IMPACT OF A SOY FEEDING PROGRAMME ON THE NUTRITIONAL STATUS OF AN ELDERLY COMMUNITY IN SHARPEVILLE

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DECLARATION

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

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The thesis is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A bibliography is appended.

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This thesis is dedicated to my daughter, Tameka Ketso Ngwenya, whom I left at home in Botswana when she was only two weeks old in order to continue with my studies.

ABSTRACT

Main Purpose of the study: To evaluate the impact of soy protein feeding intervention over a period of six months on the nutritional status of an elderly (≥60 years old) community of Sharpeville, in which poverty, household food security and malnutrition were prevalent.

Methods: An experimental design that had no control group but a comparison between hypercholesterolaemic (HC) and normocholesterolaemic (NC) groups was used with 134 randomly selected elderly respondents. The first stage involved a baseline survey which determined the prevalence of risk factors for cardiovascular disease (CVD) and nutritional status among participants. Measurements included biochemical indices (serum lipids, vitamin B_{12}, folate and homocysteine), anthropometry (weight, height and waist circumference) and dietary intake using 24h-recall and 7-day dietary diversity questionnaire. Socio-demographic information gathered from previous studies on the same subjects was used. The second stage was the preparation, formulation, and implementation of a nutrition education programme to assess its impact on nutrition knowledge after the nutrition education intervention. The nutrition education was conducted in two sections, namely an exploratory study and an experimental study. An exploratory study was conducted to assess the nutrition education needs of the elderly and was followed by the experimental study, which assessed nutrition knowledge before and after the intervention. The third stage was the implementation of the 10 grams soy protein daily feeding intervention for a period of six months and evaluation of its impact on risk factors for cardiovascular disease and on nutritional status. Sensory tests, compliance and the same measurements conducted at baseline were used at follow-up (feeding intervention). A comparison of the findings of the baseline study and follow-up study was conducted. Also to provide deeper insight into the effect of soy on the risk factors for CVD and nutritional status, respondents were further stratified into HC and NC groups based on their LDL-C levels at baseline study and results were also presented as such. The data analyses included descriptive statistics and *t*-tests on SPSS version 21.0.

Results: From the baseline study, the dietary intake results revealed a poor dietary intake which contributed to inadequate estimated average requirements (EAR) and adequate intakes (AI) of nutrients. A mainly carbohydrate-based diet was consumed with minimal intake of dairy and legumes despite a medium dietary diversity score. The anthropometric indices at baseline indicated over-nutrition based on the reported waist circumference 97.32±10.32 (80.6%) above substantial risk of CDL, obesity (75.3%) and hypertension (56.7%), with the highest percentages

for both waist circumference of substantial risk and overweight/obesity found among the women (80.9% and 79.9% respectively) and for hypertension among the men (79.1%). For the biochemical results at baseline, the prevalence of risk factors for CVD was observed as abnormal mean serum lipids such as LDL-cholesterol (3.6±1.1), HDL-cholesterol (0.73±0.4), total cholesterol:HDL-cholesterol ratio (7.9±2.9), triglyceride:HDL-cholesterol ratio (2.7±2.1) and homocysteine (17.1±9.2) in the total group. The women had high TC (5.2±1.1) indicating borderline risk of CVD as compared with men who had lower TC (4.5±0.8) and this was significantly different (p=0.049). The nutrition education programme was effective in increasing knowledge with an improvement of 14.5 percent from pre- (62.3%) to post-test (76.8%) for the total group which was statistically significant (p=0.000).

The results for the soy protein feeding intervention, the dietary intake for the total group indicated a statistically significant decrease in energy intake (p=0.001), by about 20.4 percent form baseline to follow-up, while energy intake at baseline was already below the EAR. Also a statistically significant decrease was seen from baseline to follow-up for total dietary fat (p=0.004), cholesterol (p=0.008) and animal protein (p=0.000), with a statistically significant increase only on dietary folate (p=0.001) and iron (0.001). These dietary changes were also observed for the HC and NC groups after the intervention with only fat not decreasing significantly for the HC group. For the anthropometry indices, and hypertension no significant impact after the intervention for the total group and also for the HC and NC groups was observed. The biochemical results indicated a beneficial effect of the soy-based products on the following serum lipids: a significant improvement in LDL-C (p=0.000), HDL-C (p=0.000) and TC:HDL ratio (p=0.000) for the HC group while only TC:HDL ratio showed a significant improvement for the NC group after the intervention. However, high risk factors for CVD in this elderly group were still observed, with a significant decrease after the intervention of serum folate (p=0.000) below the recommended level and a significant increase in homocysteine (p=0.000) above the recommended level. Significant differences between the HC and NC groups were seen in TC, LDL-C, LDL:HDL-C ratio and TC:HDL-C ratio at the beginning of the intervention (baseline). However, at the end of the intervention (follow-up), significant differences were observed only in TC, LDL-C and homocysteine.

Conclusion: Although the energy intake reduced significantly, only three of the micro-nutrients (pantothenate, Niacin and selenium) had a significant decrease between baseline and follow-up. Therefore the nutritional status of these elderly was not affected as it was also observed that

there was no significant impact on anthropometric indices that took place. However this intervention had a significant impact on iron intake, which was one of the deficiencies identified amongst this elderly people from previous study. Also the nutrition education and a daily consumption of at least 10g of soy had a significant beneficial effect on LDL-C, HDL-C and TC:HDL ratio for the HC groups, thus reducing risk of CVD. Although soy had a beneficial effect on blood lipid profile no effect on hypertension was observed. The guideline of a 25g intake of soy should be encouraged as recommended by FDA as an effective cholesterol-lowering food item.

Key words: Nutrition education, hypercholesterolaemia, cardiovascular disease, elderly, serum lipids

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LIST OF SYMBOLS AND ACRONYMS

%	Percentage
%E	Percentage energy
<	Greater than
<	Less than
≡	Identical to
≤	Less than or equal to
≥	Greater than or equal to
®	Registered
℃	degrees Celsius
AHA	American Heart Association
AI	Adequate intake
AIDS	Acquired immune deficiency syndrome
BMI	Body mass index
BP	Blood pressure
BTech	*Baccalaureus Technologiae*
CDL	Chronic diseases of lifestyle
CHD	Coronary heart disease
CHF	Chronic heart failure
cm	centimetre
CSL	Centre of Sustainable Livelihoods
CV	Coefficient of variation
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
DDQ	Dietary diversity questionnaire
DDS	Dietary diversity score
DoH	Department of Health
DTech	*Doctoris Technologiae*
e.g.	For example
EAR	Estimated average requirements
EAS	European Atherosclerosis Society
EER	Estimated energy requirements

EI	Energy intake
ESC	European Society of Cardiology
et al.	And others (An abbreviation of the Latin et alii)
FAO	Food and Agriculture Organisation
FBDG	Food-based dietary guideline
FDA	Food and Drug Administration
FFQ	Food frequency questionnaire
FGDS	Food group diversity score
FVS	Food variety score
g	grams
g/dl	grams per decilitre
h	Hour
Hb	Haemoglobin
HC	Hypercholesterolaemic
Hcy	Homocysteine
HDL-C	High-density lipoprotein
HIV	Human immunodeficiency virus
hrs	hours
HT	Hypertension
IDF	International Diabetes Federation
IoM	Institute of Medicine
JRF	Joseph Rowntree Foundation
KAP	Knowledge, attitude and practice
Kcal	Kilocalorie
Kcal/wk	Kilocalorie per week
kg	Kilogram
km	kilometre
LASSA	Lipid and Atherosclerosis Society of Southern Africa
m	men
m	metre
mg	milligram
mg/dL	Milligrams per decilitre
MIC	Mild cognitive impairment
ml	millilitre

mmHg	millimetres of mercury
mmol/L	Millimoles per litre
MNA	Mini nutritional assessment
MRC	Medical Research Council
MTech	*Magister Technologiae*
MUAC	Mid-upper arm circumference
MUFA	Monounsaturated fatty acids
n.d.	No date
n=	Population size
NC	Normocholesterolaemic
NCEP	National Cholesterol Education Programme
NCHS	National Centre of Health Statistics
NE	Nutrition education
NEP	Nutrition education programme
NETs	Nutrition education tools
ng/mL	Nanograms per millilitre
nmol/L	Nanomoles per litre
p	significance value
PA	Physical activity
PAL	Physical activity level
pg/mL	Picograms per millilitre
PR	Public relations
PUFA	Polyunsaturated fatty acid
QFFQ	Quantified food frequency questionnaire
r	correlation coefficient
R	Rand
RDA	Recommended dietary allowance
SA	South Africa
SAEP	Soy awareness education programme
SAHA	South African Heart Association
SBP	Systolic blood pressure
SD	Standard deviation
SFA	Saturated fatty acids
SPSS	Statistical package for social science

SSA	Statistics South Africa
SSA	Sub-Saharan Africa
SST	Serum-separating tube
STATSSA	Statistics South Africa
TC	Total cholesterol
TFA	Trans fatty acids
TG	Triglycerides
TM	Trade mark
US	United States
US$	United States Dollar
USA	United States of America
USB	United Soybean Board
USDA	United States Department of Agriculture
VUT	Vaal University of Technology
w	women
WC	Waist circumference
WHO	World Health Organisation
WHR	Waist/Hip ratio
WISHH	World Initiative for Soy in Human Health
y	years
μmol/L	micromoles per litre

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PROBLEM AND SETTING

1.1 INTRODUCTION

The population of elderly people is increasing rapidly in every country around the world (Joubert & Bradshaw 2006:204). The increase in the elderly population is due to declining fertility rates and improved living conditions that ensure good health (World Health Organisation [WHO] 2011:2). However, poor health in the elderly population is often unrecognised by governments because many age-related physiological changes suffered by the elderly could disguise symptoms of malnutrition. The prevalence of malnutrition in the elderly is demonstrated by increased morbidity, mortality and decreased quality of life (WHO 2000). Malnutrition is highly prevalent in the elderly population and increases with age (Hickson 2006:4). The magnitude of the prevalence of malnutrition (the impairment of a person's health) among community-dwelling elderly globally is reported here by highlighting a few studies: the United Kingdom reports a 12 percent prevalence (Population Reference Bureau 2007:2), the United States of America 5–12 percent (Evans 2005:38), Spain 3.3 percent (Ramon & Subirά 2001), India 14 percent (Vendantam, Subramaniam, Rao & John 2009:1328) and Bangladesh 26 percent (Kabir, Ferdous, Cederholm, Khanam, Streatfied & Wahlin 2006). In America it is estimated that at least 80 percent of older Americans are living with at least one chronic condition and 50 percent have at least two chronic ailments (Solae 2003-2011) while in South Africa (SA), chronic diseases of lifestyle (CDL), are among the top seven causes of death in the elderly population. The consequences of these diseases among the elderly are loss of independence, disability and poor quality of life (Joubert & Bradshaw 2006:212).

Although research indicates that there is improved global nutrition, in Africa, including South Africa, the nutritional status of the population is concurrently deteriorating. This is more pronounced in the elderly population since available nutrition interventions are directed primarily towards other groups comprising the younger generations – infants, young children and pregnant and lactating women (Charlton & Rose 2001:2424S; Charlton, Ferreira & Du Plessis

2008:575). As a result there is a shortage of information in research studies on the health status of the elderly.

1.2 BACKGROUND TO THE PROBLEM

1.2.1 A global perspective of malnutrition in older people

Globally, malnutrition is reported to be on the increase among the elderly. According to Ahmed and Haboubi (2010), a total of 18 percent of elderly people are currently classed as malnourished. These figures are expected to increase dramatically in the next three decades because of the increase in the number of older people. During the last decade, global migration and urbanisation of young and old people has increased and played a significant role in promoting poor dietary habits (Steyn 2006:1; Nugent 2008:75). A nutrition transition from traditional whole grains, fruits and vegetables and low-fat diets to unhealthy diets high in added sugar, saturated fat and salty foods has been observed (Steyn 2006:1; Nugent 2008:75). As a result of poor dietary habits, several CDLs, such as obesity, which is the major risk factor for a number of chronic diseases, including cardiovascular diseases and type 2 diabetes (WHO 2014a), have been observed in old people.

Obesity is increasing globally and accounts for 2.8 million deaths each year worldwide (WHO 2014b); this obesity epidemic is also reported to have reached the elderly population. A high percentage of people reach older age still being overweight and obese. In older groups, obesity is associated with poor physical performance (sedentary lifestyle), disability and depending on other people for assistance in performing basic activities such as bathing. Even though a considerable number of older people are overweight or obese there is nevertheless an increasing number of underweight (sarcopenic) people aged 80. Under-nutrition among the elderly differs across settings. The highest percentage of under-nutrition is reported for old age facilities (50–80%), followed by acute care (10–60%), with the community-dwelling elderly (10%) having the lowest percentage of under-nourished elderly people (Nowson 2007:S150).

It is reported that cardiovascular diseases (CVD) are the main cause of death and morbidity in developed countries, responsible for about half of all deaths (Maharaj & Naidoo 2007:384). In the aged population, circulatory diseases (CVD) are still the main cause of death (Stevens, Mathers & Beards 2013:636), accounting for 45 percent of deaths of older women (Stevens *et al.* 2013:633) and the prevalence is increasing. Although there have been successful measures to reduce the number of deaths caused by coronary heart disease since the year 1970, deaths due to chronic heart failure (CHF) have increased. In the ageing population, there is frequent hospitalisation owing to CHF. This places an economic burden on health care systems and also on societies already living in poverty, as CHF requires long-term pharmacological treatment (Greiser, Kluttig, Schumann, Kors, Swenne, Kuss, Werdan & Haerting 2005).

The previously mentioned rising overweight and obesity epidemic among the elderly also increases the risk of developing type 2 diabetes mellitus in this group. Globally, as of the year 2013, it has been estimated that 382 million people have diabetes worldwide, with type 2 making up to 90 percent of the cases (International Diabetes Federation [IDF] 2014). According to Puria, Kalia, Mangat, Goel and Swami (2007), globally, diabetes affects 10–20 percent of the elderly aged 65–74 years and 40 percent of the elderly over 80 years. The high prevalence of diabetes in the elderly population is characterised by complicated life-threatening health problems such as cardiovascular disease, kidney disease and eye and nerve damage (IDF 2014:24); occurrences of delayed diagnosis in this group, therefore, will create a major health burden.

1.2.2 African perspective of malnutrition in older people

In Africa the data on the prevalence of malnutrition among elderly people is sparse, indicating the lack of attention given to nutrition programmes for this group. However, the scattered studies on diverse elderly populations in Africa indicate that in African countries, most old people enter old age after long-term poverty and deprivation, with poor access to health care and diets inadequate in quality and quantity (Charlton & Rose 2001:2424S). Accordingly, many of them also suffer from age-related health problems such as hypertension, diabetes, cancer, tuberculosis, arthritis and ophthalmologic disease, especially poor eyesight (Ngatia, Gathece, Macigo, Mulli, Mutara & Wagaiyu 2008:378).

In Africa, the food intake and food patterns of older people are influenced mainly by financial status and physical and functional ability (HelpAge International, African regional centre 2004:1). However, fewer African countries provide social and welfare assistance programmes such as pension funds for the elderly (Charlton & Rose 2001:2424S). A health transition associated with urbanisation, industrialisation and westernised lifestyles, coupled with poverty, results in poverty-related diseases (Steyn 2006:2) and an increase in non-communicable diseases in Africa. According to a study by Kimokoti and Hamer (2008), up to half (48%) of elderly Africans in Sub-Saharan Africa (SSA) are underweight and almost a quarter (21%) are overweight. Furthermore, the study indicated that diets of low quality contribute to poor nutritional status among SSA elderly people. Poverty, HIV and AIDS and complex humanitarian emergencies are major contributing factors to under-nutrition.

In another study that was conducted using the mid-upper arm circumference (MUAC) nutritional indicator in pastoral and agro-pastoral areas in Ethiopia, in which the majority of the population were currently depending on food aid from donor agencies, it was found that 77.3 percent of the sample of 220 elderly were categorised as being undernourished. Among the sample group, 46.8 percent of the elderly had the MUAC values indicative of severe under-nutrition (Charlton & Rose 2001:2424S). A study which assessed the nutritional status of older people living in three different areas in Ethiopia found that the prevalence of under-nutrition was high (30.5%). Their poor nutritional status was due mainly to the recurrent failure of rains, resulting in drought and famine and household food insecurity (Tesfaye, Tessema, Zerihum, Amare, & Ahmed 2000 quoted by Helpage International Africa Region Centre 2004:15). In Kenya, the HIV and AIDS pandemic has resulted in compromised household food security owing to the reduced time spent on food production; the pandemic has also disrupted the traditional family and community support systems of older people. As a result, elderly people are at high nutritional risk, particularly older men. In Nairobi more elderly men were underweight as compared with women (32.3% and 12.8% respectively) (Wagah, Ochola, & Omalla 2000 quoted by Helpage International Africa Region Centre 2004:17).

In 1992, two sites, namely a Rwandan refugee camp in Tanzania and rural communities near Lilongwe, Malawi, were researched to measure the nutritional status of elderly people in developing countries. Using a BMI cut-off of 18.5, the prevalence of under-nutrition in both countries was reported to be higher in men than women, ranging from 19.5 percent in Tanzania to 36.1 percent in Malawi among men and from 13.1 percent in Tanzania to 27 percent in Malawi among women. Another study of older refugees in Algeria reported a higher prevalence of under-nutrition (25% for men and 11.5% for women) than in the elderly refugees in Tanzania (Charlton & Rose 2001:2424S). According to the Mini Nutrition Assessment (MNA) classification that was used in a study conducted in older adults with mild cognitive impairment (MCI) living in homes for the elderly in Cairo, Egypt, 58 (48.3%) of the sample (n=120) study that was assessed was reported as well nourished, 49 (40.8%) at risk of malnutrition and 13 (10.8%) as malnourished. It was revealed that older adults with MCI had a significantly higher frequency of being at risk of malnutrition or of being malnourished than those with normal cognition (Khater & Abouelezz 2011).

1.2.3 South African perspective of malnutrition in the elderly

The prevalence of malnutrition in the elderly of South Africa is not clearly defined owing to the previous lack of a national nutrition surveillance programme. The only data available comprise single fragmented surveys that have been undertaken among isolated groups. As a result there are no national comprehensive data on the prevalence of malnutrition in the elderly of SA. In South Africa, a massive movement of people from non-urban to urban areas, resulting in the creation of informal settlements on urban fringes, was experienced due to the elimination of the Group Areas Act in 1988, which had permitted only male migrant labourers to relocate to urban areas (Charlton 2000). Within this setting, poverty manifested in the form of alienation from the community, food insecurity, crowded homes, usage of unsafe and inefficient forms of energy, lack of jobs that are adequately paid and/or secure, and fragmentation of families (Eighty 20 2006:1). Data from the 1996 SA census indicated that 52 percent of the group aged 60 and above now lived in urban areas (Charlton 2000).

Increased urbanisation among black people in SA has led to a significant increase in the diseases of lifestyle, especially because this group had previously had low levels of risk factors for chronic diseases of lifestyle (Vorster & Bourne 2008:233). In the year 2000, reports indicated that an estimated 84 percent of deaths among the elderly population in SA were due to CDL (Joubert & Bradshaw 2006:210). These included diseases and lifestyle behaviour such as hypertension, tobacco addiction, high cholesterol, diabetes and obesity, which develop as a result of being exposed to unhealthy diets, as well as smoking, lack of regular exercise, and possibly, stress. Research also indicates that in the South African population, stroke, rather than coronary heart disease (CHD), has in the past been associated with urbanisation of black South Africans. Among blacks, death rates from stroke are double those of whites in South Africa, while hypertensive heart disease is ten times higher in the black community than in the white community. It is also known that, in comparison with Caucasians, Africans suffer from a higher prevalence of hypertension, often undiagnosed and untreated. This is specifically true of elderly people, since it has been found that blood pressure usually peaks at the age of 55–64 years (Shisana, Labadarios, Rehle, SimbayI, Zuma, Dhansay, Reddy, Parker, Hoosain, Naidoo, Hongoro, Mchiza, Steyn, Dwane, Makoae, Maluleke, Ramlagan, Zungu, Evans, Jacobs, Faber & South African National Health and Nutrition Examination Survey [SANHANES-1] 2013:83; Klieman, Hyde & Berra 2006; Kearney, Whelton, Reynolds, Muntner, Whelton & He 2005:221).

Overweight and obesity are common problems in old people in South Africa. This problem is associated with the existence of patterns of weight gain, together with an increase in abdominal obesity (Ali & Crowther 2009). According to a study by Kimokoti and Hamer (2008), 56 percent of older South Africans were found to be obese. Another study conducted by Peltzer, Phaswana-Mafunya and Ramlagan (2011) indicated that 66.7 percent of men were overweight or obese ($\geq 25 kg/m^2$) and also that 56 percent of men had abdominal obesity (WHR>0.90). Among the elderly women, 76.7 percent were overweight or obese and 70.4 percent had abdominal obesity (WHR>0.85). A study by Lloyd-Sherlock, Beard, Minicuci, Ebrahim and Chatterji (2014:4) indicated a prevalence of 78 percent in hypertension among the elderly population in SA.

Research indicates that being overweight is strongly linked to greater risk of hypertension and diabetes. In addition, obesity can aggravate arthritis and impair physical mobility and respiratory function (Villareal, Apovian, Kushner & Klein 2005:924). Over half of South Africans age 65 years and older are hypertensive (BP≥140/90mmHg). It is reported to be difficult to control or reduce blood pressure in this age group owing to transport costs, lack of knowledge of the disease and its outcomes, and poor service delivery at primary health care facilities. The elderly are reported as failing to return to a health care centre for follow-up visits (Charlton *et al.* 2008:575).

The prevalence of anaemia (Hb<13 g/dl and <12 g/dl for men and women, respectively), a health condition which causes fatigue and, in some instances, cardiovascular complications in community-dwelling older South Africans, has been reported to range between 14 percent and 25 percent, which is higher than that reported in studies of older populations in Europe and the United States (US). The most common cause of anaemia in older persons is the type associated with chronic disease. In a study of older Black South Africans, normocytic anaemia (indicative of anaemia of chronic disease) was found to be present in over 50 percent of cases of anaemia (Charlton, *et al.* 2008:571).

1.2.4 The Vaal region, Sharpeville: perspective of malnutrition in the elderly

Sharpeville is an informal settlement in South Africa with an estimated population of 37 599 people and an elderly population of about 2933, given the 7.8 percent of the population aged 60 years and above in South Africa (Statistics South Africa [STATSSA] 2011). A previous study conducted on the elderly community of Sharpeville by Oldewage-Theron, Salami, Zotor and Venter (2008) has indicated that poverty, household food insecurity and malnutrition (under- and over-nutrition) were prevalent in this group. The literacy level of the elderly was low, with only 24.6 percent of the elderly having attended a secondary or tertiary institution. The socio-economic status of the elderly was also poor. The entire household depended on the pension fund received by the elderly for basic household needs (Oldewage-Theron, Salami *et al.* 2008:10), which confirmed the presence of food insecurity. There is evidence that poor health rates tend to be associated with low education and income levels (Wardle 2002:1230).

The diet of the elderly in Sharpeville was also studied and found to be largely carbohydrate-based, constituted predominantly of starchy staple foods and insufficient animal products, dairy foods, fruit and vegetables. Medoua, Egal and Oldewage-Theron (2009:263) reported that the food items comprising the menu of the day-care centre for the elderly in Sharpeville contained low antioxidant capacity that barely reached the Recommended Dietary Allowance (RDA). The antioxidant capacity of sample extracts was evaluated using the DPPH assay, according to the method of Brand-Williams, Cuvelier, and Berset (1995). The intake of antioxidants can reduce the likelihood and incidence of non-communicable diseases (Liu 2003:517S). Deficiencies of folate, vitamin B_{12} and zinc were common in this elderly group (Oldewage-Theron, Samuel *et al.* 2008:27). The lack of minerals such as zinc in the body could result in impaired immunity which will lead to increased risk of infectious disease (Prasad, Beck, Bao, Fitzgerald, Snell, Steinberg & Cardozo 2007:843).

Furthermore, the majority of the elderly of Sharpeville were found to be suffering from hypertension (68%) [greater than or equal to 140/90 mm Hg when measured] as well as obesity, with a high prevalence in the elderly women as follows: 16.4 percent normal weight (Body Mass Index 18–24.9), 29.5 percent overweight (BMI 25–29.9), 27.9 percent obese (BMI 30–34.5) and 26.2 percent very obese (BMI 35+) (Oldewage-Theron, Salami *et al*. 2008:7). The haematological indices showed an abnormal mean serum cholesterol level of 5.4±1.4 mmol/L for the majority of the elderly (58.2%), as compared with the normal level of <5.2 mmol/L

(National Cholesterol Education Programme [NCEP] 2002). This indicated a risk of CVD. About 22.4 percent of the elderly had high levels (>5.9 mmol/L) of blood glucose that could be associated with a risk of diabetes mellitus (Oldewage-Theron, Salami *et al.* 2008:8). Owing to various health conditions that were identified in this elderly community, a study conducted on the same elderly community in Sharpeville by the same researchers (Oldewage-Theron and Kruger 2009) experienced a shortfall of the respondents in a follow-up study as a result of deaths related to CVD, on average 12 per annum.

1.3 MOTIVATION FOR AND JUSTIFICATION OF THE STUDY

Elderly people are vulnerable to health consequences associated with poor nutrition. The prevalence of chronic diseases of lifestyle and loss of life of the elderly as a result of CDL will need to be addressed. An increase in chronic diseases of lifestyle will place a major health burden on medical resources and loss of life of the elderly will create a huge impact in the household as grandparents are viewed as sole providers and primary caregivers in many households in Sharpeville (Oldewage-Theron & Kruger 2008a:130) and their pensions play a crucial role in household poverty alleviation (Charlton *et al.* 2008:551). HIV and AIDS epidemics have also impacted older persons in multiple ways. The elderly grandmothers often become primary caregivers to HIV and AIDS-infected adults, children and vulnerable and orphaned grandchildren. In SA it is estimated that 60 percent of children who stay with the elderly are AIDS orphans (Monasch & Boerma 2004). The reality of the situation is that, if the health of the grandparent deteriorates, the other people in the household will suffer. Moreover, uninformed food choices by the grandparent, who is responsible for food procurement, will impact on the entire household (Oldewage-Theron & Kruger 2008a:130).

The challenge is therefore to formally plan and implement nutrition interventions and education programmes for the elderly as optimal nutrition in older people has implications for improving their health status and general well-being as well as for saving costs related to their medical care and the utilisation of limited health care resources in SA (Charlton & Rose 2001:2427S). It has been acknowledged that proper nutrition and physical activity can extend people's lives and that nutrition interventions can contribute to the promotion of healthier ageing, in both the prevention and management of chronic diseases and their consequences (Dausch, 2003:683). The deteriorating health of the elderly of Sharpeville and the observed low intake of nutrients justifies the need to target these elderly people living in circumstances of poverty and chronic diseases of lifestyle with soy nutrition intervention programmes to address not only their health problems (CVD) but also their nutrition knowledge.

Soy has been identified as an economical food item that will provide not only essential nutrients but also additional and unique nutritional health benefits (World Initiative for Soy in human health [WISHH] n.d; United Soybean Board [USB] 2014; Venter 1999) that could be of importance in addressing some of the abnormal serum lipid cholesterol (Anderson, Johnstone & Cook-Newel 1995) and deficient nutrients observed in this elderly group. According to the US Food and Drug Administration (FDA) and the American Heart Association (AHA), foods containing soy protein should be labelled as protective against coronary heart disease. This claim was based on the clinical studies showing that at least 25 grams (g) of soy protein per day reduced the risk of heart disease (Sacks, Lichtenstein, Van Horn, Harris, Kris-Etherton & Winston 2006:1689; Yang, Shu, Jin, Zhang, Li, Li, Gao & Zheng 2005:1012). Soybeans contain all three of the macronutrients required for good health (protein 38%, carbohydrate 14% and fat – polyunsaturated 18%), as well as vitamins and minerals, including calcium, folic acid and iron and a complex array of naturally occurring bioactive non-nutrients called phytochemicals (United Soybean Board (USB) 2009, Venter 1999:24). A study conducted to determine the effectiveness of soy protein in lowering blood pressure (BP) in treatment and control groups revealed a decrease in both systolic and diastolic blood pressure in the test group over the control group (a mean systolic decrease of 2.21 mmHg and diastolic decrease of 1.44 mmHg). The decrease occurred in both groups (hypertensive and normotensive) but was greater in the hypertensive group (JiaYi, Xing, ZhiWei, Xun, He & LiQiang 2011).

Notably, not much has been done in South Africa (refer to Table 1) to study the impact of soy on the nutritional status of the elderly living in informal settlements, despite the identified essential nutrients and additional and unique nutritional health benefits of soy. The selection of the publication timeline (2000–2014) in Tables 1 and 2 allowed the researcher to examine whether there were recently published nutritional interventions among elderly people related to CVD and its risk factors. The dearth of systematic studies in this rapidly increasing population group is obviously an obstacle to the development of appropriate nutrition interventions in this regard. This study was conducted among the elderly attending a day-care centre in Sharpeville. This was a worthwhile study to undertake as it was the first study to test the effect that the inclusion of soy protein in the daily diet had on the nutritional status of an elderly African population.

Table 1 **List of nutrition intervention studies conducted among the elderly globally from 2000 to 2014**

Reference	Study setting and participants	Study design and intervention	Main significant results
Liu, Z., Ho, S.C., Chen, Y. & Woo, J. 2013. A six-month randomised controlled trial of whole soy and the isoflavone daidzein on body composition in equol-producing postmenopausal women with prehypertension.	- China, Hong Kong - Hong Kong Chinese women at least 1 year menopausal - Aged 48–65 years - with mean SBP above 120 mmHg, DBP above 80mmHg or both - Equol producer - n= 270	- Intervention to assess the effect of commonly used soy foods (flour) and purified daidzein on anthropometric measurements and body composition. - Length: 6 months - Double-blind, randomised, placebo-controlled trial :40g soy flour (whole soy group), 40g low fat milk powder plus 63mg daidzein (da daidzein group) or 40g low-fat milk powder (placebo group) daily each.	Whole soy and purified daidzein had no significant effect on body weight, BMI, waist and hip circumference waist to hip ratio, body fat percentage, fat mass and free fat mass.
Salehi, L., Mohammad, K. & Montazeri, A. 2011. Fruit and vegetable intake among elderly Iranians: a theory-based intervention study using the five-a-day programme.	Iran, Tehran - Sample n=400 n= 200 intervention and n= 200 control group	- Quasi-experimental study in a community-based sample of elderly (2008-2009). - Duration of study: 4 weeks - data collected at baseline and follow-up after 4 weeks (questionnaire used including demographic information, stages of change, self-efficacy, decisional balance, daily serving of Food Variety [FV] intake).	Baseline: FV intake was not different between groups; however, significantly increased for the intervention group at post-test. Intervention group had higher FV intake, perceived benefits and self-efficacy and lower perceived barriers.
Opedenacker,J., Delecluse,C. & Boen, F. 2011. A 2-year follow-up of a lifestyle: physical activity versus a structured exercise intervention in older adults.	- Belgium, Vlaams-Brabant - Healthy sedentary men and women - Aged 60–83 - n=186	- A controlled trial with randomisation between the intervention groups (lifestyle and structured intervention on physical fitness). -11-month study period	The structured group showed a decrease in the level of cardio-respiratory fitness muscular strength functional performance from post-test to follow-up but no decrease was reported (lifestyle intervention).

Table 1 (cont.) **List of nutrition intervention studies conducted among the elderly globally from 2000 to 2014**

Reference	Study setting and participants	Study design and intervention	Main significant results
			- Potential effect of structured intervention in the battle against inactivity in older adults was revealed.
Van Roie, E., Delecluse, C., Opdenacker, J., De Bock, K., Kennis, E. & Boen, F. 2010. Effectiveness of a lifestyle physical activity versus a structured exercise intervention in older adults.		-Two groups of sedentary older adults: lifestyle physical intervention (n=60) structured exercise intervention (n=60) which were compared with a control group (n=66) in terms of physical fitness and cardiovascular risk factors. - The lifestyle participants incorporated physical activity in daily routine and received individual home-based programme. -structured exercise group completed five supervised training sessions every 2 weeks in fitness centre. -11-month intervention for both groups.	- Equal effective improvement on functional performance (both groups). -structured exercise was more effective than life in improving cardio-respiratory and muscular fitness. - limited effect on CVD, but structured group improved in total cholesterol (TC) and high-density lipoprotein cholesterol (HDL).
Rousset, S., Droit-Volet, S & Boirie, Y. 2006. Change in Protein intake in elderly French people living at home after a Nutritional information programme targeting protein consumption.		-Two groups: the message group (n=41), participated in an information programme on protein consumption. - Control group was not given any information. - Pre- and post-intervention survey - Two-week intervention	- A decrease in animal protein intake of about 0.049g/Ib/day for control group. An increase in the intake of protein (0.041g/Ib/day) for the information group, more pronounced in women. Nutrition knowledge and protein intake increased significantly for information group.

Table 1 (cont.) List of nutrition intervention studies conducted among the elderly globally from 2000 to 2014

Reference	Study setting and participants	Study design and intervention	Main significant results
Gollub, E.A., Weddle, D.O. 2004. Improvements in nutritional intake and quality of life among frail homebound older adults receiving home-delivery breakfast and lunch.	South Texas, South Florida, Western Montana, Southwestern Virginia and Eastern Maine	-Cross-sectional field study from 5 elderly nutrition programmes. - Morning meals-on-wheels breakfast services. -Comparing two groups. 1) Breakfast (n=167) received a homebound delivered breakfast and lunch, 5 days a week. 2) Comparison group (n=214) received a home-delivered lunch 5 days per week. -Measurements: 24-hour recall, demographics, malnutrition risk, functional status, surveys of quality of life as health, loneliness, food enjoyment, food security and depression.	Improved energy/nutrients and fewer depression symptoms for the breakfast group than comparison group.
Rydlewicz, A., Simpson, J.A., Taylor, R.J., Bond, C.M. & Golden, M.H.N 2001. The effect of folic acid supplementation on plasma homocysteine in an elderly population	Aberdeen	-Randomised double-blind place-controlled trial. To explore the effects of daily supplements of 0,50,100, 200, 400 and 600 µg folic acids on plasma homocysteine in an elderly population. -Sample size (n=368, aged 65–75 -6 weeks intervention, plasma homocysteine was recorded after 3 and 6 weeks of supplementation.	-400 and 600 µg folic acids lower homocysteine level compared to placebo. -926 µg (diet and supplement is required to ensure 95% of the elderly would be without CVD risk from folate deficiency.

Table 2 **List of nutrition intervention studies conducted among the elderly in South Africa from 2000 to 2014**

Reference	Study setting and participants	Study design and intervention	Main significant results
Oldewage-Theron, W.H., Kruger, R. 2009. Impact of food aid on food variety and dietary diversity of an elderly community of Sharpeville, South Africa.	- South Africa, Sharpeville - Elderly who regularly attended the care centre since 2004 - n=170	- This study assessed the impact of a food aid intervention programme on food variety, dietary diversity for a period of 2 years. - Comparison of DDS, FVS and nutrition adequacy ratios (pre and post measurements).	Between baseline and after intervention -DDS increased: from 0-3 food groups (55.1%) to 9 food groups (98.1%). -Improved adequacy of the overall diet (from 0 .77±0.48 to 1.02±0.66) to meet daily requirements of these elderly people.

1.4 MAIN OBJECTIVE OF THE STUDY

The purpose of this study was to implement and then evaluate the impact of soy-protein intervention implemented seven days a week over a period of six months on the nutritional status of an elderly community of Sharpeville in which poverty, malnutrition (under- and over-nutrition) as well as household food insecurity and poor health were prevalent. The research focused on sustainable nutrient intakes and general well-being.

1.4.1 Sub-objectives of the study

The specific objectives were to:

1 Determine the risk factors for CVD prevalent in this elderly community in Sharpeville (serum lipids, serum Vitamin B_{12} and folate status for cardiovascular disease (CVD), weight and height for obesity, waist circumference) and assess the dietary intake (dietary intake 24hour-recall, and 7-day dietary diversity questionnaire).

2 Prepare, formulate, implement and evaluate a Nutrition Education Programme (NEP) based on soy to improve the elderly people's awareness and knowledge of the health benefits of soy.

3 To include at-least 10grams of soy protein for a period of six months in the daily diet of the elderly based on the findings of the first sub-objective.

4 Assess the acceptability (MTech study, Tshivhase 2012) of the soy products included in the menu/diet and the compliance of the elderly with the recommended diet.

5 Evaluate the impact of the soy feeding intervention on the risk factors for CVD, nutritional status of the elderly and also the impact on dietary intake through a no control group but a comparison of the hypercholesterolaemic (HC) and normocholesterolaemic (NC) groups based on their LDL-C levels at baseline study. Also a comparison of baseline and follow-up study will be provided.

1.4.2 Ethics

Approval to conduct this study was obtained from the management of the Sharpeville day-care centre for the elderly. The study was conducted following the guidelines laid out by the South African Medical Research Council and the Declaration of Helsinki. Ethical approval for this study was obtained from the University of Witwatersrand’s Committee for Research on Human Beings (approval numbers M040835, M070126) (Annexure A). The following ethical considerations were applied in this study:

- Potential benefits and hazards

Before the study was conducted, introductory visits were made to the Sharpeville day-care centre for the elderly, where the researchers were introduced to the management and the elderly. The objectives of the research were explained to the elderly in order to reach informed consent and collaboration. The benefits of the study were that the respondents were to be made aware of their nutritional status and would also gain knowledge of soy, which can be effective in changing dietary behaviour which leads to poor nutritional status. The respondents will also benefit from the soy feeding intervention. No harm or risk to the participants was involved.

- Recruitment procedures

The elderly were invited to participate voluntarily in all the stages of this study. Different sampling techniques such as power calculations were applied according to the needs of each phase of the study.

- Informed consent

Written informed consent was obtained for the project from the elderly persons attending the centre (Annexure B).

- Data protection

Numbers were allocated to respondents to serve as an identity during the study period; therefore, no name of any individual could be traced on the questionnaire and files.

These ethical principles and consent were applicable to all stages of this study.

1.5 OUTLINE OF THE THESIS

This thesis is presented in six chapters. Chapter 1, which deals with the problem and its setting, covers the background information regarding malnutrition in the elderly population at global, African, South African and Vaal region level. The motivation for conducting the study is also presented in this chapter. Chapter 2 covers fundamental aspects from the literature, such as factors that contribute towards the development of malnutrition in elderly people, assessment of nutritional risk, dietary recommendations for the elderly and strategies to address malnutrition in the elderly, focusing mainly on soy and its benefits, success stories and challenges for research. Chapter 3 deals with the baseline study, which determined the nutritional status of the elderly. Chapter 4 describes a soy awareness education programme to improve nutrition knowledge of the elderly participants on the health benefits of soy before the implementation of the soy-based feeding intervention study. In chapter 5, the soy-based feeding intervention is discussed in terms of its implementation and its impact on the nutritional status of the elderly is evaluated by comparing the results before and after the intervention. In the last chapter the researcher presents the results of this study, draws conclusions and makes recommendations for the management of the day-care centre and policy makers as well as for future research (Chapter 6). The conceptual framework for this study is presented in Figure 1 below. This study was undertaken over a period of three years with the baseline survey starting in May 2009 and the soy feeding intervention ending November 2011.

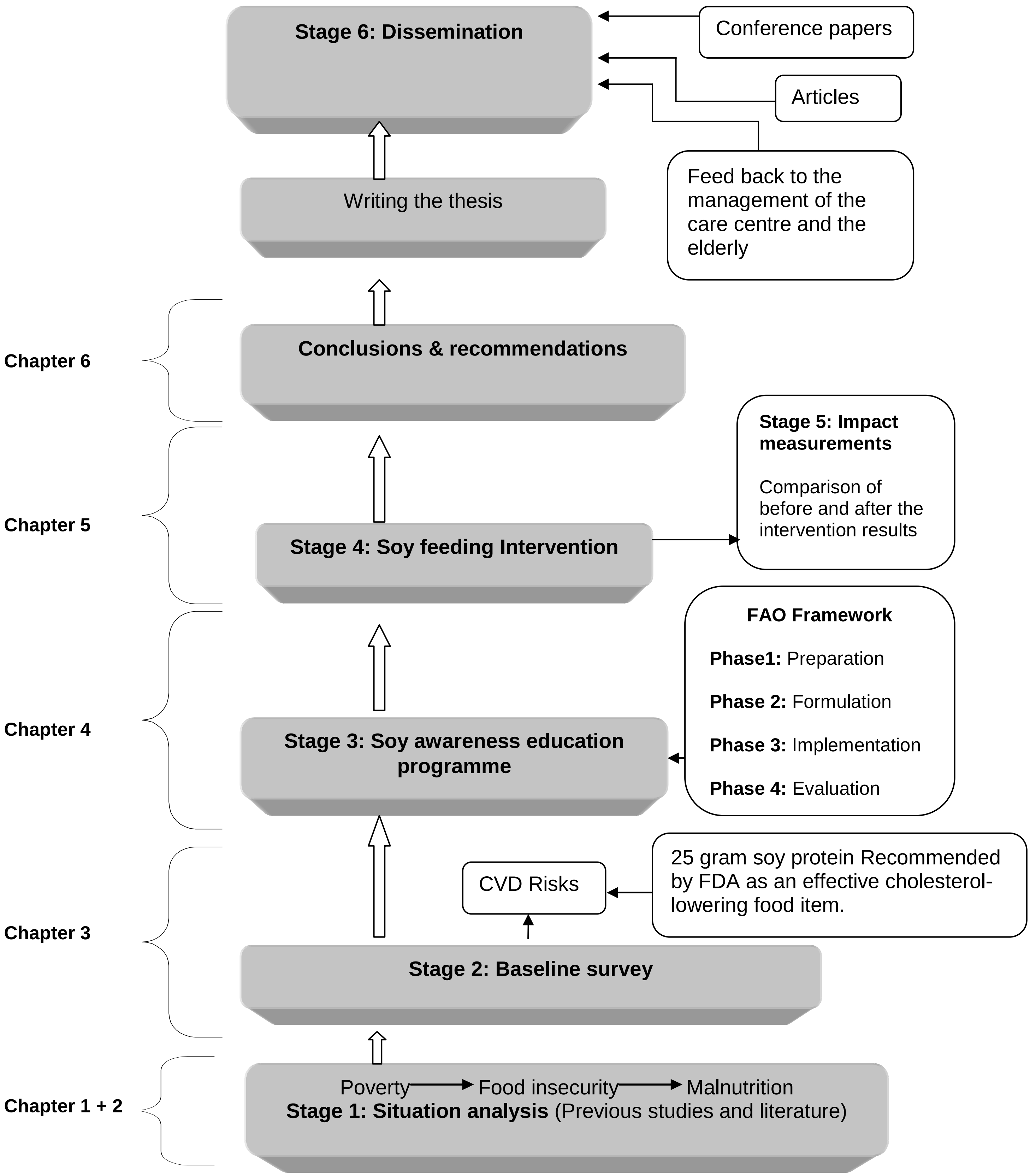


Figure 1 **Conceptual framework of the study**

2

LITERATURE REVIEW

2.1 INTRODUCTION

An elderly person is considered to be someone of 60 years and older in both South Africa [SA] (Charlton, *et al.* 2008:549) and other parts of the world (United Nations Department of Economic and Social Affairs population division 2013:3). In 1990 it was reported that, globally, elderly people made up 9.2 percent of the world population. An increase of about 2.5 percent occurred between the years of 1990 and 2013, followed by 11.7 percent in the year 2013, and it is predicted that the elderly will comprise 21.1 percent of the world population in the year 2050 (United Nations Department of Economic and Social Affairs population division 2013:3). By the year 2025, it is estimated that nearly 840 million of a total of 1.2 billion elderly in the world will be living in low-income countries (WHO 2002:6). In SA, one of the developing countries, it is estimated that 4 146 910 people are aged 60 years and older, constituting 7.8 percent of the total population of 52 981 991 million (STATSSA 2013:14). South Africa has the highest percentage of older people within the Southern African region (Kinsella and Ferreira 1997:1).

South Africa, like other developing countries, is undergoing a nutrition transition in which under- and over-nutrition co-exist, along with a serious malnutrition problem (Faber & Wenhold 2007:393). Of particular concern is the fact that demographic changes in South Africa have produced a rapidly ageing population, implying an increased prevalence of chronic ill-health, frailty and disability coupled with existing nutrition transition malnutrition at a time when nutrition interventions targeted at the elderly population in SA are limited (Joubert & Bradshaw 2006:215) and health care in SA for the poor or for older citizens has not been made a priority, resulting in the marginalisation of geriatric services (Joubert & Bradshaw 2006:215).

2.2 MALNUTRITION AND THE ELDERLY

Malnutrition is an umbrella term which describes the impairment of a person's health (Sampson 2009:507). It includes:

- Under-nutrition: a nutritional deficit resulting from an inadequate food intake or the presence of metabolically active disease(s).
- Over-nutrition: excessive food intake and/or restricted or limited activity.
- Imbalance: resulting from a disproportionate intake of particular food(s) (e.g. excessive alcohol intake or intake of energy-rich foods).

Although there have been significant medical advances and it is recognised that nutrition is a fundamental requirement for the protection and promotion of health, under-nutrition remains a significant and highly prevalent community health problem in developed countries (Food and Agriculture Organization [FAO], International Fund for Agriculture Development [IFAD] & World Food Programme [WFP] 2013). Kaiser, Bauer, Rämsch, Uter, Guigoz, Cederholm, Thomas, Anthony, Charlton, Maggio, Tsai, Vellas, Sieber and the Mini Nutritional Assessment international group (2010) investigated the prevalence of malnutrition in older adults globally. A literature search on PubMed, was performed to identify eligible studies. The aim of the study was to pool international data on the well validated Mini Nutritional Assessment (MNA) from high-quality studies published in peer-reviewed journals to provide information on the prevalence of malnutrition in older persons on a large scale. Studies published before 2000 were not incorporated. All settings relevant to the care of the older person were included, namely the community, nursing homes, acute-care hospitals and rehabilitation units. The study found that about 40 percent of hospitalised elderly and 50 percent of those in rehabilitation facilities were malnourished, and 86 percent were either malnourished or at risk of malnutrition in hospital. In comparison, about 67 percent of the elderly in nursing homes were malnourished or at risk of malnutrition. Among elderly people living in the community, 38 percent were malnourished or at risk of malnutrition (see Figure 2). Although this study covered study participants from the five continents with a strong focus on the European population (80.6% of the study data), the magnitude of the malnutrition problem in older people, according to the MNA, is very high, with the lowest prevalence reported in community-dwelling older adults and the highest prevalence in rehabilitation facilities and hospitals. However, it is estimated that 32 percent of the global burden of disease can be removed through the elimination of malnutrition, including micronutrient deficiency (Katona & Katona-Apte 2008:1582).

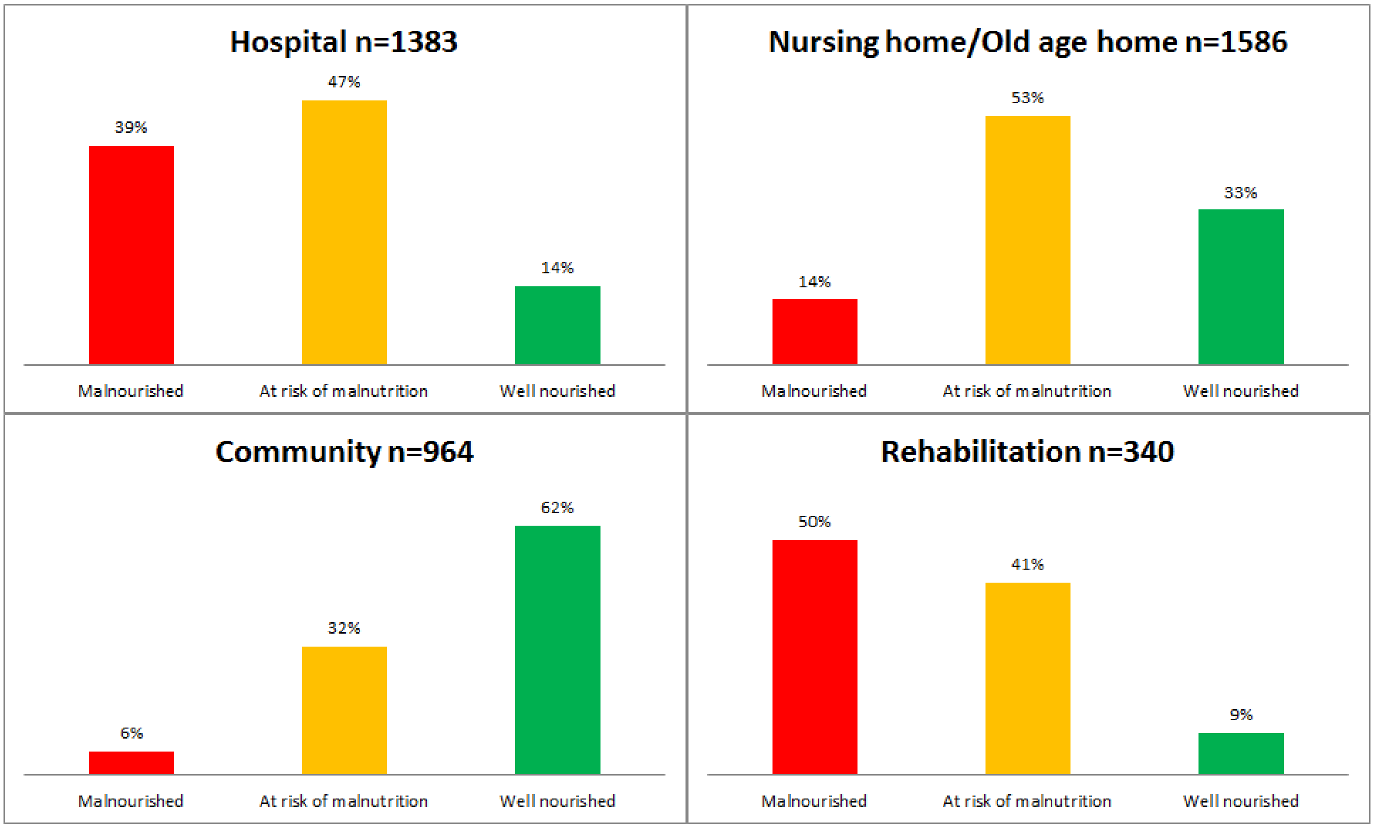


Figure 2 Distribution of malnutrition of older adults in different settings (adapted from Kaiser *et al.* 2010:1731)

2.3 FACTORS THAT CONTRIBUTE TOWARDS THE DEVELOPMENT OF MALNUTRITION IN THE ELDERLY

Changes that occur in the body as people age make the formerly simple task of nourishment more of a challenge. Malnutrition in the elderly is a multidimensional concept encompassing social, physical and medical factors (Sampson 2009:507). These factors will be discussed below:

2.3.1 Social factors

2.3.1.1 Socioeconomic status

Previous economic recessions have created significant adverse health consequences in society. The impact of an economic crisis may be especially severe for older people, particularly those who are physically vulnerable, living in poverty or dependent on private pensions (WHO 2014c). Furthermore, socioeconomically deprived individuals have higher mortality than persons with higher education, income, or occupational status (Bassuk, Berkham & Amick 2002:520). The fundamental cause of malnutrition in low-income countries is not so much lack of food, however; limited knowledge and traditional views about what older people should or should not eat play a major role (WHO 2002:12). Socioeconomic status is a major indicator of nutritional status. Where there is poverty, food insecurity followed by malnutrition, exists. Rose and Charlton (2001:384) state that a household is defined as experiencing food poverty when the amount of money spent on food is inadequate to purchase a basic, nutritionally adequate diet. Household food insecurity is defined as a household's lack of access to amounts of food of the right quality to satisfy the dietary needs of all its members throughout the year (Rose & Charlton 2002:383).

In SA, household food poverty has been shown to be greatest in Black African households headed by an older person, despite receipt of pension income (Charlton, *et al.* 2008:549). This situation is aggravated by the fact that large numbers of unemployed people related to the elderly, particularly the pensioner's children and grandchildren, depend on the old age pension for survival (Charlton *et al.* 2008:549). The source of income for the household is mainly from the elders. However, the elderly reported that the pension money was inadequate to meet their families' needs; this situation can place individuals at risk of malnutrition (Charlton, *et al.* 2008:549). The larger the household the higher the risk of household food insecurity because when household size increases the variety of food purchases begins to decline (Guthrie, Lin, Reeds & Stewart 2005:38), leading, therefore, to increased bad food choices that result in dietary deficiencies. The degree of adherence to dietary self-care behaviour is influenced by the amount of food sufficiency and affordability (Rizvi 2009:29).

The reduction of household food poverty through pension income has a negative impact on the nutritional status of the pensioners, more especially women. If food is not available in adequate quantities, the household members consume small amounts or the women (grandmothers) may forgo sustenance in favour of their grandchildren benefiting from the available food (Evans 2005:39; Charlton, *et al.* 2008:549). In a world where AIDS is the main cause of death of the younger generation, the grandmother becomes an integral figure in the daily management of the household. This involves food purchasing, meal preparations and housework (Charlton 2000; Oldewage-Theron & Kruger 2008b). Therefore limited knowledge of what elderly people should eat, more common in the elderly in low-income countries (WHO 2002:12), increases the likelihood of choosing unhealthy foods, which are often the cheapest and most heavily marketed (JRF 1994:2). The situation of unhealthy food choices may be aggravated by the fact that, when elderly people were at school, there was no such subject as nutrition education in the curriculum.

The Apartheid era in South Africa, resulted in more than one-third of the elderly population having no formal education experiences and not participating in the formal labour market. The end of Apartheid saw rapid urbanisation and the introduction of informal settlements on urban fringes (Kinsella and Ferreira 1997:4-5). The urbanisation movement was associated with increased consumption of monotonous diets with a high content of fatty and sugary foods, which are regarded as more affordable but are of poor nutrient content (Cannon 2001:1), resulting in unintentional weight gain or loss and progressive decline in health; this contrasts with rural communities, where diets are based on such foods as cereals, tubers, vegetables, and fruits (FAO 2001).

2.3.1.2 Social isolation

Older people generally spend more of their time at home or in the immediate surrounding areas and are more dependent on others in daily activities such as food preparation and eating. Owing to the modern lifestyle of people working far from home, old people find themselves in more direct contact with friends and neighbours than their own children and/or family members. Characteristics of isolation of the elderly from society include a reduction in functional capacity and social status, the breakdown of family structure, loss of family contacts and difficulties in accessing organised social services (Ramic, Pranjic, Batic-Mujanovic, Karic, Alibasic & Alic 2011:93). Social isolation, living alone and loneliness lead to lack of enthusiasm for eating, which may complicate an already marginal situation for nutritional risk in the elderly (Aliabadi, Kimiagar, Ghayour-Mobarhan, Shakeri, Nematy, Ilaty, Moosavi & Lanham-New 2008).

Isolation is associated with consumption of inadequate quantities of food in the elderly. This is more pronounced in elderly men. Globally, the most commonly consumed meal by many older people living alone is tea and toast, which is low in energy, protein and micronutrients (Sampson 2009:508). A study conducted by Ramic *et al.* (2011:95) to determine the differences in nutritional status of elderly people living alone compared with those who live in a family environment revealed a 12 percent prevalence of malnutrition in geriatric patients who live alone and an 11 percent prevalence of malnutrition in respondents who live in a family environment.

2.3.1.3 Dependency in daily activities

As people age, a decline occurs in functional status, both physical and cognitive, which affects a person's ability to shop and to prepare meals. Being unable to perform daily activities such as shopping, transportation, meal preparation, housekeeping, taking medication, managing finances, or using a telephone is a challenging issue for the elderly, especially because it leads to dependency on others (Evans 2005:39). As a result, the old people may be at risk of abuse or neglect (Charlton, *et al.* 2008:553). The elderly on average eat more slowly because of difficulties in chewing and swallowing and tend to consume smaller meals and to snack between meals (Parker & Chapman 2004:859). In situations where they depend on others for feeding, lack of patience by the people assisting the elderly may arise, leading to simply removing the uneaten foods and thus compromising the nutrition status of the elderly (Charlton *et al*. 2008:553), whose nutrient intakes are often below recommended daily allowances (Parker & Chapman 2004:859).

The reduced mobility of the elderly and the fact that old people often do not possess transport limits their ability to take advantage of multiple food special offers and bulk purchasing at discount stores to reduce the rate of household food insecurity. Within the South African context, people who live in informal settlements frequently shop mainly in smaller independent stores within walking distance from the household. This situation will also be applicable to the black elderly in informal settlements. Only what is needed is bought from these shops since they stock only limited ranges of foods and their prices are very high (Dobson *et al*. 1994:12; Kaufman & Lutz 1997:9; ACNielsen 2005:1). Public transport to the nearest town or city where discount stores are located is costly and usually includes an additional charge for luggage (Consumers' Association 1997:2; Ballantine *et al*. 2008:3). Furthermore, the reduced mobility of old people who are institutionalised or housebound poses a challenge in obtaining adequate vitamin D owing to limited sun exposure (Sampson 2009:508).

2.3.1.4 Excessive alcohol intake

Old people can develop a habit of excessive alcohol intake due to the disruption of their lifestyle by retirement and decreased social activities. However, ageing is also associated with a number of physiological changes such as declining body water content, suggesting increased sensitivity to alcohol. A study conducted by Lang, Guralnik, Wallace and Melzer (2007) found that older people tend to have a higher blood alcohol concentration after a standard dose. Loneliness can also lead to excessive alcohol consumption in old people. Often, lonely old people drink alcohol as a means to commit suicide indirectly, or as a means of coming to terms with illness and pain. This can lead to simply refusing geriatric care or stopping taking drugs that are necessary or not consuming food (Ramic *et al.* 2011:95). As a result, the alcohol intake may compromise the elderly person's nutrition.

2.3.1.5 Restrictive diets

Restrictive diets such as low cholesterol, low salt, vegetarian, kosher and halaal diets that old people may follow owing to personal preference, cultural and religious beliefs or for medical purposes can increase protein malnutrition and micronutrient deficiency as they remove or limit common high-protein foods (Sampson 2009:508). Texture-modified diets can also affect the nutritional status of the elderly because such diets rarely have the same nutritional quality as a full diet. The taste of foods regarded as healthy (lean meat) may change, which can result in a dislike and avoidance of the particular food (Sampson 2009:508).

2.3.2 Medical factors

2.3.2.1 Medications

Food, the flexible item in the elderly person's budget, may be cut back in order to support the shortfall in other expenditures such as the cost of housing and medical expenses, especially medication (Evans 2005:39). Many diseases such as thyroid, cardiovascular and pulmonary disease often lead to the use of polypharmacy, which can play a large role in unintentional weight loss through increased metabolic demand and decrease appetite and caloric intake. Although medication is important in the treatment of chronic illness, it is reported that more than 250mg of medication can impact the intake, absorption, metabolism and excretion of nutrients

(Sampson 2009:508). Constipation is another common complaint in elderly patients, resulting from a combination of polypharmacy, low-fibre diets and limited fluid intakes (Sampson 2009:508).

2.3.2.2 Chronic diseases of lifestyle

Chronic diseases of lifestyle (CDL) refer to a group of diseases that share similar risk factors owing to exposure over many decades to unhealthy lifestyle choices such as unhealthy diets, smoking, lack of regular exercise and also, possibly, stress. Major risk factors for these CDLs are high blood pressure, tobacco addiction, high blood cholesterol, diabetes and obesity. These result in various long-term diseases, culminating in high mortality rates attributable to stroke, heart attacks, tobacco- and nutrition-induced cancers, chronic bronchitis, emphysema, renal failure and many others (Steyn 2006).

Steyn (2006:1) indicated that the three most relevant components of the unhealthy lifestyle which influence the development of CDL are: the long-term use of tobacco products, the lack of regular aerobic exercise during adult life and the consumption of unhealthy diets over many decades. The unhealthy diets refer to diets similar to those of most developed westernised countries, consisting of high levels of saturated fat, particularly of animal origin, and an imbalance between the different polyunsaturated fatty acids. The diet is also very high in sodium (salt), cholesterol, alcohol, sugar and energy intake and very low in intake of fibre, vitamins and trace elements.

Chronic illnesses such as diabetes, hypertension, congestive heart failure and coronary artery disease, which are highly prevalent in the elderly, are treated with dietary restrictions and with medication that affects food intake. Restrictive diets can lead to low dietary intake as they limit sugar, salt and fat, which can contribute to making the food unpalatable or less tasty. Drugs affect nutritional status through side effects such as anorexia, nausea, and altered taste perception and through alteration of nutrient absorption, metabolism and excretion (Evans 2005:39).

2.3.2.3 Dementia

Dementia refers to a collection of disorders that are progressive and irreversible, leading to loss of intellectual skills in two or more areas, such as language, memory, visual and spatial abilities, judgement or abstract thinking, which significantly affects daily life (Golaszewski & McMluskey 2007:260). Dementia and cognitive disabilities can cause the elderly to neglect themselves, lose the ability to feed themselves or refuse to eat, which puts them at risk of inadequate food intake and therefore at high risk of malnutrition (Visvanathan & Chapman 2009). As a result of the elderly person's refusal to eat, feeding can become a time-consuming process. Excessive wandering, psychotropic medications, paranoid ideations and associated depression are other implicated factors (Hajjar, Kamel & Denson 2003).

In addition, the nutritional status of older people is associated with cognitive impairment and patients with dementia have a high risk of malnutrition because of difficulties with eating. This is supported by the findings of a study conducted by Chang and Roberts (2011), which determined the differences in the physical and psychological factors and feeding difficulties between people who are well-nourished and malnourished. In determining the predictors of risk of malnutrition and malnutrition in elderly Taiwanese with dementia residing in care facilities, the study revealed 90.4 percent of residents with dementia had a risk of malnutrition. The consequence of being unable to eat independently forces the elderly patients to rely on caregivers to assist them physically or with verbal prompts or cues during mealtimes., However, caregivers may be unable to identify the various types of feeding problems that accompany dementia or may be unaware of the feeding practices required to address those (Chang & Roberts 2011:36).

Dementia is commonly associated with weight loss. Some patients with dementia develop swallowing apraxia and must be reminded to swallow after each mouthful of food. Late-life paranoia, later-life mania and anorexia nervosa are other psychological conditions that may contribute to malnutrition in older persons (Hajjar, Kamel & Denson 2003).

2.3.2.4 Depression

Depression is a disorder that is characterised by sadness, changes in appetite, altered sleep patterns, feelings of dejection or hopelessness and, sometimes, suicidal tendencies (Frazer, Christensen & Griffiths 2005:627). Depression may occur as a result of negative life events such as the death of a loved one or may be caused by chemical imbalance or therapeutic and recreational medications. This disorder can occur at any age; however, it is the most common silent psychiatric disorder in the elderly and is frequently misdiagnosed and under-treated (Sherina, Sidik, Aini, Norhidayati 2005:57). The reason for misdiagnosis and under- treatment could be the misconception that depression symptoms are part of ageing. As depression is commonly untreated, it has significant clinical and social implications which can lead to the deterioration of an individual's quality of life and increase dependence on others (Sidik, Zulkefli & Shah 2003:148).

Depression in the elderly can often lead to malnutrition or dehydration, which can bring about various kinds of physical illnesses. Also, lower socioeconomic groups of the elderly experience increased rates of depression as a result of many elements such as inadequate diet, poor housing, poor health and lack of medical care (WHO 2014c).

2.3.3 Physical factors

2.3.3.1 Digestive issues

Normal ageing is associated with a number of significant changes in gastrointestinal function, which may impact on absorption of nutrients (Russels 2001; Lovat 1996). The elderly face digestive challenges such as feeding or swallowing difficulties, poor dentition and diminished sense of smell or taste or xerostomia [dry mouth] and loss of appetite (Charlton *et al.* 2008:559). Digestion of food begins in the mouth, and a common problem with aging is missing teeth or loss of teeth, which can hinder the ability of older adults to chew firm foods. Difficulties with chewing and swallowing can significantly impact on the type and amount of food consumed. Furthermore, a decline in sensory aspects such as taste reduces the enjoyment of food, leading to decreased dietary variety, and promotes increased dietary use of salt and sugar to compensate for these declines (Evans 2005:39). Saliva production is usually also reduced in old people, making food difficult to chew and swallow. In the stomach, the production of stomach acids is reduced. This interferes with digestion, making it more difficult for the elderly to obtain and utilise the nutrients in the food. The food moves more slowly in the digestive tract due to reduced production of acids and a decline in functional status, such as being physically active. This situation often results in constipation (Sampson 2009:508).

2.4 CARDIOVASCULAR DISEASES, RISK FACTORS AND THE ELDERLY

Cardiovascular (CVD) diseases are the leading cause of death worldwide (WHO 2014a) and are expected to increase among elderly people owing to increased life expectancy. Cardiovascular disease includes all disease that affect the heart and blood vessels, such as coronary heart disease (CHD), coronary artery disease, dyslipidaemia and hypertension (Retelny, Neuendorf & Roth 2008:468). The majority of the CVD cases and deaths occur in the elderly (> 65 years) and very old [> 80 years] (Roger, Go, Lloyd-Jones, Benjamin, Berry, Borden, Bravata, Dai, Ford, Fox, Fullerton, Gillespie, Hailpern, Heit, Howard, Kissela, Kittner, Lackland, Lichtman, Lisabeth, Makuc, Marcus, Marelli, Matchar, Moy, Mozaffarian, Mussolino, Nichol, Paynter, Soliman, Sorlie, Sotoodehnia, Turan, Virani, Wong Woo & Turner 2012) possibly due to increased exposure over time to cardiovascular risk factors (diabetes, hypercholesterolaemia and use of tobacco). Most adults at increased risk of CVD do not show any symptoms or obvious signs but they may be recognised by assessment of their risk factors (Fodor 2011:1207). Cardiovascular risk factors are highly prevalent in the South African population and are set to increase because of increasing urbanisation (Maritz 2006:97).

2.4.1 Coronary heart disease

Coronary artery disease (CAD), which results in coronary heart disease (CHD), develops when coronary arteries – the major blood vessels that supply the heart with blood, oxygen and nutrients – become damaged or diseased. Cholesterol-containing deposits (plaque) in human arteries and inflammation are usually to blame for coronary artery disease. When plaque builds up – a condition called atherosclerosis – it narrows and makes coronary arteries rigid; decreasing blood flow to the heart may eventually cause chest pain and shortness of breath. The build-up of plaque takes place over many years. A complete blockage of blood supply to the heart muscle can cause a heart attack while the blockage of the blood vessel to the brain by a blood clot can result in an ischaemic stroke (Mayoclinic 2014).

2.4.1.1 Stroke

Stroke, also known as a cerebrovascular accident (CVA), and often referred to as a brain attack, is a disease that occurs when the blood supply to part of the brain is interrupted or severely reduced, depriving brain tissue of oxygen and nutrients, which may cause the brain cells to be permanently damaged (Steyn 2007:2). A stroke may be caused by a blocked artery (ischaemic stroke) or a leaking or burst blood vessel, referred to as haemorrhagic stroke (Mayoclinic 2014). Risk factors for stroke include (Mayoclinic 2014; Heart and Stroke Foundation South Africa (HSFSA) 2014):

- Being overweight or obese
- Physical inactivity
- Heavy or binge drinking
- High blood pressure
- Cigarette smoking
- Diabetes
- High blood cholesterol
- Aged 55 and older
- Family history
- Infections such as TB, meningitis, HIV
- Head injuries

The signs and symptoms of stroke (Mayoclinic 2014; HSFSA 2014):

- Trouble with walking: sudden dizziness, loss of balance or loss of coordination
- Trouble with speaking and understanding
- Paralysis or numbness of the face, arm or leg
- Trouble with seeing in one or both eyes
- Severe headache accompanied by vomiting, dizziness or altered consciousness.

Almost 90 percent of the stroke patients are older than 65 years (Ha, Iversen & Hauge 2008), and the concern of acute stroke is that it may lead to additional nutritional problems. Stroke patients often experience exhaustion and this causes complications with eating (Bouziana & Tziomalos 2011:2). When patients consume or drink little in relation to their needs, this can worsen fatigue and result in undernourishment (Westergren 2008). Visual, speech, and language complications caused by stroke hinder sufficient communication about food desires and preferences. Reasoning shortfalls also limit patients' ability to carry out the activities required to eat a meal, thus increasing the risk of malnutrition. Women are more vulnerable than men to undernourishment because they appear to eat less and suffer stroke at an older age (Bouziana & Tziomalos 2011:2). Currently, poor blood concentrations of folate and vitamins B_6 and high concentrations of plasma homocysteine have been associated with increased risk of extracranial carotid-artery stenosis in older adults, thus proposing a significant role for these two vitamins in stroke prevention (WHO 2002:15). Deficiencies in the micronutrients folic acid, B vitamins (B_6 and B_{12}), A, C, D, E and zinc induce cerebrovascular alterations and increase the risk of stroke (Bouziana & Tziomalos 2011:2).

2.4.1.2 Heart attack

Heart attack, also known as a myocardial infarction (MI), occurs when the blood flow that transports oxygen to the heart muscle is severely reduced or stopped. This happens because of plaque build-up (atherosclerosis), which makes coronary arteries rigid and narrow or a clot forms. If the plaque breaks open and a blood clot forms that blocks the blood flow, a heart attack occurs (National Institute of Health [NIH 2013). The risk factors for heart attack that can be modified are smoking, high blood pressure, high cholesterol, lack of physical activity, high blood sugar due to insulin resistance or diabetes, and overweight and obesity. However, certain risk factors such as age and family history of early heart disease cannot be controlled. The risk of heart disease increases for men after age 45 and for women after 55 [or after menopause] (NIH 2013; Klieman, Hyde & Berra 2006).

2.4.2 Dyslipidaemia

The dyslipidaemia covers a broad spectrum of disorders of lipid (blood fats) metabolism that can be related to a) increased production of atherogenic lipoprotein particles, b) delayed degradation of atherogenic lipoprotein particles, c) decreased synthesis of protective lipoprotein particles, d) increased degradation of protective lipoprotein particles or e) a combination of the above-mentioned [a to d] (European Society of Cardiology [ESC] & European Atherosclerosis Society [EAS] 2011:1773; Schwellnus, Patel, Nossel, Dreyer, & Whitesman 2009:453). In simple terms, dyslipidaemia means an abnormality in circulating lipids, defined as elevated total or LDL-cholesterol levels, or low levels of HDL-cholesterol, which lead to the development of CVD (Fodor 2011:1207; Steyn, Blaauw, Lombard & Wolmarans 2008:720). Dyslipidaemia is an important risk factor for CHD or stroke (Fodor 2011:1207; Schwellnus *et al*. 2009:453) and an integral part of CVD prevention (ESC & EAS 2011:1773). Dyslipidaemia and hyperlipidaemia are used interchangeably to refer to abnormalities of lipids that are linked with atherosclerosis.

The prevalence of dyslipidaemia differs, depending on the definition of dyslipidaemia and the population that is studied. In the United States, the prevalence of dyslipidaemia in the adult population increases with age and peaks at 40 percent of men aged 65 to 74 (Schwellnus, *et al*.

2009:453). The dyslipidaemia prevalence in elderly people (>60 years) of South Africa, based on elevated TC (>5 mmol/L), indicates a lower percentage for African groups (44.7%), and a high percentage among Whites (97.9%), with females in all the groups having higher percentages than males. This indicates that dyslipidaemia is a serious risk factor for cardiovascular disease among the elderly in South Africa, especially women (Maritz 2006:101).

2.4.2.1 Lipid metabolism and age

Cholesterol is a biological particle (or lipid: a fat-like substance) that is crucial to cell membrane structure and function and to hormone and vitamin synthesis in humans (Félix-Redondo, Grau & Fernández-Bergés 2013:154). Total cholesterol (TC) in the blood/plasma originates in three ways: from diet, mainly from animal origin (intestinal absorption of food), from bile salts secreted by the liver and subsequently reabsorbed by the intestine and from endogenous syntheses (Félix-Redondo *et al.* 2013:154; Reddy & Katan 2004:170). However, the main importance of cholesterol lies in its role in atherosclerosis. The association between cholesterol and atherosclerosis is characterised mainly by a rise in plasma concentration (NCEP 2002:3163). The high level of cholesterol in the blood is referred to as hypercholesterolaemia (HSFSA 2007:25). Cholesterol is transported in the blood in distinct particles containing both lipids and lipoproteins as well as triglycerides [TG], which are esters of fatty acids (Félix-Redondo *et al.* 2013:155; NCEP 2002:3136).

The low-density lipoprotein cholesterol (LDL-C), which is a major atherogenic lipoprotein, transports most plasma cholesterol [about 60–70%] (NCEP 2002:3136). The LDL-C is responsible for conveying cholesterol from the liver to the peripheral tissues and depositing it in the innermost layer (intima) of the arteries under certain circumstances, thereby starting the atherosclerotic process (Félix-Redondo *et al.* 2013:154). Hence it has been identified by the Adult Treatment Panel (ATP) I and II as the primary target for cholesterol-lowering with ATP III continuing with this emphasis (NCEP 2002:3163). There is evidence that high-density lipoprotein cholesterol (HDL-C), known as good cholesterol, is protective against the development of atherosclerosis (NCEP 2002:3163) by removing excess cholesterol from cells to the liver, reducing the atherosclerotic lesions. High-density lipoproteins transport about 20–30 percent of the cholesterol. The balance of both lipoproteins (HDL-C and LDL-C) determines the onset, progression and complications of atherosclerotic plaque and, therefore, CVD (Félix-Redondo *et al.* 2013:154).

Researchers debate whether plasma triglycerides (TG) are an independent risk factor for CHD or not. Multivariate analysis in general did not identify plasma TG as an independent risk factor (Hulley, Rosenman, Bawol & Brand 1980). However, meta-analyses have established that elevated TG is in fact an independent risk factor (Austin, Hokanson & Edwards 1998; Assmann, Schulte, Funke & von Eckardstein 1998), signifying that some triglyceride-rich lipoproteins are atherogenic. A number of inter-correlated variables are associated with elevated TG as lipoprotein metabolism is integrally linked (NCEP 2002:3163). Non-lipid risk factors of obesity, hypertension, and diabetes are also interrelated with TG (NCEP 2002:3168). The most common factors that elevate TG are overweight/obesity and physical inactivity (NCEP 2002:3168). As a result, many persons with very high TG are at greater risk of CHD, even when this greater risk cannot be independently explained by triglycerides.

The concentration of TC increases with age from puberty until 45 to 55 years of age in men and then declines. In women, it continues to increase until about 10 years later, after which it declines in the last decade of life. The decrease can be explained by a reduction in LDL-cholesterol synthesis due to decreased liver function (Félix-Redondo *et al*. 2013:154). The factors that determine plasma cholesterol concentration are varied and depend on the specific situation of the elderly. These include the type of diet consumed e.g. an atherogenic diet, especially dietary fats (FAO 2010:11a), exercise or physical activity and metabolic disorders. Regular exercise does not reduce TC and LDL-C if there is no weight loss, although regular exercise is effective in increasing HDL-C and reducing triglycerides (Félix-Redondo *et al.* 2013:154). A high proportion of the elderly have a sedentary lifestyle (Healy, Clark, Winkler, Gardiner, Brown & Matthews 2011; Lambert & Kolbe-Alexander 2006:26) including the elderly in Sharpeville (Oldewage-Theron, Salami, Zotor & Venter 2008:7); a sedentary lifestyle coupled with diets rich in cholesterol and saturated fatty acids encourages the presence of disorders of lipids.

2.4.3 Hypertension

Hypertension, also referred to as high blood pressure (BP), is the force of the blood against the walls of the arteries (HSFSA 2007:20). Blood pressure is at its uppermost when the heart muscle contracts, pumping the blood to all parts of the body; this is called systolic blood pressure (SBP). When the heart is at relaxation, between beats, the BP drops; this is called the diastolic blood pressure (DBP). Blood pressure is expressed by these two numbers of the SBP and DBP readings [SBP/DBP] (HSFSA 2007:20). Blood pressure is a global health burden that affects both developed and developing countries including South Africa. However, the economic health burden is greater in developing than developed nations (Kearney, Whelton, Reynolds, Muntner, Whelton & He 2005:221). The high prevalence of BP worldwide contributes to the present and anticipated pandemic of cardiovascular disease (Seedat & Rayner 2012:60). About one billion of the world's adult population suffered from hypertension in the year 2000 and it is estimated that by the year 2025 this number will have increased to 1.56 billion. An analysis conducted by Kearney *et al*. (2005:221) on the prevalence of hypertension suggests that men and women have a similar prevalence of hypertension and that this prevalence increases with age. The physiological decline due to ageing causes arteries to dilate and stiffen, resulting in a stiff artery that is unable to accommodate the changes that occur during the cardiac cycle (Lionakis, Mendrinos, Sanidas, Fatatas & Georgopoulou 2012:136). However, the estimated number of hypertensive people by the year 2025 may be underestimated since a considerable number of older persons with hypertension are not detected (Kearney, Whelton, Reynolds, Muntner, Whelton & He 2005:222). Hypertension and high serum cholesterol often occur in parallel (NCEP 2002:3177).

The causes of hypertension are not known but various factors have been identified by various researchers as being associated with hypertension, namely socio-demographics such as old age (Kearney *et al*. 2005:221), female gender, lower education level and lower household income (Kaplan, Huguet, Feeny & McFarland 2010; Tsai, Liou & Chang 2007; Teo & Idris 1996). Other factors include geolocality, such as urban residence (Agyemang 2006), insufficient fruit intake (Tsai *et al*. 2007), high BMI, lack of physical activity and too much sodium (salt) intake (Frisoli, Scmieder, Grodzicki & Messerli 2012).

2.4.4 Cardiovascular risk factors

The principal influences on the developing of CDL such as CVD risk factors are urbanisation, globalisation, the media and advertising, agriculture and legislation and trade agreements (Steyn 2006:1). The risk factors of CVD among elderly people will be presented in the following section:

2.4.4.1 Obesity

Obesity is defined as a condition of excess or abnormal accumulation of fat in adipose tissue, which raises the risk of medical illness and premature mortality (Villareal, Apovian, Kushner &

Klein 2005:924; WHO 1997:7). There are a variety of factors that play a role in obesity, including genetic and hormonal influences and an energy imbalance. The energy imbalance involves eating too many calories and not getting the calories burned through exercise and normal daily activity (Centers for Disease Control and Prevention [CDC] 2012; Barasi 1997:18). Although excess fat is stored in different parts of the body, the abdominal or central fat which leads to obesity is strongly associated with a greater risk of diseases such as hypertension, type 2 diabetes and dyslipidaemia, manifested by high total cholesterol, high triglycerides and low high-density lipoprotein cholesterol (HDL-C) in older adults (Charlton *et al.* 2008:569; Velasquez & Bhathena 2007:72; Villareal *et al.* 2005:924). According to Yalcin, Sahin and Yalcin (2005), body mass index (BMI) in women is the most important predictor of the elevation of systolic and diastolic blood pressure.

The prevalence of overweight and obesity is increasing worldwide at an alarming rate in both developed and developing countries (WHO 1997:17) and is also observed in the elderly population (Zamboni, Mazzali, Zoico, Harris, Meigs, Francesco, Fantin, Bissoli & Bosello 2005:1011). In the elderly population, the pattern of weight gain coupled with increased abdominal obesity is observed in people around 50–60 years of age, indicating that overweight and obesity are common problems in old age (Charlton *et al.* 2008:569).

In Africa, obesity co-exists with under-nutrition; however, the prevalence of obesity is high in industrialised and economically advanced areas such as urban regions as compared with rural areas (Sidik & Rampal 2009). In recent years studies have indicated that obesity among women in Africa has been associated with an increased risk of non-communicable diseases. Studies show that food insecurity is related to overweight in women. One explanation for this is that, in humans, food deprivation that is due to insufficient resources to access food produces a tendency towards excessive eating behaviour when a plentiful food supply is available. Thus, overeating by food-insecure households when palatable food is plentiful, for example, when money for food is available, followed by a short period of involuntary food restriction, followed by overeating could be a pattern that results in gradual weight gain over time (Townsend, Peerson, Love, Achterberg & Murphy 2001:1743).

Goedecke, Jennings and Lambert (2006:65) indicated that the overall prevalence of overweight (BMI>25-29.9) and obesity (BMI ≥30) in SA is high, with more than 29 percent of men and 56 percent of women classified as overweight or obese. The adverse effects of obesity in elderly people are mortality, medical complications and a decrease in physical function owing to decline in muscle mass and strength and an increase in joint dysfunction and arthritis (Villareal *et al.* 2005:924).

2.4.4.2 Diabetes Mellitus

Diabetes mellitus is a chronic disease where the body stops producing or cannot produce enough insulin or use insulin effectively (International Diabetes Federation [IDF] 2014: 22; HSFSA 2007:22). Insulin is a hormone produced in the pancreas and it carries the sugar or glucose from the food to the blood into the body cells, where it is converted into energy needed for tissues and muscle function. Lack of insulin results in the rise of glucose levels in the blood (a condition known as hyperglycaemia) and can cause damage to arteries over time (IDF 2014:22). Untreated diabetes or complications of diabetes include kidney failure, CVD, stroke, blindness and amputation, particularly of the legs (HSFSA 2007:22).

There are three main types of diabetes (IDF 2014:22):
- Type 1 diabetes
- Type 2 diabetes
- Gestational diabetes

Type 1 diabetes is caused by an autoimmune reaction, where the body's protection system attacks the insulin-producing beta cells in the pancreas. As a result the body can no longer produce the insulin it needs. This type of diabetes can affect people of any age but it commonly occurs in children or young adults. Currently, people with type 1 diabetes need insulin every day in order to control the level of glucose in the blood, with careful monitoring of blood glucose levels using blood-test monitors (HSFSA 2007:23). Type 1 diabetes can produce symptoms such as:

- ✓ Blurred vision
- ✓ Frequent urination
- ✓ Abnormal thirst and a dry mouth
- ✓ Lack of energy or extreme tiredness
- ✓ Constant hunger
- ✓ Sudden weight loss

- ✓ Slow-healing wounds
- ✓ Recurrent infection

Type 2 diabetes is the most common type of diabetes and normally starts in middle age; however, it is now increasingly seen in children and adolescents. The risk of developing type 2 diabetes increases with age (HSFSA 2007:23). With type 2 diabetes, the body is able to produce insulin, but the produced insulin is either not sufficient or the body is not able to respond to its effects (known as insulin resistance), leading to a building up of glucose in the blood. Type 2 diabetes symptoms may take years to appear; hence many people with type 2 diabetes remain unaware of their illness. Risk factors for type 2 diabetes include:

- ✓ Poor diet
- ✓ Obesity
- ✓ Physical inactivity
- ✓ Advancing age
- ✓ Family history of diabetes
- ✓ Ethnicity
- ✓ High blood glucose during pregnancy affecting the unborn child

People with type 2 diabetes do not require daily insulin intake like people with type 1 diabetes. Type 2 diabetes can be managed by healthy diets, increased physical activity or oral medication (IDF 2014: 23).

Gestational diabetes occurs in women who develop a resistance to insulin and subsequent high blood glucose during pregnancy and tends to occur around the 24th week of pregnancy.

The number of people with type 2 diabetes is increasing rapidly worldwide owing to economic development, ageing populations, increasing urbanisation, dietary changes, reduced physical activity and changes in lifestyle patterns (IDF 2014:23). It is estimated that by the year 2025, adults aged 60 and older will comprise two-thirds of the diabetes population (Rizvi 1999). Obesity, which occurs as a result of many of the factors mentioned above, is a major risk factor of CVD and has been strongly associated with insulin resistance (Creager, Lüscher, Cosentino, & Beckman 2003:1529). Older people with diabetes are more likely to have coexistent chronic conditions like hypertension, dyslipidaemia and cardiovascular diseases that may impact on their nutritional requirements (Rizvi 2009). In the year 2000, diabetes was associated with 4.3 percent of South African adults' mortality. In that year the estimated burden of disease attributable to diabetes in South African adults of ≥30 years was as follows: 14 percent of ischaemic heart disease (IHD), 10 percent of stroke, 12 percent of hypertensive disease and 12 percent of renal disease (Bradshaw, Norman, Pieterse, Levitt and the South African Comparative Risk Assessment Collaborating Group 2007:704).

2.4.4.3 Homocysteine

Homocysteine (Hcy) is a substance in the blood that is produced when an amino acid called methionine is broken down in the body (Varga, Sturn, Misita & Moll 2005:e289). Every human being has Hcy in the blood. Elevated Hcy levels, also called hyperhomocysteinemia, create an irritation effect on the blood vessels. The causes of elevated Hcy levels are deficiency of folic acid or B vitamins, especially B_6 or B_{12}. However, people with kidney disease, low levels of thyroid hormones (hypothyroidism), using certain medication such as antiepileptic drugs and methotrexate and having a common genetic variant enzyme called methylenetetrahydrofolate reductase (MTHFR) that impairs their ability to process folate are observed with elevated homocysteine levels (Varga *et al.* 2005:e289).

Elevated levels of Hcy are positively correlated with risk of CVD in elderly people (Mckinley 2000; Mattson, Kruman, Duan 2002) and are often observed in people with thrombosis (blood clots in the veins) and atherosclerosis (Varga *et al.* 2005:e289). However, the mechanism and magnitude of the risk of CHD is not well understood, although persons with inherited forms of MTHFR have premature vascular injury and atherosclerosis (NCEP 2002:3185). Recent research shows that decreasing Hcy levels does not reduce the risk of atherosclerosis and thrombosis (Varga, Strum, Misita & Moll 2005; Abraham & Cho 2010:912). Thus, Hcy is not the cause but rather an effect of these conditions. Regardless, the magnitude of association between Hcy and CHD is not as great as that for the major risk factors; as a result, the ATP III does not list elevated Hcy as a major risk factor to modify LDL-cholesterol goals (NCEP 2002:3185). Even though elevated Hcy is not a major risk factor for CHD, the intervention of reducing elevated Hcy should continue to be implemented as this prevents vascular injury and conditions such as atherosclerosis (Brattstrom & Wilcken 2000:315).

2.4.4.4 Age and gender

As people age, the body undergoes alterations owing to the process of ageing. For instance, the function of the heart is influenced mainly by the degree of elasticity and ability to respond to pressure (compliance) of the arterial system (Stern, Behar & Gottlieb 2003:e99). Therefore an increase in resistance to the pumping actions of the heart increases the work necessary to drive the blood to the various organs of the body. As already stated, the atherosclerotic process results in thickening of the arterial wall; this leads to high blood pressure which, in elderly people, is denoted by the upper (systolic) pressure increase, the lower (diastolic) pressure decrease while the difference between the two, the pulse pressure, increases (Stern *et al*. 2003:e99). This last effect is an independent risk factor for developing CVD. For elderly people, the incidence of heart disease increases with age and blood pressure usually peaks at the age of 55–64 years (Klieman *et al.* 2006). In addition, a condition called calcification (formation of calcium crystals), which affects the heart valves, and which frequently begins during the fifties, increases the risk of CVD (Stern *et al*. 2003:e99). Furthermore, it is observed that gender is associated with risk of CVD. In the past CVDs were associated mainly with men but currently it is observed that the total number of women living with and dying of CVD and stroke exceeds that of men, as does the number of hospital discharges for heart failure and stroke. Men have a higher risk of getting heart disease than women who are still menstruating. However, after menopause, the risk for women is closer to the risk of men (MedlinePlus 2012).

2.4.4.5 Cigarette smoking

Smoking is estimated to cause nearly 10 percent of CVD (World Heart Federation [WHF] 2012; Mendis, Puska & Norrving 2011:26). It has been recognised as a dominant contributor to the risk of CHD and other forms of CVD (NCEP 2002:3178). Smoking increases cardiovascular and also non-cardiovascular morbidity and mortality (Schwellnus *et al*. 2009:453). Tobacco causes CVD in a number of ways: its use, whether by smoking or chewing, damages blood vessels by narrowing the arteries, temporarily elevates blood pressure and lowers exercise tolerance. In addition, tobacco decreases the amount of oxygen that the blood can circulate around the body and increases the tendency of blood to clot, and therefore leads to clots in arteries that ultimately result in a stroke or sudden death (WHF 2012).

The relationship of smoking to CVD risk is also said to be dose-dependent and is observed in men and women (NCEP 2002:3178). Observational data suggest that quitting smoking reduces the risk of CVD events and that the decrease in risk begins within months of quitting (NCEP 2002:3178). According to a study by Taylor, Hasselblad, Henley, Thun & Sloan (2002), it is still worthwhile for older people (>66 years) to give up smoking as the study showed that men gained up to two years of life and women gained up to 3.7 years, indicating the importance of the smoking cessation component when planning CVD modification programmes.

2.4.4.6 Physical inactivity and lack of exercise

Physical activity refers to any bodily movement that is significantly beyond resting level, resulting in energy expenditure (European Food Information Council [EUFIC] 2003; Briffa, Maiorana, Sheerin, Stubbs, Oldenburg, Sammel & Allan 2006:72). Examples of daily physical activities include housework, shopping, walking, climbing stairs and cycling. Exercise, on the other hand, is the systematic execution of physical activity for a specific purpose such as health and fitness (Briffa *et al*. 2006:72). This may include brisk walking, cycling, aerobic dance and competitive sport (EUFIC 2003).

There is scientific evidence available that indicates that an acute bout of physical activity, as well as regular exercise training generally, has a favourable effect on the coronary risk profile, namely the blood lipid-lipoprotein profile: raised triglyceride concentration and LDL-C in people with CHD [while weight reduction is achieved] (Thompson, Buchner, Piña, Balady, Williams, Marcus, Berra, Blair, Costa, Franklin, Fletcher, Gordon, Pate, Rodriguez, Yancey & Wenger 2003) raised blood pressure and glucose intolerance (Colberg, Siqal, Fernhall, Regensteiner, Blissmer, Rubin, Chasan-Taber, Albright & Braun 2010). A meta-analysis study which determined the combined effects of aerobic exercise and diet on lipids and lipoproteins in overweight and obese adults also revealed improvement in TC, LDL-C, TC:HDL-C and TG, but not HDL-C, in overweight and obese adults (Kelly, Kelly, Roberts & Haskell 2012:14). This finding on HDL-C contradicted the findings of Rendondo (2013:154). The effect of plasma lipids and lipoproteins on CVD risk and the results of a single exercise session and regular physical training on these parameters are summarised in Table 3.

Table 3 The impact of plasma lipids and lipoproteins on CVD risk and the effects of a single exercise session and regular physical training on these parameters (adapted from Schwellnus *et al.* 2009:459)

Plasma lipids and lipoproteins	Relationship to CVD risk	Effect of a single exercise session	Effect of regular physical training
Total cholesterol	Strong positive	No change	No change
Triglycerides	Somewhat positive	Decrease (14-50%)	Decrease (4-37%)
LDL-C	Strong positive	No change	Decrease or no change
HDL-C	Strong inverse	Increase (4-18%)	Increase

Among elderly people, sedentary lifestyle is common; therefore the benefits of physical activity on indicators of CVD can be minimal, as most clinical trials show that the benefits of regular training are evident after six months or longer. However, a study by Pescatello, Murphy & Costanzo (2000:433) has indicated that greater amounts of daily accumulated movement (low-intensity habitual physical activity) of ≥ 5hours were associated with a more favourable blood lipid-lipoprotein profile and glucose level in older adults living at home, independent of abdominal and overall adiposity.

2.5 STRATEGIES TO ADDRESS MALNUTRITION IN THE ELDERLY

Strategies to address malnutrition aim to reduce the prevalence of micronutrient malnutrition or a single nutrient deficiency. In the last decade, deficiency in three micronutrients, vitamin A, iron, and iodine, had the attention of the world. Zinc deficiency followed as one of the main concerns (Faber & Wenhold 2007:394). There are four key strategies in addressing malnutrition, namely supplementation, food fortification, nutrition education and food diversification.

2.5.1 Supplementation

Supplementation refers to the provision of relatively large doses of micronutrients, usually in the form of pills, capsules or syrup (WHO & FAO 2006:13), according to a pre-established time schedule (Faber & Wenhold 2007:394). Supplementation has the advantage of being capable of providing an optimal amount of a specific nutrient or nutrients in a highly absorbable form. This is one of the fastest ways to control or prevent deficiency in individuals or population groups, such as the elderly, who have been identified as being deficient. Supplementation is seen as a temporary strategy to reduce micronutrient deficiencies until more extended measures such as food fortification and dietary diversity are established (Kruger, Hendricks & Puone 2008:683; (Faber & Wenhold 2007:394). However, issues such as lack of supplies and poor compliance are constantly reported as being the main barriers to the success of such interventions (WHO & FAO 2006:13).

2.5.2 Food fortification

Food fortification refers to the practice of deliberately increasing one or more essential micronutrients such as vitamins, minerals and trace elements to processed food (WHO & FAO 2006:13) at levels higher than those found in the original food (Kruger *et al.* 2008:683). Fortification is done on easily reached and affordable foods that are regularly consumed by a large percentage of the population at risk (Faber & Wenhold 2007:394). As already mentioned, the elderly are at nutritional risk because of issues related to social factors, medical factors and physical factors; food fortification can, therefore, lead to moderately rapid improvements in the micronutrient status of this elderly population as part of a food-based approach where existing food supplies and limited access to food fail to provide adequate levels of the respective nutrients in the diet (WHO & FAO 2006:13). This food-based approach is considered a reasonably cost-effective strategy. In South Africa the fortification of household salt with iodine has been mandatory since 1995 and the fortification of two staple foods, namely maize meal and wheat flour, with essential nutrients has been mandatory since the year 2003 (Faber & Wenhold 2007:394).

Another way of fortifying nutrients can be through bio-fortification. This is the process by which the nutritional quality of staple food is improved through conventional plant breeding and/or use of biotechnology. The aim of bio-fortification is to increase nutrient levels in crops during plant growth. Bio-fortification may be a necessary strategy to reach populations where supplementation and conventional fortification activities may be difficult to implement (WHO 2014d).

Examples of bio-fortification projects include (WHO 2014d):

- Iron bio-fortification of rice, beans, sweet potato, cassava and legumes
- Zinc bio-fortification of wheat, rice, beans, sweet potato and maize
- Provitamin A carotenoid-biofortification of sweet potato, maize and cassava
- Amino acids and protein bio-fortification of sorghum and cassava

2.5.3 Nutrition education

The nutrition education (NE) component should be linked to the dietary diversification, supplementation and use of fortified food to ensure the increased consumption of micronutrient-rich food (Kruger *et al.* 2008:682). Nutrition education refers to a process by which combined communication activities such as nutrition information and beliefs, attitudes and environmental influences lead to voluntary practices that are scientifically sound, practical and consistent with individual needs and available food sources (McNulty 2013:5; Contento 2008:176; Behr & Ntsie 2008:323). The purpose of nutrition education is to promote lifelong specific nutrition-related practices or behaviour to change habits that contribute to poor health. This can be achieved by creating a motivation for change among people to establish desirable food and nutrition behaviour for the promotion and protection of good health (Behr & Ntsie 2008:323; FAO 2010a).

2.5.3.1 Nutrition education and the elderly

The increase in CVD worldwide and among the elderly population reflects the complex interactions of biology, personal behaviour and the environment (Contento 2007:176). Nutrition education among elderly people is limited. However, the increasing elderly population coupled with the rapid increase in medical expenditure due to the onset of chronic disease such as CVD and its risk factors and nutrient deficiencies has led to research interest and in older adults. Knowledge of the nutrition needs of older adults has changed and these needs differ from those of younger adults (Sahyoun, Pratt & Anderson 2004:58). The need for nutrition education among the elderly to allow them to modify their dietary practices is evident. However, a problem that arises frequently is the misconception that the mental capacity of the elderly has decreased and that there is a reluctance or inability to change health status through such educational efforts (Yassin & Seong 1995:42). Yet, research has shown that educational programmes and strategies, if carefully planned and targeted and based on the needs and interests of the group or following adult learning theory (Schultz, Nothwehr, Hanson, Chrisman & Haines 2012), can bring positive results (Yassin & Seong 1995:42; Lee, Jancey, Howat, Burke, Kerr & Shilton 2011:2).

According to the results of a study by Sahyoun *et al*. (2004:59), factors that ensure the positive outcomes of nutrition education interventions for the elderly are limiting the number of messages to one or two simple and practical messages, active interaction between participants and educators and tailoring the messages to their specific needs (Kim, June & Song (2007:45). Participants with specific health conditions were observed to have more success in making a dietary change (Sahyoun *et al.* 2004:59). Chamroonsawasdi, Phoolphoklang, Nanthamongkolchai and Munsawaengsub (2010:18) also indicated that the highest predicting factor of health-promoting behaviour in an elderly person was currently having an illness. Literature shows that age is not a limiting factor to increasing knowledge among the elderly as the gaining of nutrition knowledge is the most outstanding outcome of many nutrition education interventions for the elderly (Lee *et al.* 2011; Yassin & Seong 1995). Therefore nutrition education among the elderly should be encouraged.

2.5.3.2 Planning and implementing a nutrition education programme

The Food and Agriculture Organisation (2005) of the UN stresses that NE is especially important in situations where households have limited resources as it ensures a better and increased consumption of diversified food. Oldewage-Theron and Kruger (2008:129) confirmed that low income coupled with low literacy levels results in low dietary diversity, which leads to poor dietary intake and micronutrient deficiencies. Nutrition Education directed towards changing the attitudes, knowledge and skills of the elderly, more especially the grandmother, is vital as this will have a positive impact on the entire household. In the community of Sharpeville, the grandmother is the one mainly responsible for the food procurement, preparation and distribution in the household (Oldewage-Theron & Kruger 2008:129).

Planning is important for the accomplishment of a nutrition education intervention. The FAO has developed a framework for planning nutrition education programmes. The framework provides a logical development process based on scientific principles (FAO 1998). It is made up of four interactive phases, namely:

1) Phase1: preparation
- Defining the nutritional problem
- Determining the causes of the problems
- Establishing the educational framework

2) Phase 2: formulation
- Setting objectives
- Designing messages
- Choosing the media and multimedia combination

3) Phase 3: implementation
- Producing the materials
- Training the change agents
- Executing the communication intervention

4) Phase 4: evaluation, which will be discussed here.

The phases of the FAO framework will be described in detail in the following section.

- Phase1: Preparation

This phase is made up of three steps which involve firstly, defining the nutritional problem through the systematic analysis of nutrition and health-related problems in a community (target population), secondly, determining the cause of the problem and lastly, establishing the educational framework. In order to determine the situation analysis, various methods can be used such as a literature review of data available, interviews with stakeholders, focus groups, observation, a survey (KAP) which seeks to determine knowledge (K), attitudes (A) and practices (P) of a population, or prioritisation sessions (Behr & Ntsie 2008:327; Greyvenstein *et al*. 1999:107). Communities should participate in the process of the application of fundamental nutrition programming of assessment, analysis and action of the different phases of the framework (Behr & Ntsie 2008:327). Lee, Jancey, Howat, Burke, Kerr and Shilton (2011:2) also report that effective experimental research should allow the researcher and the participants to be partners in the development of the questions, the NEP and the evaluation. Nutrition problems to be addressed should first be analysed in order to identify the cause of the problem on which actions must be taking during the intervention. During this phase the primary, secondary and tertiary target groups should be determined and settings identified which provide the greatest access to the groups (FAO 1997).

- Phase 2: Formulation

As soon as the preparation stage is complete, formulation of the appropriate action plan and communication strategy takes place, guided by the results obtained from the preparation stage. Practical objectives are set for the group as part of strategy (Behr & Ntsie 2008:328). In this phase, messages are designed, materials are pilot tested, and the communication media suitable for the group are selected. Since a single media channel can sometimes not meet the need of the education programme, a multimedia plan is formulated in which all communication activities are integrated (FAO 1997).

- Phase 3: Implementation

The first step in this phase is the production of the materials to be used during the educational programme (Behr & Ntsie 2008:328; FAO 1997). Furthermore, people such as health workers who are going to facilitate the education programme (implementers or change agents) need to be effectively trained. The training should be based on the formulated message content as well as the methods and tools chosen to effectively communicate these messages. Once the material and training have been set up, the communication with the target group can begin (FAO 1997).

- Phase 4: Evaluation

Evaluation of a communication programme is important, but is often done poorly (Behr & Ntsie 2008:328) or not done completely. The evaluation process should be conducted with the involvement of the target population and fieldworkers since the actions to be evaluated concern them directly and the evaluation may help them improve their performance. It would be an added advantage if government representatives could also participate so that they can see the impact of the activities promoted and consider further expansion of the programme (FAO 1997).

2.5.4 Dietary diversification

Dietary diversification relates to a range of approaches that aim to increase the production, availability and access to micronutrient-rich foods, the consumption of micronutrient-rich foods or the bioavailability of micronutrients in the diet (Faber & Wenhold 2007:397). Although the benefits of this strategy are not immediate and should at the same time include short-term strategies, it is described as the most sustainable way of addressing malnutrition (Kruger *et al.* 2008:682). Food diversification can be achieved through:

- Behaviour change to improve consumption through social marketing and nutrition education
- Improved methods of preparation, preservation and cooking that preserve micronutrients
- Horticultural approaches such as home gardens

Nutrition education should stimulate the demand for certain foods, but the means and opportunities to act on that knowledge should be available. Nutrition education programmes should also provide opportunities for participants to taste nutritious foods prepared in delicious and tasty ways. This will enhance the beliefs about the value of eating these foods (Contento 2008:178). In addition, improved methods of preparation, preservation and cooking should be encouraged so that micronutrients can be preserved. Malnutrition (micronutrient deficiencies) at community and household level can be increased in the following ways (Faber & Wenhold 2007:397; FAO 1997):

➢ Diversification of crops: Since many studies have established that an increase in the individual's dietary score is related to nutrient adequacy of the diet and because this has also been established among the elderly (Oldewage-Theron and Kruger 2008), promotion of mixed cropping can therefore increase the availability of a varied diet. A variety of foods in the diet and within food groups is recommended by the SA Food-Based Dietary Guidelines (SA FBDG): "Enjoy a variety of foods".

➢ The introduction of new crops such as soybeans is determined by the nutritional requirements of the particular group. The nutrient content of the crop should be assessed by nutritionists, agronomists and breeders in collaboration. Crops selected should be easy to grow and cook and should be palatable.

➢ The promotion of indigenous food crops: The use and cultivation of indigenous crops should be encouraged, especially among the younger generation as these crops offer certain micronutrients and are resistant to drought and heat, making them easy to cultivate; they are also acceptable to local communities (Gibson & Hotz 2001).

- The home garden is usually a strategy implemented to increase fruit and vegetable production as a way to supplement the cereal-based diet at household level. Home gardening usually focuses on crops that are rich sources of Vitamin A (Faber & Wenhold 2007:397).

2.6 STRATEGIES CURRENTLY IMPLEMENTED TO ADDRESS MALNUTRITION AMONG THE ELDERLY

2.6.1 Global

These strategies include programmes such as meals on wheels, and meals served at luncheon clubs and community centres for elderly people (Food Safety Authority of Ireland 2000).

2.6.1.1 Supplemental Nutrition Assistance Program (SNAP)

This programme is formally known as the Federal Food Stamp Program. It is the largest domestic nutrition assistance programme in the US, designed to assist low-income families, including elderly people, to buy the food they need for good health every month, while improving diet quality and nutrition security. Each state has the option to provide nutrition education to participants regarding food choices (United States Department of Agriculture [USDA] 2014).

2.6.1.2 Nutrition Services Incentive Program (NSIP)

This programme intends to provide incentives to encourage efficient and effective delivery of nutritious meals to older individuals through additional funding to help providers adjust meal rates, which can positively affect the quality and number of meals provided to needy people. To be eligible for NSIP assistance, individuals receiving congregate and home-delivered meals must be aged at least 60 and qualified to receive services under the Older Americans Act. Spouses, disabled adults and volunteers younger than 60 may be served meals under some circumstances (Department of Elderly Affairs, State of Florida 2011).

2.6.1.3 Community meals, Congregate meals and Meals on wheels

These are community service meals designed to improve the health of vulnerable people such as elderly people, 60 years or older, physically or mentally unable to prepare meals, homebound or living alone. Meals on wheels originated in the United Kingdom in 1943. In Australia meals on wheels started in 1952 while in the United States of America the first home-delivered meal programme began in Philadelphia, Pennsylvania in 1954 (Wikipedia n.d.).This programme involves the delivering of healthy and nutritious hot meals to the homes of the elderly from Monday to Friday every week. In addition, frozen meals can be delivered once a week (Department of Elderly Affairs, State of Florida 2011).

2.6.1.4 Senior Farmers' Market Nutrition Program (SFMNP)

This programme supports good nutrition of elderly people by providing low-income elderly persons living in selected counties in Florida with coupons that can be redeemed for locally produced vegetables and fruits from participating farmers at local farmers' markets. The funding of this programme comes from the United States Department of Agriculture. The eligible elderly people receive \$40 (R434.80) worth (10 coupons are worth \$4 (R47.48) each) of coupons to be exchanged for fresh locally grown produce. Coupons are given out in early April and can be used until July 31 of each year (USDA 2014). For the purpose of conversion of SA Rands to US Dollars, the exchange rate R10.87 ≡ US\$ 1 as at date 16/01/2014 was applied in this study

2.6.1.5 The Emergency Food Assistance Program (TEFAP)

This is a regional programme in the United States of America that helps supplement the diets of low-income needy individuals and families including elderly people. The programme provides this group of people with emergency food assistance at no cost. In order for individuals to benefit from the programme, they should be categorised as having low income or very low income (Florida Department of Agriculture and Consumer Services 2013).

2.6.2 South Africa

2.6.2.1 The Integrated Food Security and Nutrition Programme (IFSNP)

The purpose of this programme is for all citizens of South Africa to attain physical, social and economic access to sufficient, safe and nutritious food at all times to meet their dietary and food preferences for an active and healthy life. This strategy was implemented in 2002, following the Constitutional Bill of Rights in SA, which states that every citizen has the right to have access to sufficient food and water (Department of Agriculture [DoA] 2002).

2.6.2.2 Staple food fortification programmes

Elderly people and other people in South Africa benefit from the micronutrients added in mandatory food fortification programmes and from salt iodisation (Charlton *et al.* 2008:575; Moeng & de Hoop 2008:301).

2.6.2.3 Community-based nutrition services

Many of these programmes are offered by non-government organisations (NGOs). Nutritionally vulnerable groups are provided with a nutrition supplementation programme which was formerly known as the Protein-Energy Malnutrition scheme. In this programme, vulnerable people are provided with at least one brand of staple food, enriched with nutrients. Although the programme is not targeted at the elderly, they may be eligible to access the programme if they are underweight, have cancer, HIV and AIDS or tuberculosis. Other community-based nutrition programmes of the Intergrated Nutrition Programme (INP) include soup kitchens, food parcels, and development projects such as bread baking, food preserving, vegetable gardening and animal husbandry (Charlton *et al.* 2008:576). However, luncheon clubs and soup kitchens are operated mainly by NGOs and community-based organisations. These can be situated in centre-based day care.

2.6.2.4 Meals on wheels

This programme for the aged in a community is operated by the Adventist Development and Relief Agency, an international, independent agency. Typically, a hot, nutritious midday meal is delivered to recipients' homes between one and five days a week. This programme strives to alleviate hunger and malnutrition in elderly people who cannot prepare meals for themselves. About 80 branches are operational countrywide. These branches are operated by volunteers (Charlton *et al.* 2008:576).

2.6.2.5 Food parcels

These are distributed by the Department of Social Development to the vulnerable sections of the population which spend less than R300 per month, as a temporary measure to assist the poor. Food parcels worth R300 are given to the vulnerable groups, including elderly people (Moeng & de Hoop 2008:290).

2.6.2.6 Food production

This is also a community-based nutrition programme in which the elderly people can also benefit. Its purpose is to provide households with a variety of nutritious foods in order to alleviate hunger and poverty and malnutrition through sustainable vegetable gardening and animal husbandry (Moeng & de Hoop 2008:290).

2.6.3 Sharpeville day care

The programmes that are currently in place to address malnutrition among elderly people in Sharpeville include those at national level as described above (South Africa). However, there are other projects implemented by the Centre of Sustainable Livelihoods (CSL) from the Vaal University of Technology (VUT), such as the ongoing Integrated Nutrition Education project in this elderly community which started in 2004 and has so far covered the following (Oldewage-Theron & Co-workers):

1) Supplementation: folic acids
2) Nutrition education: SAFBDG, osteoporosis, benefits of physical activity

3) Dietary diversity: Food aid programmes, Vegetable garden

Therefore, as an on-going project to address identified nutritional deficiencies or nutrition-related diseases among the elderly, this current study implemented a transition to soy because of its health benefits in nutrition-related diseases among the elderly.

2.7 SOYBEANS

Soybeans have been cultivated over many decades in Asia, but currently this plant is cultivated and consumed worldwide. Its nutritional value is very good as it is composed of high protein, making it the only plant that contains complete protein (nine essential amino acids), approximately equivalent to that of animal sources. In addition, it contains all three of the macronutrients required for good health: protein (38%), carbohydrates (30%) and an excellent fats profile (18%), as depicted in Figure 3 below (WISHH n.d.). The soybean is also rich in minerals and vitamins such as calcium, magnesium, iron, zinc and B vitamins, particularly B1, B2, E and folic acid (B9). Furthermore, the soybean contains a number of bioactive components that may potentially benefit human health, such as phytic acids, saponins, fibre, trypsin inhibitors, amino acids, peptides and isoflavones (Potter 1995:608S; Hodgson 2003:1). The amount of soy protein and isoflavones in soybeans varies according to the type of soybean, the geographical area of cultivation and the harvest year. Different processing methods can also affect the content of these nutrients (Bhathena & Velasquez 2002:1192).

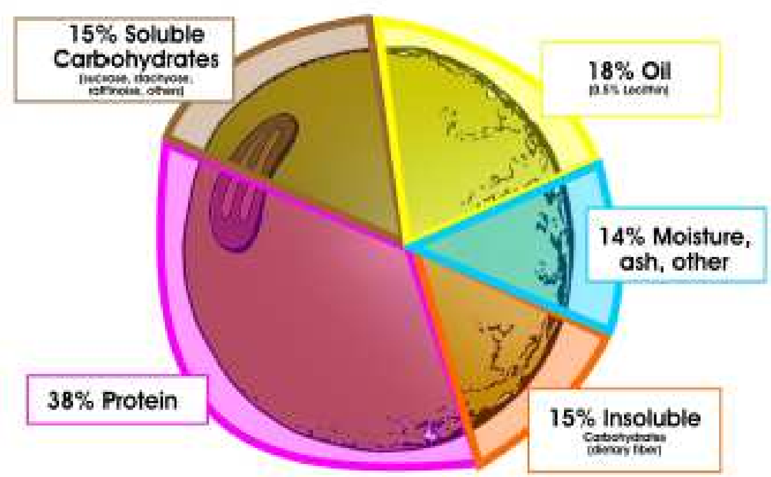


Figure 3 Composition of soybean

Furthermore, soy protein is considered an economical or affordable protein as compared with high-quality protein or complete proteins form animal sources, because soybeans can produce more kilograms of usable protein per hectare of farmland than other protein sources such as eggs, chicken and beef [see Figure 4 below] (Solae 2010). Moreover, soybeans use less water in production than other complete protein sources such as eggs, chicken and beef [refer to Figure 5 below] (Solae 2012).

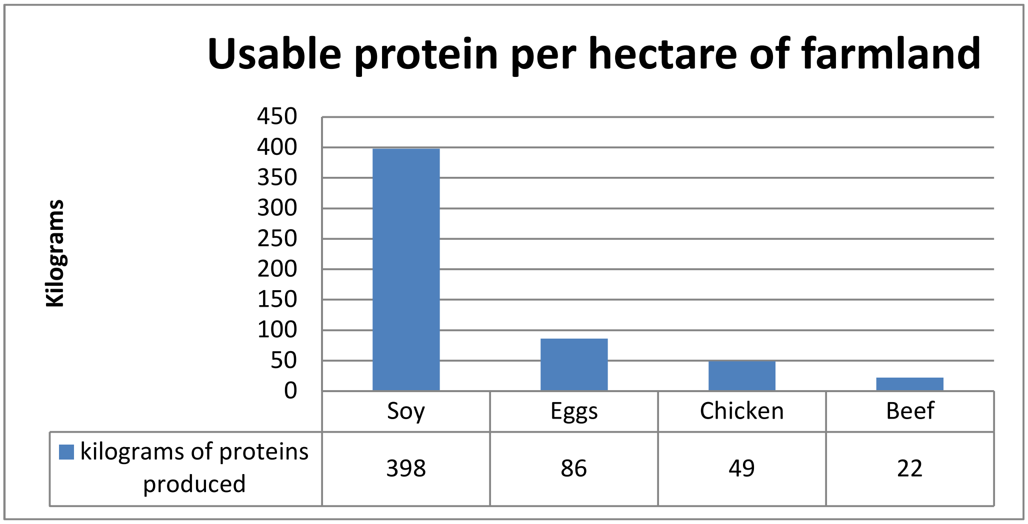


Figure 4 Soybeans compared with other complete proteins in terms of production of usable protein per hectare of farmland

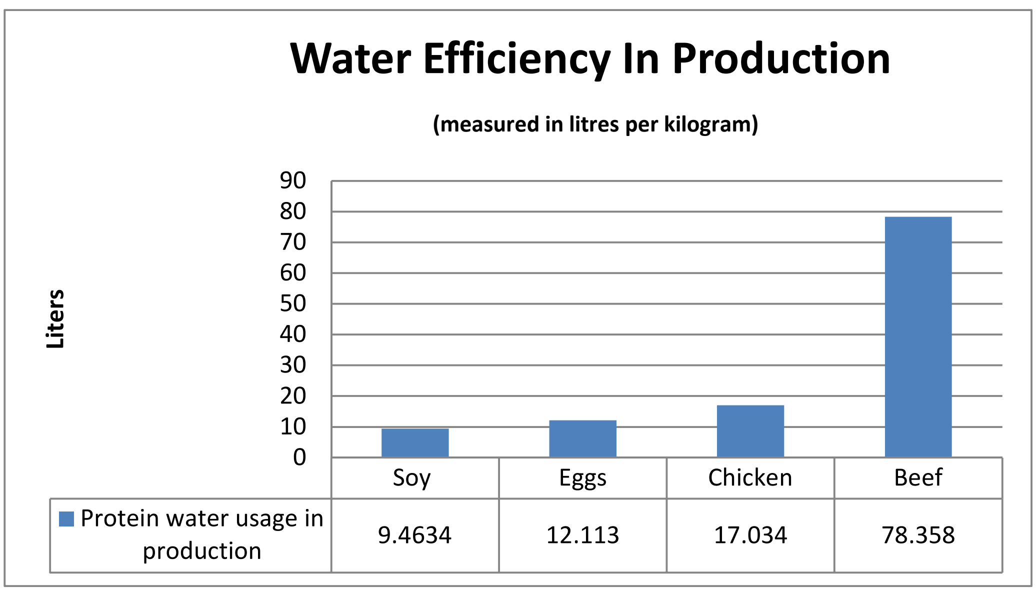


Figure 5 Soybeans compared with other complete proteins in terms of water efficiency in production

Various studies have used differing amounts of soy protein for soy interventions with ≥25g per day being the lowest amount. This highlights the importance of the amount of soy protein to be consumed per day as very important. Researchers should be aware that providing amount too high for consumption during an intervention can cause few people to abide by the protocol of the intervention more especially in communities that are not familiar with soy foods (Borodin, Menshikova, Dorovskikh, Feoktistova, Shtarberg, Yamamoto, Takamatsu, Mori & Yamamoto 2009:492).

2.7.1 Health benefits of soy

The use of soy-based products has been popularly associated with health benefits in improving lipid profiles, regulating menopause effects and reduction of the risk factors for several chronic diseases such as heart disease, cancer, and osteoporosis. The valuable effects and acceptability of soy-based products are well known. Although this study focuses mainly on soy and its effect on cardiovascular risk factors, an overview of soy health benefits in other medical conditions will be discussed in the following paragraphs.

2.7.1.1 Lipids

The USA Food and Drug Administration (FDA) and American Heart Association (AHA) recommended in 1999 that a daily consumption of at least 25 grams of soy protein as part of a diet low in saturated fat and cholesterol was effective in lowering blood cholesterol (Sacks, Lichtenstein, Van Horn, Harris, Kris-Etherton & Winston 2006:1689). However, it is not clear which components of the soybean are responsible for the beneficial effect. Many studies have been conducted focusing on identifying these components.

A meta-analysis study including 38 clinical trials has established that about 47g per day of soy protein has a beneficial effect on plasma lipids, reducing total cholesterol (TC), low-density lipoprotein (LDL-C) and triglycerides (TG) by 9.3 percent (0.60 mmol/L), 12.9 percent (0.56 mmol/L) and 10.5 percent (0.15 mmol/L) on average, respectively (Anderson *et al.* 1995:276). However, the decrease in the levels of TC and LDL-C was related to the initial serum cholesterol concentration. Similar findings were observed in another meta-analysis study including twenty-three studies from 1995 to 2002, which identified and quantified the effect of soy protein containing isoflavones on the lipid profile. This study indicated significantly reduced

TC, LDL-C and TG and significantly increased high-lipoprotein cholesterol (HDL-C), although the changes were linked to the level and period of the intake and the gender and initial serum lipid concentration of the subjects (Zhan & Ho 2005:397). Those with the uppermost cholesterol levels obtained the maximum benefits (Reddy & Katan 2004:117).

In a study that was conducted to assess the effect of soy protein versus soy isoflavones on the lipid profile in postmenopausal women given soy protein of 30g per day containing 60mg soy isoflavones (group 1) and 60mg per day of soy isoflavones (group 2) and 30g per day of casein protein (group 3, control group), indicated a highly significant decrease in atherogenic indices at 4 weeks (3.160) and 12 weeks (2.657) as compared with baseline (4.168) for women taking soy. The improvement in atherogenic indices was due to decreased TC, LDL-C, TG and increased HDL-C. No change was seen in the control group or the isoflavones group during the study period (Jassi, Jain, Arora & Chitra 2010:203). This study demonstrated that other components in soy protein may be responsible for the hypocholesterolaemic effect, and not isoflavones, as reported by other studies (Merz-Demlow, Duncan, Wangen, Xu, Carr, Phipps & Kurzer 2000:1465; Gardner, Newell, Cherin & Haskell 2001:734; Riaz 1999:89). Sacks *et al*. (2006:1690) also indicated that isoflavones have no effect on blood lipids. Anderson *et al*. (1995) revealed that every 1 percent reduction in cholesterol values is associated with an approximately 2–3 percent reduction in the risk of CVD.

Quite a few components of soy protein have been recognised as lowering cholesterol: trypsin inhibitors, phytic acid, saponins, isoflavins and fibre (Erdman 2000:2556). However, the potential cholesterol-lowering effects of soybeans are also attributed to a decrease in saturated fats and cholesterol when animal protein is replaced with soy protein, thus indirectly resulting in more favourable blood cholesterol levels and also possibly decreasing the risk of CVD (Venter 1999:27). Although fibre is said to be a cholesterol-lowering component, many published trial studies had little or no fibre (Erdman 2000:2556), indicating that fibre was not a major factor in lowering lipid profile.

2.7.1.2 Hypertension

Incorporating soy protein in the diet is described as an important nutritional strategy for preventing and treating hypertension. This can be attributed to soy protein's high content of arginine, cysteine and glycine, as compared with other proteins. In addition, isoflavones tend to act as phytoestrogens in mammals and therefore, may influence endothelial function of blood vessels through biological estrogenic mechanisms (Vasdev & Stuckless 2010). Studies that investigated the effect of supplementation of 20g to 40g soy protein in the diet of normotensive human subjects found that soy protein caused a greater significant decrease in blood pressure than non-soy proteins (Welty, Lee, Lew & Zhou 2007; Washburn, Burke, Morgan & Anthony 1999). In addition, a study conducted among low-income rural South African women indicated a significant impact of soy on the hypertensive group. The mean systolic blood pressure was significantly (p=0.000) reduced from 150.6±23.8 mmHg to 133.8 ±22.6 mmHg after the 18-month intervention. The diastolic blood pressure was also significantly (p=0.001) reduced from 99.9±13.5 mmHg before to 89.4±14.8 mm Hg after the intervention (Oldewage-Theron & Egal 2013).

On the other hand, several studies assessed the effect of soy protein with isoflavones and isoflavones alone on blood pressure and did not find a significant effect on blood pressure (Liu, Ho, Chen & Woo 2013; Matthan, Jalbert, Ausman, Kuvin, Karas, Lichtenstein 2007:962; Sacks, Lichtenstein, Van Horn, Harris, Kris-Etherton, Winston 2006:1038; Jenkins, Kendall, Jackson, Connelly, Parker, Faulkner, Vidgen, Cunnane, Leiter & Josse 2002:369; Hermansen, Søndergaard, Høie, Carstensen, Brock 2001:230).

2.7.1.3 Obesity

The literature has indicated that soy protein intake has favourable effects on obesity. However, nutrition intervention studies assessing the effect of soy on obesity are not clear since there are other studies that indicate that soy isoflavones have no improvement on the weight of pre-hypertensive postmenopausal women (Liu, Ho, Chen & Woo 2013:7). On the other hand, a study by Bakhtiari, Yassin, Hanachi, Rahmat, Ahmad, Sajadi, and Shojaei (2012) indicated a positive effect of soy isoflavones on improving body fat distribution among elderly women (60–70 years old) though the effect was considered small.

Although mechanisms responsible for the favourable effect on obesity are not clear, according to Velasquez and Bhathena (2007:76), consumption of food high in protein such as soy can suppress appetite and also positively affect satiety and reduce excess body fat in obese people. However, the suppression of appetite can put the elderly at nutritional danger as the elderly already may have a poor appetite. Soy protein ingestion also improves insulin resistance, which is a characteristic of obesity. In addition, dietary soy protein and some of its components also decrease abnormal plasma lipids and fat accumulation in liver and adipose tissue, which may decrease the risk of atherosclerosis and lipotoxicity and possibly other obesity-related complications (Velasquez & Bhathena 2007:76). In short, soy provides many nutrients that the body requires to manage weight, apart from being low in fat and calories and high in protein.

2.7.1.4 Diabetes

Evidence is emerging about the beneficial effect of soybean on people with diabetes, mostly non-insulin dependent diabetes mellitus (NIDDM). A study on the beneficial effect of intake of soy phytoestrogens in postmenopausal women with Type 2 diabetes showed that soy phytoestrogens favourably alter insulin resistance and glycaemic control, thus improving their CVD risk profile (Jayagopal, Albertazzi, Kilpatrick, Howarth, Jennings, Hepburn, Atkin 2002:1711). The carbohydrates in soy are complex, meaning they break down slowly in the body, limiting their impact on blood sugar level (low glycaemic index).

2.7.1.5 Malnutrition

More than 963 million people in the world are undernourished. Protein deficiency, also known as protein-energy malnutrition (PEM) is a major cause of malnutrition. Providing soybeans and soy-based products, which are known to be very rich in protein, can provide a more complete and healthy solution to alleviate hunger and malnutrition (Abiodun 1991; World Soy Foundation n.d.). Soy is available at a relatively low cost in great abundance and is also a versatile food product. Soy protein is highly digestible (92-100%) and contains all essential amino acids (Riaz 1999:90). It is suitable for all ages from infants to the elderly and provides an alternative protein source for those who are allergic to food such as cow’s milk and eggs.

2.7.1.6 Cancer

Soy protein consumption has been linked with reduced risk of certain type of cancer such as breast, prostate and colon. Many studies have been conducted to test the effect of soy intake on breast and prostate cancers but the results were inconclusive. A recent meta-analysis study including 35 studies which assessed an association between soy isoflavone intake and breast cancer risk in pre- and post-menopausal women revealed that the intake of soy could lower the risk of breast cancer for both groups of women in Asian countries (Chen, Rao, Zheng, Wei, Li, Guo & Yin 2014:9). However, there was no evidence to suggest an association between intake of soy isoflavones and breast cancer among pre- and post-menopausal women in Western countries (Chen *et al*. 2014:9). High intake of soy among the adolescents included in a case-controlled study indicated a low risk of breast cancer in adulthood (Shu, Jin, Dai, Wen, Potter, Kushi, Ruan, Gao & Zheng 2001:488). Furthermore, it is acknowledged that Asian women, who habitually eat a soy-based diet, have a much lower incidence of breast cancer as compared with other groups, for example Western women (Riaz 1999:89). However, on the contrary, soy products such as tofu, boiled beans and miso soup were indicated as having no protective effect against breast cancer in a collaborative cohort study in Japanese (Nishio, Niwa, Toyoshima, Tamakoshi, Kondo, Yatsuya, Yamamoto, Suzuki, Tokudome, Lin, Wakai, Hamajima & Tamakoshi 2007).

Potential anticarcinogenic effects of soybeans are linked with the isoflovanes (daidzein and genistein] (Riaz 1999:89), protease inhibitors, saponins, phytic acids and trypsin inhibitors (Venter 1999:29) found in soybeans. These components are thought to act against cancer in a number of ways: by interfering with cancer-promoting enzymes, by suppressing the activity of hormones in the body and even by hindering the process by which tumours receive nutrients and oxygen (Venter 1999:29; Riaz 1999:89). In addition, soy isoflavones may possibly stimulate epithelial cell production in the breasts of premenopausal women (Xiao 2008:1245S).

2.7.1.7 Menopause symptoms and osteoporosis

As women reach older age a decrease in oestrogen production is experienced, signalling the period of menopause. During the menopause, women experience difficulties in regulating body temperature which results in night sweats and hot flashes (Riaz 1999:90). Studies have assessed the effect of soy on hot flashes and a protective effect of reduced frequency and intensity was reported (Nagata, Takatsuka, Kawakami & Shimizu 2001:793). The protective effect of soy on menopause symptoms is attributed to the fact that soy has dietary oestrogens which are structurally similar to endogenous oestrogens. Therefore, dietary oestrogens imitate the actions of endogenous oestrogens by binding to oestrogen receptors and providing many of the biological effects observed with endogenous oestrogen. Therefore high intake consumption of soy products is likely to decrease the symptoms of hot flashes (Nagata *et al.* 2001:790).

Osteoporosis refers to a reduction in bone density which is particularly common in menopausal women and elderly individuals (70% of age >80). This condition is mainly responsible for a large number of fractures (Lockwood 2008:38). Research indicates that soy isoflavones may prevent postmenopausal osteoporosis, improve bone strength and increase lumbar spine bone mineral density [BMD] (Taku, Melby, Nishi, Omori & Kurzer 2011:337; Taku, Melby, Takebayashi, Mizuno, Ishimi, Omori, & Watanabe 2010:40). The potential mechanism associated with a positive effect of soy isoflavones on osteoporosis is the similarity in the structure of isoflavones to estradiol; they therefore act as a potential replacement for oestrogen deficiency (Lockwood 2008:40).

2.7.2 Functionality of soybeans in various applications

Since soybeans are rich in essential nutrients, soybeans can be used to produce a variety of healthy protein-packed foods, such as (Golbitz 2011; USB 2009:14):

- Soy milk and dairy alternatives
- Tofu (soy bean curd – a cheese-like food)
- Tempeh (a chucky, tender soybean cake)
- Miso (a rich, salty condiment)
- Natto (made from fermented cooked whole soybeans)
- Edamame (green soy beans)

Soy protein and its components can be incorporated into many foods for protein enrichment. These foods include (Golbitz 2011):

- High-protein meat replacements
- Energy bars and snacks
- Protein-enriched cereals
- Protein-enriched baked goods

Soy can be an important part of a healthy diet as it fits into the food plate dietary guideline in a number of ways. It can be a carbohydrate (soy flour), a protein source (soy mince), a source of good fats (soybean oil), a source of milk or milk products (tofu) and a vegetable (green soy beans or edamame), as indicated below in Figure 6 [also refer to Annexure G] (USB 2009:10):

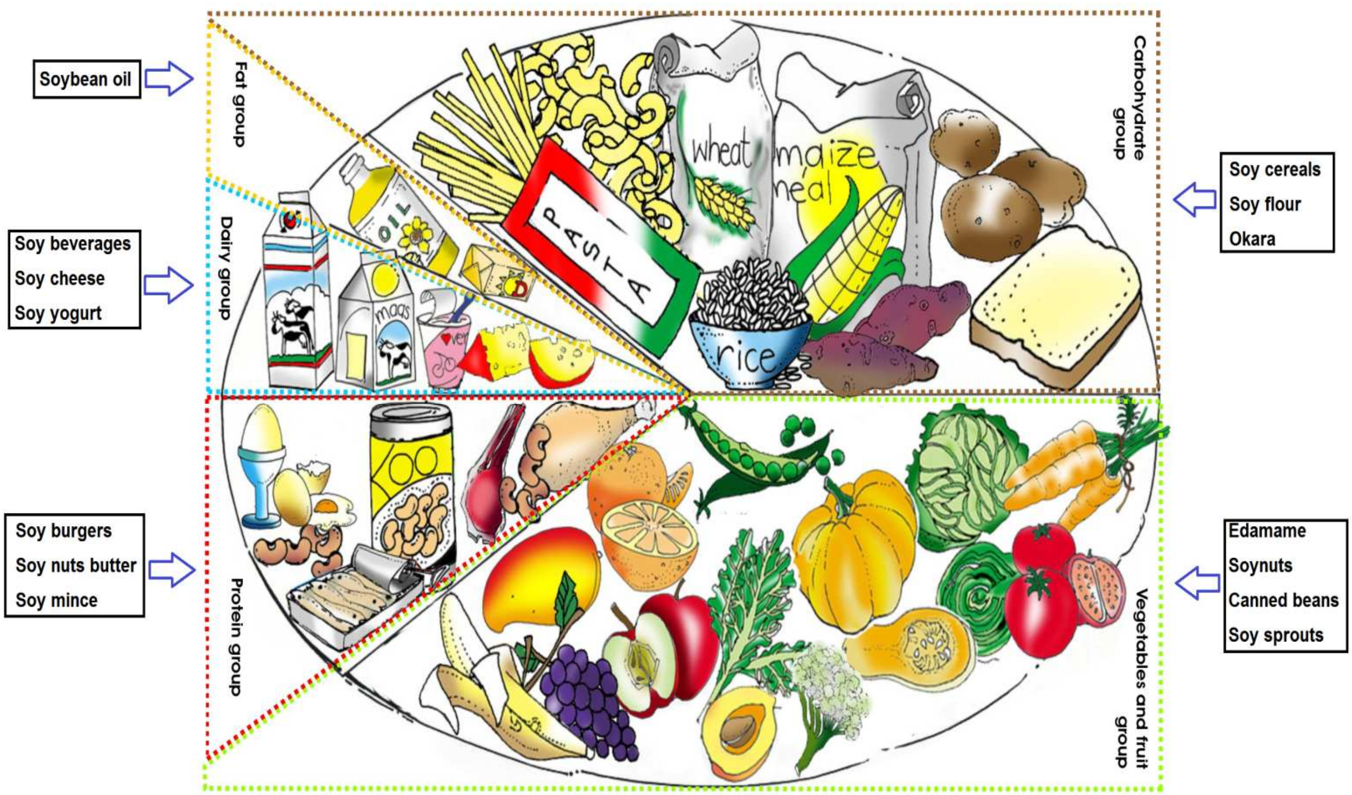


Figure 6 **How soy fits into the food plate dietary guideline**

2.8 NUTRITIONAL ASSESSMENT IN THE ELDERLY

Nutritional assessment in elderly people should be conducted routinely in the medical care of the elderly (Charlton *et al.* 2008:560), as this aids in planning for the prevention and control of specific nutrition-related health problems. Four major components of nutritional assessment for the elderly include anthropometric measurements, biochemical or laboratory indices, clinical examination and dietary intake, which will be discussed below.

2.8.1 Anthropometry

Anthropometry refers to the study of the measurement of the human body (National Health and Nutrition Examination survey [NHANES] 2007:3-7; Barasi 2003:11). Anthropometry evaluation is an essential element of elderly nutritional evaluation for determining malnutrition, overweight, obesity, muscular mass loss, fat gain and adipose tissue redistribution. Furthermore, anthropometry indicators are used to assess the prognosis of chronic and acute diseases, and to guide medical interventions in the elderly population (Sánchez-García, García-Peña, Duque-López, Juárez-Cedillo, Cortés-Núñez & Reyes-Beaman 2007). Changes in body composition differ according to gender at different life stages and are reflected in anthropometry measurements (Cheserek, Tuitoek, Waudo, Msuya & Kikafunda 2012:72; Sánchez-García *et al*. 2007). These measurements are economical and non-invasive and provide broad information on different components of the body structure. However, such measurements depend on the availability of equipment and the mobility of the older person (Charlton *et al*. 2008:560). An overview of the individual anthropometry measurements will be discussed in the following paragraphs.

2.8.1.1 Body weight

Body weight is the sum of all features of body composition and is a rough measure of total body energy stores; changes in weight thus usually parallel energy and protein balance (WHO 1998:391). Low body weight and rapid unintentional weight loss are associated with mortality and morbidity in older people (Charlton *et al*. 2008:560). The extent of weight loss over time for the elderly people gives an indication of whether nutrition intervention or further investigation is required. The weight is measured in kilograms (kg), using calibrated bathroom scales.

2.8.1.2 Height

Height is an important clinical indicator to obtain body mass index together with weight and also to estimate basal energy expenditure. Standing height is a measurement of the maximum vertical size. The height measurement can be measured from all people aged 2 years and older who are able to stand unassisted. Standing height is measured by means of a stadiometer with a fixed vertical backboard and an adjustable head piece (NHNES 2007:3-7). The standing height measure is measured in an upright standing position, with the subject not wearing shoes and the heels, buttocks and shoulders pressed against the stadiometer. Arms should hang freely with palms facing thighs. The subject should look straight ahead with the head upright and not tilted backwards. The measure of the stadiometer should be lowered until it makes contact with the top of the head (NHNES 2007:3-7). The height should be recorded to the nearest centimetre.

However, standing height measurements in the elderly may impose some complications owing to changes in body posture and thinning of vertebrae discs which can contribute to a decrease of height (Shahar & Pooy 2003:80) or even kyphosis (a curving of the spine that causes bowing of the back) in elderly people with osteoporosis. As a result, estimated height can be calculated using equations that incorporate knee height (WHO 1998:396). According to Charlton *et al*. (2008:560), the knee height is measured from the knee joint space to the heel (cm), measured from the sole of the foot at the heel to the anterior surface of the thigh with the foot and knee each flexed at 90°. The following equations have be en developed to estimate height from knee height (WHO 1998:396):

Men (white): Height (cm) = [2.08 x knee height (cm)] + 59.01
Women (white): Height (cm) = [1.91 x knee height (cm)] - [0.17 x age (y)] + 75
Men (black): Height (cm) = [1.37 x knee height] + 95.79
Women (black): Height (cm) = [1.96 x knee height] + 58.72

Furthermore, the arm span can be used when it is impossible to measure the actual height. However, with this method, the estimated results are more strongly related to the height of young adults (WHO 1998:397). The arm span value reflects the true length of the body frame (Charlton *et al*. 2008:560). When measuring the arm span, the respondent/participant should stand against a wall, with the arms extended sideways. The arms should be kept at shoulder height during the measurement. The measure is made with a measuring tape of at least 2 metres long, with an observer at each end of the tape, and the measure is recorded to the nearest 0.1 cm (WHO 1998:396).

However, of these two methods of estimating height measurements, knee height has been revealed to be a better predictor of height than arm span in older South Africans, as the arm span tends to overestimate height (Charlton *et al*. 2008:560). Both body weight and height are used to calculate the body mass index (BMI).

2.8.1.3 Body mass index

Body mass index (BMI), also known as Quetelet's Index (Barasi 1997:14), is a simple relation of height to weight that is commonly used to classify overweight and obesity in adults, calculated as weight (kg) divided by height squared (m^2), as indicated in the formula below (WHO 1997:9).

$$\boxed{\textbf{BMI = Weight in kilograms} \div \textbf{(Height in metres)}^2}$$

Body mass index reference ranges for older person are the same as for younger adults. The WHO classifies obesity as a BMI ≥30. However, the obesity BMI has subdivisions of mild, moderate and severe, as shown in Table 4.

Table 4 BMI reference values for adults and older people (WHO 1997:9)

Classification of body mass index	Cut-off point references BMI (kg/m^2)
Underweight	<18.5
Severe	<16
Moderate	16 - 16.9
Mild	17 -18.4
Desirable weight	18.5 - 24.9
Overweight	25 - 29.9
Obese	≥30
Class 1 obese (mild)	30 - 34.9
Class 2 obese (moderate)	35 - 39.9
Class 3 obese (severe)	≥40

The body mass index is strongly associated with body mass, and its reduction is an independent risk factor of adverse health outcomes. In older adults, low BMI, which indicates underweight or thinness, carries a greater risk of diminished immune response and morbidity, impairment in cognitive function and reduced physical and functional ability, which in turn affects nutritional status, forming a vicious cycle. On the other hand, high BMI or a range which shows a BMI of obesity among the elderly is associated with chronic diseases, which are the leading cause of mortality. Since low and high BMI are associated with a wide range of prevailing conditions, the achievement and maintenance of good nutritional status are critical to the health of elderly people (Cheserek, Tuitoek, Waudo, Msuya & Kikafunda 2012:67).

2.8.1.4 Waist circumference

The measure of waist circumference (WC) provides information about the intra-abdominal distribution of fat mass in adults (Charlton *et al*. 2008:560). Such fat mass is a better predictor of cardiovascular risk, diabetes (Milanović, Pantelić, Trajković & Sporiš 2011:174) and other endocrine abnormalities than BMI (Charlton *et al*. 2008:560). Waist circumference measurements are achieved by the use of an adequate length of a stretch-resistant tape. The WC is measured on the midpoint between the uppermost border of the iliac crest and the lower border of the costal margin [rib cage]. The tape should be placed around the abdomen at the level of this midway point and the reading is taken when the tape is snug but does not have to be pulled so tight that the tape compresses the skin (WHO 2008:5). However, in measuring for WC on very overweight people it may be difficult to accurately palpate those bony landmarks; in such cases placing the tape at the level of the belly button is recommended (WHO 2008:5). The WHO (1997:12) has proposed cut-off values for WC in adults (Table 5).

Table 5 Gender-specific reference values for waist circumference (cm) of metabolic complications associated with obesity (WHO 1997:12)

Gender	Classification and reference values for waist circumference (cm)		
	Ideal	Increased risk	Substantial risk
Men	<94	94.0 - 101.9	≥102
Women	<80	80.0 -87.9	≥88

2.8.1.5 Mid-upper arm circumference

Mid-upper arm circumference (MUAC) is an easy-to-perform measurement which requires only a tape measure. It is measured at the midpoint between the tip of the shoulder and the tip of the elbow (acromion process and the radial points), with the arm relaxed and hanging by the side (Charlton *et al*. 2008:560). MUAC is a valid and reliable indicator; reference values for older persons in developing countries are shown in Table 6.

Table 6 Mid-upper arm circumference reference values for older persons of African origin (adapted from Charlton & Rose 2001:2427S; WHO 2008)

Mid-upper arm circumference (cm) Older men and women of African origin	Nutritional status
>24.0	Normal weight
23.1 - 24.0	Mild malnutrition
22.1- 23.0	Moderate malnutrition
<22.1	Severe malnutrition

2.8.1.6 Skinfold thickness measurements

Skinfold thickness measures the body fat through the thickness of the fold of skin in the body with standardised callipers but requires a skilled technique. Several different locations can be used such as subscapular, supra-iliac, biceps, thigh, and calf. The distribution of skinfold thickness differs with ageing and between genders and ethnic groups (Harris & Haboubi 2005:412).

2.8.2 Biochemical indicators

Biochemical indicators refer to an assessment that can be conducted on blood and urine samples for concentration of a variety of nutrients and/or their by-products or for levels of nutrient-linked enzyme activities (Barasi 2003:13). A practitioner may order fasting blood samples, which require fasting for 10 hours before the blood is drawn (Varga, Sturn, Misita & Moll 2005:e290). Also, laboratory analysis may be carried out on samples of hair or bone marrow (Barasi 2003:13). Blood components, namely plasma, cells or serum, can provide a great deal of information, since they are more sensitive than anthropometry and clinical indicators (Charlton *et al*. 2008:565; Barasi 1997:16). Biochemical analysis can be used to determine (Barasi 1997:16) the following:

- ✓ Levels of nutrient-related products (e.g. lipoprotein levels)
- ✓ Real levels of a nutrient in relation to expected levels
- ✓ The activity of a nutrient-dependent enzyme
- ✓ The activity of a nutrient-related enzyme
- ✓ The rate of nutrient-dependent reaction

✓ The existence of a nutrient carrier or its saturation level

The biochemical measurements reference ranges for the lipids, lipoproteins, serum vitamins and CVD serum risk markers are provided in Table 7.

Table 7 Biochemical indicators: reference ranges

Total cholesterol in mmol/L [1]		LDL-cholesterol in mmol/L [2]	
<5.2	Desirable	< 3.0	Optimal
5.2-6.2	Borderline High		
≥6.2	High		
Triglycerides in mmol/L [4]		**HDL-cholesterol mmol/L [3]**	
<1.70	Normal	>1.5	Desirable
1.70-2.3	Borderline High	1.3-1.5	Borderline
2.4-5.6	High	<1	High risk (male)
≥5.7	Very High	<1.3	High risk (females)
Serum folate ng/mL [9]		**Serum vitamin B12 pgmL [8]**	
5.2-20	Normal	>200	Normal
Homocysteine µmol/L [10]			
<15 µmol/L	Normal		
15-60 µmol/L	Moderately high		
>60 to 100 µmol/L	Severely high		

[1]NCEP (2002); [2]Klug, SAHA and LASSA (2012); [3]Perk, De Backer, Gohlke, Graham, Reiner, Verschuren & Baigent (2012:43); [4]Europen Society Cardiology and European Atherosclerosis Society (2011:1793); [8]Bain, Bates, Leffan & Lewis (2012:202); [9]Maglumi (2012); [10]Faure-Delanef, Quere, Chassé, Guerassimenko, Lesaulnier, Bellet & Cohen (1997:1000); Abraham and Cho (2010)

2.8.3 Clinical indicators

Clinical indicators are used to identify alterations that may have occurred in the outer appearance of the body. These alterations may occur as a result of a number of nutritional deficiencies which could have effects on superficial structures, although many are non-specific (Barasi 2003:14). However, other alterations in appearance that are not as a result of nutritional state may also occur. Clinical signs occur most rapidly in those parts of the body where cell turnover is frequent, such as hair, skin and digestive tract (including mouth and tongue). Clinical examination may be carried out on the hair, face, eyes, mouth, tongue, teeth, gums, glands (such as thyroid) and ability to walk. A trained observer will be able to detect many changes in appearance; generally these are followed up with more specific tests of nutritional status (Barasi 1997:16).

2.8.4 Hypertension

High blood pressure (hypertension) is measured with a variety of equipment such as mercury Baumanometers or electronic BP monitors (HSFSA 2007:20). Hypertension is denoted by a reading of 140/90 mmHg or higher (Seedat & Rayner 2012:62). A person has hypertension if either of the numbers is above the cut-off point. The following cut-off points in Table 8 adapted from Seedat & Rayner (2012:62). The SA hypertension guideline 2011 can be applied to define blood pressure among elderly people:

Table 8 Hypertension reference values for South Africans (Seedat & Rayner 2012:62)

Hypertension Classification	Cut-off points
Normal	SBP 120-129 or DBP 80-84 mmHg
High normal	SBP 130-139 or DBP 85-89 mmHg
Stage 1: Mild hypertension	SBP 140-159 or DBP 90-99 mmHg
Stage 2: Moderate hypertension	SBP 160-179 or DBP 100-109 mmHg
Stage 3: Severe hypertension	SBP >180 or DBP>110 mmHg

2.8.5 Dietary intake

2.8.5.1 Dietary diversity questionnaire

The dietary diversity questionnaire is utilised to assess the rate at which food items or food groups are consumed during a specific time period [for example, a day, week, month or year] (Gibson 2005:47). The questionnaire consists of a structured list of individual foods or food groupings. The questionnaire is generally self-administered but may also be interviewer-administered. The number or types of food items may vary, as well as the number and types of frequency categories. The questionnaire may be unquantified, semi-quantified or completely quantified. The unquantified questionnaire does not specify serving sizes, whereas the semi-quantified tool provides a typical serving size as a reference amount for each food item. A quantified FFQ allows the respondent to indicate any amount of food typically consumed. Some FFQs include questions regarding usual food preparation methods, trimming of meats, use of dietary supplements, and identification of the most common brand of certain types of foods such as margarines or ready-to-eat cereals. The answers to these questions are then incorporated into calculation of nutrient intakes (WHO 1996). The strength and limitations of the dietary diversity questionnaire are presented below:

Major strength

- Relatively inexpensive
- Preferable method for nutrients with very high variability
- Does not alter intake behaviour

Major limitation

- relies on memory
- requires complex calculation
- requires literacy
- limited flexibility for describing foods

2.8.5.2 24-hour recall

The 24-hour recall method requires the respondents to recall the exact foods consumed during the previous 24-hour period or food consumed the preceding day. A trained fieldworker facilitates the interviewing process to obtain the actual food intake of the individuals. The four-stage process described by Gibson (2005:42) is followed, which entails firstly obtaining a whole list of all foods and beverages consumed during the previous day. This is followed by a detailed description of each food and beverage consumed, together with cooking methods and brand names (if possible). In the third stage, estimates of the amount of each food and beverage item consumed are obtained, usually in household measures, and entered on the questionnaire. Food models are simultaneously used to aid the respondents in estimating their food intakes and portion sizes consumed at home. Finally, in the fourth stage, the recall is reviewed to ensure that all items, including use of vitamin and mineral supplements, have been recorded correctly (Gibson 2005:42). The major strength and limitations of the 24-hour recall are presented below:

Major strength

- Little respondent burden
- No literacy requirement
- Does not alter intake behaviour

Major limitation

- Relies on memory
- Requires skilled interviewer
- Difficulty to estimate amounts

2.8.5.3 Food record

There are two types of food records, namely estimated food records and weighed food records. The estimated food record requires the subject to make a record of all food and drinks consumed, including snacks. These foods are recorded for a specific time period using household measurements. Detailed descriptions such as brand name and methods of preparation are stated for each food and beverage (Gibson 2005:44). Household measurements provide the respondents the opportunity to estimate portion sizes. However, the weighed food records provide precise estimates of usual food and nutrient intakes of individuals. In this method the subject is required to measure every food and beverage to be consumed. Methods of preparation of the food are also recorded in detail. The food records method relies more on the subject's compliance (Gibson 2005:45). The strength and limitations of the food records are presented below:

Major strength

- Does not rely on memory
- Easy to quantify amounts
- Open-ended

Major limitation

- High participation burden

- Requires literacy
- May alter intake behaviour

2.9 DIETARY RECOMMENDATIONS FOR THE ELDERLY

Attempting to provide adequate nutrition can be challenging in older populations because, firstly, their nutritional requirements are not well defined (WHO 2014e) and secondly, a decrease in organ function, changes in body mass and physical activity (Ritz 2001) alter the nutritional requirements. As a result, there is a call for special nutrient requirements as ageing has an effect on absorption, use and excretion (Wellman & Kamp 2008). From direct experiments conducted with older persons, the WHO (2002:1) has used reliable data on the amounts of nutrients required for preventing a deficiency state and chronic disease from Institute of medicine. These are described in the following sections.

2.9.1 Energy requirements

Energy is not a nutrient, but is essential for metabolic processes, heat production, muscular activity and synthesis of new tissues in the body. Energy requirements of elderly persons are generally lower owing to reduced physical activity and advancing age (Charlton *et al*. 2008:558). However, unchanged levels of energy absorption typically accompany older age and may result in obesity if energy levels are not lower (WHO 2002:54).The estimated energy requirements (EER) of people in old age appear to be 1.4 to 1.8 multiples of the basal metabolic rate (BMR) to maintain body weight at different levels of physical activity. Levels of physical activity that result in energy requirements on the higher end of the range are desirable for reducing mortality and morbidity (WHO 2002:55).

The EER refers to the average dietary energy intake that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height and level of physical activity, consistent with good health. The EER can be calculated using the following equations and applying the categories of physical activity level (PAL) below (Institute of Medicine [IoM] 2005:185):

Physical Activity Level (PAL) for women and men aged 19 and older

Women

PA = 1.00 if PAL is estimated to be ≥ 1.0 - <1.4 (sedentary)

PA = 1.12 if PAL is estimated to be ≥ 1.4 -<1.6 (low active)

PA = 1.27 if PAL is estimated to be ≥ 1.6 - <1.9 (active)

PA = 1.45 if PAL is estimated to be ≥ 1.9 - <2.5 (very active)

Men

PA = 1.00 if PAL is estimated to be ≥ 1.0 - <1.4 (sedentary)

PA = 1.11 if PAL is estimated to be ≥ 1.4 -<1.6 (low active)

PA = 1.25 if PAL is estimated to be ≥ 1.6 - <1.9 (active)

PA = 1.48 if PAL is estimated to be ≥ 1.9 - <2.5 (very active)

PA - Physical activity coefficient

PAL- Physical activity level

Equation for women aged 19 and older

EER (kcal/day) =354-(6.91x age [y]) +PA x { (9.36 x weight [kg]) + (726 x height [m])}

Equation for men aged 19 and older

EER (kcal/day) =662-(9.53x age [y]) + PA x { (15.91x weight [kg]) + (539.6 x height[m]) }

Conversion: 1 kcalorie = 4.184 Kilojoules

The acceptable macronutrient distribution range (AMDR) refers to the range of consumption for a particular energy source linked to reduced risk of chronic disease, while providing adequate levels of essential nutrients for adults, as shown in Table 9 below. These guidelines need to be applied to avoid intakes that are below or above the AMDR, which can increase the chance of high risks of chronic diseases and inadequate intake of essential nutrients (Gibson 2005:208).

Table 9 Acceptable macronutrient distribution range for adults (adapted from Institute of Medicine 2002, Gibson 2005).

Macronutrients	AMDR (as percentage [%] of energy
Carbohydrate	45 - 65
Protein	10 - 35
Fats	20 - 35

2.9.2 Macronutrient requirements

2.9.2.1 Proteins

The major function of protein in the body is growth and repair of body tissues (Barasi 2003; Food Safety Authority of Ireland 2000). Protein requirements for older people increase with age owing to a decrease in lean body mass. The increase in protein is needed to maintain nitrogen equilibrium when demands increase to heal wounds, fight infection and repair fractures (Chernoff 2005:1240S). The protein requirement, according to the estimated average requirements (EAR) for elderly people, is 56 g/day for men and 46 g/day for women (IoM 2002). The WHO (2002:57) states that protein intake of 0.9–1.1g/kg per day may be considered beneficial for healthy older persons. Food sources of protein are plants and animals. Examples of the plant sources of protein include food such as soybeans, legumes and peanut butter, while examples of animal sources of protein are eggs, dairy produce (cheese and milk-based desserts), fish and different kinds of meat (chicken, beef, mutton).

2.9.2.2 Carbohydrate

The carbohydrates are the major providers of energy in the diet. Carbohydrates are classified as sugars, starches and dietary fibre [non-starch polysaccharides] (Barasi 2003). The carbohydrate requirements of the elderly should be 45–65 percent of total energy intake obtained from various sources of food or 100 grams of the EAR (IoM 2002). Refined sugars that are rapidly digested and absorbed can cause a rapid elevation in blood glucose and high insulin. In situations where there is lack of insulin, the rise of glucose levels in the blood can cause damage to arteries over time (IDF 2014:22). Therefore complex carbohydrates which take long to digest are recommended. Non-insulin dependent diabetes mellitus, which is common among the elderly, is associated with risk factors for CVD such as overweight and diabetes.

2.9.2.3 Fats

Total dietary fat is made up of different types of fatty acids, namely saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) (FAO 2010a:22). Although the total dietary fat plays an essential role in prevention of coronary heart disease (CHD), the type of fat is of special importance (Steyn, Blaauw, Lombard & Wolmarans 2008:720). Dietary intake of total fat for older people should contribute 30 percent of total energy (%E) for sedentary and 35 percent of energy for active older persons (WHO 2002:56). However, in situations where overweight or obesity is a problem, caution on the intake of fats should be exercised.

Furthermore, the guidelines for prevention of chronic diseases (Steyn *et al*. 2008:721; FAO 2010a:11) indicate that SFA intake should be reduced to <10 percent of all energy intake (EI) for people at moderate risk of hypercholesterolaemia; for those at high risk of hypercholesterolaemia, the SFA should be <7% EI. The WHO (2002:56) is also of the same view that consumption of saturated fatty acids should be minimised and not exceed 8 percent of total energy intake for elderly people. A variety of fats should be included in the diet, particularly fats such as ω-3 fatty acids found in fish, soy, linseed, canola seed and oil, seaweed and green leaves (WHO 2002:56). Trans-fatty acids are fats that occur naturally in food such as butter and beef fat, as they are created as a result of the bacterial fermentation in the rumen of cows and sheep (Steyn *et al*. 2008:721). The TFAs of concern are those created by the commercial hydrogenation of vegetable oils (Gallagher 2008), in which the process results in fatty acids with no double bonds, resembling the chemical structure of a SFA. Trans-fatty acids should therefore be regarded as SFA and their intake should be limited. As a result the TFA increase low-density lipoprotein cholesterol (LDL-C) and decrease high-density lipoprotein cholesterol (HDL-C) levels (Krauss, Eckel, Howard, Appel, Daniels, Deckelbaum, Erdman, Kris-Etherton, Goldberg, Kotchen, Lichtenstein, Mitch, Mullis, Robinson, Wylie-Rosett, Jeor, Suttie, Tribble & Bazzarre 2000:2754). The recommended intake of trans-fatty acids should not be more than 1% E or such fats should be removed from the human food supply (FAO 2010a:17; Davis & McMurry 2009:3).

The MUFA are considered a healthy type of fat. Consuming MUFAs is beneficial in cholesterol-lowering (total cholesterol and LDL-C) when they replace SFAs in the diet (Steyn *et al*. 2008:721). The intake of MUFA is determined by calculation of difference as follows: MUFA = Total fat intake (%E) – SFA (%E) – PUFA (%E) – TFA (%E) or can be up to 15–20 percent E, as per total fat intake (FAO 2010a:11). The PUFA, are regarded as the essential fatty acids and are classified into two in the diet, the omega six (ω-6) of which linoleic acid (C18:2 ω-6; LA) is the parent fatty acid and the ω-3 PUFAs, of which α-linolenic acid (C18:3 ω-3; ALA) is the parent fatty acid. To meet the needs of essential fatty acids, an estimated average requirement (EAR) intake of 2% E from LA and 0.7%E from ALA is considered as adequate for adult human health (Steyn *et al*. 2008:721; FAO 2010a). For dietary cholesterol the American Heart Association (AHA) recommends an intake of <300mg per day as dietary cholesterol can increase LDL-C level, although to a lesser degree than saturated fat (Lichtenstein, Appel, Brands, Carnethon, Daniels, Franch, Franklin, Kris-Etherton, Harris, Howard, Karanja, Lefevre, Rudel, Sacks, Van Horn, Winston & Wylie-Rosett 2006:87). Table 10 indicates the dietary recommendations and lifestyle changes for preventing CVD.

Table 10 Dietary recommendations and lifestyle changes for preventing CVD (adapted from Schwellnus, Patel, Nossel, Dreyer & Whitesman 2009:456).

Type of fat	Description	Impact on health	Food sources
Saturated fats	These fats are full of hydrogen (saturated). Solid at room temperature	Elevates LDL-C and TC	Solid vegetable oils, full-fat hard cheese, brick margarine, fatty meats such as sausages
Trans-fats	Hydrogenated vegetable oil	Elevates LDL-C and lowers HDL-C therefore high risk of CVD	Hard margarine, pastries, biscuits and meat products
Mono-unsaturated fats (MUFA)	Liquid at room temperature	May lower LDL-C and TG and elevate HDL-C if the MUFA replaces SFA in the diet	Olive oil, canola oil, soya oil and most nuts.
Poly-unsaturated fats (PUFA)	Liquid at room temperature	Lower LDL-C therefore low risk of CVD	Walnuts, vegetables such as Safflower, sunflower

2.9.3 Micronutrient requirements of the elderly

According to Charlton *et al.* (2008:558), micronutrients (minerals and vitamins) required that differ for older persons, compared to younger persons, are fibre (older persons' requirement is lower); calcium (higher); iron (lower for women, not men); chromium (lower); and vitamin D (higher). Vitamin D is the only micronutrient where a different recommendation is made for persons in the 51–70 years and 70+ years age groups). The adequate intake (AI) and or EAR for the micronutrients, their major function in the body and good food sources are presented in Table 11 and 12.

Table 11 Micronutrients (vitamins) recommended per day for the elderly (IoM 1997; 1998; 2000; 2001; 2011)

VITAMINS				
Nutrient (g) p/day EAR/AI	**Requirements**		**Major function in the body**	**Good food sources**
	Men	Women		
Vitamin A[a] (mcg)	625	500	Better vision, growth and antioxidant role	Liver, carrots, oranges, dark green leafy vegetables
Vitamin C[a] (mg)	75	60	Prevents scurvy	Citrus fruits, tomatoes, green vegetables
Vitamin D[a] (mcg)	15	15	Prevention of degenerative diseases such as CVD	Oily fish, fortified margarine and milk
Vitamin E[a] (mg)	12	12	Maintaining of cell membrane	Vegetable oils, nuts, cereals
Vitamin K[b] (mcg)	120	90	Assists in blood clotting	Dark green leafy vegetables
Thiamin[a] (mg)	1.0	0.9	Prevents beriberi	Pork meat, nuts, whole grains
Riboflavin[b] (mg)	1.1	0.9	For body growth and red blood cell production and helps in releasing energy from carbohydrates	Yeast extracts, liver, milk
Vitamin B_6[a] (mg)	1.4	1.3	Helps the body to make antibodies, maintain normal nerve function, and keep blood sugar (glucose) in normal ranges.	Beef, fish, poultry
Folic Acid[a] (mcg)	320	320	Works together with vitamin B12 to form healthy red blood cells and helps reduce central nervous system defects such as spina bifida in unborn babies	Broccoli, liver, spinach, liver, peas, Brussels sprouts, fortified breakfast cereals
Vitamin B_{12}[a] (mcg)	2	2	Involved in making red blood cells and keeping the nervous system healthy and processing folic acids	Fortified cereals, offal, eggs, milk
Pantothenic acid[b] (mg)	5	5	Prevents an abnormal sensation in the feet and lower legs (burning foot syndrome)	Meat, cereals, vegetables, cod, salmon

[a] Estimated Average Requirement (EAR); [b]Adequate Intake (AI)

Table 12 Micronutrient (minerals) recommended per day for the elderly (IoM 1997; 1998; 2000; 2001; 2011)

MINERALS				
Nutrient (g) p/day EAR/AI	**Requirements**		**Major function in the body**	**Good food sources**
	Men	Women		
Calcium[b] (mg)	1200	1200	For strong bones and teeth	Milk and milk products, bones of tinned fish
Phosphorus[a] (g)	580	580	Helps with kidney function, muscle contractions, normal heartbeat and nerve signalling	Milk, cheese, fish, eggs
Magnesium[a] (mg)	350	265	Bone health, carbohydrate metabolism, blood pressure regulation and energy transport	Whole grain cereal, nuts, spinach
Iron[a] (mg)	6	5	Transport and storage of oxygen, aids in energy production and cell diffusion and helps the immune and central nervous systems	Offal, all red meat, egg York, dried fruit
Zinc[a] (mg)	9.4	6.8	Vital for growth and cell division, immune system, taste, smell, and appetite	Pulses, offal, seafood (oysters)
Fluoride			Formation of dental enamel and mineralisation of bones, prevents dental caries,	Avocado, cabbage, dates, cucumber, cauliflower
Iodine			For normal thyroid function	Iodised salt, cod, haddock
Selenium[a] (mcg)	45	45	Making special proteins, called antioxidant enzymes, which play a major role in preventing cell damage	Liver, Brazil nuts, shell fish, kidney

[a] Estimated Average Requirement (EAR) and [b]Adequate Intake (AI)

2.9.4 Water

Water is the largest vital component of life in humans. Water makes up to 50–60 percent of the elderly person’s body weight (Barasi 2003:221. The absence of water for a week in human body could be lethal (Popkin, D’Anci & Rosenberg 2010). Many degenerative age-related diseases aggravate the tendency towards dehydration in older persons (WHO 2002). Therefore in order for the elderly to keep being hydrated, the general rule for how much water a sedentary adult should drink in a warm environment is 1.2 to 1.5 litres (L) each day (Barasi 2003:224). The assumption is that an additional 1L of water is derived from the consumed foods. Furthermore, some guidelines suggest the intake of 6–8 glasses of per day (Barasi 2003:224).

Water for body use or functions is obtained from foods (fruit juices, fruits, milk, tea, soft drinks), from oxidation of nutrients (metabolic water, which is small in quantity), as well as water such as hard, soft, carbonated or distilled water, which is the largest source for body use (Popkin *et al.* 2010).

Water has the following uses in the body (Barasi 2003:224):

- It facilitates the process of ingestion, digestion and absorption.
- Any unabsorbed material in the colon is removed from the colon by facilitation of water.
- Nutrients are transported by water in the body.
- It regulates body temperature through the release of sweat.
- Water is produced through metabolic reactions for cellular needs.

2.10 CONCLUSION

The literature has indicated that malnutrition among elderly people is very high and is related to a combination of food insecurity, the ageing process and urbanisation (in South Africa). This combination of food insecurity and urbanisation leads to unhealthy lifestyles which influence the development of chronic diseases of lifestyle (CVD) and their major risk factors, namely high blood pressure, high blood cholesterol, diabetes and obesity. Cardiovascular diseases and their risk factors are treated with dietary restrictions and with medication that affects food intake.

However, the literature suggests the use or consumption of soy-based protein products, which have been popularly associated with many health benefits such as improving lipid profiles, preventing and treating hypertension, favourable effects on obesity, altering insulin resistance and improving glycaemic control. Furthermore, since the literature indicates that soy protein is considered an economical or affordable protein, as compared with high-quality protein or complete proteins from animal sources, this can be a cheaper means of alleviating hunger in food-insecure groups. The understanding of the literature has therefore created a foundation and support for the main objective of the research: to implement and evaluate the impact of a soy-protein intervention on the nutritional status of an elderly community of Sharpeville in which poverty, malnutrition (over- and under-nutrition) as well as household food insecurity and poor health were prevalent.

3

BASELINE STUDY

3.1 INTRODUCTION

This study formed part of a larger project which addresses malnutrition in the elderly through a food-based approach and nutrition education to improve self-sufficiency and long-term effectiveness in terms of nutrient inadequacy and dietary diversity. As mentioned earlier, this study dealt with implementing and evaluating the impact of soy-protein intervention given seven days a week over a period of six months in an elderly community attending a day-care centre in Sharpeville. The research focuses on sustainable nutrient intakes and the general well-being of an elderly community. In order to achieve the main objective of this study, a six-stage approach, as described below, was followed,

- **Stage 1: Situation analysis**

Stage 1 entailed exploring the literature and socio-demographic information from previous studies conducted in the target group. The socio-demographic data revealed that the conditions of malnutrition (under- and over-nutrition), poverty, food insecurity and poor health were prevalent in the elderly community of Sharpeville (Chapter 1 and 2). For the purpose of this study, socio-demographic information gathered from previous studies was used for the baseline study and was therefore not tested again.

- **Stage 2: Baseline survey**

Stage 2, which is reported in this chapter (Chapter 3), entailed determining the risk factors for CVD prevalent in this elderly community of Sharpeville biochemically (serum Vitamin B_{12} and folate status for cardiovascular disease) and anthropometrically (weight and height for obesity and waist circumference); nutritional status and dietary intake (24hour-recall, and 7-day dietary diversity questionnaire).

- **Stage 3: Pilot study: Soy awareness education programme**

Following the situation analysis and the baseline study, Stage 3 (Chapter 4) covered the development, testing and implementation of a soy-based nutrition education programme (NEP), for the elderly to improve their awareness and knowledge of the health benefits of soy. A soy knowledge questionnaire was developed, tested and implemented for pre- and post-intervention measurements.

- **Stage 4: Soy feeding intervention**

Stage 4 (Chapter 5) focused on implementing a soy feeding intervention for the elderly for a period of six months.

- **Stage 5: Impact measurements**

In Stage 5 (Chapter 5), the impact of the soy intervention on the risk factors for CVD and nutritional status of the elderly was evaluated by comparing the results before (baseline study) and after the intervention (soy feeding intervention) and also a comparison of the hypercholesterolaemic (HC) and normocholesterolaemic (NC) groups was conducted.

- **Stage 6: Dissemination of results**

This stage involved the dissemination of results.

This chapter focuses on Stage 2 of the study and will be presented as an entity with methods, results and discussion, conclusion and recommendations. As already mentioned, the main focus of this chapter was to determine the risk factors for CDL (CVD) and nutritional status prevalent in this elderly community of Sharpeville. It is to be noted that globally, CVD was the leading cause of death and disability in 2010 (WHO 2011). This is also true in South Africa, where CVD is accountable for 17 percent of all deaths. In addition, it is projected that 5.5 million South Africans who are older than 30 years are at risk of developing CVD, based on their total serum cholesterol level [TC] (Maritz 2006:101). This may be associated with raised total serum cholesterol levels [>5.2 mmo/L] (Maritz 2006) as well as hypertension (blood pressure of 140/90 mmHg), with a total of 6 million people hypertensive in SA (Seedat & Rayner 2012:60).

3.2 PROCEDURES AND METHODS

3.2.1 Ethics approval

For the ethical approval refer to Chapter 1, section 1.4.2, approval numbers M040835, M070126 (Annexure A). The baseline study was conducted during October and November 2009.

3.2.2 Sampling and respondents

A planned sampling procedure was applied to select the elderly to participate in this stage of the study. These elderly persons were selected from among the elderly who attend a day-care centre (n=450) in Sharpeville. The respondents were selected on the following basis:

- Women and men aged ≥ 60 years
- Elderly who voluntarily attend a day-care centre in Sharpeville
- Elderly who gave consent to participate in the baseline study

In order to determine the sample size for a representative sample for this study, the following sample size calculation (the Survey System, n.d.) was used:

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

Where:

Z = Z value (e.g. 1.96 for 95 percent confidence level)
p = percentage picking a choice, expressed as decimal (0.5 used for sample size needed)
c = confidence interval, expressed as decimal (0.098 = 9.77)

A total of 100 respondents were needed to obtain statistically representative data for this study. The sample was randomly selected from the list of the elderly who gave consent to participate in the study. An extra 34 respondents were selected to provide for possible drop-outs during the data collection period. Therefore 134 respondents formed part of the baseline study.

3.2.3 Geographical demarcation of the study

The geographic focus of the study was Sharpeville. This settlement was selected owing to the fact that previous research has already been conducted in this area by the Centre of Sustainable Livelihoods (previously known as Institute of Sustainable Livelihoods) of the Vaal University of Technology (VUT). Collaboration had already been established for certain initiatives, and was reconfirmed; expanded or new agreements were established according to needs. Sharpeville is an informal settlement with a mainly black community, situated in the Vaal region, an industrial, polluted area situated approximately 70 km south of Johannesburg, Gauteng province of South Africa (Figure 7 below). Within the informal settlement of Sharpeville, a day-care centre for the elderly is found. The elderly attend the day-care centre on Mondays and Wednesdays on a voluntary basis. The other days of the week are allocated for small group activities such as choir, Olympic and aerobics practice. From the study conducted by Oldewage-Theron and Kruger (2008:1), it was reported that the elderly in the community of Sharpeville were limited with resources and access to food, resulting in household food insecurity and poor food choice and variety. This affected their nutritional health status. In order to assist the elderly with income generation, the day-care centre offers skills training and religious activities aimed at the low-income elderly (aged 60 years or over). On the days that they attend the centre, the elderly are also offered breakfast and lunch as a means of alleviating hunger and improving their health status (Oldewage-Theron, Samuel, Grobler & Egal 2008:23).

Figure 7 Map of South Africa indicating the location of Sharpeville formal settlement (in red circle)

3.3 RECRUITMENT AND TRAINING OF FIELDWORKERS

The researchers at the Centre of Sustainable Livelihoods (CSL) of the VUT recruited and trained students from the Department of Hospitality, Tourism and PR Management as fieldworkers. All the fieldworkers were trained by professionals (a registered dietician and a nutritionist) regarding anthropometric measurements and administering the different questionnaires (24-hour recall and DDQ) to be used for the baseline study and were given detailed instructions on how to conduct fieldwork. In order to ensure the collection of high quality data fieldworkers are trained to follow standardized examination protocols, to calibrate equipment according to a prescribed schedule and method, and to measure and record the survey data with precision. Ethical principles (MRC) such as informed consent, recruitment procedures of respondent and data protection regarding personal and sensitive information were applied in the study. For this study all the anthropometric measurements were conducted by the registered public health nutritionist (USA) and dietician (RSA).

For the anthropometric measurement the training was as follows; the weighing scale should be placed on an even uncarpeted area and levelled. After the scale is switched on the fieldworker should wait for the zero indication (0.0) appearing, after which the participants should be asked to remove their shoes and heavy clothing and step on the scale, stand upright in the middle of the platform facing the fieldworker while looking straight ahead, feet flat, slightly apart, and stand still until the measurements were recorded. The participants should be weighed preferable after empty his/her bladder. Two measurements should be taken, which should not vary by more than 0.5kg, and then the average of the two measurements should be recorded. For the height measurements, the training was as follows; the height was to be measured using a Scales 2000 stadiometer, with the participants removing their shoes and ensuring they were relaxed. The body had to be touching the measuring board, with legs and knees together and straight, feet flat, and eyes straight ahead. Two readings have to be taken and the two measures should not vary by more than 5mm. The average of the two measurements was used (Kupper, Bartz, Schltink, Lukito & Deurenberg 1998:50).

The fieldworkers were to follow the following procedures to obtain the abdominal (waist) circumference; firstly they had to always explain to the participant what they were going to do before doing it. For the position, the fieldworker should instruct the participant to gather his/her gown/clothes above the waist, cross the arms, and place the hands on opposite shoulders. It may help to tell the participant to think of giving themselves a hug. If necessary the pants and underclothing should be lowered slightly below the waist. The measure site should be marked by standing on the participant's right side. Palpate the hip area to locate the right ilium of the pelvis. With the cosmetic pencil draw a horizontal line just above the uppermost lateral border of the right ilium. Cross this mark at the midaxillary line, which extends from the armpit down the side of the torso. When taking the measurements, extend the measuring tape around the waist. Position the tape in a horizontal plane at the level of the measurement mark. Make sure that the tape sits parallel to the floor and lies snug but does not compress the skin. Always position the zero end of the tape below the section containing the measurement value. Take the measurement to the nearest 0.1 cm at the end of the end of the participant's normal expiration. Call out the results to the recorder. Remove the tape measure and tell the participant the WC measurement is completed (National Health and Nutrition Examination Survey [NHANES 2007:16).

For the 24 hour recall the four-stage process described by Gibson was followed during the training and entails firstly obtaining a whole list of all foods and beverages consumed during the previous day. This is followed by a detailed description of each food and beverage consumed, together with cooking methods and brand names (if possible). In the third stage, estimates of the amount of each food and beverage item consumed are obtained, usually in household measures, and entered on the questionnaire. Food models were simultaneously used to aid the respondents in estimating their food intakes and portion sizes consumed at home. Finally, in the fourth stage, the recall is reviewed to ensure that all items, including use of vitamin and mineral supplements, have been recorded correctly (Gibson 2005:42). The dietary diversity questionnaire (DDQ), which is sometimes referred to as the list-based diet history, was explained to the fieldworkers that it consists of a structured listing of individual foods or food groupings. For each item on the food list, the respondent is asked to describe the foods (meals and snacks) that they ate or drank for a specific period for example a day or week whether at home or outside the home to estimate the frequency of consumption. The fieldworker is to write down or tick all foods and drinks mentioned. When composite dishes are mentioned the fieldworker should ask for the list of ingredients. When the respondents has finished, probe for meals and snacks not mentioned. When the respondent recall is complete, the fieldworker should fill in the food groups. For any food groups not mentioned, the fieldworker should ask the respondent if a food item from this group was consumed (FAO 2010b). In this study a 7 day unquantified (does not specify serving sizes) dietary diversity questionnaire was used which only requires ticking of the food items recalled by the respondent.

In addition to the initial training sessions, a fieldworker's instruction manual was prepared and printed for use by all fieldworkers through the project. The purpose of the manual was to ensure standardisation and uniform procedure throughout.

3.4 MEASURING INSTRUMENTS AND DATA COLLECTION

To enhance complete data collection from the respondents, a fieldwork control form (Annexure C) that was developed and implemented by Oldewage-Theron (2004) for fieldwork in the same day-care centre was adjusted according to the needs of the current study and was used on the day of data collection. The purpose was to ensure that all the respondents completed all the required activities at each station that was set. Since a number of variables were measured, the baseline study followed a descriptive cross-sectional study design. Therefore, four stations were set to accommodate four different activities of data collection during the baseline study, namely:

- Station 1: Distribution and collection of files with questionnaires
- Station 2: Anthropometry measurements (weight, height and waist)
- Station 3: Biochemical measurements (venous blood samples)
- Station 4: Completion of questionnaires (24-hour recall and 7-day dietary diversity Questionnaire (DDQ)

3.4.1 Dietary intake measurements

Dietary intake studies are time consuming and expensive. In situations where food insecurity is experienced, coupled with an illiterate population, as is the situation in many African countries, dietary research can be almost impossible to conduct; hence the need for simple, low-cost methods for the assessment of the nutritional quality of diets (Hatloy, Torheim, & Oshaug 1998:891).

3.4.1.1 24-hour recall questionnaire

- Description

The 24-hour recall is a retrospective assessment of dietary intake. Respondents are required by a trained interviewer to recall exact food and drinks consumed during the previous 24 hours. Thus the method assesses the actual intake of individuals (Gibson 2005:41). However, a limitation of this method is that it relies on memory and therefore the interviewer must assist the respondent in estimating portion sizes of food and drinks consumed, generally in household measures (Walsh & Joubert 2007:296). Objects such as a set of measuring cups, spoons and rulers, local household utensils (calibrated for use) or food models can be used as memory aids for portion size of food items (Gibson 2005:42). In this study, a 24-hour recall questionnaire was chosen for use owing to its advantage of being quick and easy to administer and because less time is required for data collection from elderly respondents with a low attention span.

- Data collection

Trained fieldworkers from the VUT conducted a structured 24-hour recall (Annexure D) validated procedure (Gibson 2005:35) and administered the questions on the actual food intake of the elderly through one-on-one interviews. The four-stage process described by Gibson entails firstly obtaining a whole list of all foods and beverages consumed during the previous day. This is followed by a detailed description of each food and beverage consumed, together with cooking methods and brand names (if possible). In the third stage, estimates of the amount of each food and beverage item consumed are obtained, usually in household measures, and entered on the questionnaire. Food models were simultaneously used to aid the respondents in estimating their food intakes and portion sizes consumed at home. Finally, in the fourth stage, the recall is reviewed to ensure that all items, including use of vitamin and mineral supplements, have been recorded correctly (Gibson 2005:42).

Since breakfast and lunch were served on the day-care centre attendance days, it was decided to complete the 24-hour recall on two days (Sunday and Tuesday) when the elderly did not attend the care centre. Therefore two 24-hour recall questionnaires for each respondent were administered on the two days (Sunday and Tuesday). The use of the two days (Sunday and Tuesday) facilitated the collection of dietary data on a week day and weekend therefore making sure that the correct qualitative, descriptive information about the respondents’ usual food consumption patterns and dietary intake at home was obtained.

3.4.1.2 A 7 day Dietary diversity Questionnaire

- Description

Since 24-hour recall may not be sufficient to describe an individual's food and nutrient intakes (Gibson 2005:41), a 7 day dietary diversity questionnaire (DDQ) was also used. In this study, owing to the lengthy contents of the Quantified Food Frequency Questionnaire (QFFQ) coupled with the problem of illiteracy among the majority of the elderly respondents [75.8%] (Oldewage-Theron, Samuel *et al*. 2008:23) who also had a low attention span, it was decided to administer and analyse an adapted, adjusted and validated 7 day DDQ [Annexure E] (Oldewage-Theron & Kruger 2008b) to determine the dietary diversity. The dietary diversity score (DDS) and the food variety score (FVS) cannot be used for nutrient intake; however, it can reflect the adequacy of nutrient intakes (Oldewage-Theron & Kruger 2008b:125).

Different researchers use different categories of food groups. For the purpose of this study the questionnaire consisted of a list of foods grouped according to the nine food groups recommended by the Food and Agriculture Organization (FAO, 2007) and as used in an earlier study on elderly people (Oldewage-Theron & Kruger 2008b), namely: (1) Flesh foods (2) Eggs, (3) Dairy products, (4) Cereals, roots and tubers (5) Legumes and nuts, (6) Vitamin A-rich fruits and vegetables (7) other fruits and juice, (8) other vegetables, and (9) oils and fats. The questionnaire was used to determine food intakes over a period of seven days in this study. A simple count of single foods (FVS) and food groups (FGDS), as was done in previous studies in developing countries, was used for the calculation of the dietary diversity score (DDS) (Oldewage-Theron & Kruger 2008b; Hatloy, Torheim, and Oshaug 1998).

The results from the studies of Oldewage-Theron and Kruger (2008) and Hatloy, Torheim, and Oshaug (1998) showed that such food scores can give a fairly good indication of the nutritional adequacy of the diet. The findings from a study conducted by Ogle, Hung, and Tuyet (2001) in Vietnam also confirmed a positive association between the two measures of diversity and intake of a variety of nutrients. Various types of dietary diversity measures, referred to as dietary variety, were calculated from the seven-day DDQ (Matla 2008:42).

- Data collection

Data were collected by means of a structured questionnaire, described above. Because of the low literacy of the respondents, one-on-one interviews were used by trained fieldworkers to gather data. During the interview food models were used to clarify food items and also help the respondents to recognise food items easily.

3.4.2 Anthropometric measurements

Anthropometric measures involve obtaining physical measurements of an individual, and relating these to standards that reflect, among other factors, the health and nutritional status of the individuals. In this way malnutrition (both under-nutrition and over-nutrition) can be revealed, growth can be monitored and the impact of the intervention programmes can be determined. Measures of anthropometry, such as weight and fat percentage, can be used to predict the risk of developing diseases of lifestyle such as obesity (Walsh & Joubert 2007:299). In this study, the anthropometric measurements included body weight, height and waist circumference (WC). Weight and height were used to calculate body mass index (BMI).

3.4.2.1 Body weight, height and body mass index

- Description

Low body weight and rapid unintended weight loss are highly predictive of mortality and morbidity in older persons. Recent weight loss may be a more sensitive indicator of nutritional status than BMI. Body mass index is an indicator of not only adiposity but also muscle mass – perhaps more so in populations with low fat mass. Both high and low BMI are associated with an increased risk of disease such as cardiovascular and diabetes (Charlton *et al.* 2008:560). Body mass index (BMI) is an indicator of body fat and its use is ideal for estimating relative risk of disease (Gibson 2005:261).

- Data collection

The body weight of the respondents was measured in light clothing, using calibrated Philips® electronic bathroom scales (model HF350 [135 kg/100g] with a two-point decimal precision). Height was measured in an upright standing position without shoes, using a Scales® 2000 portable stadiometer. Weight was determined to the nearest 0.1 kg and height to the nearest 0.5 cm. Weight and height were used to calculate body mass index (BMI=kg/m²).

3.4.2.2 Waist circumference

- Description

Waist circumference (WC) is a good indicator of intra-abdominal fat mass in adults. Such fat mass is a better predictor of cardiovascular risk, diabetes, and other endocrine abnormalities than BMI (Charlton *et al.* 2008:561).

- Data collection

Waist circumference was taken using a Seca® non-stretchable tape measure with the participant in light clothing measured just above the iliac crest to the nearest 0.1 cm (Gibson 2005).

All the above anthropometric measurements (height, weight and waist) were conducted by a registered dietician (SA) and public health nutritionist (USA) twice and the average of the two measurements was recorded, in case of variations.

3.4.3 Hypertension

3.4.3.1 Description

Hypertension is also known as high blood pressure. Blood pressure is a measure of the blood force against the walls of the arteries as the heart pumps blood through the body. The excessive pressure on artery walls caused by high blood pressure can damage blood vessels, as well as organs in the body. The higher the blood pressure and the longer it goes uncontrolled, the greater the damage (MedlinePlus 2013).

3.4.3.2 Data collection

Blood pressures (BP) were measured by a qualified nurse using a validated Tensoval® digital blood pressure monitor. Standardised techniques, namely arm position, posture of the respondent, cuff size and the number of readings that should be taken was followed as per the hypertension guidelines of South Africa 2011 (Seedat & Rayner 2012:61). Two measures were taken and the average of the two measurements was used in cases where the two measurements varied.

3.4.4 Biochemical measurements

3.4.4.1 Description

Biochemical indices are more sensitive than anthropometric and may reflect changes in nutritional status earlier than the anthropometric measures (Charlton *et al.* 2008:561). Fasting is required before measurements are taken, since plasma and serum carry newly absorbed nutrients and those being conveyed to the tissues and thus tend to reflect recent dietary intake. Therefore, plasma and serum nutrient levels provide a precise current status, rather than long-term, biomarker of nutrient status. The effect of recent dietary intake on plasma and serum nutrient concentrations can be reduced by collecting fasting blood samples (Gibson 2005:375).

3.4.4.2 Data collection

During an information session at the day-care centre before the measurements were taken, the elderly were informed that they should fast from 22:00 the day before the biochemical measurements were taken, as this is one of the requirements for the biochemical analyses. A venous blood sample was drawn with minimal stasis from seated subjects by a qualified nursing sister from 08:00 to 10:00 the next day, using a 21-gauge scalp vein infusion set with minimal use of tourniquets. Two vacutainers of 7ml serum-separating tube (SST) were used for blood collection. All blood samples were collected and handled under controlled, standardised conditions to ensure accurate and precise analytical results. Breakfast was served immediately after blood collection.

The blood samples were analysed for the full blood count, total serum cholesterol (TC), high-density lipoprotein-cholesterol (HDL-C), triglycerides (TG), serum vitamin B_{12}, serum folate and homocysteine. Analyses were done directly after the sample was taken by means of the homogeneous enzymatic colorimetric method (TC, HDL-C and TG) on a Konelab™ analyser with a coefficient of variation (percent CV) between runs of 1.2–2.8 percent for all serum variables analysed (Table 13 below). The CV is an indication of the quality assurance procedures followed to ensure reliable results. However, in this study the CV was lower than those reported by Hodson, Murray Skeaff and Fielding (2008). Serum vitamin B_{12} and serum folate were determined by immunoturbidity on TOSOH AIA-PACKB$_{12}$]. A Demeditec Homocysteine Enzymatic Assay was used to determine the serum homocysteine concentration on an automated Konelab™ analyser. A registered medical technologist continuously audited the separation procedure. Serum and plasma were stored at -80ºC for two weeks only until analysis to prevent changes in fatty acid composition with prolonged storage times (Hodson, Murray Skeaff & Fielding 2008).

Table 13 Analyses performed for the biochemical measurements

Variables	Test	Analytical method
Total Cholesterol (mmol/L)	Total cholesterol	Homogeneous enzymatic colorimetric [Konelab™]
Low-density Lipoprotein (LDL) cholesterol (mmol/L)	Low-density Lipoprotein cholesterol	Friedewald formula (Warnick, Knopp, Fitzpatrick & Branson 1990)
High-density Lipoprotein (HDL) cholesterol (mmol/L)	High-density Lipoprotein cholesterol	Homogeneous enzymatic colorimetric [Konelab™]
Triglycerides (mmol/L)	Triglycerides	Homogeneous enzymatic colorimetric [Konelab™]
Homocysteine (µmol/L	Serum homocysteine	Demeditec Homocysteine Enzymatic Assay [Konelab™]
Serum Vitamin B_{12} (pg/mL)	Serum Vitamin B_{12}	Immunoturbidity [TOSOH AIA-PACKB12]
Serum Folate (ng/mL)	Serum folate	Immunoturbidity [TOSOH AIA-PACKB12]

The Friedewald formula presented below was used to calculate low density lipoprotein (LDL-C) provided the TG do not exceed >4.5 mmol/L (Warnick, Knopp, Fitzpatrick & Branson 1990; European Society of Cardiology [ESC] and European Atherosclerosis Society [EAS 2011:1780).

In mmol/L $\Longrightarrow$ LDL-C= TC – HDL-C - (TG/2.2)

In mg/dL $\Longrightarrow$ LDL-C= TC – HDL-C - (TG/5)

The Framingham 10-year risk scoring system was applied to estimate cardiovascular risk and LDL-C levels in this group. Firstly the total risk points were calculated for each respondent based on age group and gender-specific stratified levels of TC, HDL-C, and blood pressure (systolic) as well as smoking status. Next, the risk point totals were converted to corresponding 10-year risk of CVD (Klug, South African Heart Association [SA HA] & Lipid and Atherosclerosis Society of Southern Africa [LASSA] 2012).

3.5 METHODS TO COMBAT ERROR

This study took place in a setting that was familiar and easily accessible to the participants. This assisted in making the participants more comfortable and at ease during data gathering. Since the value and applicability of the results of this study depended on the validity and reliability of the respective data collection methods, the quality of measurement was ensured in the following ways:

3.5.1 Validity

Validity refers to the ability of a scale or measuring instrument to measure what the researcher intends to measure (Coertze 1999:59; Zikmund 2003:302). There are two major forms of validity, namely external and internal validity.

3.5.1.1 Content validity

Content validity refers to the degree to which a measure covers the range of meaning included within a concept (Babbie 2010:155). To support content and measurement validity in this study, operational definitions were developed for the different concepts (e.g. hypercholesterolaemic) through literature review. This information was then applied during screening of data to ensure consistency in the classification of participants according to the defined parameters. This study also made use of a structured 24-hour recall questionnaire following validated procedures (Gibson 2005:42) for dietary assessment. Trained fieldworkers were used to ensure standardised completion of the questionnaires. Biochemical measurements were validated as follows:

- Serum cholesterol was calibrated with a commercial Konelab™ calibrator (SCAL) before the start of the analysis. Control serums (Lipotral, Nortrol and Abtrol) were run daily and documented to assure accuracy and precision.
- HDL serum was calibrated with a commercial Konelab™ calibrator (HDL/LDL calibrator) before the start of analysis. Control serums (Lipotrol) were run daily and documented to assure accuracy and precision.
- The serum triglyceride was also calibrated with a commercial Konelab™ calibrator (SCAL) before the start of the analysis. Control serums (Lipotral, Nortrol and Abtrol) were run daily and documented to assure accuracy and precision.

- For serum folate and vitamin B_{12}, accuracy was determined by diluting a high concentration calibrator by ratio of 1:2 and the concentration of the dilute sample measured ten times. The recovery of the measured concentration was 90–100 percent of the expected value. Precision inter- and intra-assay coefficient of variance was ≤15 percent (Maglumi 2012).
- For homocysteine, the supplier determined the accuracy by running 66 serum samples in comparison with an existing commercial method. Correlation coefficient (r^2=0.976, slope of 0.98 and y intercept of 0.87) was determined by linear regression (Demeditec Diagnostic GMbH, 2009).

3.5.1.2 Construct validity

According to Babbie (2010:154), construct validity refers to the degree to which a measure relates to other variables as expected within a system of theoretical relationships. To support and enhance the construct validity of this study, more than one measuring technique was used to gather information to ensure that all aspects of a phenomenon were investigated (Krefting 1991:10) and were compared to known theory in the area (e.g. a single 24-hour recall is not sufficient to describe an individual's food and nutrient intake (Gibson 2005:41), and thus a 7-day dietary diversity questionnaire (DDQ) was also used). A wide variety of sources was consulted and all the key concepts (risk factors of CVD) pertaining to the study were identified through a review of the literature. The concepts were defined according to the South African Heart Association and Lipid and Atherosclerosis Society of Southern Africa 2012 and conceptualised against the body of existing theory and research. An intervention study based on soy (Chapter 5) was conducted to test the theory of health benefits of soy. Good planning was done and advice was sought from experts (registered dietician [SA] and public health nutritionist [USA]) before the research was conducted. The intervention involved the testing of an elderly group to determine the prevalence of high scores in the construct (CVD), then teaching and implementing the soy intervention and then re-measuring its impact on the health status of the group. The construct validity proves good if a significant difference is obtained between pre-and post-test.

3.5.1.3 Face validity

Face validity is a measure of how representative a research project is at face value, and whether it appears to be a good project. The representativeness of this research and its objectives were established through consultation with leading experts in the field. A review of previous researches conducted in this elderly community was done and the current study was established according to needs.

3.5.2 Reliability

Reliability refers to whether a particular technique, applied repeatedly to the same object, yields the same results each time (Babbie 2010:150). To provide precise measurements, specific attention was given to the following aspects:

- The same questionnaires (24-hour recall and DDQ) used for the baseline study were also used for the follow-up study (chapter 5) and were administered as far as possible by the same group of trained fieldworkers following validated procedures (e.g. Gibson (2005:35) for 24-hour recall questionnaire). The DDQ used in this study was adapted from a validated food frequency questionnaire (FFQ) used in a similar community (Oldewage-Theron 2008).
- The anthropometric measurements were conducted by a registered dietician (SA) and a public health nutritionist (USA). Measurements for height were taken using a Scales® 2000 portable stadiometer. Weight was measured using calibrated Philips® electronic bathroom scales (model HF350 [135 kg/100 g] with a two-point decimal precision) and waist circumference was taken using a flexible but non-stretchable tape measure, the respondents in light clothing being measured just above the iliac crest to the nearest 0.1 cm. These measurements above were taken twice and the average of the two scores was recorded in cases where the same reading was not obtained.
- All blood samples were collected and handled by qualified nursing sisters under controlled, standardised conditions to ensure accurate and precise analytical results.

3.6 DATA CAPTURING AND STATISTICAL ANALYSIS

3.6.1 Dietary intake

Dietary intake data were analysed by a registered dietician using the Food Finder® version 3 software programme, developed by the SA Medical Research Council of South Africa (MRC) and based on SA food composition tables. Nutrient intakes were exported from Food Finder®, onto an Excel spread sheet and analysed by SPSS version 23.0 for descriptive statistics (means and standard deviations (SD) and frequencies). Median of nutrient intakes were compared with the Estimated Average Requirements (EAR), and Adequate Intake (AI) levels were used for those nutrients without an EAR for the elderly people ≥70 years old. The EAR for persons ≥70 years old was chosen based on the mean±SD age of 73.7±9.6 years of the elderly in this study. Frequencies were applied to determine the percentages of respondents with nutrient intakes below 100 percent of EAR (Institute of Medicine 2005). Since in 2002 maize and bread were fortified, the research team created extra codes for the fortified bread and maize and these codes were included in the Food Finder® programme. Therefore nutrient analysis for maize and bread of the 24hour recall used fortified values.

The Estimated Energy Requirement (EER), defined as the average dietary energy intake that is expected to maintain energy balance consistent with good health in a healthy adult of a given age, gender, weight, height and level of physical activity were calculated in this study using the equations and applying the categories of physical activity level (PAL) below (Institute of Medicine [IoM] 2005:185]:

- Equation for women aged 19 and older

EER (kcal/day) =354-(6.91x age [y]) +PA x { (9.36 x weight [kg]) + (726 x height [m])}

Where PA is the physical activity coefficient:
- PA = 1.00 if PAL is estimated to be ≥ 1.0 - <1.4 (sedentary)
- PA = 1.12 if PAL is estimated to be ≥ 1.4 -<1.6 (low active)
- PA = 1.27 if PAL is estimated to be ≥ 1.6 - <1.9 (active)
- PA = 1.45 if PAL is estimated to be ≥ 1.9 - <2.5 (very active)

- Equation for men aged 19 and older

EER (kcal/day) =662-(9.53x age [y]) + PA x { (15.91x weight [kg]) + (539.6 x height[m]) }

Where PA is the physical activity coefficient:
- PA = 1.00 if PAL is estimated to be ≥ 1.0 - <1.4 (sedentary)

- PA = 1.11 if PAL is estimated to be ≥ 1.4 -<1.6 (low active)
- PA = 1.25 if PAL is estimated to be ≥ 1.6 - <1.9 (active)
- PA = 1.48 if PAL is estimated to be ≥ 1.9 - <2.5 (very active)

Conversion: 1 kcalorie = 4.184 Kilojoules

The EAR is not used for energy, since energy intakes above the EER would be favourable to weight gain (IoM 2005).

The Top 20 list of most frequently consumed food items was calculated on both frequencies of consumption as well as on mean daily intakes (g) (Oldewage-Theron & Kruger 2008b:3). Number of respondents with daily consumption was determined by dividing the total consumption by group with mean day intakes. Per capita daily intakes were determined by dividing the total consumption of a group by the sample size (number of respondents).

3.6.2 Food variety and dietary diversity

All the data for the DDQ were captured by the researcher on Microsoft Excel spread sheet. The captured data were screened to eliminate entry errors. The data were then transferred to the SPSS for Windows version 21.0 program, which was used for analysis. The dietary data (FGDS and FVS) were statistically analysed for frequencies, means (SD) and ranges of food items consumed in the specified period. No portion sizes were taken into consideration. The following analyses were conducted:

1) Food Variety Score (FVS): Simple count of individual food items consumed over a seven-day period (Hatloy, Torheim, & Oshaugh 1998; Ruel 2003).
2) Food Group Diversity Score (FGDS): the number of food groups used over a seven-day period (Oldewage-Theron & Kruger 2008b:106)
3) Dietary Diversity Score (DDS): Counting the number of individual foods and the number of food groups used for a given period [a seven-day period for this study] (Oldewage-Theron & Kruger 2008b:106).

The FVS and FGDS were defined according to the predetermined cut-off points below (Matla 2008):

-Low dietary diversity: 0–3 food groups and <30 individual foods

-Medium dietary diversity: 4–5 food groups and 30–60 individual foods

-High dietary diversity: 6–9 food groups and >60 individual foods

3.6.3 Anthropometric measurements

All the anthropometric measurements were captured by the researcher on Microsoft Excel spread sheet. The captured data were screened to eliminate entry errors. The data were then exported to the SPSS for Windows version 21.0 program, which was used for analysis by the researcher. Descriptive statistics (mean, SD and frequencies) were determined. Height and weight measurements were used to calculate body mass index (BMI). Body mass index was calculated as weight (kg) divided by height squared (m^2) and was categorised as underweight (<18.5), normal (18.5–24.9), overweight (25–29.9) and obese (≥30), according to the World Health Organisation (1997) cut-off points. Waist circumference was categorised according to the cut-off points of women and men as follows (WHO 1997):

	Gender	**Classification of waist circumference**		
		Ideal	**Increased risk**	**Sustained risk**
•	Women	<80 cm	80.0–87.9 cm	≥88 cm
•	Men	<94 cm	94.0–101.9 cm	≥102

3.6.4 Hypertension

For hypertension or high blood pressure (BP), the SPSS for Windows version 21.0 program was also used for analysis by the researcher. Descriptive statistics (means, standard deviation (SD) and frequencies) were determined. The SA hypertension guidelines (Seedat & Rayner 2012:62), were applied to define blood pressure cut-off points: ≥ 140 mmHg for systolic and ≥ 90mmHg for diastolic blood pressure. The elderly were categorised according to the following hypertension stages (Seedat & Rayner 2012:62):

- Normal SBP 120–129 or DBP 80–84 mmHg
- High normal SBP 130–139 or DBP 85–89 mmHg
- Stage 1: Mild hypertension SBP 140–159 or DBP 90–99 mmHg
- Stage 2: Moderate hypertension SBP 160–179 or DBP 100–109 mmHg

- Stage 3: Severe hypertension SBP >180 or DBP>110 mmHg

3.6.5 Biochemical measurements

Data were captured on Excel spread sheet and exported to SPSS for the Windows version 21.0 program. Descriptive statistics (means, standard deviation (SD) and frequencies) were determined for the serum lipids TC, LDL-C, HDL-C and TG and were compared with normal ranges as follows:

- TC <5.2 mmol/L (National Cholesterol Education Programme [NCEP] 2002)
- LDL-C <3.0 mmol/L (Klug, SAHA & LASSA 2012)
- HDL-C >1.5 mmol/L (Perk, *et al.* 2012:43)
- TG <1.7 mmol/L (European Society of Cardiology [ESC] & the European Atherosclerosis Society [EAS] 2011:1793).

Serum vitamins were also compared with normal ranges as follows: Folate [5.2–20 ng/mL] (Maglumi 2012) and serum vitamin B_{12} [>200 pg/mL] (Bain, Bates, Leffan & Lewis 2012:202). For the CVD serum risk marker homocysteine (Hcy) the means were compared with the normal range of <15 µmol/L (Abraham & Cho 2010:912; Faure-Delanef, Quere, Chassé, Guerassimenko, Lesaulnier, Bellet & Cohen 1997:1000).

Two-tailed bivariate Pearson correlations were carried out to determine the associations between dietary intake, biochemical and anthropometric parameters measured in this study at a 95 percent confidence level (p-value ≤0.05) as follows:

- Body mass index (BMI), hypertension (BP) and waist circumference
- Dietary intake and BMI, waist circumference
- Serum lipids and BMI, waist circumference (WC) hypertension (BP) and diet.

3.7 RESULTS

3.7.1 Socio-demographic profile of the respondents

For the purpose of this study, socio-demographic information gathered from a previous study (Oldewage-Theron & Kruger 2008a) in the same elderly population was used for the baseline study to enhance the understanding of the context and reality of the respective respondents. A descriptive summary of the characteristics of the respondents (age, gender, home language, education and income) is presented. From the data reported by Oldewage-Theron and Kruger (2008:108), all the respondents were black (n=170, 100%). The respondents' ages were between 60 and 110 years, with a mean age of 71.2 years. A large number of the respondents were women (n=154, 90.5%) who were widowed (n=120, 70.4%).

Only less than a quarter of the respondents (n=41, 24.2%) had attended secondary school or a tertiary institution. It is clear that the majority of the elderly had low formal education attainment. According to Oldewage-Theron and Kruger (2008:108), all the sampled elderly received a state pension as source of income. In 4.2 percent (n=7) of the cases the spouse was employed. The majority of the elderly (n=112, 65.7%), reported that the households had a monthly income of R501–1,000 (77-154 US$), with the elderly person (pensioner) being the only contributor to household income (n=122, 71.6%).

The majority of the elderly did their food shopping once a month (n=139, 81.8%), mostly at supermarkets (n=116, 68.2%). More than half of the elderly spent less than R200 (18.40 US$ on date 16/01/2014) per week on food for the household (n=101, 63.31%); with 21.2 percent (n=34) of these elderly spending only between R50 (4.60 US$) and R100 (9.20 US$ on date 16/01/2014) per week on food. For the purpose of conversion of SA Rands to US Dollars, the exchange rate of R10.87 ≡ US$ 1 as at date 16/01/2014 was applied in this study. In a fairly large percentage of households the grandmother was responsible for food preparation (n=69, 40.6%), food procurement decisions (n=80, 47%), and also feeding the children (n=74, 43.5%). Of special interest to this study is that 94.1 percent of the respondents had two or more meals served per household per day. The respondents also reported an ongoing money shortage to procure their basic needs, which is a further indication of food insecurity.

The self-reported major nutrition-related health problems by the elderly respondents were high blood pressure (n=62, 36.7%) and diabetes mellitus (n=10, 5.9%). Chronic medication was used by the majority of the respondents (n=99, 58.6%), of which 29.6 percent (n=50) was for the treatment of high blood pressure (Oldewage-Theron & Kruger 2008:109).

3.7.2 Dietary intake nutrient analysis and top 20 food items consumed

Although the focus of this study on dietary intake is on those nutrients which influence the risk of CVD, as presented in Table 14, to enhance understanding of the reality of the dietary intake of these elderly people, results of other nutrient (mineral and vitamin) intakes are also presented in Table 15.

The dietary intake nutrient analysis as reported by the median of the 24-hour recall is presented in Tables 14 and 15 below. The Estimated Average Requirement (EAR) is defined as the dietary intake that meets the estimated requirements of a nutrient for 50 percent of individuals in a gender-specified group, at the given life stage (IoM 2003; Gibson 2005:206). The EAR, which is generally used to estimate the prevalence of inadequate intakes of nutrients within a group (IoM 2003), indicated a deficient intake of the majority of the nutrients by the 134 sampled elderly even though the macronutrient distribution for these elderly respondents indicated a balanced diet of 53.3 percent carbohydrates, 18.9 percent protein, and 27.5 percent fat, as compared with the acceptable macronutrient distribution range of 45–65 percent of carbohydrates, 10–35 percent of protein and 20–35 percent of fat (Gibson 2005:208).

Table 14 shows that the median±SD energy intake of both women and men was low when compared with the Estimated Energy Requirements (EER), with 90 percent (n=99) of women and 100 percent (n=24) of men consuming <100 percent of the EER. However, an exception was reported for the median (±SD) total protein and carbohydrates as compared with the EAR for total group. Higher median intakes of carbohydrates by both women and men were also observed. Although the median (±SD) dietary intake of these nutrients met the EAR for the total group, it was observed that 37.3 percent and 20.9 percent of the respondents had inadequate intakes of protein and carbohydrates, respectively. For these elderly persons, animal protein (36.70±20.77) was the main contributor to the total dietary protein intake. The median (±SD) intake of dietary fibre (8.95±4.04) of the elderly group did not meet the EAR for this nutrient and all the respondents consumed <100 percent of the EAR.

The total fat intake showed an adequate intake of 27.3 percent of total energy intake. When considering the guidelines for prevention of chronic diseases (Steyn, Blaauw, Lombard and Wolmarans 2008:721), saturated fatty acids (SFA) and trans fatty acids (TFA) which are the bad fats for health scored percentages (8.6% and 0.3% respectively) within the recommended percentage of energy intake of SFA (<10%) and TFA (<1%). The healthier dietary fats namely monounsaturated fatty acids [MUFA], polyunsaturated fatty acid [PUFA] and linolenic acids (n-3) C18:3 recorded lower percentages (10.2%, 5.1% and 0.3% respectively) than recommended for MUFA (15-20% total EI), PUFA (6-11 total EI) and linolenic acids (n-3) C18:3 (0.5-2% total EI). The linoleic acid (n-6) C18:2 (6.5%) intakes recorded percentages in line with the recommended percentage of total energy intake of 2.5-9. Even though linoleic acid (n-6) C18:2 intakes recorded percentages in line with the recommendations, the linoleic acid (n-6) C18:2 to linolenic acid (n-3) C18:3 ratio of between 5:1 and 10:1 recommended by FAO/WHO (1994) was not met by these elderly respondents. The median±SD dietary intake of cholesterol was 141.80±101.40, which was favourable when compared with the EAR. The data further showed that the men had higher cholesterol intakes than the women did. Deficient intakes of the vitamins, namely B_6, folate and B_{12}, were reported, with more than 83 percent of the elderly having inadequate intakes of all these nutrients. An independent t-test was conducted between men and women for the dietary intake variables presented in Table 14 and no significant differences were observed.

The results of the dietary intake of minerals and vitamins are presented in Table 15. The results showed that majority (84%) of the listed nutrients on Table 15 recorded deficient intakes, with majority of the nutrients having more than 70 percent of the respondents having inadequate intake of each nutrient for the total group. The list of nutrients in Table 15 showed that more deficient nutrient intakes was amongst women as 16 out of the 19 nutrients (84.2%) there was deficient intake as compared with the men as 14 out of 19 nutrients (73.7%) had deficient intake. No significant differences between men and women were observed in the dietary intake variables (minerals and vitamins) presented in Table 15 based on the independent t-test.

Table 14 Analysis of 24-hour recall: median daily intake of a sample of the elderly subjects (n=134)

Dietary Intake Variables	Women (median ±SD) (n=110)	Women <100% of EAR	Men (median ±SD) (n=24)	Men <100% of EAR	Total group (median ±SD) (n=134)	Total group <100% of EAR	Total group % of Energy Intake	EAR*/FAO WHO guideline
Total Energy (kJ)	4667.12±1704.51	90.0	4823.50±1898.72	100	4743.35±1733.36	89.6		6999 (w) 8345 (m) [#]
Total protein (g)	50.87±21.45	40.0	54.17±25.60	54.2	54.17±22.18	37.3		46 (w) 56 (m)
Plant protein (g)	15.65±6.19		16.03±5.89		15.94±6.11			
Animal protein (g)	33.40±20.35		38.10±22.81		36.70±20.77			
Total fat (g)	30.23±22.35		35.13±22.44		31.45±22.33		27.3	20-35% total EI
Cholesterol (mg)	133.00±105.74	91.8	148.30±80.09	95.8	141.80±101.40	92.5		300
SFA (g)	9.96± 8.50		11.71± 8.02		10.64± 8.39		8.6	<10% total EI
MUFA (g)	11.98± 9.60		13.76± 10.07		12.33± 9.67		10.2	By difference [a], [b]
PUFA (g)	5.8± 4.33		6.68± 4.30		6.08± 4.33		5.1	6–11% total EI
TFA (g)	0.33± 2.50		1.12± 2.73		0.36± 2.54		0.3	<1% total EI
Linoleic acids (n-6) C18:2 (g)	5.27± 4.14		6.08± 4.12		5.55± 4.14		4.4	2.5-9% totals EI
Linolenic acids (n-3) C18:3 (g)	0.36± 0.17		0.36± 0.20		0.36± 0.18		0.3	0.5-2% total EI
Carbohydrate (g)	143.13± 55.58	20.0	144.03± 52.53	25.0	143.63± 55.04	20.9		100
Total fibre (g)	8.85 ± 3.97	100	9.00 ± 4.40	100	8.95 ± 4.04	99.3		21∞ (w) 30 (m)
Vitamin B_6 (mg)	0.65±0.55	94.6	0.73±0.30	100	0.66±0.51	95.5		1.3 (w) 1.4 (m)
Folate (mcg)	94.70±79.02	97.3	119.20±64.41	100	104.35±76.95	97.8		320
Vitamin B_{12} (mcg)	0.90±1.38	81.8	1.33±0.83	87.5	0.97±1.30	82.8		2

*****Dietary Reference Intake as presented by Estimated Average Requirement for females and males >70 years old, and ∞Adequate Intake (AI) levels where no EAR is available.
Estimated Energy Requirements for sedentary women aged 73.8 years, height = 1.57m and weight =73.61 kg and male of 73.6 years, height =1.68m and weight 71.1 kg
[a] Total fat [%E] – SFA[%E] – PUFA [%E] – TFA[%E] [b] can be up to 15-20%E, according to total fat intake
EI: Energy Intake, FAO: Food and Agriculture Organisation of the United Nations (2010a); WHO: World Health Organisation (2003)

Table 15 Analysis of 24-hour recall (minerals and vitamins): median daily intake of a sample of the elderly subjects

Dietary Intake Variables	Women (median ±SD) (n=110)	Women <100% of EAR	Men (median ±SD) (n=24)	Men <100% of EAR	Total group (median ±SD) (n=134)	Total group <100% of EAR	EAR/AI*
Calcium (mg)	188.86±158.10	99.1	212.36±173.12	100	191.14±160.31	99.3	1200∞
Iron (mg)	4.83±3.61	55.5	5.36±2.34	58.3	4.92±3.41	51.5	5 (w) 6(m)
Magnesium (mg)	166.15±52.32	95.5	167.30±68.11	100	167.30±55.21	93.3	265 (w) 350(m)
Phosphorus (g)	627.47±217.12	40.9	627.47±251.46	33.3	627.47±222.78	39.6	580
Potassium (mg)	1113.99±478.01	100	1165.23±443.31	100	1121.74±470.67	100	4700∞
Sodium (mg)	604.55±438.86	99.1	643.18±446.49	100	643.18±438.64	99.3	2500
Zinc (mg)	5.69± 2.80	72.7	6.04± 2.96	95.8	5.77±2.82	72.4	6.8 (w) 9.4 (m)
Copper (mg)	0.58± 0.23	100	0.59± 0.23	100	0.59±0.23	100	20∞
Selenium (mcg)	22.97± 20.88	89.1	27.00± 19.41	75.0	23.54±20.60	86.6	45
Manganese (mcg)	1665.38± 1018.13	53.6	1809.53± 880.88	41.7	1739.74±993.11	51.5	1800∞
Vitamin A (mcg)	220.00± 709.11	84.5	439.00± 422.88	75.0	250.00±665.86	81.3	500 (w) 625 (m)
Thiamin (mg)	0.53± 0.38	94.6	0.58± 0.23	95.8	0.53±0.36	94.0	0.9 (w) 1.0 (m)
Riboflavin (mg)	0.50± 0.48	90.0	0.60± 0.30	25.8	0.53±0.45	89.6	0.9 (w) 1.1 (m)
Niacin (mg)	15.34 ± 8.24	26.4	16.38 ± 9.48	16.7	16.28±8.46	24.6	11
Pantothenate (mg)	6.63±4.44	30.9	7.21±5.24	20.8	6.80±4.58	29.1	5∞
Vitamin C (mg)	13.35±31.28	96.4	14.58±9.76	100	13.60±28.66	97.0	60 (w) 75 (m)
Vitamin D (mcg)	0.85±1.91	100	1.10±1.59	100	0.87±1.85	99.3	15
Vitamin E (mg)	1.71±2.37	99.1	2.40±2.30	100	1.81±2.35	99.3	12
Vitamin K (mcg)	14.02±100.27	79.1	50.89±130.96	79.2	18.53±106.28	79.1	90∞ (w) 120∞ (m)

*Dietary Reference Intake as presented by Estimated Average requirement for females and males >70 years old and ∞Adequate Intake (AI) levels where no EAR is available.
Dietary reference intake (IoM 2003)

The results in Table 16 indicate the top 20 food items most frequently consumed and the mean daily intake of sampled respondents who consumed these foods on the days as measured by the 24-hour recalls. From the results it is clear that the main type of food consumed by this group was carbohydrate-rich food, as 10 out of 20 foods were carbohydrates. Protein sources consumed were chicken, beef, beef stew and milk. Chicken ranked 3rd on the top 20 most frequently consumed foods with beef and beef stew 14th and 18th respectively. Milk was ranked 7th in the top 20 most frequently consumed foods. However, beef and beef stew were consumed by a minority of the respondents (n=13, 9.8% and n=9, 6.8 respectively). The per capita intakes indicated inadequate portion sizes of beef (13.61 g) and beef stew (10.15 g). No plant protein source, for example legumes (soy), appeared in the top 20 food items consumed by this group. Although milk was ranked 7th and consumed by close to two-thirds of the respondents (n=82), the mean daily intake was very small (83.7 g). It appears that milk is the only dairy product and thus calcium-rich source consumed by this group among the top 20 foods most frequently consumed.

When per capita intakes are compared, adequate portion sizes of carbohydrate-rich foods are consumed in the form of rice (141.5 g), stiff maize meal porridge (93.76g), soft maize meal porridge (86.54 g) and bread (66.58 g). The other carbohydrate-rich foods showed small per capita food portions ranging from 15.34 g of scones to 45.11 g of Maltabella. Regarding the protein-rich food sources, the per capita food portions (daily intake) showed adequate intakes of chicken (102.11 g) but small intakes of beef (23.76 g) and milk (51.59 g).

The per capita intake of fruit and vegetable was very low (90.03 g) compared with the 400 g recommended by the WHO/FAO (2003). The elderly were found to have a low frequency of fruit and vegetable intake, with only three vegetables listed, namely pumpkin (9th), cabbage (13th) and beetroot (15th). No fruit appeared on the top 20 food items list, except for fruit juice which was ranked 19th and was consumed by a small number of people (n=6); (Table 16). This indicates that the fruit and vegetable intakes of these elderly people is far lower than the South African Food-Based Dietary Guideline (SAFBDG) recommends, namely: "Eat plenty of vegetables and fruits every day and/or eat at least five portions of vegetables and fruits every day (Love & Sayed 2001:S24; Naude 2013:51). Less-nutritious food items such as tea and coffee were reported among the top 20 food items consumed by this elderly group, with coffee being number 1 and coffee being number 20. It is important to note that sugar was reported low among the top 20 food items.

Table 16 Top 20 food items consumed as measured by 24-hour recall (n=134)

Ranking of food item	Food item	Total consumption by group (g)	Mean ± SD daily intake (gram per person consuming these foods)	Number of respondents with daily consumption (n)	Per capita daily intake (g)
1	Tea	24605	259 ± 165.51	95	185
2	Rice	18820	254.3 ± 138.71	74	141.50
3	Chicken	13580	142.9 ± 64.87	95	102.11
4	Maize meal (stiff)	12470	249.4 ± 117.57	50	93.76
5	Maize meal (soft)	11510	166.8 ± 83.23	69	86.54
6	Bread	8855	104.2 ± 54.46	85	66.58
7	Milk (fresh)	6862	83.7 ± 68.86	82	51.59
8	Maltabella, cooked sorghum	6000	272 ± 59.22	22	45.11
9	Pumpkin	3850	72.6 ± 27.47	53	28.95
10	Potatoes	3130	71.1 ± 29.92	44	23.53
11	Cold drink	3000	333.3 ± 219.37	9	22.56
12	Scones	2040	145.7 ± 72.72	14	15.34
13	Cabbage	1945	72 ± 41.86	27	14.54
14	Beef	1810	139.2 ± 96.48	13	13.61
15	Beetroot	1810	64.6 ± 21.12	28	13.61
16	Samp	1780	197.8 ± 86.14	9	13.38
17	Sugar	1504	12.1 ± 7.84	124	11.31
18	Beef stew	1350	150 ± 98.36	9	10.15
19	Fruit juice	1250	208.3 ± 58.45	6	9.40
20	Coffee	1200	200 ± 83.67	6	9.02

3.7.3 Food variety score, dietary diversity score and nutrient adequacy

Owing to the irregular attendance of the elderly, only 98 respondents completed the DDQ. In Table 17, the results show that a total of 95 different individual food items within the nine nutritious food groups were consumed in seven days by the elderly respondents. The overall range of individual food items consumed by individuals during the seven-day data collection period was between 10 and 92 foods. The majority of the respondents (n=64, 65.3%) consumed 31–60 individual food items in seven days, with the highest consumption occurring in the category of 41–50 individual food items by 23.5 percent (n=23) of the respondents. This indicated a medium FVS. When assessing the number of food items within the various food groups, the flesh group was the only group that was consumed by all the elderly respondents. The food groups with the most variety were the cereals with 18 food items followed by vegetables and fruits with 17 food items each. The least popular food groups among these elderly respondents were the egg group, with 17 respondents (17.4%) not consuming the food item during the seven-day period, followed by the legume group (n=10,10.2%).

Table 17 Elderly food access as measured by the food variety within the food groups consumed over a period of one week (n=98)

Flesh Group (n=16)	Eggs Group (n=1)	Dairy products (n=9)	Cereals Group (n=18)	Legumes Group (n=5)	Vitamin A Rich Group (n=7)	Fruit Group (n=17)	Vegetables Group (n=17)	Fat Group (n=5)	Total individual food items Eaten from All Groups (n=95)
0 = 0	0 = 17	0 = 6	0 = 1	0 = 10	0 = 1	0 = 4	0 = 1	0 = 2	10 – 20 = 1
1 = 3	1 = 81	1 = 4	1 = 0	1 = 38	1 = 0	1 = 6	1 = 1	1 = 5	21 – 30 = 16
2 = 7		2 = 8	2 = 0	2 = 13	2 = 2	2 = 7	2 = 4	2 = 38	31 – 40 = 21
3 = 7		3 = 13	3 = 0	3 = 14	3 = 10	3 = 11	3 = 5	3 = 27	41 – 50 = 23
4 = 12		4 = 16	4 = 2	4 = 11	4 = 24	4 = 11	4 = 11	4 = 16	51 – 60 =20
5 = 12		5 = 13	5 = 1	5 = 12	5 = 22	5 = 12	5 = 12	5 = 10	61 – 70 = 4
6 = 13		6 = 11	6 = 7		6 = 21	6 = 11	6 = 12		71 – 80 = 4
7 = 7		7 = 12	7 = 5		7 = 18	7 = 4	7 = 15		81 – 90 = 5
8 = 11		8 = 8	8 = 7			8 = 6	8 = 9		91 – 92 = 4
9 = 11		9 = 7	9 = 3			9 = 6	9 = 5		
10 = 3			10 = 7			10 = 3	10 = 4		
11 = 2			11 = 12			11 = 3	11 = 4		
12 = 3			12 = 6			12 = 2	12 = 2		
13 = 1			13 = 9			13 = 0	13 = 2		
14 = 1			14 = 9			14 = 2	14 = 3		
15 = 3			15 = 7			15 = 2	15 = 1		
16 = 2			16 = 6			16 = 5	16 = 4		
			17 = 14			17 = 3	17 = 3		
			18 = 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

Table 18 summarises the food variety within food groups. The mean FVS (±SD) for all the foods consumed from all the food groups in a period of seven days by this elderly group was 47.94±18.36. This revealed a medium food variety since the cut-off points for low, medium and high FGDS and FVS respectively are: 0–3 food groups and <30 individual foods, 4–5 food groups and 30–60 individual foods, and 6–9 food groups and >60 individual foods (Matla 2008). Of the nine food groups, the cereals group had the highest mean variety score (±SD) of 11.89(±3.94), confirming the high ranking of carbohydrate-rich foods found in the Top 20. Legumes and nuts had the second lowest mean variety scores (±SD) of 2.14(±1.58), confirming the lack of legumes such as soy in the diet, in the top 20 and inadequate intakes of zinc and iron by this elderly group.

Table 18 Summary of the food variety within the food groups

Food groups	Mean	SD	Range of scores∞
Cereals, roots and tubers	11.89	3.94	0–18
Other vegetables	7.43	3.92	0–17
Vitamin-A rich fruits and vegetables	5.02	1.44	0–7
Flesh foods (meat, poultry, fish)	6.65	3.45	1–16
Fats and oils	2.82	1.15	0–5
Dairy	4.74	2.47	0–9
Other fruits	6.42	4.51	0–17
Legumes and nuts	2.14	1.58	0–5
Eggs	0.83	0.38	0–1
Total food items	47.94	18.36	10–92

∞ The range of scores indicates the range of individual food items consumed within each group.

The dietary diversity score among all nine nutritious food groups is summarised in Table 19 below. The mean DDS/FGDS for the total group was 8.57±0.81, with a total range of 4–9 food groups used during the seven-day data collection period. Almost all the respondents (n=97, 99%) could be classified as having a high FGDS (using 6–9 groups).

Table 19 Summary of food group diversity

Number of food groups consumed (n=9)	Frequency	Percentage
1	0	0
2	0	0
3	0	0
4	1	1
5	0	0
6	1	1
7	7	7.1
8	20	20.4
9	69	70.4
Total	**98**	**100**

3.7.4 Anthropometric measurements

The anthropometric indices of the elderly respondents are presented in Table 20 below. The results showed a weight range of 38–123 kg, a height range of 1.43–1.82 m, a BMI range of 15.1–44.6 kg/m^2 and a range of waist circumference (WC) of 71–121cm. The mean±SD weight and height of the total group were 73.1 ±15.2 and 1.59±0.08 respectively. The mean ± SD BMI of the group was 29.03 (±5.62) kg/m^2, indicating an overweight elderly group, with the 2.2 percent (n=3) who were underweight represented by men. The results showed that the majority of the respondents (n=106, 79%) were overweight and obese. A sixth (n=30, 22.4%) of the sampled elderly had desirable weight/normal weight (18.5–24.9). The overall results indicated the prevalence of overweight and obesity in this sampled group. The WC results indicated that majority of the elderly are at substantial risk of CDL (n=108; 80.6%), with only five people having ideal WC. An independent t-test indicated a statistical significant differences between men and women in height (p=0.000) and BMI (p=0.000).

Table 20 Descriptive statistics of anthropometric variables measured

Parameters and unit of measure	Women Mean±SD (n=110)	Women n (%)	Men Mean±SD (n=24)	Men n (%)	Total group Mean±SD (n=134)	Total group n (%)	p value (≤0.05)
Weight (kg)	73.56± 15.43		71.13± 13.71		73.13± 15.1		0.518
Height (m)	1.57± 0.65[c]		1.68± 0.82[c]		1.59 ± 0.08		0.000
Body Mass Index *(kg/m^2)	29.83± 5.46[c]		25.37± 4.91[c]		29.03 ± 5.62		0.000
Underweight <18.5							
-Severe <16		0 (0.0)		2 (8.3)		2 (1.5)	
-Moderate 16-16.9		0 (0.0)		0 (0.0)		0 (0.0)	
-Mild 17-18.4		0 (0.0)		1 (4.2)		1 (0.7)	
Desirable weight 18.5-24.9		22 (20.0)		8 (33.3)		30 (22.4)	
Overweight 25-29.9		34 (30.9)		8 (33.3)		42 (31.3)	
Obese ≥30							
-Mild 30-34.9		36 (32.7)		5 (20.8)		41 (30.6)	
-Moderate 35-39.9		13 (11.8)		0 (0.0)		13 (9.7)	
-Severe 40+		5 (4.5)		0 (0.0)		5 (3.7)	
Waist circumference (cm)*	97.51 ± 10.16		96.46 ± 11.20		97.32 ± 10.32		0.674
Ideal <80[a] and <94[b]		3 (2.7)		2 (8.3)		5 (3.7)	
Increased risk 80.0-87.9[a] and 94.0-101.9[b]		18 (16.4)		3 (12.5)		21 (15.7)	
Substantial risk ≥88[a] and ≥102[b]		89 (80.9)		19 (79.2)		108 (80.6)	

World Health Organisation (WHO) 1997*; [a] Women and [b] Men; [c] in the same row refer to statistically significant differences between the variables p=≤0.05 (independent-test)

3.7.5 Hypertension

The blood pressure measurements (Table 21) indicated that n=76, 56.7 percent of the total respondents suffered from hypertension ≥140/90 mm Hg. The results further showed that within the respondents who suffered from hypertension ≥140/90mm Hg, a larger percentage was men (n=19, 79.2%) than women (n=57, 51.8%). Furthermore, thirty one percent (n=42) of the elderly had normal blood pressure (<120–129 mmHg/<80–84 mmHg) and 11.9 percent of the elderly (n=16) had high normal blood pressure levels (130–139 mmHg/85–89 mmHg,) indicating a risk of developing hypertension.

Table 21 Blood pressure results of the elderly sample

Blood pressure * classifications (mmHg)	Women (n=110) f (%)	Men (n=24) f (%)	Total group (n=134) f (%)
Normal			
SBP <120-129 or DBP <80-84	38 (34.5)	4 (16.7)	42 (31.3)
High normal			
SBP 130-139 or DBP 85-89	15 (13.6)	1 (4.2)	16 (11.9)
Stage 1: Mild hypertension			
SBP 140-159 or DBP 90-99	24 (21.8)	11 (45.8)	35 (26.1)
Stage 2: Moderate hypertension			
SBP 160-179 or DBP 100-109	20 (18.2)	3 (12.5)	23 (17.2)
Stage 3: Severe hypertension			
SBP >180 or DBP >110	13 (11.8)	5 (20.8)	18 (13.4)

*South African hypertension guideline 2011 (Seedat & Rayner 2012), n: sample, f: frequency of respondents

The elderly group had a mean±SD systolic and diastolic blood pressure of 140.31± 26.4 and 84.34 ± 16.63, respectively, which indicate normal blood pressure. However, the mean SBP for men (152.42 ± 29.05) indicated mild hypertension. Of a total of 134 respondents, 39.6 percent (n=53) had normal SBP and 56.7 percent (n=76) had normal DBP, (Table 22). Sixty four of the respondents suffered from systolic hypertension, n=34, 18 and 12 had mild, moderate and severe systolic hypertension levels respectively. However, less than a quarter of the group (33%) suffered from diastolic hypertension (mild, moderate and severe diastolic hypertension levels). An independent *t*-test indicated a significant difference between men (152.42±29.05) and women (137.66±25.22) only in SBP (*p*=0.028).

Table 22 Systolic and diastolic blood pressure measurements of the elderly

Blood Pressure * classifications (mmHg)	Women n=110 (Mean ±SD)	Women n (%)	Men n=24) (Mean ±SD	Men n (%)	Total group n=134 (Mean ±SD)	Total group n (%)	p value between women & Men p≤0.05
Systolic blood pressure	137.66 ± 25.22[a]		152.42 ± 29.05[a]		140.31 ± 26.4		0.028
Diastolic blood pressure	83.83 ± 16.07		86.71 ± 19.19		84.34 ± 16.63		0.498
Systolic blood pressure							
Normal <120-129		48 (43.6)		5 (20.8)		53 (39.6)	
High Normal 130-139		16 (14.5)		1 (4.2)		17 (12.7)	
Stage 1: Mild hypertension 140-159		23 (20.9)		11 (45.8)		34 (25.4)	
Stage 2: Moderate hypertension 160-179		16 (14.5)		2 (8.3)		18 (13.4)	
Stage 3: Severe hypertension >180		7 (6.4)		5 (20.8)		12 (9.0)	
Diastolic blood Pressure							
Normal <80-84		64 (58.2)		12 (50.0)		76 (56.7)	
High normal 85-89		13 (11.8)		1 (4.2)		14 (10.4)	
Stage 1: Mild hypertension 90-99		15 (13.6)		7 (29.2)		22 (16.4)	
Stage 2: Moderate hypertension 100-109		10 (9.1)		2 (8.3)		12 (9.0)	
Stage 3: Severe hypertension >110		8 (7.3)		2 (8.3)		10 (7.5)	

*South African hypertension guideline 2011 (Seedat & Rayner 2012)

3.7.6 Biochemical measurements

The biochemical data are presented in Table 23 and show that the mean±SD values for total serum cholesterol: (TC) 5.0±1.1 mmol/L, and serum triglycerides (TG): 1.6±0.8 mmol/L, indicated no risk of CVD. However, of these elderly, 40.3 percent and 36.6 percent had high values of TC and TG respectively as compared with normal ranges. Although the mean TC level for the total group indicated normal indices, the mean TC level for women was 5.2±1.1, indicating borderline risk of CVD. The mean±SD of LDL-cholesterol (3.6±1.8 mmol/L) of the total sample was higher than the recommended level of <3.0 mmol/L (Klug, SA Heart & LASSA 2012), and the mean±SD of HDL-cholesterol (0.7±0.4 mmol/L) of the total group was very low compared with the recommended level of >1.5 mmol/L (Perk *et al*. 2012:43). A total of 76.1 percent (n=102) of the respondents had values of LDL-cholesterol above the normal range and the HDL-cholesterol indicated that 97 percent (n=130) of the respondents had values lower than the normal range of >1.5 mmol/L. These values indicate CVD risk. Furthermore, based on the LDL-C level (Hermansen, Hansen, Jacobsen, Clausen, Dalgaard, Dinesen, Holst, Pedersen & Astrup 2005:844; Jenkins, Kendall, Marchie, Faulkner, Wong, Souza, Emam, Parker, Vidgen, Trautwein, Lapsley, Josse, Leiter, Singer & Connelly 2005:381), 76.1 percent of the respondents were hypercholesterolaemic. The high mean±SD homocysteine (17.1±9.2) indicated further risk of hypercholesterolaemia. More women than men had homocysteine levels above the normal range.

When evaluating the risk of CVD in this group through the cholesterol ratio, TC: HDL-cholesterol and given that the ideal cholesterol ratio is 3.5:1[<3.5] (University of Ottawa Heart institute 2013), the results further indicated a greater risk of CVD, with a ratio of 7.9:1, with a mean±SD 7.9±2.93 above the normal range. Furthermore, the ratio of triglycerides: HDL indicated high levels (2.7±2.1) above the normal range of <2 (Hill 2012), indicating risk of CVD in the total group. The observed means±SD of serum vitamin B_{12} (613.96±293.5) and folate (8.9±4.9) were within the recommended ranges of >200 pg/ml (Bain, Bates, Leffan & Lewis 2012:202) and 5.2–20 nmol/l (Maglumi 2012), respectively. However, of the 134 elderly respondents, 7.5 percent had low levels of vitamin B_{12} and 19.4 percent had low levels of folate. The independent *t*-test showed a significant differences between men and women for TC (p=0.049), HDL (p=0.001), LDL: HDL (p=0.000), TC:HDL (p=0.000), TG:HDL (p=0.000) and Hcy (p=0.024).

Table 23 Selected biochemical indices of the elderly respondents (n=134)

Parameters and unit of measure	Normal ranges	Women Mean ±SD (n=110)	Women (%) with low[a] or high[b] values	Men Mean ±SD (n=24)	Men (%) with low[a] or high[b] values	Total group Mean ±SD (n=134)	Total group (%) with low[a] or high[b] values	p value between women & Men $p \leq 0.05$
Total Cholesterol (mmol/L)	<5.2[1]	5.2±1.1	44.5[b]	4.5±0.8	20.8[b]	5.0±1.1	40.3[b]	0.049
LDL- Cholesterol (mmol/L)	<3.0[2]	3.7±1.1	80.9[b]	2.9±0.9	54.2[b]	3.6±1.1	76.1[b]	0.354
HDL-Cholesterol (mmol/L)	>1.5[3]	0.7±0.3	98.2[a]	0.7±0.6	91.7[a]	0.73±0.4	97.0[a]	0.000
Triglycerides (mmol/L)	<1.7[4]	1.6±0.8	32.7[b]	1.9±0.8	54.2[b]	1.6±0.8	36.6[b]	0.714
LDL: HDL ratio	>0.4[5]	5.5±2.1	0.9[a]	6.2±3.6	0.0[a]	5.6±2.4	0.7[a]	0.000
TC: HDL ratio	<3.5[6]	7.6±2.4	98.2[b]	9.1±4.5	91.7[b]	7.9±2.9	97.0[b]	0.000
Triglycerides: HDL ratio	<2.0[7]	2.4±1.7	55.5[b]	4.1±3.1	66.7[b]	2.7±2.1	57.5[b]	0.000
Serum Vitamin B_{12} (pg/ml)	>200[8]	617.4±291.8	7.3[a]	598.5±307.3	8.3[a]	613.96±293.5	7.5[a]	0.969
Serum folate (ng/ml)	5.2-20[9]	9.1±5.1	20.0[a]	7.8±3.8	20.8[a]	8.9±4.9	19.4[a]	0.065
Homocysteine (µmol/L)	<15.0[10]	16.9±7.2	60.0[b]	18.2±15.5	50.0[b]	17.1±9.2	58.2[b]	0.024

[a] Low values, [b] high values compared to normal range; [1]NCEP (2002); [2] Klug, SAHA and LASSA (2012); [3]Perk *et al*. (2014:43); [4]ESC and EAS (2011:1793); [5] MedTV (2006); [6]University of Ottawa heart institute (2013); [7]Hill (2012); [8]Bain *et al*. (2012:202); [9]Maglumi (2012); [10]Abraham and CHO (2010).

3.7.7 Correlations of dietary intake, biochemical and anthropometric parameters measured in this study

The Pearson correlation analysis reflected in Table 24 showed that BMI levels related significantly (*p*-value <0.01) to waist circumference and diastolic blood pressure. A significantly (*p*=0.01) high positive association existed between the prevalence of BMI and waist circumference (*r*=0.776, *p*=0.000). Furthermore, a significant positive association was observed between DBP level and BMI (*r*=0.240, *p*=0.005), and SBP levels (*r*=0.458, *p*=0.000) and WC (*r*= 0.230, *p*= 0.008)

Table 24 Correlations between body mass index, hypertension and waist circumference

Correlations

		BMI	SBP	DBP	Waist-C
BMI	Pearson Correlation	1	.087	.240**	.776**
	Sig. (2-tailed)		.320	.005	.000
	N	134	134	134	134
SBP	Pearson Correlation	.087	1	.463**	.112
	Sig. (2-tailed)	.320		.000	.198
	N	134	134	134	134
DBP	Pearson Correlation	.240**	.463**	1	.228**
	Sig. (2-tailed)	.005	.000		.008
	N	134	134	134	134
Waist-C	Pearson Correlation	.776**	.112	.228**	1
	Sig. (2-tailed)	.000	.198	.008	
	N	134	134	134	134

**. Correlation is significant at the 0.01 level (2-tailed).

No statistically significant correlations were found between dietary intake and BMI and WC. Moreover, no significant relationship was established between the serum lipid levels and BMI or hypertension levels of the elderly people in this study. However, with regard to the serum lipids and WC correlations, there was a positive correlation (*p*-value=<0.01) between TG and WC (*r*=0.268, *p*=0.002). This would indicate that individuals with high WC have high levels of triglycerides. A significant (*p*-value <0.01) positive association existed between age and serum TC (*r*=0.280, *p*=0.001), LDL-C (*r*=0.271, *p*=0.002), homocysteine (*r*=0.246, *p*=0.005) and serum folate (*r*=0.210, *p*=0.018). When considering correlations of age and serum lipids based on gender, a significant (*p*=0.017) positive association was established between men's age and serum folate *(r*=0.492). Women's age correlated significantly with the serum lipids as follows: TC (*r*=0.318, *p*=0.001), LDL-C (*r*=0.290, *p*=0.003) and Hcy (*r*=0.344, p=0.000). No significant correlations of FVS and FGDS with serum lipids, BMI, BP and WC were established.

3.8 DISCUSSION

The objective of this baseline study was to determine the risk factors for CVD prevalent in the elderly community of Sharpeville. In South Africa, CDL are the leading causes of death among the elderly, with CVD (Ischaemic heart disease) and stroke being the leading single causes of death (Joubert & Bradshaw 2006:211). Cardiovascular disease risk factors are prominent in the South African population and are expected to increase because of increasing urbanisation (Maritz 2006:98). Sixteen percent of all deaths in SA in 2011 were due to diseases of the circulatory system (Statistics SA 2014) , which also contributes to more deaths in women than in men (Statistics SA 2014; Labadarios, Dhansay, & Hendricks 2008:131).

The risk of poor dietary intake and its implications on the lifestyle and, most importantly, the health status of this elderly community were observed. These elderly people received a monthly pension, but the money available was reported to be insufficient to procure their basic needs, as the majority of the elderly households had a monthly income of R501–1,000 (46.09–91.99 US$) with the elderly person being the only contributor to the household income. Charlton, Ferreira and Du Plessis (2008:552) reported that black African households headed by an older person in South Africa had the highest rate of food poverty across all ethnic groups and that the risk of food poverty was experienced more in larger households. This is in agreement with the findings of the study by Oldewage-Theron, Salami, Zotor and Venter (2008:12), in which households of the elderly in Sharpeville had an average size of 5 people and spent less than R200 (18.40 US$) per week on food. The calculations indicated that less than R5, 80 (0.53 US$) were spent on food per person per day. The R5, 80 spent on food per person per day indicates extreme poverty, considering the definition of poverty by WHO (2014c), which defines poverty in absolute terms as income less than 2 US$ a day.

Shortage of food impacts unequally on individual household members, where adults, especially women/grandmothers, may sacrifice sustenance in favour of their grandchildren benefiting from the available food (Charlton, *et al*. 2008:553) or working members may be fed at the expenses of nonworking members (Kruger, Schőnfeldt & Owen 2008:11). With a fairly large percentage of the elderly in Sharpeville reporting that the grandmother was responsible for food preparation, food procurement decisions, and feeding the children (Oldewage-Theron, Salami *et al.* 2008:12) the deficient intake of a majority of nutrients and the low mean energy intake as compared with the EAR and EER respectively reported in this study for these elderly persons may indicate sacrifices of nourishment by the elderly in favour of other family members and insufficient funds to procure food. Charlton *et al.* (2008:553) indicated that older persons who share a pension income may be at risk of inadequate nutrition and this applies especially to women.

The food budget of the elderly was spent once a month mostly at supermarkets, followed by street vendors and supermarkets, then supermarkets and spaza shop [uck shop] (Oldewage-Theron, Salami *et al.* 2008:12). These data are consistent with the findings of Bear, Bradnum, Tladi, and Pedro (2005:9), who stated that low-income households in SA spent their food budget at three places, namely in spaza shops close by, in large wholesalers located on the periphery of the townships and in supermarkets near the workplace. However, wholesalers which have multiple special offers which low-income household could take advantage of were not mentioned as other places of food purchasing by these elderly people. A possible explanation is that public transport to where the nearest wholesalers are located may be costly and usually includes an additional charge on luggage, as is also reported by the Consumers' Association 1997:2; Ballantine, Rousseau and Venter 2008:3. Therefore, the elderly, who often do not possess their own means of transport, choose to purchase once a month near their homes to avoid additional costs to their food budget. These trips for food purchasing are often pre-planned to coincide with other activities such as collecting of pensions and visits to clinics. However, when money is limited, such pre-arrangements can be replaced by daily shopping, mainly buying only what would be eaten that day (Dobson, Beardsworth, Keil & Walker 1994:13) at nearby shopping places (spaza shops). Spaza shops are generally not good sources of fresh food products such as fruits, vegetables and dairy (Labadarios, Steyn & Nel 2011:10); as a result this doubles the relative odds of having deficient intakes of the majority of nutrients owing to poor dietary diversity. The results of mean (±SD) food variety and mean (±SD) dietary diversity in this study were contradictory in that the FVS indicated a medium variety and the FGDS indicated a high food group variety. This shows that a limited number of food items from each group were consumed, even though most food groups were consumed by the elderly. In general, a varied diet is associated with improved health outcomes. However, it should also be acknowledged that a diversified diet of poor quality may also contribute to poor health from the standpoint of CVD. The diet quality has to be considered rather than the variety of foods and a varied diet should be selective (e.g. vegetables and fruits, legumes and sources of dietary fatty acids). The respondents in this study consumed a mainly high processed carbohydrate diet with the cereal group being the most diverse. This was also evident from the top 20 food items consumed. Of the top 20 food items consumed, seven foods were from the cereal group. Low intakes of dietary fibre were observed that were due to the small portions of vegetables and fruits eaten infrequently and the lack of intake of legumes.

Lack or shortage of income in this elderly group, as already mentioned, can contribute to unhealthy lifestyles, predisposing the elderly to the development of chronic diseases such as obesity, hypertension and hyperlipidaemia observed in this study, as well as diabetes, reported by Oldewage-Theron and Kruger (2008:109), owing to consumption of an unhealthy diet, coupled with lack of regular aerobic exercise. The consumption of highly energy-dense foods observed in this study is one of the food coping strategies in low-income situations. On a per-calorie basis, energy-dense foods are likely to be cheapest and prove more economical for low-income populations and more palatable than the alternatives of nutritious food such as legumes or lean meat cuts (Seligman, Laraia, & Kushel 2010:304; Drewnowski & Specter 2004:6). The diet of these elderly people also consisted of slightly high saturated fat, particularly of animal origin. Although the total dietary fat, SFA and TFA intake met the recommended percentage of energy intake, the majority of the healthier dietary fatty acids (MUFA, PUFA and linolenic acids (n-3) C18:3) scored percentages that did not meet the recommended energy intake guidelines for prevention of chronic diseases. This was because the main sources of dietary fat were flesh foods (meat and poultry), as also observed in the 20 top food items consumed by the elderly, followed by dairy and lastly, fats and oils. The essential linoleic and linolenic fatty acids have a positive influence on blood lipid concentration and play an important role in the working of the nervous system (Gallagher 2008). The main source of linoleic acid in the diet comprises vegetable oils such as sunflower oil, soybean and maize oils and nuts and seeds. Normally, these are more available than the food sources of linolenic acid, namely walnuts, linseed and rapeseed oil. This was also true in this study, in which the diet of the group met the guidelines for linoleic acid but just missed the recommended intake of linolenic acid. The intake of dietary fatty acids (MUFA, PUFA and linoleic acids (n-3) C18:3), which scored percentages that were not within the recommended guidelines for energy intake, could lead to an increase in LDL-C, and in turn, the risk of heart disease (Lichtenstein, Kennedy, Barrier, Danford, Ernst, Grundy, Leveille, Van Horn, Williams & Booth 1998). In this study, the median daily protein intake was sufficient for total group. This result corresponds to the findings of a study conducted on free-living elderly in Umlazi, South Africa (Mkhize, Napier and Oldewage-Theron 2013). However, the source was mainly from animals and these contain dietary cholesterol and account for a slightly high percentage of saturated fat intake. The dietary cholesterol intake was, however, within the recommended guidelines. The slightly high intake levels of saturated fat although within the recommended guideline could be addressed by including in the diet cheaper alternatives to meat such as legumes (soy), which will also provide additional health benefits.

Owing to the low variety of foods with a high moisture content, such as vegetables and fruits, which allow the consumer to feel full on fewer calories (Drewnowski & Specter 2004:8), the prevalence of obesity and deficient intakes of all the dietary vitamins, namely A, B_6, folate, B_{12}, C, D, E, and K reported in this elderly group is expected. However, it is interesting that of the top 20 food items consumed, the fruit group was represented by fruit juice only. It is possible that the fruit intake scores of these food-insecure participants is being driven by high juice consumption, bearing in mind that there is less access to fresh produce in food-insecure communities. However, juice intake was only listed number seventeen not very high on the list.

According to Goedecke, Jennings and Lambert (2006:65), the overall prevalence of overweight (BMI >25-29.9) and obesity (≥30) in SA is high, with more than 29 percent of men and 56 percent of women classified as overweight or obese. In this study, the prevalence is much higher than that reported by Goedecke *et al.* (2006:65). The overall prevalence of obesity was 75.3 percent, with 54.1 percent of men and 80.0 percent of women being overweight or obese. Although the mean BMI of this elderly group indicates a mainly overweight (29.03±5.62) group, the majority of the respondents were either overweight or obese, which is a negative risk factor for CVD since these elderly people also have raised LDL-C levels. Moreover, the fact that aspects such as reduced sense of taste, smell, complications in chewing because of poor-fitting dentures or oral health problems, and difficulties in swallowing occur in the elderly (WHO 2002:22) could lead to eating less on some occasions. Cycles of involuntary food deprivation coupled with over-eating when food is plentiful can also lead to an unhealthy pre-occupation with food and metabolic changes that promote fat storage (Townsend *et al.* 2001:1741). This becomes worse given the availability of cheap, energy-dense foods in low-income communities and explains, at least in part, the prevalence of obesity in this elderly group.

However, the severity of the prevalence of cardiovascular risk in this elderly group is indicated by the waist circumference, more especially among women. The WC mean 97.51±10.16 for women indicated a substantial risk level (≥88 cm) and the waist circumference mean of 96.46±11.20 for men showed increased risk (94.0–101 cm). The WC was the most outstanding anthropometric feature in this study in terms of overnutrition. Over 80 percent of the respondents were at substantial risk, with more women than men at substantial risk. Waist circumference is a good indicator of intra-abdominal fat mass in adults. Such fat mass is a better predictor of cardiovascular risk than BMI (Charlton *et al*. 2008:561). The very low levels of physical activity in these elderly persons of Sharpeville, as reported by Oldewage-Theron *et al.* (2008:7), could have a direct impact on the obesity and WC levels.

Hypertension is one of the major contributors to CVD in the SA population and the national prevalence rate for women and men was 10.2 percent in 2012 (Shisana *et al*. 2013:83). In this study, the prevalence of hypertension was higher than the national prevalence. Fifty seven percent of the respondents suffered from hypertension ≥140/90 mmHg, with a large percentage of both men (79.1%) and women (51.8%). The inadequate intake of essential micronutrients such as potassium in reducing hypertension could have contributed to the high prevalence of hypertension in this group (Sacks, Willett, Smith, Brown, Rosner & Moore 1998:136). The higher prevalence of obesity and lack of physical activity may also have contributed to higher blood pressure since a positive relationship was shown to exist between BMI, diastolic BP and waist circumference (WC). Obesity and not being physically active are well known risk factors of hypertension (Mayo Clinic 2012). According to Yalcin, Sahin and Yalcin (2005), BMI in women is the most important predictor of the elevation in SBP and DBP. However, in this study, BMI was associated with increased DBP in women, and among men, BMI was related to increased SBP. Charlton, Steyn and Levitt (2007:1) indicate that a dietary pattern that is rich in fruits, vegetables and dairy products and low in salt can reduce BP significantly; however, in this study the low intake of fruits, vegetables and dairy products contributed to low magnesium and calcium even through the sodium intake was moderate.

The lipid levels indicated mainly low HDL and high LDL-C levels. However, the lipid variables means for TC (5.0±1.10), LDL-C (3.6±1.08) and TG (1.6±0.81) were within normal ranges, even though these levels were close to ≥5.2, ≥3.0 and ≥1.7 respectively, increasing the CVD risk profile. These results contradict the suggestions of Maritz (2006:101) and Vorster (2002:242) that black South Africans might be protected against atherosclerosis-related diseases because of favourable serum lipid profiles such as low TC and a relatively higher proportion of protective HDL-C. The serum TC, LDL-C and Hcy values in this study showed an association with age among the women. However research has indicated that serum total cholesterol concentrations increase with age, peaking in those 55–64 years old (Shisana, Labadarios, Rehle, Simbayl *et al.* 2013:83), and as a result, caution in the type of fat used in the diet should be exercised.

Increased consumption of refined carbohydrates has been associated with production of high glucose and insulin concentrations (Ma, Chiriboga, Olendzki, Li, Leung & Hafner 2006:160). Eventually, this may decrease insulin sensitivity, elevating fasting triacylglycerol concentration and reducing the HDL-C levels, a profile that increases the probability of CHD (National Institutes of Health 2014) especially when coupled with a low-fibre diet, whereas a high-fibre diet may counteract the negative effect of a high intake of refined carbohydrates on TG levels. No significant correlation was observed in this study to prove this finding. The elevated TG levels in this group are consistent with findings that urbanisation has been associated with increases in TG levels in black people (Bourne, Lambert, Steyn 2002). There was a positive correlation (p-value = <0.01) between TG and WC (r=0.268, p=0.002).

High carbohydrate diets are also hypothesised to increase plasma triglycerides (Jayawardena, Byrne, Soares, Katulanda, Yadav & Hills 2013:4; Parks 2001:2772S); in this study the mean level of triglycerides of the respondents was 1.6±0.81 mmol/L, which was close to the >1.70 mmol/L cut-off that is considered to be a risk indicator of CVD. A possible explanation for the low mean serum triglyceride level may be the 53.3 percent of total calories obtained from carbohydrates in this sample. The American Heart Association (2011:21) has indicated that a rise in triglycerides is associated with very high intakes of carbohydrates (>60% of total calories) but this was not found in this study.

The high homocysteine mean value of 17.1±9.20 for the total group as compared with <15 µmol/L also indicated further risks of CVD. Reduced plasma folate has been negatively associated with elevated serum homocysteine levels (Vrentzos, Papadakis, Malliaraki, Zacharis, Mazokopakis, Margioris, Ganotakis & Kafatos 2004:1013). The deficient intake of dietary folic acid and vitamin B_{12} owing to low intakes of fruits and vegetables and legumes (soy) did not have a negative impact on the serum vitamins B_{12} and folate, as these were within the normal ranges. However, 7.5 percent and 19.4 percent of the respondents were deficient in these two micronutrients respectively. However, the mean serum folate of 8.9±4.89 ng/ml was close to the lower limit of the normal range (5.2 ng/ml), which could be a major contributing factor to elevated homocysteine levels; the correlation was, however, not significant.

3.9 CONCLUSION

The results of this study confirmed that lack or shortage of income in this elderly group might have contributed to observed unhealthy lifestyles such as the consumption of poor, energy-dense diets which influence the development of CVD risk factors such as obesity and hypertension. The results also showed that lipid abnormalities are frequent in this elderly population. Although a high dietary diversity score was achieved by this group, prevalence of CVD risk factors was still a major problem. This confirms the need to educate the elderly in how to modify their food procurement and preparation by being selective (e.g. choosing vegetables and fruits, legumes and good sources of dietary fatty acids) in order to address the high prevalence of CVD risk factors, rather than emphasising the variety of foods. For the elderly who struggle to feed their families, poorer quality foods may prove more economical, indicating that these households not only need nutrition education to improve their diets but greater access to less expensive healthy food options as well.

The results of the baseline study were used for the planning and development of a soy awareness education programme (Chapter 4) and a soy feeding intervention (Chapter 5) to improve this elderly group's awareness and knowledge of the health benefits of soy, and in this way, address sustainable nutrient intakes and general well-being. The education programme and soy feeding interventions are described in the following chapters.

4

SOY AWARENESS EDUCATION INTERVENTION

4.1 INTRODUCTION

Food is a necessity and also one of life's great pleasures but because people are unable to increase control over what they eat to improve their own health, food and food eating patterns currently have a direct correlation with four of the ten leading causes of death. These are coronary heart disease, cancer, stroke and type 2 diabetes. This is more pronounced in developed than in developing countries (National Centre of Health Statistics [NCHS] 2003 quoted by Contento 2007:1). Recent studies have reported that obesity is on the rise, and is associated with various chronic diseases (WHO 2014b, Kearns, Dee, Fitzgerald, Doherty & Perry 2014). Many chronic diseases and health conditions are a result of individual and social patterns of behaviour (Oldewage-Theron and Kruger 2008:1).

In South Africa there is a lack of attention given to the health care needs of the elderly, many of the nutrition programmes being directed primarily towards children, youth and maternal care (Charlton & Rose 2001:2424S; Charlton, *et al.* 2008:575). Acute or chronic health problems that the elderly may have are diagnosed and treated at primary health care facilities. However, the primary health facilities can be of no assistance in the nutritional needs of the elderly when overcrowding and shortages are experienced, as is currently the case (Charlton *et al*. 2008:575). Hence there is a need to reinforce specific nutrition-related practices or behaviour through nutrition education to help elderly people understand such circumstances and change habits that contribute to poor health.

Other studies conducted among the target group reported food insecurity among these elderly people, with Chapter 3, baseline stud indicating CVD risk factors such as obesity, hypertension and abnormal serum HDL and LDL-C levels. Therefore it can be assumed that practices or behaviours that contribute to poor health exist in this elderly community. Positive change in individual's dietary knowledge and behaviour, the community's conditions of living, social structures and food-related policies may therefore lead to a reduction in the risk of disease. Hence prevention becomes possible (FAO 1997).

Nutrition education is described as an essential programme needed to reinforce specific nutrition-related practices or behaviour to help people understand and change habits that contribute to poor health (Behr & Ntsie 2008:323). Current literature on health promotion and nutrition education programmes for the elderly population is limited. There is a wide opportunity for further development of effective strategies for older people to learn how to integrate healthy nutrition choices, healthy lifestyle and proper nutrition into their everyday lives, as these are crucial to the prevention of chronic diseases and poor nutritional status.

This chapter will be presented as an entity, including methods, results and discussion, conclusion and recommendations. For the ethical approval of this study refer to Chapter 1, page 13, approval numbers M040835, M070126 (Annexure A).

4.2 METHODS

4.2.1 Study design and sample size

An exploratory survey was carried out to assess the nutrition education needs of the elderly before the experimental education intervention study. The exploratory survey was based on adult learning theory. This theory employs approaches that are problem-based and collaborative rather than didactic and may be helpful in the assessment of nutrition education needs of the elderly (Schultz, Nothwehr, Hanson, Chrisman & Haines 2012).

For the exploratory survey, a convenience sample of n=155 elderly persons from the 450 elderly attending a day-care centre in Sharpeville was selected. The convenient sample was achieved through choosing every second person from the 450 list of names of the elderly attending the day care centre. The experimental study (education intervention study) also used a convenience sample of 121 (n=121) from 450 elderly persons. Criteria for inclusion in both the exploratory and experimental study were elderly men or women ≥60 years who voluntarily and regularly attended the day-care centre and who gave consent to participate in the study.

The nutrition education programme (NEP) was conducted from 19 April 2010 to 01 December 2010. In this NEP, the Food and Agriculture Organisation's (FAO) framework (Figure 8 below) for education programmes was used to develop, test and implement the soy awareness education programme for the elderly. The framework provides a valid development process based on scientific principles (FAO 1998). The framework consists of four phases. In Phase1, the preparation phase, the nutritional problems are defined and the causes of the problems are determined. Phase 2 involves the formulation, where the objectives are set, messages are designed and the appropriate media are chosen. In Phase 3, the implementation phase, the materials are produced, the change agents are trained and the communication intervention is executed, and lastly, in Phase 4, the communication intervention is evaluated.

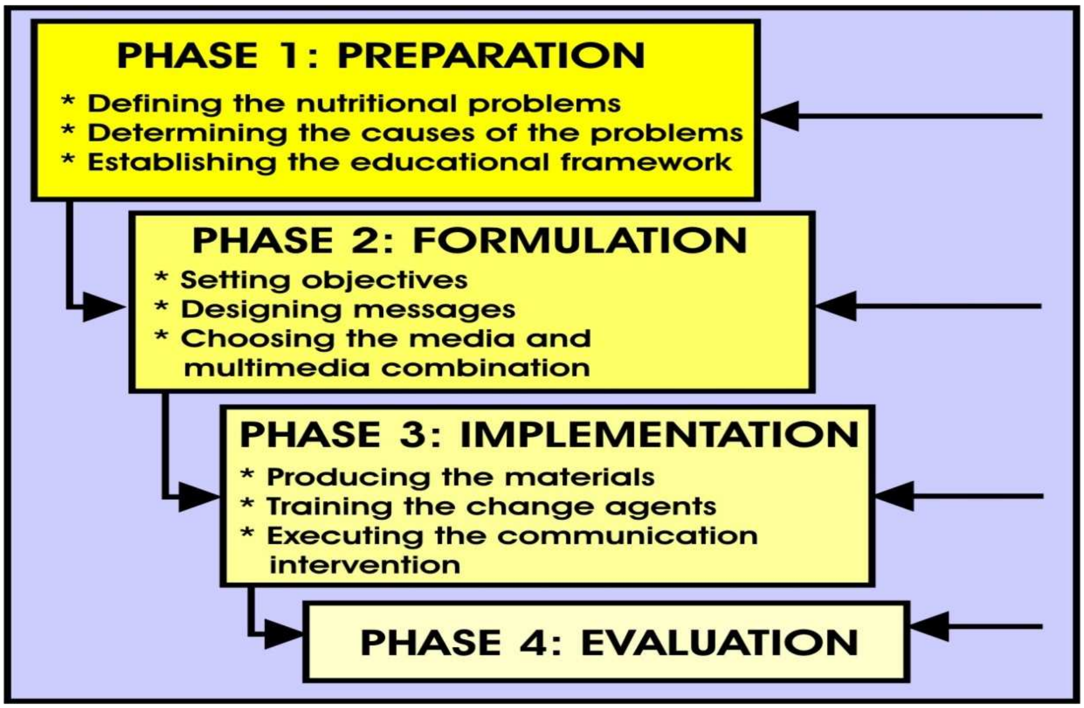


Figure 8 FAO framework for nutrition education (FAO 1998)

The following sections will provide descriptions of the four phases as applied in this study.

4.2.2 Phase 1: Preparation

4.2.2.1 Defining the nutritional problem

In order to plan and develop a nutrition education programme for the elderly community of Sharpeville, firstly the nutritional problems were defined. Systematic analysis of nutrition- and health-related problems of the elderly people was carried out by the researcher from the data of previous studies (n=6 articles), including the socio-economic background and nutritional status and dietary intake conducted on the same group by other researchers (Oldewage-Theron & Kruger 2008a; Oldewage-Theron, Salami, Zotor & Venter 2008; Oldewage-Theron, Samuel &

Venter 2008; Oldewage-Theron, Samuel & Djoulde 2009; Oldewage-Theron, Samuel, Grobler & Egal 2008; Medoua, Egal & Oldewage-Theron 2009).

Furthermore, a separate session, using one-on-one informal discussions with the elderly during exploratory visits, was conducted for a period of four days to analyse health-related problems. A convenience sampling technique was used, selecting the first elderly people to sit next to the researcher on a bench next to the hall entrance and engage in informal conversation. This technique was used so as to not disturb the daily activities at the day-care centre. A total of 20 interviews/discussions with 11 women and 9 men were held within the four days allocated for this process. The researcher visited the day-care centre in the morning before the commencement of the daily activities of the elderly and sat on a bench next to the entrance of the hall where the elderly gather, and observed them as they entered the hall. As some of the elderly sat next to the researcher on a bench, an informal conversation was initiated by the researcher regarding a health condition that the researcher might have observed in the elderly, such as difficulties in walking. The researcher communicated with the respondents without the use of a structured interview guide. However, besides the observed health conditions, the researcher kept in mind the health-related problems identified from previous studies so as to initiate conversation in that regard. This method allows the respondents to speak more freely and openly, as they may see this as simply a conversation (Guion, Diehl & McDonald 2011:2). As soon as possible the researcher made notes of the main points of the conversation so as to compile field notes. This strategy was used as a means of developing an understanding of the setting and also to uncover new areas or topics of interest that may have been overlooked by previous studies and the baseline study. Furthermore, consultations with experts (a dietician and public health nutritionist) who had conducted other research in the same group, as well as the baseline results, assisted in the identification and analysis of the food and nutrition issues of greatest interest to the community.

In addition, an exploratory survey which assessed the nutrition education needs of the elderly was carried out. The methods for the exploratory survey included firstly, the development of the nutrition education needs questionnaire (Annexure F). The questionnaire was compiled by the researcher to assess two major aspects, namely 1) the nutrition education tools (NETs) preferred by the elderly and 2) nutrition education topics preferred by the elderly for the NEP. The questions for the nutrition education tools preferred were partially based on and adapted from a similar study by an MTech student (Holeni 2013), the purpose of the questionnaire being to determine the nutrition education tools needed by female caregivers in Boipatong. However, the questions were adjusted to suit the aim of the current study. The nutrition education topics (see section 1.12 of the questionnaire, Annexure H) were generated from the health concerns raised by the elderly in one-on-one casual discussions that the researcher held with the elderly in introductory sessions. The existing literature on nutrition also assisted in the formulation of some of the questions. Language proficiency, education and literacy skills were also considered. Secondly, data were collected through one-on-one interviews with the elderly by trained fieldworkers. The questions in the section about nutrition education tools (NETs) needed by the elderly consisted of multiple-choice questions and the questions about nutrition education topics required prioritising the topics to be included in the nutrition education programme by choosing three topics and rating them as first, second and third in importance (1=most, 3 least). This process helps to ensure that the nutrition education programme is more relevant to the target group's needs (Lee, Jancey, Howat, Burke, Kerr & Shilton 2011:2). The data collected for the exploratory study included gender, current nutrition knowledge, reading ability, academic qualifications, the sources of the nutritional advice obtained by the respondents, nutritional tools preferred, language preferred for the education programme tools, colour preferred for the education programme tools, items on nutritional information preferred for clarification, font type and size preferred and preferred education topics to be included in the nutrition education programme. The collected data were analysed and the results of this exploratory survey were used to establish the problem.

4.2.2.2 Determining the cause of the problem

The cause of the problem was determined through literature review, studying the data of previous studies (n=6 articles) conducted on the same group including socio-economic background and nutritional status and dietary intake by other researchers, as well as the baseline results. The Food and Agriculture Organisation (1997), states that it is important to understand the reasons for people's behaviour, since such an understanding is crucial to the ability to influence or change certain types of behaviour.

4.2.2.3 Establishing the educational framework

Meetings were held with the management of the day-care centre and a dietician and a public health nutritionist who had also conducted research in the same group to discuss the content and format of the NEP tools, based on the exploratory survey results.

4.2.3 Phase 2: Formulation

Phase 2 commenced immediately after the information had been collected and analysed in Phase 1. This phase focused on the NEP formulation and developing the tool to be used based on the results of the nutrition education needs questionnaire.

4.2.3.1 Setting the objectives

The NEP was developed as part of the aim of addressing CVD risks and/or malnutrition in the elderly, with the objective of determining the knowledge of soy of the elderly and to improve their awareness and knowledge of the health benefits of soy. Given the poor health status, as observed in chapter 3, and the economic situation of this elderly group, it was found to be necessary to implement soy awareness education for this group. Soy has been identified as an affordable food item that will provide not only essential nutrients but also additional and unique nutritional health benefits that could be of importance in addressing the nutrition crisis in this population. According to the US Food and Drug Administration (FDA) and the American Heart Association (AHA), foods containing soy protein should be labelled as protective against coronary heart disease. This claim was based on clinical studies showing that at least 25 grams of soy protein per day reduced the risk of heart disease (Sacks, Lichtenstein, Van Horn, Harris, Kris-Etherton & Winston 2006:1689; Yang *et al*. 2005:1012). Soybeans contain all three of the macronutrients required for good health (protein 38%, carbohydrate 14% and fat – polyunsaturated 18%) as well as vitamins and minerals, including calcium, folic acid and iron (United Soybean Board (USB) 2009). This justifies the need to target these elderly with soy awareness nutrition education to address their knowledge status and also to arouse their interest in providing nourishing food such as soy for themselves. Hence it was decided to call the NEP a Soy Awareness Education Programme (SAEP).

4.2.3.2 Designing the messages

Appropriate messages were chosen and designed, based on literacy level and age, as well as the results of the exploratory study and the baseline study, taking into consideration the topics agreed upon by the management of the day-care centre, the dietician and the public health nutritionist during the session for the establishment of the educational framework. The messages were written after consulting the literature for the latest information and the text was checked for correctness by the dietician.

4.2.3.3 Choosing the media

As already highlighted, the nutrition education needs questionnaire was used to measure two major aspects. The nutrition education tools (NETs) preferred by the elderly as found in the process of choosing the media will be addressed in this section. The questionnaire (Annexure F) results were utilised to choose the media required by the elderly for the SAEP, taking into consideration different elements such as language, font size and clarification of items required in the design of the tool for better understanding of the information.

4.2.4 Phase 3: Implementation

4.2.4.1 Producing the material

The first step was the technical presentation of the Soy Awareness Education Programme (SAEP) material. The tool that was produced for the SAEP for the elderly was the pamphlet, the second preferred tool, based on the results of the exploratory study. A graphic designer was consulted to design the page layout, size and illustrations of the tool. The layout and design of the tool took into consideration the target group specifications for better reading and understanding. The draft pamphlets were proofread by both the dietician and the public health nutritionist for recommendations. After minor changes were implemented, the pamphlets were sent back to the graphic designers for finalisation and printing.

Since the four major nutrition areas that were decided on were divided into a total of 10 sub-topics to be dealt with during the intervention, 200 copies of the soy awareness education pamphlets (Annexure G) for each sub-topic (200x10) were printed out for the elderly to receive during each session. Any effective NEP for the elderly should be designed in a way that will suit the elderly and engage them by being interactive. The Centre of Sustainable Livelihoods (CSL) obtained the FBDG pamphlets from the Department of Health (DoH) and these were also used during the SAEP.

The soy knowledge questionnaire was also produced. Firstly, the questions were compiled by the researcher after exploring the socio-demographic data of other studies conducted in the target group. In addition, results obtained from the nutrition education needs questionnaire and questions in the existing nutrition knowledge questionnaires were also used to compile the soy knowledge questionnaire (Annexure H), together with necessary advice from the promoters, who are also a dietician and a public health nutritionist respectively (content validity). The questionnaire was used to assess the level of knowledge of soy of the elderly both prior to and following the SAEP. The questionnaire included demographic questions such as gender and age so as to characterise the respondents. A total of 24 multiple-choice questions and true or false statements were compiled. These questions sampled the four major topics addressed in the soy awareness education programme and were phrased simply.

Secondly, the questionnaire was tested for reliability (Cronbach's alpha). To test the reliability of the measuring instrument (Soy knowledge questionnaire), the researcher randomly selected 10 respondents in Gaborone, Botswana to participate. These respondents met the criteria for inclusion, namely male and female elderly ≥60 years and living in low-income circumstances. The selection of respondents in Botswana was due to the researcher being home for the school holidays and to avoid wasting time since the elderly in Sharpeville do not attend the day-care centre during school holidays when they take care of the children. The elderly in Botswana were selected at a local church. The researcher requested a list from the church secretary of all the people aged 60 years and above. A total of 20 people were listed. In order to select 10 people to participate, the names on slips of paper were drawn randomly from a container.

- **Data collection for reliability test**

The data were collected over a period of four consecutive weeks by the researcher, who was fluent in the local language, completing the individual questionnaires through one-on-one personal interviews with the elderly. This was used to measure the internal consistency of all the questions on a weekly basis. Completed questionnaires were captured and analysed. Based on the Cronbach alpha score of above 0.7, the questionnaire was accepted as reliable.

In the third step, a total of 250 copies of the validated soy knowledge questionnaire were produced and used to assess the level of soy knowledge of the elderly in Sharpeville both prior to and following the Soy Awareness Education intervention.

4.2.4.2 Training the change agents

From the Department of Hospitality, Tourism and Public Relations management, BTech students were recruited and trained as fieldworkers by the Centre of Sustainable Livelihoods (CSL) to ensure standardisation in completion of questionnaires. These students had to be able to speak the Sotho language as the majority of the elderly people spoke Sotho. All the fieldworkers were trained on aspects of administering the different questionnaires to be used for the entire study and were given detailed instruction in how to conduct fieldwork. Emphasis was placed on the objectives and importance of the project.

Since the questionnaire was compiled in English and the target sample spoke Sotho, the questionnaire was translated by two translators on different occasions (an elderly person who had previously been a health professional and a trained fieldworker who also worked part-time as an assistant administrator for the CSL). The two translators were chosen because they were familiar with the terminology of the subjects covered by the instrument, had interview skills and were fluent in English and Sotho. The translator should be well-informed of the English-speaking culture but his/her mother tongue should be the primary language of the target group (WHO 2012). The translators had to consider the definition of the original term and attempt to translate it in the most relevant way in a simple, clear and concise way. Thereafter, the results of this process were compared and adjusted to produce a complete translated version of the questionnaire. The fieldworkers were briefed about the translated version of the questionnaire and each had a translated copy. For the Soy Awareness Education Programme, the research team consisted of two members, namely the researcher and the trained fieldworker who acted as the facilitator of the SAEP because she was fluent in Sotho. The facilitator had been trained previously by the CSL and assisted in translation of the soy knowledge questionnaire. The message for the SAEP was made available to the facilitator a month before the intervention to study and translate. The programme facilitators should be very familiar with the communication activities to be able to communicate messages effectively. Since a single medium cannot by itself meaningfully alter nutrition-related habits, nutrition education normally involves the use of different media, which calls for the training of all involved and for effective coordination (FAO 1997).

4.2.4.3 Executing the communication intervention

The Soy Awareness Education Programme was conducted from 25 October 2010 to 24 November 2010, making a total of four weeks allocated for the SAEP. The sessions were conducted on Mondays and Wednesdays every week excluding the Mondays and Wednesdays of pension pay-outs. Only 1 hour 30 minutes was allocated for lecturing to accommodate the low attention span of the elderly. This included time for handing out of pamphlets, lecturing, comments and questions. The educational sessions were conducted using the lecturing method and the major component of the SAEP was the reminder pamphlets (results of the exploratory study) which were provided for each topic in every session for the elderly to take home. All the sessions were conducted in Sotho since this was the language of the majority of the elderly. The respective educational sessions were all held at the care centre in a hall (see Figure 9 below, Collage of the soy awareness education programme). The venue was easily accessible and had the advantage of being a familiar setting for the elderly. This assisted in making the participants more comfortable and at ease and encouraged them to engage in the educational sessions and also to ask questions pertaining to the topic.

Figure 9 Collage of the soy awareness education programme

For the soy awareness education programme, the research team consisted of two members, namely the researcher and the trained fieldworker (also part-time assistant administrator for the

CSL) who acted as the facilitator of the SAEP because she was fluent in Sotho. The researcher who was more familiar with the aim of the study but not fluent in Sotho assisted in clarifying information or answering questions posed by the elderly. The researcher also assisted in handing out of the pamphlets with the help of the elderly monitors at the care centre. The researcher marked the attendance register after each session. After the morning prayers at the care centre, the researcher introduced the nutrition education programme by giving a short overview of the objective of the research. Then the facilitator continued with the SAEP by introducing the four major topics and the sub-topics to be dealt with weekly. The discussions on each topic involved first providing the definition, then explaining the functions of the discussed nutrients in the human body and lastly, identifying good food sources of the nutrients.

The messages regarding basic nutrition, food and its composition and healthy eating, including what constitutes a good diet, were discussed simultaneously. The first major topic discussed, macronutrients, was divided into three individual sessions for each of the three macronutrients; protein, carbohydrates and fats. First the definitions were provided, followed by the functions and lastly the food sources for the nutrient discussed. Once the elderly were informed about the functions and understood the different sources of each macronutrient discussed, they were then asked to identify foods that were the healthier sources. This encouraged the elderly to participate and was also used as a strategy to provide clarity to the researchers on whether the elderly understood the content. During the educational session where protein was discussed, the researcher highlighted the importance of introducing soy as a substitute for animal protein. The researcher also explained that soy was going to be discussed in detail in the sessions to follow as it was the main component of the education programme. The next macronutrient discussed was carbohydrates. The importance of including unrefined grains in the daily diet was highlighted. When fats were discussed, the difference between good and bad fats was explained as well as the negative impact of bad fats on their health.

The next major topic that was discussed was the micronutrients, which were also divided into sub-topics, namely vitamins and minerals. The same principle which was applied during the discussions of the different macronutrients was applied for the different micronutrients. This involved providing definitions, followed by the functions of the nutrient in the body and lastly, the food sources of the nutrient. The vitamins and minerals needed by the elderly for better health were discussed. The different foods served at the care centre were talked about in terms of the different vitamins and minerals obtained from them and also to emphases the importance of eating a variety of foods. The importance of drinking clean water and the function of water in the body were also discussed.

Following the discussion of micronutrients and water, soy was introduced and discussed. The composition of the soybean was described, highlighting the presence of the previously discussed nutrients in the soybean. Soy's convenience for today's busy lifestyle was noted in that it contains most of the necessary nutrients and is economical and easy to prepare. The equivalence of the quality of soybean protein to animal protein was emphasised. The different forms of soy such as soybeans, soy milk and soy fibre (okara) were discussed in order to highlight the healthy food options available for the elderly to incorporate in their daily meals. To enhance the knowledge of soy, the researchers brought samples of soybeans and soy products such as soy mince, soy flour, soy sauce and soy milk to show to the elderly. The healthy benefits of using soy as food were also explained, namely reduced hypertension, menopause regulation and regulation of glucose levels in diabetes, prevention of bone loss (osteoporosis), obesity and certain cancers, as some of these health conditions were reported to be common in this elderly community (Oldewage-Theron, Salami *et al.* 2008).

Finally, the pamphlets on 11 South African Food-Based Dietary Guidelines were presented to the elderly. In this session an overview of healthy food choices for healthy living and the application of the FBDG during meal planning was provided. The elderly were informed that following the FBDG would assist them in making wise food choices for themselves and their families. At the end of each session the key points were reviewed to provide a sense of completion.

As part of a pre-planned strategy employed to strengthen awareness of soy, the health benefits of soy and its use by the elderly to improve their health and nutritional status, soy demonstrations were held on 4 April 2011 (see Figure 10 below: Collage showing the demonstration of soy recipes to the elderly). The purpose of the soy demonstrations was to demonstrate how to cook the soy recipes using ingredients readily available in the households of the elderly, as revealed by the situation analysis, in order to increase interest in soy. The elderly were given the soy recipe pamphlets (Annexure I) to follow during the demonstrations and to take home and share with the entire household. The research team consisted of three members: the researcher, a food science specialist (Dr S Duvenage) and a fieldworker (Joy Senoelo). The demonstrations were conducted by the specialist using English and the fieldworker translating into Sotho. The researcher assisted in the handing out of the pamphlets, portioning of the food and handing out of the food samples to the elderly for tasting. Research highlights the necessity for programmes to provide opportunities for participants to taste healthy foods prepared in delicious and tasty ways. This will enhance the beliefs about the value of eating these foods (Contento 2008:178).

Figure 10 Collage showing the demonstration of soy recipes to the elderly

4.2.5 Phase 4: Evaluation

A week before the commencement of the education intervention, trained fieldworkers administered the evaluation questionnaire (soy knowledge questionnaire) at the care centre hall, by means of personal interviews with the elderly as indicated by Figure 11 below, to obtain pre-measurements. The repeated measurements were collected from the same individuals after the

SAEP, thus avoiding misleading inferences. The soy knowledge questionnaire was utilised for pre-measurement (18, 21 October 2010) and post-measurement (21 November and 01 December 2010).

Figure 11 Fieldworker interviewing the elderly

4.3 QUALITY OF MEASUREMENTS

Accuracy in measurement is of great importance in scientific research. Measuring mental aspects of human beings can be complex. In many cases, numerical assessments of the mental attributes of human beings are accepted as readily as numerical assessments of their physical attributes, but it is important to understand that the values assigned to mental attributes can never be completely precise. The imprecision is often looked upon as being too small to be of any practical concern. However, the degree of the imprecision is much greater in the measurement of mental attributes than in that of physical attributes. Meaningful research in this regard requires determining the reliability of the data-gathering instrument to be used (Willmott & Nuttall, 1975 as quoted by Key 2002).

4.3.1 Reliability

According to Coertze (1999:57), Cooper and Schindler 2003:236) and Malhotra (2007:284), reliability refers to the degree to which an instrument produces consistent results if repeated measurements are conducted on the same subject or the same group. In this pilot study certain measures were applied to enhance the reliability of the instruments, as already discussed above. Based on the scores revealed the questionnaire was accepted as reliable.

If the correlation among the items was high, then the Alpha Cronbach was greater. The higher the alpha, the more reliable the test is. The acceptable level is usually 0.7 and above. The literature explains that the coefficient alpha is an internal consistency index designed for use with measurements containing items that have no right answer. This is a very useful tool in social science research because instruments in this field of study often ask respondents to rate the degree to which they agree or disagree with a statement on a particular scale (Key 2002).

The quality of the measurements in this pilot study was also improved through the following:

- ✓ The conditions under which the measurements took place were standardised by using only well-trained fieldworkers to conduct data gathering.
- ✓ The instruments were discussed with the promoter (dietician) to judge how well the instruments met the standards and the objectives of the study.
- ✓ The measuring instrument was tested prior to the pilot study.
- ✓ Different aspects of nutrition were covered in this study. Parmenter and Wardle (1999:299) emphasise that concentrating on a particular aspect of nutrition, for example fat, fibre and cholesterol, can be useful but would not be appropriate for use in measuring the overall nutrition knowledge of a population.
- ✓ Reliability was applied as a criterion for the admissibility of any secondary data for this study e.g. data obtained from the initial baseline study (Oldewage-Theron, Dicks, Napier & Rutengwe 2005)

4.3.2 Validity

Validity refers to the ability of a scale or measuring instrument to measure what the researcher intended to measure (Coertze 1999:59; Zikmund 2003:302). There are two major forms of validity, namely external and internal validity. External validity refers to the possibility of generalising the causal relationship discovered to other people, settings, time and contexts (Cooper & Schindler 2003:23).

Internal validity refers to the ability of a research instrument to measure what it is purported to measure. In this study content validity was addressed. The content validity of a measuring instrument is the extent to which it provides adequate coverage of the investigative questions guiding the study (Cooper & Schindler 2003:232). The following were applied to ensure content validity:

- The questions compiled were based on explored socio-demographic data of other studies conducted in the target group, results obtained from the Nutrition Education needs questionnaire (Annexure F) and questions in the existing nutrition knowledge questionnaires.
- The instrument was discussed with the promoter to judge how well the instrument met the standards.
- The original measuring instrument was tested prior to the pilot study.

4.4 DATA ANALYSIS

4.4.1 Reliability test

A spread sheet for each week's data was designed to capture the data. Statistical analyses were performed by a statistician, using SPSS version 21.0 to show the scores and descriptive statistics, frequencies and Cronbach's Alpha. If the questionnaire reached a Cronbach Alpha score above 0.70, the questionnaire was accepted.

4.4.2 Exploratory and experimental study

The data for the exploratory study were captured by the researcher on Microsoft Excel® spreadsheet. The data were then exported to the SPSS for Windows version 21.0 program, which was used for analysis by the statistician and the researcher. Descriptive statistics (mean, SD and frequencies) were determined.

For the experimental study, the pre-test and post-test data were captured on a Microsoft Excel® spreadsheet. All statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS) version 21.0, with the assistance of a statistician. Descriptive statistics (means and frequencies) and paired *t*-tests were conducted to determine statistically significant differences of knowledge of the elderly before and after the intervention. Pearson's product moment correlation coefficient was used to find out the factors correlated with knowledge of the elderly. A statistical probability of $p=\leq 0.05$ was considered significant.

The pre-and post-measurements were scored, and correct answers were worth one point out of a total of 24 possible points. An Excel spreadsheet was prepared containing columns with the headings of question numbers, percentage of respondents who answered correctly before the NEP, percentage of respondents who answered correctly after the NEP and variance between before and after results, and the correct answers for each of the questions was recorded in the appropriate columns. The variance between before and after results shown in the fourth column was calculated by taking the post-questionnaire scores and subtracting the pre-questionnaire scores. This column was developed to facilitate the comparison of the two scores. The difference between the two scores showed whether or not knowledge was gained by the elderly in the soy awareness education programme. A positive number in the variance column showed that more people answered the questions correctly on the post-intervention questionnaire than on the pre-intervention questionnaire. A lower percentage score on the post-questionnaire than on the pre-questionnaire resulted in a negative number in the variance column. These indicated a decrease in number of people with correct answers after the intervention.

The results were reported through the use of tables and bar graphs. These were created to compare the results of the pre- and post-intervention measurements for each question (percentage of people with correct answers). Each colour of the bar graph represented a different column, with blue representing the percentage of people with correct scores before the NEP and red bars showing the correct scores after the NEP. The green bars showed the variance between the two results.

4.5 RESULTS

4.5.1 Phase 1: Preparation

4.5.1.1 Defining the nutritional problem: results

The results of the background characteristics of the sampled elderly are presented in Table 25 below. A total of 155 elderly respondents participated in the exploratory study. More than two thirds of the respondents were female (87.7%) while 12.3 percent were male. The mean age was 78 with a range from 102–60 years. Most respondents were in the age group 70–79 years (54.2%), followed by the age group 80–99 (29.7%), the age group 60–69 (10.3%) and fewest in the 90 years and above age group (5.8%). The self-rated current nutrition knowledge status showed that about 1.3 percent of the respondents had excellent nutrition knowledge while 3.9 percent had very good nutrition knowledge. Relatively high percentages were reported for good (41.9%) and fair (42.6%) nutrition knowledge. About 10.4 percent of the respondents had fair nutrition knowledge or below.

The scores for reading ability show that about 58.8 percent of the respondents had good reading ability and 44.2 percent had low reading ability. Reading ability of fair and below was reported by 44.7 percent. The results in Table 25 further indicate that the majority of the respondents reported that the highest standard completed in school was below standard 5 (56.1%), with 21.3 percent having completed standard 6–7. About 11.7 percent of the respondents had completed standard 8–9. A relatively small percentage of the respondent attained college education (5.2%). It is very clear in this distribution that the majority of the elderly have low formal education attainment.

Table 25 Background characteristics of the elderly respondents (n=155)

Characteristics	Frequency	Percentage (%)
Gender		
Male	19	12.3
Female	136	87.7
Age groups (years)		
60 - 69	16	10.3
70 – 79	84	54.2
80 – 89	46	29.7
≥ 90	9	5.8
Current nutrition knowledge, according to respondents		
Excellent	2	1.3
Very good	6	3.9
Good	65	41.9
Fair	66	42.6
Bad/poor	8	5.2
Don't know	8	5.2
Reading ability, according to respondents		
Excellent	6	3.9
Very good	45	29.2
Good	35	22.7
Fair	27	17.5
Bad/poor	24	15.5
Don't know	18	11.7
Highest standard completed in school		
Below standard 5	87	56.1
Standard 6-7	33	21.3
Standard 8	8	5.2
Standard 9	10	6.5
College	8	5.2
Don't know	9	5.8

4.5.1.2 Determining the cause of the problems: results

Table 26 shows summarised results obtained from previous studies conducted among the elderly in Sharpeville which were assessed to determine the cause of the problem. Through these studies it was revealed that poverty and food insecurity were the main factors that contributed to poor health such as CVD and its risk factors, such as obesity, hypertension, diabetes and abnormal serum lipids, among these elderly people. Baseline study (previous chapter) results also revealed high prevalence of CVD risk factors (high level of obesity, hypertension and abnormal serum lipids) among an elderly community living in low-income conditions.

Table 26 Studies reviewed to determine the cause of malnutrition among the elderly

Previous studies (n=6 articles)	**Summary of results**
Oldewage-Theron & Kruger 2008a	The elderly had a low mean dietary diversity score of 3.41±1.34 and low mean food variety score of 4.77±2.2. The diet of the elderly was mainly carbohydrate-based and nutrient deficient.
Oldewage-Theron, Salami, Zotor & Venter 2008	The majority of the elderly had low income (R500-R1000 per month). There was high prevalence of food insecurity, obesity/overweight (83.7%) among elderly women. The elderly had inadequate intake of micronutrients and Increased risk of coronary heart diseases owing to high levels of obesity, hypertension and TC.
Oldewage-Theron, Samuel & Venter 2008	Half of the elderly sample (51.5%) were zinc deficient as compared with RDA.
Oldewage-Theron, Samuel & Djoulde 2008	The elderly had poor dietary intake coupled with high prevalence of vitamin A and E deficiency (mean 1.41±1.4 micromol/L and 2.1±1.1 mg/l respectively).
Oldewage-Theron, Samuel, Grobler & Egal 2008	The elderly had a high prevalence rate of anaemia for women (13.2%) as compared with men (12.5%) and deficiencies of vitamin B_{12} and folate.
Medoua, Egal & Oldewage-Theron 2009	The fruit diversity and portion sizes of the meals at the day-care centre were small, resulting in low total dietary antioxidant capacity which is necessary to reduce incidence of non-communicable diseases.

4.5.1.3 Establishing the educational framework: results

From the exploratory study the respondents were also asked to identify the sources of most of their nutrition advice. In Table 27 shows that the majority of the respondents (61.3%) obtained their nutrition advice from Vaal University of Technology personnel (researchers), followed by the sister at the local clinic (23.2%) as another source. In the option of “Others” (6.5%), the elderly indicated that they obtained advice from church and some indicated that they had no source of nutrition advice. To assess the need for the nutrition education programme, the respondents were asked if they preferred to learn more about nutrition. The majority of the elderly (98.7%) preferred to learn about nutrition with only 1.3 percent showing no interest in it.

Table 27 Distribution of respondents by source of nutrition advice and preference for learning more about nutrition (n=155)

Source of nutrition advice	Frequency	Percentage
Vaal University personnel	95	61.3
TV	3	1.9
Sister at clinic	36	23.2
Magazine	6	3.9
Family members	5	3.2
Others	10	6.5
Willingness to learn about nutrition		
Yes	153	98.7
No	2	1.3

As a result of the high interest in nutrition education among the elderly people, the situation analysis and the exploratory survey results, the content and format of the NEP tool was discussed and finalised.

4.5.2 Phase 2: Formulation

4.5.2.1 Setting of objectives: results

The NEP was developed as part of the project for addressing malnutrition in the elderly. In order to achieve the objectives of developing an appropriate NEP, sub-objectives were formulated as follows:

- Help the elderly to understand the health benefits of soy and then have the elderly demonstrate awareness and knowledge of soy.
- Encourage the use of affordable/economical protein from soybeans
- Help the elderly to understand how soy fits into the recommended dietary food plate guideline.
- Empower the elderly on how to cook the soy recipes using readily available ingredients in their households

4.5.2.2 Designing messages: results

The results in Table 28 indicate the distribution of the respondents by nutrition education topics preferred by the elderly. When examining the results of the total group, nutrition and cardiovascular disease (nutrition and hypertension 106.6% and nutrition and heart disease 89.6%) were topics of great concern to the majority of the elderly. More than half of the respondents also indicated the following topics as important: osteoporosis (65.2%), nutrition needs for the elderly (54.8%) and nutrition and diabetes (53.5%). On the other hand, the respondents were not keen to learn about following topics: obesity and overweight (30.4%), diseases of lifestyle related to diet (28.4%), HIV and AIDS and nutrition (20.6%), exercise and nutrition (15.6%) and least interest was shown in food and nutrient composition (10.4%). Of special interest to this study is that soy topics were of little interest to the elderly, with only 47.2 percent reported as being interested in learning about soy and its health benefits, 18 percent in soy and its nutrients and 17.8 percent in soy and its different uses. Important variations were established in the priority of interest in topics among male and female respondents. Of the top five topics rated as important by the respondents, male elderly persons expressed more interest in topics related to health promotion while female respondents were interested in topics related to diseases. When looking only at the topics on soy, both genders regarded the topic of soy and its health benefits as the first priority of interest. However, soy and its different uses was the most important topic for male respondents.

Table 28 Distribution of the respondents by nutrition education topics preferred by the elderly (n=155)

TOPIC	TOTAL GROUP				MALES				FEMALES			
	1 Most important % x 3	2 Fairly important % x 2	3 Least important % x 1	Total sum	1 Most important % x 3	2 Fairly important % x 2	3 Least important % x 1	Total sum	1 Most important % x 3	2 Fairly important % x 2	3 Least important % x 1	Total sum
1 Role of nutrition in health	10.3	4.5	4.5	44.4	5.7	0	2.6	8.3	25.2	9	1.9	36.1
2 Nutrition and heart disease	20	9	11.6	89.6	2.1	2.6	0.7	5.4	58.1	15.5	11	84.6
3 Soy and its health benefits	9.7	7.1	3.9	47.2	3.9	2.6	0.7	7.2	25.2	11.6	3.2	40
4 Osteoporosis	11	11.6	9	65.2	7.8	1.4	0.7	9.9	25.2	21.9	8.4	55.5
5 Foods and nutrient composition	1.3	1.3	3.9	10.4	0	1.4	0.7	2.1	3.9	1.3	3.2	8.4
6 HIV/AIDS and nutrition	1.3	7.7	1.3	20.6	0	2.6	0	2.6	3.9	12.9	1.3	18.1
7 Exercise and nutrition	1.3	3.9	3.9	15.6	0	1.4	0.7	2.1	3.9	6.5	3.2	13.6
8 Nutrition and hypertension	21.3	18.1	6.5	106.6	9.6	0	0	9.6	54.2	36.1	6.5	96.8
9 Soy and its nutrients	1.3	3.9	6.5	18	2.1	1.4	1.9	5.4	1.9	6.5	4.5	12.9
10 Nutrition needs for the elderly	3.9	13.5	16.1	54.8	2.1	6.4	1.9	10.4	3.3	20.7	14.2	38.2
11 Nutrition and diabetes	9.7	7.7	9	53.5	0	2.6	1.9	4.5	9.7	12.9	7.1	29.7
12 Soy and its different uses	0.6	2.6	9	17.8	0	0	0.7	0.7	1.9	5.2	8.4	15.5
13 Diseases of lifestyle related to diet	3.2	5.2	8.4	28.4	2.1	1.4	0	3.5	7.7	9	8.4	25.1
14 Obesity and overweight	5.2	4.5	5.8	30.4	2.1	1.4	0	3.5	13.6	7.7	5.8	27.1

Of the topics preferred by the elderly, the following were chosen:

- Basic nutrition, food and nutrient composition and health
- Healthy eating including what constitutes a good diet (balanced diet)
- Soy nutrient composition and its health benefits among elderly people
- Application of the South African Food-Based Dietary Guidelines during meal planning

4.5.2.3 Results for choosing the media and multimedia combination

Table 29 results showed that just over half of the respondents preferred the nutrition calendar (51.3%) as an appropriate educational tool for the SAEP, with 15.6 percent identifying pamphlets/booklets and 14.9 percent wanting the lecture method. The majority of the respondents (72.3%) preferred the text for the preferred tool to be written in Sotho (72.3%), followed by 13.5 percent of the elderly who preferred English. Tswana, Zulu and the option of “Others”, such as the Swati and Xhosa languages, were identified by 14.2 percent of the elderly. The majority of the respondents (63.9%) said they preferred the selected tool to be designed in black and white, while more than a quarter (34.8%) preferred bright colours. An almost equal proportion of the respondents preferred the illustrations needed on the preferred tool to be, colour drawings or photos (47.1% and 42.6% respectively). The respondents indicated that the font type and font size appropriate for the preferred tool should be Arial 14 (54.8%) or Arial 12 bold (40%), to facilitate easier reading.

Table 29 Nutrition education tool preferred and its design specifications

Variables	Respondents (n=155) Frequency	Percentage (%)
Nutrition education tools		
Fridge magnets	0	0
Posters	10	6.5
Place mats	4	2.6
Magazine article	14	9
Pamphlets	24	15.5
Calendar	79	51
Lectures	23	14.8
Language		
Sotho	112	72.3
Tswana	7	4.5
English	21	13.5
Zulu	10	6.5
Afrikaans	0	0
Others	5	3.2
Material/tools colour		
Black and white	99	63.9
Bright colours	54	34.8
Pastel	2	1.3
Illustrations for clarification in the tool		
Cartoons	16	10.3
Colour drawings	73	47.1
Photos	66	42.6
Font size for better reading		
Arial 14 Enjoy a variety of food	85	54.8
Arial 10 Enjoy a variety of food	3	1.9
Arial 12, bold **Enjoy a variety of food**	62	40
Arial 10, upper case ENJOY A VARIETY OF FOOD	5	3.2

For the types of visuals preferred for the tool, namely photography, black and white or colour drawings, the results in Table 30 showed that for visuals of variety of food the respondents preferred a photo (63.9%) followed by coloured pictures (35.5%), with black and white pictures preferred by only 0.6 percent. For the visuals of milk and egg the respondents preferred the coloured pictures (53.3%) followed by a photo (41.9%). For visuals which showed chicken and fish, the results revealed that the elderly preferred a photo (52.3%), with coloured pictures preferred by 46.5 percent; the black and white picture (1.3%) was least preferred. About 91 percent of the respondents preferred coloured pictures when it came to the visuals of the maize meal (pap), while 6.5 percent was reported for photos and only 1.3 percent for the black and white pictures (question 1.11.4). The majority of the elderly preferred coloured pictures for legume visuals, 21.3 percent preferred a photo and 1.3 percent chose black and white (question 1.11.5). When considering the total average scores of the different types of illustrations, as shown in Table 28, it is clear that the majority of the elderly preferred coloured drawings (60.8%), followed by photos (37.2%), with only 2.1 percent preferring black and white drawings.

Table 30 Distribution of respondents by types of illustrations preferred for nutrition education tool (n=155)

Variables	**Types of Visuals**					
	Coloured drawings 		**Black and white drawing** 		**Photos** 	
	Frequency	%	Frequency	%	Frequency	%
Visuals of food groups	35	35.5	1	0.6	99	63.9
Visuals of eggs and milk	83	53.5	7	4.5	65	41.9
Visuals of chicken and fish	72	46.5	2	1.3	81	52.3
Visuals of maize meal (pap)	141	91	4	2.6	10	6.5
Visuals of legumes	120	77.4	2	1.3	33	21.3
TOTAL AVERAGE	**90**	**60.8**	**3**	**2.1**	**58**	**37.2**

4.5.3 Phase 3: Implementation

4.5.3.1 Producing the materials: results

The results of the exploratory study were used to determine the content of nutrition education and the tool to be used, as already stated. The messages were divided into four core NEP topics, namely macronutrients, micronutrients, soy and its health benefits and food-based dietary guidelines (FBDG). These were further divided into sub-topics making a total of 10 sub-topics. The tool that was decided on for the Soy Awareness Education Programme for the elderly was the pamphlet(s) (see Figure 12 below and also refer to Annexure G) based on the results of the exploratory study. Keeping in mind that the majority of the respondents selected the calendars (51%) as the tool preferred, and that calendars are expensive and take time to design and print, the research team decided to combine pamphlets (15.5%) with the lecturing (14.8%) method; these were the second and third preferred methods of media/tool for this SAEP. However, calendars were to be produced and distributed for the elderly by the CSL at the end of the year for the purpose of NE knowledge retention. The layout and design of the pamphlets took into consideration the target group's specifications, such as larger font size and supporting colour illustrations of the four topics for better reading and understanding.

Figure 12 Example of pamphlets used during the soy awareness education intervention

The results on the reliability (Cronbach's alpha) of the soy knowledge questionnaire in Table 31 below revealed that the questionnaire could be accepted as reliable. Four hundred copies of the soy knowledge questionnaire were printed for the pre- and post-tests.

Table 31 Reliability results of soy knowledge questionnaire

QUESTIONS COVERED IN THE QUESTIONNAIRE	α STUDY SAMPLE
1Which of the following is not a micronutrient?	0.678
2 Which of the following food item contain mostly proteins?	0.747
3 Which of the following food item contains mostly carbohydrates?	0.680
4 Which of the following fats is good for your health?	0.747
5 People need water in the body for	0.747
6 The good things about beans, soybeans and split peas is that	0.747
7.1 What is the main reason for eating meat/chicken?	0.719
7.2 What is the main reason for eating pap/rice?	0.747
7.3 What is the main reason for drinking milk?	0.747
7.4 What is the main reason for eating vegetables?	0.747
7.5 What is the main reason for eating oranges?	0.747
8.1 Soybeans are a cheap substitute for meat in the diet	0.747
8.2 Calcium is a mineral that the body uses to build strong bones and teeth	0.747
8.3 Soybeans contain good fats needed for good health	0.739
8.4 The sugar in sweets is better than the sugar in fruits	0.747
8.5 Soy may prevent diseases such as hypertension and diabetes	0.747
8.6 Fibre helps us to feel full	0.730
8.7 Cereals are usually low in saturated fat and cholesterol	0.673
8.8 Using soy food has no health advantage	0.747
8.9 Whole soybeans are the starting point of soy milk	0.747
8.10 Drinking extra water when you are out in warm weather is good	0.747
8.11 Soybeans contain proteins, carbohydrates, fats, vitamins and minerals	0.747
8.12 Soybeans are an excellent source of protein	0.714
9.0 How many glasses of water should you drink per day to be healthy?	0.749
Mean α	**0.746**

4.5.3.2 Executing the communication intervention: results

Table 32 below indicates the soy awareness education programme schedule for the elderly of Sharpeville. The education programme was executed over four weeks, using lecturing and pamphlets as the educational tools.

Table 32 Soy awareness education programme schedule for the elderly of Sharpeville

Date	Activity	Type of tools used	Week
Monday 25/10/2010	Introduction of the four major nutrition topics and the sub-topics Introduction of macronutrients Macronutrient 1-Proteins	Lecturing and pamphlets	1
Wednesday 27/10/2010	Macronutrient 2-Carbohydrates	Lecturing and pamphlets	
	Macronutrient 3-Fats	Lecturing and pamphlets	
Monday 01/11/2010	Introduction of the micronutrient Micronutrients 1-Vitamins	Lecturing and pamphlets	2
Wednesday 03/11/2010	Micronutrients 1-Minerals	Lecturing	
Monday 15/11/2010	Water	Lecturing and pamphlets	3
	Introduction to soy	Lecturing, pamphlets and demonstrations	
Wednesday 17/11/2010	Health benefits of soy	Lecturing and pamphlets	
	Uses of soy How soy fits into the plate	Lecturing, pamphlets and demonstrations	
Monday 22/11/2010	Introduction to food-based dietary guidelines	Lecturing and pamphlets	4
Wednesday 24/11/2010	Food-based dietary guidelines	Lecturing and pamphlets	

4.5.4 Phase 4: Evaluation results

The soy awareness education programme started with a total of n=121 elderly attending the day-care centre. Because attendance was voluntary and owing to natural events such as death, only 110 completed the post-intervention measurements. Eleven (11) drop-outs were recorded and were therefore eliminated from the results. Only a complete data set with pre- and post-intervention data was thus used (n=110). No significant differences were observed in knowledge between the drop-outs and participants in 19 out of 24 questions and it was therefore assumed that the drop-outs would not have made a significant contribution to the results should they have completed the study. The questions with significant differences were Question 4: Which fat is good for health? (p=0.03), Question 5: People need water in the body for what? (p=0.027), Question 8.1: Soybeans are cheap substitutes for meat in the diet (p=0.034), Question 8.5: Soy may prevent diseases such as hypertension and diabetes (p=0.002) and lastly, Question 8.11: Soybeans contain proteins, carbohydrates, fats, vitamins and minerals (p=0.033). Of the demographic factors, namely income, educational level, employment and language, only education level showed a significant difference between the participants and drop-outs (p=0.001).

The results of the soy knowledge determined by pre- and post-intervention measurements indicated that, on average, the respondents were able to increase their knowledge of soy (Table 33). Of all the 24 questions covering the SAEP, the overall number of correct answers improved significantly (p=0.000) from 62.3 percent at pre-test to 76.8 percent after the SAEP. The researcher found that only one question (Question 1: which of the following is not a micronutrient?) scored higher in the pre-intervention questionnaire than in the post-intervention questionnaire.

In addition, the results in Table 33 were also compared within the four topics (macronutrients and micronutrients, water and health, functions of foods in the body and soy and its health benefits and uses) by comparing the average points achieved for the topic during the pre- and post-tests. It was observed from the results that the elderly had the highest overall knowledge in pre- and post- tests on soy and its health benefits and use (72.7% and 90.3%), in which the knowledge increased significantly (p=0.000) after the intervention, followed by water and health (65.2% and 80.9%), where the knowledge did improve but not significantly (p=0.176), then macronutrients and micronutrients (63.6% and 76%), with the elderly having low knowledge scores on functions of foods in the body (45.3% and 57.6%). Table 33 summarises the respondents' scores in the two tests.

Table 33 Results of soy knowledge before and after the soy awareness education intervention

Topics and questions	% of respondents who answered correctly before the NEP (n=110)	% of respondents who answered correctly after the NEP (n=110)	Variance between before and after results	Significance between pre- and post-tests p≤0.05
Macro- and micronutrients				
1 Which of the following is not a micronutrient?	22.7	9.1	-13.6	0.005
2 Which of the following food items contain mostly protein?	47.3	83.6	36.4	0.000
3 Which of the following food items contain mostly carbohydrates?	41.8	69.1	27.3	0.000
4 Which of the following fats is good for your health?	74.6	86.4	11.8	0.019
8.2 Calcium is a mineral that the body use to build strong bones and teeth	93.6	100	6.4	0.008
8.4 The sugar in sweets is better than the sugar in fruits	80.9	89.1	8.2	0.083
8.7 Cereals are usually lower in saturated fat and cholesterol	84.6	94.6	10	0.011
Overall score	**63.6**	**76**	**12.4**	**0.087**
Water and health				
5 People need water in the body for	40	57.3	17.3	0.010
8.10 Drinking extra water when you are out in warm weather is good	98.2	100	1.8	0.158
9 How many glasses of water should you drink per day to be healthy?	57.3	85.5	28.2	0.001
Overall score	**65.2**	**80.9**	**15.7**	**0.176**
Function of food in the body				
7.1 What is the main reason for eating meat/chicken?	40.9	50	9.1	0.175
7.2 What is the main reason for eating pap/rice?	59.1	75.5	16.4	0.005
7.3 What is the main reason for drinking milk?	36.4	56.4	20	0.003
7.4 What is the main reason for eating vegetables?	4.6	13.6	9	0.012
7.5 What is the main reason for eating oranges?	41.8	54.5	12.7	0.047
8.6 Fibre helps us feel full	89.1	95.5	6.4	0.071
Overall score	**45.3**	**57.6**	**12.3**	**0.002**
Soy and its health benefits and use				
6 The good thing about beans, soybeans, split peas is that	58.2	73.6	15.4	0.017
8.1 Soybeans are a cheap substitute for meat in the diet.	96.4	100	3.6	0.045
8.3 Soybeans contain good fats needed for good health	76.4	98.2	21.8	0.000
8.5 Soy may prevent diseases such as hypertension and diabetes	83.6	100	16.4	0.000
8.8 Using soy food has no health advantages	48.2	63.6	15.4	0.021
8.9 Whole soybeans are the starting point of soy milk	56.4	89.1	32.7	0.000
8.11 Soybeans contain proteins, carbohydrates, fats, vitamins and minerals	81.8	99.1	17.3	0.000
8.12 Soybeans are an excellent source of protein.	80.9	99.1	18.2	0.000
Overall score	**72.7**	**90.3**	**17.6**	**0.000**
Mean Score for all the questions	**62.3**	**76.8**	**14.5**	**0.000**

For better comprehension of the results, the results were further analysed by classifying the questions into four main variables, namely 1) macronutrients and micronutrients, 2) water and health, 3) functions of foods in the body and 4) soy and its health benefits and uses.

4.5.4.1 Macronutrients and micronutrients

Seven questions were compiled to assess knowledge of macronutrients and micronutrients. Figure 13 below summarises the respondents' scores on macro- and micro-nutrients. In Question 1: which of the following is not a micronutrient; the elderly were asked to select the nutrient which was not classified as a macronutrient from among proteins, vitamins, carbohydrates and fats. The correct answer, vitamins, was chosen by 22.7 percent of the respondents in the pre-test and 9.1 percent in the post-test. This indicated that the knowledge did not improve or increase significantly (p=0.005).

The elderly were asked in Question 2: which of the given food items (soybeans, apples and carrots) contain mostly proteins and in Question 3: which of the given food items (potatoes, soybeans, fish and oranges) contain mostly carbohydrates. Less than half of the respondents could not identify the correct answers in pre-tests (Question 2, 47.3% and Question 3, 41.8%). An improvement in knowledge was observed for the two questions after the intervention, with a 36.4 percent improvement for Question 2 and a 27.3 percent improvement for Question 3. Knowledge improved significantly (p=0.000) for both Questions 2 and 3.

Question 4 covered which fat is good for health. The elderly were required to select all relevant options for the question from four options given, namely soy oil, mayonnaise, margarine/Rama and lard. With two answers correct (soy oil and Rama), the two totals were added together. The highest scores were reported for margarine/Rama (52.7%) during the pre-test, and the soy oil score was 21.9 percent. There was an improvement of 11.8 percent from pre-test (74.6%) to post-test (86.4%), which was significant (p=0.019). The majority of correct answers for the post-test were given on soy oil (71.8%) with margarine/Rama receiving only 14.6 percent correct answers.

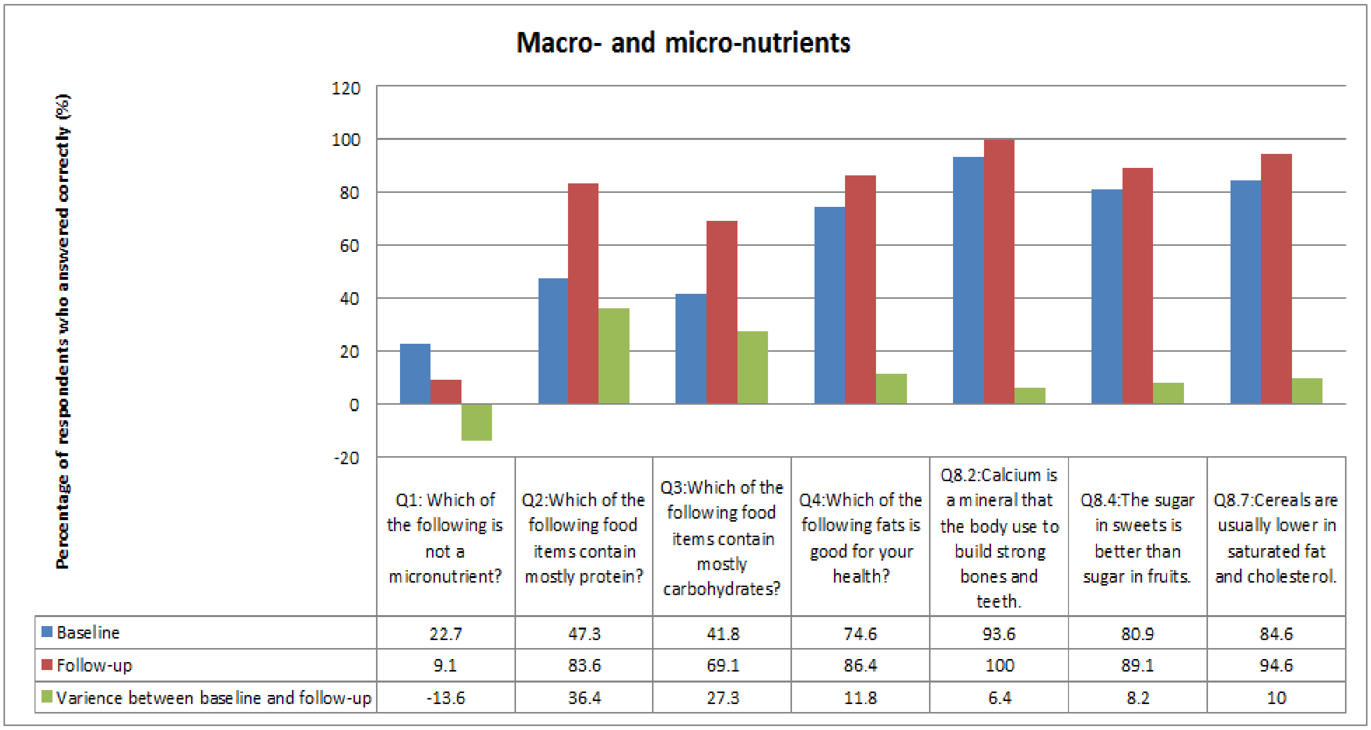


Figure 13 Nutrition knowledge scores of the elderly in questions on macronutrients and micronutrients

Of special interest to this study is that with regard to the statement, “Calcium is a mineral that the body uses to build strong bones and teeth” (Question 8.2) 93.6 percent of the respondents knew the correct answer before the intervention. There was an increase in the knowledge of this question to 100 percent in the post-test. When the elderly were presented with nutrition knowledge statements such as “The sugar in sweets is better than the sugar in fruits” (Question 8.4) and “Cereals are usually low in saturated fats and cholesterol” (Question 8.7) the majority (80.9% for Question 8.4 and 84.6% for Question 8.7) already knew the answer before the intervention. Nevertheless, there was an improvement of knowledge after the intervention with Question 8.4 scoring 89.1 percent and Question 8.7 scoring 94.6 percent in the post-test; however, the knowledge for Question 8.4 did not improve significantly (p=0.083), while Questions 8.2 and 8.7 improved significantly (p=0.008 and p=0.011 respectively) after the soy education intervention.

4.5.4.2 Water and health

The results of the questions on water and health are presented in Figure 14. In Question 5 the elderly were asked “People need water in the body for what?” The elderly were to select the correct answer from the following options: (a) energy b) digestion (c) protecting against infection and (d) building muscles. The results showed that only 40 percent of the respondents were knowledgeable about the need of water in the body before the intervention. However, the knowledge increased by 17.3 percent after the intervention. In Question 8.10, the respondents were given a statement which required true or false as an answer. The majority (98.2%) of the respondents before the intervention agreed with the statement “Drinking extra water when you are out in the warm weather is good”. After the intervention all the respondents (100%) were aware that drinking extra water when you are out in the warm weather is good. Before the intervention, more than half of the respondents (57.3%) knew how many glasses of water to drink per day to be healthy. The knowledge improved significantly (*p*=0.001) by 28.2 percent after the soy awareness education programme.

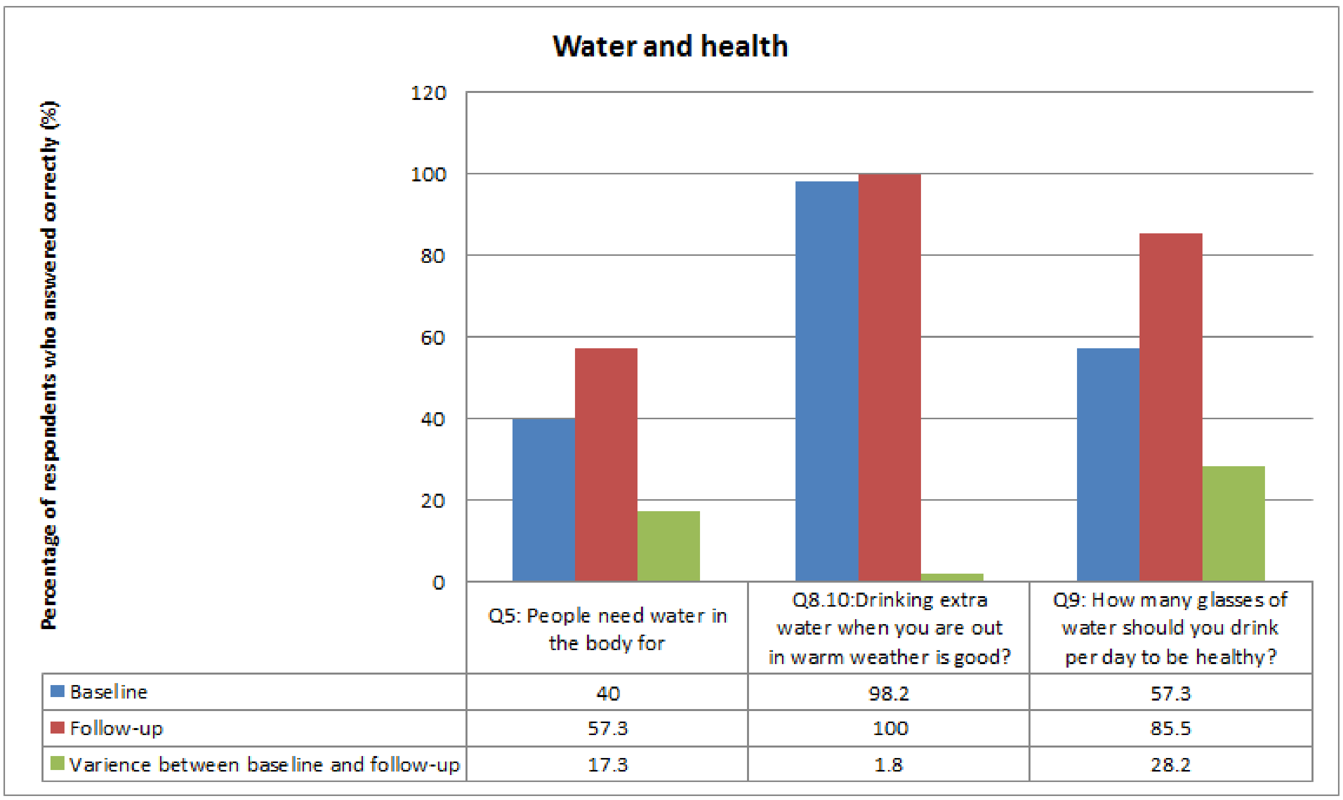
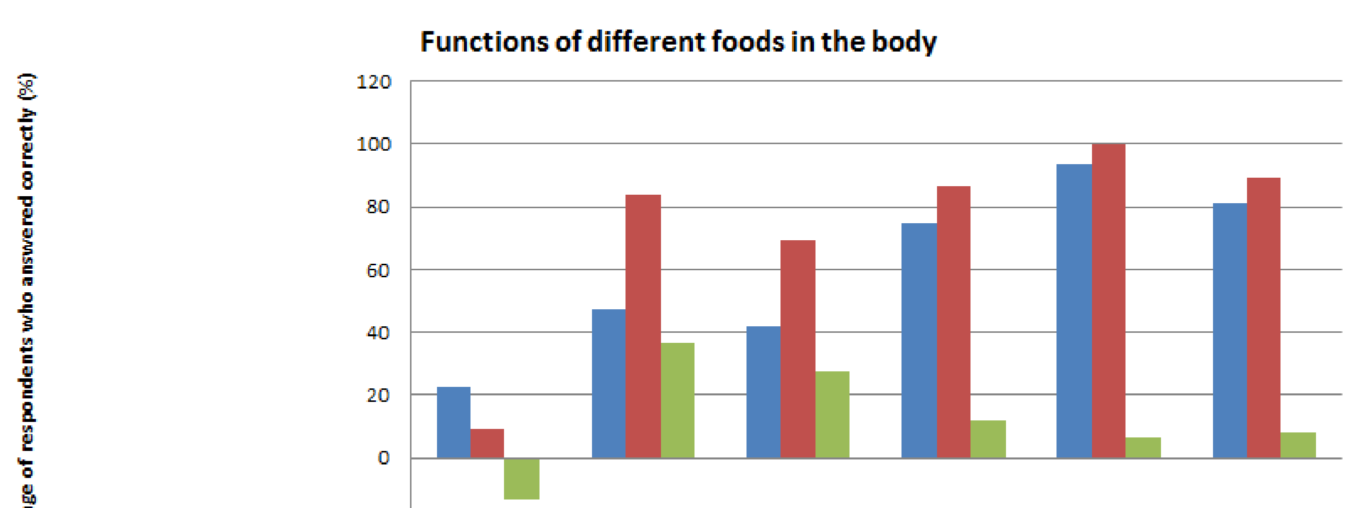


Figure 14 Nutrition knowledge scores of the elderly on water and health questions

4.5.4.3 Function of foods in the body

In questions 7.1, 7.2, 7.3, 7.4 and 7.5, the participants were asked what the main reason is for eating the different food items such as meat/chicken (Question 7.1) pap/rice (Question 7.2), milk (Question 7.3), vegetables (Question 7.4) and oranges (Question 7.5). The participants were to select the correct answer from the given food functions options, namely: gives energy, builds muscles, for strong teeth and bones, heals sores and protects against infections. Figure 15 shows the respondents' scores on the functions of different foods in the body. The results revealed that the elderly had poor knowledge of the functions of different foods in the body before the intervetion, with less than 50 percent of the respondents knowing the correct answer to 4 out of 6 questions before the education intervention. If we consider the results on macronutrients and micronutrients so far presented it is clear that the elderly respondents' knowledge of nutrients is poor as the functions of food are related to the nutrient content of the food. However, there was improvement in knowledge after the intervention in all the questions, with knowledge improving significantly in Questions 7.2 (p=0.005), 7.3 (p=0.003), 7.4 (p=0.012) and 7.5 (p=0.047). The results of the question on the main reason for eating vegetables (Question 7.4) revealed that the majority (more than 80%) of the elderly lacked the knowledge before the intervention and that even after the intervention the knowledge of more than 80 percent of the respondents was very poor. The results displayed in Figure 15 regarding the statement, "Fibre helps us to feel full" (Question 8.6) confirm that knowledge improved by 6.4 percentage points from 89.1 percent before the intervention to 95.5 percent after the SAEP (p=0.071).

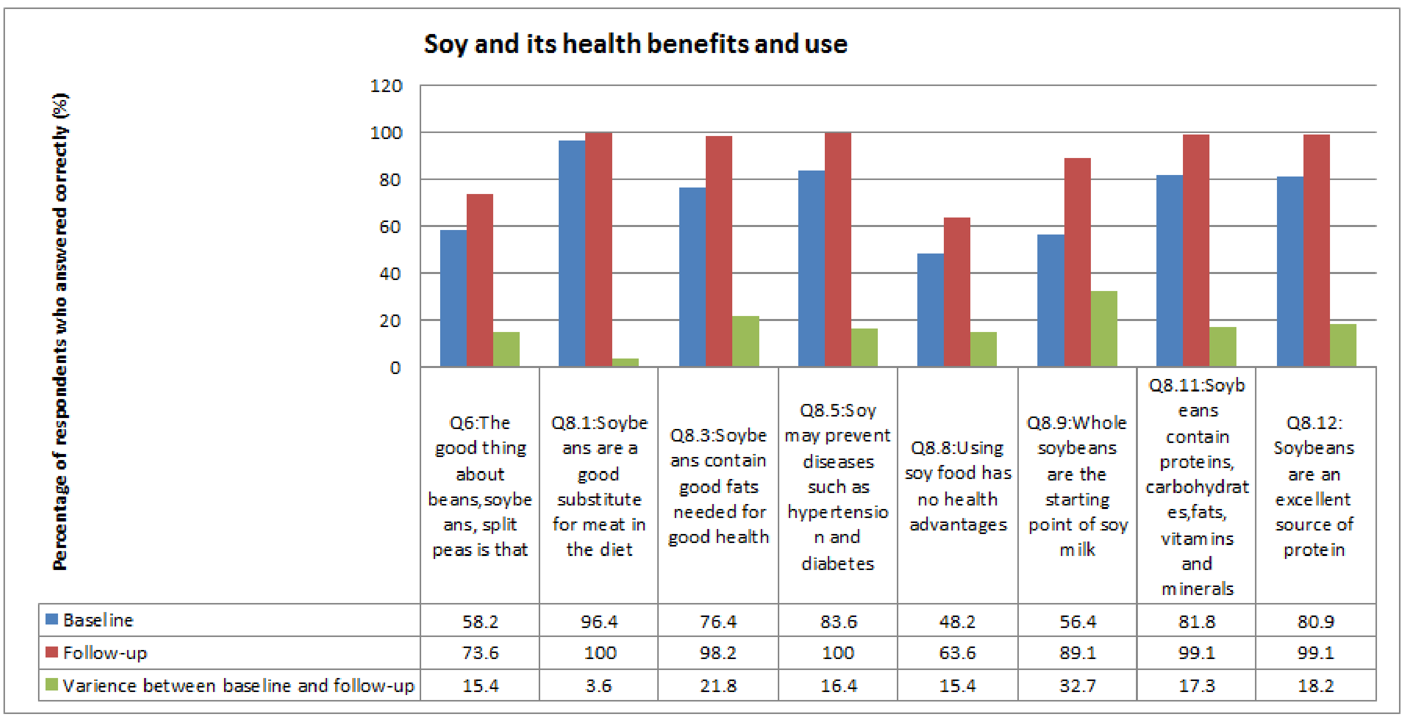


	Q7.1: What is the main reason for eating meat/chicken?	Q7.2: What is the main reason for eating pap/rice?	Q7.3: What is the main reason for drinking milk?	Q7.4: What is the main reason for eating vegetables?	Q7.5: What is the main reason for eating oranges?	Q8.6:Fibre helps us feel full.
Baseline	22.7	47.3	41.8	74.6	93.6	80.9
Follow-up	9.1	83.6	69.1	86.4	100	89.1
Varience between baseline and follow-up	-13.6	36.4	27.3	11.8	6.4	8.2

Figure 15 Respondents' scores on functions of different foods in the body

4.5.4.4 Soy and its health benefits and use

The results of the knowledge of soy, shown in Figure 16, revealed that knowledge of soy was low at pre-test. On the other hand, for all eight questions relating to soy and its health benefits and uses, the total number of correct answers improved from 72.7 percent at pre-test to 90.3 percent after the NEP, with an improvement of 17.6 percentage points which was the improvement was significant (*p*=0.000). The results indicate that the knowledge of the elderly improved significantly after the SAEP concerning statements such as 8.9 “Whole soybeans are the starting point of soy milk”, where the percentage of correct answers increased from 56.4 percent to 89.1 percent (*p*=0.000), 8.3 “Soybeans contain good fats” increasing from 76.4 percent to 98.2 percent (*p*=0.000), 8.12 “Soybeans are an excellent source of protein” from 80.9 percent to 99.1 percent (*p*=0.000), 8.5 “Soybeans may prevent hypertension and diabetes” from 83.6 percent to 100 percent (*p*=0.000) and “Soybeans contain proteins, carbohydrates, fats, vitamins and minerals” from 81.8 percent to 99.1 percent (*p*=0.000).



	Q6:The good thing about beans,soybeans, split peas is that	Q8.1:Soybeans are a good substitute for meat in the diet	Q8.3:Soybeans contain good fats needed for good health	Q8.5:Soy may prevent diseases such as hypertension and diabetes	Q8.8:Using soy food has no health advantages	Q8.9:Whole soybeans are the starting point of soy milk	Q8.11:Soybeans contain proteins, carbohydrates,fats, vitamins and minerals	Q8.12: Soybeans are an excellent source of protein
Baseline	58.2	96.4	76.4	83.6	48.2	56.4	81.8	80.9
Follow-up	73.6	100	98.2	100	63.6	89.1	99.1	99.1
Varience between baseline and follow-up	15.4	3.6	21.8	16.4	15.4	32.7	17.3	18.2

Figure 16 Results of knowledge of soy and its health benefits and use

The overall score of the knowledge of soy nutrition improved significantly (from 62.3% to 76.8%, *p*=0.000). Furthermore, correlations were drawn between knowledge and socio-demographic factors such as gender, age and educational level. In so doing, the possibility was created of relating the findings to the socio-demographic factors.

4.5.4.5 Correlation of knowledge and other variables

Pre- and post-scores of knowledge were correlated with gender and age but no significant correlations were found.

4.6 DISCUSSION

This study was designed to measure the knowledge and awareness of the health benefits of soy before and after application of the Soy Awareness Education Programme (SAEP) that was developed, tested and implemented for the elderly of Sharpeville based on the FAO framework. The target group participated in an exploratory study before the experimental study was implemented. This exploratory study was designed to assess the nutrition education needs of an elderly community of Sharpeville participating in a SAEP.

The findings in current nutrition knowledge according to the participants self-rating from the exploratory study revealed that both good and fair nutrition knowledge were reported high. The majority of the elderly had low educational attainment; the nutrition knowledge reported was to be expected among this elderly community of Sharpeville. The good and fair nutrition knowledge may be due to that the elderly have been exposed to some nutrition information since 2004, when the Vaal University of Technology (Centre of Sustainable Livelihoods [CSL]) partnered with the day-care centre; hence results indicate that the elderly obtained their nutrition advice from Vaal University of Technology (VUT) personnel as the main source and the sister at the local clinic as the second source.

In this study the majority of the elderly showed willingness to learn about nutrition and to participate in the nutrition education programme. One might expect willingness in this sampled group as they had been made aware during introductory visits that the Centre of Sustainable Livelihoods, with which the elderly are familiar are going to conduct a research. Previous researches have already been conducted in this centre by the CSL of the Vaal University of Technology. Collaboration had already been established for certain initiatives, and was reconfirmed or expanded or new agreements were established according to need. The results suggest that the involvement of experts from the VUT (dietician and public health nutritionist) or people with whom the elderly had good relationships can encourage the willingness and eagerness of the elderly to participate in nutrition education programmes. Similar findings have also been reported by Yassin & Seong (1995:49), where the elderly considered experts such as physicians as important sources of nutrition information and also rated them as the most reliable and trustworthy. It thus appears that people whom the elderly believe to be reliable and trustworthy in the community can and should play an important role in providing nutrition information.

From the findings of source of nutrition advice, although only a small percentage of the elderly in this study named churches as an information source, it may be necessary to use churches to reach vulnerable elderly people under circumstances of overcrowding of primary health facilities where the elderly obtain health information. Churches can be found in nearly every community. They can be a means of increasing awareness and knowledge of specific health practices, disseminating new knowledge and overcoming the potential limitation in the elderly of lower studying ability and eliminating the rigidness of their habits.

In terms of the nutrition education tool preferred and its design specifications, the elderly respondents preferred a nutrition calendar written in the Sotho language, with colour drawings for illustrations. Since calendars with nutrition information were designed by the CSL and made widely available for the elderly every year and contained easily read printed material providing an important source of nutrition information to this elderly group, a similar nutrition education tool with a similar design specification was identified as the preferred tool in this study. It seems that familiarity with printed material (a calendar) is very important in this group of elderly people in terms of the reliability and accuracy of nutrition information published. Similar findings have been reported in other studies regarding the elderly and their preference for printed or written materials as Schultz, Nothwehr, Hanson, Chrisman and Haines (2012:150) study indicated that the elderly preferred flyers, brochures or health newsletters. However, no studies have been found reporting on the use of calendars for nutrition information for the elderly. In a study by Yassin & Seong (1995:49), newspapers, as the most readily available printed material, were regarded by the elderly as an important source of accurate information published for public consumption. Furthermore, in a study conducted by Lee *et al*. (2011:4), the elderly revealed that the programme and material (booklet) used were motivating and appropriate. These results show that it is essential to assess suitable delivery methods and tools for older adults when planning and implementing a nutrition programme for the elderly as each group may favour different delivery methods and tools.

With regard to nutrition education topics preferred by the elderly for the SAEP, the findings revealed that the importance of topics for the elderly as a group varied (Table 5). Most of the topics, in order of importance, were related to nutrition and cardiovascular disease (nutrition and hypertension and nutrition and heart disease), osteoporosis, nutrition needs for the elderly and nutrition and diabetes. A possible explanation for this response may be that the group is likely to be suffering from some of these health conditions at the present moment; therefore inclusion of these topics in the NEP is viewed as a means to obtain health knowledge vital in addressing their current health status, and as a result, could yield positive changes in health status or possibly health behaviour, dietary behaviour and nutrient intake as well as nutritional risk level. Chamroonsawasdi, Phoolphoklang, Nanthamongkolchai and Munsawaengsub (2010:18) indicated that the highest predictive factor of health-promoting behaviour in an elderly person was currently having an illness.

On the other hand, the respondents were not keen to learn about obesity and overweight, diseases of lifestyle related to diet, HIV and AIDS and nutrition, exercise and nutrition and food and nutrient composition, the latter being the least important to them. The topic of obesity and overweight was rated number 8 out of the 14 topics. It could be suggested that the topic is viewed as of less health-related concern to the respondents as they may not perceive themselves as such. Venter, Walsh, Slabber and Bester (2009), revealed that in African communities in South Africa large body size is regarded as a sign of marital harmony, affluence and sufficient food supply. Many black women believe that having a big body (overweight) is desirable (Puoane, Bradley & Hughes 2005:92; Maloti-Mvalo & Puoane 2011:44).

A cross-sectional analytical study conducted by Prinsloo, Joubert, Mohale, Nyindi, Matu, Ntechane and Struwig (2011:370) reported that older women had a greater tendency to be obese than their younger counterparts. This inaccurate perception of body weight correlates with the participant’s level of education, with the least educated women showing the greatest difference between perceived and actual categories of BMI (Puoane *et al*. 2005:92). This belief about large body size is now compounded by the idea that being thin can be equated with HIV and AIDS virus infection (Puoane *et al*. 2005:92; Maloti-Mvalo & Puoane 2011:44). These perceptions may also be possible in this elderly community living in similar African communities practising similar cultural beliefs and also having low educational attainment. These factors could make it challenging to educate and motivate people to lose weight.

HIV and AIDS was also one of the topics that the elderly were not keen to learn about. Similar findings, where HIV and AIDS (sexually transmitted diseases) education was given a low rating by the elderly, have been reported by Green and Adderley-Kelly (2002:43). With most of the HIV and AIDS educational programmes in Africa directed at the younger generation and women of reproductive age (Wilson & Adamchak 2001:8), one may expect the elderly to have a low preference for learning about the topic and to perceive the topic as more relevant to the younger generation. The elderly are generally being neglected when it comes to HIV and AIDS owing to the many common conditions suffered by elderly that could disguise symptoms of HIV and AIDS (Spearman & Bolden 2005:51). In addition, the stigma attached to HIV and AIDS might discourage the elderly from learning about the topic, as, by showing interest, one may be stigmatised as being infected with HIV or having AIDS. On the other hand, Green and Adderley-Kelly (2002:43) are of the view that a great deal of information on HIV and AIDS is available in the media, and therefore the elderly may feel satisfactorily informed regarding this topic.

The topic on exercise and nutrition was also rated less important. The result could suggest that since the elderly participated in planned physical activities such as aerobics and walking on a weekly basis at the day-care centre, they may view the topic as a repetition of the physical activities conducted at the centre. In addition, limitation of their body fitness may discourage them from wanting to learn about the topic as they may associate physical activity with fatigue and perceive physical activity as targeted at young people and not relevant to older groups. Exercise can induce more of a feeling of fatigue in older people than in those who are young. Furthermore, lack of self-efficacy may also influence the rating of the topic as less important. Self-efficacy is defined as “one’s confidence in one’s ability to exercise or to become physically active” (Lambert, Bohlmann & Kolbe-Alexander 2001:S15). When considering results of a study conducted by Oldewage-Theron, Salami, Zotor and Venter (2008:7) on the same elderly group, only 14.5 percent reported heavy exercise/activity levels, 32.3 percent reported moderate activity, and 27.4 percent and 25.8 percent light or no excise/activity levels respectively, as measured by the validated physical activity questionnaire. These respondents can be considered as not very active; therefore it is likely that this group will have little interest in physical activity.

Results compiled by Lambert and Kolbe-Alexander (2006:26) on levels of physical activity in older adults in South Africa also revealed that seniors spent an average 2583 kcal/wk (±3027 kcal/wk) in physical activity, suggesting that physical activity levels decline with advancing age. This has also been well acknowledged in developed countries (Nied & Franklin 2002:419). A study by Chamroonsawasdi *et al*. (2010:17) on health-promoting behaviours found that exercise was one of the behaviours given lower priority (20.4%) by the elderly under the universal coverage scheme. On the other hand, considering that black people perceive large body size as a sign of marital harmony, affluence and sufficient food supply (Venter *et al.* 2009) and a feature that prevents one from being stigmatised as infected with HIV or AIDS (Matoti-Mvalo & Puoane 2011:44), this cannot motivate the elderly to engage in physical activity for fear of losing weight. Moreover, the lack of need of exercise and nutrition information by this elderly group may reflect the respondents' unawareness of the health benefits of exercise in preventing or reducing cardiovascular disease, which is the most important topic to the group.

Food and nutrient composition was indicated as the least important topic by the elderly in this study. Considering that the sampled group is a low-income group, where food procurement is managed as a survival strategy (Ballantine, Rousseau & Venter 2008:3), only what is needed is purchased and same type of food is always purchased to avoid waste owing to the unacceptability of any unusual food items (Dobson, Beardsworth, Keil & Walker 1994:12), there is a probability that nutrient composition becomes secondary in importance in constrained economic conditions, and hence is regarded as a less important topic. Similar findings, where food and nutrient composition was rated least important, was reported in the low-income female caregiver groups from Eatonside, Boipatong and Alexandra informal settlements in South Africa (Marumo 2009:134). The most important food product attributes influencing purchase choice in order of importance to the low-income caregivers was satiety value, affordability, taste, product acceptability, convenience/ease of preparation, household influence, appearance, value for money, product quality, packaging size, texture, product safety/shelf life, brand loyalty and, in last place, nutrient content (Marumo 2009:134). In addition, the low formal education attainment of the sample group may mean that they have no awareness or basic knowledge of the nutrient composition of food.

Regarding soy topics, although results indicated that the elderly are not familiar with soy, when considering only soy-related topics covered in this study, it is interesting that this group rated the health benefits of soy as the most important of the soy topics, followed by soy and its nutrients and lastly, soy and its different uses. It can therefore be inferred that the target group's rating of topics tends to be directed to health benefits addressing their current health status. There is sufficient evidence to indicate that results reported by the respective target group are in concurrence with Chamroonsawasdi *et al*. (2010:18), indicating that the factor most strongly predictive of health-promoting behaviour in an elderly person is having an illness. Having a present illness motivated the elderly to practise the health-promoting behaviour since doctors or health facilities were visited and proper treatment as well as knowledge or information on health-promoting behaviour was obtained from health personnel.

However, when looking at the results of the preferred topics in terms of gender (male and female) categories, important variations were established in the priority of interest among male and female respondents. Of the top five topics rated as important to by the respondents, male elderly expressed more interest in topics related to health promotion while female respondents were interested in topics related to disease. The need for health promotion topics by the male respondents may be a practical concern on how to have a healthy life and manage changes that accompany ageing. The interest of female respondents in topics related to diseases such as cardiovascular disease and osteoporosis may be due to the fact that respondents are suffering from these medical conditions and that they may not receive complete information about managing the condition through informed food choices. The low rating of the topic about soy and its different uses by male respondents is not surprising. This may be related to the possibility that male respondents perceive knowledge of use of food (food preparation) as more relevant to the females, as most food preparation and procurement decisions were the responsibility of the mothers and grandmothers in the households of this black community (Oldewage-Theron and Kruger 2008:111).

From the assessment of the needs of the elderly, a combination of pamphlets and lecturing methods was found to be suitable as NETs and was applied in the main experimental study (Soy Awareness Education Programme) leading to a suitable intervention, as confirmed by the positive feedback from the soy awareness education survey which will be discussed next.

A high response rate of 90.9 percent was obtained for the Soy Awareness Education study which may be as a result of partnership between the researchers and the elderly participants in the development of the message, media selection, nutrition education programme schedule and evaluation. The positive collaboration encourages continued participation in the NEP. The programme was based at the day-care centre with minimal interruptions to the weekly activities at the centre. The use of the centre also reduced barriers to participation, such as transport costs and interruption of daily activities, which would have posed a problem if the programme had been scheduled on other days when the elderly did not attend the day-care centre. Owing to this, only a small number of drop-outs (n=11) was experienced.

Kim, June and Song (2007:45) states that it is quite difficult to motivate an elderly group to participate actively in educational programmes because elderly people find it relatively difficult to understand the contents of the programme and may forget what they have learned more easily than other age groups. To overcome these specific difficulties, the nutrition education programme in this study, from planning to implementation, included the target group. As a result, suitable methods, tools and messages were developed according to the elderly group's specifications. Moreover, the presence of experts during the study played an important role of assuring the elderly of the quality of nutrition information provided to them. The exploratory study revealed that the involvement of experts or people with a good relationship with the elderly can encourage the willingness and eagerness of the elderly to participate in nutrition education programmes. The dietician and public health nutritionist are people with whom the elderly have long established a good partnership in research. A study by Kim, June and Song (2007:45) on the effect of nutrition education and exercise programmes on perceived dietary behaviours, food intake and serum lipid profile in elderly Korean women living in residential homes, also supports this view, revealing that positive knowledge change can be brought about effectively only when the interactions between the educator and subjects are long-lasting.

According to the results of the soy awareness study, the SAEP was found to be effective in increasing knowledge and awareness of soy and its health benefits. On average, the soy knowledge of the elderly sampled in this study can be rated as good. This corresponds well to the self-rated nutrition knowledge results reported for the exploratory study. The objective of the SAEP, which was to increase knowledge and awareness of the health benefits of soy products, was achieved and it is hoped that the knowledge will promote the use of soy among the elderly people living in Sharpeville as means to improve their nutritional status. It needs to be noted that in the exploratory study the majority of the elderly (98.7%) were willing to learn about nutrition. Considering that motivation is important for learning outcomes (Kostanjevec, Jerman & Koch 2011:249), the motivational level of having a disease will influence the development and changing of attitudes and behaviour of the elderly people to permanently maintain these new approaches. Since the consumption of a wide variety of food is considered a key component in the adequacy of a diet (Clausen, Charlton, Gobotswang & Holmboe-Ottesen 2005)), this was an opportunity to teach elderly people living under circumstances of low income how to include soy as an individual affordable food that includes three macronutrients and some micronutrients required for good health and provides unique nutritional health benefits. Soy can be of great importance in enhancing dietary diversity and addressing CDL, resulting in the improved nutritional status and well-being of the elderly.

Although the knowledge of soy has improved, some main domains covered in this study, such as macronutrients and micronutrients and functions of foods in the body, need more attention as the overall knowledge of the elderly of each main separate domain was low. The results revealed that the elderly had the highest overall knowledge for pre- and post- tests on soy and its health benefits and use, followed by water and health, then macronutrients and micronutrients, with low knowledge scores on the functions of foods in the body. However, it is of interest to note that the two domains (macronutrients and micronutrients and functions of foods in the body) of which the group had the least knowledge, are linked to the topic (food and nutrient composition) that they least wanted to learn about, as indicated in the needs assessment survey. This confirms that when participants lack interest in a topic, the educational intervention is not effective. This explains, therefore, the low knowledge in these domains. This finding is supported by Choi, Kim and Park (2007:139) who noted that a nutritional intervention may be more effective when participants have a high degree of interest in and awareness of their health status. Also memory challenge due to age and complexity of knowledge may have contributed to the low knowledge. This also indicates that nutrition messages should be food-based, rather than nutrient-based.

It was also observed that the elderly had difficulties in defining or understanding the nutrients, making it very difficult to apply the standards for identifying food according to its function in the body by the content of a particular nutrient. A possible explanation for this may be that the majority of the elderly had low educational attainment and no basic knowledge of nutrients since, when they were at school, there was no such subject as nutrition education in the curriculum; a decline in working memory as a result of ageing may also affect the ability to understand concepts such as nutrients. However, continuous implementation of basic nutrition knowledge to the elderly should enable them to comprehend the concepts of nutrients, as ageing is associated with increases in pragmatic intelligence, such as word meanings (vocabulary) (Salthouse 2000 quoted by Miller 2010:190).

The lack of knowledge of food and its nutrient composition or food and its function in the body can increase health problems such as insufficient intake of certain nutrients as a result of uninformed food choices. The researcher is of the view that the low intake of fruits and vegetables by this group as reported in chapter 3 and by Oldewage-Theron and Kruger (2008:116) might also be due to the lack of knowledge about the functions of fruit in the body, despite income challenges, as revealed by this study. Also, fruits may be difficult to eat by the elderly. A study with the aim of assessing fruit and vegetable consumption and the variables that influence it among the elderly in Iran showed that low consumption of fruits and vegetables by the elderly tended to increase with age, and that knowledge was associated with higher consumption (Salehi, Eftekhar, Mohammad, Tavafian, Jazayery and Montazeri 2010:6). This suggests a need for further investigation into the perceived benefits of food by the elderly in Sharpeville in order to gain insight into their knowledge and develop a suitable NEP to increase their knowledge.

However, it is interesting that the function of calcium in the body was well known by the elderly. This knowledge may be due to knowledge previously acquired from the osteoporosis educational programme that was conducted for the elderly of the day-care centre by Salami, a post-doctoral fellow in the CSL from Nigeria in 2004 (Unpublished data). It appears that the elderly can retain knowledge in other domains. A motivational factor such as desired health outcomes plays an important role in one’s ability to comprehend health information (Miller 2010:191). Although research states that working memory declines in later life, cognition models also recognise that ageing is associated with growth in pragmatic intelligence, general world knowledge and domain-specific knowledge such as nutrition or one's chronic disease (Salthouse 2000 quoted by Miller 2010:190). Therefore, greater accumulation of health knowledge among older adults may safeguard against age declines in health literacy. In this study, neither gender nor age influenced the knowledge level, as reported in the study of Hendrie, Coveney and Cox (2008:1369). The overall analysis of the SAEP for the elderly of Sharpeville showed improvement of knowledge after the intervention.

4.7 CONCLUSION

This study confirmed that a participatory approach with the elderly and their involvement in the development of nutrition education programmes is paramount in order to ensure that the message and media channel are relevant, meaningful and acceptable to them. This study has shown that the elderly were interested in knowing more about certain nutrition topics in order to address and maintain their current health status. There is a need to be creative and innovative in reaching the elderly, as channels such as calendars appear to appeal to these elderly people. Education with printed material has the potential to increase nutrition knowledge in elderly people, as evident in this study. The level of motivation of the elderly towards learning is crucial for learning outcomes, as revealed by this study. Factors such as gender differences, cultural aspects and social settings should be taken into consideration to develop an appropriate and effective nutrition education programme. Furthermore, grouping the elderly according to characteristics such as interest in health topic, gender or functional status may allow nutrition information to be more specific and the NEP to be more effective, allowing more attention to be paid to high-risk groups.

Based on the knowledge gained by the elderly, it is recommended that the soy dietary intervention should be implemented to enhance the beliefs about the value of eating these foods (Contento 2008:178) and also to address the CVD risk factors.

5
SOY-BASED INTERVENTION STUDY

5.1 INTRODUCTION

Older people are a proportion of the population that have special health needs and nutritional requirements. These needs and requirements arise from long-established dietary habits, a lifetime of different disease encounters and changes in body structure and metabolism (Risonar, Rayco-Solon, Ribaya-Mercado, Solon, Cabalda, Tengco & Solon 2009:2; Nowson 2007: S151). In Africa, fewer efforts are undertaken with regard to nutrition interventions for the elderly (Charlton & Rose 2001:2427S), although this population is increasing fast. The implication of the increasing elderly population is that it will soon become a significant health, social and economic concern of governments, if this is not already happening. In addition, the burden of disease in ageing individuals is expected to double when the elderly are exposed to low-income situations where the prevalence of under-nutrition and over-nutrition and their associated infectious diseases, as well as over-nutrition and the risks associated with chronic diseases of lifestyle, are common (Solomons 2001). Although research highlights the importance of preventative health strategies commencing in early life as likely to have the greatest effect on chronic disease, Nowson (2007:S150) states that significant reductions in morbidity and mortality can also be achieved through the adoption of healthy dietary practices in later life between 70 and 90 years.

A study conducted by Oldewage-Theron and Kruger (2008:8) on the impact of food aid on the food variety and dietary diversity of an elderly community in Sharpeville, South Africa, indicated that the prevalence of overweight and obesity decreased significantly by 13.1 percent at follow-up; in the same study, the prevalence of hypertension decreased by 10 percent among these respondents. Moreover, the mean serum cholesterol level was reduced from borderline risk to a normal level. This study showed that food aid with improved dietary diversity is necessary in reducing the risk of CDL in an elderly community. These results are a confirmation of the sentiments of Nowson (2007:S150).

However, low economic status makes the adoption of healthy dietary practices a challenge, leading to obesity, hypertension and high cholesterol levels which are associated with risk factors for CDL, all of which were shown to be prevalent in the elderly community of Sharpeville by the baseline study (Chapter 4) and by the studies of Oldewage-Theron, Salami, Zotor and Venter 2008 and Oldewage-Theron and Kruger (2008:8). It was confirmed that these elderly were poor with limited resources and access to food, resulting in household food insecurity and poor food choice and variety. This affected their nutritional status (Oldewage-Theron & Kruger 2008a:2). Low socio-economic status in the elderly might cause depression, often leading to malnutrition, which can induce various kinds of physical illness, resulting in a decline in dietary diversity, including food variety. Research indicates that improving nutrition is one of the most important approaches to lowering the levels of depression and that it can lead to improved mood and cognitive performance, particularly in elderly people (Mokhber, Majdi, Ali-Abadi, Shakeri, Kimiagar, Salek, Moghaddam, Sakhdari, Azimi-Nezhad, Ghayour-Mobarhan & Soluti 2011:68).

Although diversity in diets is a necessity for the achievement of balanced nutrient intake for optimal nutrition (Oldewage-Theron & Kruger 2008b:103), the portion sizes and number of portions served might be limited for older people, as is evident from the baseline study, and therefore not impact as much on nutrient adequacy. This was also observed by Oldewage-Theron & Kruger (2008b:116) with regard to milk intake, with 52.5 percent of the respondents consuming milk but the mean daily intake being small (67 g). Since the consumption of a wide variety of foods is considered a key component in the adequacy of a diet (Clausen *et al.* 2005) and because variety is difficult for elderly people with low income to achieve, soy, as an affordable individual food containing three of the macronutrients required for good health and providing unique nutritional health benefits, can be of great importance in enhancing dietary diversity and addressing CDL. Its use could bring about improved nutritional status and well-being in the elderly. This consideration therefore justified the need to target elderly people living under circumstances of poverty and chronic diseases of lifestyle with a soy intervention programme to address these problems.

This chapter covers stage 4: soy feeding intervention and stage 5: impact measurements of this entire study. Stage 4 was focused on analysing the nutritional content of the existing menu at the care centre in order to identify nutritional inadequacies [MTech study] (Tshivhase 2012). After determining the nutritional inadequacies and conducting a situation analysis, a soy intervention including 10 g of soy protein in the daily diet of the elderly was implemented for a period of six months. Compliance with study protocol with respect to soy consumption was then assessed, while soy intake and acceptability were assessed by the plate-waste method. Sensory analyses were partially conducted since preliminary sensory tests had already been conducted in a study by Tshivhase (2012).

In stage 5, the impact of the soy intervention on the nutritional status of the elderly was evaluated by comparing the dietary intake (24-hour recall), dietary diversity and food variety (DDQ) as well as the anthropometric and the biochemical results, before and after the intervention. The first section of this chapter describes the soy intervention conducted for the elderly of Sharpeville and then lastly, presents the impact measurements of the soy intervention on the nutritional status of the elderly.

5.2 DESCRIPTION OF THE INTERVENTION

5.2.1 Study design, study population and recruitment

A single-system design was applied in this study, which refers to the study of a single subject which can be an individual, a group or a community, on a repetitive basis (Strydom 2005:145). The single-system approach was chosen because it is an ideal way to evaluate the effectiveness of an intervention or the effects of manipulating an independent variable.

A total of 134 respondents who participated in the baseline study formed part of the intervention study. In order to determine a representative sample, the following power calculation (Gibson 2006:6) was used:

$$n = \frac{2 \text{ X } (u+v)^2 \text{ X } s^2}{E^2}$$

Where u = 1.28 corresponds to a ß for the test of 90% power;

v = 1.96 corresponds to a significance level of 95% for a two-tailed hypothesis;

E = the expected mean reduction in serum cholestrol level, set at 1.0 g/l for this study;

s = the standard deviation of the change in the nutrition status, assumed to be

2.2 for this study (as previously determined in this elderly community. In this intervention study a total of 102 respondents were needed to obtain statistically representative data.

The elderly respondents were further stratified into two groups based on the LDL-C levels at baseline [Chapter 3] (Hermansen, Hansen, Jacobsen, Clausen, Dalgaard, Dinesen, Holst, Pedersen & Astrup 2005:844; Jenkins *et al.* 2005) to determine the hypercholesterolaemic (≥3.0 mmol/L) and normocholesterolaemic (<3.0 mmol/L) groups. Ethical approval was obtained. Refer to Chapter 1 section 1.4.2 for more details in regard to ethical approval for this entire study.

5.2.2 Food product selection and preliminary sensory testing

5.2.2.1 Criteria applied to select the products

Because previous studies (Oldewage-Theron, Salami *et al.* 2008; Oldewage-Theron & Kruger 2008a) conducted in the same sample revealed a high prevalence of poverty, food insecurity, malnutrition and risk factors of CDL and because the results of the baseline study confirmed the findings of the previous studies, soy was identified in the literature as an affordable food item that will provide not only essential nutrients but also additional and unique nutritional health benefits that could be of importance in addressing the nutritional crisis in this population. The literature indicates that soybeans are the only legumes that contain complete protein. It contains all three of the macronutrients required for good nutrition, namely 38 percent protein, 30 percent carbohydrates and 18 percent fat. Soy is also described as rich in vitamins and minerals such as calcium, folic acid, iron, phosphorus, magnesium, thiamin and zinc. In addition, soy contains chemical substances such as phytoestrogens, which may confer significant long-term health benefits against the risk of CVD, and which are hypocholesterolaemic, anti-carcinogenic and hormone-altering. Soy is therefore the solution, not only to the high prevalence of poverty, food insecurity, malnutrition and risk factors for CDL, but also to osteoporosis and menopausal problems (Venter 1999:24).

5.2.2.2 Different food products identified for the intervention

In order to determine which soy food products to include in the intervention study, the elderly participated in an MTech study conducted by Tshivhase (2012), the aim of which was to develop, implement and evaluate a new menu that is cost-effective, nutritionally adequate and acceptable to the elderly people attending the day-care centre in Sharpeville. The care centre management requested a menu which had alternative protein dishes, and which included fish as well as legumes such as soy products, beans and lentils.

Owing to the limited financial resources of the Sharpeville care centre it was impossible to obtain and provide the elderly with all the soy foods that had been tasted during the MTech study. It was therefore decided that in this intervention the available soy protein products would be used. These included plain sweetened soy milk (prepared on site), Redi Re-charge (a high-protein, flavoured porridge drink referred to as soy soft porridge in this study), MannaPack™-Potato (fortified potato and soy protein meal pack referred to as soy instant mashed potatoes in this study) and whole soybeans. The products were provided by the Centre of Sustainable Livelihoods (CSL) of the Vaal University of Technology.

5.2.2.3 Preparation and preliminary sensory testing

The preparations and preliminary sensory testing of the food products to be included in this intervention were conducted as part of the MTech study (Tshivhase 2012). The contribution of the MTech study to this DTech study was the partial sensory analysis of some of the soy products. Firstly, the menu at the care centre was evaluated in terms of the amount and variety of protein dishes given to the elderly during lunch time. The menu was analysed on the Food Finder 3 software program developed by the Medical Research Council (MRC) and was based on the South African Food Composition Tables (Langenhoven, Kruger, Gouws & Faber 1991). Twelve protein dishes, which included soy, legumes, fish, beans and lentils, were chosen and tasted by the participants.

5.2.3 Preparations for the intervention

5.2.3.1 Equipping of production facilities

An iron container (Figure 17), donated by the Rotary Club of Vereeniging to the Sharpeville Care of the Aged, was used as the milk production facility and for storage of supplies. In the iron container the soy-cow machine, which was used for soy milk production, was installed by the manufacturer. The machine was purchased by the CSL of the Vaal University of Technology for the Sharpeville care centre. Electricity and water were also installed from the adjacent kitchen. The iron container was equipped with a variety of utensils and equipment necessary for soy milk production. Burglar-proofed door and windows were installed for the safety of the equipment and utensils in the container. The kitchen in the care centre was also used for preparation of soy soft porridge for breakfast and instant mashed potatoes for lunch for the elderly.

Figure 17 Iron container used as a facility for soy milk production

5.2.3.2 Training in preparation of soy food products

Since four soy food products (soy milk, whole soybeans, soy and potato mash and soy-based maize meal porridge) were identified and provided to the elderly to eat during the intervention, training was carried out to ensure the quality production of each food item. The researcher, volunteer food service workers and the elderly, were trained in the preparation of the different soy products as follows:

- **Soy milk**

All the volunteer food service workers and the MTech student (Joy Senoelo), who was also a trained fieldworker for the CSL, were trained by the manufacturer of the soy-cow machine in how to operate the machine and also how to produce soy milk. Safety measures and hygiene of the machine were also addressed during training. The researcher was trained by the MTech student in how to operate the machine, safety measures, how to produce the milk and the hygiene of the machine for a period of four months every week on Mondays, except the week of pension pay-outs. The milk produced during the training sessions was used by a registered food technologist (Cameroon) to conduct the chemical and shelf-life analysis of the soy milk at the

VUT laboratory, and the rest of the milk was used for sensory evaluation by the elderly. Table 34 shows the nutritional analysis of the soy milk (Duvenage, Oldewage-Theron, Egal & Medoua 2013:4).

Table 34 Macronutrient and energy content of soy milk (Duvenage *et al.* 2013:4)

Ratio[a]	Moisture(g/100g)	Soluble solids (g/100g)	Total Fat(g/100g)	Total Carbohydrate (g/100g)	Total Protein (g/100g)	Energy (g/100g)
1:4 (n=6)	82.15±33.96†	5.28±0.18‡	0.85±0.1§	1.52±0.09¶	1.45±0.05††	81.62†3.18‡‡
1:2 (n=4)	74.29±39.29†	7.31±1.85‡	1.27±0.07§	2.51±0 .07¶	2.31±0.03††	128.2†2.28‡‡

Authors' own construction

[a]Volume ratio rehydrated minced soybeans: water, for cooking of soy mash

Means in the same column with similar superscripts are different ($p \leq 0.05$)as reported by *t*-tests(equal variances not assumed) †,1.7995E-09;‡,1.8E-09; §,6.02E-05;¶,1.03479E-07;††,5.54E-10;‡‡,4.85662E-09.

- **Instant soy mashed potatoes**

The researcher demonstrated to the elderly how to prepare the instant potatoes for themselves at home. The demonstration was conducted in the centre's hall. Since the instant potatoes were also to be prepared for lunch for the elderly at the care centre, the researcher also demonstrated to the food service workers how to prepare, store and serve the soy-based potatoes. The nutritional analysis of the MannaPack™-Potato served during the intervention is displayed in Table 35 below.

Table 35 Nutritional analysis of MannaPack™-Potato

Product Name: MannaPack™-Potato (Fortified Potato and Soy Protein Meal pack)			
NUTRITION FACTS			
Serving size: ¼ cup (22g) (1/2 cup prepared)			
Amount per Serving			
Calories 80			Calories from fat 5
			% Daily value*
Total fat 0.5g			1%
Saturated fat 0g			0%
Trans fat 0g			
Cholesterol 0mg			0%
Sodium 90mg			4%
Total Carbohydrate 16g			5%
Dietary fibre 2g			9%
Sugars 1g			
Protein 3g			
Vitamin A 6%		Vitamin C 0%	
Calcium 6%		Iron 8%	
Vitamin D 20%		Vitamin E 6%	
Thiamin 6%		Riboflavin 8%	
Niacin 10%		Vitamin B6 15%	
Folate 15%		Vitamin B_{12} 15%	
Zinc 4%			
*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300 mg
Sodium	Less than	2,400mg	2,400 mg
Total Carbohydrates		300g	375g
Dietary Fibre		25g	30g

- **Whole soybeans**

To demonstrate to the elderly how to cook with soybeans as part of the intervention, soy demonstrations were held on 4 April 2011. The demonstrations were conducted by a food science specialist with assistance from the researcher and a fieldworker. The purpose of the soy demonstrations was to show how to cook the soy recipes using the ingredients readily available in the households of the elderly, as revealed by the situation analysis, so as to increase interest in soy. The elderly were given the soy recipe hand-outs (Annexure I) to follow during the demonstrations and to take home and share with the entire household. The nutritional analysis of dried, cooked soybeans is shown in Table 36 below.

Table 36 Nutritional analysis of soybeans, dried, cooked (Wolmarans, Danster, Dalton, Rossouw & Schőnfeldt 2010)

Product name: Soybean, dried, cooked Per 100g edible food					
Macronutrients	**Amounts**	**Minerals**	**Amounts**	**Vitamins**	**Amounts**
Moisture	62.6 g	Calcium	102 mg	Vitamin A	1 µg RE
Energy	784 kJ	Iron	5.1 mg	Thiamin	0.16 mg
Tot N	- g	Magnesium	86 mg	Riboflavin	0.29 mg
Protein	16.6 g	Phosphorus	245 mg	Niacin	0.4 mg
Plant protein	16.6 g	Potassium	515 mg	Vitamin B6	0.234 mg
Animal protein	0.0 g	Sodium	1 mg	Folate	54 µg
Fats	9.0 g	Zinc	1.15 mg	Vitamin B_{12}	0.0 µg
SFA	1.30 g	Copper	0.41 mg	Pantothenate	0.18 mg
MFA	1.98 g	Manganese	820 µg	Biotin	- µg
PFA	5.06 g			Vitamin C	2 mg
Cholesterol	0 mg			Vitamin D	0.00 µg
CHO	8.8 g			Vitamin E	0.35 mg
Total Fibre	5.1 g				
AdSu	0.0 g				
Ash	- g				

- **Soft porridge**

The soy soft porridge was a product that had previously been served to the elderly in the care centre. However, the researcher observed the preparation of the product by the food service workers to ensure that the prescribed procedures printed on the package on how to prepare the product were followed. The food service workers were instructed by the researcher not to serve soy soft porridge and soy instant mashed potatoes on the same day. The nutritional analysis of Redi-Recharge (soft porridge) is presented in Table 37.

Table 37 Nutritional analysis of Redi-Recharge (soft porridge)

Parameter ingredient	Nutritional profile (100g)	%RDA individuals >13yrs
Moisture (g)	8.0	[-]
Kilojoules (kJ)	1488.3	[-]
Protein (g)	18.5	33.21
Total fat (g)	9.3	[-]
Saturated fat (g)	0.7	[-]
monounsaturated fat (g)	1.4	[-]
polyunsaturated fat (g)	1.3	[-]
cholesterol (mg)	0.0	[-]
Total CHO (g)	50.0	[-]
Dietary Fibre (g)	7.0	[-]
Sugar (g)	10	[-]
Calcium (mg)	132.6	[-]
Iron (mg)	8.7	48.45
Magnesium (mg)	53.0	[-]
Phosphorus (mg)	175.7	[-]
Potassium (mg)	175.6	[-]
Sodium (mg)	21.3	[-]
Zinc (mg)	6.5	59.22
Copper (mg)	3.5	[-]
Iodine (mg)	0.0	[-]
Selenium (mcg)	0.0	[-]
Manganese (mg)	0.4	[-]
Vitamin A (RE)/(mcg)	534.9	59.43
Thiamine (mg)	0.5	39.05
Riboflavin (mg)	0.5	38.64
Nicotinamide (mg)	5.4	34.01
Vitamin B6 (mg)	0.1	8.25
Folic Acid (mcg)	71.7	17.94
Vitamin B 12 (mcg)	1.3	54.38
Pantothenic acid (mg)	0.4	7.29
Biotin (mcg)	3.5	11.79
Ascorbic acid (mg)	48.3	64.34
Vitamin D3 (mcg)	0.4	8.25
Vitamin E (mg/TE)	0.9	5.68

5.2.3.3 Sensory analysis

Sensory analyses were conducted during an MTech study. A total of 200 randomly selected elderly people participated in the sensory evaluation of the dishes. A validated sensory evaluation questionnaire (Kearney 2008:176) with hedonic scale was used for the evaluation. The questionnaire was administered by trained fieldworkers in one-on-one interviews with the elderly. The participants were assessed on the colour, texture, taste, smell and portion size of the food product and their preference for including the product on the menu. The sensory analysis of some of the soy products will be reported as for the study referenced. The compliance questionnaire (Annexure J) also included a few sensory questions and those results will also be presented.

5.2.4 Implementing the soy intervention

The soy intervention entailed the consumption by the elderly people of an average of 156 g daily of a soy-based product with an equivalent of 10 g of soy protein. The elderly were asked to consume 1 daily serving of either plain soy milk, soy soft porridge, soy instant mashed potatoes or cooked whole soybeans for seven days of the week for a period of six months. Table 38 below shows the daily consumption of different soy-based products, the place where the product was consumed and the amount of soy protein in grams contained in the product consumed on a specific day by the elderly of the Sharpeville day-care centre. The soy protein grams presented in Table 38 were calculated with reference to the nutritional analysis of the product (refer to Table 34; 35; 36 and 37).

Table 38 Daily consumption of different soy protein products by the elderly of Sharpeville day-care centre

Days of the week							
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Soy products	Soy mashed potatoes Or Soy soft porridge	Whole soy beans	Soy mashed potatoes Or Soy soft porridge	Soy milk	Soy milk	Soy milk	Soy milk
Place where the soy product was consumed	Day-care centre	Home	Day-care centre	Home	Home	Home	Home
Soy consumed per day per person in grams	150g soft porridge	60g	80g mashed potatoes	200 g	200g	200g	200g
Amount of soy protein in grams for a specific product per day	27.8g	10g	10.9g	4.62g	4.62g	4.62g	4.62g

The plain sweetened soy milk was produced at the day-care centre by the researcher and the two fieldworkers who voluntary assisted in their free time (Figure 18). The production of the soy milk was done during four days of the week: Sunday, Monday, Tuesday and Wednesday. On Sundays the soybeans were weighed and spread out to remove foreign matter. The beans were then washed and soaked overnight. A ratio of 3 to 4 cups of water for each cup of soybeans was required to soak the beans. A total of 12 kg of soybeans (24 kg of soaked soybeans) per day was required to produce 90 litres of soy milk.

On Monday morning, the beans that had been soaked overnight were drained and rinsed. Then the soy-cow machine was started up and the grinder cooker pressure release valves were tested according to the procedures in the operation manual of the machine before batch processing started for the day.

After the start-up and testing procedures had been performed, the soy milk production took place as per the instructions. While the machine processed each batch of milk (45 minutes), the researcher washed the 1-litre bottles that were used for packaging the milk for the elderly. Because the container had not been equipped with washing sinks, the care centre's kitchen sinks were used for the washing of the bottles. The processed soy milk in the soy-cow machine was drained into the 20-litre buckets (see Figure 18) which were stored in the walk-in refrigerator at the care centre's kitchen to be packaged the following day into individual 1-litre bottles. Procedures for shutting down the soy-cow machine were completed every evening before stopping work. Large plastic bowls were used for washing parts of the machine. Another 12 kg of beans were soaked before stopping work, as preparation for Tuesday's soy milk production.

On Tuesdays the same procedures that had been performed on Mondays to produce the milk were repeated, and while the machine was processing each batch of milk the researcher manually packaged the milk produced on Monday into the individual 1-litre bottles and stored them in the shelves in the refrigerator (Figure 18). The milk was sweetened with a small amount of sugar. Since only five 20-litre buckets were available for storing the milk, the packaging of the milk into bottles had to be done early on Tuesday mornings to allow the researcher to re-use the buckets for production on Tuesdays and also to create space in the walk-in refrigerator. The milk produced on Tuesday was stored in the refrigerator and packaged on Wednesday morning, making a total of 180 litres of milk to be given to ±170 elderly. A total of 24 kg of dry whole soybeans was used to produce 180 litres of soy milk per week. The milk was distributed to the elderly on Wednesdays at 12:00 with the assistance of elderly monitors and the management (Figure 18). A control list with the names of the elderly was used to hand out the milk; this list was also used to monitor the receiving of empty bottles and to identify the elderly who participated fully during the intervention. The elderly were constantly reminded of the health benefits of eating or drinking soy products, as explained during the pilot study (Soy awareness education programme) so as to encourage the consumption of the soy food products.

Figure 18 A collage of soy milk production and distribution

Initially, a total of five hundred empty 1-litre bottles were purchased by the CSL for the packaging of soy milk and every week 180 bottles were to be used for the milk. In order to be able to continue giving the elderly soy milk, the researcher and the elderly had to exchange those bottles every week. The researcher gave each respondent a bottle of milk to take home and the respondent had to give the researcher an empty bottle to use for the following week. The elderly were asked to consume one daily serving of soy milk (250 ml/200 g) for four days of the week: Thursday, Friday, Saturday and Sunday (the days that the elderly do not attend the day-care centre).

There was one week each month when the elderly did not attend the day-care centre owing to pension pay-outs. It was therefore decided to give them a pack of instant soy mashed potatoes to eat at home during the pension pay-out week. The pack of soy instant mashed potatoes was given to them a week before the pension pay-outs and they were asked to consume one serving (80 g) of the soy mashed potatoes daily during that week. The potatoes were also served at lunchtimes at the day-care centre on Mondays or Wednesday, alternating with the soy soft porridge. See Figure 19: instant soy mashed potatoes served to the elderly during the intervention.

Figure 19 Instant soy mashed potatoes served to the elderly during the intervention

The soy soft porridge was prepared for the elderly by the food service workers on Mondays or Wednesdays for breakfast (Figure 20 Soy soft porridge served to the elderly during the intervention). The elderly were accustomed to the soft porridge since it had previously been served in the care centre. The food service workers were instructed by the research not to serve the elderly the soy soft porridge and soy instant mashed potatoes on the same days.

Figure 20 Soy soft porridge served to the elderly during the intervention.

Whole soy beans were also consumed by the elderly during the intervention. About 180 small packets of 400g of whole dry soy beans (Figure 21) were packaged by the researcher in plastic bags for the elderly to take home to cook and eat on Tuesdays when they did not attend the day-care centre. The elderly were instructed to soak about ¼ cup (63 ml) of dry soy beans and grind or mince them before cooking in any dish they prepared for themselves on Tuesdays. It was anticipated that 1 cup (250 ml) of dry soy beans would make about 3 cups (750 ml) of soaked cooked beans; 1 cup of cooked soy beans is equivalent to 75 grams. The respondents had to consume ¾ cup (189 ml) which is equivalent to 56.7 grams of cooked soy beans.

Figure 21 Packets of whole soy beans given to the elderly during the intervention

Participants were instructed to main their usual dietary habits and level of physical activity throughout the study. Cooking with soy, using ingredients readily available in the household, was demonstrated for the elderly during the soy demonstrations. During the intervention, one week was allocated for the assessment of study protocol with respect to soy consumption, using a soy compliance questionnaire that was compiled by the researcher. During that week the elderly were provided with instant mashed potatoes to eat since the researcher was also involved in the data collection and therefore could not produce the milk. Compliance as applied in this study will be described in detail in section 5.7: Management of the intervention.

5.2.5 Provision of supplies

All the soy food products used for the intervention, namely the soybeans, soy soft porridge and soy instant mashed potatoes as well as sugar and salt were provided by the Centre of Sustainable Livelihoods (CSL) of the Vaal University of Technology. The researcher informed the CSL of the level of stock a month in advance to allow for the processing of orders and payment of the suppliers. The goods were received from the suppliers and delivered at the care centre and stored in the production container.

5.2.6 Management of the intervention

5.2.6.1 Quality and portion control of the food products

To enhance the quality and portion control of the soy products given to the elderly during the intervention, the researcher was involved in the entire process of soy-milk production, namely the production of the milk, washing of milk bottles, packaging and storing milk and distribution of the milk to the elderly. Every week, two 1-litre packages of the soy milk were stored in different places – the refrigerator and a cool dry place – as a means of observing the shelf life of the milk and to also to use the milk as proof to the respondents if there were any complaints about the milk being spoiled.

The researcher controlled the production of the soy instant mashed potatoes and soy soft porridge and addressed any discrepancy observed during the preparation of the products. The food service workers were trained in how much of the soy instant mashed potatoes and soy soft porridge to serve (portion size) to the elderly. The researcher also weighed the whole soybeans given to the elderly into 400 g portions. A control list containing the names of the respondents was used in the distribution of the milk, instant potatoes and whole beans. Portion sizes consumed at home were not monitored by the researcher, but the researcher relied on the respondents to comply. However a compliance questionnaire was to be used by the researcher during the study period to assess if study protocol was followed in terms of portion sizes.

5.2.6.2 Compliance with study protocol with respect to soy consumption

On the fifth month of the intervention, compliance with study protocol with respect to soy consumption was assessed using a soy compliance questionnaire (Annexure J). The questionnaire was administered by trained fieldworkers who completed the individual questionnaires by means of one-on-one personal interviews with the elderly. Health problems experienced by the elderly during the intervention were recorded (Oshiro, Maskarine, Petitpain, Hebshi & Novotny 2004:205).

5.2.6.3 Plate waste method

To evaluate the acceptability and intake of the soy products served to the elderly at the care centre, a plate waste method was conducted. In this study, plate waste is expressed as the portion or quantity of edible food served to the elderly that is not eaten after breakfast and lunch at the day-care centre. The food service workers counted and prepared the required packets of soft porridge and mashed potatoes for the day and portioned them during serving as explained by the researcher. One plate of food was set aside for weighing and recording of portion sizes served to the elderly. Any remaining leftovers on the plates after breakfast and lunch were to be measured. Plate waste is a well-known reason for food loss at food service and consumer level. It is unreasonable for one to expect that plate waste could be eliminated in any food service owing to day-to-day variations in appetite and energy needs and in the tastes and preferences of individuals (Buzby & Guthrie 2002).

5.3 MEASURING INSTRUMENTS AND DATA COLLECTION BEFORE AND AFTER THE INTERVENTION

The pre-test measurements were conducted during October and November 2009 (baseline study) before the intervention began. As soon as the six months of the soy-based intervention was completed, the post-test measurements were conducted (21 November 2011). To increase complete data collection from the respondents, a fieldwork control form was used on the day of data collection (Annexure C). The purpose was to ensure that all the respondents completed all the required activities at each of the stations set as shown in Figure 22: Collage of different activities of data gathering for post-test measurements. Three stations were set up to accommodate the three different activities of data collection, namely:

- Station 1: Handing out files with questionnaires
- Station 2: Anthropometry measurements (weight, height and waist)
- Station 3: Biochemical measurements (Venous blood samples) and hypertension measurements

The completed questionnaires and the files were returned to station 1, where the researcher double-checked that all measurements had been completed.

Figure 22 Collage of different activities of data gathering during post-test measurements

5.3.1 Soy compliance questionnaire

The soy compliance questionnaire (Annexure J) was compiled by the researcher. The questions were guided by the study protocol and demonstrations to the elderly regarding soy consumption, together with necessary advice from the promoter, who is also a dietician (content validity). Data were collected by fieldworkers in one-on-one interviews with the elderly. Health problems experienced by the elderly during the intervention were recorded on the questionnaire. A limited number of sensory questions were included in this compliance questionnaire, since the sensory analyses had already been conducted by means of a validated sensory evaluation questionnaire with hedonic scale during an MTech study (Kearney 2008:176). The sensory analysis of some of the soy products will be reported as for the study referenced, as well as the current study.

5.3.2 24-hour recall questionnaire

The same 24-hour recall questionnaire (Annexure D) that was used for the pre-measurements was administered and same procedures were followed as described in Chapter 4 (baseline study).

5.3.3 7-day Dietary diversity questionnaire

The 7-day dietary diversity questionnaire (Annexure E) used during the baseline study was also used for assessing dietary intake after the soy intervention. The protocol applied during the baseline study was also followed during the collection of the post-test measurements.

For the completion of the questionnaires (24-hour recall and 7 day dietary diversity questionnaire) which were inside the files, the trained fieldworkers followed respondents to their respective seats in the hall.

5.3.4 Anthropometric measurements

The same procedures applied during the baseline study were followed for the anthropometric (weight, height and waist circumference) measurements of the intervention study.

5.3.5 Hypertension

Blood pressure measurements were conducted by qualified nursing sisters. The same procedures were followed as described in Chapter 4 (baseline study).

5.3.6 Biochemical measurements

The biochemical measurements were conducted by qualified nursing sisters and a registered medical technologist. The same techniques were applied for biochemical measurements as in the baseline study.

5.4 DATA ANALYSIS

For all the parameters measured in this study, namely dietary intake, anthropometric, hypertension and biochemical measurements, a comparison was drawn between the results of the baseline and follow-up studies and also between the hypercholesterolaemic and the normocholesterolaemic group. Data were analysed on the statistical package for social sciences (SPSS) version 21.0. Descriptive statistics were determined for the two studies (baseline and follow-up) and for the two groups (hypercholesterolaemic and normocholesterolaemic). Two-tailed independent t-tests were conducted to determine significant differences (p=<0.05) between the two sub-groups hypercholesterolaemic and normocholesterolaemic at baseline or follow-up. Paired t-tests were used to determine significant differences (p=≤ 0.05) within groups (hypercholesterolaemic or normocholesterolaemic) before and after the intervention.

5.4.1 Soy consumption compliance

The data for the compliance questionnaire were captured in a prepared Excel spreadsheet. Statistical analyses were performed using SPSS version 21.0. Frequencies were determined for all items for descriptive purposes.

5.4.2 Plate waste

Plate waste was measured by weighing the amount of food remaining on the plates, with results presented as percentage by weight of the served amount of food.

5.4.3 Dietary intake measurements

5.4.3.1 24-hour recall

The data from the dietary recalls were analysed by a registered dietician using the Food Finder® version 3 program, developed by the MRC 2004 and based on SA food composition tables. Nutrient intakes were exported from Food Finder® to an Excel spreadsheet and analysed by SPSS version 21 for descriptive statistics (means and SDs). Comparisons were made of the results between the baseline and follow-up studies and also hypercholesterolaemic and normocholesterolaemic groups. Percentages of energy intake were compared with the FAO/WHO guidelines and nutrient intakes were compared with the EAR and AI levels for those nutrients without an EAR for the elderly people ≥70 years old.

The Top 20 list of most frequently consumed food items was calculated both on frequency of consumption as well as mean daily intakes (g) (Oldewage-Theron & Kruger 2008b:3) for the studies (baseline and follow-up) and the groups (hypercholesterolaemic and normocholesterolaemic). Comparisons were drawn between the studies and the groups.

5.4.3.2 Dietary diversity and food variety

The same protocol applied to dietary diversity and food variety analysis during the baseline study was followed in the follow-up study (refer to chapter 3). Food variety score and FGDS were calculated before and after the intervention.

5.4.4 Anthropometric measurements

Anthropometric measurements were captured by the researcher on Microsoft Excel spreadsheet. The SPSS for Windows version 21.0 program was used for analysis. The procedure applied during the baseline study was also used during the analysis of the anthropometric (weight, height and WC) and hypertension measurements in the follow-up study.

5.4.5 Hypertension measurements

The same protocol applied during the baseline study for blood pressure measurements was applied in the follow-up study.

5.4.6 Biochemical measurements

The same protocol applied for analysis during the baselines study was followed for the follow-up study.

5.5 RESULTS

5.5.1 Drop-outs

The results in Table 39 indicate that a total of 65 elderly people did not complete the follow-up measurements after the soy intervention owing to lack of turn up from the elderly during the measurement phase and also incomplete data set were other measurements such as blood samples were not taking because of fear of needles and ethics of voluntary participation was followed and these measurements were therefore eliminated from the results. This resulted in poor compliance to the completion of the study. Although a provision was made for drop-outs by including an extra 32 respondents, a total of 33 drop-outs were observed for the intervention study, giving the statistically required sample of 102. Baseline parameters of participants compared with those lost to follow-up indicated that a significant ($p \leq 0.05$) difference between the drop-outs and the participants was shown only for serum homocysteine. Therefore it was assumed that if the drop-outs had completed the study they would not have made a significant contribution to the results of other serum lipids. However, the results to follow on homocysteine will provide clarity on the significant differences observed here.

Table 39 Baseline parameters of participants compared with those lost to follow-up and thus excluded from the study results

Baseline variables	Participants (n=69) (mean±SD)	Drop-outs (n=65) (mean±SD)	*p*-value
Total cholesterol (mmol/L)	4.95±1.02	5.14±1.18	0.319
LDL-C (mmol/L)	3.46±0.97	3.68±1.18	0.231
HDL-C (mmol/L)	0.74±0.41	0.73±0.31	0.891
Triglycerides (mmol/L)	1.65±0.88	1.59±0.73	0.679
Serum Vitamin B_{12} (pg/mL)	612.39±296.25	615.63±292.91	0.949
Serum folate (nmol/L)	9.55±4.78	8.22±4.94	0.116
Serum homocysteine (µmol/L)	15.61±5.28	18.77±11.88	0.047

Values are means with 95% confidence interval; Significance at $p=\leq 0.05$

Since a single-system approach was chosen to evaluate the effectiveness of an intervention (Strydom 2005:145), firstly, a comparison of the findings of the baseline study (n=69, drop-outs excluded) and the follow-up study (n=69) is presented. Secondly, to provide deeper insight into the effect of soy on the risk factors for CVD and nutritional status of the elderly, the findings are also reported according to hypercholesterolaemic and normocholesterolaemic groups, as the elderly were stratified based on their LDL-C levels at baseline (Hermansen *et al.* 2005:844; Jenkins *et al.* 2005). Only a complete data set with baseline and follow-up measurements (n=69) was used to report the results for hypercholesterolaemic and normocholesterolaemic groups.

Based on the baseline study reported in Chapter 3, (n=134), 76.1 percent (n=102) of the respondents were hypercholesterolaemic and 23.9 percent (n=32) were normocholesterolaemic.

Furthermore, of the complete data set for this chapter (n=69), with the respondents stratified based on their LDL-C level, 72.5 percent (n=50) of the sample was hypercholesterolaemic and 27.5 percent (n=19) was normocholesterolaemic. The sample for the hypercholesterolaemic and normocholesterolaemic groups is similar to that for the baseline study (chapter 3), in which more than 70 percent of the respondents were hypercholesterolaemic and more than a third of the respondent's normocholesterolaemic. Therefore the presence of the key subgroup within the sample was ensured.

5.5.2 Compliance, sensory and plate waste results

The results in Table 40 below indicate that the majority of the elderly adhered to the study protocol with respect to consumption of the soy products offered during the intervention. The highest adherence in terms of consumption of the product at home was to soy milk (n=75, 63%) in which the procedure required consumption of at least one cup of soy milk per day. The majority of the respondents followed the prescribed frequency of intake of soy milk at home of 2–4 days of the week (n=98, 82.4%). However, the majority of the elderly did not comply with the instructions given for consuming the whole soy beans and the soy mashed potatoes at home. Although the instruction for consumption of soybeans was that the beans should be eaten every Tuesday at home (4 times a month), only 7.6 percent of the elderly complied (4–6 times per month). Since the mashed potatoes given for home consumption was to be eaten during pension pay-out week only, 4.2 percent of the sample reported that they ate soy mashed potatoes daily. For the products that were served at the centre for breakfast and/or lunch, namely soy soft porridge and soy mashed potato, the majority of the respondents, 74.8 percent and 95.8 percent respectively, indicated that they had consumed the product. However it appears that many of the elderly were focusing on the intake of the soy-based food product, but did not consider the portion size. For example, only 32 respondents (26.9%) consumed a large serving spoon (80 g) of soy mashed potato per day during the pension pay-out week, as instructed. Moreover, some of the elderly pointed out that they had difficulties in grinding the soy beans and that the beans took long to cook. However, different types of dishes were prepared using soy beans, namely soup, plain boiled soy beans, a dish containing samp and beans, and beans mixed with beef stew, cabbage or spinach. Of these dishes prepared using soy beans, soup and plain boiled beans were popular dishes consumed by 39.5 percent and 22.7 percent of the elderly respectively.

The most prominent benefit of using the soy food products, as reported by these elderly people, was that they felt more energetic (n=60; 50.4%) after eating the soy product, followed by the benefit of experiencing no more problems with bowel movement (n=38; 31.9%). About 75 percent of the elderly indicated other different advantages of using soy products, such as reduced BP at check-up at the clinic, improved appetite, good satiety value, no pains in the body (knees, bones and headaches), weight gain, reduced ulcers and no feeling of constipation. Only eight (6.7%) respondents indicated that there were no advantages to using the soy products. Almost all of the elderly respondents (95%) indicated that if soy were no longer provided by the centre, they might buy it for themselves if it is affordable. Reasons such as being aware of the health benefit of reduced BP, the provision of good health and energy by soy, fondness of the taste of soy and knowledge of its nutrient composition were mentioned as reasons for buying soy for themselves. As regards the side-effects of soy, 80.7 percent (n=96) of the elderly had no side-effects. However, small numbers of the elderly reported side-effects such as constipation (n=15; 12.6%) followed by diarrhoea (n=3; 2.5%), bloating (n=2; 1.7%) and others (ulcer and heartburn) in a total of 2.5 percent (n=3) of respondents.

Table 40 Compliance with study protocol with respect to soy consumption by the elderly (n=119)

Variables	n	%
Frequency of intake of soy milk at home		
Daily	4	3.4
2-4 days of the week	98	82.4
5-6 days of the week	17	14.3
Every day of the week	0	0
Never	0	0
Amount of soy milk consumed per day		
1 litre	2	1.7
A sip	0	0
Half a cup	36	30.3
One cup	75	63
Two cups	6	5.0
Do you always eat mashed potatoes when served in the centre?		
Yes	114	95.8
No	5	4.2
Frequency of intake of soy mashed potato at home		
Daily	5	4.2
2-4 days of the week	52	43.7
5-6 days of the week	30	25.2
Every day of the week	10	8.4
1-3 times per month	6	5
4-6 times per month	1	0.8
Never	14	11.8
Amount of prepared soy mash consumed per day at home		
1 tablespoon	3	2.5
2 tablespoons	34	28.6
A large serving spoon	32	26.9
1 cup	30	25.2
>1 cup	4	3.4
Do you always eat soy soft porridge when served in the centre?		
Yes	89	74.8
No	29	24.4
Frequency of intake of soy beans at home		
Daily	8	6.7
2-4 days of the week	16	13.4
5-6 days of the week	19	16
Every day of the week	5	4.2
1-3 times per month	49	41.2
4-6 times per month	9	7.6
Never	10	8.4

Table 40 (cont.) Compliance with study protocol with respect to soy consumption by the elderly (n=119)

Variables	n	%
Dishes cooked using soy beans		
Plain boiled beans	27	22.7
Boiled beans and samp	13	10.9
Beans mixed with beef stew	17	14.3
Beans mixed with cabbage and/or spinach	14	11.8
Beans mixed with minced meat	7	5.9
Boiled beans as snack	2	1.7
Soup	47	39.5
Other dishes	6	5
Advantages of using soy		
Feeling more energetic	60	50.4
Less meal preparation time	2	1.7
No more bowel problems	38	31.9
Others		
Side-effects of soy		
Bloated	2	1.7
Diarrhoea	3	2.5
Constipation	15	12.6
Allergy	0	0
None	96	80.7
Others	2	1.7

For the sensory results, Table 41 shows that the taste of the soy product was liked a lot by majority of the elderly people, with milk liked a lot by 95 percent of the elderly, followed by soy mashed potato (84.9%) and soy soft porridge (62.2%) in third place. The majority of the sample also indicated that they liked the colour of the soy milk a lot (98.3%). From the MTech study (Table 42) soy mince was used to prepare soy cabbage stew, soy pasta, soy spinach cakes and soy cottage pie. The taste and texture of soy cabbage stew were liked a lot by 83.7 percent of the respondents. In addition, the colour, smell and portion size of the soy cabbage stew was liked a lot by 87.8 percent, 73.7 percent and 75.5 percent of the respondents respectively. As regards the soy pasta dish, the majority indicated that they liked the taste (83.7%), texture (73.5%), colour (69.5%) and smell (71.4%) a lot. The sensory results of the soy cottage pie dish indicated that taste (87.8%), texture (71.4%), colour (87.8%) and smell (91.8%) were liked a lot by the majority of the respondents.

Table 41 Sensory results of the elderly for soy products (n=119)

Variables	Like a lot	Like a little	Dislike a lot
Soy Milk			
Taste	113 (95)	4 (3.4)	1 (0.8)
Colour	118 (99.2)	0 (0.0)	0 (0.0)
Soy mashed potatoes			
Taste	101 (84.9)	14 (11.8)	3 (2.5)
Soy soft porridge			
Taste	74 (62.2)	16 (13.4)	28 (23.5)
Part of menu	76 (63.9)	14 (11.8)	28 (23.5)

Table 42 Sensory results of the elderly for soy products (n=200) (Tshihvase 2012)

Variables	Like a lot	Like a little	Neither like nor dislike	Dislike a little	Dislike a lot
Soy cabbage stew					
Taste	83.7	8.4	7.9	0	0
Texture	83.7	14.3	0	0	0
Colour	87.8	26.5	6.1	2	0
Smell	73.7	18.4	10.6	0	0
Portion size	75.5	20.4	4.1	10.2	12.2
Part of menu	70.9	20	5	4.1	0
Soy pasta					
Taste	83.7	14.3	2	0	0
Texture	73.5	26.5	0	0	0
Colour	69.5	26.5	2	2	0
Smell	71.4	18.4	10.2	0	0
Portion size	20.4	44.9	12.2	10.3	12.2
Part of menu	85.7	6.1	4.1	4.1	0
Soy spinach cake					
Taste	77.6	14.3	2	6.1	0
Texture	73.5	18.4	2.1	2	4
Colour	73.5	18.4	4.1	0	4
Smell	63.3	0	10.2	2	6.1
Portion size	36.7	32.7	8.2	4.1	18.3
Part of menu	73.5	10.2	4.1	4	8.2
Soy cottage pie					
Taste	87.8	28.6	0	0	0
Texture	71.4	12.2	0	0	0
Colour	87.8	10.2	0	2	0
Smell	91.8	8.2	0	0	0
Portion size	65.3	26.5	2.1	4.1	2
Part of menu	89.8	8.2	0	2	0

For the plate waste results, plates that were collected after breakfast and lunch had no waste. However, the researcher did observe on one occasion during lunch that four of the elderly people were not eating but taking the food away in personal containers. When the researcher asked why they were not eating, they indicated that they were feeling full at that moment but that they would eat the rest in the evening at home.

5.5.3 Dietary intake nutrient analysis and top 20 food items

The dietary intake nutrient analyses as reported by the median of the 24-hour recall for baseline and follow-up studies are presented in Table 43 below. Only four nutrients (dietary fibre, vitamin B_6 and B_{12}, and folate) had increased intakes after the intervention, but still did not meet the EAR. For one of these nutrients, namely folate, the increased intake from baseline to follow-up was statistically significant (*p*=0.0001). In both baseline and follow-up studies the median carbohydrate intakes were higher than EAR. Macronutrient distribution at baseline indicated a balanced diet of 52.9 percent carbohydrates, 19.1 percent protein, and 27.3 percent fat; in the follow-up study a balanced diet was also achieved, comprising 57.4 percent carbohydrates, 17.1 percent protein and 24.7 percent total fat, as compared to the acceptable macronutrient distribution range of 45–65 percent of carbohydrates, 10–35 percent of protein and 20–35 percent of fat (Gibson 2005:208). The median±SD energy intake for both baseline and follow-up were low when compared with the Estimated Energy Requirements (EER), with energy intakes decreasing significantly (*p*=0.001) after the intervention. A significant decrease in total protein (*p*=0.000) and animal protein (*p*=0.000) was seen in the follow-up study, with animal protein being the main contributor to the total dietary protein intake. The percentage of total fat contribution to total energy intake showed adequate intake for both baseline and follow-up studies. However, a significant (*p*=0.004) decrease of 2.6 percent in energy intake from total fat was observed after the intervention. When considering the guidelines for prevention of chronic diseases (Steyn, Blaauw, Lombard and Wolmarans 2008:721), a statistically significant decrease in the intake of SFA (*p*=0.020), and cholesterol (*p*=0.008) intakes was seen. However, a significant decrease was also observed for the healthier dietary fat MUFA (*p*=0.001). The reduction of SFA and cholesterol is associated with lower risk of heart disease and stroke (AHA 2014). A decrease of 41.1 mg (31.9%) from baseline in the intake of dietary cholesterol was seen in the follow-up study. The MUFA, Linolenic acids (n-3) C18:3, PUFA and Linoleic acids (n-6) C18:2 at baseline and follow-up recorded lower percentages of energy intake than recommended. Although there was a decrease in the intake of PUFA and Linoleic acids (n-6) C18:2 observed in the follow-up study, this was not statistically significant.

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Table 43 Comparison analysis of 24-hour recall of baseline and follow-up studies: median daily intake of a sample of the elderly subjects

Dietary intake parameter	Unit of measure	Baseline study (n=69)			Follow-up study (n=69)			Significance between groups (p-value)	EAR/ FAO and WHO guidelines
		Median	SD	% of Energy intake	Median	SD	% of Energy intake		
Total energy intake	kJ	4738.14	2006.07		3771.10	1830.07		0.001	6999 #
Total protein	g	50.52	24.05		42.85	18.51		0.000	46
Plant protein	g	15.33	6.61		14.46	8.24		0.611	
Animal protein	g	32.80	22.64		24.78	16.99		0.000	
Total fat	g	30.47	22.89	27.3	24.16	17.89	24.7	0.004	20-35% total El
Cholesterol	mg	129.00	118.41		87.90	99.47		0.008	300
SFA	g	11.05	8.32	8.6	6.62	6.21	7.3	0.020	<10% total El
MUFA	g	11.54	9.69	10.2	8.49	7.13	8.3	0.001	Balance[a,b] [Total fat-(SFA+TFA+PUFA)
PUFA	g	5.71	4.95	4.8	4.85	5.30	4.4	0.108	6-11% total El
TFA		0.32	3.17	0.3	0.20	2.47	0.2	0.061	<1% total El
Linoleic acid (n-6) C18:2	g	4.94	4.77	4.2	4.31	5.17	4.0	0.188	2.5-9% total El
Linolenic acid (n-3) C18:3	g	0.33	0.18	0.3	0.25	0.15	0.2	0.001	0.5-2% total El
Carbohydrate	g	141.92	63.60		118.02	66.93		0.010	100
Dietary fibre	g	8.40	4.34		9.48	4.78		0.900	21
Vitamin B_{12}	mcg	0.99	1.54		1.00	1.51		0.515	2
Vitamin B_6	mg	0.65	0.65		0.67	0.70		0.730	1.3
Folate	mcg	110.50	92.54		146.86	102.22		0.001	320

Estimated Energy requirements for sedentary women aged 73.8 years, height = 1.57m and weight =73.61 kg, EER (kcal/day) = 354-(6.91x age [y]) + PA x { (9.36xweight [kg]) +(726x height [m])}, *****Estimated Average requirement for females aged ≥70 years, ∞Adequate Intake levels for females ≥70 years old, [a] Total fat [%E] – SFA[%E] – PUFA [%E] – TFA[%E] [b] can be up to 15–20%E, according to total fat intake, EI: Energy Intake, FAO: Food and Agriculture Organisation of the United Nations, WHO: World Health Organisation
P-value: statistically significant difference between the parameters p≤0.05 (paired t-test for equality of medians)

The dietary intake results for hypercholesterolaemic and normocholesterolaemic elderly groups showed that for each group respectively 8 and 9 out of 17 nutrients in Table 44, the intake decreased significantly from baseline to follow-up study. Energy decreased significantly by about 20.1 and 17.6 percent for the HC and NC group. A decrease in intake was observed after the intervention in the major nutrients provided by soy food products, namely plant proteins, carbohydrates and fats. Only four nutrients (vitamin $B_{12,}$ $B_{6,}$ fibre and folate) showed increased intake at follow-up for the hypercholesterolaemic group, while in the normocholesterolaemic group, two nutrients (folate and vitamin B_6) increase in intake at follow-up. Only folate was the increase between groups and within groups was significant.

Table 44 Comparison analysis of 24-hour recall of hypercholesterolaemic and normocholesterolaemic groups at baseline and follow-up: median daily intake of a sample of the elderly subjects

Dietary intake parameter	Hypercholesterolaemic (n=50)		Normocholesterolaemic (n=19)	
	Baseline Median±SD	Follow-up Median±SD	Baseline Median±SD	Follow-up Median±SD
Total energy intake kJ	4689.22±1950.07[a]	3718.75±1604.42[a]	4895.70±2163.29[b]	4032.30±2358.45[b]
Total protein (g)	49.74±23.25[a]	43.08±17.44[a]	59.62±26.32[b]	39.83±21.46[b]
Plant protein (g)	15.05±6.96	14.24±8.52	19.40±5.6	14.46±7.66
Animal protein (g)	30.15±21.85[a]	24.85±16.01[a]	40.20±24.85[b]	24.52±19.73[b]
Total fat (g)	28.70±22.67	23.28±16.91	31.72±23.81[a]	26.46±20.75[a]
Cholesterol (mg)	126.10±128.90[a]	86.70±107.79[a]	133.00±87.76[b]	102.40±75.59[b]
SFA (g)	10.56±8.32	9.33±5.91	12.94±8.35[a]	6.40±7.11[a]
MUFA (g)	11.51±10.02[a]	8.48±7.39[a]	11.94±8.97[b]	8.60±6.57[b]
PUFA (g)	5.83±4.14	4.77±4.77	5.03±6.73	4.87±6.61
TFA (g)	0.34±3.49	0.23±2.84	0.29±2.15	0.14±0.79
Linoleic acid (n-6) C18:2 (g)	5.04±3.97	4.29±4.65	4.42±6.52	4.31±6.49
Linolenic acid (n-3) C18:3 (g)	0.32±0.16[a]	0.26±0.15[a]	0.34±0.21[b]	0.23±0.13[b]
Carbohydrate (g)	140.40±61.72[a]	117.53±61.36[a]	151.14±69.22	135.83±80.54
Dietary fibre (g)	7.60±4.04	9.46±4.26[a]	10.10±5.1	10.06±5.94[a]
Vitamin B_{12} (mcg)	0.97±1.55	1.16±1.42	1.00±1.56	0.69±1.75
Folate (mcg)	111.30±88.42[a]	138.05±91.95[a,c]	109.60±103.75[b]	201.40±116.28[b,c]
Vitamin B_6 (mg)	0.63±0.62	0.65±0.59[a]	0.68±0.73	0.73±0.92[a]

Estimated Energy requirements for sedentary women aged 73.8 years, height = 1.57m and weight =73.61 kg, EER (kcal/day) = 354-(6.91x age [y]) + PA x { (9.36xweight [kg]) +(726x height [m])}, *****Estimated Average requirement for females aged ≥70 years, ∞Adequate Intake levels for females ≥70 years old, [a] Total fat [%E] – SFA[%E] – PUFA [%E] – TFA[%E], [b] can be up to 15-20%E, according to total fat intake, EI: Energy Intake, [a, b, c] in the same row refer to statistically significant difference between the parameters p≤0.05 (independent [between groups] and paired[within groups] t-test for equality of variance)

The results of the median daily intake of minerals and vitamins of a sample of the elderly at baseline and follow-up are presented in Table 45. Although the soy products that were consumed during the intervention contained the majority of nutrients listed in Table 44, deficient intakes were still recorded at follow-up. An adequate median intake was reported for only iron and niacin as compared with the EAR at baseline, with only iron and niacin adequate at follow-up. There was a significant increase only in the intake of iron (*p*=0.001) and thiamin (*p*=0.024) after the intervention where a significantly decrease intake of selenium (*p*=0.000), B_3 (*p*=0.000) and pantothenate (*p*=0.000) and niacin (*p*=0.000) were observed. The intake of 14 nutrients (calcium, magnesium, phosphorus, potassium, sodium, copper, selenium, manganese, niacin, pantothenate and vitamins C,D, E and K) were found to have decreased after the intervention as compared to baseline, but only selenium, niacin and pantothenate decreased significantly (*p*=0.05).

Table 45 Analysis of 24-hour recall (minerals and vitamins): median daily intake of elderly

Dietary intake variables	Baseline study median ±SD) n=69	Follow-up study median ±SD n=69	Significance between groups (*P*-value)	EAR/ FAO and WHO guideline
Calcium (mg)	215.04±196.72	192.70±248.28	0.215	1200∞
Iron (mg)	5.03±4.40	7.16±4.66	0.001	5
Magnesium (mg)	172.80±60.73	160.00±67.72	0.645	265
Phosphorus (mg)	632.18±247.26	564.86±234.95	0.053	580
Potassium (mg)	1074.16±573.93	1007.70±550.56	0.166	4700∞
Sodium (mg)	619.70±525.25	522.45±600.30	0.932	2500
Zinc (mg)	5.54±3.15	5.70±3.18	0.882	6.8
Copper (mg)	0.58±0.24	0.51±0.28	0.219	20∞
Selenium (mcg)	20.16±19.51	14.77±14.62	0.000	45
Manganese (mcg)	1670.75±1006.02	1663.80±1075.65	0.171	1800∞
Vitamin A (mcg)	255.00±766.34	294.70±467.80	0.187	500
Thiamin (mg)	0.50±0.45	0.63±0.52	0.024	0.9
Riboflavin (mg)	0.58±0.58	0.59±0.64	0.151	0.9
Niacin (mg)	16.02±9.38	11.08±8.34	0.000	11
Pantothenate (mg)	6.66±4.83	3.94±3.10	0.000	5∞
Vitamin C (mg)	11.80±36.06	8.80±31.19	0.128	60
Vitamin D (mcg)	0.95±2.40	0.65±2.14	0.433	15
Vitamin E (mg)	1.82±2.80	1.55±4.17	0.991	12
Vitamin K (mcg)	16.87±122.54	8.73±193.30	0.169	90∞

*****Estimated Average requirement and ∞Adequate Intake levels for females and males ≥70 years old, ∞Adequate Intake levels for females and ≥70 years old, FAO: Food and Agriculture Organisation of the United Nations, WHO: World Health Organisation (2003); p-value: statistically significant difference between the parameters p≤0.05 (paired *t*-test)

The dietary intake of minerals and vitamins for hyper- and normocholesterolaemic respondents is presented in Table 46 below. The hypercholesterolaemic group had a significant increase only in iron and thiamin after the intervention. Also within the hypercholesterolaemic group, a significant decrease in intake of selenium, niacin, and pantothenate was observed. For the normocholesterolaemic group, no significant increase in any nutrient within the group was seen. However, a significant decrease was observed in copper, selenium, and pantothenate in the normocholesterolaemic group from baseline to follow-up. The independent *t*-test showed significant differences in calcium and potassium between groups at baseline and also at follow-up (Table 46).

Table 46 Comparison analysis of 24-hour recall (minerals and vitamins) of hyper- and normocholesterolaemic elderly groups in baseline and follow-up studies

Dietary intake parameter	Unit of measure	Hypercholesterolaemic (n=50)		Normocholesterolaemic (n=19)	
		Baseline Median±SD	Follow-up Median±SD	Baseline Median±SD	Follow-up Median±SD
Calcium	mg	218.91±132.66[a]	188.00±206.29[b]	188.14±304.76[a]	226.94±334.58[b]
Iron	mg	4.99±4.30[a]	6.92±4.22[a]	5.84±4.68	7.32±5.69
Magnesium	mg	158.40±60.60	152.29±65.98	182.80±60.79	169.40±73.56
Phosphorus	mg	626.85±220.42	561.93±202.85	642.50±302.94	571.90±306.87
Potassium	mg	1095.21±421.50[a]	1035.04±370.17[b]	1056.50±835.96[a]	962.85±868.01[b]
Sodium	mg	610.67±519.28	487.78±567.28	663.80±544.53	588.60±680.90
Zinc	mg	5.56±3.32	6.12±3.28	5.54±2.74	5.54±2.94
Copper	mg	0.56±0.24	0.52±0.29	0.61±0.24[a]	0.51±0.25[a]
selenium	mcg	17.38±19.05[a]	14.76±15.13[a]	23.73±21.01[b]	20.16±13.54[b]
Manganese	mcg	1596.08±1067.39	1483.50±1044.25	1882.90±845.33	1910.44±1175.35
Vitamin A	mcg	280.00±772.14	297.16±308.64	252.00±770.33	285.40±74
Thiamin	mg	0.48±0.46[a]	0.61±0.50[a]	0.56±0.44	0.66±0.58
Riboflavin	mg	0.57±0.53	0.59±0.53	0.63±0.68	0.61±0.85
Niacin	mg	14.96±8.74[a]	10.57±6.92[a]	19.41±10.57	11.99±11.00
Pantothenate	mg	6.49±4.64[a]	3.59±2.88[a]	9.83±5.28[b]	4.73±3.60[b]
Vitamin C	mg	11.35±23.95	8.60±9.29	13.20±57.33	10.50±57.56
Vitamin D	mcg	0.84±2.68	0.66±2.32	1.02±1.49	0.51±1.64
Vitamin E	mg	1.84±3.03	1.41±4.75	1.80±2.15	1.63±1.89
Vitamin K	mcg	15.69±118.83	6.69±201.10	27.95±135.24	24.65±174.95

[a, b, c] in the same row refer to statistically significant difference between the parameters p=≤0.05 (independent [between groups] and paired [within groups] t-test for equality of variance)

Table 47 presents the top 20 food items most frequently consumed and the mean daily intake of sampled respondents who consumed these foods on the days included in the 24-hour recalls in the baseline and follow-up studies. From the results it was clear that the main food group consumed by this elderly group at baseline study was carbohydrate-rich foods, which made up to 45 percent (n=9) of the top 20 food items. However, an increase in carbohydrate-rich foods was observed at follow-up. For these carbohydrate-rich foods, adequate portion sizes were observed only for rice at baseline, and for stiff maize meal porridge and bread at follow-up. Additional carbohydrate-rich foods such as oats, mahewu and soy mashed potatoes were seen in the follow-up study. A non-nutritious food item, namely tea, was ranked 1st in the top 20 food items consumed by the elderly in both baseline and follow-up studies.

An increase in protein sources was observed in the follow-up study as compared with the baseline study. The per capita intake of the majority of the protein sources was very low at both baseline and follow-up, with the exception of cooked chicken at baseline. The protein sources in the baseline study were of animal origin only, namely chicken, ranked 3rd, and beef, ranked 14th. The intervention introduced plant protein sources such as soy milk, which was ranked 9th and soy mashed potatoes ranked 13th but very small portions were consumed. The fresh milk, which was ranked 6th at baseline was ranked 3rd at follow-up. The per capita intake of milk, which was very small at baseline (50.2 g), increased sharply to 100.1 g after the intervention. Moreover, more milk, including soy and sour milk, was seen among the 20 top food items consumed at follow-up and these were ranked 9th and 11th of the top 20 food items consumed. However, the increased calcium sources at follow-up did not significantly increase the calcium intake of the elderly, as reported earlier (refer Table 45).

Five vegetables, namely pumpkin, beetroot, cabbage, spinach and green beans appeared on the top 20 food items at baseline, but with a very low total per capita intake (63.6 g) as compared with the recommended 400 g (WHO/FAO 2003) and fruit juice. However no fruit and vegetables appeared at follow-up among the top 20 food items consumed. This explains the decline in intake of the vitamins thiamin, niacin, and pantothenate in this group at follow-up, reported earlier on (refer to Table 45).

Table 47 Top 20 food items consumed as measured by 24-hour recall in baseline and follow-up studies

	Baseline study (n=69)				Follow-up study (n=69)			
Ranking of food item	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods)	Per capita daily intake (g)	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods	Per capita daily intake (g)
1	Tea	10220	262.05 ±162.73	148.1	Tea, brewed	15350	383.75±190.95	222.5
2	Rice	7520	221.18±107.19	109	Maize meal (stiff)	7310	182.75±141.87	105.9
3	Chicken, cooked	6850	155.68±74.63	99.3	Milk, fresh	6905	186.62±177.51	100.1
4	Maize meal (stiff)	4990	237.62±120.50	72.3	Bread	4125	98.21±44.18	59.8
5	Maize meal (soft)	4160	166.4±63.37	60.3	Rice	4064	162.56±161.89	58.9
6	Milk (fresh)	3462	98.91±79.10	50.2	Cold drink	4050	506.25±335.34	58.7
7	Maltabella, cooked sorghum	3050	277.27±81.74	44.2	Maltabella	3040	178.82±147.56	44.1
8	Bread	3050	95.31±38.87	44.2	Chicken, cooked	3040	98.07±35.91	44.1
9	Pumpkin	1705	77.5±31.0	24.7	Soy milk	2760	197.14±149.53	40.0
10	Cold drink	1650	330±210.95	23.9	Maize meal (soft)	1840	153.33±66.10	26.7
11	Scones	1220	203.33±70.90	17.7	Sour milk	1600	266.67±186.19	23.2
12	Beetroot	1035	69±22.69	15.0	Coffee	1200	300±212.13	17.4
13	Potatoes	930	66.43±28.45	13.5	Potato, mashed (soy)	1195	54.32±27.53	17.3
14	Beef, cooked	650	162.5±135.74	9.4	Beef cooked	1140	95±59.47	16.5
15	Cabbage	610	61±35.02	8.8	Stew, beef	1075	119.44±106.67	15.6
16	Sugar	596	11.25±7.9	8.6	Mahewu	1030	257.5±194.66	14.9
17	Spinach	580	72.5±31.51	8.4	Scones	1000	125±145.04	14.5
18	Gravy	470	39.17±13.79	6.8	Oats	980	163.33±78.91	14.2
19	Green beans	465	77.5±31.27	6.7	Stew, chicken	980	98±35.53	14.2
20	Fruit juice	450	225±35.36	6.5	Sugar	934	24.58±16.98	13.5

Tables 48 and 49 present data for the top 20 food items consumed as measured by 24-hour recall for hyper- and normocholesterolaemic groups in the baseline and follow-up studies. The main source of food consumed by both groups was carbohydrate-rich food. However, an increase in the frequency of carbohydrate-rich food was observed at follow-up for the hypercholesterolaemic group. Some interesting differences are noted in Table 48 and 49 when comparing the follow-up results of the hyper- and normocholesterolaemic groups in terms of fruit and vegetable intakes. The hypercholesterolaemic group included no fruits and vegetables at follow-up, while the normocholesterolaemic groups included three vegetables: cabbage, ranked 14th, green beans, ranked 15th and spinach, ranked 19th. Therefore this explains the decreased intake of dietary fibre by the hypercholesterolaemic group at follow-up reported earlier in Table 44. Although the normocholesterolaemic group had vegetables among the top 20 food items consumed at follow-up, the per capita intake was very low compared with the 400g recommended by the WHO/FAO (2003). A decrease was also observed in the follow-up study in the frequency of intake of vegetables by the normocholesterolaemic group.

The protein sources for both groups were chicken, beef and fresh milk at baseline with only the hypercholesterolaemic group having sour milk as an additional source of protein at baseline. Soy milk was observed as one of the sources of protein for both groups at follow-up. The intake of soy mashed potato in the follow-up study appeared only on the hypercholesterolaemic group's top 20 list of food items consumed (Table 48 and 49). The per capita intake of soy milk by the hypercholesterolaemic group (50.2 g) was almost four times that of the normocholesterolaemic group (13.2 g), but still did not meet the recommended intake. At follow-up, Introduction of less healthy foods such as cold drinks were ranked 4th, fried potato chips were ranked 17th and increased portions of sugary food items were observed among the top 20 food items consumed by the normocholesterolaemic group. Soy mashed potatoes did not form part of the top 20 food items consumed by the NC group.

Table 48 Top 20 food items consumed by hypercholesterolaemic group as measured by 24-hour recall in baseline and follow-up studies

Hypercholesterolaemic group (n=50)								
Baseline study					Follow-up study			
Ranking of food item	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods)	Per capita daily intake (g)	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods	Per capita daily intake (g)
1	Tea, brewed	7570	280.37±186	151.4	Tea, brewed	10800	372.41±182.05	216
2	Rice	5660	226.4±111.01	113.2	Maize meal, stiff	4870	173.93±119.64	97.4
3	Chicken	4840	142.35±70.88	96.8	Milk, fresh	4440	185±164.48	88.8
4	Maize meal, stiff	3790	236.88±126.05	75.8	Rice	3104	155.2±177.09	62.1
5	Milk fresh	2757	106.4±83.98	55.1	Mabela	2950	196.67±148.26	59
6	Maize meal, soft	2610	153.53±58.84	52.2	Bread	2730	94.14±32.76	54.6
7	Bread	2455	102.29±40.99	49.1	Soy milk	2510	194.08±154.83	50.2
8	Maltabella	2450	272.22±87	49.0	Cold drink	2300	460±341.69	46
9	Cold drink	1100	366.67±288.68	22.0	Chicken, cooked	2100	95.46±32.33	42
10	Pumpkin	995	71.07±26.18	19.9	Maize meal, stiff	1540	171.11±58.19	30.8
11	Scone	840	210±80.83	16.8	Coffee	1100	366.67±202.07	22
12	Potatoes	640	64±27.57	12.8	Sour milk	1100	220±164.32	22
13	Beetroot	625	62.5±20.72	12.5	Soy potato, mashed	1080	56.84±28.69	21.6
14	Cabbage	490	61.25±38.24	9.8	Stew, beef	1075	119.44±106.67	21.5
15	Spinach	460	65.71±26.99	9.2	Scones	930	132.88±154.81	18.6
16	Sugar	456	11.69±7.19	9.1	Beef, cooked	850	85±40.62	17
17	Sour milk/maas	450	225±35.36	9.0	Oats	780	156±85.91	15.6
18	Fruit juice	450	225±35.36	9.0	Sugar	705	24.31±15.55	14.1
19	Carrot	435	62.14±31.60	8.7	Stew, chicken	630	90±25.17	12.6
20	Beef stew	360	360±0.0	7.2	Mahewu	600	300±282.84	12

Table 49 Top 20 food items consumed by normocholesterolaemic group as measured by 24-hour recall in baseline and follow-up studies

Normocholesterolaemic group (n=19)								
Baseline study					Follow-up study			
Ranking of food item	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods)	Per capita daily intake (g)	Food item	Total consumption by group	Mean ± SD daily intake (gram per person consuming these foods	Per capita daily intake (g)
1	Maize meal stiff	2900	290±122.02	152.6	Tea, brewed	4550	413.64±219.19	239.5
2	Tea	2550	231.81±167.74	134.2	Milk, fresh	2465	189.62±206.53	129.73
3	Rice	1850	308.33±120.07	97.4	Maize meal, stiff	2440	203.33±188.60	128.4
4	Maize meal soft	1800	180±48.31	94.7	Cold drinks	1750	583.33±381.88	92.1
5	Chicken	1500	115.39±54.56	79	Bread	1395	107.31±63.53	73.4
6	Bread	1465	112.69±53.57	77.1	Rice	960	192±83.19	50.5
7	Milk fresh	785	98.13±66.65	41.3	Chicken cooked	940	104.44±45.03	49.5
8	Pumpkin	505	72.14±31.87	26.6	Sour milk	500	500±0.0	26.3
9	Potatoes	480	80±45.61	25.3	Mahewu	430	215±162.63	22.6
10	Beef	320	320±0.0	16.8	Stew, chicken	350	116.67±55.08	18.4
11	Samp	300	300±0.0	15.8	Maize meal soft	300	100.00±69.28	15.8
12	Fruit juice	250	250±0.0	13.2	Fruit juice	300	300±0.0	15.8
13	Maltabella	250	250±0.0	13.2	Beef, cooked	290	145±134.35	15.3
14	Gravy	250	41.67±11.69	13.2	Cabbage	255	85±32.79	13.4
15	Green beans	215	71.67±43.68	11.3	Green beans	250	62.50±12.58	13.2
16	Cold drink	200	200±0.0	10.5	Soymilk	250	250±0.0	13.2
17	Spinach	180	90±42.43	9.5	Potato chips fried	250	250±0.0	13.2
18	Sugar	164	13.67±9.41	8.6	Sugar	229	25.44±22.07	12.1
19	Beetroot	160	53.33±11.55	8.4	Spinach	200	50±14.14	10.5
20	Beef stew	150	150±0.0	7.9	Oats	200	200±0.0	10.5

5.5.4 Food variety and dietary diversity

At baseline, a total of 87 different individual food items within the nine nutritional food groups was consumed in seven days by the elderly respondents as compared with 94 food items at follow-up after the soy intervention (Tables 50 and 51 below), indicating an increase of seven individual foods. The overall range of individual food items consumed during the seven-day data collection period for the baseline study was between 8 and 77 foods, while in the follow-up study the overall range was 8–88 foods. The majority of the respondents (n=48, 69.6%) at baseline consumed between 21 and 50 individual food items in seven days. At follow-up, between 21 and 50 individual food items were consumed by the majority of respondents (n=88, 71%).

When assessing the number of food items within the various food groups, the flesh and cereal groups were the only groups consumed by all the elderly respondents at both baseline and follow-up. The cereal group makes up the bulk of food items consumed within a week by these respondents both in baseline and follow-up studies. In the follow-up study, 11 and 8 cereal food items were consumed by a large number of respondents (n=21, 30.4%). The cereal group, which had the greatest variety, was followed by fruits, vegetables and flesh at baseline and follow-up.

An increase in variety was observed in the flesh, dairy, cereal, legume and vitamin A-rich groups at follow-up as compared with baseline. A decrease from the baseline study was observed in other fruit and vegetable groups at follow-up, except for the fat group, which remained the same in terms of variety.

Table 50 Elderly food access as measured by the food variety within the food groups consumed over a period of one week at baseline survey (n=69)

Flesh Group (n=11)	Eggs Group (n=1)	Dairy products (n=9)	Cereals Group (n=17)	Legumes Group (n=5)	Vitamin A Rich Group (n=7)	Fruit Group (n=15)	Vegetables Group (n=15)	Fat Group (n=5)	Total individual food items eaten from all Groups (n=87)
0 = 0	0 = 15	0 = 2	0 = 0	0 = 5	0 = 1	0 = 4	0 = 3	0 = 5	8 – 20 = 6
1 = 2	1 = 54	1 = 7	1 = 1	1 = 30	1 = 2	1 = 10	1 = 2	1 = 9	21 – 30 = 19
2 = 10		2 = 14	2 = 1	2 = 14	2 = 10	2 = 7	2 = 6	2 = 22	31 – 40 = 15
3 = 10		3 = 15	3 = 0	3 = 13	3 = 12	3 = 15	3 = 5	3 = 26	41 – 50 = 14
4 = 10		4 = 5	4 = 1	4 = 6	4 = 19	4 = 8	4 = 7	4 = 6	51 – 60 = 11
5 = 8		5 = 9	5 = 7	5 = 1	5 = 14	5 = 3	5 = 10	5 = 1	61 – 70 = 3
6 = 12		6 = 8	6 = 8		6 = 6	6 = 9	6 = 8		71 – 77 = 1
7 = 2		7 = 4	7 = 6		7 = 5	7 = 5	7 = 6		
8 = 5		8 = 4	8 = 6			8 = 1	8 = 6		
9 = 6		9 = 1	9 = 3			9 = 3	9 = 3		
10 = 1			10 = 7			10 = 2	10 = 8		
11 = 3			11 = 7			11 = 0	11 = 3		
			12 = 4			12 = 0	12 = 1		
			13 = 6			13 = 0	13 = 0		
			14 = 4			14 = 1	14 = 0		
			15 = 2			15 = 1	15 = 1		
			16 = 2						
			17 = 4						

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 51 Elderly food access as measured by the food variety within the food groups consumed over a period of one week in follow-up study (n=69)

Flesh Group (n=13)	Eggs Group (n=1)	Dairy products (n=11)	Cereals Group (n=20)	Legumes Group (n=7)	Vitamin A -rich Group (n=8)	Fruit Group (n=16)	Vegetables Group (n=13)	Fat Group (n=5)	Total individual food items eaten from all groups (n=94)
0 = 0	0 = 19	0 = 2	0 = 0	0 = 3	0 = 1	0 = 3	0 = 5	0 = 7	8 – 10 = 2
1 = 3	1 = 50	1 = 9	1 = 1	1 = 5	1 = 2	1 = 9	1 = 2	1 = 17	11 – 20 = 2
2 = 9		2 = 10	2 = 1	2 = 19	2 = 7	2 = 13	2 = 4	2 = 23	21 – 30 = 20
3 = 16		3 = 20	3 = 0	3 = 18	3 = 15	3 = 11	3 = 3	3 = 19	31 – 40 = 18
4 = 7		4 = 6	4 = 0	4 = 7	4 = 12	4 = 12	4 = 6	4 = 2	41 – 50 = 14
5 = 6		5 = 10	5 = 4	5 = 10	5 = 17	5 = 4	5 = 12	5 = 1	51 – 60 = 5
6 = 9		6 = 2	6 = 5	6 = 5	6 = 8	6 = 2	6 = 14		61 – 70 = 6
7 = 8		7 = 3	7 = 8	7 = 2	7 = 3	7 = 4	7 = 6		71 – 80 = 1
8 = 3		8 = 2	8 = 10		8 = 4	8 = 5	8 = 4		81 – 88 = 1
9 = 1		9 = 2	9 = 4			9 = 2	9 = 3		
10 = 2		10 = 2	10 = 6			10 = 0	10 = 3		
11 = 3		11 = 1	11 = 11			11 = 1	11 = 5		
12 = 1			12 = 4			12 = 0	12 = 1		
13 = 1			13 = 5			13 = 0	13 = 1		
			14 = 5			14 = 1			
			15 = 1			15 = 1			
			16 = 1			16 = 1			
			17 = 0						
			18 = 1						
			19 = 1						
			20 = 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

Table 52 summarises the food variety within food groups at baseline and follow-up. The mean FVS (±SD) of all the foods consumed by this elderly group from all the food groups in a period of seven days was 37.67(±14.34) at baseline, indicating medium food variety (30-60 individual foods). However, a slight increase in the FVS (±SD) was observed at follow-up (38.71±15.69), but it still fell within the category of medium food variety. The mean score for legumes increased at follow-up by a mean of 1.34.

Table 52 Summary of the food variety within the food groups

Food groups	Baseline (n=69)			Follow-up (n=69)		
	Mean	SD	Range of scores∞	Mean	SD	Range of scores∞
Cereals, roots and tubers	9.65	3.87	1 – 17	9.81	3.63	1 – 20
Other vegetables	5.97	3.24	0 – 15	5.77	3.12	0 – 13
Vitamin A-rich fruits and vegetables	3.99	1.58	0 – 7	4.28	1.77	0 – 8
Flesh foods (meat, poultry, fish)	5.14	2.61	1 – 11	5.04	2.86	1 – 13
Fats and oils	2.32	1.09	0 – 5	1.93	1.09	0 – 5
Dairy	3.80	2.20	0 – 9	3.78	2.48	0 – 11
Other fruits	4.19	3.12	0 – 15	4.20	3.39	0 – 16
Legumes and nuts	1.83	1.18	0 – 5	3.17	1.66	0 – 7
Eggs	0.78	0.42	0 – 1	0.72	0.45	0 – 1
Total food items	37.67	14.34	8 – 77	38.71	15.69	8 – 88

∞ The range of scores indicates the range of individual food items consumed within each group

The dietary diversity score across all nine nutritious food groups is summarised in Table 53 below for both studies. Almost all the respondents could be classified as having a high dietary diversity score (using 6–9 groups) at both at baseline (n=68, 98.6%) and follow-up (n=68, 98.6%).

Table 53 Summary of food group diversity

Number of food groups Consumed (n=9)	Baseline (n=69)		Follow-up (n=69)	
	Frequency	Percentage	Frequency	Percentage
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	1	1.4	1	1.4
5	0	0	0	0
6	0	0	1	1.4
7	7	10.1	6	8.7
8	16	23.2	20	29
9	45	65.2	41	59.4
Total	**69**	**100**	**69**	**100**

Tables 54 and 55 present the food variety within food groups in the baseline and follow-up studies for the hypercholesterolaemic group, and Tables 55 and 56 present the food variety for the normocholesterolaemic group. The baseline results (Tables 54 and 56) showed that the hypercholesterolaemic group had more food variety than the normocholesterolaemic group – 83 and 76 respectively at baseline. This was interesting as the difference was due to higher variety in the fruit, vegetable and fat groups of foods for the hypercholesterolaemic group as compared with the normocholesterolaemic group. The total range of individual food items consumed at baseline by hypercholesterolaemic individuals during one week was 8–77 and by normocholesterolaemic individuals, 10–68 (Tables 54 and 56).

At baseline, a low variety of foods (<30 food items) was consumed by 38 percent (n=19) of the hypercholesterolaemic respondents, followed by 58 percent (n=29) in the medium food variety and 4 percent (n=2) in the high variety categories (Table 54). In the normocholesterolaemic group, a low variety of foods (<30 foods items) was consumed by 31.6 percent (n=6), followed by 57.9 percent (n=11) in the medium and 10.5 percent (n=2) in the high variety categories at baseline (Table 57). However, at follow-up, the majority, 48 percent (n=24) and 73.7 percent (n=14) of the hypercholesterolaemic and normocholesterolaemic respondents respectively, consumed a medium variety of foods. When evaluating the number of food items within the various food groups, it is clear that, in the normocholesterolaemic group, 5 food groups – flesh, dairy, cereals, vitamin A-rich and fruit groups – were consumed by all the respondents (n=19) at baseline (Table 56), whereas only flesh and cereal groups were consumed by all the hypercholesterolaemic respondents at baseline (Table 54). An increase of 10 food items in total food variety was observed in the hypercholesterolaemic group after the intervention (refer to Tables 54 and 55), while in the normocholesterolaemic group, the total individual food items eaten from all groups after the intervention remained the same as for the baseline study (refer to Tables 56 and 57). The majority of the food groups for the hypercholesterolaemic respondents increased in variety at follow-up. The variety of legumes and dairy products, which were part of the soy intervention, increased in both hypercholesterolaemic and normocholesterolaemic groups at follow-up. However, this increase was more pronounced in the hypercholesterolaemic group. The cereal group remained the food group with highest variety in both groups in baseline and follow-up studies.

Table 54 Baseline study: Hypercholesterolaemic elderly food access as measured by the food variety within the food groups consumed over a period of one week (n=50)

Flesh Group (n=11)	Eggs Group (n=1)	Dairy products (n=8)	Cereals Group (n=17)	Legumes Group (n=4)	Vitamin A-rich Group (n=7)	Fruit Group (n=15)	Vegetables Group (n=15)	Fat Group (n=5)	Total individual food items eaten from all groups (n=83)
0 = 0	0 = 11	0 = 2	0 = 0	0 = 4	0 = 1	0 = 4	0 = 2	0 = 4	8 – 10 = 2
1= 1	1 = 39	1 = 5	1 = 1	1 = 21	1 = 2	1 = 6	1 = 1	1 = 7	11 – 20 = 2
2 = 7		2 =10	2 = 1	2 = 9	2 = 8	2 = 6	2 = 4	2 = 16	21 – 30 =15
3 = 9		3 =14	3 = 0	3 = 10	3 = 9	3 = 10	3 = 3	3 = 17	31 – 40 =11
4 = 9		4 = 3	4 = 1	4 = 6	4 = 12	4 = 8	4 = 7	4 = 5	41 – 50 = 11
5 = 6		5 = 6	5 = 5		5 = 13	5 = 2	5 = 8	5 = 1	51 – 60 = 7
6 = 8		6 = 5	6 = 6		6 = 1	6 = 5	6 = 5		61 – 70 = 1
7 = 2		7 = 2	7 = 4		7 = 4	7 = 4	7 = 4		71 – 77 = 1
8 = 3		8 = 3	8 = 5			8 = 0	8 = 5		
9 = 3			9 = 1			9 = 2	9 = 2		
10 = 0			10 = 6			10 = 1	10 = 6		
11 = 2			11 = 4			11 = 0	11 = 2		
			12 = 3			12 = 0	12 = 0		
			13 = 5			13 = 0	13 = 0		
			14 = 3			14 = 1	14 = 0		
			15 = 2			15 = 1	15 = 1		
			16 = 1						
			17 = 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

Table 55 Follow-up study: Hypercholesterolaemic elderly food access as measured by the food variety within the food groups consumed over a period of one week (n=50)

Flesh Group (n=12)	Eggs Group (n=1)	Dairy products (n=11)	Cereals Group (n=20)	Legumes Group (n=7)	Vitamin A-rich Group (n=8)	Fruit Group (n=16)	Vegetables Group (n=13)	Fat Group (n=5)	Total individual food items eaten from all groups (n=93)
0 = 0	0 = 15	0 = 2	0 = 0	0 = 2	0 = 1	0 = 3	0 = 4	0 = 5	8 – 10 = 2
1 = 5	1 = 35	1 = 8	1 = 1	1 = 5	1 = 2	1 = 5	1 = 1	1 = 12	11 – 20 = 1
2 = 5		2 = 7	2 = 1	2 = 14	2 = 6	2 = 9	2 = 3	2 = 19	21 – 30 =17
3 = 14		3 = 16	3 = 0	3 = 13	3 = 11	3 = 9	3 = 2	3 = 12	31 – 40 = 9
4 = 7		4 = 3	4 = 0	4 = 3	4 = 9	4 = 10	4 = 6	4 = 1	41 – 50 =12
5 = 4		5 = 6	5 = 3	5 = 5	5 = 9	5 = 2	5 = 9	5 = 1	51 – 60 = 3
6 = 5		6 = 2	6 = 3	6 = 3	6 = 6	6 = 0	6 = 8		61 – 70 = 4
7 = 6		7 = 2	7= 7	7 = 2	7 = 3	7 = 3	7= 5		71 – 80 = 1
8 = 3		8 = 0	8 = 8		8 = 3	8 = 3	8 = 2		81 – 88 = 1
9 = 0		9 = 2	9 = 2			9 = 2	9 = 2		
10 = 2		10 = 1	10 = 3			10 = 0	10 = 3		
11 = 2		11 = 1	11 = 8			11 = 1	11 = 3		
12 = 1			12 = 3			12 = 0	12 = 1		
			13 = 4			13 = 0	13 = 1		
			14 = 3			14 = 1			
			15 = 0			15 = 1			
			16 = 1			16 = 1			
			17 = 0						
			18 = 1						
			19 = 1						
			20 = 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

Table 56 Baseline study: Normocholesterolaemic elderly food access as measured by the food variety within the food groups consumed over a period of one week (n=19)

Flesh Group (n=11)	Eggs Group (n=1)	Dairy products (n=9)	Cereals Group (n=17)	Legumes Group (n=5)	Vitamin A-rich Group (n=7)	Fruit Group (n=10)	Vegetables Group (n=12)	Fat Group (n=4)	Total individual food items eaten from all groups (n=76)
0 = 0	0 = 4	0 = 0	0 = 0	0 = 1	0 = 0	0 = 0	0 = 1	0 = 1	10 – 20 = 2
1 = 1	1 = 15	1 = 2	1 = 0	1 = 9	1 = 0	1 = 4	1 = 1	1 = 2	21 – 30 = 4
2 = 3		2 = 4	2 = 0	2 = 5	2 = 2	2 = 1	2 = 2	2 = 6	31 – 40 = 4
3 = 1		3 = 1	3 = 0	3 = 3	3 = 3	3 = 5	3 = 2	3 = 9	41 – 50 = 3
4 = 1		4 = 2	4 = 0	4 = 0	4 = 7	4 = 0	4 = 0	4 = 1	51 – 60 = 4
5 = 2		5 = 3	5 = 2	5 = 1	5 = 1	5 = 1	5 = 2		61 – 68 = 2
6 = 4		6 = 3	6 = 2		6 = 5	6 = 4	6 = 3		
7 = 0		7 = 2	7 = 2		7 = 1	7 = 1	7 = 2		
8 = 2		8 = 1	8 = 1			8 = 1	8 = 1		
9 = 3		9 = 1	9 = 2			9 = 1	9 = 1		
10 = 1			10 = 1			10 = 1	10 = 2		
11 = 1			11 = 3				11 = 1		
			12 = 1				12 = 1		
			13 = 1						
			14 = 1						
			15 = 0						
			16 = 1						
			17 = 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

Table 57 Follow-up study: Normocholesterolaemic elderly food access as measured by the food variety within the food groups consumed over a period of one week (n=19)

Flesh Group (n=13)	Eggs Group (n=1)	Dairy products (n=10)	Cereals Group (n=15)	Legumes Group (n=6)	Vitamin A-rich Group (n=8)	Fruit Group (n=8)	Vegetables Group (n=11)	Fat Group (n=4)	Total individual food items eaten from all groups (n=76)
0 = 0	0 = 4	0 = 0	0 = 0	0 = 1	0 = 0	0 = 0	0 = 1	0 = 2	19 – 20 =1
1 = 2	1 = 15	1 = 1	1 = 0	1 = 0	1 = 0	1 = 4	1 = 1	1 = 5	21 – 30 =2
2 = 4		2 = 3	2 = 0	2 = 5	2 = 1	2 = 4	2 = 1	2 = 4	31 – 40 =9
3 = 2		3 = 4	3 = 0	3 = 5	3 = 4	3 = 2	3 = 1	3 = 7	41 – 50 =2
4 = 0		4 = 3	4 = 0	4 = 4	4 = 3	4 = 2	4 = 0	4 = 1	51 – 60 =3
5 = 2		5 = 4	5 = 1	5 = 2	5 = 8	5 = 2	5 = 3		61 – 67 =2
6 = 4		6 = 0	6 = 2	6 = 2	6 = 2	6 = 2	6 = 6		
7 = 2		7 = 1	7 = 1		7 = 0	7 = 1	7 = 1		
8 = 0		8 = 2	8 = 2		8 = 1	8 = 2	8 = 2		
9 = 1		9 = 0	9 = 2				9 = 1		
10 =0		10 = 1	10 = 3				10 = 0		
11 = 1			11 = 3				11 = 2		
12 = 0			12 = 1						
13 = 1			13 = 1						
			14 = 2						
			15 = 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

Table 58 presents a summary of the food variety within the food groups consumed at baseline and follow-up by the hypercholesterolaemic and normocholesterolaemic groups. In Table 58, an increase in the mean FVS (±SD) for all the food consumed from all the food groups in a period of seven days was observed in the follow-up study (38.34±16.50) as compared with 36.70±13.79 at baseline for the hypercholesterolaemic group. A decrease of mean FVS (±SD) from baseline (40.21±15.80) was observed after the intervention (39.68±13.23) for the normocholesterolaemic group. However, the means of the FVS (±SD) of both groups remained at medium dietary diversity at follow-up, as it was at baseline.

Table 59 shows that the majority of the hypercholesterolaemic group (98%; n=49) at baseline and the majority of the hypercholesterolaemic (96%; n=48) group at follow-up could be classified as having a high dietary diversity score. In the normocholesterolaemic sample all the respondents could be classified as having a high dietary diversity score in both baseline and follow-up studies.

Table 58 **Summary of the food variety within the food groups**

	Hypercholesterolaemic (n=50)						Normocholesterolaemic (n=19)					
	Baseline			Follow-up			Baseline			Follow-up		
Food groups	**Mean**	**SD**	**Range of scores∞**	**Mean**	**SD**	**Range of scores∞**	**Mean**	**SD**	**Range of scores∞**	**Mean**	**SD**	**Range of scores∞**
Cereals, roots and tubers	9.44	3.88	1 –17	9.76	3.91	1 – 20	10.21	3.88	5 –17	9.95	2.88	5 – 15
Other vegetables	5.98	3.17	0 –15	5.74	3.21	0 – 13	5.95	3.50	0 –12	5.84	2.95	0 – 11
Vitamin A-rich fruit & veg	3.84	1.61	0 – 7	4.18	1.89	0 – 8	4.37	1.46	2 – 7	4.53	1.39	2 – 8
Flesh foods	4.86	2.42	1 –11	5.02	2.68	1 – 12	5.89	3.02	1–11	5.11	3.37	1 – 13
Fats and oils	2.30	1.15	0 – 5	1.90	1.07	0 – 5	2.37	0.96	0 – 4	2.00	1.16	0 – 4
Dairy	3.54	2.08	0 – 8	3.54	2.49	0 – 11	4.47	2.41	0 – 9	4.42	2.39	1 – 10
Other fruits	4.10	3.25	0 –15	4.38	3.70	0 – 16	4.42	2.84	1 –10	3.74	2.4	1 – 8
Legumes and nuts	1.86	1.20	0 – 4	3.12	1.72	0 – 7	1.74	1.15	0 – 5	3.32	1.53	0 – 6
Eggs	0.78	0.42	0 –1	0.70	0.46	0 – 1	0.79	0.42	0 – 1	0.79	0.42	0 – 1
Total foods items	36.70	13.79	8 – 77	38.34	16.50	8 – 88	40.21	15.80	16 – 68	39.68	13.23	19 – 67

∞ The range of scores indicates the range of individual food items consumed within each group

Table 59 **Summary of food group diversity**

Number of food groups Consumed (n=9	Hypercholesterolaemic (n=50)				Normocholesterolaemic (n=19)			
	Baseline		Follow-up		Baseline		Follow-up	
	n	%	n	%	n	%	n	%
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	1	2	2	4	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	2	4	0	0	0	0
7	5	10	6	12	2	10.5	2	10.5
8	13	26	19	38	3	15.8	4	21.1
9	31	62	21	42	14	73.7	13	68.4
Total	**50**	**100**	**50**	**100**	**19**	**100**	**19**	**100**

n= frequency, % percentage

5.5.5 Anthropometric measurements and blood pressure

The anthropometric indices and blood pressure of the elderly respondents at baseline and follow-up studies are presented in Table 60 below. The results indicated a slight increase in the means of the majority of the variables in the follow-up study as compared with the baseline study. However, according to the paired samples test the increase between the baseline and follow-up study variables was not significant. After the intervention, the means of BMI, WC, systolic and diastolic BP remained in the overweight, substantial risk, mild hypertension and normal hypertension categories, respectively.

Table 60 Comparison of anthropometric variables of the elderly at baseline and follow-up

Variables and unit of measure	Baseline study (n=69)		Follow-up study (n=69)		Significant difference between groups (*p*-value)
	Mean	SD	Mean	SD	
Height (m)	1.58	0.85	1.57	0.86	0.053
Weight (kg)	73.51	15.59	74.17	16.00	0.445
Waist circumference (cm)	97.74	10.02	97.44	16.77	0.874
Body Mass index kg/m2	29.25	5.53	30.00	6.07	0.108
Systolic blood pressure (mmHg)	140.12	25.59	142.94	24.390	0.453
Diastolic blood pressure (mmHg)	83.32	16.03	84.71	16.68	0.559

Statistically significant difference between the variables $p \leq 0.05$; paired *t*-test for equality of variances

In Table 61, the results of the anthropometric and hypertension variables of the hypercholesterolaemic and normocholesterolaemic elderly groups at baseline and follow-up are presented. The results revealed a decrease, although not a significant one, in WC in the normocholesterolaemic elderly group from baseline to follow-up study. A mean change of BMI classification from overweight at baseline to mild obese at follow-up was observed in the hypercholesterolaemic group. The normocholesterolaemic elderly group remained in the overweight category after the intervention even though there was an increase, which was not, however, significant. The diastolic BP mean of the normocholesterolaemic elderly groups also changed from normal to high normal hypertension. However, in all the changes mentioned with regard to the anthropometric and hypertension variables of the hypercholesterolaemic and normocholesterolaemic groups, there were no statistically significant differences within the groups HC or NC before and after (paired t-test) and between the groups, HC and NC at baseline or follow-up (independent *t*-test).

Table 61 Comparison of anthropometric variables of the hypercholesterolaemic and normocholesterolaemic elderly groups: baseline and follow-up.

Variables and normal ranges	Hypercholesterolaemic (n=50)		Normocholesterolaemic (n=19)	
	Baseline Mean±SD	Follow-up Mean±SD	Baseline Mean±SD	Follow-up Mean±SD
Height (m)	1.58±0.81	1.57±0.83	1.59±0.096	1.57±0.093
Weight (kg)	74.92±16.24	74.82±16.52	69.79±13.43	72.47±14.79
Waist circumference (cm) Ideal <80 cm♀ or <94 cm ♂	97.96±10.54	98.16±12.64	97.16±8.76	95.54±24.94
Body Mass index kg/m2 underweight <18.5, normal 18.5-24.9, overweight 25-29.9 and obese ≥30	29.95±5.63	30.24±6.11	27.41±4.92	29.35±6.09
Systolic blood pressure (mmHg Normal 120-129 mmHg	139.72±27.29	141.82±25.91	141.16±21.11	145.89±20.19
Diastolic blood pressure (mmHg) Normal 80-84 mmHg	82.72±16.15	82.88±13.88	84.89±16.04	89.53±22.20

♀ Female; ♂ Male

Although no statistically significant changes were observed in the means of the BMI of the hypercholesterolaemic group at follow-up, and the mean (±SD) BMI showed mild obesity, Figure 23 below shows a high prevalence of obesity of 52 percent (30%, 18% and 4% observed for mild [class 1], moderate [class 2] and severe [class 3] obesity, respectively) among the respondents. The normocholesterolaemic group mean at follow-up indicated overweight (Table 61); Figure 24 shows that about 25 percent of the elderly were obese after the intervention as compared with 20 percent at baseline. Figures 25 and 26, show that both groups had increased percentages of hypertensive (mild to severe) respondents after the intervention, with the hypercholesterolaemic group increasing from 54 percent to 62 percent and the normocholesterolaemic group from 52.6 percent to 63 percent.

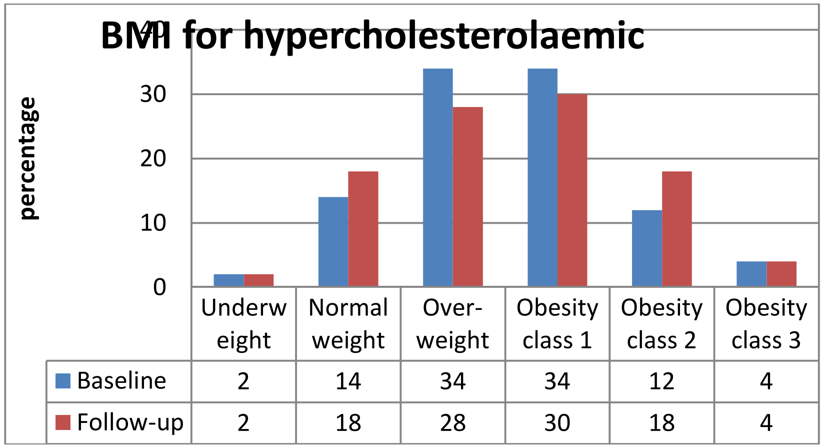

Figure 23 Body Mass Index classification of hypercholesterolaemic (n=50) elderly group in baseline and follow-up studies.

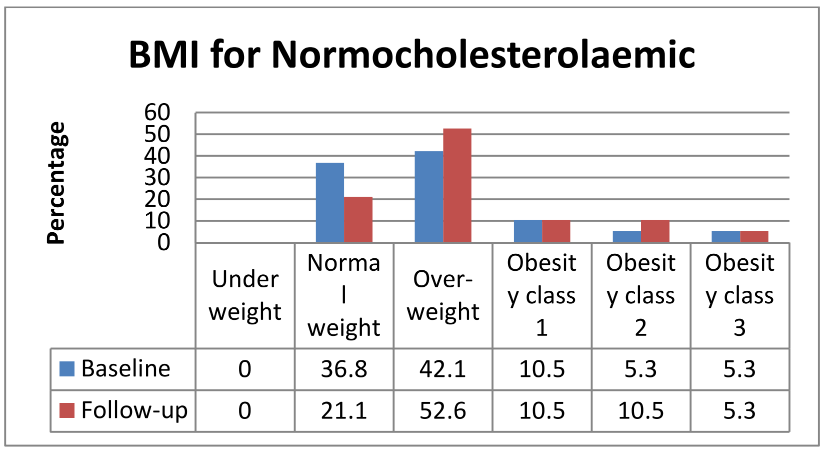

Figure 24 Body Mass Index classification of normocholesterolaemic (n=19) elderly group in baseline and follow-up studies

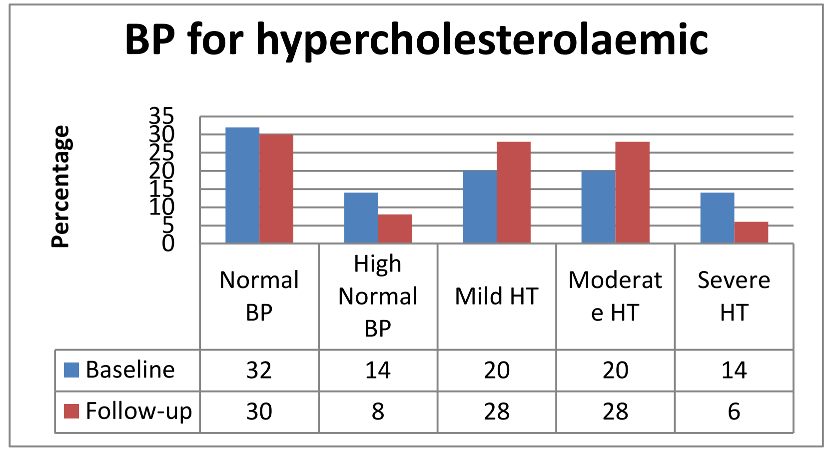

Figure 25 Prevalence of hypertension in hypercholesterolaemic (n=50) elderly group in baseline and follow-up studies

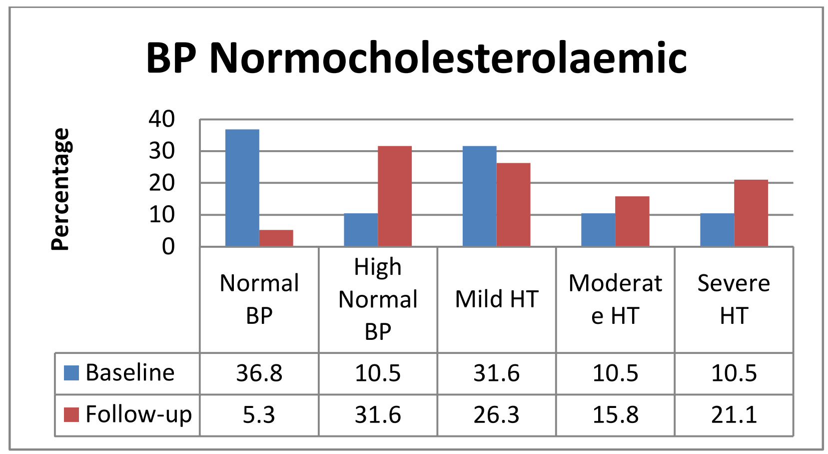

Figure 26 Prevalence of hypertension in normocholesterolaemic (n=19) elderly group in baseline and follow-up studies

5.5.6 Biochemical measurements

The biochemical results (Table 62) for the total group at baseline and follow-up; the paired *t*-test indicated significant changes for serum lipids, namely LDL-C (p=0.002), HDL-C (p=0.000), LDL: HDL ratio (p=0.000), TC: HDL ratio (p=0.000), Vitamin B_{12} (p=0.000), serum folate (p=0.000) and homocysteine (p=0.000) after the intervention. Although the mean serum TC, LDL:HDL ratio and TG:HDL ratio indicated no risk of CVD after the soy intervention, the majority of the serum parameters, namely LDL-C (3.0±0.080), HDL-C (1.2±0.32), TG (1.7±0.61), TC:HDL ratio (3.9±1.57), serum folate (4.0±2.17) and homocysteine (25.8±6.94) the follow-up values still did not meet the recommended levels (<3.0 >1.5, <1.7, <3.5mmol/L, <5.2 ng/mL and <15 µmol/L respectively), and therefore indicated risk of CVD. An interesting significant decrease was seen in serum vitamin B_{12} between baseline and follow-up and a significant increase in homocysteine, which was higher than the normal range.

Table 62 Biochemical measurements of the elderly in baseline and follow-up studies

Parameter and unit of measure	Normal ranges	Baseline study (n=69)		Follow-up study (n=69)		Significant difference between groups (p-value)
		Mean	SD	Mean	SD	
Total Cholesterol (mmol/L	<5.2	5.0	1.02	4.9	0.87	0.918
LDL-Cholesterol (mmol/L)	<3.0	3.5	0.97	3.0	0.80	0.002
HDL-Cholesterol (mmol/L)	>1.5	0.7	0.41	1.2	0.32	0.000
Triglycerides (mmol/L)	<1.7	1.7	0.88	1.7	0.61	0.725
LDL:HDL ratio	>0.4	5.6	2.63	3.3	1.46	0.000
TC:HDL ratio	<3.5	7.9	3.20	3.9	1.57	0.000
Triglycerides: HDL ratio	<2.0	2.8	2.14	2.3	1.59	0.110
Serum Vitamin B_{12} (pg/mL)	>200	612.4	296.25	330.29	92.40	0.000
Serum folate (ng/mL)	5.2-20	9.6	4.78	4.0	2.17	0.000
Homocysteine (µmol/L)	<15.0	15.6	5.28	25.8	6.94	0.000

The lipid parameters for the hypercholesterolaemic and normocholesterolaemic groups before and after the six-month soy feeding intervention are summarised in Table 63. Changes in the lipid profile were seen in both groups after the intervention. In the hypercholesterolaemic group a significant improvement was observed for LDL-C (*p*=0.000), HDL-C (*p*=0.000) and TC: HDL ratio (*p*=0.000), whereas in the NC group only the TC: HDL ratio showed significant (*p*=0.000) improvement, although these values were still above recommended levels in both groups after the intervention. In the normocholesterolaemic group, an increase in TC, LDL-C and HDL-C levels and a decrease in TG were observed from baseline to follow-up, but these were not statistically significant.

The TG: HDL ratio improved significantly in both groups, meeting the recommended level of <2 after the intervention. The TG levels of both groups were at borderline after the intervention. However, in the hypercholesterolaemic group, a significant decrease was seen in LDL: HDL ratio (*p*=0.000) and vitamin B_{12} (*p*=0.000) levels, although the levels were still above those recommended (>0.4mmol/L and >200 pg/mL respectively); also observed were significantly decreased levels of folate (*p*=0.000) and homocysteine (*p*=0.000) to lower than the recommended levels. A similar trend was observed for the NC group. Although the drop-outs' results previously showed that there was a significant (*p*=≤0.05) difference between the drop-outs and the participants only in only serum homocysteine, homocysteine parameter would not have made a significant contribution to the results since both groups had a significant increase in homocysteine from baseline to follow-up. Significant differences between the hypercholesterolaemic and NC groups were seen in TC, LDL-C, LDL: HDL-C ratio and TC: HDL-C ratio at the beginning of the intervention (baseline). However, at the end of the intervention, significant differences were observed only in TC, LDL-C and homocysteine.

Table 63 Biochemical measurements of the hypercholesterolaemic and normocholesterolaemic elderly groups in baseline and follow-up studies

Parameter and unit of measure	Unit of measure	Normal ranges	Hypercholesterolaemic (n=50)		Normocholesterolaemic (n=19)	
			Baseline Mean±SD	Follow-up Mean±SD	Baseline Mean±SD	Follow-up Mean±SD
Total cholesterol	mmol/L	<5.2	5.3±0.9[a]	5.1±0.6[b]	4.0±0.7[a,c]	4.4±0.7[b,c]
LDL-Cholesterol	mmol/L	<3.0	3.9±0.7[a,c]	3.2±0.8[b,c]	2.3±0.5[a]	2.5±0.7[b]
HDL-Cholesterol	mmol/L	>1.5	0.7±0.2[a]	1.2±0.3[a]	0.9±0.7	1.1±0.3
Triglycerides	mmol/L	<1.7	1.6±0.7	1.7±0.6	1.8±1.2	1.7±0.6
LDL:HDL ratio		>0.4	6.3±2.5[a,c]	2.8±1.0[c]	3.7±1.9[a,b]	2.4±1.0[b]
TC:HDL ratio		<3.5	8.5±3.0[a,c]	4.5±1.3[c]	6.3±3.6[a,b]	4.2±1.4[b]
TG: HDL ratio		<2.0	2.6±1.5[b]	1.6±1.0[b]	3.3±3.2[a]	1.8±1.0[a]
Serum Vitamin B_{12}	(pg/mL)	>200	622.2±291.74[b]	330.3±95.7[b]	586.6±314.5[a]	330.3±85.6[a]
Serum Folate	nmol/L	5.2-20	9.2±4.4[a]	4.9±1.9[a]	10.6±5.6[b]	4.6±1.7[b]
Homocysteine	(µmol/L)	<15.0	15.7±5.5[c]	24.5±6.7[a,c]	15.3±4.7[b]	29.3±6.6[a,b]

[a, b, c] in the same row refer to statistically significant difference between the parameters p≤0.05 (independent [two groups Hypercholesterolaemic and Normocholesterolaemic compared at baseline or at follow-up] and paired [within groups change] *t*-test for equality of variance)

Furthermore, changes in the majority of the mean (±SD) lipid profiles observed in the hypercholesterolaemic group after the intervention are evident from the decreased percentage in the prevalence of abnormal lipid profiles in the hypercholesterolaemic group from baseline to follow-up (Figure 27 below). The percentage of people with abnormal TC, LDL-C, TC: HDL ratio, HDL and TG: HDL levels was reduced from baseline to follow-up by 14 percent, 42 percent, 20 percent, 18 percent and 32 percent respectively in the hypercholesterolaemic group. An increase from baseline to follow-up was observed in TG, folate, vitamin $B_{12,}$ and homocysteine in respondents with abnormal serum lipids (Figure 27).

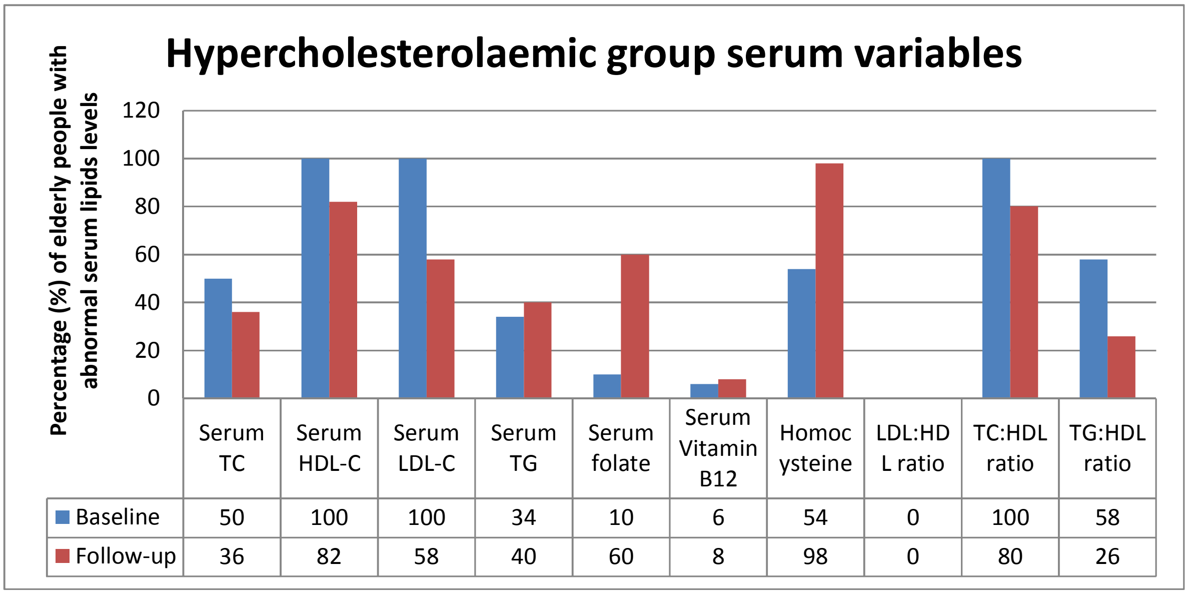

Figure 27 Prevalence of abnormal lipid profiles for hypercholesterolaemic group in baseline and follow-up studies

For the normocholesterolaemic group, an increase in the percentage of people with abnormal serum was seen for TC, LDL-C, TG, folate and homocysteine (Figure 28). The highest increase was recorded for homocysteine.

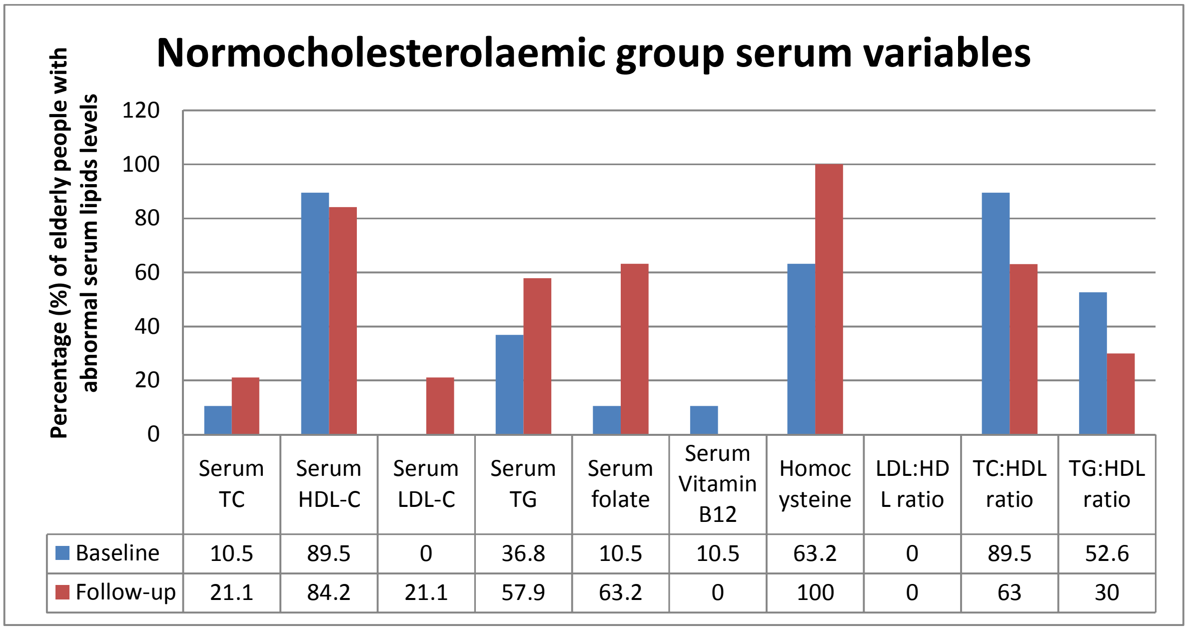

Figure 28 Prevalence of abnormal lipid profiles for normocholesterolaemic group in baseline and follow-up studies

5.6 DISCUSSION

Studies have demonstrated that soy protein can have a beneficial impact in decreasing abnormal serum lipid profiles such as total serum cholesterol (TC), LDL-C and triglyceride (TG) levels, as well as mortality rates from CVD (Borodin *et al.* 2009:495; Anderson *et al.* 1995:281). The decrease in the levels of these serum lipids is associated with significant levels of biologically active components that impart health benefits beyond basic nutrition. As a result, a daily intake of 25 g of soy protein was approved by the Food and Drug Administration (FDA) of the United States of America as an effective cholesterol-lowering food item. In this chapter, an evaluation was carried out to measure the effect of an average of 156 g daily from a soy-based product, with an equivalent of 10 g soy protein consumed for a period of 6 months, on the nutritional status (CVD risk factors) of the elderly of Sharpeville. The baseline and follow-up results were compared, as were the results of the hyper- and normocholesterolaemic groups as stratified based on their LDL-C levels at baseline.

Although the soy-based product were incorporated into the existing diet of the participants rather than a controlled diet setting, several nutrient intake levels decreased after the intervention period with an increase only in vitamin B_6, B_{12}, dietary fibre and folate from baseline to follow-up studies, but these increases for vitamin B_6, B_{12}, dietary fibre were neither statistically significant nor adequate, but only folate was statistically significant whereas, iron, and niacin were adequate at follow-up, with both having a significant increase in the intake of iron after the intervention. These decreases may be associated with a decline in vegetable and fruit intakes and a decrease in carbohydrate food items with small portion sizes from baseline to follow-up studies.

Of major concern is that energy intake decreased significantly by about 20.4 percent form baseline to follow-up, while energy intake at baseline was already below the requirements. The fact that consumption of food high in protein such as soy can suppress appetite (Velasquez & Bhathena 2007:6), (which the elderly may already have poor appetite) and also positively affect satiety and reduce excess body fat in obese people (Velasquez & Bhathena 2007:6) cannot be overlooked. Although the energy reduced, only three of the micro-nutrients (pantothenate, Niacin and selenium) had a significant decrease between baseline and follow-up. The nutritional status of these elderly was not affected as it was also observed that no significant impact on BMI took place. However this intervention had a significant impact on iron intake, which was one of the deficiencies identified amongst this elderly people from previous study (Oldewage-Theron, Samuel et al. 2008:28). Although the food items (soy beans, soy soft porridge, soy milk, soy mashed potatoes) included in the intervention were meant to increase the elderly people's range of foods by incorporating such items as legumes, starchy food, and dairy and also increase nutrient intake, the decline in nutrient intake can be attributed to lack of compliance with the study protocol in the consumption of some of the soy products, especially those consumed at home, since the researcher was able to monitor consumption at the centre only.

This study showed that the single most important attribute influencing compliance in the consumption of the soy-based products was convenience based on the high frequency of consumption of soy food readily available for consumption from the compliance questionnaire, followed by taste acceptance and health benefit. The current study shows that convenience plays an important role in the implementation of dietary interventions for elderly people. Soy products that offered convenience in preparation and consumption were consumed according to the study protocol by the majority of the elderly. However, with the whole soybeans, the elderly experienced difficulties in grinding the soybeans and felt that the beans took too long to cook. The main benefit of using the soy products, as indicated by more than half of the participants in the follow-up study, was feeling more energetic after eating the product.

The study also showed that soy protein was well tolerated and the participants felt that eating the soy products was safe. About 95 percent of the respondents indicated that, if soy were no longer provided by the centre, they would buy it for themselves as long as it proved to be affordable. The self-reported reasons for buying the product for themselves were the satiety value obtained from the soy product, health benefits such as no constipation and reduced BP at check-ups at the clinic, as well as knowledge of the health benefits. The sensory results also revealed high acceptance scores which indicated a high level of tolerance of the soy products. A small percentage of the respondents experienced at least one episode of mild gastrointestinal side effects such as constipation, diarrhoea and bloating. The content of fibre in soy product and soy milk may in part explain these side effects.

The follow-up study results showed no significant effects on the BMI and hypertension variables of the elderly after the intervention. The results of this study on the effect of soy protein on BMI are consistent with the study findings of Liu, and co-authors (2013:4) who evaluated the effect on BMI of using 25.6 g soy protein in women aged 48–65 years old. With regard to the hypertensive results reported in this study, several other studies also did not report any significant effect of soy protein intake on BP (Sacks *et al.* 2006:1038; Matthan, Jalbert, Ausman, Kuvin, Karas, Lichtenstein 2007:962; Jenkins, Kendall, Jackson, Connelly, Parker, Faulkner, Vidgen, Cunnane, Leiter & Josse 2002:369; Hermansen, Søndergaard, Høie, Carstensen, Brock 2001:230). The prevalence of hypertension increased from 53.6 percent at baseline to 62.3 percent at follow-up. In both the baseline and follow-up studies, the prevalence of hypertension was found to be very high in comparison with smaller, randomly selected studies undertaken from 1982–1996 in South African black women, which found a prevalence of 25 percent. Furthermore, the hypertension prevalence of 62,3 percent after the intervention was lower than the prevalence reported for the national sample of older South Africans who participated in the study of Global Ageing and Adults' Health (SAGE) in 2008 (Peltzer & Phaswana-Mafunya 2013:66). However, the high prevalence of obesity – 42 percent at baseline and 44.9 percent at follow-up – could result in a high prevalence of hypertension in older women (Maritz 2006), as observed in this study.

The results of the follow-up study as compared with those of the baseline study showed a significant positive effect on the majority of the serum lipids, namely LDL-C (p=0.002), HDL-C (p=0.000), LDL: HDL ratio (p=0.000), TC: HDL ratio (p=0.000) and serum Vitamin B_{12} (p=0.000). However a negative significant effect was observed for serum folate (p=0.000) and homocysteine (p=0.000) after the intervention. This significant positive effect suggests that an amount as low as 10g of soy protein can have a hypocholesterolaemic effect on elderly people. However, it also seems likely that the decreased intake of total dietary fat and cholesterol by the participants from baseline to follow-up studies may have created conditions suitable for the soy protein to have a positive effect on the serum lipid profiles. Although the mean serum TC, LDL:HDL ratio and TG:HDL ratio indicated no risk of CVD after the intervention, the majority of the serum parameters, namely LDL-C (3.0±0.080), HDL-C (1.2±0.32), TG (1.7±0.61), TC:HDL ratio (3.9±1.57), serum folate (4.0±2.17) and homocysteine (25.8±6.94), and the follow-up values of some variables were still on the borderline of risk while others did not meet the recommended levels (<3.0 >1.5, <1.7, <3.5 mmol/L, >5.2 ng/ml and <15 µmol/l respectively), therefore indicating risk of CVD. A significant decrease was also observed in serum vitamin B_{12} between baseline and follow-up, as well as a significant increase in homocysteine, which was higher than the normal range.

Since the nutrient composition of the soybean includes no vitamin B_{12} and little dietary vitamin B_6 and folate, and because the dietary intake results of vitamin B_6, B_{12} and folate at baseline and follow-up showed a deficiency in these nutrients necessary for reducing homocysteine (McCully 2007:1563S), the lack of these vitamins could be related to increased homocysteine levels observed at follow-up. Furthermore, in examining the results of the baseline and follow-up studies of serum vitamin B_{12}, it is noteworthy that the discontinuation of the vitamin B_{12} supplementation intervention by Grobler (2009) [unpublished data], which was followed by the soy intervention, led to a significant decrease in serum vitamin B_{12} levels. This indicates, therefore, that dietary supplementation of vitamin B_{12} is not enough to improve the serum vitamin B_{12} of the elderly respondents.

The stratified sample allowed the researcher to evaluate the rare extremes of the given population. The results of the hypercholesterolaemic (HC) group showed changes in the lipid profile after the intervention. The percentage of hypercholesterolaemic elderly people with abnormal TC, LDL-C, TC: HDL, HDL-C and TG: HDL levels at baseline was reduced at follow-up. A significant improvement was observed in LDL-C, HDL-C, and TC: HDL ratio levels, but these values were still above the recommended levels of <3.0, >1.5 mmol/L and <3.5 respectively after the intervention. The significant increase in HDL-C and significant decrease in LDL-C in this study were consistent with the studies of Baum, Teng, Erdman, Weigel, Klein, Persky, Freels, Surya, Bakhit, Ramos, Shay and Potter (1998) and Anderson *et al.* (1995:281) respectively. However, the results in this study with regard to HDL-C in the hypercholesterolaemic group were not consistent with the results in a meta-analysis of 38 studies (Anderson *et al.* 1995:281), which reported a non-significant increase in serum HDL-C.

Although a decrease from baseline to follow-up was also observed for the serum TC values in the hypercholesterolaemic group, it was not significant. The results were inconsistent with those of Gardner and co-authors (2001:732), which showed a significant decrease of TC in hypercholesterolaemic postmenopausal women. However, since changes in TC are independent of changes in body weight, dietary fat intake, saturated fat and dietary cholesterol (Anderson *et al*. 1995:281), in this study a significant decrease in the intake of dietary cholesterol and a non-significant decrease of total fat, and saturated fat were observed in the hypercholesterolaemic group. However, no correlation was established between dietary cholesterol and TC in this study.

Only the TG: HDL ratio decreased significantly, meeting the recommended level of <2 after the intervention in hypercholesterolaemic group. An abnormal TG: HDL-C ratio has been proved to be a highly significant predictor of an atherogenic lipid profile and a risk in the development of heart disease, far more significant than high serum cholesterol, LDL:HDL ratio and the TC:HDL-C ratio (Gaziano, Hennekens, O'Donnell, Breslow & Buring 1997; da Luz, Favarato, Faria-Neto, Lemos, Chagas 2008:432). This hypercholesterolaemic group was therefore at low risk of CVD after the intervention. However, the dietary intake of the hypercholesterolaemic group showed low intake of fruits and vegetables at follow-up, as was also found by Medoua *et al*. (2009), leading to low fibre and vitamin intake and antioxidant capacity, which is necessary to reduce the incidence of non-communicable diseases (Medoua *et al.* 2009). Since it has been proved that dietary fibre can lower TG level (Mozzafarian, Appel, & Van Horn 2011), lack of fibre intake by the hypercholesterolaemic group may explain the non-significant increase in the level of serum TG to borderline risk. The increased serum TG level and the HDL-C <1.5mmol/L of the hypercholesterolaemic elderly after the intervention suggests the advisability of a comprehensive lipid treatment. The top 20 food items consumed measured by 24-hour recall for the hypercholesterolaemic group at baseline and follow-up showed that the main source of food consumed was carbohydrate-rich food, with an increase in the frequency of carbohydrate-rich food observed at follow-up. One small, randomised, crossover study conducted by Abbasi, McLaughlin, Lamendola, Kim, Tanaka, Wang, Nakajima and Reaven (2000) associated a high-carbohydrate diet with higher fasting TG and lower HDL-C levels. The finding of the significant decrease in the HDL: LDL ratio in the hypercholesterolaemic group in this study is inconsistent with that of other studies conducted in similar low-income communities in SA, such as the Qwa-Qwa community (Oldewage-Theron & Egal 2013).

On the other hand, when looking at the results of the normocholesterolaemic (NC) group, the dietary intake results showed the introduction of less healthy foods such as cold drinks, fried potato chips and increased portions of sugary food items on the list of top 20 food items consumed at follow-up. Considering that the literature indicates that the highest predictive factor of health-promoting behaviour in an elderly person is having an illness, and that having an illness increases the motivational level of compliance crucial for the outcomes of the intervention for the elderly people (Chamroonsawasdi *et al.* 2010:18), this less healthy dietary intake may indicate that the NC group was aware that they were normocholesterolaemic, hence the small per capita intake of the intervention food items such as soy milk (13.2 g). Soy mashed potatoes also did not appear among the top 20 food items consumed by the NC.

The introduction of fatty foods by the NC group did not significantly increase dietary cholesterol and SFA after the intervention. However, the serum lipid levels of the NC group such as TC increased significantly after the intervention; LDL-C also increased but not significantly. The increase in these lipids was still within the recommended level. No positive significant difference was observed in dietary cholesterol and serum TC level. The results of this study with regard to the TC levels of the NC group are similar to the results of Oldewage-Theron and Egal (2013:434).

When comparing the hypercholesterolaemic and normocholesterolaemic groups, both groups showed abnormal mean values for HDL-C, TC:HDL ratio, serum folate and homocysteine at follow-up, with a statistically significant difference between the groups only for Hcy. The Hcy levels increased more in the NC group than in the hypercholesterolaemic group after the intervention. Significant differences between the hypercholesterolaemic and NC groups were seen in TC, LDL-C, LDL: HDL-C ratio and TC: HDL-C ratio at the beginning of the intervention (baseline). However, after the intervention (follow-up), significant differences were observed only in TC, LDL-C and homocysteine. The top 20 food items consumed by the two groups indicated that per capita intake of soy milk of the hypercholesterolaemic group (50.2 g) was nearly four times that of the normocholesterolaemic group (13.2 g), but still did not meet the recommended intake.

5.7 CONCLUSION

In conclusion, the findings of this study showed that hypercholesterolaemia, obesity and hypertension were prevalent among this elderly group. The daily consumption of 10 grams of soy protein coupled with the reduction of dietary fat and cholesterol had a hypocholesterolaemic effect, particularly on hypercholesterolaemic subjects. Therefore it is possible that substituting any low fat protein source may beneficially impact serum lipids in elderly people of Sharpeville. It was thus proven that a diversified diet with moderate daily intake of soy may be a safe, inexpensive and practical method for improving the risk of cardiovascular disease and reducing the need of medical treatment in the elderly population.

6

CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

Globally, cardiovascular diseases are the leading causes of death (Mathers, Salomon, Ezzati, Begg, & Lopez 2006). In previous years, CVD was described as affecting affluent populations. However, recently CVD rates have declined among the affluent whereas it has increased in middle- and low-income populations. Currently CVD is responsible for about 17 percent of all deaths in SA, with CVD (ischaemic heart disease) and stroke being the leading single causes of death among the elderly (Joubert & Bradshaw 2006:211). It is estimated that 5.5 million South Africans older than 30 years are at risk of developing CVD. This could be due to raised total serum lipid levels that result from poor diets (Joubert & Bradshaw 2006:211).

An adequate diet is a component of successful ageing. However, the key determinant leading to malnutrition within the elderly population is poverty. Unhealthy diets due to poverty and the nutrition transition are promoting overweight and obesity, which are risk factors for CVD. The lack of attention given to the health care needs of the elderly in Africa, including South Africa, makes the situation even worse; many of the nutrition programmes are primarily directed to other groups such as children and pregnant mothers.

6.2 OBJECTIVES

The objective of this study was to implement and evaluate the impact of a soy-protein intervention, given seven days a week over a period of six months, on the nutritional status of an elderly community of Sharpeville, in which poverty, malnutrition (under- and over-nutrition) as well as household food insecurity and poor health were prevalent. The specific sub-objectives were to:

- Determine the risk factors for CVD prevalent in this elderly community of Sharpeville (Serum lipids, vitamin B_{12} and folate status for cardiovascular disease (CVD), weight and height for obesity and waist circumference) and nutritional status.
- Develop, test and implement a Nutrition Education Programme (NEP) based on soy to improve the elderly sample's awareness and knowledge of the health benefits of soy.

- To include soy protein in the daily diet of the elderly based on the findings of the first two sub-objectives

- Assess the acceptability of (Tshivhase 2012) and compliance in the consumption of soy products included in the menu of the elderly.

- Evaluate the impact of the soy intervention on the nutritional status of the elderly (biochemically, and anthropometrically, and assess the impact on dietary intake).

6.3 LIMITATIONS

6.3.1 Voluntary drop-outs and sample size

In the exploratory survey (n=155), there were fewer men (n=19) respondents than women. As a result, the findings of this study do not represent the nutrition education needs of an elderly male population in South Africa. Oldewage-Theron, Samuel and Venter (2008) have shown that in Sharpeville, there are far more older women than older men.

The soy awareness education intervention results may not be generalised owing to the convenience sampling applied and some self-selection bias may have occurred. However, these findings can be used as preliminary information when planning nutrition education programmes for the elderly with similar background characteristics.

A limitation of the soy intervention study was the small sample size which resulted when a total of 65 elderly people did not complete the follow-up measurements. Nevertheless, the stratified samples, namely the hypercholesterolaemic (n=50) and normocholesterolaemic (n=19) groups, in the soy intervention study were represented by percentages similar to those in the baseline study (more than 70% of the respondents being hypercholesterolaemic and more than a third of the respondents normocholesterolaemic). However, the sample size of only 19 people in the normocholesterolaemic group may have resulted in less statistical significance.

6.3.2 Measuring instruments

The dietary diversity results (DDQ and 24-hour recall) may have been confounded by memory loss in the elderly people as it was a retrospective questionnaire relying on memory. However, the simultaneous use of these methods was intended to overcome this.

In the soy knowledge questionnaire, the low attention span of the elderly prohibited the inclusion of many topics to assess knowledge; in this study the measuring instrument did not assess knowledge of the SA FBDG by the elderly even though the guidelines formed part of the education programme.

6.3.3 Poor compliance

In this study the least amount of soy protein consumed by the elderly was 4.62g per day but, on average, 10g of soy protein per day was consumed instead of the recommended 25g per day (Sacks *et al*. 2006:1689). Although the recommended amount of 25g soy protein is not high, it may be easier for Asians than for elderly South Africans to accept since soy is customarily eaten by Asians. High amounts of soy for people who are not familiar with it may result in fewer people following the intervention programme (Borodin *et al.* 2009:492). On the other hand, 10g soy protein per day has been shown to make a practical contribution to health and metabolic changes in TC levels (Sadler 2005), as observed in Asian studies which indicate a low prevalence of CVD risk factors due to the fact that older Japanese and Shanghai adults consume approximately 6–11g and 8.8±6.3g respectively of soy protein per day (Messina & Nagata 2006; Yang *et al*. 2005:1012). In addition, compliance in the consumption of some of the soy-based products in this study, such as whole soybeans, was found to be poor owing to the lack of convenience in cooking it.

6.3.4 Absence of control group

The absence of the control group in the study design was one of the study limitations.

6.3.5 Time lapse between the baseline study and the implementation of the intervention

Limitation could be the 12 months lapsed between baseline and implementation of soy based feeding intervention. However, during the 10 months nutrition education was implemented to sensitise the elderly people about the health benefits of soy. Furthermore the lapse in time should not have influenced the results because during the eight years before this study was implemented no significant changes in dietary intakes and socio-economic status were observed (Oldewage-Theron & Kruger 2008a; Oldewage-Theron, Salami *et al*. 2008; Oldewage-Theron, Samuel & Venter 2008; Oldewage-Theron, Samuel &

Djoulde 2008; Oldewage-Theron, Samuel, Grobler & Egal 2008; Medoua, Egal & Oldewage-Theron 2009; Otitoola, Oldewage-Theron & Egal 2015).

6.4 MAIN FINDINGS

6.4.1 Literature

6.4.1.1 Nutritional health status of the elderly

Globally, malnutrition is reported to be on the increase in elderly people. Currently 16 percent of those ≥65 years and 2 percent of those ≥85 years old are classified as malnourished. These figures are predicted to rise dramatically in the next 30 years (Ahmed & Haboubi 2010). However, in SA chronic diseases of lifestyles (CDL) were also reported on the increase and were accountable for an estimated 84 percent of deaths among elderly people in the year 2000 (Joubert & Bradshaw 2006:210). The literature further reports that increased urbanisation which is often coupled with poor nutrition among the black people in South Africa has also led to significant increase in diseases of lifestyle (Vorster 2002:243). The elderly people amongst these settings are experiencing health problems such as obesity, hypertension, CDV and diabetes mellitus.

6.4.1.2 Nutrition education

Health promotion and nutrition education programmes for the elderly population are limited owing to uncertainty about whether nutrition education interventions at a later age can improve the health status and quality of life and reduce health care expenditure (Sahyoun *et al.* 2004). The literature tended to report only limited success by nutrition education interventions in changing behaviour and increasing knowledge but certain features, such as limiting information to one or two simple, practical messages and targeting specific needs, had positive outcomes (Sahyoun *et al.* 2004).

6.4.1.3 Food-based intervention for the elderly

Literature indicates that elderly people are largely excluded in food interventions owing to misconceptions that they do not need assistance because they get assistance from their families. However, there is evidence that food-based interventions are important for the elderly since their nutritional status is compromised by taking care of other household members. A survey of pensions in Namibia and South Africa indicated that the bulk of the pension fund (43%) is spent on the entire household, 29 percent on individual relatives and only 28 percent directly on pensioners themselves (HelpAge International 2012:5). The literature also indicates that food interventions for the elderly conducted in a social environment have a positive effect on the nutritional status of the elderly since meals with peers reduce the risk of the food being passed on to grandchildren. Older persons who have difficulties in preparing meals for themselves can benefit from such community food-based interventions.

6.4.2 Baseline study

Extreme poverty – less than 2 US$ a day (Fosu 2007:734) – and food insecurity exist in the elderly community of Sharpeville. The majority of the elderly had low formal education attainment. The risk of food poverty such as poor dietary intake leading to deficient intake for the majority of nutrients and low mean energy intake were observed. In this elderly group, the poor diets, which consisted mainly of a diet high in processed carbohydrates with the cereal group being the most diverse, a high intake of saturated fats, particularly of animal origin and very low frequency and small portions of vegetables and fruits, contributed to poor health outcomes. The mean daily protein intake was sufficient for both men and women. However, the protein was mainly of animal origin, and accounting for the high intake of saturated fat. The dietary cholesterol intake, however, was within the recommended guidelines.

With this poor dietary intake, a high prevalence of CVD risk factors, namely obesity (75.3%), hypertension (56.7%), dyslipidemia/ hypercholesterolaemia manifested by high LDL-C, low HDL-C, high TC: HDL ratio, high TG: HDL ratio and high homocysteine levels, was observed in the total group. The most outstanding anthropometric feature was the waist circumference with a mean (±SD) 97.32±10.32, which indicates a substantial risk level (≥88), with over 80 percent of the respondents at risk. Cardiovascular disease remains the major health problem faced by governments globally and in South Africa. This was also true of the elderly community of Sharpeville.

6.4.3 Soy awareness education intervention

The results of the exploratory study which was designed to assess the nutrition education needs of the elderly before the experimental study (NEP) reflected positive findings important for educators to consider when planning a NEP for the elderly. Firstly, the results revealed a high level of interest by the elderly people in participating in the nutrition education intervention. Secondly, the results showed that it was essential to assess suitable nutrition education delivery methods, tools and messages preferred when planning and implementing nutrition programmes for the elderly, as each group may favour different delivery methods, tools and messages. Overall, the exploratory study proved to be beneficial in formulating a nutrition education programme that was relevant to the needs of the target group, namely the use of a familiar tool (a calendar), written in the local language (Sotho) and having coloured drawings for illustration. The results showed that topics preferred by the elderly for the Soy Awareness Education Programme (SAEP) varied based on gender and motivational level (current health status).

The implementation of the SAEP, based on the exploratory study results, resulted in a high attendance rate of 90.9 percent. The SAEP was found to be effective in increasing knowledge and awareness of soy and its health benefits by 14.4 percent on average from pre-test (63%) to post-test (77.4%). The results indicate that knowledge of soy was fairly good before the intervention, and then improved to good after the intervention. A statistically significant improvement in the number of correct answers was achieved in 20 out of 24 survey questions and statements in the post-test.

6.4.4 Soy-based feeding intervention study

6.4.4.1 Drop-outs

The elderly had 99.3 percent rate of participation during the feeding process. This included all collection of the different soy food product to be consumed during the intervention and consuming the soy food products served at the centre. However a drop-out rate of about 49 percent was experienced during the measurement phase owing to lack of turn up from the elderly during the measurement time and also incomplete data set were other measurements such as blood samples were not taking because of fear of needles and ethics of voluntary participation was followed. Therefore this resulted in poor compliance to the completion of the study. The results of the baseline serum lipid parameters of those lost to follow-up indicated that a significant difference (*p*=0.047) between the drop-outs and the participants was seen only in serum homocysteine. Furthermore, the complete data set for the soy-based feeding intervention indicated a similarly representative percentage of hypercholesterolaemic and normocholesterolaemic groups as for the baseline study, when the elderly were stratified based on their LDL-C levels (Hermansen, *et al*. 2005:844; Jenkins *et al.* 2005).

6.4.4.2 Compliance in consumption of soy product, sensory tests and plate waste

Compliance in the consumption of the soy-based product was measured by a questionnaire and the results indicated that majority of the elderly adhered to the study protocol focusing on the intake of soy-based products such as milk and potatoes, but not soybeans. The prescribed portion sizes were not considered by these elderly. Convenience in preparation and consumption of the soy-based products influenced adherence to study protocol; as a result, there was less consumption of soybeans in this intervention study because they were perceived as difficult to grind or cook. Different types of dishes were prepared using the soybeans provided. Soybean soup and plain boiled soybeans were the more popular dishes prepared and consumed. Self-reported advantages of using the soy-based products by the elderly were the provision of energy, elimination of bowel movement problems, good satiety value and reduced BP at check-ups at the local clinic. The majority of the elderly indicated no signs of side effects from consuming the soy-based products. However, gastrointestinal side effects such as constipation, diarrhoea, bloating and heartburn were indicated by a minority of the elderly. The sensory results revealed that the majority of the elderly liked the taste of the soy product, the taste of milk being most enjoyed, followed by soy mashed potatoes then soy soft porridge. Plate waste was not measured as plates came back empty from the dining hall, but a few elderly people were observed not eating but taking the food home.

6.4.4.3 Dietary intake results

The dietary intake follow-up results indicated that the consumption pattern did not change dramatically during the intervention. However, a slight decrease was observed in the majority of nutrients, with a statistically significant decrease in total dietary fat, cholesterol and animal protein. Similar patterns were observed in the dietary intake results of the hypercholesterolaemic (HC) and normocholesterolaemic (NC) groups. However, an increase in the sodium intake was observed in the NC group. The top 20 food items consumed indicated that the elderly groups' diets were still largely carbohydrate-based after the intervention. The introduction of plant protein (soy) and an increased per capita intake of milk were observed after the intervention. The frequency and per capita intake of fruits and vegetables was reduced at follow-up. The majority of the soy-based food products appeared on the list of the top 20 food items consumed by the HC group; as a result an increase in the total of food items consumed from all food groups was seen only in the HC group. The introduction of less healthy foods with high levels of sugar and fats, such as cold drinks and fried potato chips, was observed in the top 20 food items consumed by the NC group.

6.4.4.4 Anthropometric and hypertension results

The anthropometric and hypertension results indicated that the soy-protein intervention (follow-up study) had no significant beneficial effect on the high levels of BMI, BP (SBP and DBP) and waist circumference reported in the elderly people during the baseline study. The percentage of elderly people reported with a BMI range of overweight to obesity increased for the NC group after the intervention while a decrease was observed for the HC group. Furthermore the percentage of hypertensive people increased in both groups from baseline to follow-up by 8 percent and 10.6 percent respectively. The mean waist circumference (WC) of the NC group decreased by 1.62 cm and the WC of the HC group increased by 0.2 cm after the intervention. Neither of the changes in the WC of each group was statistically significant. No significant changes were observed within and between the groups in the anthropometric and hypertension measurements.

6.4.4.5 Biochemical results

The biochemical results indicated a beneficial effect of the soy-based products on the following serum lipids: a significant decrease in LDL-C, TC: HDL ratio and a significant increase in HDL-C for the total group after the intervention. However, after the intervention, high risk factors for CVD were observed in this elderly group, with a significant decrease in serum folate, which was below the recommended level, and a significant increase in homocysteine to above the recommended level.

Furthermore, the soy-based feeding intervention proved to be more beneficial to the serum lipid levels of the HC group than the NC group. This was seen from the decrease in the prevalence of elderly people with abnormal serum lipids in the HC group as compared with an increase in the percentage of people with abnormal serum lipids in the NC group. Significant differences between the HC and NC groups were seen in TC, LDL-C, LDL: HDL-C ratio and TC: HDL-C ratio at the beginning of the intervention (baseline). However, after the intervention (follow-up) significant differences were observed only in TC, LDL-C and homocysteine.

6.5 CONCLUSION

This study has found that CVD risk factors were prevalent amongst the elderly of Sharpeville as a result of household food insecurity and poor dietary intake. A soy awareness education programme proved to be effective in significantly improving the knowledge of the elderly after the intervention. The participatory approach was important in this study to ensure that messages and media channels were relevant, meaningful and acceptable to the elderly, ensuring a positive impact. However, the soy feeding intervention indicated that there was no dramatic increase in dietary diversity, although there was lack of compliance in the intake of some of the soy-based products and the per capita intake of these products was small. The daily intake of 10g of soy protein had a statistically significant impact on the serum lipids, the impact being more pronounced in the hypercholesterolaemic group. This indicates that food-based interventions that include legumes such as soy, which are less expensive, coupled with a diversified diet of selected food items such as reduced saturated fat and cholesterol, are healthy options in this situation of elevated serum lipids.

6.6 RECOMMENDATIONS

6.6.1 The elderly and the management of the elderly care centre

The following recommendations are made for the elderly and the management of the elderly care centre:

- Long-term interactions between the educators or researchers and respondents/participants are recommended as the soy education intervention study showed that this allows positive knowledge increase to be brought about effectively. By determining the understanding of individual variables, the researchers could critically assess the difficulties of the elderly in understanding the of role nutrients in human nutrition. Effective continuous training of the elderly in basic nutrition knowledge is recommended because an important factor influencing human nutrition behaviour and human health is the ability to correlate knowledge of the composition of food items with the impact of food on human health (Wansink, Westgren & Cheney 2005). Elderly people equipped with good nutrition knowledge will be less susceptible to poor eating habits, and their knowledge will impact on the entire household as the elderly in Sharpeville are often the breadwinners, responsible for food procurement and preparation in the households in this community.

- Household food insecurity and poor dietary intake are the leading causes of poor health among these elderly people. Food products such as soy-based products, which are affordable and have unique health benefits, are recommended for daily consumption in the day care centre and in the households of the elderly to provide potential beneficial effects on their elevated serum lipids.

- Furthermore, strict monitoring is required during meals by the management of the day care centre to prevent the elderly from taking the food home instead of eating it themselves. Taking the food away does not guarantee that the elderly will eat it, and efforts to improve nutritional status of the elderly may not succeed.

6.6.2 Policy makers and health workers

A national policy on older persons, which can identify principal areas of intervention for this population, should be established in South Africa. Health policies in South Africa are largely focused on other groups of the population such as youth, children and maternal care issues.

Since the majority of the elderly showed an interest in the nutrition education intervention, nutrition education programmes among the elderly should be encouraged. Policy makers should therefore design long-term educational programmes to promote health in the elderly. Because the elderly trust their churches and church leaders, health professionals should consider engaging such organisations or people in implementing nutrition education as this can provide some relief to the overcrowded primary health facilities and nurses from whom the elderly obtain health information. Churches and other religious groups can also play a role in increasing awareness and knowledge of specific health practices and in introducing new knowledge if collaboration between health departments and faith based organisations is established.

It is recommended that a soy dietary intervention should be implemented in parallel with the supplementation of vitamins such as vitamin B_{12} and folic acid since the soy intervention, unlike supplementation, does not have an impact in the short term. Furthermore, CVD risk factors among the elderly should be continually monitored and more successful strategies designed for prevention, early detection and treatment.

6.6.3 Future research

The researcher recommends the following for future research:

- Since knowledge of soy improved significantly, it is recommended that further studies assess the impact of the knowledge gained on the dietary behaviour of the elderly population.

- Since this was an exploratory study, the results suggest that researchers need to conduct more studies so as to come up with what constitutes a well-constructed nutrition education intervention for the elderly.
- A well-designed soy-based intervention study with a control group, a statistically representative sample and at least 25 grams of soy protein products daily is recommended in this elderly community to assess the impact of soy protein on CVD risk factors.
- The 10g per day of soy protein administered to elderly people of Sharpeville should encourage investigation into its long-term effect.

6.7 OUTCOMES AND SELF-EVALUATION OF THE STUDY

The outcomes of the study based on the study objectives are presented below:

6.7.1 Reliability of the study

The NEP study has illustrated how using adult learning principles (a participatory approach) may be helpful in the assessment of nutrition information needs among the elderly poor and in obtaining their perceptions of NE in order to plan effective nutrition education in future. The NEP questionnaire was tested for reliability and had a Cronbach's alpha of 0.76. This study has also proved valuable in contributing to an understanding of how a NEP can influence knowledge among elderly people.

6.7.2 Data collection

The data collected during the various stages of the study presented no difficulties and were easy to evaluate.

6.7.3 Achievement of objectives

Overall, the sub-objectives and main objective of this study were achieved. Since this study was an exploratory study, issues and actions necessary for the successful execution of a similar intervention for future research were revealed. The risk factors for CVD prevalent in this elderly community of Sharpeville were identified effectively. The participatory approach applied during the NEP proved to be essential, since it allowed the elderly to learn what was relevant and acceptable to their needs and therefore improved the elderly respondents' awareness and knowledge of the health benefits of soy for the identified risk factors of CVD. The information provided enabled the elderly to participate in the soy feeding intervention with enthusiasm, and a high level of acceptance of the soy-based product was achieved despite the high drop-out rate in the study.

6.7.4 Benefits to the elderly people

The elderly people were made aware of their nutritional status before the soy feeding intervention and were provided with nutrition knowledge based on soy. It is anticipated that the knowledge of soy gained by the elderly will empower them to adopt healthy dietary practices that will lead to good nutritional status. It is also expected that better food choices will be made, incorporating soy which is affordable and provides essential nutrients and additional unique health benefits. The demonstration of the soy recipes and the recipe hand-outs to the elderly will enable them to prepare healthy foods using soy and the ingredients readily available in their households. The elderly respondents also benefited from the soy feeding intervention, which increased and diversified their intake of dietary protein, alleviated hunger during that period and reduced the level of abnormal serum lipids.

6.7.4 Success of this study

The success of this study is that it provides insights that can be used in planning similar interventions for elderly people in terms of the amount of soy protein used. Although the intake of 10g of soy protein in this study may not have significant clinical relevance, the study revealed that the public health implication may be important in terms of reducing the prevalence of abnormal serum lipids. Regular intake of 10g soy protein per day may make a useful contribution to health, and it is easy to incorporate this amount in the diet for people not familiar with soy (Sadler 2005).

The successful completion of this study will lead to a post-graduate qualification. Various articles can be published with co-authors, relating to assessment of the nutrition education needs of the elderly, the impact of a soy nutrition education programme on nutrition knowledge of the elderly, assessment of the prevalence of CVD risk factors in the elderly community and the impact of soy protein on CVD risk factors. Furthermore, the production of soy milk using the soy-cow machine provided an opportunity for capacity building.

6.8 Concluding remarks

The prevalence of cardiovascular disease and the risk factors associated with the disease are increasing rapidly among the elderly. To date, no research has been conducted to assess the effect of soy protein on the risk factors of cardiovascular disease among the elderly in SA, regardless of the approved health claim that daily intake of 25g of soy protein is protective against CVD (Sacks *et al.* 2006) and also the historically low incidence of cardiovascular disease in elderly Asian people. The results of this study confirmed the prevalence of CVD risk factors among the elderly in Sharpeville. The soy feeding intervention indicated that soy protein may have an impact on abnormal serum lipids associated with CVD among the elderly. Moreover, a soy feeding intervention can improve dietary diversity in terms of plant protein sources and also alleviate hunger. The nutrition education based on soy proved to be effective in improving the nutrition knowledge of the elderly. The knowledge gained of the health benefits of soy and its impact on serum lipids will enhance the need for self-sufficiency in soy protein through the food gardens implemented by Oldewage-Theron and co-researchers in this elderly community.

6.9 THE ROLE OF THE RESEARCHER

The role of the researcher in this study was the following:

✓ Reviewing the literature and writing the proposal.

✓ Compiling the nutrition education needs questionnaire and the soy knowledge questionnaire.

✓ Developing, testing and implementing the soy awareness education programme.

✓ Collecting the data (nutrition education needs, soy knowledge, dietary intake, compliance, anthropometric and biochemical) with the assistance of trained fieldworkers and experts.

✓ Production of the soy milk, distribution and control of the soy-based products for the soy feeding intervention.

✓ Training of the food service volunteers in the preparation and portion serving of the soy-based products (soft porridge and mashed potatoes).

✓ Initially, a statistician assisted with data analysis and later the researcher completed further statistical analysis and interpreted the data.

✓ Writing of the thesis.

6.10 RESEARCH OUTPUTS

Two manuscripts from this study are in the final stages and will be sent for review. The articles are titled:

1. Assessment of the nutrition education needs of the elderly of Sharpeville, South Africa.

2. The impact of a soy awareness education programme on knowledge of the health benefits of soy among the elderly attending a care centre in Sharpeville, South Africa

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ANNEXURES

ANNEXURE A Ethical approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

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

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M070126**
PROJECT	Multi-Micronutrient Supplementation to Address Malnutrition amongst the Elderly Attending the Sharpeville Care of theAged
INVESTIGATORS	Prof W Oldewage-Theron
DEPARTMENT	Inst. of Sustainable Livelihoods
DATE CONSIDERED	07.01.26
DECISION OF THE COMMITTEE*	Approved Unconditionally (The Committee suggest-

delay the quality of life information to the end of the study so that it does not confound findings

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

DATE 07.01.30 **CHAIRPERSON** ....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof W O-Theron

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

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

CLEARANCE CERTIFICATE PROTOCOL NUMBER M040835

PROJECT	Sharpeville Integrated Nutrition Project for the Elderly
INVESTIGATORS	Prof W Oldewage-Theron
DEPARTMENT	Hospitality & Tourism
DATE CONSIDERED	04.08.27
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 04.09.03 CHAIRPERSON .... (Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof Cs Venter

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

ANNEXURE B Informed consent form

Informed consent

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

I hereby indemnify the Vaal University of Technology (VUT) or any employee of the VUT, against any liability that may originate during my participation in this research project. I further undertake that I will not lay any claim against the VUT or any VUT employee for damage or personal disadvantage that I may suffer as a result of this research.

....
Signature/mark/thumb print of the Volunteer participant

Signed at ....on...

I, ... herewith confirm that the above participant has been fully informed about the nature, conduct and risk of the above study.

STUDY DOCTOR:

Printed Name Signature Date and Time

TRANSLATORS/FIELDWORKERS/OTHER PERSON EXPLAINING INFORMED CONSENT
.... (DESIGNATION):

Printed Name Signature Date and Time

Witnesses

Name... Name ....
Signature .... Signature ....
Signed at ....on..

ANNEXURE C Fieldwork Control form

SHARPEVILLE INTEGRATED NUTRITION PROJECT (SINP)
SOY INTERVENTION PROJECT
FIELDWORK CONTROL

Participants Study ID number : ....

Stations	Activity	Beginning of the clinical trials	End of trial
Station 1: Check/control	Handing out of file and check consent form and deatils		
Station 2: Socio-demographic and health data	-Socio-demographic questionnaire -Health questionnaire		
Station 3: Clinical signs, blood	-Oral tempersure............... -Blood pressure............. -Clinical signs -Drawing of blood		
Station 4: Cafe	Handing out of snacks		
Station 5: Anthropometry	-Weight..................... -Height..................... -Waist circumference............		
Station 6: Dietary intake	-24-hour recall -Food frequency questionnaire -Compliance		
Station 1: Check/control	Control that all fieldwork is complete		

ANNEXURE D 24-hour recall questionnaire

24 – HOUR RECALL

Subject ID Number: _______________ Gender: Male/Female

Interviewer: ____________________

Date: _______ / ________ / 2008

Tick what the day was yesterday:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Would you describe the food that you ate yesterday as typical of your habitual food intake?

Yes	No

If not, why?...

I bought some food	My visitor brought me some food	Other reasons (pls. specify)

I want to find out about everything you ate or drank yesterday, including food you bought. 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.

ime (approximately)	**Place**	**Description of food**	**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 (after breakfast)					

Time (approximately)	Place	Description of food	Amount	Amount in grams (office use Only)	Code (office use only)
Middle of the day (Lunch time)					
During the afternoon					
At night (dinner time)					

Time (approximately)	Place	Description of food	Amount	Amount in grams (office use) Only)	Code (office use) only)
After dinner, before going to sleep					
* Do you take any vitamins (tablets or syrup)				Yes	No
Give the brand name and dose of the vitamin/tonic:					

ANNEXURE E Dietary Diversity questionnaire

DDQ LIST OF FOODS AND FOOD GROUP DIVERSITY

PLEASE INDICATE THE FOOD YOU ATE DURING THE PAST SEVEN (7) DAYS BY A (X)

GROUP 1: Flesh foods (meat, poultry, fish) diversity	Yes	No
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	**Yes**	**No**
Eggs		
Group 3: Diary products diversity	**Yes**	**No**
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	**Yes**	**No**
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	**Yes**	**No**
Sugar beans		
Peas (dried)		
Jugo beans		
Peanut butter		
Peanut or any other nuts		
Soya		
Group 6: Vitamin A-rich fruits and vegetables diversity	**Yes**	**No**
Pumpkin		
Carrots		
Wild leafy vegetables (morogo)		
Fresh and dried		
Spinach		
Butternut		
Apricots (Applelkoos)		
Peach (yellow cling)		
Mango		
Group 7: Other fruits (and juices) diversity	**Yes**	**No**
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	**Yes**	**No**
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	**Yes**	**No**
Butter		
Sunflower oil		
Margarine		
Lard		
Salad oil		

ANNEXURE F **Nutrition education needs questionnaire for the elderly**

VAAL UNIVERSITY OF TECHNOLOGY

NUTRITION EDUCATION QUESTIONNAIRE FOR THE ELDERLY

Please note that information gathered from you as the respondent will be treated with respect and confidentiality. Personal and sensitive information will not be identifiable from any reports.

Please complete the following

Date...
Name and surname...
Gender M................F..
Date of Birth...
Address...

1. **Please tick the answer you think is the correct one**.

1.1 How do you describe you current nutrition knowledge?

Excellent	Very good	Good	Fair	Bad/Poor	Don't Know

1.2 How do you describe your reading ability?

Excellent	Very good	Good	Fair	Bad/Poor	Don't Know

1.3 What is the highest standard completed in school?

Below Standard 5	Standard 6-7	Standard 8	Standard 9	College	Don't Know

1.4 Where do you mostly get your nutritional advice from?

VUT staff	TV	Sister at clinic	Magazine	Family members	Others specify ....

1.5 Would you prefer to learn more about nutrition?

YES	NO

1.6 If your answer to question 1.5 is YES, what type of nutrition tools/materials would you prefer?

Fridge magnets	Posters	Place mats	Magazine articles	Pamphlets/ Booklets	Calender	Lectures

1.7 What language should the nutrition education material/tool be?

Sotho	Tswana	English	Zulu	Afrikaans	Other, specify.........................

1.8 Should the nutrition education materials/tools be:

a) Black and white

b) Bright colours

c) Pastel colours

1.9 What do you think should be included for clarification on the nutrition information?

a) Cartoons

b) Colour drawings

c) Photos

d) Others specify...

1.10 Which font size would you prefer for better reading? **(Tick only <u>ONE</u> option)**

a) Enjoy a variety of food

b) Enjoy a variety of food

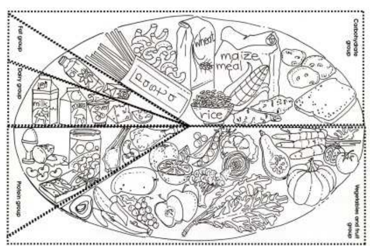
c) **Enjoy a variety of food**

d) ENJOY A VARIETY OF FOOD

1.11 **<u>Tick</u>** the pictures that you would prefer for nutrition education material/tools.

1.11.1 a)

b)



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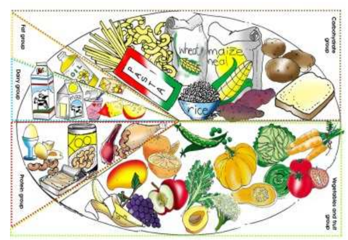

1.11.2 a)

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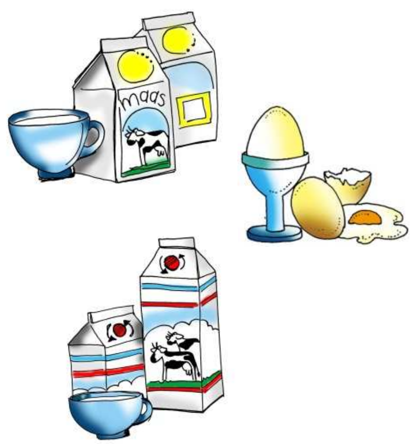
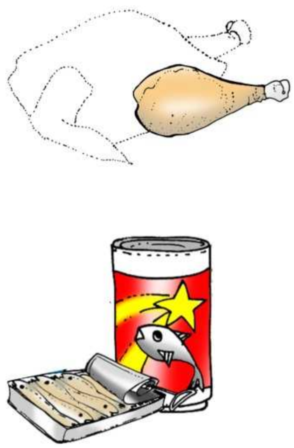


c)

1.11.3 a) b) c)



1.11.4 a) b) c)

1.11.5 a) b) c)

1.12 Which of the following topics would you like to learn more about? Choose only **three** and rate them as first, second and third important (1=most, 3 least).

Topic	**Importance**
1 Role of nutrition in health	
2 Nutrition and heart disease	
3 Soy and its health benefits	
4 Osteoporosis	
5 Foods and nutritient composition	
6 HIV/AIDS and nutrition	
7 Exercise and nutrition	
8 Nutrition and hypertension	
9 Soy and its nutrients	
10 nutrition needs for the elderly	
11 Nutrition and diabetes	
12 Soy and its different uses	
13 Diseases of lifestyle related to diet	
14 Obesity and overweight	

Thank you for your assistance!!

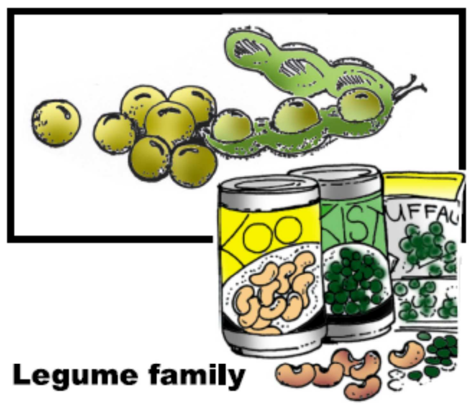
K. Marumo

DTech student at VUT.

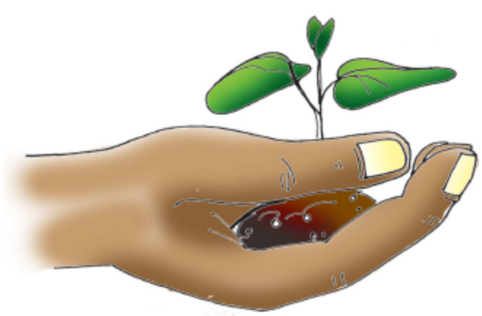
Learn about

Soy

Introduction to soy

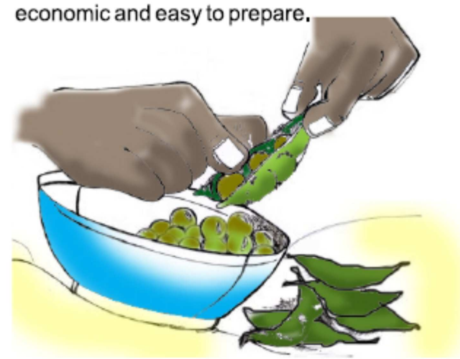


Soybean plant

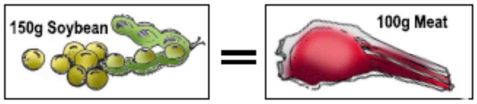


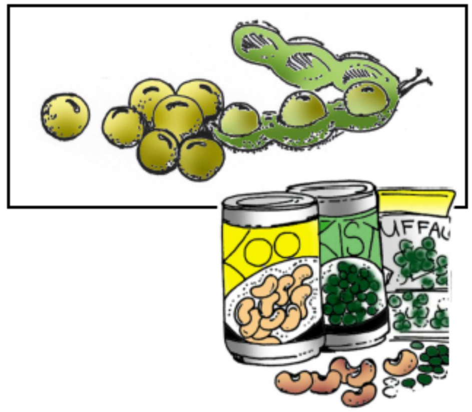
- Soy comes from the soybean plant.
- A soybean is a hard dry bean that can be yellow, black or brown.
- Soybeans belong to the legume family- the same family as peas, beans and lentils.

- Soybeans have been a popular food in many parts of the world for more than 5000 years. Soybeans are often called "super beans" because there are so many ways to use them that are beneficial for human nutrition and good health.
- Soy suit today's busy lifestyle because it contains most of the necessary nutrients, is economic and easy to prepare.



Learn about Soy

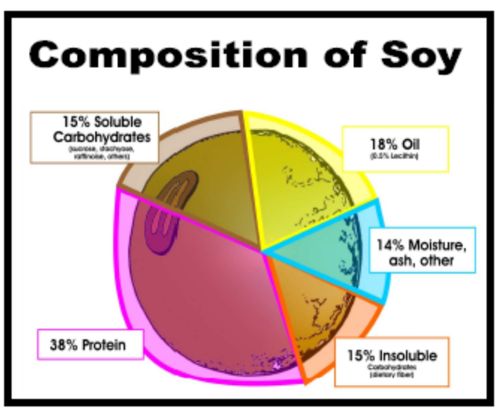


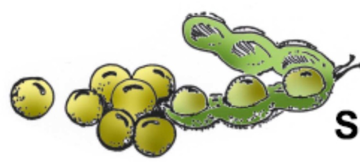


- Soy protein contains all essential amino acids.
- The soybeans **oil** is rich in polyunsaturated fat and contains only minimal saturated fats.
- Fats like soybeans are needed to regulate our body temperature.
- Soy can replace meat. It is a cheap substitute of meat.

Legume family

- Soybeans contain all three of the macro-nutrients required for good nutrition: protein, carbohydrate and fat, as well as vitamins and minerals including calcium, folic acid and iron.
- The mature soybean is about 38% protein, 30% carbohydrate, 18% oil, and 14% moisture, ash and hull.





Soy

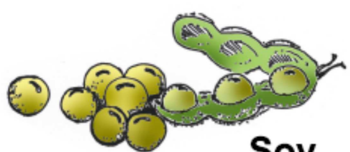
- Soy is the world's foremost provider of protein and oil.
- Soybeans are high in **protein** and contain phyto chemicals, such as isoflavones that give significant long-term health benefits.
- The soybean is an excellent source of protein that is highly digestible (92-100%).
- The soybean protein is equivalent to animal protein in quality.
- When we eat 150g of soybeans, the protein content it is equivalent to eating 100g of meat/fish/chicken/ egg.

Learn about Soy

Key points to remember

❖Some people may be allergic to soy

❖No to the raw soybeans (Unappealing and impossible to eat). Can not be digested



Soy

Health benefits of Soy

Using soy as food has many health advantages. Soybeans have some unique characteristics which make them quite different from other healthy foods.

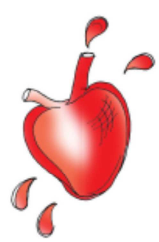
Soy has many vitamins and minerals and is high in protein and fiber and low in saturated fat and contains no cholesterol.

These are all very important parts of a health diet.

Soy is suitable for infants to adults and provides an alternative protein source for those who are allergic to foods such as cow's milk and eggs.

Soy may also prevent diseases such as:

- **Chronic heart disease**, substitution for animal protein by soy reduces intakes of saturated fat and cholesterol, therefore indirectly resulting in a more favourable blood cholesterol level and potentially reducing the risk of coronary heart disease. Soy lowers blood cholesterol, since it is low in saturated fat and contains no cholesterol
- Isoflavones in soy may also have a protective role for **certain cancer**. Soy bean-based diets may protect against cancer of the breast, prostate and colon. This is because soybean component completely prevent or suppress the generation of tumours in various organs.
- The fibre in soybeans regulates glucose levels in **diabetes.**
- Prevent bone loss (**osteoporosis**),



- Reduce **hypertension** (high blood pressure)
- **Menopause** regulation and

- **Obesity** is a medical condition in which excess body fat has accumulated to an extend that it may have a bad effect on health. Soy promotes weight loss since it contains polyunsaturated fat.

Learning about Soy

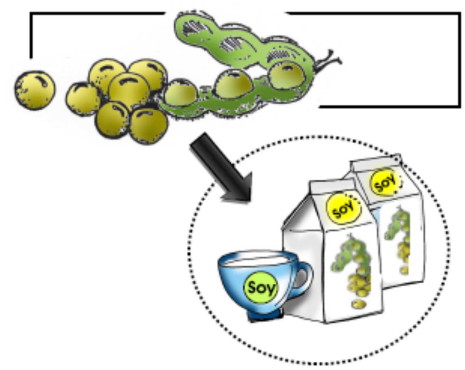
Key point to remember

Soy flour is gluten-free

Uses of Soy

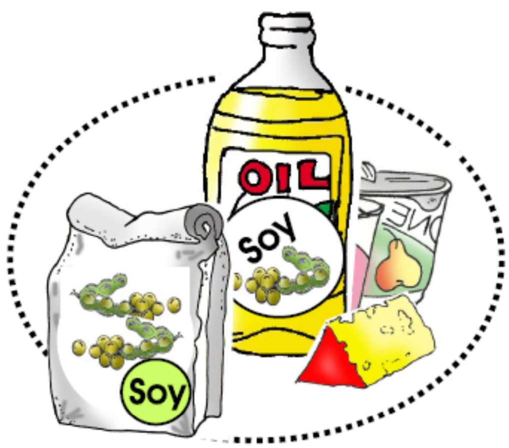
-What can you make from soy?

Soybeans are used in many dishes. Whole soybeans are the starting point for soy milk.



Other products that are made from soybeans are:

- Margarine and shortening are made from soymilk
- Soy cheese, soy yogurt and soy beverages are made from soymilk
- Soy fibre (Okara, soy bran, soy isolate fibre) – high quality, inexpensive sources of dietary fibre.
- Okara can be baked or added as fibre to cookies, as well as being made into sausages.
- Soy flour, is made from roasted soybeans ground into a fine powder.
- Soy sauce, a dark brown liquid made from soybeans that have undergone a fermenting process
- Soy nuts, roasted soy nuts are whole soybeans that have been soaked in water and then baked until browned.
- Soy oil, is the natural oil extracted from the whole soybeans

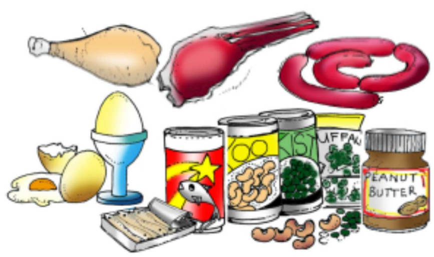


Learn about

The healthiest proteins are the leanest. This means that they have the smallest amount of fat and calories. The best protein choices are:

Fish or shellfish, Skinless chicken or turkey, Low-fat or fat-free dairy (skim milk, low-fat cheese), and egg whites or egg substitute. The best red meats are the leanest cuts (loin and tenderloin). Other healthy options are beans, legumes (lentils and peanut butter), and soy foods e.g soymilk.

Protein can help with weight control because it helps you feel full and satisfied from your meals.



INTRODUCTION TO NUTRIENTS

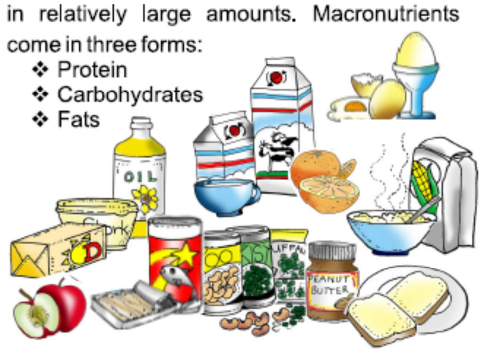
What are nutrients?

Nutrients are chemicals in foods that are important to human growth and function. Nutrients are classified as macronutrients and micronutrients.

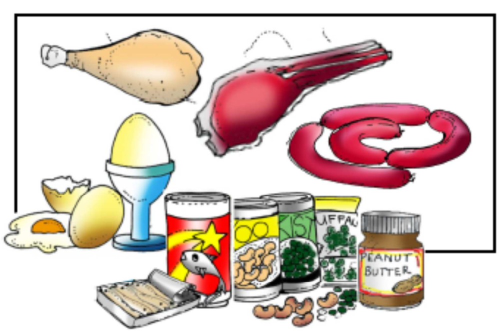
What are macronutrients?

Macronutrients are nutrients that are required in relatively large amounts. Macronutrients come in three forms:

- Protein
- Carbohydrates
- Fats



Learning about Proteins



What are proteins?

The word protein is derived from the Greek and it means "holding first place". Proteins are chains of amino acids. When we eat foods that contain protein, the digestive juices in your stomach and intestine go to work. They break down the protein in food into basic building blocks called **amino acids.**

There are lot of amino acids but 22 of them are very important to human health. Of those 22 amino acids, our bodies can make 13 of them without us ever thinking about it. Our bodies can't make the other nine amino acids, but we can get them by eating protein-rich foods. They are called essential amino acids because it's **important** that we get them from the foods we eat. The essential amino acids are considered a **high quality** protein. Without these amino acids, we would eventually waste and die.

Functions of protein in the body

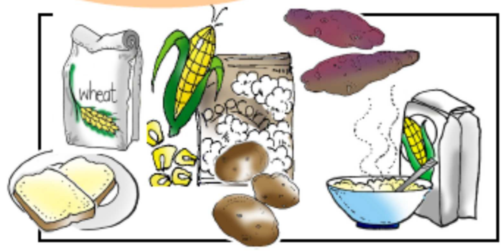
Protein is an important macronutrient that builds up, maintains, and replaces the tissues/muscles in your body. By tissues we mean the stuff our body's made up of (muscles, your organs, and your immune system are made up mostly of protein).

Where can we get protein?

Protein from **animal sources**, such as meat and milk, is called complete protein, because it contains all nine of the essential amino acids. Soybean which is a vegetable protein also contains all the nine essential amino acids. Most **vegetable protein** is considered incomplete because it lacks one or more of the essential amino acids.

Learn about

Carbohydrates

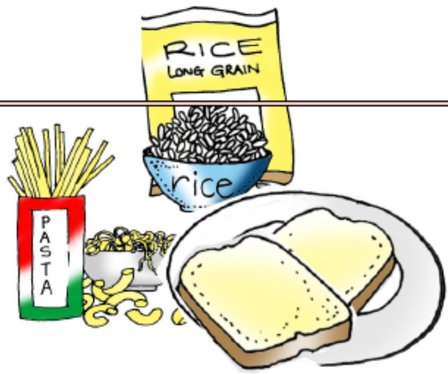


What are carbohydrates?

Carbohydrates are a group of substances found in both plants and animals, composed of carbon, hydrogen and oxygen in the ratio 1:2:1. There are different types of carbohydrates and they are classified based on the number of sugar units in their total chain.

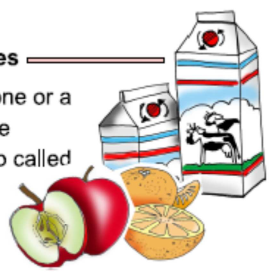
There are two major types of carbohydrates in foods: simple and complex. Most foods contain carbohydrates, which the body breaks down into simple sugars.

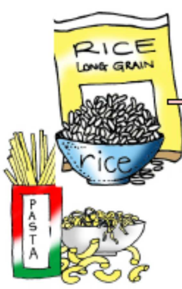
Complex carbohydrates add more fibre, vitamins and minerals to the diet than foods high in refined sugars. Foods high in complex carbohydrates are usually lower in calories, saturated fat and cholesterol.



Simple carbohydrates

These are built up of one or a few sugar units. Simple carbohydrates are also called ***simple sugars***.





Complex carbohydrate

These are built up of three to more than ten sugar units. These are also called ***starches***.

Functions of carbohydrates in the body?

Carbohydrates are an important source of energy for the body.

Where can we get carbohydrates?

Simple sugars are found in refined sugars, like the white sugar we find in a sugar bowl. If you have a lollipop, you're eating simple carbohydrates.

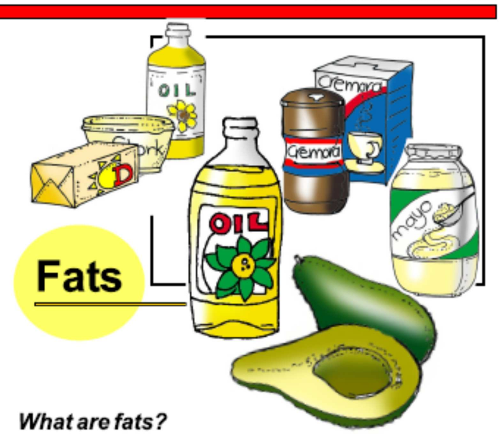
But you'll also find simple sugars in more nutritious foods, such as fruit and milk. It's better to get your simple sugars from food like fruit and milk. **Why?** Because they contain vitamins, fibre, and important nutrients like calcium. A lollipop does not.

Complex sugars or starches include grain products, such as bread, crackers, pasta, and rice. As with simple sugars, some complex carbohydrate foods are better choices than others.

Refined grains, such as white flour and white rice, have been processed, which removes nutrients and fibre. But unrefined grains still contain these vitamins and minerals.

Unrefined grains also are rich in fibre, which helps your stomach work well. Fibre helps us feel full, so we are less likely to over eat these foods.

Learn about



What are fats?

Like carbohydrates and proteins, fats are one of the three main components of the food we eat. **Fats** are composed of lipids, substances that are insoluble in water, but soluble in organic solvents like acetone. There are three major types of fats:

Unsaturated fats: These are found in plant foods and fish. These may be good for heart health. The best of the unsaturated fats are found in olive oil, peanut oil, canola oil, albacore tuna, and salmon.

Saturated fats: These fats are found in meat and other animal products, such as butter, cheese, and all milk except skim. Saturated fats are also in palm and coconut oils, which are often used in commercial baked goods. These are the bad fats.

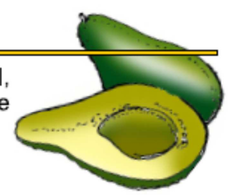
Trans fats: These fats are found in margarine, especially the sticks. Trans fats are also found in certain foods that you buy at the store or in a restaurant, such as snack foods, baked goods, and fried foods. These foods should be eaten in small amounts.

Functions of fats in the body?

The body uses fat to build cells and to help body processes. Fat also has many other important functions in the body. We need some fat in our diets in limited amounts to provide energy and help absorb some vitamins (A, D, E and K).

Too much fat or too much of the wrong type of fat can be unhealthy. Eating too much saturated fat can raise blood cholesterol levels and increase the risk of heart disease. Like saturated fats, trans fats can raise cholesterol and increase the risk of heart disease.

Where can we get fats?

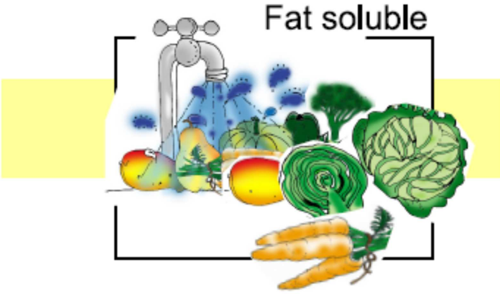


Avocado, Mayonnaise, oil, butter, margarine, Coffee creamer

Some dairy products contain fat, too. Some foods, including most fruits and vegetables, have almost no fat. Other foods have plenty of fat. They include nuts, oils, butter, and meats like beef.

Vitamins are classified as

Fat soluble



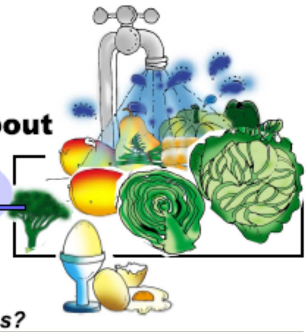
Water-soluble

INTRODUCTION TO NUTRIENTS

What are micronutrients?

Micronutrients are nutrients required in smaller amounts.

- Vitamins
- Minerals



Learning about

Vitamins

What are Vitamins?

Vitamins are chemical compounds that the body needs in small to help it function properly. Vitamins are classified as fat soluble and water-soluble

.Fat-soluble

These vitamins include A, D, E and K dissolve easily in fats and oils. Fat soluble Vitamins can be stored in the body.

Functions of the Fat-soluble vitamins

Vitamin A Improves our eyesight and prevents blindness

Vitamin D Strong and healthy bones

Vitamin E Protects the body against **infections**

Vitamin K Assists with blood clotting

Where can we get fat-soluble vitamins?

Vitamin A	Carrots, pawpaw, mango
Vitamin D	Egg, liver, cheese
Vitamin E	Sunflower oil, spinach, cereal
Vitamin K	Broccoli, peas, cabbage

.Water-soluble vitamins

These vitamins belong to the B-complex group with exception of vitamin C. The body has limited storage capacity for these vitamins. When present in large amount they are removed through urine.

Functions of water-soluble vitamins

B-complex group help the body to process all the different nutrients to supply energy.

Vitamin C heals cuts and wounds. Protects us against infections

Where can we get water-soluble vitamins?

B-complex group	Peanuts, beans, eggs, liver
Vitamin C	Tomatoes, oranges, spinach, pumpkin

Learn about

Minerals

What are minerals?

Minerals are components of food that the body needs in small amounts to help chemical processes, and to build tissues and fluids.

These minerals include:

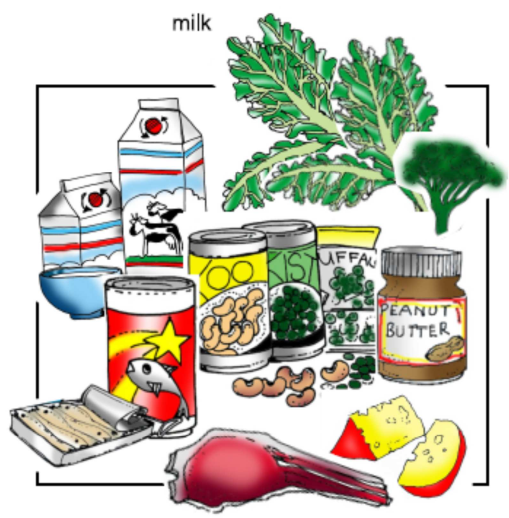
Iron, zinc, copper, phosphorus, calcium, sodium and potassium, magnesium and fluoride.

Functions of minerals

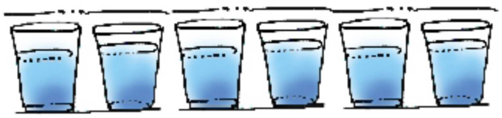
Iron	Improves our mental and physical ability. It is needed for formation of blood
Zinc	Reduces skin problems and protects us against infections
Copper	Healthy blood
Phosphorus	Assist with strong bones and teeth
Calcium	Assists with strong bones and teeth
Magnesium	Muscle development and strong bones

Where can we get minerals?

Iron	Liver, nuts, dried fruit
Calcium	Milk, cheese, peas
Zinc	Fish, meat, dried beans
Magnesium	Dark green vegetables, nuts, milk



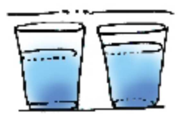
Water

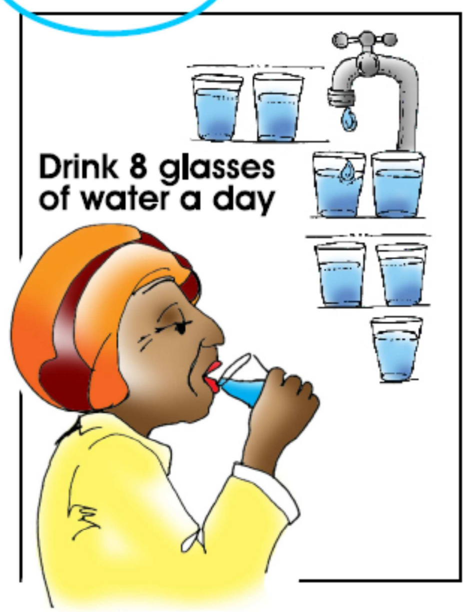


Key points to remember

Be sure to drink some extra water when you're out in warm weather, especially while playing sports or exercising.

You can help your body by drinking when you're thirsty and drinking extra water when it's warm out. Your body will be able to do all of its wonderful, waterful jobs and you'll feel great





Almost every part of the body contains large amounts of water. All living things must have water to survive. We can live without food for a few weeks, but we cannot live without water for more than a few days.

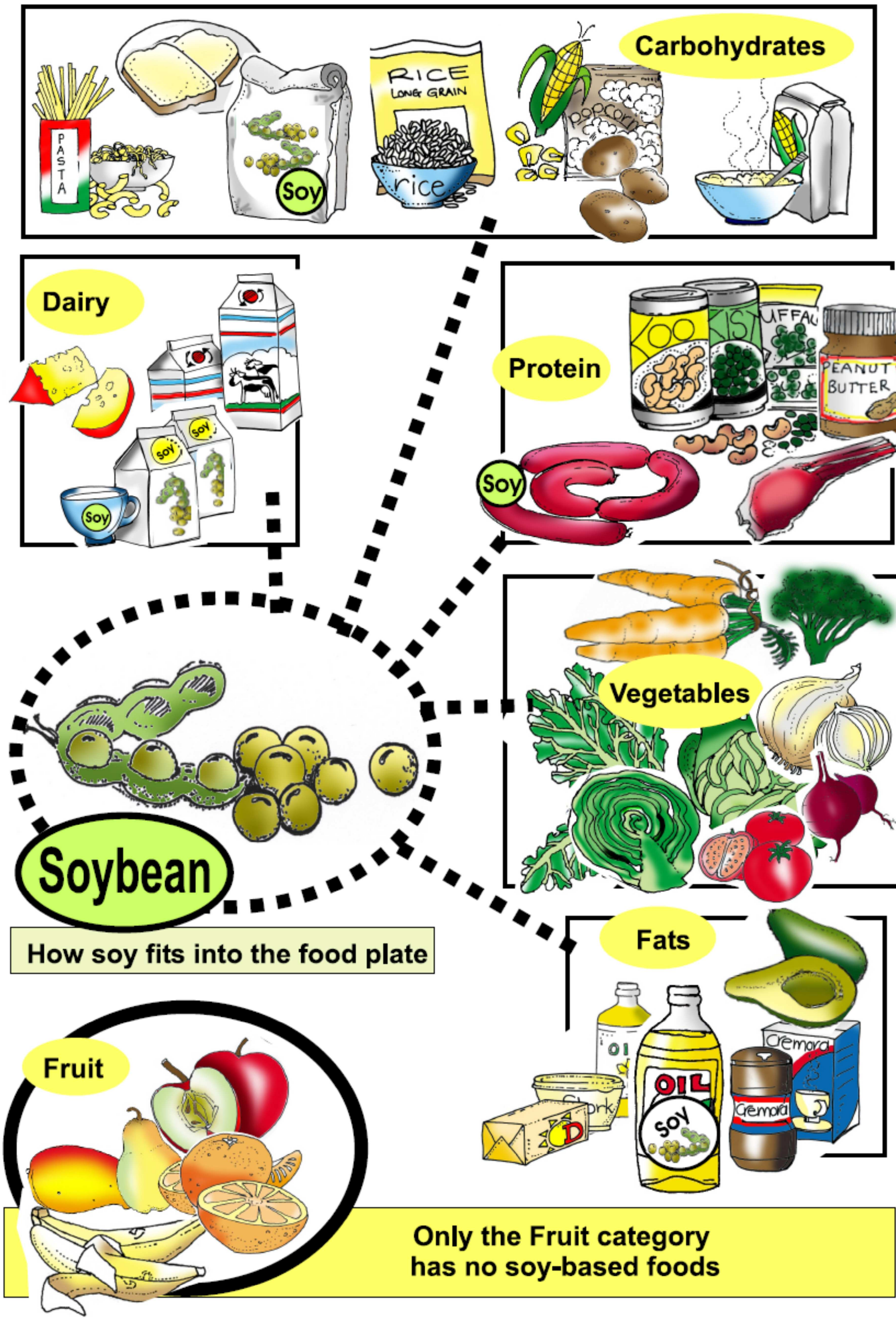
Why people need water

- ❖ To make body cells and fluids, such as blood, digestive juices and tears
- ❖ For body processes, such as digestion, which take place in water
- ❖ To keep the lining of the mouth, gut, lungs and other parts of the body moist and healthy
- ❖ For urine which carries away body waste
- ❖ For sweat to cool the body.

Where can we get water?

Your body doesn't get water only from drinking water. Any fluid you drink will contain water, but water and milk are the best choices. Lots of foods contain water, too. Fruit contains quite a bit of water, which you could probably tell if you've ever bitten into a peach or plum and felt the juices dripping down your chin! Vegetables, too, contain a lot of water think of slicing into a fat tomato from the garden.

We need about 6-8 glasses of clean and safe water per day.


Carbohydrates
PASTA
Soy
RICE LONG GRAIN
rice
popcorn
Dairy
soy
Soy
Protein
PEANUT BUTTER
Soy
Vegetables
Soybean
How soy fits into the food plate
Fats
OIL
soy
Cremora
Fruit
Only the Fruit category
has no soy-based foods

Annexure H Soy Knowledge questionnaire

SOY KNOWLEDGE QUESTIONNAIRE FOR THE ELDERLY

The purpose of this questionnaire is to determine the soy nutrition knowledge of the elderly people of the care centre of Sharpeville. The answers to these questions will be kept strictly confidential and personal information will not be identifiable from any reports or publications.

Date : ……………………………………………..
Name and Surname : ……………………………………………..
Gender : ....
Date of birth : ……………………………………………..

Answer all the questions by ticking the answer that you think is right.

1. Which of the following is not a micronutrient? Tick all the relevant options)

   a) Proteins

   b) Vitamins

   c) Carbohydrates

   d) Fats

2. Which of the following food items contain protein? (Tick all the relevant options)

   a) Soybeans

   b) Apples

   c) Carrots

3. Which of the following food item contain carbohydrates? (Tick all the relevant options)

   a) Potatoes

   b) Soybeans

   c) Fish

d) Oranges

4. Which of the following fat is good for your health? (Tick all the relevant options)

a) Soy oil

b) Mayonnaise

c) Margarine/Rama

d) Lard

5. People need water in the body for:

a) Energy

b) Digestion

c) Protecting against infection

d) Building muscles

6. The good thing about beans, soybeans, split peas is that

a) They contain a lot of fat

b) We can eat them instead of meat and still be very healthy

c) They are easy to cook

7. What is the main reason for eating the following food items:

Food item	**Gives energy**	**Build muscles**	**Strong teeth and bones**	**Heals sores**	**Protect against infections**
Meat/chicken					
Pap/rice					
Milk					
Vegetables					
Oranges					

8. Tick if the following are true or false

	True	**False**
Soybean are a cheap substitute for meat in the diet		
Calcium is a mineral that the body use to build strong bones and teeth		
Soybeans contain good fats needed for good health		
The sugar in sweets is better than the sugar in fruits		
Soy may prevent diseases such as hypertension and diabetes		
Fibre helps us feel full		
Cereals are usually lower in saturated fats and cholesterol		
Using soy as food has no health benefits		
Whole soybeans are the starting point for soy milk		
Drinking extra water when you are out in the warm weather is good		
Soybeans contain proteins, carbohydrates, fats, vitamins and minerals		
Soybeans is an excellent source of protein		

9. How many glasses of water should you drink per day to be healthy?

1-2	**2-3**	**3-4**	**5**	**6-7**	**≥8**

Thank you very much!!

Annexure I **Soy recipe pamphlet**

Soy Exuberance

Cooking with soy

Sharpeville care centre

04 April 2011

Dr SS Duvenage

BASIC METHOD FOR COOKING SOY BEANS

- Store in airtight containers: suitable for long periods.
- Spread beans out and remove all foreign matter.
- Rinse quantity to be cooked under running water
- Choose one soaking method:
    - Long: Whole beans require up to 8 hours soaking. If using hot water, less time will be needed.
    - Short: Boil in unsalted water for 3 to 5 minutes. Remove from heat, cover, soak 40 to 60 minutes.
- Ratio:3 to 4 cups of water for each cup of soybeans
- Pinch of bicarbonate of soda added during soaking: improve texture, reduce cooking time. Destroy vitamins.
- After soaking, drain, rinse beans.
- Add boiling water to beans (3 cups of water for each cup of beans)
- Bring to a light boil for 10 minutes and reduce heat. Simmer 2 to 4 hours or until tender. Skim off excess foam.
- Cook until quite soft to improve digestibilityand tastiness.
- If cooked without soaking, cooking time is much longer.
- Split beans, need a shorter soaking and cooking time. Add salt only after the beansare soft. Acid foods (e.g tomatoes) extend cooking, add towards the end.

HOW MUCH SOY IS RECOMMENDED?

To benefit, an average soy protein intake of 15g/person/day is recommended. As 38% of the soy bean consists of protein, the implication is that at least 40g soy needs to be consumed/person/day.

Soy raisin bread

Yield: 1 medium or 2 smaller breads

250ml	1cup	Maize meal
250ml	1cup	Cake flour or whole meal flour
250ml	1cup	Soaked, grinded soybeans
2.5ml	1/2teaspoon	Salt
10ml	2 teaspoons	Bicarbonate of soda
2.5ml	½ teaspoon	Mixed spice
125ml	1/2cup	Seedless raisins
125ml	1/2cup	Milk
125ml	1/2cup	Water
125ml	1/2cup	Treacle sugar
15ml	1 tablespoon	Cooking oil
15ml	tablespoon	White vinegar

1. Line the base of one 1.2 litre/ 5 cup cylindrical container with greased greaseproof paper. A heatproof glass jug or washed and dried tins will be suitable
2. Mix the maize meal, cake or whole meal flour, grinded soy, salt, bicarbonate of soda, mixed spice and raisins together in a large bowl.
3. Warm the milk and water in a small sauce pan and stir in the sugar, oil and vinegar.
4. Add to the mix dry ingredients and mix in.
5. Fill the jug or tin with dough. The containers should be about 2/3 full. Cover neatly with foil or greased greaseproof paper and tie securely with string.
6. Fill a deep, heavy-based saucepan that will accommodate the jugs or tins to a depth of 5cm with water and bring to a boil

7. Place a trivet in the pan, stand the jug or tins on top, cover the pan and steam for $1^{1/2}$ hours. Add more boiling water to maintain the required level as necessary.
8. Cool the loaves for a few minutes in the jug or tins, and unmold.
9. Serve warm, as a tea bread or the savoury dishes
   Recognition to:"Boston brown bread" the bread Bible 2010:226.

Tasty soy meat balls with sweet and sour curry sauce

Yields: 16 medium meat balls

Meat balls

250g	1cup	Soy beans: soaked and grinded or cooked and mashed
250g		Minced meat
½		Onion, chopped
1		Garlic clove, finely chopped
60ml	4tablespoon	Tomato sauce
2.5ml	½ teaspoon	Ground coriander
0.5ml	1 pinch	Cayenne pepper
2.5ml	½ teaspoon	Barbeque spice
5ml	1 teaspoon	Dried parsley
5ml	1 teaspoon	Salt
2		Eggs
45ml	3 tablespoons	Brown onion soup powder
60ml	4 tablespoons	Cake flour
45ml	3 tablespoons	Cooking oil

- Cooked soybeans are perishable. Eat same day, or store in refrigerator for up to a week
- 250g raw soy beans= 250ml (1 cup) raw soy beans
  = 500g (500ml/ 2 cups) soaked beans

Meat balls:

1. Mix all the ingredients for the meat balls, excluding the cooking oil
2. Form firm medium sized meat balls
3. Preheat a 24cm diameter pan with the oil

4. Fry the meat balls at medium heat till cooked through and well browned on all sides

Sweet and sour curry sauce

10ml	2 teaspoons	Cooking oil
10ml	2 teaspons	Curry powder
1		Onion, finely chopped
½		Fresh pineapple, chopped into slices
200ml	4/5 cup	Brown vinegar
0,5ml	½ teaspoon	Salt
0,5ml	½ teaspoon	Black pepper
75 ml	5 tablespoons	Smooth apricot jam
125ml	½ cup	Brown/ treacle sugar
30 ml	2 tablespoons	Corn flour
125 ml	½ cup	Water

Sweet and sour curry sauce:

1. Heat the oil and fry the curry powder lightly
2. Add the onion and sauté until glazed
3. Add the pineapple and sauté until glazed
4. Mix in the rest of the ingredients, excluding the corn flour and water. Bring to the boil.
5. Mix the corn flour and water to a smooth paste and stir into sauce
6. Simmer till shiny and thick
7. Serve with the meat balls.

Recognition to: The Good Cook:Grains, pasta & pulses. 1985. Time-Life Books. P157.
Bean Renaissance: the intelligent food choice. 2002. Dry bean producer's organisation. P78.

Annexure J Soy compliance questionnaire

VAAL UNIVERSITY OF TECHNOLOGY
SOY PROTEIN BASED PRODUCTS COMPLIANCE QUESTIONNAIRE FOR THE ELDERLY PEOPLE

Please note that information gathered from you as the respondent will be treated with respect and confidentiality. Personal and sensitive information will not be identifiable from any reports.

Please complete the following

Date ....

Name and surname..

Gender   M................F...

Date of Birth...

Address...

For each of the following questions, please tick the option that is most appropriate for your choice.

Section 1: Soy milk

1.1 How often do you drink soy milk at home?

a) Twice a day
b) Four times in a week
c) Times in a week
d) Every day of the week

1.2 How much of the soy milk do you usually drink or use per a day?

a) 1 litre
b) A sip
c) Half a cup
d) One cup
e) Two cups

1.3 How much do you like the taste of soy milk?

a) Like a lot b) Like a lot c) Don't like

1.4 How much do you like the colour of the soy milk?

a) Like a lot b) Like a lot c) Don't like

1.5 Do you want soy milk to be always available in the centre for you to drink?

Section 2: Soy mashed potatoes

2.1 Do you always eat mash potato when it is served in the centre?

a) YES b) NO

2.2 How often do you eat soy mash potato at home?

a) Twice a day
b) Four times in a week
c) Times in a week
d) Every day of the week

2.2 How much of the soy mashed potatoes do you usually use per a day at home?

a) 1 Table spoon
b) 2 Table spoons
c) Large Saving spoon
d) 1 cup

2.3 How do you like the taste of soy mash potatoes?

a) Like a lot b) Like a lot c) Don't like

Section 3: Soy soft porridge

3.1 Do you always eat soy soft porridge when served for breakfast in the centre?

a) YES b) NO

3.2 How do you like the taste of the soy soft porridge?

a) Like a lot b) Like a little b) don't like

3.3 Do you want the soy soft porridge to be always available in the centre for you to eat?

a) YES b) NO

Section 4: Soy beans

4.1 How often do you eat the soy beans at home?

a) Twice a day
b) Once a week
c) Once a day
d) Once in a month
e) None

4.2 Which dishes do you cook using the soy beans?..

Thank you for your assistance!!

K. Marumo

DTech student at VUT.

Annexure K Turnit report

Turnitin Originality Report

DTech thesis by Kuda Marumo

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Annexure L Declaration of language editing

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19 November 2014

To Whom It May Concern

This certifies that the following thesis has been edited for English language correctness and fluency. I trust that the corrections made have been applied after due consideration by the author of the document:

IMPACT OF A SOY FEEDING PROGRAMME ON THE NUTRITIONAL STATUS OF AN ELDERLY COMMUNITY IN SHARPEVILLE

submitted in fulfilment of the requirements of the degree

Doctoris Technologiae

Food Service Management

in the

Department of Hospitality, Tourism and PR Management

Faculty of Human Sciences

Vaal University of Technology

by

KUDA MARUMO-NGWENYA

Mary Hoffman
(SATI Registration: 1001632)