutritional status and health results. Micronutrient malnutrition in terms of vitamin A and iron deficiency is prevalent, with rural areas being affected more than the urban areas (Faber et al., 2007).

The findings of this study confirmed poverty resulting in reduced dietary variety indicating household food insecurity which leads to malnutrition (both under and over nutrition), as well as poor health status in this rural community. These findings correlate with other studies conducted among the rural communities in South Africa (Kirkland, Kemp and Lori, 2011; Labadarios, Steyn and Nel, 2011; Maliwichi, Oni and Obadire, 2012) and confirm the need to educate the rural communities and other communities in the importance of consuming diversified diets to ensure nutrient adequacy absent of malnutrition related diseases. This will enable rural communities to transform the food attainment, preparation, and meal patterns to address the high occurrence of micronutrient deficiencies and diseases of lifestyle. Coaching on food acquisition, preparation, and meal planning skills should, therefore, go together with nutrition education.

5.5 RECOMMENDATIONS

Women being the majority of the total population in world and the caregivers in most rural households should be imparted with nutritional knowledge which in turn will have an impact on increasing the nutritional status of the whole population. The high predominance of insufficient

nutrient intake amongst the respondents proves the need for operational and wide attainment nutrition strategies aimed at improving nutrient intake in rural areas.

5.5.1 Recommendation to policy makers

- **Government initiatives**

The community based nutrition programme formulated by the Department of Health such as the soup kitchen and food parcelshas encouraged food based programmes to improve nutrient adequacy for poor communities. More community based nutrition programmes should be developed to assist the most vulnerable groups i.e. women and children in attaining the optimal nutrition and decreasing nutrient deficiencies. Suitable government interventions should thus be aimed at improving the health status of the women and children which will lead to a healthier community. Constant monitoring of community nutrition programmes should be done in order to ensure that the nutritional status of victims of malnutrition is improved.

Social grants for the children and the sick should be reviewed by government since the funds are insufficient to meet the daily requirements of children. The government should eliminate illiteracy level of women since the illiteracy level of the mother will have a negative impact on the nutritional status of the children.

Researchers have confirmed that nutrition education for the poor communities is necessary and likely to prevent malnutrition (FAO, 2005; Contento, 2007:2; WHO, 2010). This study proved that women should be the focus of nutrition education since women are mainly responsible for the food obtaining, preparation, and distribution within the household in this community. Nutrition education programmes for the rural citizens should include the importance of dietary diversity in the diet to lessen nutritional problems and related diseases as validated by other researchers (SADHS, 2005; 2010). Choosing a variety of foods across and within food groups to supply the needed vitamins, minerals, and other micronutrients required for optimal health is important (Drewnowski, Henderson, Driscoll and Rolls, 1997). Inadequate dietary intake is considered one of the main causes of micronutrient deficiencies. Dietary Diversification of households is necessary, and a national food production policy should target the attainment of balanced production and accessibility of a range of necessary essential food products (Gopalan, 2001).

168

- **Non-Government Organisations**

Non-Government Organisationshave a crucial role to play in addressing nutritional problems faced by rural communities within the society at large and through its numerous services it can open doors for opportunities whereby the nutritional needs and the concerns of the rural communities can be met. School feeding schemes that are run by Non-Government Organisations should focus on meeting the daily nutritional needs by providing nutritious meals to children which will impact on the future generation. Community centre kitchens or lunch clubs would also benefit children and women by obtaining the necessary meals in a social environment and furthermore to increase the concentration span of children at school.

- **Integrated Nutrition Programme (INP)**

The INP originated by the Department of Health is precisely focused on mothers and children especially in rural communities to address nutritional issues. It is important that the controllers of the INP acknowledge the rural communities when developing nutrition strategies to eliminate malnutrition, both over and under nutrition. The INP should focus on meeting the daily nutritional needs of the most vulnerable groups through nutrition education, food fortification and supplementation strategies in order to improve nutrient adequacy of the malnourished.

5.5.2   Recommendation for agricultural interventions

Active agriculture can be a speedy solution to food insecurity and malnutrition. The World Health Organisation (2004b) indicates that vegetable gardens are an extremely virtuous easing hobby for the unemployed to practice, since nurturing the garden will encourage physical activity, without fatigue, and with mental inspiration and the ability to enjoy seasonals and fruit. Physical activity can assist in keeping blood pressure down and eliminate the diseases associated with obesity and overweight (WHO, 2000a; 2004b; Jaf and Qudar, 2008).

The Department of Agriculture should aim at lowering the prices of food as much as possible so that nutrient dense food can be easily accessible even to poor communities. The effectiveness and the good relationships between agriculture and other sectors may have a strong impact on rural labour markets and, therefore, additional jobs may be created (FAO, 2005a; Lyne et al., 2009; Van Zyl, Kirsten and Binswanger, 1996; United National Development Programmers (USDP), 2010).

5.5.3 Recommendation for nutrition education

- **Nutrition education**

Nutrition education is vital to educate women to adapt to food attaining, preparation and meal patterns to address the incidence of various micronutrient deficiencies. A sustainable nutrition education programme would benefit the rural communities by assisting women to make informed nutritious food choices and, therefore, improve the dietary patterns, food habits, food preparation and meal planning skills within an inadequate household budget. The results of the study conducted by Andresen et al. (2009) showed that women in South Africa do not receive sufficient nutrition education and lacked information and necessary skills on how to help prepare nutritious foods.

Nutrition knowledge should be strengthened in different target groups using numerous forms such as posters, practical sessions, radios and television broadcast in order to be operative and rapidly conveyed even in remote areas.

5.6 RECOMMENDATIONS FOR FUTURE RESEARCH

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

- It is recommended that the tools used to measure dietary diversity in this study be used in a larger population group on different farms and other rural communities to enhance the reliability and validity of the study.

- This study further highlights the need for a nutrition intervention to prevent the advancement of malnutrition and will, therefore, enable this community to adjust present food choices when purchasing food and healthier food preparation methods to address the increased prevalence of food insecurity and undiversified diets leading to micronutrient deficiencies.

- A three day or less recall should be investigated to determine household dietary diversity as a seven day recall is a very long period and, therefore, could not be easily remembered.

- Identify and implement a study to increase the dietary diversity and food variety by increasing fruit and vegetable portion size, since the majority of women in this community did not meet the World Health Organisation goals for fruit and vegetable intake of >400g in a nutrition education programme to improve the overall diet content.

- The South African food based dietary guidelines should include indigenous plants such as wild herbs as it plays a very important role in dietary diversity. This will assist the nutritionists to identify and promote all indigenous plants present in each area of the country.

- The relations between socio-economic status, food intake patterns and overweight status of women with appropriate interventions to improve overall dietary intake patterns.

- Community support for improved nutrition for the rural dwellers and community-based structures should be investigated.

- Only women were interviewed in this study since they are caregivers, however, in order to have a better idea of a comprehensive dietary diversity of a family, men should be included as part of a rural food diversity study as well.

REFERENCES

Abercrombie, R., Labadarios, D and Steyn, N.P. 2002. The food quality and seasonal food variety in the Orange Free State. *South African Journal of Clinical Nutrition,* (36) 2: 98-102.

Abrahamson, L., Lennernas, M., Risvik, E and Sepp, H. 2001. The contribution of food groups to the nutrient intake and food pattern among preschool children. *Food quality and preference,* (8)1: 108-116.

AHA. 2008. Body composition tests. Available at: http//www.americanheart.org/presenter.jhtml?identifier=4489 [Accessed in January 2008].

AHA. 2009. Heart disease and stroke statistics-update at a glance [online]. Available at: http//www.americanheart.org/downloadableheart/124025o946756ls-1982%20%heart%20and stroke%20update.042009.pdf [Accessed 10 October 2009].

Alberts, N., Burger, S., Monyeki, K. D., Nthangeni, G and Steyn, N. P. 2001. Seasonal variation in dietary intake of the adult population of Dikgale. *South African Journal of Clinical Nutrition,* (14) 4: 140-145.

Aliber, M. 2009. Exploring Statistics South Africa's National household survey as a source of information about food security and subsistence agriculture.Unpublished report, Centre for Poverty Employment and Growth. *Human Science Research Cou*ncil. Pretoria.

Allen, J.K. 2007. Effect of soy protein-containing isoflavones on lipoprotein in post-menopausal women. Menopause, 14: 106-114.

Altman, M., Hart, T and Jacobs. 2009. Food security in South Africa. Centre for poverty employment and growth. Pretoria. *Human Science Research Council*. Pretoria.

American Heart Association (AHA). 2007. Biotin deficiency. *Circulation*, 116: 11-16.

Anderson, J.W., Baird, P., Davis, R.H., Ferreri, S., Knudston, M., Koraym, A., Waters, V and Withers, C.L. 2009. Health benefits of fiber. *Nutrition Reviews*, 67(4): 188-205.

Anderson, J.W and Pasapuleti, V.K. 2008. Dietary fiber and associated phytochemicalism prevention and reversal of diabetes. Nutraceuticals and Glycaemic health and type 2 diabetes. In: Pasapuleti V.K and Anderson, T.W (eds.). *Ames, lowa; Blckwell Publishing Professionals,* 1-10.

Andresen, E.C., Wandel, M., Barth, W., Eide, Herselman, M and Iversev, P. 2009. Delivery of the Nutrition Supplementation Programme in the Cape Town metropolitan area from the perspective of mothers of under-5s: A qualitative study. *South African Journal of Child Health*, 3: 3.

Aune, D., Chan D., Lau, R., Vieira, R., Greenwood, D., Kampman, E and Norat, T. 2011. Dietary fibre, whole grains and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. *British Medical Journal*, 343: d6617.

Arab, L and Steck-Scott, S. 2004. Cancer and diet. In: Gibney, M.J., Margetts, B.M., Kearney, J.M and Arab, L., eds. Public Health Nutrition, Oxford, Blackwell, 341-356.

Ashwell, M and Hsieh, S.D. 2005. Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *International Journal of Food Sciences and nutrition*, 56 (5): 303-307.

Azadbakht, L. 2008. Soy protein intake, cardio renal indices and C-reactive protein in type 2 diabetes with nephropathy. A longitudinal randomized clinical trail. *Diabetes Care*, 31: 648-654.

Baez, J. E. 2007. Guidelines for designing evaluations of community-based nutrition promotion programs. Available at:
http://siteresources.worldbank.org/EXTLACREGTOPNUT/Resources/GuidelinesForDesigningEvaluations.pdf.

Barker, M.E and Barker, L.E. 2004. Dietary behaviors and socio-cultural demographics. *British Journal of Nutrition,* (64)2: 319.

Baynes, R.D., Meriwether, W.D., Bothwell, T.H., Fernandes Costa, F.J., Bezwoda, W.R and MacPhail, A. 1986. Iron and folate status of pregnant Black African women in Gazankulu. *South African Medical Journal*, 70: 148-51.

Behr, A and Ntsie, P., 2008. Nutrition promotion strategies. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council*, 315-348.

Berry, B. 2007. Agricultural-Food, Past, Present and Future Report South Africa. Agricultural-Food. Canada.

Berry, L., Hall, K., Hendricks, K. 2010. Strengthening knowledge and understanding of dietary supplements statistics on children in S.A: 2003.

Bhutta, Z.A., Ahmed, T., Black, R.E., Cousens, S., Dewey, K., Giugliani, E., Haider, B.A., Kirkwood, B., Morris, S.S., Sachdev, H.P.S., Shekar, M. *2008.*What works? Interventions for maternal and child undernutrition and survival for the Maternal and Child Undernutrition, Study Group. Available at: *www.thelancet.com. [Accessed in February 2008], Vol. 371, Issue 9610, 417-440.*

Bickel, G., Nord, M., Price, C., Hamilton, W and Cook, J. 2000. Guide to measuring household food security. Alexandria VA: U.S. Department of Agriculture, Food and Nutrition Service. Available at: http://www.fns.usda.gov/fsec/files/fsguide.pdf.

Black, R.E., Morris, S.S and Bryce, J. 2003. Where and why are 10 million children dying every year? *Lancet*, 361: 2226 – 34.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., Mathers, C and Rivera, J. 2008. Maternal and child under-nutrition: Globaland regional exposures and consequences. *Lancet*, 371 (9608): 243–60.

Bouis, H. 2008. Rising food prices will result in severe declines in mineral and vitamin intakes of the poor. Washington DC: Harvest Plus.

Brand-Miller, Jennie, 2003."Low-Glycemic Index Diets in the Management of Diabetes: A meta-analysis of randomized controlled trials," *Diabetes Care*, 6 (8): 2261-2267.

Bradshaw, D., Groenewald, P., Laubscher, R., Nannan, N., Nojilana, B., Norman, R., Pieterse, D and Schneider, M. 2003. Initial burden of disease estimates for South Africa, 2000. *South African Medical Research Council*. Cape Town.

Browne, C., Love, P and Vorster, H. H. 2001. Development of food-based dietary guidelines for South Africa, *South African Journal of Clinical Nutrition*, (14)3: S3-S6.

Bryce, J., Coitinho, D., Darnton-Hill, I., Pelletier, D and Pinstrup-Andersen, P. For the Maternal and Child Undernutrition Study Group. 2008. Maternal and child undernutrition: effective action at national level. Series, Maternal and child undernutrition. The Lancet 2008, 371:510-526.

Budd, G.M and Volpe, S.L. 2006. School based obesity prevention: research, challenges and recommendations. *Journal of School Health*, 76: 485-495.

Centre for Disease Control (CDC). 2002. Body Mass Index (BMI)-for age growth charts [online]. Available at: http://www.cdc.gov/nccdphp/growthcharts [Accessed 25 February 2007].

Charlton, K.E., Wolmarans, P., Marais, A.D and Lombard, C.J. 1997. Micronutrient intake and cardiovascular risk factors in older coloured South Africans. *East African Medical Journal*, 74: 478-486.

Charlton, K.E., Ferreira, M and Du Plessis, L.M. The nutritional status and needs of older person, 2008. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town. *South African Medical Research Council*, 547-590.

Chen, C.Y., Milbury, P.E., Lapsley, K and Blumberg, J.B. 2005. Flavanoids in almond skin are bioavailable and act synergistically with vitamin C and E to enhance hamster and human low density lipoprotein (LDC) resistance to oxidation. *Journal Nutrition*, 135 (6): 1366-73.

Chopra, M and Darnton-Hill, I. 2006.Responding to the crisis in sub-Saharan Africa: The role of nutrition. *Public Health Nutrition*: 9(5), 544–550.

Clausen, A.R and Steyn, P. 2005. Predictors of Food Variety and dietary diversity among older persons in Botswana. *Nutrition,* (21): 14-22.

Clausen, T. 2005. Nutritional predictors of function-decline and short survival in a prospective survey of older persons in Botswana. *South African Journal of Clinical Nutrition*, 18(1): 372.

Clemens, L.H., Slawson, D.L and Klesges, R.C. 1999. The effect of eating out on the quality of the diet of menoupausal women. *Journal American Diet Association*, 99: 442-444.

Cloete, J., Lenka, M., Marais, L and Venter, A. 2009. The Role of Urban Agriculture in addressing Household Poverty and Food Security: The case of South Africa. Paper prepared forthe Global Development Network Project. Institutional Capacity Strengthening ofAfrican Public Policy Institutes to Support Inclusive Growth and the MDGs, April 2009.

Cole, T.J. 1997. Sampling study size and power. In B.M. Margetts and M. Nelson (eds.): Design concepts of nutritionally epidemiology. New York: Oxford University Press, 64-86.

Cunnane, S., Drevon, C.A., Harris, B., Sinclair, A., Spector, A and Salem, N. 2004. Report on the subcommittee on: Recommendations for intake of polyunsaturated fatty acids in healthy adults. International Society for the study on of Fatty Acids and Lipids. *Nutrition Journal*, 22.

Daly, R.M., Bass S and Nowson, C. 2006. Long-term effects of calcium-vitamin-D_3 Fortified milk on bone geometry and strength in older men, 39(4): 946-953.

Derrickson, P.J., Sakai, M and Anderson, J. 2001. Interpretations of the "Balanced Meal". Food security indicator. Society Nutrition Education, 33 (3) 155-160.

De Klerk, M., Drimie, M. 2004. Food security in South Africa: Key policy issues for the medium term. Pretoria. *Human Science Research Council (HSRC).*

De Moura, F., Lewis, K.D and Falk, M.C. 2009. Applying the FDA definition of whole grains to the evidence for cardiovascular disease health claims. *Journal of Nutrition*, 109: 112383.

Department of Agriculture and Land Affairs (DOA). 2002. *The integrated food security strategy for South Africa*. Pretoria: DOA. Available: http://www.nda.agric.za/docs/Policy/FoodSecurityStrat.pdf.

Department of Agriculture (DOA), 2006. Strategic Plan for the Department of Agriculture: The Department of Agriculture, South Africa, Pretoria, 86.

Department for International Development (DFID). 2004. Agriculture, hunger and food security. Available: http://dfid-agriculture-consultation.nri.org/summaries/wp7.pdf.

DOA. 2007. National Issues: Food Security. Pretoria: The National Agricultural Directory 2007, 53.

Devereux, S and Maxwell, S. (Eds). 2003. Food Security in Sub-Saharan Africa. Intermediate Technology Development Group (ITDG), London.

Dewey, K.G and Brown, K.H. 2003. Update on technical issue concerning complementary feeding of young children in developing countries and implications for intervention programs. *Food and Nutrition bulletin*, 24: 5-8.

Dhansay, M.A., Marais, C.D and Labadarios, D. 2007. Selected micronutrient status: Section D: Zinc status. In: Labadarios, ed. National Food Consumption Survey- Fortification Baseline (NFCS-FB): South Africa, 2005. Directorate Nutrition, DOH. Stellenbosch, University of Stellenbosch.

DOH), 1998. Integrated Nutrition Programme for South Africa. Summary of broad guidelines for implementation. Draft Document 5. Pretoria.

DOH, 2002a. Integrated Nutrition Programme. A Foundation for Life.Issue 3.Pretoria.

DOH, 2002b. Directorate Nutrition. Integrated Nutrition Programme Strategic Plan 2002/03 to 2006/07. Pretoria.

DOH. 2003. Regulations relating into the fortification of certain food stuffs. Durban. Government Printer.

DOH. 2004a. South African guidelines for healthy eating for adults and children over the age of seven, Pretoria, DOH, Directorate Nutrition [online]. Available at: http: // www.fao.org/ag/agn/nutrition/education_guidelines_zaf_en.stm [Accessed 03 N0vember 2007].

DOH. 2004b. South Arica Demographic and Health Survey 2003. Preliminary report. Pretoria, DOH. Available at: http://www.hst.org.za/indicators/SADHS_1998_Full.pdf; [Accessed November 03, 2007].

DOH. 2004c. Integrated Nutrition Programme- A foundation for life. Issue 4. Pretoria. DOH.

DOH. 2005. Integrated Nutrition Programme for South Africa. Policy and implementation guidelines. (Unpublished document) Pretoria. DOH.

DOH. 2007a. HIV and AIDS and STI Strategic Plan for South Africa 2007-20011. Government Printer. Pretoria. DOH.

DOH. 2007b. Department of Health embarks on a national study on the health of older persons [online] 2007. Available at: http//www.hst.org.za/news/20041552 [Accessed 15 March 2008].

DOH. 2007c. South Arica Demographic and Health Survey 2003. Full report.Department of health, Medical Research Council, OrcMacro. 2007. Pretoria, Department of Health. Available at: www.doh.gov.za/docs/misc/sadhs.html. [Accessed in July 2008].

DOH. 2007d. Statistics of Clinic-based vitamin A Supplementation for 2004. Pretoria, DOH.

DOH. 2008. Integrated Nutrition Programme. A foundation for life.Issue 5. Pretoria, DOH.

Drewnowski, A., Henderson, S. A., Driscoll, A and Rolls, P. J. 1997. The dietary variety score: Assessing diet quality in healthy and older adults. *Journal of the American Diet Association*, 97 (3): 266–271.

Du Plessis, L.M., Labuschagne, I.L and Naude, C.E. 2008. Nutrition during pregnancy and lactation.In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, A right based approach. Cape Town. *South African Medical Research Council*, 349-376.

Earl, R and Borra, S.T. 2000. Guidelines for dietary planning In: L.K. Mahan and S. Escott- Stump, eds. Krause's food, Nutrition and Diet therapy 10th edition Philadelphia, W.B. Sanders company.

Eleventh, P.B., Chumlea, R., Eiben, W.C., Harries, O., Heymsfield, K., Launer, C., Rosenburg, I.H., Solomon, N.W., Svanborg, A., Van Staveren, W and Wellas, B. 1998. Uses and interpretation of anthropometry in elderly for the assessment of physical status. Report of the Nutrition Unit of WHO:

Elmadfa, I and Kornsteiner, M. 2009. Dietery fat intake. A global perspective. *Annuals of Nutrition Metabolism*, 52(1): 2-5.

European Nutrition for Health Alliance. 2006. Malnutrition in older people in the community: Policy recommendations changes. London: European Nutrition for Health Alliance.

Evans, A. 2009. The feeding of the nine billion. Global Food Security for the 21st Century. The Chatham House Report. London. The Royal Institute for International Affairs.

Faber, M., Venter, S.L and Benade, A.J.S. 2002a. Increased vitamin A intake in children aged 2-5 years through targeted home gardens in rural South African community. *Public Health Nutrition*, 5:11-6.

Faber, M., Phungula, MA, Venter, SL, Dhansay, MA and Benade, A.J. 2002b. Home gardens focusing on the production of yellow and dark green leafy vegetables increase the serum retinol concentrations of 2-5 years old children in South Africa. *American Journal of Clinical Nutrition*, 76: 1048-54.

Faber, M and Wenhold, W. 2009. In contemporary Intergrated Nutrition Programme. Available on website http://www.wrc.org.za.Nutritional Intervention Research Unit. Pretoria: *South Medical Research Council,* 23 (3).

FAO, 1998. Implementing the right to food in national legislation, Rome. Italy.

FAO. 1999: 1-2. Food Supply and Distribution Systems to Cities. Rome. Italy.

FAO. 2005a. Oilseeds, oils and oilmeals: FAO food outlook, pp 22-25 [online]. Available at: http://www.fao.org/docrep/008/j6801e08 [Accessed 23 April 2009].

FAO. 2005b. Protecting and promoting good nutrition in crisis and recovery, a resource guide. Rome. Italy.

FAO. 2005c. Voluntary guidelines on the progressive realization of the right to adequate food in the context of national food security. Adopted by the 127th session of the FAO Council, November 2004, Rome. Italy.

FAO. 2005d. The right to food-voluntary guidelines. Rome. Italy.

FAO.2006. The state of food insecurity in the world. Rome. Italy.

FAO.2007a. Assessment of the world food security situation. 3rd Session of the Committee on World Food Security [online]. Available at: http://www.ftp.fao.org/docrep/fao/meeting/001/j9455e.pdf _[Accessed 12 June 2007).

FAO (Nutrition and Consumer Protection Division). 2007b. Guidelines for measuring household and individual dietary diversity. Version 3. Rome, Italy.

FAO. 2007c. FAO stats [online].Available at: http://www.faostat.fao.org/site/342/default.aspx [Accessed 14 March 2010].

FAO. 2008. Soaring food prices put further pressure on African agriculture. Press Release dated 19June 2008 [Online]. Available at :http://www.fao.org/newsroom/en/2008/1000868/index.html [Accessed 17 July 2008].

FAO. 2009a. Fats and fatty acids in human nutrition. A report of an expert consultation, ISSN 0254 4725: 14-22.

FAO. 2009b. World summit on food security in Rome [Online]. Available at: http//www.fao.org.wsfs/world-summit/wsfs-cgallenges/en [Accessed 23 March 2010].

FAO. 2009c. The state of agricultural commodity markets. Rome, Italy.

FAO. 2010. The State of Food Security in the world. Rome. Italy.

FAO. 2012. The state of food insecurity in the world 2012. Rome. Italy.

Fawzie, W.W., Msimanga, G.I., Urassa, W., Hertzmark, E., Petraro, P., Willet, W.C and Spiegelman, D. 2007. Vitamins and perinatal outcomes among HIV negative women in Tanzania. *Nutritional English Medical Journal*, 356: 1423-1431.

Florencio, C.A. 2001. Developments and variations in school-based feeding programs around the world. *Nutrition Today*, 36 (1): 29-36.

Food finder 3. 2002. Dietary Analysis software program, version 1.0.7. *South African Medical Research Council*. Cape Town.

Fox, M.K., Davansay, B and Jankowski, L. 2004. Feeing infants and toddlers study: What foods are infants and toddlers eating? *Journal American Diets Association*, 104 (Suppl 1): S22-30.

Gallagher, 2008. The nutrients and their metabolism. In: Mahan, L.K and Scott-Stump, S., eds. Krause's Food and Nutrition Therapy. 12th edition. St Loius, Missouri: *Elsevier*, 50-59.

Gericke, G.J., Labadarios, D and Ntsie, P.R. 2008. Knowledge attitude and behaviour (KAB) on food fortification of women of child bearing age (NFCS-FB-I). Abstract 71. 2008. Nutrition Congress: Evidence based Nutrition leading the Way in Innovation. 28 September – 2 October 2008. Pretoria, South Africa.

Gibson, R.S. (ed.). 2005. Principles of Nutritional assessment, 2nd ed. Oxford: Oxford University Press, 34-35.

Gopalan, C. 2001. Achieving household nutrition security in societies in transition: An overview. *Asia Pacific Journal of Clinical Nutrition*, 10: S10–S11.

Hammond, K. 2008. Assessment: Dietary and clinical data. In: Mahan, L.K&Escott-Stump, S. Krause's (eds.). Food and Nutrition Therapy.12th ed. St Louis, Missouri, *Elseiver*, 400-1.

Hammond, K. 2008. Dietary assessment: In: Mahan, L.K and Escott-Stump, S. Krause's (eds.). Food, nutrition and diet therapy. 12th ed. Philadelphia: WB Sanders Company. 384-410.

Heady, D and Fan, S. 2008. Anatomy of a crisis.The Causes and Consequences of Surging Food Prices. IFPRI Discussion Paper 00831 (December). National Food Policy Institute. Washington DC.

Hendricksson, K.M., Lindblad, U., Agren, B., Nilsson-Ehle, P and Rastam, L. 2001. Association between body weight, body composition and cholesterol levels in middle-aged men. The coronary risk factor study in Southern Sweden (CRISS). *European Journal of Epidemiology*, 17 (16): 521-526.

Hendricks, M.K., Goeiman, H and Dhansay, A. 2008. Food-based dietary guidelines and nutrition interventions for children at primary healthcare facilities in South Africa. *Maternal and Child Nutrition*, 3.251-258.

Hendricks, S.L and Lyne, M.C. 2009. Does food security improve when smallholders access a niche market? Lessons from the Embo Community in South Africa.The African Centre for Food Security, University of KwaZulu-Natal, Durban.

Heymsfield, S. Band Williams, P.J. 1998. Nutritional assessment by clinical and biochemical methods. In: Shills, M.E and Young, V.R. eds. Modern Nutrition in Health and Disease. Philadelphia, Lea and Febiger.

Hoddinott, J and Yohannes, Y. 2001: 7. Dietary diversity as a food security indicator. Food and Nutrition Technical Assistance, Academy of educational development, Washington DC.

Hseih, S.D., Yoshinanga, H and Muto, T. 2003. Waist-to-height-ratio.A simple and practical index for assessing central fat and metabolic risks in Japanese women and women. *International Journal of obesity and related metabolic disorders*, 27(5): 610-616.

Hsieh, S.D and Muto, T. 2004. The superiority of waist-to-height ratio as an anthropometricindex to evaluate clustering of coronary risk factors among non-obese men and women.The Institute for Cancer Prevention and Elsevier Inc. *Preventive Medicine,* 40: 216– 220.

Hsieh, S.D and Muto, T. 2005. The superiority of waist-to-height ratio as an anthropometric index to evaluate clustering of coronary risk factors among non-obese men and women. *Preventative Medicine*, 40: 216– 220.

Hsieh, S.D., Muto, T., Yoshinaga, H., Tsuji, Arimoto, S., Miyagawa, M., Hoshihara, Y and Hara, M. 2006. Waist-to-height ratio, a simple and effective predictor for metabolic risk in Japanese men and women. *International Congress Series*, 1294: 186–189.

Human Science Research Council (HSRC), 2004. Food security in Africa: Key policies issues for the medium term. Human Science Research Council (HSRC). Retrieved 20 February 2005 from www.sarpn.org.za.

Institute of Medicine (IOM). 1997. Dietary reference intakes for calcium, phosphorus , magnesium, vitamin D and fluoride. Washington DC, Food and Nutrition Board, National Academy Press. Available at: www.nap.edu [Accessed June 15, 2004].

IOM. 1998. Dietary reference intake for thiamine, riboflavin, niacin, vitamin B6 pantothenic acid, biotine and choline. Washington DC, Food and Nutrition Board, National Academy Press. Available at: www.nap.edu [Accessed June 15, 2004].

IOM. 2001. Dietary reference intake for vitamin A, vitamin k, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. Washington DC, Food and Nutrition Board, National Academy Press. Available at: http//www.nap.edu [Accessed 15 June 2004].

IOM. 2002. Dietary reference intake for energy carbohydrates, fiber, fat, fatty acids, cholesterol, and protein and amino acids. Washington DC, Food and Nutrition Board, National Academy Press. Available at: http//www.nap.edu [Accessed 15 June 2004].

International Food Policy Research Institute (IFPRI) and FAO 2008. Impact of climate change and bio-energy on nutrition. Available: http://www.fao/ag/agn/agns/files/HLC2_Food_Safety_Bio-energy_Climate_Change.pdf [accessed July 17 2008].

Ismail, S and Manandhar, M. 1999. Better Nutrition for Older People: Assessment and Action. London, Help Age International and London school of Hygiene and Tropical Medicine.

Ismail, S., Immink, M., Mazar, I and Nantel, G. 2003a. Community based food and Nutrition programmes. What makes them successful? A review and analysis of expenses. Rome. FAO.

International Zinc Nutrition Consultative Group (IZiNCG). 2004. Assessment of the risks of zinc deficiency in populations and options for its control. *Food and Nutrition Bulletin*, 25: S91-S204.

Jacobs, P. 2009. Identifying a target for food security in South Africa. Unpublished Reoprt, Centre for poverty employment and growth. Pretoria. *Human Science Research Council*.

Jaf, M and Qudar, E.L. 2008. Dietary intake of selected common vegetable foods and their total arytenoids determination.

Javier, E., Baez. 2007. Guidelines for designing and evaluations of community based nutrition programs.

Jooste, P.L. 2004. Monitoring the effect of introduce mandatory iodization at an elevated Iodine concentration. *Journal of food science Nutrition,* 55(7) 555-9 -8.

Jooste, P.L., Labadarios D., Nel H and Strydom E. 2007. Iodine content of household salt, drinking water and iodine status of women and children. In: Labadarios D, ed. National Food Consumption Survey- Fortification Baseline (NFCS-FB) South Africa, 2005. Pretoria. DOH.

Katzenellengogan, J and Joubert, G. 2008. Data collection and measurements: Joubert, G and Ehrlich, R. (eds) epidemiology-A research manual for South Africa 2nd. South Africa: Oxford South Africa.

Kennedy, G., Nantel, G and Shetty, P. 2003. The scourge of hidden hunger.Global dimension of micronutrient deficiencies, 32(1-14).

Kennedy, G., Berardo, A., Papavero, C., Horjus, P and Ballard, T. 2010. Proxy measures of household food consumption for food security assessment and surveillance: Comparison of the household dietary diversity and food consumption scores. Public Health Nutrition, 13: 2010-2013.

Kennedy, G., Ballard, T and Dop, M. 2011. Guidelines for Measuring Household and Individual Dietary Diversity, 21.

Kesa, H and Oldewage-Theron, W. 2005 .Anthropometric indications and nutritional intake of women in Vaal Triangle, South Africa. *Public Health Nutrition,* 119: 294-300.

Key, T.J. 2005. Cancers. In: Geissler, C and Powers, H. eds. Human Nutrition. London, *Elseveir*, 415-425.

Kgaphola, M.S and Boshoff, E. 2002. Proposal for a conceptual frame of reference to study household's food accessing strategies and utilization patterns. *Journal of family ecology and consumer sciences*, 30: 65-74.

Khuzwayo, P.M.N. 2008. Food and Nutrition security. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council*, 167.

Kirkland, T.M., Kemp, R and Lori M. R. 2011.Toward Improved Understanding of Food Security: A Methodological Examination Based in Rural South Africa. A working paper.

Kris-Etherton, P.M., Eckel, R.H., Haward, W.S and Appel, L.J. 2003. Omega 3 fatty acids and cardio-vascular diseases. New recommendations from the American Heart Association. Arteriocler Thromb Vasc Biol, 23: 151-152.

Kruger, H.S., Venter, C.S, Voster, D.S.C., Hester, H and Margetts, B.M. 2002. Physical inactivity is the major determinant of obesity in the North West Province, South Africa: The Thusa study. *Nutrition Study*, 18: 422-427.

Kruger, H.S., Hendricks, M and Puoane, T. 2008. Nutritional management of multiple nutrient deficiencies. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council*, 663-694.

Labadarios, D., Steyn, N.P., Mgijima, C., Dladla, N. 2005. Review of the South African nutrition policy 1994 -2002 and targets for 2007: achievements and challenges. Nutrition 2005, 21 100-108.

Labadarios, D. ed. 2007. National Food Consumption Survey-Fortification Baseline, South Africa, 2005 (NFCS-FB). Stellenbosch, University of Stellenbosch.

Labadarios, D., Moodie, I.M and Van Rensburg, A. 2007. Selected micronutrient status. Vitanim A. In Labadarios, D. edition. National Food Consumption Survey-Fortification Baseline, South Africa, 2005 (NFCS-FB). Stellenbosch, University of Stellenbosch.

Labadarios, D., Swart, R., Maunder, E.M.W., Kruger, H.S., Gericke, G.J., Kuzwayo, P.M.N., Ntsie, P.R., Steyn, N.P., Schloss, I., Dhansay, M.A., Jooste, P.L and Dannhauser, A. 2008. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-I) South Africa, 2005. *South African Journal of Clinical Nutrition*, 21(3): 247–300.

Labadarios, D., Davids, Y.D., Mchiza, Z and Weir-Smith, G. 2009. The Assessment OfFood Insecurity In South Africa. Unpublished paper, Centre for Poverty, Employment and Growth. *Human Sciences Research Council*.

Labadarios, D.,   Steyn, N.P and Nel, J. 2011. How diverse is the diet of adult South Africans? Available at: http://www.nutritionj.com/content/10/1/33. *Nutrition Journal*, 10:33 doi:10.1186/1475-2891-10-33.

Labadarios, D., Mchinza, Z.J., Steyn,N.P., Gericke, G., Maunder, E.M.W., Davidsa Y and Whadi-ah Parker, D. 2011. Food security in South Africa: a review of national surveys. Accessed on 4 October 2011, *Bull World Health Organisation 2011,* 89:891–899

Lado, C. 2001. Environmental and socio-economic factors behind food security as a policy strategy in Botswana. Development of Southern Africa, 18 (2): 141-168.

Ladzani, R., Nel, J. H and Steyn, N. P. 2008. An evaluation of the effectiveness of nutrition advisors in three rural areas of Northern Province. *South African Journal of Clinical Nutrition,* (13)3: 75-79.

Laing, M. 2011. The ramifications of food security. University of Kwazulu-Natal's (UKZN) African centre for crop improvement.Corporate relations division of UKZN. Touch issue: 2.

Lamberg. 2006. Rx for obesity: eat less, exercise more, and maybe get more sleep. JAMA, 295: 2341-4.

Langenhoven, M., Kruger, M., Gouws, E and Faber, M. 1991. Medical Research Council (MRC) food composition tables.3rd ed. Parow. *South African Medical Research Council.*

Lombard, M.J and Burger, H.M. 2007. Development and validation of a culturally specific dietary assessment tool to determine habitual dietary patterns of people living in high esophageal cancer risk areas in rural Transkei (Unpublished data).

Lee, R. D and Nieman, D.C. 2003. Nutritional Assessment. 3rded. New York: McGraw-Hill Hill. NCHS, growth standards [online]. Available at:http//www.who.int/nutrigrowthbd/reference/en [25 February 2007].

Lee, R. D and Nieman, D.C. 2010. Nutritional Assessment, 3rded. New York: McGraw-Hill Higher Education, Toronto, Ontario.

Liao, F.H. 2007. Effectiveness of soy based protein compared with traditional low calorie diet on weight loss and lipid levels in overweight adults. *Nutrition*, 23: 129-142.

Limpopo Department of Agriculture. 2002. Revitalisation of 3664. *African Journal of Agricultural Research*.

Mahan, L.K and Scott-Stump, S. 2008.Krause's food and nutrition Therapy, 12th edition. Missouri, Saunders.

Mamabolo, R.L., Alberts, M., Styne, N.P., Delemarre-Van de Waal, H.A., Nthangeni, N.G and Levitt, N.S. 2004. Evaluation of the effectiveness of iron and folate supplementation during pregnancy in a rural area of Limpopo province. *South African Journal of Clinical Nutrition*, 17: 15-17.

Mann, J and Trusswell, A.S. 2007. Essentials of human nutrition.3rd edition. New York. Oxford Press.

Mann, 2006. Nutrition recommendations for the treatment of type 2 diebetes and the metabolic syndrome: An advanced based review. *Nutrition Review*, 64: 422-427.

Maritz, 2006. Dyslipidaemia in South Africa. In: Steyn, K., Fourie, J and Temple, N eds. Chronic Diseases of Lifestyle in South Africa: 1995-2005. Technical Report. Cape Town. *South African Medical Research Council*, 97-108.

Matshe, I. 2009. Contribution of Smallholder Production to Food Security: Evidence From Sub-Saharan Africa. Unpublished paper, Centre for Poverty, Employment and Growth, *Human Sciences Research Council.*

Mauder, E.M.W and Meaker, J.L. 2007. The current and potential contribution of home grown vegetables to diet in South Africa. Pietermaritzburg, University of KwaZulu-Natal (UKZN).

May, J and Woolard, I. 2007. Poverty traps and structural poverty in South Africa: Reassessing the evidence from KwaZulu-Natal. Unpublished paper, School of Development Studies, Howard College Campus, University of KwaZulu-Natal, Durban.

Mayet, F.G. 1985. Anaemia of pregnancy. South African Medical Journal of Nutrition, 67: 804-809.

MacIntyre, U.E., Venter, C.S. Voster, H.H and Steyn, H.S. 2001a. A culture-sensitive quantitative food frequency questionnaire used in an African population; 2Relative validation by 7-day weighed records and biomarkers. *Public Health Nutrition*, 4: 63-71.

Maclntyre, U.E.,Venter, C.S., Vorster, H.H and Steyn, H.S. 2001b. A combination of statistical methods for the analysis of the relative validation data of the quantitative food frequency questionnaire used in THUSA study transition, health and urbanization in South Africa. *Public Health Nutrition*, 4: 45-51.

MacIntyre, U.E., Venter, C.S., Vorster, H.H and Steyn, H.S. 2001c. A culture-sensitive quantitative food frequency questionnaire used in an African population. Development and reproducibility. *Public Health Nutrition*, 4: 3-62.

MacIntyre, U.E, Kruger, H.C, Venter, C.S and Voster, H.H. 2002. Dietary intake of an African population in different stages of transition in the North West province, South Africa: The Thusa Study, 2002. *Nutrition Res*, 22: 239-56.

Magbagbeola, J. A. O., Adetoso J. A and Owolabi, O. A. Neglected and underutilized species (NUS): A panaceafor community focused development to poverty alleviation/poverty reduction in Nigeria. Journal of Economics and International Finance. Available online at:http://www.academicjournals.org/JEIF, 2(10), 208-211.

Magdoff, F. 2008. The world food crisis.Sources and solutions.Monthly review. In: World hunger statistics. Available at: http://www.uvm.edu/~fmagdoff/World%20Food%20Crisis.pdf. 1-15.

Maliwichi, L. L., Oni, S. A and Obadire, O. S. 2012. An investigation into the factors affecting food availability, choices and nutritional adequacy of smallholder farming households under irrigation and farming in Vhembe district of Limpopo, province, South Africa. Centre for Rural Development and Poverty Alleviation, School of Agriculture, University of Venda, South Africa.

Malnutrition Matters.   2009. Malnutrition. Food Technology Solutions. Available online at: www.malnutrition.org. Accessed on: 21/11/09.

Margetts, B.M and Nelson, M., 2006. Design concepts in nutritional epidemiology 2nd edition. New York. Oxford Press, 124-132.

Marias, D., Marias, M.L and Labodorios, D. 2007. Use of knee height as a surrogate measure of height in older South African. *South African Journal of clinical Nutrition*, 20:39-44.

Martin C., Carolina, D and Diaz–Bellina, E. 2008. The impact of global and domestic trade liberalization of poverty and inequality in Argentina, 6-7.

Matla, M.T.H. 2008. The contribution of food access strategies to dietary diversity of farm worker households on Oranje farm in the Fouriesburg district (RSA). Master in Consumer Science, University of Pretoria.

Mauder, E. M. W., Khoza, S., Kuzwayo, P.M.N and Barth Eide, W. 2008. A right based approach to community nutrition. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council,*1-46.

Maunder, E. M. W., Matji, J and Hlatshwayo-Molea, T. 2001. Enjoy a variety of foods – difficult but necessary in developing countries. *The South African journal of clinical nutrition*, 14 (3 Supp): S7-S11.

Maxwell, D., Watkins, B., Wheeler, R and Collins, G. 2003. The coping strategies index: a tool for rapidly measuring food security and the impact of food aid programmes in emergencies. In: FAO. International workshop on Food security in complex emergencies: building policyframeworks to address longer-term programming challenges. Tivoli, 23-25 September 2003. Available at: ftp://193.43.36.44/docrep/fao/meeting/009/ae513e.pdf.

Maxwell, D. 1996. Measuring food insecurity: The frequency and severity of coping strategies. In: FAO International workshop on Food security in complex emergencies: building policy frameworks to address longer-term programming challenges. *Food policy*, 21 (3) 291-303.

Mbaya, S. 2003. The Southern African food security crisis. A paper presented at the meeting: Food Security in Southern Africa: Causes and Responses from across the Region, on the 18th March 2003. *Human Sciences Research Council*. Pretoria.

Mbhenyane, X., Makuse, S., Ntuli, S., Mbhatsani and Sayed, N. 2008. Different cultural preselects and different diets in South African communities. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council,* 199-232.

Micronutrient Forum. 2007.Available at: www.micronutrientforum.org.

Millennium Village Project, 2010. Harvest of Development in Rural Africa: The Millenium Village after Three Years. MVP. New York.

Mjonono, M., Ngidi, M and Hendriks, S. 2012. Investigating household food insecurity coping strategiesand the impact of crop production on food security usingcoping strategy index (csi). [Accessed in July 2012]. *African Journal of Agricultural Research,* Vol. 7(25), 3653-3664.

Mkhize, N.X. 2011. Situational analysis of free living elderly in Umlazi township. M Tech Consumer Science: Food and Nutrition, Durban university of Technology.

Moeng, L and de Hoop, M.E. 2008. Government community nutrition programmes and strategies. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council,* 287-314.

Mostert, D., Steyn, N.P., Temple N.J and Olwagen, R. 2005. Dietart intake of pregnant women and their infants in poor black South African community. *Curationis*, 28 (4): 19-9.

National Institutes of Clinical Excellence (NICE).(2006). Nutrition support in adults: Oral nutrition support, enteral tube feeding and parental nutrition. Available at: http//www.nice.org.uk/pdf/CGO32NCE.pdf_[Accessed 1 May 2006].

National Institute of Health (NIH). 2000. The practical guide: identification, identification and treatment of overweight and obesity in adults. US National Heart, lung and Blood Institute.NHI publication number 00-4048.

Napier, C.E. 2006. Evaluation of a feeding programme in addressing malnutrition in a primary school. D.Tech. Food Services Management. Vaal University of Technology.

Nel, J.H and Steyn, N.P. 2002. Report on South African food consumption studies undertaken amongst different population groups (1983-2000): average intakes of foods commonly consumed. Pretoria. DOH.

NICUS (Nutrition information centre University of Stellenbosch). 2003. Dietary reference intakes [online]. Available at: http//www.sun.ac/nicus [Accessed 20 October 2009].

NICUS. 2005. Tuberculosis and nutrition. Available at: http://www/sun/ac/za [Accessed February 20, 2008].

NICUS. 2005. Understanding the vitamin scenario confusion. Available at: http//www.sun.ac.za/nicus [Accessed 15 February 2008]. Niedel, S. 2000. Diabetes diversified. Diabetes Update, 2000: 22-23.

Nojilana, Norman, Dhansay, Labadarios, Van Stuijvenberg and Braadshaw. 2007. Estimating the burden of disease attribute to iron deficiency anaemia in South Africa in 2000. *South African Medical Journal*, 97: 741-746.

Nord, M., Coleman-Jensen, A., Andrews, M and Carlson, S. 2009.Household food security in the United States*.*ERR-108. Available: http://humanneeds.vcu.edu/files/FS-ERR108.pdf.

Norman, K., Pichard, C., Lochs, H and Pirlich, M. Prognostic impact of disease-related malnutrition. Clinical Nutrition. Available online at: http://dx.doi.org/10.1016/j.clnu.2007.10.007. [Accessed February, 01, 2008].*Elsevier*, 27 (1): 5-15.

Nzinguheba, G., Palm, G.A., Berhe, T., Denning, G and Dicko, A. 2010. The African Green Revolution: Results from the Millennium Villages Project. Advances Agronomy, 109: 75-115.

Oldewage-Theron, H.W., Salami, L.I., Zotor, F.B., Matiwane, N and Venter, C.S. 2005a. The elderly and health: A case study from Sharpville, South Africa. Proceedings of the Inaugural National Congress. Nairobi. Kenya, 1-30.

Oldewage-Theron, H.W and Kruger, R. 2008b. Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpville. *South African Journal of Nutrition for the elderly*, 27(1/2).

Oldewage-Theron, H.W., Fuller, L, 2008. Food quality and safety. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town. *South African Medical Research Council*, 663-694.

Olsson, E and Karlstrom, B. 2003. Body composition, dietary intake and estimated energy expenditure in female patients on geriatric rehabilitation wards. *Scandinavian journal of nutrition*, 47(4): 179-187. Available at :http://www.foodandnutritionresearch.net/index.php/fnr/article/view/1491.

Oni, S.A., Maliwichi, L.L., Obadire, O.S 2011. Assessing the contribution of smallholder irrigation to household food security, in comparison to dry-land farming in Vhembe district of Limpopo province, South Africa. *Afr. J. Agric. Res*., 6(6): 1991-637X.

Oram, M and Moley, J.E. 2000. Assessment of protein energy malnutrition in older persons Part 1. History, examination, body composition and screening tools. *Nutrition*, 16: 50-63.

Palmer, K and Sender, J. 2006. Prospects for on-farm self employment and poverty reduction. Analysis of the South African income and expenditure survey 2000. *Journal of Contemporary African Studies*, 24 (3):347-376.

Pauw, K. Mncube, L. 2007. The impact of growth and redistribution on poverty and inequality in South Africa. Retrieved 3 September 2007 from www.commerce.uct.ac.za.

PePinstrup and Andersen, A.H.2008. Achieving the full potential of food security: 53-57. Cape Town. *South African Medical Research Council*.

Peterson, R.C., Thomas, R.G., Grundman, M., Bennet D., Doody, R., Ferris, S., Galasko, D., Kaye, J., Levey, A., Pfeiffer, E and Sano, M. 2005. Vitamin E and donepizil for the treatment of mild cognitive impairment. *English Journal of Medicine*, 352:2379-88.

Pieters, M and Jerling, J.C. 2005. Measuring the glycaemic index-concensus and issues of debate. *South African Journal of Clinical Nutrition*, 18: 232-6.

Plassman, B.L., Langa, K.M and Fisher, G.G. 2007. Prevalence of dementia in the United States: the aging demographics and memory study. *Neuro epidemiology*, 29(1-2): 125-132.

Presidency. 2007. Development indicators-mid term review. Pretoria. The Presidency.

Ramakrishnan, U and Huffman, S.L. 2001. Multiple micronutrient malnutrition. What can be done? In: R.D. Semba and M.W Bloem, eds. Nutrition and Health in Developing Countries. Totowa, N.J. *Humana Press*, 365-91.

Rankinen, T., Zubeni, A., Chagnon, Y.C., Weisnagel, S.J., Argyropoulus, G., Walts, B., Perusse, L and Bouchard, C. 2006. The human obesity gene map: the 2005 update. Obesity (Silver Spring). Apr, 14(4): 529-644.

Refiel, C., Nord, M., Sudeghizadeh, A and Mohammed, H.E. 2009.Assessing the internal validity of a household food survey–based food security measure. *Nutrition journal*, 8: 28.

Regional Inter-Agency Co-ordination Support Office (RIACSO). 2002. HIV/AIDS and the southern African Humanitarian Crisis. Report from Consultation organised by UNAIDS and RIACSO. Johannesburg, 6-7.

Riboli, E and Norat, T. 2003. Epidemiologic evidence on the protective effects of fruits and vegetables on cancer risk. *American Journal of Nutrition*, 78:559S-569S.

Rice, A. L. 2007. Vitamin A deficiency: counting the cost in women's lives. Available: http://pdf.usaid.gov/pdf_docs/PNADK394.pdf.

Rice, K. 2012. Eating seasonally for optimal health. Exeminer.com

Ruel, M. T. 2003. Operationalising dietary diversity: A review of measurement issues and research priorities. *Journal for Nutrition*, (133): S3911-S3926.

Ruel, T.M., Grebmer, K., Nestorova, B., Menon, P., Olofinbiyi, T., Fritschel, H and Yohannes, Y. 2010. Global Hunger Index. Challenge of hunger: Focus on the challenges of child malnutrition. IFPRI. Washington DC, 25(27-56).

SADAFF, 2010. Report on the occasion of the Agriculture, S.A congress, 1-11.

SADC (Southern African Development Community) FANR Vulnerability Assessment Committee. 2003. Towards identifying impacts of HIV/AIDS on food insecurity in southern Africa and implications for response: Findings from Malawi, Zambia and Zimbabwe. Harare, Zimbabwe.

Sanchez, P., Palm, C., Sachs, J.D., Denning G and Flor, R. 2007. The African Millenium Villages. United States of America, 104: 16775-16780.

SASSA , 2008. Food Bank Programme. South Africa Social Security Agency (SASSA) Strategic Plan 2008/09-2010/11, Pretoria: Department of Social Development.

Sayed. 2002. Graduate reading the fundamentals of nutrition security in rural in Schonfeldt. H (Ed). Nutrition security in rural communities. Pretoria. Flemish Interuniversity Council.

Schneider, M., Norman, R., Parry, C., Bradshaw, D and Puddemann, A. 2007a. Estimating the burden of disease attributable to alcohol intake in South Africa in 2000. *South African Medical Journal of Nutrition*, 97:664-672.

Schneider, M., Norman, R., Parry, C., Bradshaw, D and Puddemann, A. 2007b. Estimating the burden of disease attributable to low fruit and vegetableintake in South Africa in 2000. *South African Medical Journal of Nutrition*, 97:717-723.

Schoeller, D.A. 2009. The energy balance equation: looking back and looking forward are two very different views. *Nutrition Reviews*, 65(5): 249-254.

Scholtz, S.C., Vorster, H.H and Matshego, L. 2001. Food from animals can be eaten everyday-not a conundrum. *South African Journal of Clinical Nutrition*, 14(3): 39-46.

Scott, J. 2007. Nutritional anaemia-B vitamins. The Guidebook Nutritional Anaemia. Sight and Life Pres, 22-23.

Sebate, J. 2003. Nut consumption and body weight. *American Journal of Clinical Nutrition,* 78 (suppl): 647S-50S.

Senekal, M., Mchiza, Z and Boley, S. 2008. Nutrition for adults: In Steyn, N.P and Temple, N (eds.). In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town: *South African Medical Research Council*, 479-546.

Slabber, 2005. Complexity of consumer understanding of the glycaemic index concepts and practical guidelines for incorporation in diets. *South African Journal of Clinical Nutrition*, 18:252-7.

Smith, L.C and Haddad, L. 2000. Overcoming child malnutrition in developing countries: Past achievements and future choices. Food, Agriculture and the Environmental Discussion Paper 30.*International Food Policy Research Institute*. Washington, DC.

Soqele, S and Bruyns, N. 2007. Consumer studies grade 12 learners book, a right based approach. Cape Town: South Africa, (module 1-9) ISBN 978-1-77-01615-5, 62-74.

Soqele, S and Bruyns, N. 2006. Consumer studies grade 11 learners book, a right based approach. Cape Town: South Africa (module 1-7) ISBN 555-1-77-01635-2, 43-44.

STATSSA (Statistics South Africa). 2005. Stats in brief. Pretoria.

STATSSA, 2006. Mid-year population estimates in South Africa, [online]. Statistical release P0302. Available at: http//www.ststsa.gov.za/publication/P03022006.pdf_[Accessed 26 February 2008].

STATSSA. 2007. Income and expenditure of households 2005/2006 [online]. Available at: http//www.statssa.gov.za/publication/statskeyfindings.asp [Accessed 10 March 2008].

STATSSA, 2011. General household survey 2011. Statistical release. P0318. Available at: http//www.statssa.gov.za/publication/statskeyfindings.asp [Accessed on 11 July 2011].

Steenkamp, G and Delport, L. 2005. The South African glygaemic index and load guide. Place, Glycaemic Index Foundation of South Africa.

Steve, M.J., Farre, R., Frigola and Pilamunga, M. 2001. Continents of vitamin B1 B2 B6 and B12 in pork and meat products. 1.

Steyn, K. 2006. Hypertension in South Africa. In: Steyne, K., Fourie, J., Temple, N.J. eds. Chronic Diseases of Lifestyle in South Africa: 1995-2005. Technical Report. Cape Town, *South African Medical Research Council*, 80-96.

Steyn, N.P. 1988. Nutritional status of 11 year old children in the Western Cape Province of South Africa, PhD. Thesis: Stellenbosch, University of Stellenbosch.

Steyn, N.P., Labadarios, D and Huskisoon, J. 2000. General Introduction. In Labadarios, D. (Ed) National Consumption Survey Pretoria. Department of Health: Directorate of Nutrition.

Steyn, N.P and Labadarios, D. 2000. Dietary Intake: the 24-hour recall method. In D. Labadarios, ed. The National Food Consumption Study (NFCS): Children aged 1-9 years, South Africa, 1999. Pretoria: DOH, 218-312.

Steyn, N.P., 2006a. Nutrition and chronic diseases of lifestyle in South Africa, In: K. Steyn, J. Fourie and N. Temple (eds). Chronic Diseases of lifestyle in South Africa: 1995-2005. Technical Report. Cape Town. *South African Medical Research Council*, 33-41.

Steyn, N.P. 2006b. Dietary changes and the health transition in South Africa: Implications for Health policy. *South African Medical Research Council*: Cape Town.

Steyn, N.P. 2006c. Nutrition and Chronic Diseases of Lifestyle in South Africa. In: D Labadarios, ed. The National Food Consumption Survey (NFCS): Children aged 1-9 years, South Africa, 1999. Pretoria. DOH, 219-311.

Steyn, N.P., Bradshaw, D., Norman, R., Joubert, J.D., Schneider, M and Steyn, J. 2006. Dietary Changes and the Health Transition in South Africa: Implications for Health Policy. Cape Town, *South African Medical Research Council.*

Steyn, N. P and Nel, J. H. 2006. Dietary intake of adult women in South Africa and Nigeria with the focus on the use of spreads. Available at: http://www.mrc.ac.za/chronic/kenyareport.pdf.

Steyn, N.P., Blaauw, R., Lombard, M.J., Wolmarans, P. 2008. Nutritional management of chronic non- communicable diseases. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town. *South African Medical Research Council,* 695-749.

Stipanuk, H.M. 2006. Disturbances of energy balance. In: HM Stipanuk. Biochemical, Physiological, Molecular Aspects of Human Nutrition. 2nd ed. Missouri, Saunders.

Sun, W. Y., Sangweni, B., Chen, J and Cheung, S. 1999. Effects of a community-based nutrition education program on the dietary behavior of Chinese-American college students. *Health Promotion International*, 14 (3): 241-250. Available at: http://heapro.oxfordjournals.org/content/14/3/241.full.

Swindale, A and Bilinsky, P. 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide. Version 2. Food and Nutrition Technical Assistance Project (FANTA), Academy for Educational Development. NW Washington, DC, 20009-5721.

Swart, R and Dhansay, A. 2008. Nutrition in infants and pre-school children.In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town. *South African Medical Research Council*, 377-440.

Swindale, A and Ohri-Vachaspati, P. 2004. Measuring household food consumption: A technical guide. Washington D.C: Food and Nutrition Technical Assistance (FANTA) Project, Academy for Educational Development (AED). Available: http://pdf.usaid.gov/pdf_docs/Pnadd641.pdf.

Tinsa, F., Ben Amor, S., Kaabachi, N., Ben Lasound, M., Bousseta, K and Bousnina, 2009. Unusual case of thiamine responsive megolablastic anaemia. *La Tunisie Medicale*, 87 (2): 159-163.

Tsugawa, N., Shiraki, M., Suhara, Y., Kamao, M., Tanaka, K and Okano, T. 2006. Vitamin K tatus of healthy Japanese women: age-related vitamin K requirement for gamma-carboxylation of osteocalnin. *American Journal of Clinical Nutrition*, 83 (2): 380-386.

United Nations Millennium Project. 2005. Investing in Development: A practical plan to achieve the Millennium Development Goals, UNDP, New York Millennium Project reports accessed at http://www.unmillenniumproject.org/reports/index.htm.

UNAIDS (Joint United Nations Programme on HIV/AIDS) and WHO (World Health Organisation). 2007. WHO Fact Sheet, 2007. AIDS epidemic update–regional summary.Geneva: UNAIDS and WHO.

UNICEF. 1990. Strategy for improved nutrition of children and women in developing countries, 15.

UNICEF. 2004. Progress for Children: A Child Survival Report Card. New York: UNICEF. Available at: http://www.unicef.org/publications/files/29652L01. [Accessed 25 August 2005], 1(21

UNICEF. 2008. Programme Guidance on Management of Severe Acute Malnutrition: Programme and Supply Components of scaling up an integrated approach.

United National Development Programmers (USDP). 2010. What will it take to achieve the millennium development goals, 39.

United Nations Systems. 2004. Nutrition for Improved Development Outcomes: 5th Report on the World Nutrition Situation. Standing Committee on Nutrition (SCN).

USAID 2003. USAID Sub Saharan Africa [online]. Available at: http://www.africastories.usaid.gov/search_detail.cfm?storycountry ID=24 and sectored=0 and year ID=3 [Accessed 2 April 2010].

U.S. Department of Agriculture (USDA). 2009. Food Security in the United States: Measuring Household Food Security. Available at http://www.ers.usda.gov/Briefing/FoodSecurity/measurement.htm.

Van der Berg, S. 2006. Public spending and the poor since the transition to democracy. In Bhorat, H. and Kanbur, R. (eds). Poverty and Policy in Post-apartheid South Africa, Cape Town. *Human Science Research Council*. Press.

Van Stuijvenberg, M.E., Smuts, C.M., Lombard, C.J and Dhansay, M.A. 2008. Comparison of the efficacy of NaFeEDTA, ferrous fumarate and electrolytic iron as fortificants in South African brown

bread. 2008 Nutrition Congress Evidence based Nutrition leading the way 28 September – 2 October 2008. Abstract 6

Van Zyl, J., Kirsten, J and Binswanger, H. 1996. Agricultural land reform in South Africa: policies, markets and mechanisms. Cape Town: Oxford University Press.

Vijayaranghavan, 2004. Iron deficiency anaemia. In: Gibney, M.J., Margetts, B.M., Kearney, J.J and Arab, L. eds. Public Health nutrition. Oxford, *Blackwell Science*, 226-235.

Von Grebmer, K., Ruel, M.T., Menon, P., Nestorova, B., Olofinbiyi, T., Fritschel, H and Yohannes, Y. 2010. Global Hunger Index. The challenge of hunger: Focusing on the crisis of child under-nutrition. Bonn, Washington DC. Dublin.

Vorster, H.H., Love, P and Browne, C. 2001. Development of the food-based dietary guidelines for South Africa- The process. *South African Journal of Clinical Nutrition,* 14(3).

Voster, H.H., Venter, C.S., Wissing, M.P and Margetts, B.M. 2005. The nutrition health transition in the North-West province of South Africa: a review of the THUSA (Transition and health during urbanisation of South Africans. *Journal of Public Health Nutrition*, 8: 480-490.

Wach, T.D. 1995. Relation of mild-to-moderate malnutrition to human development: correctional studies. *Journal of Nutrition*, 125: 2245S-54S.

West, K. P. 2006. Protein-energy malnutrition (PEM) and undernutrition: causes, consequences, interactions and global trends. Available at:
http://ocw.jhsph.edu/courses/InternationalNutrition/PDFs/Lecture2.pdf

Wenhold, F., Kruger, S and Muehlhoff, E. 2008. Nutrition for school aged children and adolescents. In: Steyn, N.P and Temple, N (eds). Community Nutrition Textbook for South Africa, a right based approach. Cape Town. *South African Medical Research Council*, 441-478.

White, Z. 2006. Iron nutrition in infancy and early childhood. The specialist Forum, 6 (3): 43-8.

WHO. 1995. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. WHO Technical Report Series 854. Geneva: World Health Organization.

WHO. 1997. Obesity: Preventing and managing the global epidemic. Report on the consultative meeting. Geneva, WHO.

WHO. 1998a. Uses and interpretation of anthropometry in the elderly for assessment of physical status. *Journal Nutrition Health Aging*, 2: 5-17.

WHO. 1998b. Preparation and use of food based dietary guidelines. Report of a joint FAO/WHO consultation.Technical Report, Series No. 880.Geneva. WHO.

WHO. 2000a. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series 894. Geneva.

WHO. 2000b. Nutrition for Health and Development. A Global Agenda for Combating Malnutrition. Geneva.

WHO. 2000c. Health Promotion. Bridging the Equity Gap. Fifth International Conference on Health. Mexico.

WHO. 2000d. Management of the child with serious infection or severe malnutrition. Guidelines for care at the first referral level in developing countries. Publication number WHO/FCH/CAH/OO.1 Department of Child and Adolescent Health and Development. Geneva.

WHO. 2000e. The Asia-Pacific perspective: Redefining obesity and its treatment. Health Communications Australia: Melbourne.

WHO. 2001a. Iron deficiency anemia. Assessment, prevention and control. A guide for programme managers. WHO/NHD/01.3. Geneva.

WHO, 2001b. Health and nutritional status of the elderly in the former Yugoslav Republic of Macedonia. [Online] Available at: http://www.euro.who.int/Document/E72060.pdf [Accessed 14 March 2008].

WHO. 2003a. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert consultation. 2000. WHO Technical Report Series No. 916. Geneva.

WHO. 2003b. Nutrient requirements for people living with HIV/AIDS: Reports of a technical consultation. Geneva. WHO.

WHO. 2003c. Global Database on Child Growth and Malnutrition. Available at: http://www. who.int/nutgrowthbd [accessed in April 2007].

WHO. 2004a. Global database on body mass index [online]. Available at: http: //www.apps.who.int/bmi/index/jsp?intropage=intro-3.html [Accessed 27 May 2008].

WHO. 2004b. Expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *The Lancet*, 157-163.

WHO. 2005. Preliminary results of the World Health Survey 2002-2003: International physical activity data, South African results. Geneva. WHO.

WHO. WFP and UNICEF. 2005. Community-based management of severe acute malnutrition. www.who.org.

WHO. 2007. Tuberculosis care with TB. HIV co-management: Integrated management of adolescent and adult illness (IMAU). Geneva. WHO.

WHO. 2008a. Intervention on diet and physical activity: What works in press? Geneva.

WHO. 2008. Waist circumference and Waist-hip ratio. Report of a WHO Expert Consultation. Geneva.

WHO. 2009. Preventing and controlling micronutrient deficiencies in populations affected by an emergency.

Wolmarans, P and Wentzel-Viljoen, E. 2008. The South African food composition database and tools for collecting and analysis of dietary intake. In: Steyn, N.P and Temple, N (eds). Community textbook of South Africa. A right-based approach.Cape Town.*South African Medical Research Council,* 795-824.

Woodward, M. 2002. Weight loss. In: Ratnaike, R.N, ed. Practical Guide to Geriatric Medicine. Sydney. McGraw, 464.

World Bank. 2006. Repositioning Nutrition as Central to Development: A strategy for large-scale action, Directions in Development.The International Bank for Reconstruction and Development.The World Bank, Washington, DC.

World Food Program (WFP), 2000. Follow-up on the World food Summit.Progress in implementation of the World Food Summit plan of action. Rome.WFP. Available at: www.wfp.org/policies/ [Accessed 10 December 2001].

WFP. 2006. Ending child hunger and under-nutritioninitiative. Global framework for action: summary note. Informalconsultation on the ending child hunger and under-nutrition initiative.Press release, October 9.
http://documents.wfp.org/stellent/groups/public/documents/resources/wfp111813.pdf.

Zeppelin, J. 2005. Uptake, localization and non-carboxylase roles of biotin. *Annual Nutrition Reviews*, 25: 175-196.

Zevenbergen, H., De Brea, A., Zeeleberg, M., Laitinen,K., Van Duijin, J and Flotter, E. 2009. Foods with high fat quality are essential for healthy diets. *Annuals of Nutrition Metabolism*, 54(1): 15-24.

Zimmermann, M. 2007. Interactions between iron vitamin A, riboflavin, copper and zinc in the aetiology of anaemia. The guide book. Nutritional Anaemia. *Sight and Light Press*, 28-29.

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26 February 2009

Reference: Proposal Approval Hlatshwayo

Miss NQ Hlatshwayo
H707 Mthini Road
4359 Kwa Mashu

Dear Miss Hlatshwayo

MASTER'S DEGREE IN TECHNOLOGY: CONSUMER SCIENCES: FOOD AND NUTRITION

We are pleased to advise that the Faculty of Applied Sciences Research Committee approved the following:-

1.   Research Proposal and Dissertation Title, being:

        THE EFFECT OF SEASONAL FOOD VARIETY AND DIETARY DIVERSITY ON THE
        NUTRITIONAL STATUES OF A RURAL COMMUNITY

        Supervisor: Dr C Napier

        Please note that any proposed changes in the dissertation title require the approval
        of both your supervisor and the Faculty Research Committee.

2.   Application for funding in the amount of R15 000,00

        Please note that this funding is not paid directly to you but is controlled by your Head
        of Department. Any proposed changes to this funding allocation requires the
        approval of your supervisor, and the Faculty of Applied Sciences Research Committee.

The Institutional Research Committee has stipulated that:

(a)   ownership of any patent registered in respect of the results of your Master's/Doctor's
        Degree in Technology studies be retained by you as the initiator of the project;

(b)   should you make any profit from the results of your Master's/Doctor's Degree in
        Technology studies, you will be required to repay pro rata, the funding investment
        which the University has made in approving your request for funding;

c)   if the Durban University of Technology provided the equipment/materials for the creation of artefacts, this cost would be refunded to the University if such artefacts are sold;

(d)   Durban University of Technology be given first refusal in respect of any possible future sale by you of any patent that may be registered in respect of your said project.

May we remind you that in terms of Rule G24(2)(b), if a candidate fails to obtain the Master's/Doctor's Degree within the maximum time period allowed after first registering for the qualification, the Senate may refuse to renew the student's registration or may impose any conditions it deems fit. A student may thus apply to the Faculty Research Committee for an extension.

Please note that you are required to reregister every year. You are invited to apply for Postgraduate funding from the Postgraduate Development Services Office (PGDS) (conditions apply), the forms for which are available on the DUT website at www.dut.ac.za. You are further invited to contact the PGDS office for assistance with various aspects of your research studies.

Should you experience any problems relating to your research studies, your supervisor must be informed of the matter as soon as possible. If the difficulty persists, you must then approach your Head of Department and thereafter the Executive Dean of the Faculty.

Please refer to the 2009 General Rule Book concerning the rules relating to postgraduate studies, which include *inter alia* acceptable minimum and maximum time frames, submission of thesis/dissertations, etc.

Please do not hesitate to contact me if I can be of any assistance.

Yours faithfully
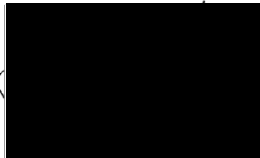
Mrs G Shackleford
Faculty Officer
Applied Sciences

cc
        PGDS Office
        PGDS Finance: Ms R Govender
        Head of Department
        Dr C Napier

DURBAN UNIVERSITY of TECHNOLOGY

Research Proposal

Faculty	Applied Sciences
Department	Food and Nutrition Consumer Sciences
Degree	MTech: Consumer Sciences Food and Nutrition

Student Surname	Hlatshwayo		Student No	
First Names	Nelisiwe		Title	Miss
Address	H707 Mthini road, Kwa-Mashu 4359			

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Title of Dissertation/Thesis	The effect of seasonal food variety and dietary diversity on the nutritional status of a rural community in KZN

Supervisor / Promoter	C. Napier		Title	Dr

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031 373 2326		082 412 2486	086 676 4283	carinn@dut.ac.za

Joint Supervisor/ Promoter			Title	

Tel (W)	Tel (H)	Cell	Fax	e-Mail

	Budget	Motivation Costs	
1.	Consumable Details	Refreshments for subjects, the data collection will take place in the community for at least 3-4 days and respondents cannot stand and wait to be assessed and interviewed without refreshments (100 subject x R 10.00)	R1000.00
		Printing: Baseline data gathering (100 subjects x questionnaires x 0.50 per page x 30 pages)	R1500.00
2.	Outside Specialist Services	Statistical Consultation. A Biostatistician will be needed for the different types of statistics for this study.	R1500.00
		Fieldwork Remuneration: Anthropometric measurements (100 subjects x 80 min per	R3350.00

204

		subject) 134hrs x R25.00 per hr	
3.	Books /Journal / documents		
4.	Library Charges	Interlibrary loans and literature	R200.00
5.	Equipment		
6.	Travel Costs	Meeting with stakeholders to explain the project and gain consent, travelling to the community by the researcher and fieldworkers to conduct the survey (4 people x 5 Transport days x 140km = 2800km x R2.90/km =)	R8 150.00
7.	Other	Stationery for field workers : Files / pens / rulers / staplers / tags	R200.00
	TOTAL		R15 900.00

1. Field of Research and Provisional Title

The effect of seasonal food variety and dietary diversity on the nutritional status of a rural community in KZN

2. Context of the Research

Introduction

A diversified diet is a very important aspect of human well being. The human body requires a fine balance of protein, carbohydrates, vitamins, minerals and fats to maintain an optimal level of functionality. The intake of a variety of food especially fruits, vegetables and grains is encouraged by the World Health Organisation (WHO). Obtaining all these nutrients requires the consumption of a large variety of food stuff some of which are not affordable to indigent rural community; hence their ability to achieve dietary diversity. At least 55% of nutrients consumed a day should be carbohydrates. These carbohydrates should be consumed from a variety of foods (Mann and Truswell, 2007; Becker and Hogman, 1999).

Most of the breadwinners in rural areas are migrant labourers who spend most of their time in cities and are therefore unable to cater to the diverse dietary requirements. Poor population suffer most from achieving dietary diversity because they consume a usual diet based on starchy stable food containing little or no animal or dietary products and a few fruits and vegetables resulting in multiple nutrient deficiencies (Ruel, 2005).

Diversified diets are thus a necessity for achievement of balanced nutrient intake for optimal nutrition. Optimal nutrition is essential for functional health status and mental well being of humans (Clausen, 2005).

The dietary guidelines given to the US public by The US Department of Health aim to improve the nutrient intake of the population so that illness due to chronic diseases can be reduced. The US Department of Health introduced a dietary diversity score (DDS) which makes it clear that all food groups i.e. dairy, grain, fruits, vegetables and meat should be consumed daily (Ashima Kant, Arthur Schatzkin, Tamara B Harris, Regina G Ziegler and Gladys Block 2002).

| Section C: Ethics | | | | | | | |
| Note: Ethics requirements are faculty specific. Kindly ensure that you are aware of and have complied with the relevant ethics requirements. | | | | | | | |

Tick as appropriate:

Humans		Organisations		Animals		Environment	
Yes √	No	Yes	No√	Yes	No√	Yes	No√

Indicate Category

1.	Exempt from Ethics and Biosafety Research Committee Review (straightforward research without ethical problems)	
2.	Expedited review (minimal risk to humans, animals or environment)	√
3.	Full Ethics and Biosafety Research Committee review recommended (possible risk to humans, animals, environment, or a sensitive research area)	
4.	Full Ethics and Biosafety Research Committee review required (risk to humans, animals, environment, or a sensitive research area)	

INFORMATION LETTER

Mphakathi waseMalangeni

Umfundi wase Nyuvesi i Durban University of Technology ukhethe ukwenza ucwaningo endaweni enihlala kuyona. Lolucwaningo lumayelana nomthelele wokudla okutshalwayo emasimini kuwowonke amasizini onyaka ekwenyuseni izinga lomsoco nezakhamzimba kwizakhamuzi zabesifazane basemaphandleni.

Lolucwaningo aluphoqi muntu kodwa ozoba yinxenye yalo uzongena ngokuzikhethela. Ongaba yinxenye kuzoba ngumuntu wesifazane ophakathi kweminyaka eyishumi nesishiyagolombili namashumi ayisikhombisa nanhlanu. Lolucwaningo luzokwenziwa emakhaya ngokuba ubuzwe imibuzo ethize mayelana nendlela odla ngayo nangesimo sakho sempilo. Yonke imiphumela yalolucwaningo iyoba yimfihlo futhi iyovalelw ngaphakathi enyuvesi ukuze ingabonwa muntu. Akuholwa lutho kodwa kufunakala nje ulwazi kuphela. Lolucwaningo aluhlange nezepolitiki futhi aluyona elenhlangano ethile

Abazoba yinxenye yalolucwaningo bayacelwa ukuba bakholeke futhi bathembeke uma bebuzwa imibuzo ngoba izimpendulo ezingelona iqiniso zingaholela ekubeni kutholakale imiphumela engelona iqiniso. Ucwaningo luzothatha isikhathi esingangemizuzu engamashumi amabili nje kuphela. Lolucwaningo luzokweniwa izikhathi ezine isehlobo, isekwindla isentwasahlobo kanye nasekwindla. Bonke abayinxenye yalolucwaningo bayaziswa ukuthi bavumelekile ukuphuma noma nini kulo uma bethanda. Awukho umthetho ophoqayo ukuba yinxenye kuze kube sekugcineni.

Singajabula kakhulu kodwa uma abayinxenye bengaba yinxenye kuwona wonke amasizini ukuze kutholakale imiphumela eyiqiniso.

Siyabonga kakhulu kubobonke abazovolontiya ukuba yinxenye yalolucwaningo. Uma uvuma ukuba yinxenye yalolucwaningo ngizocela ugcwalise ifomu okuwuphawo lokuthi uzoba yinxenye yocwaningo ngokuzikhethela.

CONSENT FORM

Mina……………………………………………ngiyavuma ukuba yinxenye yocwaningo ngokuvolontiya futhi ngiyazi ukuthi angeke ngihole lutho. Ngizoba yinxenye yocwaningo amasizini onke. Ngiyathembisa ikuthi ngizokhuluma iqiniso lonke neqiniso lodwa.

Yimina okholekile

…………………………

(Sayina ngenhla noma ushaye isiphambano)

INFORMATION LETTER

To: The community of Malangeni

The student of the Durban University of Technology will conduct a study in your area about the effect of seasonal food variety and dietary diversity on the nutritional status of women. The participants of this study will volunteer and no one will be forced to be part of the study. All participants must be women between the ages of eighteen and seventy-five. The study will be conducted at homes of all participants. Participants will be expected to answer questions about the types of food they eat in different seasons as well as other health questions. Please note that the study is not related to any political party.

Participants are encouraged to be as honest as possible in answering questions since false information may lead to false results. Each interview will take a maximum time of twenty minutes. This research study will be conducted in all four seasons, therefore all participants are urged to participate inn all four seasons in order to give ensure quality results. Participants may however pull out of the study anytime should they want to.

All answered questions will be locked away by the University officials and kept in a place no unauthorized persons may see them. NO PAYMENT will be made to participants.

A big THANK YOU is extended to all those who will participate and give honest answers. Please sign the consent form if to agree to voluntarily participate in the study.

CONSENT FORM

I…………………………………..agree to participate in the research study about the effect of seasonal food variety and dietary diversity in a rural community of Malangeni in KZN. I have read the information letter and understood it clearly. I promise to be as honest as possible in answering questions in order to ensure quality results. I promise to participate in all four seasons.

Yours faithfully

…………………………………..

Please sign on the dotted line above

FIELD WORKER MANUAL

Why am I here?

The Department of Food and Nutrition Consumer Sciences has a variety of research projects in communities around Durban. Research fieldwork in communities cannot be conducted without the assistance of fieldworkers.

What is a Field Worker?

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

How should I behave?

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

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

2. Respect: the subject must be treated with respect at all times. For example, he must be greeted politely, thanked for his time and co-operation; he must not be forced to answer a question that

he is not willing to answer. The field worker must never show if she disagrees with something the subject has said.

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

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

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

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

8. Neat Appearance: the field worker must always look neat and well groomed, but never overdressed. The following guidelines for dress should be followed:

- wear neat, simple and comfortable clothes

- do not wear badges or emblems of organisations, churches, etc. as these may influence the way subjects answer.

- dress so that the subject will concentrate on the interview and not on the way you are dressed.

How do I interview the subject?

If the subjects in a project are children, the parents and/or caregivers will need to be involved in the interview process to verify information that is needed for the questionnaires. If the subjects are adolescents they can usually remember what they ate and can answer their own questions. If the questions need to be translated the interviewers must be careful not to change the focus of the question.

1. How do I begin?

- ✶ Greet the subject politely and introduce yourself.

- ✶ Ask what language the subject would prefer to speak.

- ✶ Explain what the interview is about. Let the subject ask questions about the research. Reassure the subject that the answers are confidential and that neither the subject nor his or her address will be identified.

- ✶ Put the subject at ease. Be flexible and sensitive to the subject. Some subjects may be tense or apprehensive. In such cases, talking about something general, e.g. the weather may put the subject at ease.

2. How do I conduct the interview?

- During the interview direct the questions to the subject, but if it is a child and he or she cannot answer, ask the parent/caregiver for the information needed.
- Ask the questions exactly as they are written on the questionnaire. Try even to keep your tone of voice the same for each subject so as not to lead the subject or to give him an idea of how you want him to answer. You may have to explain a question or use different wording if the subject cannot understand it.
- Ask the questions in the order that they appear on the questionnaire. If the subject refuses to answer the question, record the lack of response and go on to the next question.
- Follow the instructions on the questionnaire. Sometimes it may seem that a subject has already answered a question when he answered a previous one, but the interviewer must still answer the question. For example, the questions about polony and atchaar. Start the question: "We have already mentioned this, but…".
- Do not lead the respondents. Do not try to influence the way the subject answers. Keep your facial expression friendly, but neutral. Never show surprise or shock or approval to the

subject's answers. Try to avoid unconscious reactions such as nodding the head, frowning, raising the eyebrows. Never give your own opinions.

- Keep the tone of the interview conversational. Be friendly and courteous. Do not make the subject feel as if he or she is taking an examination or is on trial be familiar with the questionnaire so that you can ask questions conversationally rather than reading them stiffly. The questionnaire is designed to keep the amount of writing to a minimum. However, if a subject gives a long response to an 'other' question, say, 'excuse me while I write that down'. Don't make the subject feel as though you have forgotten he is there.

- Keep control of the interview. Do not let the subject go off into irrelevant conversation. If he or she does, bring him or her gently back to the interview.

- Allow the subject time to think; do not hurry him to answer. However, if he is silent for too long, repeat the question, or 'prompt' him. For example, say 'you have told me how you cook cabbage; now please tell me how you cook pumpkin.

- Follow the instructions on the questionnaire for recording the responses. Record all responses, including negative responses or refusals to answer.

- **Make sure that you have written in the subject's number.**

3. How do I end the interview?

Tell the subject that you have finished the interview.

Reassure him that everything he has told you is confidential.

Thank him for his time and cooperation. Direct him to the next stage. Greet him.

Interview for the 24-Hour Recall Questionnaire.

The 24-hour recall is a questionnaire on what the subject has eaten the day before over a 24 hour period. Often the 24-hour recall is used to establish whether the QFFQ is valid or not. It is important to think of the 24-hour recall questionnaire as being a totally separate questionnaire and not a cross-reference to the QFFQ. Therefore, the answers to the questionnaire need to be very detailed. You will need to ask what is eaten and drunk, what type of food or drink is consumed, the brand name, the preparation method and the quantity consumed. Remember to include spreads, sugar and milk to tea / coffee, snacks, sweets, juices, sauces, salts and other condiments.

Example: The subject is asked what she has in the morning on waking up.

I: What do you have in the morning when you wake up?

S: I drink tea and then have porridge.

I: How do you take your tea?

S: With 2 sugars and a little milk.

I: How big is the spoon and is it level or heaped? (*Showing the teaspoon*).

S: It is like that spoon and I also have it heaped.

I: What type of porridge did you eat and how much did you have? (*Showing a bowl or cup*).

S: I had soft mealie meal porridge and I had about 2 of those cups to the fill in a bowl.

I: Do you put anything else in the porridge?

S: Yes, 2 spoons of sugar, like my tea, and a little margarine about 1 spoon.

I: At about what time was this meal?

S: At 6 am.

I: Where did you have this meal?

S: At home.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
6 am	**Home**	**Tea, rooibos**	**1 cup/mug**		

		With milk, full cream	**little milk – 2 tablespoons**		
		And sugar, white	**2 heaped teaspoon**		
		Soft mealie meal porridge	**2 cups**		
		With sugar, white	**2 heaped teaspoon**		
		And margarine, hard brick	**1teaspoon**		

Portion sizes

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Stiff porridge	125 g	275 g	425 g	600 g	800 g

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Soft porridge	125 g	275 g	425 g		575 g
Samp and beans	100 g	200 g	375 g	600 g	800 g
Rice	70 g	105 g	190 g		310 g
French fries	30 g	90 g	185 g		340 g
Fried beef	15 g	45 g	80 g		120 g
Beef with bone	45 g	75 g	120 g		180 g
Meat stew	55 g	165 g	275 g		385 g
Sausage/ Wors	20 g	50 g	90 g		135 g
Offal	20 g	60 g	100 g		140 g
Pilchards	15 g	45 g	90 g		150 g
Mashed pilchards	15 g	45 g	90 g		240 g
Fried fish	50 g	70 g	105 g		155 g
Cabbage, potato	15 g	45 g	75 g		105 g

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
and onion					
Spinach, potato	15 g	45 g	75 g		105 g
Tomato and onion gravy	10 g	30 g	60 g		100 g
Pumpkin	15 g	35 g	60 g		80 g
Carrots, potato	45 g	65 g	80 g		95 g
Green mealie	50 g	110 g	180 g		260 g
Beetroot salad	10 g	30 g	65 g		85 g
Fat cake	20 g	50 g	70 g		90 g
Bread	15 g	45 g	80 g		120 g
Margarine	2,5 g	7,5 g	12,5 g		17,5 g
Dumpling	20 g	70 g	125 g		175 g
Apple	70 g	130 g	195 g		265 g
Banana	40 g	60 g	95 g		130 g

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Canned peaches	30 + 10 g	70 + 15 g	110 + 25 g		150 +35 g
Custard	5 g	20 g	35 g		65 g
Atjar	10 g	45 g	80 g		120 g
Polony	5 g	15 g	30 g		45 g
Peanuts	5 g	20 g	60 g		105 g
Cheese curls	6 g	18 g	38 g		62 g

Other questionnaires

We may also use any of the following questionnaires:

Food Frequency Questionnaire

Socio-demographic questionnaire

Nutrition knowledge questionnaires

Health questionnaires

Smaller questionnaires drawn up by each individual researcher e.g. lunch box content of school children.

SOCIO-DEMOGRAPHIC QUESTIONNAIRE: AFRICAN COMMUNITY

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 number:……..…….

Please answer all questions by marking the correct answer with **X,** except where otherwise indicated.

 Where do you live?

....

2. PERSONAL INFORMATION

2.1 Your role in the family

Mother	Grandmother	Father	Grandfather	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 Do you live in?

Town/City	Farm	Squatter camp	Rural village	Hostel	Township	Other, specify…………...

3.2 Do other people live in your house?

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	Level of schooling	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 Has any children in your household died in the past?

Yes	No

Reason: ………………………..

3.7 In what type of house are you staying?

Brick	Clay	Grass	Wood	Zinc/shack

3.8 How many rooms does your house have?

< 2 rooms	3-4 rooms	> 4 rooms

3.9 Are there other houses/shacks within the same yard of the main house?

Yes	No

3.10   How are you currently living?

Homeless	
Living with relatives	
Living with friends	
Hostel accommodation	
Squatter home	
Rented house/flat	
Own house/flat	
Employees Properties	
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 the state of your house (e.g. too small, repairs, damp, etc.)?

…………………………………………………………………………………………………
…………………………………………………………………………………………………

3.13. Do you have problems with the following?

Mice/ Rats	
Cockroaches	
Ants	
Flees	
Mosquitoes	
Geckos	
Frogs	
Snakes	
Bed Bugs	

3.14. What is the floor inside your house made of?

Cement	
Tiles	
Carpet	
Dirt	
Sand	
Dung	
Other, please state	

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. Are you doing part time jobs on week ends and school vacations?

Yes	No

4.7 What is the exact title of your current job?
(Including self-employed)

4.8. What is the total income in the household per month?

<	R501-R1000	R1001-R1500	R1501-	R2001-R2500	> R2500

4.9. Please specify the monthly income in the household (if willing)…………………..

4.10. How often does it happen that you do not have enough money to buy food?
for you and your family?

Always	Often	Sometimes	Seldom	Never

4.11.   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?

0	1	2	3	4	5	6	7	8	9

People

4.12.   How often do you buy food?

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

4.13.   Where do you buy food?

Tuck shop	Street vendor	Wholesalers	Supermarket	Other, specify…………………

4.14. What type of transport do you use to get around?

Taxi	
Bus	
Train	
Own vehicle	
Other Specify	

4.15. 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 500	I do not know

5   EDUCATION AND LANGUAGE

5.1. What is your highest education level?

None	Primary School	Standard 8	Standard 10	College/FET	Other post school

5.2 What language is spoken mostly in the house?

Zulu	Xhosa	English	Afrikaans	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…………………………….

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 type of food is 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 per day?

0	1	2	3	> 3

6.7 Where do you eat most of your meals?

Home	Friends	Work	School	Other, specify…………………….

6.8 Where do your children eat most of their meals?

Home	Friends	School	Other, specify…………………….

6.9 Does your home have the following items and how many?

	Yes	**No**	**Quantity**
Electrical stove			
Gas stove			
Telephone / Cellphone			
Primus or paraffin stove			

Microwave			
Hot plate			
Radio			
Television			
Refrigerator			
Freezer			
Bed with mattress			
Mattress only			
Lounge suite			
Dining room suite			
Electrical iron			
Electrical, kettle			
Car			
Bicycle / Motorbike			

6.10 What type of fuel do you usually use for food preparation?

Wood fire	Paraffin	Electricity	Gas	Coal/Charcoal	Other, specify……………

6.11 What type/s of material are your pots made off (tick all relevant options)?

Cast iron	Aluminium	Stainless steel	Clay	Other, specify……………

Thank you very much for your co-operation. We appreciate the time.

24 – HOUR RECALL

Subject number: _____   Interviewer: _____

Date: _____ / _____ / 20___

Tick what the day was yesterday:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

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	Code (office use

				use Only)	only)
After dinner, before going to sleep					
* Do you take any vitamins or supplements (tablets or syrup)	Yes	1	No	2	
Folate					
Iron					
Other					
Give the brand name and dose of the vitamins/tonic:					

FFQ LIST OF FOODS AND FOOD GROUPS DIVERSITY

PLEASE INDICATE THE FOOD YOU ATE DURING THE PAST SEVEN (7) DAYS BY A (X)

GROUP 1: Flesh foods (meat, poultry, fish) diversity	Y	N
Chicken		
Beef		
Pork		
Tinned fish (pilchards)		
Fish (fresh / whole)		
Lekgotlwane (finely chopped, cooked meat)		
Mutton		
Tinned fish (tuna)		
Chicken runners and heads		
Chicken livers		
Goat (meat)		
Mogodu and malana		
Dried meat (biltong)		
Viennas / polony		
Russians		
Sausage (wors)		
Steak		

Group 2: Eggs diversity		
Eggs		
Group 3: Dairy products diversity		
Milk, unpasteurized (cow)		
Evaporated milk (unsweetened)		
Maas/ inkomasi		
Powdered milk		
Skim or low-fat milk (pasteurized)		
Full cream milk (pasteurized)		
Cheese		
Custard		
Ice cream		
Yoghurt		
Ultramel		
Yogisip		

Group 4: Cereals, roots and tubers diversity	Y	N
Rice		
Pap (Maize)		
Macaroni/pasta/spaghetti		
Maize rice (mielierys)		
Samp (stampmielies)		
Bread (white or brown)		
Whole wheat bread		
Dumpling		
Fat cakes		
Scones		
Biscuits		
Buns / bread rolls		
Mabela (soft porridge)		
Maize meal porridge		
Corn flakes		
Oats		
Wheat bix		
Mageu		
Potatoes		
Sweet potatoes		
Umqombothi		
Traditional beer		
Group 5: Legumes and nuts		

Sugar beans		
Peas (dried)		
Jugo beans		
Peanut butter		
Peanut or any other nuts		
Soya		
Group 6: Vitamin A rich fruits and vegetables diversity		
Pumpkin		
Carrots		
Wild leafy vegetables (morogo) Fresh and dried		
Spinach		
Butternut		
Apricots (Applelkoos)		
Peach (yellow cling)		
Mango		
Group 7: Other fruits (and juices) diversity		
Deciduous fruits		
Apple		
Peaches		
Pear		
Grapes (black/green)		
Plum		

Sub – tropical fruit		
Lemon		
Orange		
Naartjie		
Banana		
Pineapple		
Avocado		
Blueberry		
Cherry		
Kiwi fruit		
Raspberry		
Watermelon		
Wild watermelon(tsamma)		
Guava		
Juices		
Juice (100% pure juice e.g. Ceres/Liquifruit)		
Group 8: Other vegetables diversity		
Onions		
Cabbage		
Beetroot		
Rhubarb		
Turnips (raap)		
Gem-squash (lemoenpampoen)		

Tomatoes		
Green beans (fresh)		
Peas (fresh – green)		
Cauliflower		
Chili (red/green)		
Lettuce		
Mushroom		
Baby marrow		
Green pepper		
Sweet-corn (baby)		
Corn-on-the-cob(white)		
Garlic		
Group 9: oils and Fats diversity		
Butter		
Sunflower oil		
Margarine		
Lard		
Salad oil		

COPING STRATEGY INDEX FOR MALANGENI COMMUNITY

Subject number: _____   Date: _____

Interviewer: _____

In the past 30 days, if there have been times when you did not have enough food or money to buy food, how often has your household had to:	All the time? Every day	Pretty often? 3-6 */week	Once in a while? 1-2 */week	Hardly at all? <1* /week	Never	Raw score	Severity weight	Score = Relative Frequency x weight
Relative frequency score	**7**	**4.5**	**1.5**	**0.5**	**0**			
a. Borrow food from neighbours?							1	
b. rely on less expensive food?							1	
c. Buy food on credit?							2	
d. Visit neighbours to eat?							1	
e. Gather food from crops?							2	
f. Limit portion sizes?							1	
g. Reduce the number of meals eaten in a day?							2	
h. Bartering(exchange food from their crops)							3	
i. Restrict consumption by adults in order for small children to eat?							3	
j. Sell some of their belongings in order to get money to food?							4	
TOTAL HOUSEHOLD SCORE								

Severity weight: 1=least severe; 4=most severe

ANTHROPOMETRIC, HEALTH AND MEDICAL AND QUESTIONNAIRE

Section A:

Surname		ID number (if applicable)	
First Names		Age	
Height	, m	Weight	, kg
Gender	Male ☐☐ Female ☐		
Waist Measure/cm		Blood Pressure	

Section B:

HEALTH QUESTIONNAIRE:			
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 or teeth?			
Any affection of the ears or nose?			
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. Do you suffer from **Cancer?**			
11. Do you suffer from **Diabetes**			
12. Do you suffer from **Hypertension?**			
How do you know? Professional Diagnosed or Self			Specify ………………………….
10. Any other illness?			

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)	

	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 …………………………………………………………… …………………………………………………………… ……………………………………………………………		

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

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

Does you're spouse or partner smoke at this moment?	**Tick the correct block**
1. Yes	
2. No	
3. Not applicable	

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

Section C:

MEDICATION QUESTIONNAIRE:

	Yes	No
1. Do you use any medication?		
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?**

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)	

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)	

Has there been a death of a child under 5 years within the family?	**Tick the correct block**
1. Yes	
2. No	

If yes answer the next two questions

How old was the child?	**Tick the correct block**
1. Still born	
2. 0-7 days	

3. 0-3 Months	
4. 4-12 Months	
5. 13 – 24 Months	
6. 2-5 years	

Do you know the cause of death	**Tick the correct block**
1. Yes	
2. No	

If yes please specify:

_____
_____

_____
_____

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

LANGUAGE EDITING CERTIFICATION

This is to certify that the language editing of this dissertation by Ms N Nsele was done by Prof L A Greyvenstein.

Prof L A Greyvenstein was a member of the South African Translators' Institute, membership number: 1001691. She completed her primary, secondary and tertiary education, including a doctoral thesis, in English. She has done the English language editing of many proposals, dissertations, theses and scientific articles.
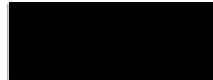
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