Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

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- Clarina Vorster for language editing.
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- The National Research Fund (NRF) for the financial assistance.

DECLARATION

I declare that "**Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans, 2017"** is my own work; that it has not been submitted previously for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete reference.



DATE: 16/11/2017

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PREFACE

This thesis is presented in article-format and consists of three peer-reviewed published or submitted manuscripts as recommended by the North-West University's s guidelines for postgraduate studies. The thesis is set out as follows:

Chapter 1: Introduction. In this chapter the topic is introduced as formulated from literature. The rationale, aim and objectives are also included in this chapter.

Chapter 2: Literature review. In this chapter a comprehensive literature study is presented.

Chapter 3: Research Methodology. This chapter describes the research methodology employed for the study and statistical analysis of the data in detail.

Chapter 4: The first article is the association between dietary adherence (as determined by a dietary adherence score), anthropometric measurement and blood pressure is investigated. This manuscript was submitted to the journal: *South African Journal of Clinical Nutrition.*

Chapter 5: The second article explores the challenges and barriers to the implementation of, and adherence to chronic non-communicable disease interventions. The manuscript was accepted for publication by the journal *HealthSA.*

Chapter 6: The third article explores the needs of the study population regarding implementation and compliance with chronic non-communicable disease interventions. In addition the opinions of key roleplayers from the Department of Health in the Western Cape as to the performance of possible intervention strategies to address the CNCDs epidemic is explored by means of the multicriteria mapping (MCM) interviewing technique. This manuscript will be submitted to the *Public Health Research Journal.*

Chapter 7: Summary. In this chapter results of this study are discussed, conclusions are drawn and recommendations are made based on the findings of this study.

The first author, namely the PhD candidate, was responsible for the initiation and all parts of this

thesis. This includes the literature searches, collection and cleaning of data, statistical analyses, as well as writing of the manuscripts with valuable input and assistance provided by my promoter and co-promoter who were included as co-authors in each manuscript.

Permission has been granted by my co-authors that the manuscripts may be submitted in this thesis (See the author contribution form page xi).

The relevant references are provided at the end of each chapter. Each manuscript was prepared according to the guidelines for authors of the relevant journals. These are provided before each manuscript.

The Harvard referencing system was used for chapters 1, 2, 3 and 7. The Vancouver referencing style was used for chapters 4, 5 and 6 as per the relevant journal's instruction.

AUTHOR CONTRIBUTIONS AND STATEMENT

The researchers listed below contributed to this thesis in the following capacities:

Ms. N. Solomons

Responsible for initial proposal of the study along with all the comprehensive literature searches, study protocol and methodology, data collection, data cleaning, statistical analyses. The design and planning of research articles and the thesis, as well as writing all sections of this thesis.

Prof. Salome Kruger (promoter)

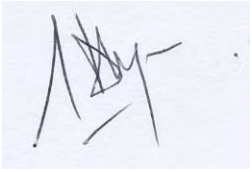
Responsible for guidance, intellectual input, statistical assistance, and critical evaluation of statistical analyses and also the final product.

Prof. Thandi Puoane (co-promoter)

Responsible for guidance, intellectual input, and critical evaluation of the final product.

The following is a declaration by the promoters regarding their contribution to this thesis:

I hereby declare that I approved the manuscripts which I co-authored, and that my role in this thesis as stated above is a true reflection of my actual contribution. I also give my permission that the manuscripts may be published as part of the PhD thesis of Ms Nasheetah Solomons.



Date: 12/12/2017



Date: 12/12/2017

SUMMARY

TITLE

Challenges with the implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

AIM

To investigate challenges to the implementation of nutrition interventions aimed at chronic non-communicable diseases (CNCDs) at government, community and individual levels in the Langa PURE study site in Cape Town, South Africa.

METHODS

This cross-sectional study was embedded in the Prospective Urban and Rural Epidemiological (PURE) Study. The PURE study is a large-scale worldwide epidemiological cohort study. The PURE study aimed to recruit approximately 150,000 participants aged between 35 and 70 years living in more than 600 communities in 17 low-, middle- and high-income countries around the world. The participating countries' selection were based on representativeness of different economic levels and the study sites included were based on the commitment of investigators to collect good quality data over the planned 10-year period. The University of the Western Cape's (UWC) School of Public Health (SoPH) committed itself to carry out data collection in Langa (urban community) in the Western Cape Province and Mount Frere (rural community) in the Eastern Cape Province.

The current study was conducted in the urban study site (Langa). For phase 1 of the study existing baseline information (demographic, dietary, anthropometric and blood pressure (BP)) was used for secondary data analysis, 300 participants were randomly selected. For phase 2 DoH officials were identified and interviewed using the multicriteria mapping (MCM) interviewing method. For phase 3, 47 participants were selected to participate in FDGs. Data were collected at baseline from the existing PURE Western Cape Province cohort for cross-sectional analysis. For the second part of this study, 300 male and female participants aged between 35 and 70 years, from the urban

community were included. Structured interviews on challenges to the implementation of nutrition interventions aimed at chronic non-communicable diseases (CNCDs) with the study participants were conducted, using a questionnaire. The multi-criteria mapping (MCM) interviewing method was used to conduct interviews with key officers from the Department of Health (DoH), to explore best courses of action to address CNCDs. Structured interviews were also conducted with DoH officials to determine challenges to the implementation of exisiting nutrition interventions aimed at CNCDs, as well as to determine their awareness of existing CNCDs policies. The third part of the study was a qualitative analysis of focus group discussions with a subsample of the PURE participants to explore challenges and barriers to the implementation of, and adherence to, CNCDs interventions.

Medians and frequencies were calculated for demographic data, anthropometric measurements, smoking habits, alcohol use and BP of men and women. The dietary data was analysed using the MRC Foodfinder III software package. Furthermore, diet adherence was determined by calculating a dietary adherence score which was based on a combination of the Dietary Approaches to Stop Hypertension (DASH) guidelines and the South African Food-Based Dietary Guidelines (SAFBDG). The dietary adherence score was calculated using an adaptation of the DASH score. Correlations were calculated between continuous variables (dietary intakes, anthropometric variables and BP) for men and women. A comparison between anthropometric variables and BP, by diet quality (adherence group) was determined using the Mann-Whitney U test. The presence of associations between diet adherence category and body mass index (BMI) (overweight/obese vs normal weight), waist-height ratio (WtHR) (</>0.5), waist-hip ratio (WHR) and waist circumference (WC) (</> cut-points), were determined by means of the chi square test (two-by-two tables). Logistic regression and odds ratios were used to determine associations between BP as the dependent variable and dietary adherence score, age, smoking and physical activity as covariates. Data analysis was done using the Statistical Package for Social Studies (SPSS) version 23 (SPSS Inc., Chicago, IL, USA) software programme. The MCM data was analysed using the MCM software package 2016 version (University of Sussex).

The responses of the participants to the structured interviews were presented as frequencies. The results of the MCM interviews were summarised. The focus group discussions were analysed using

content analysis.

RESULTS AND CONCLUSION OF MANUSCRIPTS

Three manuscripts were written to meet the aims of this thesis. In the first manuscript, the association between dietary adherence score and blood pressure, as well as anthropometric measurements were investigated. Positive relationships were found between age, for both men and women and systolic and diastolic BP. A significant positive relationship between added sugar intake and systolic blood pressure (SBP) was only present in the women's group. A significant positive relationship was found between SBP, diastolic blood pressure (DBP) and BMI for men only. No significant differences existed between blood pressure of men or women in the lowest and top tertile groups, according to dietary adherence score, but a significant inverse correlation between the dietary adherence score and SBP in women was found. The findings revealed that there were no significant differences between anthropometric measurements or blood pressure in the three groups according to dietary adherence, but women with the highest adherence scores had the lowest SBP.

In the second manuscript, the aim was to determine the challenges that participants had regarding CNCDs interventions and their needs from intervention programmes were explored. In addition, the strategies that the Department of Health officials viewed as the best options to address the CNCDs epidemic were also investigated. Participants sought education on foods associated with weight gain, what food and drinks to purchase and how to prepare healthy food and recipes as part of CNCDs intervention programmes. Department of Health officials regarded the integration of health services, community participation, improved inter-sectoral partnerships and food taxation as the most favourable options to address the CNCDs epidemic. The findings revealed that current CNCDs interventions should be adapted to include context-based needs of community members.

In the third manuscript, perceived challenges with the implementation of, and adherence to, CNCDs intervention health messages were explored. The study attempted to gain an understanding of participants' expectations of CNCDs intervention programmes and explored the acceptability and preference of health message dissemination. In addition, preferred modes of health message dissemination were explored. Four themes emerged from the data analysis: practical aspects of

implementation and adherence to intervention programmes; participants' expectations of intervention programmes; aspects influencing participants' acceptance of interventions and their preferences for health message dissemination. The findings revealed that, although participants found current methods of health message dissemination in CNCD interventions acceptable, they faced real challenges with implementing and adhering to these messages.

GENERAL CONCLUSION

The study revealed that the challenges faced with the implementation of and adherence to CNCDs health messages are multifactorial and that current CNCDs intervention programmes do not necessarily meet participants' expectations and perceived needs. This indicates the need for culturally-sensitive health messages and dietary recommendations that are context-based. By including the community members from the onset when planning CNCDs intervention programmes, possible gaps between the planned interventions of the Department of Health and the expectations about intervention programmes of target groups could be addressed.

Keywords: Chronic non-communicable diseases, challenges, dietary adherence score, intervention programmes, multi-criteria mapping, urban black population

OPSOMMING

TITEL

Hindernisse teen die implementasie van voedingintervensies vir kroniese nie-oordraagbare siektes op owerheid, gemeenskap en individuele vlakke in ’n stedelike swart bevolking in Suid-Afrika

DOELWIT

Die doelwit van hierdie die tesis was om:

- Hindernisse teen die implementasie van voedingintervensies gemik teen kroniese nie-oordraagbare siektes (KNOS) in die Langa PURE kohortstudie in Suid-Afrika te bestudeer.

METODES

Die dwarsprofielstudie is deel van die “Prospective Urban and Rural Epidemiological” (PURE) Studie. Die PURE studie is ’n grootskaalse wêreld-wye epidemiologiese kohortstudie. Die PURE studie beoog om ongeveer 150,000 deelnemers tussen die ouderdomme van 35 en 70 jaar in meer as 600 gemeenskappe in 17 lae-, middel-, en hoë-inkomste lande wêreldwyd te werf. Die Skool van Publieke Gesondheid van die Universiteit van Wes-Kaapland het data in die Langa (stedelike gemeenskap) in die Wes-Kaap en Mount Frere (landelike gemeenskap) in die Oos-Kaap ingesamel.

Vir die eerste gedeelte van hierdie studie is kwantitatiewe demografiese, dieet-, antropometriese en bloeddruk (BD) data vir deursnee-analise by die basislyn ingesamel uit die PURE Wes-Kaapprovinsie kohortstudie. Vir die tweede fase van die studie is 300 manlike en vroulike deelnemers tussen die ouderdom van 35 en 70 jaar van die stedelike gemeenskap ingesluit. Gestruktureerde onderhoude is met deelnemers gevoer met behulp van vraelyste, om hindernisse teen die implementasie van voedingintervensies, gemik teen KNOS, te identifiseer. Die multi-kriteria kartering onderhoudmetode is gebruik om onderhoude met sleutelpersoneel van die Departement van Gesondheid te voer om strategieë te verken wat as die beste beskou word om die KNOS epidemie stop te sit. Gestruktureerde onderhoude met behulp van ’n vraelys is ook met personeel van die Departement van Gesondheid gevoer om hindernisse teen die implementasie van

voedingintervensies, gemik teen KNOS, te identifiseer, asook om hul kennis van bestaande KNOS beleide vas te stel. Die derde fase van die studie was fokusgroepbesprekings met ’n subgroep van die PURE studie deelnemers om hindernisse en versperring teen die implementasie van, en meewerkendheid van KNOS intervensies te bepaal.

Mediane en frekwensies vir demografiese data, antropometriese metings, rookgewoontes, alkoholinname en bloeddruk vir mans en vrouens is bepaal. Die dieetdata is geanaliseer met behulp van die MNR “Foodfinder” III program. Verder is dieetkwaliteit bepaal deur ’n dieetinskiklikheidstelling, gebaseer op ’n kombinasie van die “Dietary Approaches to Stop Hypertension” (DASH) en die Suid Afrikaanse Voedsel-Gebaseerde Riglyne (SAVGBR).

In die eerste manuskrip is die moontlike assosiasie tussen dieet-meewerkendheidstelling, bloeddruk en antropometriese metings ondersoek. ’n Positiewe verwantskap/verhouding tussen sistoliese en diastoliese bloeddrukke en ouderdom by beide mans en vroue is gevind. ’n Beduidende positiewe verhouding tussen bygevoegde suikerinname en sistoliese bloeddruk is by die vroue gevind. ’n Beduidende positiewe verwantskap tussen diastoliese bloeddruk en LMI was teenwoording alleenlik by die mans. Geen beduidende verskille was teenwoordig tussen die bloeddruk van mans en vroue in die laagste en hoogste tertielgroepe volgens dieet-meewerkendheidstelling nie, maar ’n beduidende omgekeerde korrelasie tussen dieet-meewerkendheidstelling en sistoliese bloeddruk is by vroue gevind. Die resultate het bewys dat daar geen beduidende verskille was tussen antropometriese metings of bloeddruk in die drie groepe volgens dieet-meewerkendheidstelling nie.

Met die tweede manuskrip is beoog om die uitdagings/hindernisse rakende KNOS intervensies, asook deelnemers se behoeftes ten opsigte van KNOS intervensieprogramme te ondersoek. Kennis van die Departement van Gesondheid amptenare met betrekking tot huidige beleide vir KNOS, sowel as strategieë as die beste opsies om die KNOS epidemie te bekamp, is ook met die Departement van Gesondheid personeel ondersoek. Resultate het aangedui dat huidige KNOS intervensies aangepas moet word om behoeftes in die konteks van die gemeenskap te adresseer.

In die derde manuskrip is uitdagings/hindernisse teen die implementasie en volging van KNOS gesondheidsboodskappe ondersoek. Daar is gepoog om insig te verkry oor wat studiedeelnemers

van KNOS intervensieprogramme verwag en die aanvaarbaarheid en voorkeure van disseminasie van gesondheidsboodskappe is ook ondersoek. Die metodes vir die disseminasie van gesondheidsboodskappe wat deelnemers verkies, is ook bestudeer. Vier temas het na vore gekom: praktiese aspekte van implementasie en volging van intervensieprogramme; deelnemers se verwagtinge van intervensieprogramme; aspekte wat deelnemers se aanvaarbaarheid van intervensies beïnvloed en deelnemers se voorkeur vir gesondheidsboodskap-disseminasie. Resultate het bevind dat, alhoewel huidige disseminasiemetodes van gesondheidsboodskappe aanvaarbaar was, deelnemers uitdagings/hindernisse met die implementasie en volging van die boodskappe ondervind.

ALGEMENE GEVOLGTREKKING

Daar is bewys dat die uitdagings ten opsigte van die implementasie en volging van KNOS gesondheidsboodskappe multifaktoriaal is en dat huidige KNOS intervensieprogramme nie aan die deelnemers se verwagtinge en behoeftes voldoen nie. Daar is dus ’n behoefte vir kultuur-sensitiewe gesondheidsboodskappe en dieetvoorstelle wat deelnemers se konteks in ag neem. Deur gemeenskapslede by die beplanning van KNOS intervensieprogramme te betrek kan moontlike leemtes tussen die Departement van Gesondheid en groepe op wie die intervensies gemik is verhoed word.

Trefwoorde: Kroniese nie-oordraagbare siektes, hindernisse, dieetinskiklikheid, multi-kriteria kartering, intervensieprogramme, stedelike swart bevolkingsgroep

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LIST OF ABBREVIATIONS

AMI	Acute Myocardial Infarct
ALA	Alpha linolenic acid
AHA	American Heart Association
ADA	American Diabetes Association
ARVs	Anti-retrovirals
apoB	Apolipoprotein B
BP	Blood pressure
BMI	Body Mass Index
CRP	C-Reactive Protein
CANSA	Cancer Association of South Africa
CVD	Cardiovascular Disease
CHC	Community Healthcare Centre
COPD	Chronic Obstructive Pulmonary Disease
CAD	Coronary Artery Disease
CHD	Coronary Heart Disease
CNCDs	Chronic Non-communicable Diseases
DALYs	Disability adjusted life years

DHA	Docosahexaenoic acid
DHS	Demographic and Health Survey
DoH	Department of Health
DM	Diabetes Mellitus
DASH	Dietary Approaches to Stop Hypertension
EPA	Eicosapentaenoic acid
ER+	Oestrogen Receptor positive
FBG	Fasting blood glucose
FEV_1	Forced Expiratory Volume in 1 second
FGDs	Focus Group Discussions
FV	Fruit and vegetables
GI	Glycaemic index
GL	Glycaemic load
GLUT4	Glucose transporter subtype 4
$HbA1_C$	Glycosylated Heamoglobin
HSFSA	Heart and Stroke Foundation of South Africa
HDL	High-density lipoprotein
HIV	Human Immunodeficiency Virus

HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HOMA	Homeostatic assessment model
ICCC	Innovative Care for Chronic Conditions
IHD	Ischaemic Heart Disease
IGF-1	Insulin Growth-like factor 1
LCD	Low-carbohydrate diets
LCM	Low Carbohydrate Mediterranean
LDL	Low-density lipoprotein
LICs	Low-income countries
LMICS	Low-middle income countries
MUFA	Monounsaturated fatty acids
MI	Myocardial Infarct
NHANES	National Health and Nutrition Examination Survey
NCR	National Cancer Registry
NCDs	Noncommunicable diseases
NDoH	National Department of Health
NGOs	Non-Governmental Organisations
ω-3	Omega-3

ω-6	Omega-6
PA	Physical activity
PUFA	Polyunsaturated fatty acids
PURE	Prospective Urban Rural Epidemiology
RCT	Randomised control trial
SA	South Africa
SANHANES-1	South African National Health and Nutrition Examination Survey
SADHS	South African Demographic and Health Survey
SAFBDGs	South African Food Based Dietary Guidelines
STATSSA	Statistics South Africa
TLC	Therapeutic Lifestyle Changes
TFAs	Total fatty acids
TM	Traditional Mediterranean
TG	Triglycerides
TB	Tuberculosis
T2DM	Type-2 Diabetes Mellitus
UMICs	Upper-middle income countries
WHtR	Waist-height-ratio

WHR	Waist-hip ratio
WC	Waist circumference
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION, AIMS, OBJECTIVES AND HYPOTHESIS

1.1 Introduction

Numerous studies have proven conclusively that chronic non-communicable diseases (CNCDs) - diseases that are non-transmissible and non-infectious - are the main cause of adult mortality and morbidity worldwide (Whiteside, 2014; Oli *et al.,* 2013). This term encompasses mainly diabetes, cardiovascular diseases, cancers and chronic respiratory diseases (Herrera-Cuenca *et al*., 2014; Li, 2014; Ezzati *et al.*, 2012). Currently CNCDs are responsible for more than 50% of the global disease burden and are expected to be responsible for more deaths than that due to infectious diseases (Rossier *et al.,* 2014; Isaacs *et al.*, 2014; Levitt *et al.,* 2011). The rapid increase in CNCDs in low- and middle-income countries is well–documented, South Africa being classified as an upper middle-income country (UMIC) according to the World Bank income classification, is also experiencing this trend (Alwan *et al.*, 2009; Teo *et al.*, 2009). According to Dalal (2011), non-communicable diseases (NCDs) will be responsible for 46% of deaths in sub-Saharan Africa (SSA) with higher age-standardised death rates in four of these countries, namely the Democratic Republic of Congo, Ethiopia, Nigeria and South Africa, in comparison with those in high-income countries.

1.2 Problem statement: setting and background

According to the South African 2011 mortality and causes of death report, NCDs accounted for six of the top ten causes of death in persons aged 15-49 years; eight of the top ten causes of death in the 50-64 years category and nine out of the top ten causes of death for persons aged 65 years and older in the Western Cape province of South Africa (Statssa, 2011).

The growing epidemic is attributable to several factors: firstly, the ageing population owing to the decrease in mortality due to infectious diseases and secondly, urbanisation which is accompanied by changes in lifestyle due to economic development. These changes include dietary changes (adoption of a Westernised diet which is high in fat and refined carbohydrates) and decreased physical activity as a result of easy access to transport. Smoking, adiposity and alcohol use have also been implicated conclusively in the CNCDs epidemic in developing countries (Gostin, 2014; Puoane, 2013; Bhalla, 2013; Baldwin *et al.* 2012; Pouane *et al.*, 2012; Dalal *et al.*, 2011). In South Africa, the number of

persons afflicted with CNCDs is growing in both rural and urban areas and is highest among the poor who live in urban areas. Thus urbanisation, together with the growing CNCDs epidemic, is adding to the great strain placed on the country's public health sector, which is the chief provider of healthcare for the poor (Isaacs *et al.*, 2014).

Findings from the recent South African National Health and Nutrition Examination Survey (SANHANES-1) were that South Africans surveyed, who had self-reported histories of CNCDs, fit the CNCDs profile – being overweight or obese, having a high fat and refined carbohydrate diet, consumed excessive amounts of alcohol, smoked tobacco and were less physically active. The rates of self-reported CNCDs history were also highest in formal urban areas (Shisana *et al.*, 2013).

In 2006, the National Department of Health in South Africa developed national guidelines for the management and control of NCDs which are comparable with international standards (Mayosi *et al.*, 2009; South Africa, 2005). These guidelines were however not implemented effectively since they were not circulated widely enough and the handling and control of chronic diseases were not monitored or reviewed (Mayosi *et al.*, 2009). Quite a number of community-based interventions for CNCDs exist in South Africa, the efficacy of which is not known. There is also a lack of association between non-governmental organisations (NGOs) and community-based organisations concerned with CNCDs and government, with each level working independently even though their ultimate goal is the same (Mayosi *et al.*, 2009). South Africa is unique in that it is faced with a quadruple burden of disease (HIV/AIDS; nutritional deficiencies, injuries and chronic diseases) which places major strain on its resources (Westaway, 2010; Household, 2010; ECONEX, 2009). The public outcry from concerned health authorities has resulted in declarations made to address the exploding CNCDs epidemic, however, in order to formulate an effective, cost-effective and sustainable intervention which will not put added strain on current resources, possible challenges should be identified first.

This study's first research question is thus: how adherent are urban South Africans living in the Western Cape to existing CNCDs policy guidelines and do those who are adherent have a healthier metabolic profile than those who do not adhere? The second question is: what are the challenges that need to be addressed in order to plan a successful and sustainable CNCDs intervention

programme in South Africa?

1.3 Rationale

Chronic non-communicable diseases, in particular diabetes, cardiovascular disease, cancer and chronic respiratory disease which are known as the four most prevalent NCDs, are forecast to increase the mortality worldwide by 17% by the year 2015 (Ebrahim *et al.,*2013*;* Alwan *et al.,* 2009).

Many studies have evidently identified the risk factors, some of which are common to the prominent CNCDs. These modifiable risk factors which include physical inactivity, overweight/obesity, tobacco use, unhealthy diet and harmful alcohol use have been the focus of much research and intervention programmes in some countries (Wagner *et al*., 2012; Habib *et al.,* 2010; de-Graft Aikins *et al.*, 2010; Westaway, 2010; Alwan *et al.,* 2009; De Caterina *et al.*, 2006). The epidemic of these CNCDs however continues to grow and this calls for urgent interventions to curb the scourge.

Many interventions have been implemented worldwide, but not many have been successful in achieving their aims (de-Graft Aikins *et al.*, 2010). One possible explanation for this failure could be that these interventions only aimed to educate target populations with the belief that knowledge would be enough to achieve the desired result, usually behavioural change (de-Graft Aikins *et al.,* 2010). Researchers have proven that knowledge alone does not ensure change and that many levels (political, social, socio-economic, cultural, etc.) need to be addressed in order to obtain the desired outcome (de-Graft Aikins *et al.*, 2010; Puska *et al.,* 2002). Documented intervention programmes which have been successful and sustainable targeted the identified disease condition at more than one level, unlike unsuccessful intervention programmes (de-Graft Aikins *et al*., 2010; Wolff *et al.*, 2003; Puska *et al.*, 2002; Nissinen *et al.*, 2001).

The Prospective Urban and Rural Epidemiology (PURE) study aims to identify social, individual and community factors with the view to develop societal interventions and policies to address the CNCD epidemic worldwide (Yusuf *et al.*, 2007).

Hence, the data collected in the PURE cohort from the Langa urban community in the Western

Cape Province in South Africa was used to investigate challenges to the implementation of nutrition interventions aimed at CNCDs at a government, community and individual level. Data collected in this study could thus assist in the planning of a "tailor-made" intervention programme which could effectively stem the CNCDs epidemic in similar settings worldwide.

1.4 Theoretical framework

Chronic non-communicable diseases usually appear slowly, their development is progressive and their treatment is often multifaceted. The current health systems which are mostly based on "an acute, reactive and episodic model", are thus not suited to address the need of persons at risk of developing, nor those suffering from chronic conditions (Nuño e*t al.,* 2012). The WHO Innovative Care for Chronic Conditions (ICCC) Framework (Figure 2) which is an improved international version of the Chronic Care Model (CCM) is geared towards addressing the needs of persons at risk of developing chronic conditions as well as those who are afflicted by chronic conditions based on scientific evidence (Nuño e*t al.,* 2012; Epping-Jordan *et al.*, 2004; WHO, 2002). The ICCC framework consists of three levels, namely the macro (policy), meso (healthcare organisation and community) and micro (individual and family) levels (Nuño e*t al.,* 2012; Epping-Jordan *et al.*, 2004; WHO, 2002). The macro level focuses on legislation and regulation, leadership and advocacy, inter-sectoral action, integration of policies, partnerships between all stakeholders, financing and the provision and development of human resources (Nuño e*t al.,* 2012; WHO, 2002). At the meso level, the ICCC emphasises the role of the community and the importance of integration-coordination of services and resources. The community and the healthcare organisation are equally responsible for chronic care (Nuño e*t al.,* 2012; WHO, 2002). At the micro level, the focus is on interaction between healthcare professionals, patients and families and community partnerships. The ICCC framework targets all stages in the prevention and management of chronic conditions: "from health promotion and prevention, to diagnosis, treatment, care, rehabilitation and palliative care" (Nuño e*t al.,* 2012). Even though this framework has been applied in both high- and low-income countries, the effective application of the framework has not been assessed (Nuño, e*t al.,* 2012).

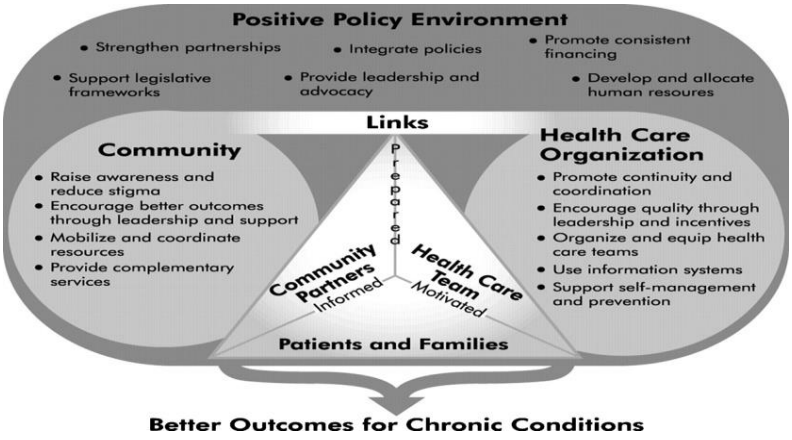


Figure 1.1: Innovative Care for Chronic Conditions Framework

Source: (Nuño *et al.*, 2012)

1.5 Aim of the study

The aim of this study was to investigate challenges to the implementation of intervention programmes aimed at CNCDs in the Langa PURE study site in South Africa.

1.6 Objectives of the study

The following objectives were formulated:

- To determine participants' dietary adherence by calculating a diet adherence score according to a Dietary Approaches to Stop Hypertension (DASH)-style diet.
- To determine if there was an association between dietary adherence score, anthropometric measurements (waist circumference, body mass index, waist-hip ratio, waist-to-height ratio) and blood pressure in a South African urban dwelling black population.
- To investigate participants' awareness of existing CNCDs intervention programmes in their community and their willingness to participate in nutrition intervention programmes.
- To determine challenges the target groups faced regarding CNCD interventions and what they require from a CNCD nutrition intervention programme.
- To explore what courses of action the Department of Health (DoH) officials involved in the prevention of the CNCD epidemic, think would perform best.

- To determine DoH officials' awareness of existing CNCD policies and what factors they perceive as obstacles to address the CNCD epidemic.
- To explore perceived challenges with the implementation of and adherence to health messages disseminated as part of a CNCD intervention programme.
- To gain an understanding of participants' expectations of CNCD intervention programmes.
- To explore the acceptability and preferences of health message dissemination methods in CNCD intervention programmes.

1.7 Research hypothesis

- Participants do not adhere to a Dietary Approaches to Stop Hypertension (DASH)-style diet.
- There is an inverse association between dietary adherence score and waist circumference, body mass index, waist-hip ratio, waist-to-height ratio and blood pressure, respectively in a South African urban dwelling black population.
- Department of Health (DoH) officials and target groups have different perceptions of what is needed in nutrition intervention programmes aimed at CNCDs in South Africa
- Individuals will be more willing to participate and adhere to advice given at intervention programmes, if they perceive it to meet their needs.
- Individuals will be more willing to participate and adhere to advice given at intervention programmes, if they find the advice culturally acceptable.

1.8 Significance of the study/value of the study

By identifying factors and perception differences which prevent target audiences from implementing current interventions aimed at eradicating the CNCDs epidemic, government (DOH) and other bodies concerned with public health (such as CANSA, HSFSA) could reconsider current interventions. This study aids in identifying whether a need for "tailor-made" interventions is required, or whether existing intervention programmes should be expanded to address issues identified as being deterrents to the implementation of current CNCDs interventions. For example, one of the risk factors for CNCDs is being overweight or obese, however, in the Black population being overweight or obese may be regarded as an indication of wealth (Stern, *et al.*, 2010).

1.9 Scope and limitations

Chronic non-communicable diseases need to be addressed urgently in order to curb its growth and ease the burden on the overtaxed public health sector. Although many attempts and systems have been put in place in an attempt to address this epidemic, it is not showing any signs of improvement. Innovative ways need to be found to address this epidemic in conjunction/concurrently with other epidemics (such as HIV/AIDS, TB) in an already overtaxed healthcare sector.

An attempt to identify obstacles to controlling/curbing the CNCDs growth needs to be identified, so that intervention programmes and policy can be "tailor made" to suit the target audience.

Limitations of the study are:

Only two community healthcare centres (CHCs) service the Langa community, but Langa hospital is no longer in operation and Vanguard CHC is situated adjacent to Langa in Bonteheuwel. Permission to access Langa hospital for this study was refused by the City of Cape Town on the grounds that they do not provide healthcare to persons with CNCDs. Permission was granted to access Vanguard CHC, however, the manager of the facility CHC declined the opportunity to participate in the study. Thus, no data is included for the municipal level of the study. In addition, only six out of the ten officials from the DoH were willing to participate in the study.

The researcher was unable to carry out any secondary analysis of the baseline biochemical data (cholesterol, triglycerides, blood glucose, LDL-cholesterol and HDL-cholesterol) since at the time of writing up this thesis, the blood samples had not yet been analysed as such, secondary analysis was limited to anthropometry and blood pressure measurements.

Dietary adherence was determined by calculating a dietary score based on a combination of the Dietary Approaches to Stop Hypertension (DASH) guidelines and the South African Food-Based Dietary Guidelines (SAFBDG). The dietary adherence score was calculated using an adaptation of the DASH score. However, the quantified food frequency questionnaire used to collect dietary data did not distinguish between refined carbohydrate and complex carbohydrate intake. We were thus unable to draw clear conclusions regarding fibre intake, even though it is known that South Africans

traditionally consumed a starch-based diet. Regarding legume intake, very few participants consumed lentils, beans or soy and soy products and concrete conclusions regarding legume intake could also not be drawn.

1.10 Organisation of the remainder of the report

The rest of the document is set out as follows:

Chapter 2: Literature review. In this chapter a comprehensive literature study is presented.

Chapter 3: Empirical Investigation. This chapter discusses the research methodology employed for the study and analysis of the data in detail.

Chapter 4: Article 1: This chapter presents a comparison of the blood pressure and anthropometric profiles of participants with the highest dietary adherence scores (based on SAFBG and DASH-style dietary guidelines), compared with those with the lowest dietary adherence scores of an existing cohort study.

Chapter 5: Article 2: This chapter presents data obtained at provincial level (DoH) regarding existing policies for CNCDs and data obtained during multicriteria mapping (MCM) interviews with DoH personnel.

Chapter 6: Article 3: This chapter presents the qualitative analysis of the data obtained from the focus group discussions in the form of a publication published in a scientific journal.

Chapter 7: Conclusions and recommendations. For this chapter, conclusions were drawn from all the findings of the study and recommendations are made based on these findings. The results are used to summarise findings on challenges to the implementation of nutrition intervention programmes aimed at CNCDs in an urban Western Cape Black community.

A reference list of all the resources used is provided and copies of all research instruments (questionnaires) used during this study are provided as appendices.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to appraise the existing literature on chronic non-communicable diseases (CNCDs), to emphasise the significance of the problem, as well as to review earlier efforts to control this epidemic. The challenges, failures and successes of nutrition interventions aimed at CNCDs are also explored. To this end, the appraisal of literature is conducted on:

a) CNCDs and its risk factors, with a focus on nutrition;
b) the burden of CNCDs;
c) nutrition intervention programmes aimed at CNCDs, highlighting successes and failures; and
d) frameworks for existing intervention programmes.

The following electronic databases were accessed for the purpose of this literature review: EbscoHost Web (Academic Search Complete, Academic Search Premier, CINAHL Plus, MEDLINE Complete and Nursing Reference Centre); Science Direct; SAGE Journals Online; SciVerse Hub; Google and Google Scholar. The following keywords were employed: non-communicable diseases; chronic non-communicable diseases; chronic diseases of lifestyle; lifestyle, healthy lifestyle interventions; risk factors; intervention programmes; frameworks for intervention programmes; diabetes; cardiovascular diseases; cancer; physical activity; and diet. Additional sources were identified by hand searching reference lists of articles cited by authors in primary sources.

2.2 Definitions

Chronic non-communicable disease: Chronic non-communicable diseases (CNCDs) refer to the four major chronic diseases of lifestyle, which have a profound impact on mortality and morbidity rates worldwide (Alwan & MacLean, 2009). These four major diseases are type-2 diabetes mellitus (T2DM), cardiovascular diseases (CVDs), some types of cancers and chronic respiratory diseases (Wagner & Brath, 2012; Habib & Saha, 2010; Westaway, 2010; Alwan *et al*., 2009). The rapid

increase of these CNCDs is mostly observed in low- and middle-income countries (LMICs) and is associated with unhealthy eating habits, decreased physical activity, smoking (tobacco use) and alcohol use. Urbanisation, industrialisation and globalisation, in turn, are linked to these changing behaviours (Wagner *et al*., 2012; Habib *et al*., 2010; Westaway, 2010; Alwan *et al*., 2009; Puska, 2002). Some of the CNCD risk factors, which include unhealthy eating habits, decreased physical activity, smoking (tobacco use) and alcohol use, are considered to be modifiable (Wagner *et al*., 2012; Habib *et al*., 2010; Alwan *et al*. 2009; Steyn, 2007; Puska, 2002).

Cardiovascular disease: The term cardiovascular disease (CVD) is the all-encompassing term used to describe any disorder of the heart and blood vessels. It includes, among others, stroke, heart attack and heart disease due to high blood pressure (Steyn, 2007). It has been documented globally that CVD is responsible for most deaths annually (World Health Organisation [WHO], 2011a).

Type-2 diabetes mellitus: Type-2 diabetes mellitus is a long-term illness, which manifests when the pancreas manufactures an inadequate amount of insulin, or when the body is unable to utilise the insulin it produces successfully. This leads to increased levels of glucose in the blood (hyperglycaemia). It often results from excess body weight and physical inactivity. T2DM is linked to decreased life expectancy, increased morbidity as well as diminished quality of life, because of its related complications (WHO, 2011b).

Cancer: Cancer (tumour/neoplasm) refers to the fast growth of abnormal cells, which can occur in any part of the body, or its organs (WHO, 2011c).

Chronic respiratory diseases: Chronic respiratory diseases are long-lasting medical conditions, which affect the respiratory system. The most reported are asthma, chronic obstructive pulmonary disease (COPD), occupational lung diseases and pulmonary hypertension (WHO, 2011d)

Obesity: Obesity can be defined as 'an excess of body adiposity' or having a body mass index (BMI) of 30kg/m^2, or more (Shah & Braverman, 2012; Hurt *et al*. 2010; Caballero, 2007; Berrington de Gonzalez *et al*., 2010). BMI is often used to determine a person's weight status. BMI is determined by dividing the weight in kilograms, by the square of the height in metres (Shah *et al*., 2012). According to the World Health Organisation (WHO), a person with BMI below 18.5kg/m^2 is

considered to be underweight; between 18.5 and 24.9kg/m^2 – normal weight; 25.0 to 29.9kg/m^2 – pre-obese; 30.0 to 34.9kg/m^2 – obese class I; 35.0 to 39.9kg/m^2 – obese class II; and above 40 kg/m^2 – obese class III (WHO, 2004). Obesity has been linked to increased mortality rates due to heart disease, dyslipidaemia, sleep apnoea, cognitive dysfunction, non-alcoholic liver disease, stroke and cancers (Dalais *et al*., 2014; Mitchell *et al.,* 2011; Berrington de Gonzalez *et al.,* 2010).

2.3 Global and South African epidemic of chronic non-communicable diseases

The number of individuals suffering from, or who are at risk of developing, CNCDs which is referred to worldwide as CVDs, cancer, diabetes and chronic respiratory diseases, are increasing annually (Wagner *et al*., 2012; Habib *et al.,* 2010; Westaway, 2010; Alwan *et al.,* 2009). The global, as well as South African epidemic of each CNCD is discussed briefly.

South Africa (SA) differs from other countries in transition, in that it has a quadruple burden of disease, which is HIV/AIDS; Maternal and child mortality; CNCDs and Violence (Maredza *et al*., 2011*;* Household 2010; Kean and Erasmus 2009). In South Africa, the number of deaths from HIV is still higher than from the four major CNCDs, however, the disability adjusted life years (DALYs) indicate that, currently, CNCDs and HIV each account for 35% of the disease burden (Hofman, 2011). Heart disease is often associated with wealth, but in SA it has been revealed that stroke, due to hypertension, is more prevalent in persons living in poverty (Hofman, 2011; Mayosi *et al*., 2009). In South Africa, there has been an increase of CNCDs involving individuals residing in rural communities, however, the statistics are still lower than those individuals of poor socio-economic status, who reside in urban areas (Draper *et al.*, 2014; Household, 2010).

In SA, most of the poor do not have access to affordable, nutritious foods, with many individuals residing in urban areas and known to consume foods with a higher fat content and little fruit and vegetables (Hofman, 2011; Kruger *et al.*, 2005). In addition, most of the poor people live in environments that are not conducive to physical activity. Most often, there are no designated safe areas to exercise, walk, ride a bicycle or play. Additionally, they are also far removed from places built for leisurely activities and public swimming pools (Hofman, 2011; Kruger *et al*., 2005).

South Africa is leading in the development and implementation of legislation for tobacco control, with the passing of the Tobacco Products Control Act (83 of 1993) and increasing tobacco taxes to 52% per pack (Maredza *et al.*, 2011; Hofman, 2011). SA is also not lagging far behind the rest of the world, in terms of obesity. A recent systematic analysis showed that South African women had the highest prevalence of obesity in 2013 (Ng *et al.*, 2014). Besides the influence of urbanisation on dietary and lifestyle habits on weight, culture also plays a very important role. Ethnic black women often do not view themselves as being overweight, as it is perceived to be attractive and related to respect, dignity and wealth (Micklesfield *et al.*, 2013; Malaza *et al.*, 2012; Stern *et al.*, 2010). The success of interventions for HIV/AIDS has resulted in an increased survival rate of HIV-positive persons, however, the known side effects of long-term ARVs & increasing age of HIV-survivors will also contribute to the growth of CNCDs (Lalkhen & Mash, 2015).

In his speech at the SA Summit on the Prevention and Control of Non-communicable diseases, held in Gauteng, September 2011, the Health Minister, Aaron Motsoaledi, expressed his concern for the CNCDs epidemic that South Africa is facing. The summit culminated in the South African Declaration on the prevention and control of non-communicable diseases (South Africa Department of Health [DoH], 2011).

2.3.1 Type-2 Diabetes mellitus

In the year 2014, it was estimated that 422 million people in the world were living with type-2 diabetes mellitus (T2DM). This represents an increase in T2DM prevalence of 8.5% worldwide (WHO, 2016). As stated by the International federation of Diabetes (IDF), 2.2 million cases of T2DM were reported in South Africa in 2015 (IDF, 2015). According to findings from the SANHANES-1 report, persons of coloured and Asian/Indian ethnicity had significantly elevated glycosylated haemoglobin (HbA1c) levels compared to those from White or Black ethnic groups. (Shisana *et al.,* 2013).

2.3.2 Cardiovascular diseases

In 2015, it was estimated that 17.7 million people had died from CVDs. Of the 17.7 million, 7.4 million and 6.7 million deaths were due to coronary artery disease stroke, respectively. This

comprised 31% of all global deaths in that year. More than 80% of these deaths occurred in LMICs, with an equal distribution across genders (WHO, 2017).

Statistics from the American Heart (2010) indicate that approximately 82, 600, 000 American adults suffer from one or more type/s of CVD, with 40,400,000 being older than 60 years of age (Starr, 2012). In America, it has been predicted that approximately one death every 39 seconds is attributable to CVD (Bhupathiraju & Tucker, 2011).

According to the Heart and Stroke Foundation of South Africa (HSFSA), in 2015, 6.3 million individuals suffered from hypertension in South Africa – 130 heart attacks and 240 strokes occurred on a daily basis (HSFSA, 2016). The estimated number of daily deaths due to CVD in South Africa equates to 20% of daily deaths caused by HIV/AIDS (Maredza *et al.*, 2011). Even though HIV is still considered the leading cause of deaths in South Africa, the number of deaths due to cardiovascular disease is forecasted to increase by 48% between the years 2000 and 2030, in the economically active age group (35 - 64 years), unless strategies are put in place to address the problem (Hofman, 2011).

2.3.3 Cancer

According to the WHO, cancer is the second biggest contributor to global deaths with an estimated 8.8 million people losing their lives due to this disease. In addition, the WHO had predicted that 14 million people would be diagnosed with cancer in 2012 (WHO, 2017). It has been forecasted that, by the year 2030, the number of cancer cases will increase to 82% in low-income countries (LICs), 70% in LMICs and 70% in upper-middle-income (UMICs), with only an expected 40% increase in high-income countries (HICs) (Wagner *et al*., 2012).

Breast cancer is the most common cancer diagnosed in women. It accounts for one in every three cancers diagnosed, with more than 230 000 new cases diagnosed annually in the United States (Thomson, 2012). According to the South African National Cancer Registry [SANCR] (African Cancer Registry Network [AFCRN], 2012), the topmost nutrition-related cancers in South African men are prostate cancer, cancer of the lungs, colorectal cancer, oesophageal cancer and stomach cancer. In South African women, the topmost nutrition-related cancers diagnosed are breast cancer,

cervical cancer, colorectal cancer and oesophageal cancer (AFCRN, 2012). Each year, in South Africa, it is estimated that about 4000 deaths are attributable to cancer (Mayosi *et al.*, 2009). According to a report by Health 24, dated 26 August 2014, the information officer of the Cancer Association of South Africa (CANSA) highlighted the common cancers in South African women and men. S/he also stated that some cancers, such as cervical cancer, breast cancer, oesophageal cancer, uterine cancer and lung cancer were more prevalent among black South African women (CANSA, 2017).

2.3.4 Chronic obstructive pulmonary diseases

A number of chronic respiratory diseases exist, the most common group being chronic obstructive pulmonary disease (COPD), which usually refers to chronic bronchitis and emphysema, both of which are characterised by progressive airflow obstruction that is only reversible to a degree (Schwellnus *et al*., 2008). According to the WHO, there are 235 million individual asthma sufferers worldwide. In 2015, more than 3 million people died from COPD globally (WHO, 2016). COPD is the leading cause of lung-related death and disability (Schwellnus *et al*., 2008). Besides the systemic consequences of chronic respiratory disease, co-morbities, such as cardiac disease, diabetes mellitus, hypertension, osteoporosis and psychological disorders are also frequently present in COPD sufferers (Schwellnus *et al*., 2008).

The predominant non-communicable chronic respiratory diseases in South Africa are COPD, asthma, occupational lung disease and lung cancer (Mayosi *et al.*, 2009). Statistics for non-communicable chronic respiratory diseases in South Africa are not readily available, however, South African demographic and health surveys' (SADHS) self-reported data in 2003 found that more women (8.5%) than men (7.8%) suffer from asthma, which is categorised as a chronic respiratory disease. A study conducted in Cape Town supported the SADHS findings and revealed that asthma was more common in rural than urban areas (Cullinan, 1998; Mayosi *et al.*, 2009).

2.4 Causes and risk factors for CNCDs

As far back as the early 1900s, increasing levels of CNCDs were associated with socio-economic development, as witnessed by increased salaries, education, employment, lifestyle changes,

improved health status and life expectancy (Amuna & Zotor, 2008).

2.4.1 Epidemiological and nutrition transition

In South Africa, as in other developing countries, migration from rural to urban areas has been linked with significant lifestyle changes, especially changes in diet (to a more 'westernised' one that is fatty and calorie-dense), lifestyle habits (consumption of alcohol and smoking) and decreased activity levels (Crowther, 2009). This nutrition transition, defined as a shift in dietary habits, together with changes in lifestyle, result in increased weight gain over time and, ultimately, the development of CNCDs (Bishwajit *et al*., 2014; Crowther, 2009; Amuna *et al*., 2008).

The key risk factors for CNCDs are similar in almost all countries (Wagner *et al*., 2012). These nine risk factors, as identified by the INTERHEART study are:

1) Tobacco use;
2) Lack of physical activity;
3) Excessive alcohol use;
4) A diet that is high in calories and sugar;
5) A diet that is high in salt;
6) High saturated and trans-fatty acids (*trans*-fats) intake;
7) Low fruit and vegetables intake;
8) Obesity; and
9) Psychosocial stress

(Wagner *et al*., 2012; Maredza *et al.*, 2011; Habib *et al.,* 2010; Alwan *et al*., 2009).

This review will focus on nutrition-related risk factors, including tobacco use and physical activity.

2.4.2 Tobacco use

Smoking has been associated with death resulting from the development of 21 diseases. These diseases include 12 types of cancer, 6 categories of CVDs, diabetes, COPD and pneumonia (Carter *et al*., 2015; Vineis *et al*., 2007). The mortality rate of smokers is reportedly 2-3 times higher than

that of non-smokers (Carter *et al*., 2015).

2.4.2.1 Tobacco use and obesity

Even though smokers seemingly have a lower bodyweight and body mass index (BMI) compared to non-smokers they tend to have larger waist circumferences (WC) and waist-hip-ratios (WHR) than non-smokers (Kim *et al*., 2012; Clair *et al*., 2011). According to literature, abdominal fat (determined by WC and WHR) is associated with the risk for diabetes and cardiovascular disease (Clair *et al.,* 2011). Greater risk of abdominal obesity is associated with heavy smoking [more than 10 cigarettes per day] compared to light smoking [up to 10 cigarettes per day] (Clair *et al*., 2011).

2.4.2.2 Tobacco use and diabetes

Tobacco use has been autonomously linked with the occurrence of diabetes. The aetiology is not yet completely understood, however, it is alleged that the advancement of visceral obesity (fat tissue surrounding the intra-abdominal organs), increased hypercortisolemia, nicotine-induced impaired beta-cell function and increases in inflammatory markers, as well as oxidative stress, due to smoking, are to blame (Hilawe *et al*., 2015; Luo *et al.,* 2013; Shuster *et al.,* 2012). Smoking has also been linked with visceral fatness, which in turn has been linked to more health risks than peripheral adipose tissue. It has also been established that visceral fatness results in hepatic insulin resistance and the elevated production of glucose, as well as increased production of very low lipoproteins by the liver (Kim *et al*., 2012).

In the diabetic population, it has been reported that smoking increased the risk of death, coronary heart disease (CHD), stroke and myocardial infarct (MI), with the risk for CHD, stroke and proteinuria being directly associated with the number of cigarettes smoked daily (Nagrebetsky *et al*., 2014). In addition, it has been revealed that smokers with diabetes have increased levels of glycated haemoglobin (HbA_{1c}) and are also at greater risk of experiencing severe hypoglycaemia (Nagrebetsky *et al*., 2014). The findings of a previous study have shown an association between passive smoking and the risk of type 2 diabetes (T2DM), however, the researchers recommended that further studies be done to conclusively confirm their findings (Wang *et al.,* 2013).

2.4.2.3 Tobacco use and cardiovascular disease

Tobacco use is considered to be one of the major contributors to the high CVD mortality rate, with smokers exposed to twice the risk of suffering an acute myocardial infarct (AMI) compared to non-smokers (Wambua & Jamal, 2012; Huxley & Woodward, 2011). In addition, it has been revealed that female smokers are exposed to a 25% greater risk of developing CHD than men are. However, the reason for this variation in risk between genders is unknown (Huxley *et al*., 2011). The proposed mechanisms for the development of CVD in smokers include an inflammatory response and modification of the smoker's lipid profile. For several years, various studies have revealed that smoking results in an elevated peripheral leukocyte count, while promoting atherosclerosis, by changing the smoker's lipid profile (Wambua *et al*., 2012; Kim *et al.,* 2012). Epidemiological studies have not only proven that cigarette smoking increases the incidence of MI and fatal coronary artery disease (CAD), evidence also exists that passive smoking is associated with more or less a 30% increase in CAD (Salahuddin *et al*., 2012; Ambrose & Barua, 2004).

2.4.2.4 Tobacco use and cancer

The association between tobacco use and cancer goes as far back as 1670 (Hymowitz, 2011). Over the years population studies, animal experiments, cellular pathology and the identification of cancer-causing chemicals in cigarette smoke has all cemented the link between tobacco use and cancer (Proctor, 2012). Tobacco use has been strongly associated with lung cancer (Hymowitz, 2011; Proctor, 2012). Cigarette smoking has been shown to cause atrophy of the cilia lining the upper airway passages, which is responsible for the removal of harmful particles from the lungs (Proctor, 2012). In addition, polycyclic aromatic hydrocarbon, a known cancer-causing chemical plus other carcinogens including arsenic, chromium and nickel, has been identified in cigarette smoke (Proctor, 2012). Smoking has also been linked to 17 types of cancers, including cancer of the lip, mouth, oesophagus, stomach, colorectum, liver, pancreas, liver, larynx, urinary bladder, kidney and renal pelvis (Alexandrov *et al.,* 2016; Carter *et al.,* 2015). In their research on head and neck cancer, Zhang *et al.* (2015) found that tobacco use was a greater risk factor for head and neck cancer compared to alcohol use (Zhang *et al.,* 2015)

2.4.2.5 Tobacco use and chronic obstructive pulmonary disease

Over the years, a number of risk factors linked to the development of COPD have been identified (for example, genetic, occupational or environmental exposure, gender, age, respiratory infections, socio-economic status, nutrition and co-morbidities). However, smoking and exposure to second-hand smoking are still pinpointed as major risk factors for COPD, which is ranked as the third most frequent cause of worldwide mortality (Burney *et al*., 2013; Parker & Eaton, 2012).

2.4.3 Lack of physical activity

Since the 1950s, inactivity of the US population has been deemed a matter of concern. This resulted in President Eisenhower creating the Council on Fitness and Health in an attempt to increase physical activity. In 2000, it was estimated that less than 30 per cent of the US population had an adequate level of physical activity (Caballero, 2007).

In South Africa, the Demographic and Health Survey [DHS] (South Africa Department of Health [DoH], 2003) found that 32% of adolescent men and 47% of adolescent women were inactive. The same survey also reported that of the men and women (15 years and older) surveyed, 48% of the men and 63% of the women were inactive (SA DoH, 2003). In 2010, it was estimated that approximately 46.9% of adults (18 years and older) were physically inactive in South Africa (WHO, 2010). Reports that are more recent inform that only 24% of South African women and 36% of men participate in sufficient levels of daily health-enhancing physical activity (Kolbe-Alexander *et al.,* 2012).

2.4.3.1 Lack of physical activity and overweight/obesity

Physical activity has been proven to aid weight loss and weight maintenance (Wiklund, 2016; Hruby *et al.,* 2016). It thus follows reason that a lack of physical activity could be a contributing factor to overweight and obesity. In fact, low physical activity or a decrease in physical activity has been associated with an increased risk of weight gain (Hruby *et al.,* 2016; Wiklund, 2016).

2.4.3.2 Lack of physical activity and cardiovascular disease

Since 1953, many studies have proven that a lack of physical activity is linked to an increased risk of cardiovascular and coronary heart disease (Shiroma & Lee, 2010). Chronic low-grade inflammation has recently been observed to be the common factor linking T2DM, metabolic syndrome, insulin resistance, endothelial dysfunction and CVD (Balducci *et al*., 2012). It has been suggested that a lack of physical activity have a direct effect on the structure and functioning of blood vessels and in this way, alter the risk of cardiovascular disease (Thijssen *et al.,* 2010). Several studies have shown that physical activity reduces levels of C-reactive protein (CRP), an acute-phase protein, which is an independent predictor of CVD and coronary artery syndromes, as well as other pro-inflammatory cytokines (Shrivastava *et al*., 2015; Balducci *et al.,* 2012; Yousuf *et al.,* 2013). This anti-inflammatory effect was greatest in groups that performed a combination of aerobic and resistance exercises at a high-intensity level, including daytime physical activity for a long duration of time (Balducci *et al.*, 2012). The anti-inflammatory effect was perceived to be due to inhibition of pro-inflammatory pathways, stimulation of anti-inflammatory pathways, as well as modulation of adipokines, which regulate insulin sensitivity (Balducci *et al*., 2012).

2.4.3.3 Lack of physical activity and diabetes mellitus

A lack of exercise has been associated with reduced muscle mass and obesity (Ozougwu *et al.,* 2013; Marinho *et al.*, 2013; Olokoba *et al.,* 2012). Excess intra-abdominal fat (visceral fat) is known to cause insulin resistance, a characteristic of T2DM (Ozougwu *et al.,* 2013; Olokoba *et al.* 2012). Over the past decade, several studies involving animal and human models have demonstrated that insulin action is improved and glucose absorption enhanced, after exercise (Khan, 2013; Maarbjerg *et al*., 2011). This increased insulin sensitivity has been demonstrated in healthy, insulin resistant and type 2 diabetic subjects. This insulin sensitivity is perceived to be due to increased glucose transporter type 4 (GLUT4) translocation to the surface membrane, during exercise and a combination of several small enhancements in insulin signalling and microvascular perfusion (Maarbjerg *et al*., 2011).

2.4.3.4 Lack of physical activity and cancer

Even though the mechanism involved in cancer and physical inactivity has not been clearly ascertained, it has been proven that obesity (excessive adiposity), excess energy intake and physical inactivity, increase the risk of many cancers and other chronic diseases of lifestyle (Kushi *et al*., 2010).

2.4.3.5 Lack of physical activity and COPD

In recent years, researchers have established that physical inactivity and obesity can lead to the development of COPD. Although the exact interrelationship is unclear, it is known that both physical inactivity and obesity are associated with low-grade systemic inflammation. It has been established that low-grade systemic inflammation plays a pivotal role in the pathogenesis of many chronic diseases. Spirometry is often used to measure lung function. The measurements made with this test include forced expiratory volume in 1 second (FEV_1), a measurement of the maximum amount of air an individual can forcefully blow out of their lungs in one second (Ranu *et al*., 2011). C-reactive protein (CRP) levels have been linked to a lower FEV_1 and strongly and independently linked with a higher occurrence of bronchial hyper-responsiveness in a study conducted by Ten Hacken (2009). In persons suffering from COPD, physical inactivity has been linked to more hospitalisations, co-morbidities and adverse outcomes (Troosters, 2013; Zanoria & ZuWallack, 2013).

2.4.4 Alcohol use

An excessive intake of alcohol has been linked to increased risks of cancer of the breast (female), colon, rectum, liver, oral cavity, pharynx, larynx and oesophagus (Chan & Giovannucci, 2011; Room & Rehm, 2010).

2.4.4.1 Alcohol and overweight/obesity

Excessive alcohol intake and binge drinking has been associated with an increased risk of becoming overweight and obese (Traversy *et al.,* 2015; Yeomans, 2010). Several possible explanations for the

effect of alcohol on weight gain have been put forth in the literature. One explanation is that the kilocalories (kcal) from alcohol is additive to kcal from other food and beverages consumed (Yeomans, 2010). It has been observed that an increased food intake was consumed by study participants on days alcohol was consumed (Yeomans, 2010). It was thus hypothesised that alcohol stimulates appetite and promote overconsumption of food in the short term (Yeomans, 2010). Since it has been proven that alcohol affects a number of hormones associated with satiety, it has been suggested that alcohol may affect kcal intake by limiting the effect of these hormones (Traversy *et al.,* 2015). Alcohol has also been shown to inhibit fat oxidation, thus frequent alcohol intake may result in increased body fat over years (Traversy *et al.,* 2015).

2.4.4.2 Alcohol and cardiovascular disease

Moderate alcohol consumption has also been associated with a decreased risk for developing CVD (Bhupathiraju *et al*., 2011; Sisson *et al*., 2005). On the other hand, irregular heavy drinking (>60g of pure alcohol or ≥5 drinks at a time) i.e. binge drinking has been linked to a 45% higher risk for CVD. It has been documented that regular heavy drinkers (>2days/week) have a 25% lower risk for CVD in comparison with non-drinkers. Irregular heavy drinkers (2 days or less per week) were found to have a notably higher risk for CVD compared to non-drinkers (Bhupathiraju *et al*., 2011).

Even though wine is perceived to be more beneficial, all forms of moderate alcohol intake seem to be of benefit. Wine has been found to be of greater benefit against CVD risk than beer and beer is said to have a greater benefit than spirits (Bhupathiraju *et al*., 2011). Various modes of action have been considered, to explain the association between alcohol and CVD. Studies have shown that 30g of ethanol per day resulted in higher levels of HDL-C and apolipoprotein A1. In addition, moderate alcohol consumption might improve the thrombolytic profile. Yet other researchers have observed that moderate alcohol intake is associated with lower CRP levels and higher insulin sensitivity. Red wine advocators believe that reservatol is cardioprotective due to its antioxidant and anti-apoptotic effects (Bhupathiraju *et al.,* 2011).

Currently the American Heart Association (AHA) recommends that alcohol consumption should be limited to no more than two drinks per day for males and one drink per day for females. In addition,

the Association recommends that non-drinkers should not start to consume alcohol, because of the risks associated with its heavy consumption, such as addiction, liver disease and cancer (Bhupathiraju *et al*., 2011).

2.4.4.3 Alcohol and diabetes mellitus

A low to moderate consumption of alcohol has been associated with decreased risk of T2DM in many studies (Mekary *et al*., 2011; Crandall *et al*., 2009; Baliunas *et al*., 2009). It has been suggested that several factors may play a role, including increased insulin sensitivity, post-moderate alcohol intake, changes in the levels of alcohol metabolites, increased HDL cholesterol levels, or the anti-inflammatory effect of alcohol (Baliunas *et al*., 2009).

BMI has been found to be a determining factor in the risk of developing T2DM and alcohol consumption. Moderate and heavy drinking is associated with increased risk of T2DM in men with low BMI, while moderate alcohol consumption seems to have a protective effect in men with higher BMIs (Pietraszek *et al.*, 2010). The type of alcohol consumed is also a determinant in the risk of developing T2DM, with wine being the most protective and spirits being the most harmful (Pietraszek *et al*., 2010).

Even though researchers have agreed, in recent years, that alcohol intake plays a role in the risk of T2DM, the physiological mechanism is not clear. In their systematic review and meta-analysis, Baliunas *et al*. (2009) found that an alcohol intake of 51g/d for women and 62g/d for men, was harmful and, therefore, reinforced the current recommendation for low alcohol intake (Baliunas *et al*., 2009).

2.4.4.4 Alcohol use and cancer

Studies have clearly established that alcohol consumption is a factor for cancers of the mouth, pharynx, larynx, oesophagus, liver, colon, rectum and breast (Room *et al.,* 2010). Excessive intakes of alcohol, defined as more than 2 drinks per day in men, have been associated with a two-fold risk of colon cancer and an increased risk of colorectal adenoma (Chan *et al*., 2010; Parkin, 2011; Latino-Martel *et al*., 2011; Baan *et al*., 2007). In their study, Breslow *et al*. (2011) found that the

quantity of alcohol consumed affected all-site cancer mortality in men, whereas the frequency was more important in females. Higher alcohol consumption was linked to increased risk of colorectal cancer in women and more frequent drinking was associated with increased prostate and breast cancer risk (Breslow *et al*., 2011). Acetaldehyde, which is the first product formed during the metabolism of ethanol, causes DNA damage and has been classified as a Group 1 carcinogen (Connor, 2016; Room *et al*., 2010; Secretan *et al*., 2009; Baan *et al.,* 2007). It has also been hypothesised that excessive alcohol use reduces folate, a co-factor in DNA synthesis, repair and methylation (Hu *et al*., 2016). It is believed that folate deficiency might induce p53 mutations resulting in the development of cancer (Chan *et al*., 2010).

2.4.5 Dietary intake

An inadequate quality diet is a key cause of worldwide mortality and morbidity, with diet-related health problems, such as CNCDs, topping the list of health problems due to under-nutrition (Imamura *et al*., 2015). Over the past four decades, the dietary composition in LMICs has changed to a more calorific one, which is high in total and saturated fat (Imamura *et al*., 2015; Kearney, 2010).

Determinants of dietary intake have been identified as income, urbanisation, trade liberalisation, transitional food corporations, retailing, food industry marketing, as well as consumer attitudes and behaviour (Kearney, 2010). High intakes of energy, especially of calorie-dense, but low-nutrient dense foods, are a major problem in industrialised societies (Egger & Dixon, 2014). Excessive consumption of calories will result in the individual becoming overweight and/or obese, which in turn could result in the individual becoming insulin resistant and consequently developing T2DM and CVD (Egger *et al.,* 2014; De Caterina *et al*., 2006). A large percentage of the increased caloric intake can be attributed to a high intake of sweetened beverages, as well as excess intake of low-cost energy-dense food, which displaces calories from fresh fruits and vegetables (Caballero, 2007).

"Metaflammation", a term used to describe a form of low-grade chronic and systemic inflammation that appears to be present in many chronic diseases, was originally credited to obesity. Subsequent studies, however, have described increased risk and elevated metaflammation from

overconsumption of sugars, salt, alcohol and fats (saturated and trans), as well as inadequate intake of fibre, fruit, vegetables, grains and certain nutrients (Egger *et al*., 2014).

2.4.6 Diet and diabetes mellitus

2.4.6.1. Carbohydrates

The glycaemic index (GI) is "an indicator of carbohydrate quality that reflects the effect on blood glucose" (Salas-Salvadó *et al*., 2011; Oh *et al*., 2005). The glycaemic load (GL) is "an indicator of both carbohydrate quality and quantity" (Salas-Salvadó *et al*., 2011; Oh *et al.,* 2005). It has been revealed that high GI and GL diets are linked to increased risk of diabetes and that low-GI diets are linked to improved glycaemic control, insulin sensitivity and other biomarkers for diabetes (Salas-Salvadó *et al.,* 2011). A strong postprandial metaflammatory trajectory has been seen with the consumption of highly processed foods (Egger *et al.,* 2014).

2.4.6.2 Dietary fibre

Studies have shown that high intakes of fibre and fibre-rich foods reduce the risk of T2DM (InterAct Consortium [The], 2015; Post *et al*., 2012). Soluble fibre is known to slow down gastric emptying and intestinal nutrient absorption and, in this way, play an important role in controlling postprandial glycaemia and insulin responses and satiety (Salas-Salvadó *et al*. 2011). A high insoluble fibre (cereals, legumes, nuts) intake has also been linked to decreased incidence of T2DM. It has been hypothesised that this could be because food sources of insoluble fibre contain many bioactive phytochemicals (Salas-Salvadó *et al.,* 2011).

2.4.6.3 Dietary fat

In their systematic review, Salas-Salvadó *et al*. (2011) concluded that dietary fat is not a risk factor for T2DM. They also found that total fat consumption of 18-40% of energy did not affect body fatness. Recent studies have shown that vegetable-based high-fat diets (35-40% of total energy) improved insulin sensitivity, decreased triglyceride (TG) levels and elevated HDL cholesterol levels (Salas-Salvadó *et al*., 2011; Halton *et al*., 2008; Hession *et al*., 2009). However, Salas-Salvadó *et al.*

(2011) conclude that, since no long-term randomised studies had been done on the effects of high-fat diets, well-founded recommendations cannot be made. Additionally, their study also found that the type of fat (saturated versus unsaturated fatty acids) play a role in the risk of diabetes. It has been established that mono-unsaturated fatty acids (MUFAs) have no effect on T2DM development, whereas saturated fatty acids (SFA), especially from the consumption of processed meat and total meat intake has been associated with the risk of T2DM (Salas-Salvadó *et al*., 2011).

2.4.6.4 Salt

Hypertension is often present in persons with diabetes due the increased rate of atherosclerosis seen in diabetes (Feldstein, 2002). Since hypertension in a person with diabetes has been linked to various harmful effects, it has been recommended that the prevention of hypertension should be the goal. Therefore, it has been recommended that this population group should restrict their salt intake, since it has been proven that salt restriction provides a modest reduction on blood pressure in persons with T2DM (Ekinci *et al*., 2011).

2.4.6.5 Fruit and vegetables

In a critical review of the literature, Boeing *et al*. (2012) assert that an increased intake of fruit and vegetables might indirectly reduce the incidence of T2DM, by preventing weight gain, which is considered the chief risk factor for T2DM. However, this review also found no proof that increased fruit and vegetable consumption increased the risk of T2DM, independent of overweight. Others concluded that specific vegetable groups, especially green leafy vegetables and root vegetables, might be valuable in preventing diabetes (Boeing *et al.,* 2012; Cooper *et al.*, 2012a). In addition, it has been established that inclusion of a larger amount of vegetables, as well as a bigger variety of fruit and vegetables, is associated with a decreased risk of T2DM (Cooper *et al*., 2012b). Concerns about the effect of the sugar content of fruit on glycaemic control of persons with T2DM have also been proven to be unfounded. Christensen *et al*. (2013), in their randomised controlled trial (RCT), found that limiting fruit intake had no effect on HbA_{1c} and recommended that fruit consumption should not be strictly limited in persons with T2DM.

2.4.7 Diet and cardiovascular disease

The association between diet and CVD has been researched extensively for almost half a century (Mente *et al*., 2009). The universal agreement from current available literature is that a dietary pattern that is low in saturated and *trans*-fatty acids TFAs), while high in fruit and vegetables, whole-wheat products and polyunsaturated fatty acid (PUFAs), including ω-3 fatty acids, is probably helpful in preventing CVD (Mente *et al*., 2009).

2.4.7.1 Carbohydrate intake

It has been documented that a high carbohydrate intake can have an unfavourable effect on fat and glucose metabolism, which increases the risk of CVD (Oh *et al*., 2005). Evidence exists to support the claim that a high glycaemic load (GL), or glycaemic index (GI), may increase the risks of CHD and T2DM. On the other hand, total carbohydrate intake has a weaker association with these conditions. In addition, it has also been established that the undesirable effect of a high carbohydrate intake, or glycaemic load, is more enhanced in persons with underlying insulin resistance (Oh *et al*., 2005).

In their prospective study, Oh *et al*. (2005) found a relationship between high carbohydrate intake and risk for haemorrhagic stroke, which was independent of other cardiovascular risk factors. Their findings also revealed that this relationship was more powerful in females, who were overweight or obese (Oh *et al*., 2005). In their study that explored the risk of stroke and carbohydrate intake, Oh *et al.* (2005) found that total carbohydrate intake was a greater risk factor for total and haemorrhagic stroke, than glycaemic index, or glycaemic load. A possible explanation for this is that, as previously established, a high-carbohydrate intake may decrease total LDL and HDL levels, which may cause weakening of the arterial wall and subsequently, the rupturing of intra-cerebral arteries (Oh *et al*., 2005).

Another possible explanation is that with a higher carbohydrate intake, there might be a compensatory lower intake of protein. A low intake of animal protein has been linked to an increased risk of haemorrhagic stroke (Oh *et al.,* 2005). Yet another possible explanation is that high carbohydrate, low-protein diets may increase blood pressure, which is a powerful risk factor

for stroke. Carbohydrates have also been linked to higher CRP levels, which may signify a worsening of insulin resistance that might be associated with an increased risk for stroke (Oh *et al.,* 2005).

Literature documents that the risk for chronic diseases may be lessened by means of a high fibre intake (Lottenberg *et al.*, 2010; Oh *et al*., 2005). It has been hypothesised that fibre might improve postprandial glycaemic response and insulin levels (Oh *et al*., 2005; Fuji *et al*., 2013). It is also assumed that the micronutrients, present in fibre-containing foods, might have an additive effect on lowering the risk of stroke (Oh *et al*., 2005). Based on their findings, the researchers suggest that the risk of haemorrhagic stroke can be decreased, especially in overweight women, by replacing refined starches and sugar with whole-wheat, high-fibre forms of carbohydrate (Oh *et al*., 2005).

2.4.7.2 Dietary fat

A diet high in SFA, TFA and dietary cholesterol (chol) plays an exceptional role in the advancement of atherosclerosis (Derman *et al*., 2008a). Mente *et al*. (2009), in their systematic review, found a relationship between low fat diets, increased TG and decreased high-density lipoprotein (HDL) cholesterol levels. These authors also found that diets supplemented with unsaturated fatty acid, such as olive oil, tended to have a beneficial effect on serum fats (Mente *et al*., 2009).

The AHA currently recommends consuming <7% of energy as saturated fat and <1% of energy as TFA to decrease CVD risk. The latest Dietary Guidelines for Americans also recommend the replacement of SFA with dietary sources of MUFAs and polyunsaturated fats (PUFAs) (Bhupathiraju *et al*., 2011).

Saturated fat has been implicated in the increased risk of CVD by increasing the low-density lipoprotein (LDL) concentrations (Bhupathiraju *et al*., 2011). Studies reveal that by substituting SFA with unsaturated fatty acids increases the HDL to LDL ratio, which reduces the risk for CVD (Vafeiadou *et al*., 2015; Kris-Etherton & Fleming, 2015; Guasch-Ferré *et al*., 2015). *Trans*-fatty acids have recently been identified to be as bad a risk for CVD as SFA. Additionally, it has been predicted that CVD risk could be decreased by 17%, should TFA be substituted with SFA, MUFA or PUFA (Bhupathiraju *et al*., 2011).

2.4.7.3 Fruit and vegetables

Fruit and vegetable (FV) intake has been directly linked with lower mortality from ischaemic heart disease (Bazzano *et al.,* 2002). This same study revealed that the incidence of stroke, stroke mortality, ischaemic heart disease (IHD) mortality, CVD mortality and all-cause mortality in the greater USA population decreased with regular FV intake (Bazzano *et al*., 2002).

It has been reported that the global total mortality, because of inadequate FV consumption, is approximately 2.64 million deaths per year (Bhupathiraju *et al*., 2011). It has been forecast that consuming 600g of FV per day may decrease the global strain of IHD and ischaemic stroke by 31% and 19%, respectively. A range of studies has shown that the protective effects of FV are dose-dependent (Wallace *et al*., 2013; Wang *et al*., 2014). The mode through which FV exert their beneficial effects are not fully known, but it has been hypothesised that it includes antioxidant and anti-inflammatory effects (Bhupathiraju *et al*., 2011).

The authors also recently noted that there is a relationship between a greater variety of FV and lower circulating C-reactive protein levels, which is a systemic inflammatory marker. In addition, it is believed that the bioactive constituents in FV, such as carotenoids, vitamin, fibre, magnesium and potassium work together to advance a holistic protective effect (Bhupathiraju *et al*., 2011).

2.4.7.4 Fish intake

The results regarding the beneficial effect of an increased fish intake have been conflicting (Mente *et al*., 2009). Concern has been raised regarding the increased risk for prostate cancer with high fish intakes, as well as the potential effects of mercury and other contaminants (Bhupathiraju *et al*., 2011). It has been documented that individuals, who consumed fish 2-4 times per week, had a 23% lower risk of CVD mortality. Each 20g/d of fish intake was linked to a 7% lower risk of CVD mortality. The preparation method has also been noted to affect the beneficial effect of fish. Grilled or baked fish, but not fried fish, has been established to reduce the risk of incident heart failure. It is believed that the omega-6 (ω-6) fatty acid ratio is increased during frying, as omega-3 (ω-3) fatty acids might be lost, or substituted, with the frying oil (Bhupathiraju *et al*., 2011).

2.4.7.5 Salt

Excess salt intake is known to play a major role in the development of hypertension (Aaron & Sanders, 2013; Ha, 2014). This has led to researchers investigating the effect of dietary salt reduction on blood pressure, with many revealing that reducing the dietary intake of salt would result in lower blood pressure and decreased risk for CVD (Appel *et al*., 2011; Bibbins-Domingo *et al*., 2010). In their projection, Bibbins-Domingo *et al*. (2010) found that a salt intake reduction of 1g per day would be more cost-effective than prescribing anti-hypertensive medication.

2.4.8 Diet and cancer

It has been confirmed that diet plays an important role in reducing cancer risk, which has resulted in the American Cancer society releasing nutrition guidelines, based on this scientific evidence (Thomson, 2012).

2.4.8.1 Carbohydrates

The intake of highly refined carbohydrates has been linked to colorectal cancer. It is believed that the short-term insulin spikes, following refined carbohydrate ingestion, may stimulate colonic carcinogenesis (Chan *et al.,* 2010). A systematic review by Chan & Giovannucci (2010) determined that findings of studies investigating the effect of high glycaemic load, or glycaemic index, as well as the risk of colorectal adenoma, or cancer, has been inconsistent (Chan *et al*., 2010).

2.4.8.2 Dietary Fat

Dietary fat has been found to have a diffident effect on breast cancer risk (Khoarahmin & Azadbakht, 2014; Thomson, 2012). The type of dietary fat consumed, influences the risk of developing specific types of breast cancer (Khoarahmin & Azadbakht, 2014; Thomson, 2012). Saturated fat has been linked with an increased risk for post-menopausal cancer, while polyunsaturated fat has been linked with increased cancer risk, despite the menopausal status, however, monounsaturated fat has been found to have no link to any cancer risk (Thomson, 2012). Regarding the tumour subtype, vegetable oil-based margarine has been linked with a 31% greater

risk of developing oestrogen-receptor/progesterone-receptor negative tumours (Thomson, 2012).

A high-fat diet (>40% of energy as fat) consisting of a higher intake of processed meats, margarine, butter and other animal fats, has been linked to double breast cancer risk (Thomson, 2012). In their study investigating the effect of dietary fat on sex hormones, Young *et al*. (2011) found that a high-fat diet is linked to a 51% increase in plasma estradiol, however, ω-3 fatty acids had no effect on sex hormone levels (Young *et al*., 2011). Post-menopausal women, therefore, may decrease their breast cancer risk by following a low-fat diet, which may aid in the reduction of age-linked weight gain, a risk factor for breast cancer (Thomson, 2012).

2.4.8.3 Vegetables and fruit

No cohort studies or systematic reviews have revealed, consistently, that FV intake is linked to a decreased risk for breast cancer, or total cancer mortality (Wang *et al*., 2014; Thomson, 2012; Chan *et al.,* 2010).

2.4.8.4 Salt

The high incidence of stomach cancer in Eastern countries, such as Japan and Korea, has led to the suspicion that this might be due to their high-salt dietary pattern (Kanavos, 2006).

2.4.8.5 Red meat

Studies conducted over the years have found a link between high red meat consumption and increased risk for colon cancer (Chan *et al*., 2010; Aykan, 2015; Norat *et al*., 2005). It has been suggested that red meat might fuel the release of endogenous insulin, which is considered a mitogen (Chan *et al*., 2010). Various studies have found that meat prepared at high temperatures for prolonged periods, play a major role in the risk for colon cancer (Chan *et al*., 2011; Chan *et al*., 2010; Zheng & Lee, 2009). The carcinogenic mechanism involved is that, when meat is cooked at high temperatures, mutagenic heterocyclic amines are formed from creatinine, which interacts with amino acids (Mahan *et al.*, 2012; Chan *et al*., 2010).

2.4.9 Obesity

Obesity, especially central obesity, is a well-known risk factor for CVD and is due to an excessive calorie intake (De Caterina *et al*., 2006). Abdominal obesity has been associated with insulin resistance, oxidative stress and increased levels of (adipo) cytokines and inflammatory markers, which lead to endothelial dysfunction (Ten Hacken, 2009). It has been revealed that adipose tissue is an active secretory organ, which plays a role in the regulation of many pathological processes (Lottenberg *et al*., 2010; Jung & Choi, 2014). Abdominal obesity has been associated with insulin resistance, oxidative stress and increased levels of (adipo) cytokines and inflammatory markers, which lead to endothelial dysfunction (Ten Hacken, 2009).

Studies have also revealed that obesity is linked to the accumulation of macrophages in adipose tissue (Lottenberg *et al*., 2010; Fantuzzi, 2005). Obesity, therefore, seems to increase the risk for CVD via two inflammation-mediated pathways. Firstly, obesity enhances insulin resistance, which raises the production of many inflammatory mediators. Secondly, it is linked to an inflammatory response, which results in the production of several pro-inflammatory cytokines and hormones (Fardet & Boirie, 2013; De Caterina *et al*., 2006).

In the past, obesity has always been associated with excess intake, therefore, treatment and prevention strategies were mostly focused on changing individual behaviour. During the past ten years, the focus of the treatment of obesity has changed to other factors that might be contributing to the obesity epidemic, such as the person's working and living environments. The ways in which these contribute to obesity, include automation and mechanisation, which result in decreased energy expenditure (Caballero, 2007).

2.4.9.1 Obesity and cardiovascular disease

Obesity is defined as "a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems" (Sarnali, 2010). Obesity can often be attributed to an amalgamation of excessive calories, lack of physical activity and genetic predisposition (Sarnali, 2010). Studies has shown that a significant relationship exists between glycaemic load and risk for CHD in overweight and obese

women (Kulie *et al*., 2011; Oh *et al*., 2005).

2.4.9.2 Obesity and diabetes mellitus

Obesity has been linked to insulin resistance and the subsequent development of T2DM (Kumar, 2013; Schuster, 2010; Hussain *et al*., 2010; Schwellnus, 2009). Chronic overweight/obesity encourages a vicious cycle of pro-inflammatory release and macrophage infiltration, which leads to metabolic imbalances, such as insulin resistance and T2DM (Schuster, 2010; Hussain *et al*., 2010). Chronic overeating results in an elevated free fatty acids level, which leads to decreased glucose uptake by the skeletal muscle and the cardiac muscle. In addition, the increased fatty acids level has an inhibitory effect on beta cells, which leads to decreased beta cell function and, consequently, decreased insulin secretion. Another outcome of increased adiposity is oxidative stress, which has been proven to play a role in the development of T2DM, as well as hypertension and CVD disease (Schuster, 2010; Hussain *et al*., 2010).

Inflammation has been implicated in diabetes development and progression. Prolonged inflammation in fat tissue, liver and skeletal muscle aggravates insulin resistance and causes beta cell dysfunction at the islets (Schuster, 2010; Hussain *et al*., 2010).

2.4.9.3 Obesity and chronic obstructive pulmonary disease

Over the past two decades many studies have identified a relationship between obesity and the risk of asthma in childhood, though the mechanism is not clearly understood (Noal *et al.,* 2011; Franssen *et al*., 2008). In his systematic review, Sood (2010) concluded that obesity is an independent risk factor for asthma, as well as for chronic airflow obstruction. In addition, he also found strong evidence that obesity, not only leads to the development of asthma, but is also linked to the persistence and intensity of asthma symptoms (Sood, 2010). In contrast, obesity has also been shown to have a protective effect in COPD, on the level of hyperinflation, especially in individuals, who have severe COPD (El-Shafey & El-Deib, 2015; Hanson *et al.,* 2014). A recent meta-analysis concluded that overweight and obesity were associated with decreased mortality in persons with COPD, in comparison with those, who had a normal BMI (Hanson *et al*., 2014).

2.4.9.4 Obesity and cancer

Obesity has been linked to the development of several cancers, as well as reduced survival from especially lung, breast and pancreatic cancer (Tan *et al*., 2015). Body weight has constantly been linked to greater risk of postmenopausal cancer, however, this is not the case for premenopausal breast cancer development (Thomson, 2012). A possible reason for this is that greater body fat results in higher plasma oestrogen levels; since most cancers are oestrogen receptor positive (ER^+), it seems that circulating oestrogen plays a role in the risk for developing breast cancer (Thomson, 2012).

A rat model, suggests oestrogen is not the chief cause of obesity-linked disease, but that insulin-like growth factor 1 (IGF-1) and associated insulin levels could be a dynamic risk factor (Zhu *et al*., 2012). In support of this, a previous meta-analysis has shown that waist circumference (which is an indicator of central obesity and insulin resistance) increases breast cancer risk by 79% and 50% respectively in premenopausal and postmenopausal women (Connolly *et al*., 2002). The authors, therefore, concluded that the reduction of visceral fatness is important to control breast cancer risk (Connolly *et al*., 2002).

A meta-analysis of case-control and prospective studies has shown that being overweight is associated with an increased risk for colon cancer. It has been proposed that obesity-related insulin resistance and the associated hyperinsulinaemia might play a role in colon cancer pathogenesis, by increasing the levels of bioactive insulin-like growth factors (Chan *et al*., 2010).

2.4.10 Other factors

Globalisation has facilitated the accessibility of many products, especially to the low- and middle-income countries, which were previously inaccessible. These include tobacco, alcohol and modern technology, all of which contribute to the NCD epidemic in some way or another (Camilo *et al*., 2010; Beaglehole & Yach, 2003).

Globalisation is perceived to have had a great impact on diet, activity and ensuing imbalances, which has led to the obesity epidemic. According to Popkin (2006), even though the global food

production, marketing and distribution sectors are at the core of the obesity epidemic, he asserts that other aspects: (1) mechanisation and automation, (2) modern food processing, marketing and distribution techniques, (3) global mass media expansion and (4) other factors also play a great role (Camilo *et al*., 2010; Popkin, 2006).

2.5 Global consequences of chronic non-communicable diseases

It has been forecasted that, by the year 2020, CNCDs will be the principal cause of death in all countries (Kankeu *et al*., 2013). CNCDs affect, not only on the afflicted persons (affecting their functional ability), their households (extra medical costs) and livelihood (affecting ability to work), but also on the country's economy and healthcare sector, through productivity losses, lengthy incapacity and increased health and social care spending (Jakovljevic & Milovanovic, 2015; Muka *et al*., 2015; Theodore, 2011).

In its report on the global status of NCDs, the WHO states that CNCDs are currently the main cause of mortality. Additionally, the report states that CVD (48%), cancers (21%), chronic respiratory diseases (12%) and diabetes (3%) were the main causes of death in 2008 worldwide, with almost 80% of these deaths occurring in LMICs (WHO, 2014).

In LMICs, financial costs for CNCDs are often carried by the households, since people often are not affiliated to a health insurance scheme. Besides this extra financial burden, the afflicted person is often unable to earn an income, which places further financial strain on the household. The costs are also higher if the person suffers from multi-morbidity. Additional income losses are incurred when another household member has to care for the affected person (Jakovljevic *et al*., 2015; Muka *et al.,* 2015; Kankeu *et al*., 2013).

A great number of the persons with CNCDs fall in the working-age category (18 to 65 years). The increased morbidity and mortality rates, due to CNCDs, therefore, will also greatly affect economic growth, especially in developing countries (Chaker *et al*., 2015; Theodore, 2011).

2.6 Prevention of CNCDs

Literature is filled with suggestions, on how CNCDs can be addressed. Many dietary interventions and specific nutrients have been investigated as potential means of prevention and treatment of CNCDs, however, no consensus has been reached as to which dietary approach is the gold standard (Mente *et al*., 2009).

Whole-wheat foods contain a number of substances with potentially protective health benefits, such as antioxidants, phytoestrogens and fibre, which have been linked to lower energy intake, improved metabolic profile and lower risk of obesity, central adiposity, diabetes and cardiovascular disease (Merchant *et al*., 2009).

A review of possible dietary approaches, which may be protective of CNCDs risk, will be presented in the following sections.

2.6.1 Dietary approaches to prevent CNCDs

Different dietary approaches have been developed and tested over the years to address obesity, CVD, diabetes mellitus and cancer. These approaches include, low-fat diets, low-GI diets, Dietary Approaches to Stop Hypertension (DASH), Therapeutic lifestyle changes (TLC), low-carbohydrate diets, high-protein diets and the Mediterranean diets (Ebrahimof & Mirmiran, 2013; Ajala *et al.,* 2013; Mozaffarian *et al.,* 2011).

2.6.1.1. Low-fat diets

A low-fat diet comprises fat that supplies approximately 30% of the total caloric intake (Brehm *et al*. 2003; Larsen *et al.* 2011)

Obesity: Overweight and obesity are risk factors for CNCDs; therefore, weight reduction is seen as the primary strategy for the prevention of CNCDs (Hu *et al*., 2012). Low-fat diets have been traditionally recommended for weight loss (Hu *et al*., 2012). A recent systematic review concluded that low-fat diets are not advantageous over other dietary interventions for long-term weight loss (Tobias *et al*., 2015).

Cardiovascular disease: Although it has been determined that low-fat diets are beneficial for the reduction of LDL-cholesterol levels, this beneficial effect does not extend to TG, HDL-C and insulin resistance (Ebrahimof & Mirmiran, 2013). A recent systematic review revealed that high fat diets raised TG levels and lowered HDL cholesterol levels. However, the researchers found that low fat diets were more beneficial than high-fat diets on total cholesterol, as well as LDL cholesterol, in the long term (Schwingshackl & Hoffmann, 2013a).

Diabetes: Weight loss has been established to improve insulin resistance, glucose control and decrease the development of comorbities (Nordmann *et al*., 2006; Noto *et al*., 2013). Different types of diets have been prescribed, including low-fat and low-carbohydrate diets (Makris & Foster, 2011). A year-long study revealed that low-fat diets resulted in weight losses, similar to that achieved with low-carbohydrate diets (Davis *et al*., 2009).

Cancer: The amount of fat consumed might be linked to prostate and oesophageal cancer, however, there is no conclusive proof that the amount of fat consumed can be linked to breast cancer, ovarian cancer, lung cancer or pancreatic cancer (Schwab *et al*., 2014).

2.6.1.2 Low-GI diet

***Obesity*:** Even though it has been established that a low-GI diet improves satiety, many studies have failed to confirm that it results in weight loss, without alteration to energy and macronutrient composition (Makris, 2011).

***Cardiovascular disease*:** Low GI carbohydrates have been linked to a reduced risk of myocardial infarct, when it is substituted for SFA in the diet (Jakobsen *et al.*, 2010; Hu, 2010). Total carbohydrate and not GI or dietary GL, has also been strongly linked to the risk of stroke (Oh *et al*., 2005). A high consumption of refined carbohydrates increases the risk of haemorrhagic stroke and this effect is worse in persons who are overweight or obese (Oh *et al.,* 2005).

A higher wholegrain (fruit, vegetables, legumes and whole-wheat cereals) intake has been linked to a 21% lower risk of CVD cases. The beneficial effect of the wholegrain mode of action in CVD risk includes its effect on insulin sensitivity, blood pressure, lipids and inflammation (Bhupathiraju *et*

al., 2011).

Diabetes: When assessing a low-GI diet in comparison with other diets in type 2 diabetic individuals, those who consumed a low-GI diet presented increased levels of HDL-cholesterol and slightly lower HbA_{1c} levels, as opposed to those on the high-GI diet. However, the Low-GI diet did not have any effect on weight loss (Ajala *et al*., 2013).

2.6.1.3 Dietary Approaches to Stop Hypertension (DASH)

Obesity: The DASH diet that is endorsed by the American Heart Association (AHA), advocates a low SFA, cholesterol and total fat intake and emphasises fruits, vegetables, fat-free dairy products, wholegrain products, fish, poultry and nuts. The diet also encourages decreased intake of lean red meats, sweets, added sugars and sugar-containing drinks, which has been proven valuable for weight loss (Shirani *et al.,* 2013; Champagne *et al*., 2011; Bhupathiraju *et al*., 2011; Hodson *et al*., 2010).

***Cardiovascular diseases*:** A high salt intake has been linked directly with hypertension, CVD and renal damage. The DASH diet addresses this issue by encouraging the intake of foods that are naturally lower in sodium, such as fruit and vegetables (Shirani *et al*., 2013; Bhupathiraju *et al*., 2011; Derman *et al.*, 2009b). Other dietary recommendations, incorporated in the DASH diet, include a high intake of natural food sources of potassium, calcium and magnesium – nutrients that potentially have blood pressure lowering effects (Derman *et al*., 2009b).

It has been proven that the DASH diet aids in the treatment and prevention of hypertension; effectively lowers blood pressure; aids in weight loss; lowers plasma apolipoprotein B (apoB) and CRP concentrations; improves insulin sensitivity and the metabolic syndrome (Shirani *et al.,* 2013; Bhupathiraju *et al*., 2011; Hodson *et al*., 2010). The mechanism employed by the DASH diet to lower blood pressure is unclear, however, Hodson *et al*. (2010) revealed that it does not alter the peripheral vascular function and concluded that it is mediated through autonomic and cardiac mechanisms.

Diabetes: It has been suggested that the DASH diet may improve insulin resistance and high blood glucose levels, as well as decrease the risk for T2DM (Azabakht *et al*., 2011; Ard *et al*., 2004). This is attributable to the diet's high fibre, antioxidant constituents, unsaturated fatty acids and low-fat dairy content. In addition, it has been proposed that this dietary approach may be beneficial for the management of risk factors of persons with T2DM (Shirani *et al*., 2013; Liese *et al*., 2009).

The DASH diet has also been investigated in individuals with T2DM to determine its impact on cardiovascular risks (fasting blood glucose, HbA_{1c}, weight, waist circumference and lipid profiles), which this population is prone to (Azabakht *et al*., 2011). This study established that the DASH diet could decrease LDL and the TG levels, while it increases HDL cholesterol. Therefore, the researchers concluded that the DASH diet might play a significant role in the management of cardiovascular risks in the T2DM population (Azabakht *et al*., 2011).

Cancer: DASH-style diets have been associated with a decreased risk of colorectal cancer, but not breast cancer. This has been attributed to the high consumption of plant foods, in combination with decreased intake of red and processed meat, as well as refined carbohydrates, which this dietary approach recommends (Fung *et al.,* 2011).

COPD: No studies have been conducted to evaluate the effectiveness of the DASH diet in the COPD population, although it can be postulated that, since the diet results in weight loss, it could have some benefit for persons with COPD, who are overweight.

2.6.1.4 Therapeutic lifestyle changes (TLC)

Obesity and Cardiovascular diseases: The therapeutic lifestyle changes (TLC) approach is aimed at lowering blood pressure through dietary changes (increased consumption of non-starch polysaccharides, whole grains, dietary fibres, vegetables, fruits, oily fish and poultry, with no or very low consumption of saturated and TFAs, refined cereals, sugar, red meat, calorie-dense foods and sweetened beverages). In addition, exercise (2.5-4 hours/week), weight control, decreased alcohol consumption and the elimination of tobacco use is advocated (Mitra *et al*., 2012; Bhupathiraju *et al*., 2011; Scisney-Matlock *et al*., 2009).

The problems associated with TLC include patient difficulty with implementation recommendations, as well as healthcare professionals having trouble with the prescription of TLC as a method for better hypertension control (Scisney-Matlock *et al*., 2009). Despite these issues with prescription and implementation, plenty of evidence exists to support the TLC approach as an effective method to lower and improve blood pressure control (Scisney-Matlock *et al*., 2009; Bavikati *et al*., 2008).

Diabetes: Various RCTs have revealed that the implementation of dietary modifications and increased physical activity has beneficial effects on the blood glucose and lipid profile of individuals with T2DM. The authors, therefore, concluded that the TLC approach is a good defensive measure against T2DM (Mitra *et al*., 2012).

2.6.1.5 Low-carbohydrate diets (LCD)

There is no uniform definition for a low-carbohydrate diet (LCD). Low-carbohydrate diets (LCDs) vary from very low-carbohydrate, moderately low-carbohydrate and moderate-carbohydrate intakes (Wylie-Rossett *et al.,* 2014). Very low-carbohydrate diets (VLCDs) frequently specifies the total amount of carbohydrate intake allowed, whereas other levels of LCDs specify the carbohydrate intake as a percentage of energy intake (Wylie-Rossett *et al.* 2014). Some define LCDs as having a carbohydrate content of <130g/d, which equates to 26% of total calories, of a 2000-calorie diet (Fields *et al.,* 2016; Feinman *et al*., 2015; Liebman, 2014). While others define it as a carbohydrate intake ≤45% of energy from carbohydrates (Fields *et al.,* 2016).

Obesity: Studies have revealed that a LCD initially results in greater weight loss in comparison to calorie-restricted and low-fat diets (McAuley *et al*., 2006; Gardner *et al*., 2007; Sacks *et al*., 2009; Foster *et al*., 2010). At one year, the difference between LCDs and other weight loss diets are insignificant (McAuley *et al*., 2006; Dansinger *et al*., 2005; Gardner *et al*., 2007; Shai *et al.,* 2008). Similarly, a recent systematic review and meta-analysis concluded that similar weight loss is achieved with a LCD, or balanced weight loss diet (Naudé *et al*., 2014; Makris, 2011).

Cardiovascular disease: Evidence exists that low-carbohydrate diets (LCDs) are effective in weight loss, which could cause short-term beneficial effects on CVD risk markers (Wylie-Rosett *et al.,* 2013; Ajala *et al*., 2013). A recent systematic review and meta-analysis, however, found no cardiovascular benefit (Noto *et al*., 2013). The authors also raised concerns regarding the nutritional quality of LCDs, which tend to result in decreased consumption of fibres and fruits and increased consumption of protein from animal sources, cholesterol and saturated fat. They recommended that, despite existing support for LCDs, these diets should not be endorsed until further studies have been conducted to assess the effect of plant versus animal protein (Noto *et al*., 2013).

Diabetes: A number of RCTs have revealed that LCDs result in lower fasting blood glucose (FBG) levels, HbA_{1c}, serum insulin and/or homeostatic model assessment (HOMA), to a similar extent as isocaloric low-fat diets (Hu *et al*., 2014a; Noto *et al*., 2013). Various studies have revealed that the weight loss experienced with LCDs resulted in improved CVD biomarkers and glycaemic levels, evident in persons with T2DM (Appel *et al*., 2005; Nordmann *et al.,* 2006; Hussain *et al*., 2012; Paoli *et al*., 2013; Forsythe *et al*., 2008). Conclusions drawn from studies were that weight loss was reliant on adherence to the diet, rather than the macronutrient composition of the diet (Liebman, 2014).

2.6.1.6 High-protein diet

A diet that consists of a protein intake above the recommended daily allowance (RDA) is known as a high-protein diet (Delimaris, 2013).

***Obesity*:** High protein diets often result in rapid weight loss, which improves body composition (Ebrahimof & Mirmiran, 2013). In contrast, Schwingshackl and Hoffmann (2013b) determined that high-protein diets had neither a better, nor a worse, effect on the outcome of obesity, in comparison to low-fat diets.

***Cardiovascular disease*:** It has been established that high protein diets have a beneficial effect on the reduction of biomarkers for CVD and BP (Ebrahimof & Mirmiran, 2013; Wycherley *et al*., 2012).

***Diabetes*:** In a two-year long study, a high-protein, low-carbohydrate diet did not result in bigger weight loss, when compared to a low-fat diet (Krebs *et al*., 2012). A year-long randomised controlled trial also found that high-protein, low-carbohydrate reducing diets did not exhibit better effects on glycaemic control in type 2 diabetics than high carbohydrate reducing diets (Larsen *et al*., 2011).

***Cancer*:** An increased cancer risk may be associated with high protein diets (Delimaris, 2013). In their study, Levine *et al*. (2014) determined that a high protein intake was associated with a four-fold increase in cancer (Levine *et al.,* 2014).

2.6.1.7 Mediterranean diet

The Mediterranean diet (made up of approximately 40% energy from fat, high in whole grains, fruit and vegetables) is considered as effective as low-carbohydrate and low-fat diets in weight reduction over a 2-year period (Merchant *et al*., 2009). In their study, Merchant *et al*. (2009) found that, when participants consumed between 47% and 64% of their calories from carbohydrates, they were less likely to be overweight or obese (Merchant *et al*., 2009).

The Mediterranean diet is defined by the following components: high ratio of monounsaturated and saturated fatty acids, moderate alcohol intake, high legume intake, high grain intake, high fruit and nuts intake, high vegetable intake, low meat and meat products intake, high fish intake and moderate milk and dairy products intake (Bhupathiraju *et al*., 2011; MartÍnez-González *et al*., 2008).

Obesity: A number of studies, including a 2-year dietary intervention study, have revealed that the Mediterranean diet is an effective alternative to low fat diets for weight loss (Shai *et al*., 2008). A more recent meta-analysis of RCTs revealed that the Mediterranean diet might be beneficial for weight loss, particularly; if it is calorie-restricted and physical activity is encouraged (Esposito *et al*., 2011). In addition, this type of diet revealed a greater weight loss than low-fat diets. A concern that the high fat content of this diet could result in weight gain, was also verified as unfounded by this meta-analysis (Esposito *et al*., 2011).

Diabetes and CVD have some risk factors in common and, since many studies have revealed that, the Mediterranean diet plays a role in the prevention of CVD and may be beneficial in the prevention of diabetes (MartÍnez-González *et al*., 2008). The chief protective features of this diet include a high fibre and vegetable intake, low TFAs and a moderate alcohol intake. Since this diet makes plentiful use of olive oil, there is a high ratio of MUFA to SFA. Diets, rich in MUFAs, improve lipid profiles and glycaemic control in individuals with diabetes, which implies that a high intake improves insulin sensitivity (MartÍnez-González *et al*., 2008).

In a study that compared the 2003 American Diabetes Association (ADA) diet with the traditional Mediterranean (TM) diet and low carbohydrate Mediterranean (LCM) diets, revealed that the LCM diet was the only one that resulted in an increase in the HDL-C levels and was also superior in reducing LDL, TG and $HbA1_c$ levels (Elhayany *et al*., 2010).

Cancer: It has been postulated that the consumption of the Mediterranean diet (MD) could decrease the incidence of colorectal, breast, prostate and pancreatic cancers by up to 25%, 15% and 10% respectively and it might even prevent the development of endometrial cancer. A review of studies, associated with the MD and cancer prevention, however, concluded that there is no definitive proof of the association of MD with different types of cancer (Knotou *et al.,* 2011).

2.6.2 Novel substrates/ controversial or experimental treatments

2.6.2.1 Fruit and vegetables

Obesity: A critical review of prospective and intervention studies on the association of fruit and vegetable (FV) consumption and weight loss concluded that increased FV consumption leads to weight loss, if it is used as a substitute for fat and energy-dense foods. In addition, the authors state that it is probable that increased FV consumption contribute to weight stability (Boeing *et al*. 2012).

Type 2 diabetes**:** According to a review that included five cohort studies, daily consumption of three or more servings of fruit and vegetables did not result in a significant decrease in T2DM risk (Hamer & Chida, 2007). Subsequently, other systematic reviews and meta-analyses have supported this finding (Wu *et al*., 2015; Boeing *et al*., 2012). A more recent meta-analysis has indicated that

increased consumption of, especially, green leafy vegetables could be linked to a decreased risk of T2DM (Wang *et al*., 2016). The EPIC-Norfolk study revealed that a high consumption of FV was related to a 22% T2DM risk reduction (Harding *et al.*, 2008). This study also found that the risk reduction was highest for plasma vitamin C, resulting in a 62% reduction in diabetes risk

A study conducted in China revealed that vegetable intake and not fruit, was inversely linked to T2DM risk (Villegas *et al*., 2008), however, in the EPIC-Norfolk study, the link with diabetes risk was stronger for fruit, than vegetables (Harding *et al.* 2008). Other studies have also revealed the link between plasma vitamin C and reduced diabetes risk, as well as a link between carotenoids status and intake (Ylönen *et al*., 2003; Ford *et al*., 1999; Facchini *et al*., 2000). Carotenoids have been potential markers of fruit and vegetable intake, as well as glucose metabolism (Spence *et al*., 2010).

The Botnia Dietary study revealed that dietary carotenoid intake in men at high risk of T2DM was inversely linked with fasting plasma glucose concentrations, while plasma ß-carotene concentrations was inversely linked with insulin resistance (Ylönen *et al*., 2003). The Third National Health and Nutrition Examination Survey also found an inverse link between serum carotenoids (especially ß-carortene and lycopene) and fasting serum insulin concentration (Ford *et al.,* 1999). An inverse relationship was also found between steady-state plasma glucose and plasma glucose concentrations of α-carotene, ß-carotene and lutein, in a small study of non-diabetic persons (Facchini *et al*., 2000). In their critical review, Boeing *et al*. (2012) found no link between FV consumption and T2DM risk.

Cardiovascular diseases: The role of fruit and vegetables in the prevention of CVD has also been investigated. One study conducted by Van't Veer *et al*. (2000) found that individuals, who had a daily FV intake of 150g/d, had a 16% lower mortality from cardiovascular disease. It has been suggested that the decreased risk for stroke and mortality from CVD could be due to the effect of specific nutrients (potassium, antioxidants, folic acid) which are abound in fruit and vegetables (Wang *et al*., 2014; Boeing *et al*., 2012; Bazzano *et al*., 2002).

Cancer: A critical review on the link between vegetable and fruit consumption and risk of chronic diseases concluded that, even though some evidence reveals an association between FV consumption and cancer risk, it has not been proven conclusively that this is true (Boeing *et al.,* 2012). Similarly, a more recent meta-analysis of prospective cohort studies found that a higher consumption of fruit and vegetables was not substantially associated with a decreased cancer mortality risk (Wang *et al*., 2014). The authors, however, stated that fruit and vegetable consumption might be linked to specific cancer sites and recommended that studies should be conducted to verify the relationship between the intake of different fruit and vegetables with various types of cancer.

COPD*:* An increased intake of fruits has been found to be inversely associated with the risk of COPD (Celik & Topcu, 2006). A case-control study conducted on a Japanese population sample revealed an inverse relationship between vegetable consumption and the risk of COPD (Hirayama *et al*. 2010b*)*, which is similar to the findings of other studies (Celik & Topcu, 2006; Watson *et al*., 2002). Observational studies reveal that a diet with high intakes of fruit, vegetables, oily fish and whole grains is positively associated with forced expiratory volume in seconds (FEV_1) (Shaheen *et al.,* 2010; Tabak *et al*., 2001; Varraso *et al*., 2007a; Varraso *et al.,* 2007b). In addition, when NHANES data of the US population was analysed, it showed that higher intakes of vitamin C, E and total carotenes were all linked to FEV_1 (Hanson *et al.,* 2014). In their critical review, Boeing *et al*. (2012) assessed that it is possible for a high intake of FV to reduce the risk of COPD.

2.6.2.2 Garlic

Diabetes: There are reports that various constituents of garlic oil have the same hypoglycaemic effect as that of glibenclamide (Ashraf *et al.,* 2011; Liu *et al*., 2006). In addition, garlic has been shown to reduce blood glucose levels in rat, mice and rabbit models (Ashraf *et al.,* 2011). It has been suggested that garlic might induce an increase in the pancreatic secretion of insulin, release bound insulin or enhance insulin activity, which results in its hypoglycaemic effect (Londhe *et al*., 2011).

Cardiovascular diseases: *Garlic* is often used in the preparation of food in many households. Much research has been done to investigate the beneficial effects of garlic on CVD (Bayan *et al.*, 2014). Garlic's health benefits, apparently, are attributed to the sulphur-compounds and their by-products. Garlic is reported to prevent CVD by various mechanisms, including platelet aggregation and reducing LDL-cholesterol via the inhibitory action of alliin and allicin on hepatic hydroxymethylglutaryl-CoA reductase activity (Tsai *et al.,* 2012; Rahman & Lowe, 2006).

Cancer: It has been reported that individuals, who consume high amounts of garlic have decreased risk for cancer of the colon and stomach (Setiawan *et al*., 2005; Hu *et al*., 2014b). An evidence-based review of human studies has revealed garlic's antimutogenic ability in cancer of the stomach, colon, rectum, breast, lung and endometrium (Tsai *et al.,* 2012). There is, however, a paucity of data linking garlic with decreased risk for cancer of the prostate, oesophagus, larynx mouth, ovary and renal cells (Tsai *et al*., 2012). Animal models and cell studies suggest that garlic is chemopreventive for several types of cancers (Bayan *et al.,* 2014; Majewski, 2014; Londhe *et al*., 2011). The proposed mechanisms of action involved in garlic's chemopreventive effect, are the inhibition of cell proliferation, blocking the cell cycle, inducing cell apoptosis and blocking invasion and metastasis (Tsai *et al.,* 2012; Londhe *et al*., 2011).

2.6.2.3 Soy protein

Obesity: It has been established that soy protein has a positive effect on satiety and reduces excess body fat in obese animals and humans (Tripathi *et al.,* 2013; Velasquez & Bhathena, 2007). During animal studies, soy protein has been documented to induce lower body weight, in comparison with casein protein (Velasquez *et al*., 2007). In human studies, subjects, who were fed a soy-based meal replacement, lost more weight as opposed to the control group (Velasquez *et al*., 2007).

Diabetes: It has been determined that soy protein intake decreases hyperinsulinaemia, by stimulating insulin secretion at a lower rate (Tripathi *et al*., 2013). The results of a prospective cohort study in men with high BMI revealed that 2-hour plasma glucose and fasting plasma glucose increases were prevented with soybean intake. This effect is perceived to be attributable to the fibre content and glycaemic index of soybeans (Asif *et al*., 2013; Tatsumi *et al*., 2013).

Cardiovascular disease: Various studies have verified that phytoestrogens are beneficial in modulating CVD risk markers (Asif & Acharya, 2013; Tripathi *et al*., 2013; He *et al*., 2011). Intakes of soy products are associated with lower serum cholesterol levels (Asif & Acharya, 2013; Tripathi *et al*., 2013). Soy protein has also been associated with lower blood pressure [BP] (Moghaddam *et al*., 2014). It has been suggested that soy polyphenols affect endothelial function and thus BP. Another possible mechanism is that soy protein intake is thought to increase nitric oxide levels, which have a vasodilatory effect (Moghaddam *et al*., 2014).

Cancer: It has been ascertained that soybeans are beneficial in breast cancer. It is believed that the bioactive compounds present (including phytic acid, α-linolenic acid and isoflavones) might aid health through antioxidant, anti-inflammatory and oestrogen-modulating effects (Thomson, 2012). It has also been determined that high soy intake has been linked to a 14% reduction in breast cancer risk. This benefit was more obvious in premenopausal women (Thomson, 2012).

COPD: A recent study revealed an inverse relationship between soy intake and COPD risk and respiratory symptoms. It has been suggested that isoflavones act as anti-inflammatory agents in the lung and, in this way, protect it from carcinogens in smokers (Hirayama *et al*., 2010a).

2.6.2.4 Omega-3 fatty acids

Obesity: Obesity, as well as its comorbidities (T2DM, CVD), have been associated with inflammation (Belchior *et al*., 2015; Lorente-Cebrián *et al*., 2013). Omega -3 (ω-3) fatty acids are known to be anti-inflammatory, therefore, it makes sense that an increased intake would be beneficial to obese persons (Belchior *et al*., 2015; Lorente-Cebrián *et al.,* 2013; Talukdar *et al.,* 2012; Tokunaga *et al*., 2012). Recently, researchers have investigated whether ω-3 fatty acids might be beneficial for weight loss in obese persons (Martinéz-Victoria & Yago, 2012). Even though only a few studies have been conducted on humans, the results of these studies have shown that persons with higher ω-3 fatty acid intakes tend to have lower body weight, lowest BMI and improved overall health (Simopoulos & DiNicolantonio, 2016; Martinéz-Victoria & Yago, 2012). It has been proposed that ω-3 fatty acids can reduce adiposity, ease postprandial hunger sensation and promote an increase in lean tissue mass (Campbell & Bello, 2012; Oh *et al.,* 2010).

Diabetes: The results have been inconsistent about ω-3 fatty acids' effect on insulin sensitivity and T2DM (Lorente-Cebrián *et al.,* 2013). A recent study, however, has concluded that increased body ω-3 fatty acid levels decreases obesity rates, glucose intolerance and fat tissue inflammation (Belchior *et al.,* 2015).

Cardiovascular disease: Omega -3 (ω-3) fatty acids have been under investigation since the 1970s, when it was observed that Eskimos in Greenland had low ischaemic heart disease rates (Vedtofte *et al*., 2014; Kromhout *et al*., 2012). The beneficial effect was attributed to the anti-thrombotic effect of long-chain PUFAs obtain because of their high fish intake (Bhupathiraju *et al*., 2011).

Studies have shown that 1-2 servings of fatty fish per week are sufficient for primary prevention (Mozaffarian 2008; National Heart Foundation of Australia 2008). Yet other studies suggest that ω-3 fatty acids may be of benefit for secondary prevention (Mohebi-Nejad & Bikdeli, 2014). It is believed that ω-3 fatty acids decrease CVD risk by preventing arrhythmias, decreasing heart rate and blood pressure, as well as reducing platelet aggregation and decreasing TG levels (Bhupathiraju *et al*., 2011). In their systematic review, Mente *et al*. (2009) found that ω-3 fatty acids were only of benefit in the prevention of CHD in individuals, who are at high risk and women.

Recently researchers have been studying the effect of plant-based ω-3 fatty acids, alpha linolenic acid (ALA), which is a short-chain ω-3 PUFA, on CVD risk. Food sources include rapeseed oil, soybean, flaxseed and walnuts. Since ALA can be converted into eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which is found in fish, it has been suggested that plant-based ω-3 fatty acids may be substituted for fish in the diet (Rajaram, 2014). The limitation of this is that evidence to support this is limited and conflicting.

Studies on animals have shown that ALA has anti-arrhythmic attributes (Devarshi *et al*., 2013; Kromhout & De Goede, 2014; Mozaffarian *et al.*, 2011). A meta-analysis of five prospective studies have shown that high ALA intakes lower risk for fatal heart disease by 21%, but increases prostate cancer risk (Brouwer *et al.*, 2004). The current recommendation for ALA is 2-3g per day for both primary and secondary prevention (Bhupathiraju *et al*., 2011). Mente *et al*. (2009) found increased fish intake only had a protective impact in populations, who are at higher risk for CHD.

Cancer: Observational studies have suggested that there is a link between the incidence of colorectal, lung and prostate cancers (Renehan *et al*., 2008; Gandini *et al*., 2011). A systematic review and meta-analysis of RCTs, however, found that fatty acid supplementation has no effect on the incidence of cancer or total mortality (Zhang *et al*., 2014).

COPD: COPD is associated with both airway and systemic inflammation. It has been hypothesised that, since ω-3 fatty acids are beneficial for inflammatory conditions, such as rheumatoid arthritis and CVD, it might also be beneficial for persons with COPD (Fulton *et al*., 2012). Currently there is a paucity of information regarding the beneficial effects of ω-3 fatty acids on COPD (Fulton *et al.,* 2012). A recent prospective study explored the Alternative Healthy Eating Index (AHEI) 2010 and the risk of COPD. It determined that a diet, with a high intake of whole grains, PUFAs, nuts and long-chain ω-3 fatty acids and a low intake of red and processed meats, refined grains and sugar sweetened beverages, was associated with a lower risk of newly-diagnosed COPD (Varraso *et al.,* 2015).

2.6.2.5 Micronutrients

2.6.2.5.1 B vitamins

***Obesity*:** Recently researchers have linked food fortification and excess vitamin intake with obesity and the subsequent rise in the incidence of T2DM (Zhou *et al*., 2010a; Zhou & Zhou, 2014). Over the past decades, the increase in weight gain and diabetes has been linked to carbohydrate intake. Zhou *et al*. (2010a), as well as Zhou and Zhou (2014) argue that this swift increase in the global prevalence of obesity and T2DM, followed the worldwide implementation of B-vitamins (niacin, thiamine and riboflavin) fortification of foods, especially grains. In addition, Zhou *et al*. (2014) assert that weight has increased, parallel with the increased levels of B-vitamin fortification. Niacin has been implicated with glucose intolerance, insulin resistance and liver injury, which are all signs of obesity and T2DM (Zhou *et al*., 2010a). Since it is known that B-vitamins stimulate appetite, it has been hypothesised that chronic excess B-vitamins intake may be responsible for the increased energy intakes observed, which in turn contributes to the obesity epidemic (Zhou *et al*., 2010a; Zhou & Zhou, 2014).

Diabetes: Several studies have established that vitamin B_1 and B_{12} deficiencies are present in persons with type-1 and type-2 diabetes (Obeid *et al*., 2013; Al-Atta *et al*., 2012; Satyanarayana *et al*., 2011; Pflipsen *et al*., 2009; Thornalley *et al*., 2007). More recent studies have revealed that low levels of plasma pyridoxal 5'-phosphate (PLP) and altered vitamin B_6 metabolism are present in persons with T2DM (Nix *et al*., 2015; Valdés-Ramos *et al*., 2015). These findings are similar to other studies where the blood PLP of T2DM sufferers was compared to that of non-diabetic persons (Satyanarayana *et al*., 2011; Ahn *et al*., 2001). Conversely, it has been suggested lately that excess intakes of vitamins can increase the risk of diabetes, by promoting obesity. In addition, certain vitamins trigger adverse effects, such as niacin's ability to cause glucose intolerance and insulin resistance (Zhou *et al*., 2010a; Zhou & Zhou, 2014).

***Cardiovascular disease*:** Homocysteine is a sulfur-containing amino acid, which is produced by the demethylation of methionine (Bhupathiraju *et al.,* 2011). Every 5μmol/L of homocysteine has been linked to an estimated 20% increased risk for CVD disease, in the absence of the usual CVD risk factors (Bhupathiraju *et al*., 2011). B vitamins (folate, B_6 and B_{12}) have been associated with lower homocysteine levels (Bhupathiraju *et al*., 2011). Due to conflicting results, no consensus has been reached, therefore the current recommendation is that further research is needed before dose recommendations can be made (Bhupathiraju *et al.,* 2011).

Cancer: While appraising the existing literature, the researcher observed the results of studies assessing the effects of single, or combinations of vitamin and mineral supplements, to be conflicting. The findings of one meta-analysis of 6 RCTs of folic acid supplementation, revealed folic acid to be associated with an increased risk of any cancer, whereas another meta-analysis found that folic acid supplementation is associated with 40% to 50% decrease in the risk of oesophageal, gastric and pancreatic cancers (Baggott *et al.*, 2012; Larsson *et al.*, 2006). A small study, investigating the link between folate, methionine and vitamins B_{12} and B_6 intake with prostate cancer, revealed that lower intakes of folate and B-vitamins are linked to increased colorectal adenoma in persons older than 60 years of age (Vidal *et al*., 2012). The investigators hypothesised that age may alter the link between cancer and folate. Regarding a dose-response meta-analysis of the link between vitamins B_6, B_{12} and methionine to breast cancer risk, Wu, Kang and Zhang (2013) found that PLP concentrations and methionine intake might be inversely linked with breast cancer

risk in postmenopausal women. The authors, however, recommend that further research be done to confirm their findings (Wu *et al*., 2013).

COPD: Studies have found that the presence of decreased blood levels of vitamin B_{12} and folate in persons with COPD, lead to increased levels of plasma homocysteine, which is a CVD risk factor (Tsiligianni & Van der Molen, 2010)

2.6.2.5.2 Carotenoids

Obesity: Carotenoids (α-carotenes and β-carotenes) found in FV are known to safeguard cells from oxidative stress (Bonet *et al.,* 2015; Suzuki *et al*., 2006). Obesity, it has been established, contributes to oxidative stress, which in turn has been associated with CHD, T2DM and certain cancers (Suzuki *et al*., 2006). In their study, Suzuki *et al.* (2006) found a positive link between abdominal adiposity and low serum levels of several carotenoids in females, but not in males. Similarly, Markovits *et al.* (2009) found that obese patients had abnormally elevated markers of inflammation and oxidation products together with reduced plasma carotenoid levels. β-carotene supplementation has been shown to have a beneficial effect on adiposity in animal and human studies (Bonet *et al*., 2015; Canas *et al*., 2012; Amengual *et al*., 2011).

Diabetes: Oxidative stress plays a major role in the development of T2DM. It has been suggested that carotenoids that have antioxidant functions may decrease T2DM risk, by reducing oxidative stress (Sluijs *et al.,* 2015). The analysis of the dietary intake of the EPIC-NL study participants (Beulens *et al*., 2009) revealed that higher dietary intakes of β-carotene and α-carotene are linked to decreased risk of diabetes (Sluijs *et al*., 2015).

Cardiovascular disease: The effect of carotenoids in CVD disease found its roots in studies, which established that the increased fruit and vegetable intake decreased CVD risk (Boeing *et al*., 2012; He *et al*., 2007). A range of different types of studies had conflicting results (Voutilainen *et al.,* 2006; Liu, 2013; Ciccone *et al*., 2013). Therefore, the current consensus, until further investigation, is that the increased consumption of carotenoid-rich fruit and vegetables should be encouraged (Bhupathiraju *et al*., 2011).

Cancer: Literature shows that the link of β-carotene to lung cancer is controversial (Gallicchio *et al*., 2008; Vieira *et al*., 2016; Martínez *et al*., 2012; Fritz *et al*., 2011). In 1996, an epidemiological study revealed that there is an association between serum β-carotene levels and incidence of lung cancer (De Luca & Ross, 1996). In contrast, two intervention studies found that high doses of β-carotene increased the risk of lung cancer in smokers (Schäffer *et al*., 2013; Dela Cruz *et al*., 2011).

COPD: Studies have established that an association does exist between lower level of vitamin A and the risk of COPD and that daily oral supplementation of 25 000 IE of vitamin A, reduced COPD symptoms (Schäffer *et al.* 2013). In addition, it has been suggested that a local vitamin A deficiency may develop because of chronic cigarette exposure, since a systemic vitamin A deficiency is often not present in smokers (Schäffer *et al*., 2013; Lin *et al*., 2010).

2.6.2.5.3 Vitamin E

Obesity: According to Via (2012), obese persons have decreased levels of vitamin E. In obese persons, extracellular modelling (changes in the number and size of fat cells, activation of macrophages pro-inflammatory and stimulation of a fibrotic process that limits adipocyte growth) has been linked to metabolic disturbances (Alcalá *et al*., 2015). In their insulin resistant, hypertriglyceridaemic mouse model, Alcalá *et al.* (2015) found that the administration of vitamin E improved insulin resistance and triglyceride levels, improving fat tissue expansion by decreasing the fibrotic process.

Diabetes: Increased serum levels of α-tocopherol are linked to the reduced risk of diabetes in the general population, except middle-aged smokers (Kataja-Tuomola *et al*., 2008). Studies of T2DM patients revealed decreased serum levels of vitamin E (Valdés-Ramos *et al*., 2015; Via 2012). A recent meta-analysis of antioxidant interventions in T2DM patients established that Vitamin E supplementation had a beneficial effect on glycaemic control (Akbar *et al.*, 2011). The meta-analysis, however, revealed that higher doses of vitamin E (600mg daily), for longer periods (2 months), resulted in the biggest decrease in HbA_{1c} (Akbar *et al*., 2011).

Cardiovascular disease: Vitamin E acts as a chain-breaking antioxidant in plasma and on LDL to prevent the proliferation of free radical damage in membranes (Lobo *et al*., 2010; Saliha *et al*.,

2014; Khalid, 2007). Since oxidised LDL has been identified as being atherogenic, various large epidemiological studies have been conducted in an attempt to assess the role of vitamin E in CVD (Bhupathiraju *et al.*, 2011; Vardi *et al.,* 2013). Even though the epidemiological studies had consistent results, a review of RCTs has revealed that Vitamin E supplementation does not prevent CVD (Myung *et al*., 2013; Ye *et al.,* 2013; Hankey, 2012). The current debate is around which form of vitamin E and dosage is the best to prevent CVD. Currently evidence does not support vitamin E supplementation for primary and secondary CVD prevention (Fortmann *et al*., 2013; Myung *et al*., 2013; Desai *et al.* 2014). The different findings between RCTs and observational studies suggest that the beneficial effects of α-tocopherol, another form of vitamin E, transpire in the presence of other nutrients (Bhupathiraju *et al.,* 2011). Therefore, the current recommendation is that it is best to obtain vitamin E from food (Bhupathiraju *et al*., 2011).

Cancer: Vitamin E taken in diets or as supplements that are high in ϒ- and δ- tocopherols has been found to be chemopreventive (Smolarek a& Nanjoo Suh, 2011). In contrast, supplementation with high doses of α-tocopherol has been found to be effective for cancer prevention (Yang *et al.*, 2012). Vitamin E's carcinogenic effects are perceived to stop the formation of nitrosamine and to promote immune system function. In addition, it acts as an antioxidant, by scavenging free radicals in cell membranes (Iqubal *et al*., 2014).

COPD: Numerous studies have linked vitamin E with lung function (Lin *et al*., 2010). A large RCT revealed that the supplementation with 600IU of α-tocopherol, every other day, resulted in a 10% decrease in risk of chronic lung disease in women (Agler *et al*., 2011). A study that involved 3 European countries established that vitamin E intake is associated with a lower COPD mortality (Tsiligianni *et al*, 2010; Ford *et al.,* 2014. In addition, low serum levels of vitamin E have also been linked to more wheezing, phlegm production and dyspnoea (Hanson *et al*., 2014; Tsiligianni *et al*., 2010).

2.6.2.5.4 Vitamin C

Obesity: It has been reported that obese persons have increased levels of oxidative stress (Fernández-Sánchez *et al*., 2011). Vitamin C is an antioxidant, which has been observed to retain

beneficial effects in obese animal and human studies (Garcia-Diaz *et al*., 2014). In addition, Garcia-Diaz *et al.* (2014) assert that vitamin C could be involved in a variety of mechanisms, implicated in the initiation, development and further consequences of body weight increase. Vitamin C deficiency has been reported to be present in 35-40% of obese persons, who planned to undergo bariatric surgery (Via, 2012). Additionally, Via (2012) asserts that serum levels of vitamin C are inversely associated with BMI.

Since vitamin C is an antioxidant, it has been theorised that it may have a preventative effect on CVD (Baradaran *et al.,* 2014). Various studies, however, had contrasting results, which is understood to be due to vitamin C acting as a pro-oxidant in high oxidative stress environments (Bhupathiraju *et al.,* 2011; Figueroa-Méndez & Rivas-Arancibia, 2015; Bouayed & Torsten Bohn, 2010). Two studies, focusing on the individual role of vitamin C, found no effect of vitamin C on chief cardiovascular occurrences, total heart attacks, or CVD mortality (Desai *et al.,* 2014; Moser & Chun, 2016). Regardless of the lack of evidence to support the role of vitamin C in CVD prevention, 500mg/d supplemental vitamin C, for at least a month, has been associated with lower serum LDL and TG levels (Bhupathiraju *et al.,* 2011). It has been established that the protective effects of antioxidant nutrients against CVD are lost when isolated; therefore, the current recommendation is that antioxidants are best obtained through the consumption of healthy foods, instead of supplements (Bhupathiraju *et al*., 2011).

Diabetes: Several studies have shown that diabetic patients have low levels of vitamin C and increased levels of oxidative stress (Valdés-Ramos *et al*., 2015; Christie-David *et al*., 2015). Recently, it has been suggested that hyperglycaemia could be the initiation step for oxidative stress (Rafighi *et al*., 2011). In addition, DM is considered a state of chronic inflammation, which is linked to oxidative stress (Garcia-Bailo *et al*., 2011). Vitamin C is an antioxidant, which is able to scavenge free radicals, improve hyperlipidaemia and reduce BP (Rafighi *et al.,* 2011; Baradaran *et al.*, 2014). In addition, due to its similarity in structure, vitamin C can replace glucose in many chemical reactions and in this manner, prevent on-enzymatic glycosylation of proteins (Rafighi *et al*., 2011).

Cancer: A dose-response meta-analysis, investigating the link between vitamin C intake and lung cancer, established that the level of vitamin C intake was associated with the risk of lung cancer (Luo *et al.,* 2014). A 7% reduction on risk was observed for every 100mg/d increase in intake (Luo *et al.,* 2014).

COPD: Various studies have shown that a higher intake of vitamin C is linked to improved lung function (Itoh *et al*., 2013; Park *et al*., 2012; Hanson *et al.,* 2014). In addition, Ansari *et al.* (2010) concurred that vitamin C supplementation delayed the deterioration of lung function in their study subjects.

2.6.2.5.5 Vitamin D

Obesity: Various studies have established conclusively that low serum levels of vitamin D are associated with obesity (Cipriani *et al*., 2014). It has been determined that 25-hydroxy-vitamin D (25(OH) D) levels decrease by 1.15% for each unit increase in BMI (Cipriani *et al*., 2014). Possible reasons for this are:

1) a high body fat content act as a pool for fat-soluble vitamin D, elevates its sequestration and in so doing, cause it to be less bioavailable;
2) synthesis of 25(OH)D might be reduced in obese persons due to hepatic steatosis;
3) decreased synthesis due to limited sunlight exposure and limited outdoor activity; and
4) the higher circulating leptin and interleukin-6 levels may have an inhibitory effect on 25(OH)D synthesis via their receptors.

Diabetes: One of several studies has shown that vitamin D supplementation can increase insulin sensitivity by up to 54% (Talaie *et al*., 2013). It has been suggested that vitamin D reduces insulin resistance through its effect on calcium and phosphorus metabolism and via up regulation of the insulin receptor gene (Maestro *et al.,* 2002). In addition, a 20 year follow up study on 4843 patients with T2DM has shown that vitamin D intake was linked to a reduced prevalence of T2DM (Pittas *et al.,* 2006).

***Cardiovascular disease*:** Various studies have determined that vitamin D is beneficial for primary CVD prevention. Most studies have revealed that CVD occurrences were associated with low vitamin D levels. Regardless of these positive findings, it has been recommended that RCTs be carried out to prove a causal role concretely (Bhupathiraju *et al.,* 2011). Current proof, from observational studies, show that vitamin D is most useful in individuals with low, or sub-optimal levels (Welsh & Sattar, 2014; Bhupathiraju *et al*., 2011; Borges *et al.,* 2011).

Cancer: Vitamin D deficiency has been linked with cancer of the colon, breast, ovaries and pancreas (Zhang & Naughton, 2010). It has been established that Vitamin D aids the regulation of cell growth and has been evidenced to inhibit the spread of cancer. Lung, colon, kidney, breast and prostate cancer models have demonstrated that Vitamin D fulfils a vital role in the activity against metastasis (Zhang *et al*., 2010).

COPD: It has been determined that increased levels of vitamin D is associated with improved lung function (Zendedel *et al.,* 2015; Tsiligianni, *et al*., 2010). Findings from a variety of studies have shown that persons with COPD tend to be vitamin D deficient (Ghoneim *et al*., 2015; Zendedel *et al*., 2015; Persson *et al*., 2012; Tsiligianni *et al*., 2010). Vitamin D deficiency has also been implicated in the increased incidence of chronic respiratory infections (Hejazi & Entezari-Maleki, 2010). Vitamin D plays an important role in airway remodelling via the inhibition of tumour necrosis factorα and improvement of IL-10 in immune cells (Berraies *et al.,* 2014). In addition, a RCT study has shown that vitamin D reduced the worsening of COPD and improved FEV_1 (Zendedel *et al*., 2015).

2.6.2.5.6 Calcium

Obesity: Calcium is known to affect numerous biochemical actions concerned with weight regulation [fat absorption and adipocyte differentiation] (Bougle *et al.,* 2009). Several studies of calcium supplementation in women revealed reduced weight gain in those, who were in the treatment group (Davies *et al.,* 2000; Astrup, 2008). On the other hand, results from studies of calcium supplementation in obese patients had been conflicting (Zhou *et al*., 2010b; Li *et al* 2016). Calcium supplementation only had a beneficial effect on weight loss for those who had lower

intakes (Bougle *et al.,* 2009).

Cardiovascular disease: Calcium is an essential nutrient, which is not only essential for bone formation, but also plays a role in nerve conduction, muscle contraction, cell adhesiveness and mitosis and blood coagulation (Vaskonen, 2003). In the aging population, low calcium intakes have been linked to osteoporosis, hypertension, colon cancer, breast cancer and renal stones (Heaney *et al*., 2012; Vaskonen, 2003).

Throughout the past decade, numerous studies have been conducted to assess the effect of calcium on CVD events (Chung *et al*., 2016). Concerns regarding increased cardiac events associated with calcium intake from diets, or supplements have not been verified and, therefore, current recommendations for calcium intake are still being recommended (Heaney *et al*., 2012).

Cancer: The findings of several studies, conducted over the past decade, have concluded that calcium plays a protective role in cancer of the colon, rectum, breast and ovaries (Davoodi *et al.,* 2013; Lappe *et al*., 2007; Merritt *et al.,* 2013). The proposed mechanism involved is that calcium might affect several intracellular pathways, which lead to differentiation in normal cells and apoptosis in transformed cells (Davoodi *et al*., 2013).

COPD: COPD has been implicated in bone loss (Cielen *et al.,* 2014; Mazokopakis & Starakis, 2011). Calcium supplementation, in combination with vitamin D, has been shown to improve balance, increased bone mineral density (BMD), inhibited bone remodelling and improved muscle function in persons with COPD (Cielen *et al*., 2014).

2.6.2.5.7 Fibre

Obesity: Epidemiological, observational and cross-sectional studies have revealed that an inverse relationship exists between dietary fibre intake and body weight (Papathanasopoulos & Camilleri, 2010). In addition, some intervention studies in humans disclosed weight reduction with fibre-rich diets, or dietary fibre supplements (Slavin, 2013; Papathanasopoulos & Camilleri, 2010).

Cardiovascular disease: Epidemiologic studies have revealed that the consumption of 15g of fibre per 1000kcal lowers the risk of CVD and CHD by reducing LDL levels (Slavin, 2013). On the other hand, RCTs suggest that fibre might have a beneficial role in lowering CRP levels, apolipoprotein levels and BP. Water-soluble fibres, in particular, has proven to be the most effective for reducing serum LDL-cholesterol levels without having any effect on HDL levels (Slavin, 2013).

Diabetes: In 2004, researchers, exploring the link between GI and GL with the incidence of T2DM, established that increased consumption of cereal and fruit fibre was associated with a decreased risk of diabetes (Gross *et al*., 2004). Many studies have since verified those studies (Makris, 2011; Schulze *et al*., 2004). The results from a recent meta-analysis showed that fasting blood glucose (FBG) and $HbA1_c$ improved significantly in patients with T2DM, when their dietary fibre intake was increased (Post *et al.,* 2012).

Cancer: The European Prospective Investigation into Cancer and Nutrition (EPIC) study and many other large cohort studies have clearly determined that a dose-response association between fibre intake and risk of colorectal exist (Aune *et al*., 2011; Murphy *et al*., 2012; Riboli *et al*., 2002). The results from a systematic review and meta-analysis revealed that for every 10g/day consumption of total dietary fibre and cereal fibre there is a 10% decrease of colorectal cancer risk. In addition, a 20% reduction in risk of colorectal cancer is observed for every three servings (90g/day) intake of whole grains (Murphy *et al*., 2012; Aune *et al.,* 2011).

2.6.2.5.8 Coffee

Obesity: It has been suggested that the caffeine present in coffee could raise energy expenditure and, therefore, reduce body weight (Greenberg *et al.*, 2006). A study conducted in a Malaysian population revealed no significant association between coffee consumption of >2 cups per day and obesity (Haque *et al*., 2015). However, the findings of several observational studies determined that high coffee intake (>4 cups per day) was linked to a reduced risk of obesity (Nordestgaard *et al.*, 2015). The findings of a recent Mendelian randomised study failed to find a causal link between coffee intake and risk of obesity (Nordestgaard *et al.,* 2015).

Cardiovascular disease: Evidence exists that indicate that there is an inverse relationship between coffee intake and risk for CVD (Mure *et al.,* 2013). Similarly, a recent review assessing the impact of coffee and health determined that coffee is beneficial for CVD. This review suggests several mechanisms by which the bioactive constituents in coffee confer beneficial effects on the coffee consumer (Cano-Marquina *et al.*, 2013). These actions include the effects on the arterial wall (by affecting flow-mediated dilation), blood pressure and lipid metabolism (Cano-Marquina *et al*., 2013).

Diabetes: An inverse relationship between coffee consumption and the incidence of T2DM has been observed, with a recent study finding of a 25% reduction in risk for diabetes in individuals, who consumed ≥4 servings of coffee a day (Jiang, Zhang & Jiang, 2014; Cano-Marquina *et al.,* 2013; Mure *et al*., 2013). Zhang *et al*. (2011) found a substantial link between a lower HbA_{1c} in women with T2DM and higher decaffeinated coffee intake, but no similar results were found in population-based studies. According to Bhupathiraju *et al*. (2014), the findings of their research observed that participants, who increased their consumption of coffee over a period of 4 years, had a reduced risk of T2DM, while the reverse was true for those who reduced their coffee consumption over the same period. The mechanism involved is not clear, however, it has been suggested that coffee's beneficial effects could be due to its antioxidant activity (Mure *et al*., 2013; Abrahão *et al*., 2013).

Cancer: Evidence exists that coffee intake of up to 6 cups per day has no detrimental effect on most cancer sites (Arab, 2010). The protective role of coffee in different cancer types is still controversial; with many studies finding that coffee has *neither a beneficial, nor adverse* effect (Zeegers, 2001; Zhou *et al.*, 2012; Dong *et al.*, 2011). There is, however, some evidence of a possible protective role of coffee for liver cancer risk. The coffee's protective role against cancer is hypothesised to be due the pro-inflammatory actions of caffeine (Cano-Marquina *et al*., 2013; Arab, 2010).

COPD: The results of studies investigating the effects of caffeine intake on the respiratory system, has been conflicting (Hirayama *et al*., 2012). One study found that coffee intake had very little impact on the factors of COPD (Hanson *et al*., 2014). Recently a case-control trial found a positive association between coffee consumption and caffeine intake and prevalence of COPD (Hirayama *et*

al., 2012).

2.6.3 Physical activity

It is evident that regular exercise, as primary prevention, is able to avert, or impede, the onset of illness and disease (Derman *et al.,* 2008a). It is believed that physical activity acts on the cardiovascular system and in this way, brings about positive changes in metabolism, body weight and body composition (Derman *et al*., 2008a). The beneficial effects of exercise are, however, of short duration and a lasting commitment to do regular exercise at high intensity is needed to reduce the risk of chronic diseases (Colberg *et al*., 2010; Derman *et al*., 2008a). The benefits of regular exercise for diabetics include: improved insulin sensitivity in muscle and the liver, improved glucose uptake by muscle, better glycaemic control, reduction in $HbA_{1c,}$ improved lipid profile, decreased body weight, lower blood pressure, decreased risk of embolisms and reductions in overall cardiovascular risk (Khan, 2010; Derman *et al*., 2009b). Several prospective cohort and cross-sectional observational studies have established that higher levels of physical activity are beneficial in preventing the development of diabetes (Colberg *et al*., 2010). Regarding hypertension, the consensus is that the beneficial effects of exercise on blood pressure can be seen if a hypertensive individual exercises for more than 30 minutes of exercise per week (Derman *et al*., 2009b).

Credible proof exists for the benefits of physical activity and the prevention of colon, endometrial and breast cancer (Winzer *et al*., 2011; Derman *et al*., 2009a). Current evidence also suggests that physical activity is associated with decreased lung, endometrial, prostate and ovarian cancer risk (Winzer *et al*., 2011; Derman *et al*., 2009a). It has been proven that a daily bout of 30 to 60 minutes of moderate to high-intensity aerobic activity can reduce the risk of colon cancer by 30%, with a dose-response being seen (Derman *et al*., 2009a). The American College of Sports Medicine (ACSMA 2011) recommends that healthy adults and cancer survivors participate in exercise of moderate-intensity for a minimum of 30 minutes during 5 days of the week. On the other hand, the American Institute for Cancer (AIC) and the World Cancer Research Fund (WCRF) promotes 60 minutes of moderate-intensity exercise, or 30 minutes of vigorous-intensity exercise daily to reduce cancer risk (Kushi *et al*., 2010; Winzer *et al.,* 2011). It has been theorised that physical activity may be linked to improved immune function and decreased gut transit time, which decreases exposure to

carcinogens and so reduces risk of colon cancer (Derman *et al*., 2009a). Many studies have revealed that women, who are physically active, had a lower breast cancer risk, with moderate and high levels of physical activity being related to a 20 to 40% decrease in breast cancer (Derman *et al*., 2009a). The decreased breast cancer risk can be due to a decrease in oestrogen and androgen concentrations, fortification of the immune system and decreased body fat (Winzer *et al.,* 2011; Derman *et al*., 2009a).

2.6.4 Smoking cessation

Smoking cessation is said to be one of the most important and cost-effective means of reducing COPD risk, as well as preventing and delaying the development of airflow limitation (Parker & Eaton, 2012a; Schwellnus *et al*., 2008). A pooled analysis conducted in 2008, determined that the risk for head and neck cancers was decreased in persons, who had ceased to smoke 1-4 years previously, while those, who had stopped smoking more than 20 years previously, had a head and neck cancer risk equal to individuals, who had never smoked (Marron *et al*., 2010). It has also been revealed that smoking cessation reduces the risk of developing a primary tumour of all major types of lung cancers (Parsons *et al*., 2010). In their year-long prospective study, Gepner *et al*. (2011) determined that smoking cessation decreased risk for cardiovascular disease, especially in women. They also established that the increased HDL-C levels, after smoking cessation, counteracted the impact of subjects' weight gain, after smoking cessation. It has been asserted that the effect of smoking cessation has an almost immediate effect on an individual's health, by reducing the risk of cardiac events and that the effect of smoking on cardiovascular risk is reversible over time (Bullen, 2008).

Smoking cessation, it has been found, has no short-term benefits for the reduction of diabetes risks (Yeh *et al.,* 2010; Tonstad, 2009). The beneficial effects of smoking cessation were found to be evident only approximately, 5 years post smoking cessation (Tonstad, 2009). Smoking cessation has been linked to increased risk of developing NCDs due to the weight gain, which is often experienced in this population. This weight gain often results in greater waist circumference, which leads to insulin resistance (Mackay *et al.*, 2013). The conclusion drawn from studies exploring smoking cessation is that smoking quitters should be educated on weight gain preventionto

minimise their risk for developing CNCDs (Yeh *et al.,* 2010; Tonstad, 2009).

2.6.5 Alcohol use

A review of 84 studies concluded that about one drink of alcohol per day results in a 14-25% reduction in cardiovascular disease, but that heavier consumption of alcohol was linked to increased risk for stroke and mortality (Ronksley *et al*., 2011; Patra *et al*., 2010). Recently, evidence has emerged that moderate red wine consumption might provide additional cardiovascular benefits (Lippi *et al*., 2010). Moderate alcohol consumption was linked to the lowest diabetes risk, while heavy intake was linked to an increased diabetes risk (Boggs *et al*., 2010).

2.7 Intervention programmes, policies and/or guidelines for chronic non-communicable diseases in other countries

Worldwide CNCDs are placing the biggest demand on health care expenditure with up to 10.4 billion euros being spent on obesity-related healthcare (Jakovljevic & Milovanovic 2015; Mayes & Oliver 2012; Chan *et al*. 2010). In order to address the CNCDs epidemic, intervention programmes are often implemented. It has been asserted that a successful intervention programme should have the following characteristics:

1) it reaches the desired target,
2) is cost-effective and
3) involves many levels and disciplines

(De-Graft Aikins *et al.*, 2010; Puska 2002).

Hunter and Reddy (2013) assert that, in order to be all-inclusive, a CNCD prevention programme should integrate policies that have been planned to cultivate an atmosphere, in which people are urged to make and maintain healthy living choices, as well as advance health literacy. The prevention programme should also encourage people to safeguard and improve their health, while providing health services that focus on early detection, as well as cost-effective management of CNCDs and their associated risk factors (Hunter *et al*., 2013). In addition, Chan *et al*. (2012)

suggest that effective public health interventions, especially those aimed at addressing obesity should, "(1) target the food environments, the physical activity environments and the broader socioeconomic environments; (2) directly influence behaviour, aiming at improving eating and physical activity behaviours; and (3) support health services and clinical interventions."

Although intervention programmes for CNCDs had previously focused on modifiable risk factors, very few have accomplished the desired result (WHO 2011e; Puska, 2002; Puska *et al.,* 2002). The interventions that are currently implemented include legislation to control salt content of processed foodstuffs in many countries, namely, the United Kingdom (UK), Belgium, Greece, Hungary, the Netherlands, Paraguay and Portugal (Charlton, Webster and Kowal 2014). Alcohol intake restriction is another intervention against CNCDs, with the UK Government recommending that men should not consume more than 3-4 units [23-32g/d pure alcohol] per day and women, not more than 2-3 units [16-24g/d pure alcohol] (Nichols *et al*., 2012). The promotion of physical activity, as a means of preventing CNCDs, is another worldwide approach taken, with some cities in countries, for example, Sao Paulo in Brazil that launched their "Agita Mundo/Move for Health" global campaign in 1995. The success of this campaign resulted in the WHO adopting this effort for World Health Day in 2002 (Kolbe-Alexander *et al*., 2012).

In the United States of America (USA), the Healthy People Program, since its inception in 1979, has been a prominent part of the country's approach to address population health. This program provides a detailed framework and plan for the improvement of the country's health, which can be utilised in policies and programmes. This program is updated every decade to accommodate the changing health needs of the country, as well as to make improvements to the programme, based on evaluations made during the preceding decade (U.S. Department of Health and Human Services, 2011). The success of this initiative, however, has been questioned, since very few of its objectives have been met (Fielding *et al.,* 2013). The main challenges for this programme, as identified by Fielding *et al.* (2013), are:

1) evidence-based targets are not being set;
2) documentation of important data is not done often enough, which makes tracking progress difficult;

3) the programme's objectives are not prioritised at national level;
4) issues regarding the integration of healthcare delivery with those aimed at wider health determinants need to be addressed;
5) barriers to health inequities, which are worsened by a lack of universal health insurance coverage and what they perceive to be the greatest challenges of all; and
6) changing the attitude of the population about what the best way is to decrease preventable diseases (Fielding *et al*., 2013).

During the community interventions for health (CIH) projects in China, India and Mexico, the investigators sought to determine whether it was possible to upscale targeted interventions for CNCDs to a population level. The findings of this RCT revealed that up scaling community-based health promoting interventions for CNCDs to a whole population approach was practical, affordable and effective for the control of risk factors for CNCDs in LMICs (Dyson *et al*., 2015).

2.8 Consequences of CNCDs in South Africa

In 2010, it was determined that the overall costs of CVDs had more than doubled over the previous 20 years (Maredza *et al.,* 2011). The prediction is that the overall costs of chronic diseases will continue to rise, which will affect efforts to address poverty, unless the CNCDs epidemic is stemmed (Alwan *et al*., 2009). It has also been estimated that the annual national disability grants would increase to R4.2 billion by 2040, due to the escalation of CVD (Household, 2010). According to Hofman (2011), unless the chronic conditions of the epidemic in South Africa are addressed, the cost to the health system, as well as the existing negative effect on South Africa's workforce and productivity, will worsen. In SA, most of the deaths from CNCDs occur in persons younger than 60 years, particularly in the economically productive age group of 35-64 years (Hofman, 2011).

2.8.1 Policies and guidelines

The National Department of Health established the Directorate of Chronic Diseases, Disabilities and Geriatrics, which developed national guidelines for the prevention and control of NCDs (Maredza *et al*., 2011; Mayosi *et al*., 2009*).* Guidelines to address hypertension, chronic diseases of lifestyle and T2DM have also been developed (Draper *et al*., 2014; Maredza *et al*., 2011). Even though these

guidelines included interventions, proven cost-effective in low- and middle-income countries, it has been revealed that these guidelines had no great effect on the primary prevention and management of the common heart conditions (Maredza *et al*., 2011). Recently, the guidelines for the management of ischaemic stroke and transient ischaemic attack has been revised, which is perceived to be an important measure in the campaign to lessen the disease burden, due to stroke (Maredza *et al*., 2011).

2.8.2 Legislation

In February 2011, the Minister of Health signed off regulations on the reduction of *trans*-fat to no more than 2 grams per 100g of oil or fat (SA DoH, 2011). A high intake of trans-fatty acids has been associated with the development of CVD, which, consequently, can result in the development of other CNCDs, such as cancer and T2DM (HSFSA, 2016). Additionally, in March 2013, Dr Motsoaledi signed into law the regulation for the reduction of sodium content in foodstuffs. Food manufacturers of basic foodstuffs were expected to comply with these regulations by 2016 and further salt reductions are expected to be met by 2019 (South Africa Department of Health [DoH], 2013).

Current legislation in place to address CNCDs in South Africa include, the tobacco control act that came into effect in 1993 and the Liquor Act that was implemented in 2003 (Mayosi, 2009). Recent developments include the launch of the Western Cape Department of Health's Western Cape of Wellness (*WoW*) initiative and the sugar tax, proposed by the finance minister during his 2016 budget speech (Donnelly, 2016; Fokazi, 2015).

2.8.3 Interventions

In South Africa, as in many other countries, CVD is not considered as serious a health issue as the HIV/AIDS epidemic (Maredza *et al*., 2011). A few guidelines that target hypertension, chronic diseases of lifestyle and diabetes have been developed, however, these might not have a great enough effect (Maredza *et al*., 2011).

Many community-based programmes that address CNCDs have been implemented in South Africa,

however, most have not scaled up, nor have they been evaluated to establish their efficacy (Maredza *et al*., 2011). South Africa has been at the forefront regarding tobacco control, but despite this, the smoking rate is still considered unacceptably high, therefore, advocacy groups have appealed to the Minister of Finance to increase the tobacco tax rates, in the hope that it will produce the desired result (Maredza *et al*., 2011; Mayosi *et al*., 2009)

In South Africa, there are many community-based interventions for the control and management of NCDs. These include the Community Health Intervention Programme (CHIPS), the Woolworths Health Promotion Programme, the Soul City Health Promotion Programme, the Promoting Healthy Lifestyles in Khayelitsha Project and the Vuka South Africa: Move For Your Health. In addition, there are several non-governmental organisations (NGOs) that focus on CNCDs, including the Cancer Association of South Africa (CANSA), the Heart and Stroke Foundation of South Africa and the National Council Against Smoking (Mayosi *et al*., 2009)

2.8.3.1 Community-based intervention programmes in the South Africa

The Sports Science Institute of South Africa (SISSA) has implemented a number of projects to address the increasing rate of obesity and CNCDS in the Western Cape Province of South Africa. These projects are:

- **The Community Health Intervention Programme (CHIPS**) was initiated in 1997. The aim of this programme is to create a culture of health by encouraging physical activity and health education in previously disadvantaged communities.
- **Healthnutz,** is a programme aimed at children aged 5-12 years, run by dedicated teachers at three primary schools in the Western Cape. The aim of this project is to introduce physical activity to children in a fun and non-competitive manner.
- **OptiFit Outreach** programme, which persons aged 15 to 60 years of age can join for a fee of R20 per month, provides members with a cheap and conveniently situated exercise venue. At these community-based venues, members' anthropometric measurements and BP are also regularly monitored.

- **Live It Up** is a seated exercise programme offered twice weekly to 55-year-olds and older in 16 communities. The programme also provides education on CNCD management.

(Sports Science Institute of South Africa [SSISA], 2015)

Medical Aid schemes have also implemented different strategies to aid their members and the community at large, to incorporate healthier habits. Discovery Health's 'Vitality' Programme and Momentum's 'Multiply' reward programmes are just two such initiatives. Discovery Health has implemented its Vitality Schools Programme in 2008 with the aim of encouraging physical activity in schoolchildren (Discovery Health, 2008a).

The Soul City Institute for Health and Development Communication was established in 1992. Over time, it has expanded its range of health intervention programmes according to the needs of the country (Soul City Institute for Health and Development Communication, 1992). On their website they have toolkits for NCDs and nutrition (https: /www.k4health.org/toolkits/pc-ncd).

In 2005, the DoH launched the 'Move for Health Day' initiative with the slogan 'Vuka South Africa, move for your health' (South African Government, 2015). This campaign stemmed from the initial National Department of Health (NDoH) and the local WHO office's 'Move for Health' campaign, which was launched in 2002. Afterwards, the NDoH launched its Healthy Lifestyles campaign that evolved into the current 'Vuka SA' campaign (Kolbe-Alexander *et al*., 2012).

2.8.3.2 Non-governmental organisations and advocacy groups

Many NGOs, like the Heart and Stroke Foundation of South Africa (HSFSA), established in 1980, are rallying to fight CNCDS. The HSFSA focusses on fighting preventable heart disease and stroke, in the hope of decreasing premature deaths and morbidity. Over time, the number of programmes offered has expanded to include Saltwatch; the Heart mark; testing and screening; 'go red for women'; '#have heart', 'cooking from the heart'; and others (Heart and Stroke Foundation of South Africa [HSFSA], 2011).

Another NGO, the Cancer Association of South Africa (CANSA) came into existence to combat cancer in South Africa. It enables research, educates the public and provides support to all people affected by cancer (Cancer Association of South Africa [CANSA], 2015).

2.8.4 Successes and failures of current/existing interventions in South Africa

South Africa's most successful health intervention thus far, is its HIV/AIDS programme. Currently, not much progress has been made to address the CNCDs epidemic, even though goals had been set at a national summit on NCDs in September 2011 (Mayosi *et al*., 2012). Positive steps include:

- the signing of the regulation to reduce sodium intake;
- the Health ministry's plan to reduce alcohol advertising;
- the phasing in over a 14-year period of the National Health Insurance Project to assure universal health coverage;
- a re-engineered system of Primary Health Care (PHC); and
- the launch of the SANHANES by the Human Sciences Research Council (HSRC), which will provide data regarding the prevalence of CNCDs and their risk factors (Mayosi *et al*., 2012).

2.8.4.1 Private sector

In the private sector, medical aid companies have introduced rewards-based wellness programmes, of which Discovery's 'Vitality' (Discovery Health, 2008b) and Momentum's 'Multiply' (Momentum Health, 2008) are examples, in an effort to combat CVDs. Incentives, such as discounts on the purchases of healthier food options, gym memberships and movie tickets are offered by both medical schemes to members, who join the rewards programmes for a certain fee. These incentives are aimed at encouraging healthy behaviour by, for example, providing access to facilities for prevention. Research, conducted by Discovery with individuals, who had signed up for their rewards programme and were committed to using the facilities for prevention made available to them through the programme, revealed that hospital admissions and claims costs related to cardiovascular conditions had been reduced (Maredza *et al*., 2011). The downside of this rewards-based wellness programme is that the member is expected to pay an extra fee, which could be the

reason why only, approximately, 40% of Discovery Health beneficiaries are on the 'Vitality' programme (Maredza *et al*., 2011).

The pharmaceutical company, PharmaDynamics, has launched the 'iChange4Health' programme, as part of a joint initiative with the Chronic Disease Initiative for Africa [CDIA] (PharmaDynamics 2015; Chronic Disease Initiative for Africa [CDIA], 2015). The aim of this programme is to assist South Africans to substitute their bad habits with healthier ones. In addition, PharmaDynamics has teamed up with the HSFSA to produce a free cookbook in 2012 (PharmaDynamics, 2015)

2.8.4.2 Food industry

In South Africa, Woolworths has voluntarily reworked a number of their brand-specific recipes to contain less salt (Maredza *et al*., 2011*).* In addition, Woolworths has also implemented its 'the Woolworths Making the Difference' (MTD) programme (Woolworths, 2004), which aims to promote a healthy lifestyle through nutrition and physical activity, using school-based interventions. Currently 230 schools, located in the Western Cape, are participating in this programme. The Healthy Tuck Shop Guide, recently added to the MTD programme and developed by registered dieticians, aims to aid schools with the provision of healthier eating options to learners daily (Marraccini *et al*., 2012). Many food products also display the CANSA, glycaemic index (GI), South African Diabetes Association (SADA) and /or Heart and Stroke foundation (Heart Mark) on their labels, in order to aid the population in making better food purchasing choices, which, consequently, could play a role in the prevention and/or management of CNCDs.

2.8.4.3 South African Food Based Dietary Guidelines

The South African Food Based Dietary Guidelines (SAFBDGs), which are based on existing eating patterns and diet-related health problems, were developed over a period of four years with the intention to address nutrition-related health problems in South African persons, who do not have special dietary needs (Vorster, 2013). It consists of thirteen brief, distinct and easy to understand messages, tested for understanding, aptness and relevance in groups of various ethnic backgrounds, in rural and urban areas. These guidelines have been updated in 2014 to make them more acceptable to the South African population (Vorster, 2013; Gibney *et al.,* 2001).

2.9 Barriers to intervention programmes in South Africa

The main challenges in addressing the CNCD epidemic in South Africa are poverty, unemployment, sexism and socioeconomic inequalities. In addition, the South African public health system is unable to cope with the demands placed on it, while the lack of health surveillance and health information need to be addressed (Mayosi *et al*., 2012).

In the Western Cape Province of South Africa, the primary healthcare approach has been implemented to address the rising number of CNCDs cases (Lalkhen *et al*., 2015; Draper *et al*., 2014). In order to provide a good service, an adequate number of staff, knowledgeable about CNCDs and its management is required, as well as the availability of the necessary tools (Parker *et al.,* 2012). A recent survey of the health promotion services for individuals with CNCDs revealed that patients preferred to receive their health messages from a trained health professional, which is not always possible, due to staff constraints (Parker *et al*., 2012). In addition, staff members are not always aware of the availability of policies and health material, as not all facilities have access to health promotion materials (pamphlets). In addition, factors such as patients' literacy levels and language barriers are also impediments to health education (Draper *et al*., 2014; Parker *et al*., 2012). Other barriers include a poorly managed healthcare system, disruption in drug supply and healthcare workers' incapability to manage CNCDs (Lalkhen *et al*., 2015).

2.10 Summary

The problem of CNCDs is worldwide and it has been predicted to worsen in years to come, unless drastic measures are taken to address it. Many countries, including South Africa, have started to pay attention to the CNCD epidemic and have implemented certain actions to stem its growth. Although many issues still need to be addressed (social inequalities, poverty, staff shortages), some progress has been made. Unless the populations' 'buy in' is obtained, decreasing CNCD morbidity and mortality will be impossible.

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CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This study is embedded in the Prospective Urban and Rural epidemiology (PURE) study, a large-scale worldwide epidemiological cohort study (Teo *et al*., 2009). This study was initiated in 2009 and is currently still active. This chapter will be divided into two sections, section 1 will describe the methodology of the PURE study and section will describe the methodology utilised in the current study.

3.2 Section 1: Methodology for the PURE study

3.2.1 Study design

A cross-sectional study design was used.

3.2.2 Study population

The PURE study aimed to recruit approximately 150,000 participants, aged between 35 and 70 years, living in more than 600 communities, in 17 low-, middle-, and high-income countries around the world (see Table 1). The selection of the participating countries was based on the representativeness of different economic levels and the study sites included were based on the commitment of investigators to collect good quality data over the planned 10-year period (Teo *et al*., 2009). The UWC SoPH committed itself to conduct data collection in Langa (urban community) in the Western Cape Province and Mount Frere (rural community) in the Eastern Cape Province.

3.2.3 Sample size

The sample size of the University of the Western Cape's PURE study sites consisted of 2000 men and women. One thousand participants were recruited from each identified study site.

3.2.4 Sampling method

For the PURE study, households and individual selection criteria were based on:

- representativeness;
- apparent physical and mental health – no known serious diseases;
- feasibility of long-term follow-up;
- at least one household member aged between 35 and 70 years; and
- the relevant household member continuing to live in their current residence for at least the next four years.

Exclusion criteria included:

- individuals not intending to continue living in their current residence for the following 4 years; and
- serious known diseases.

Table 3.1: Participating countries and target recruitment goals (Teo *et al*., 2009)

World bank income classification	Country	Urban communities	Urban individuals	Rural communities	Rural individuals	Total
High-income countries (HIC)	Canada	44	5500	21	4500	11000
	Sweden	3	3500	3	1500	5000
	UAE	1	1000	2	1000	2000
Upper-middle-income countries(UMIC)	Argentina	14	2500	14	2500	5000
	Brazil	22	2500	42	2500	5000
	Chile	6	2500	9	2500	5000
	Malaysia	61	5000	26	5000	10000
	Poland	1	1000	3	1000	2000
	South Africa	4	2000	4	2000	4000
	Turkey	29	1000	12	1000	2000
Lower-middle-income countries (LMIC)	China	100	25000	117	25000	60000
	Colombia	30	2500	10	2500	5000
	Iran	9	2500	7	2500	5000
Low-income countries (LIC)	Bangladesh	30	2500	26	2500	5000
	India	31	15000	60	15000	30000
	Pakistan	3	1000	3	1000	2000
	Zimbabwe	2	500	2	500	1000

3.3 Quantitative method

3.3.1 Data collected in the PURE study

Existing data collected for the PURE study in 2010 (anthropometry, dietary intake, physical activity and blood pressure) formed part of the data for this study. The PURE study was initiated in 2009 (Cape Town, South Africa) and is currently still on-going. Since this current study was embedded in the bigger PURE study, the participants were already familiar with the fieldworkers and the researcher had no need to introduce them, or have them sanctioned by the participants. The fieldworkers therefore visited selected households, introduced themselves and explained the purpose of the study. Written informed consent was obtained and individuals were assured that confidentiality would be maintained (Figure 3.1).

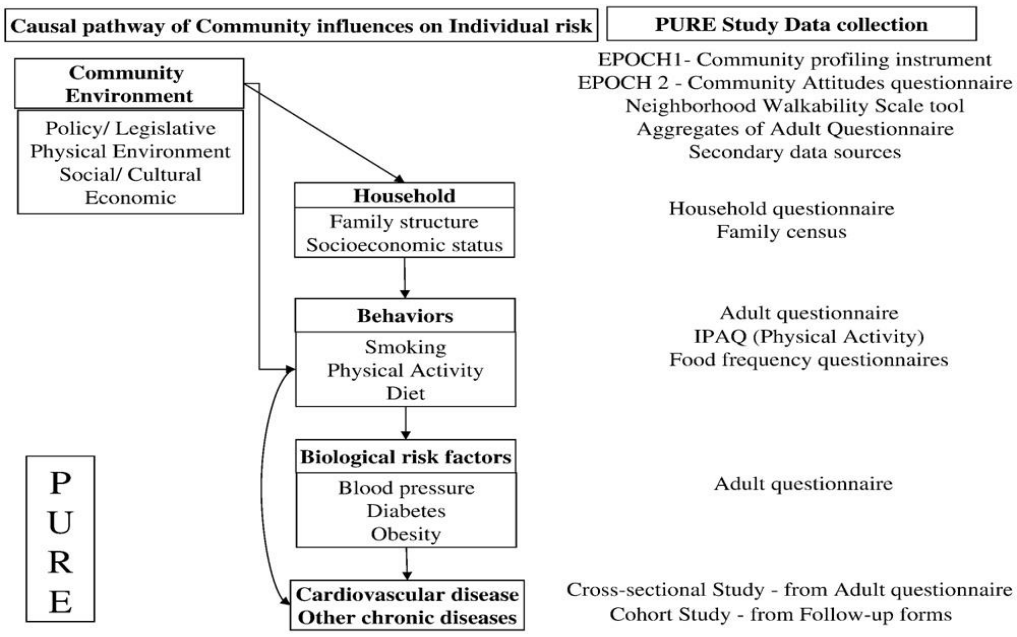


Figure 3.1: PURE study data collection (Teo *et al*., 2009)

Subsequently, all questionnaires were completed and physical measurements (blood pressure, height, weight, waist, hip and mid-upper arm circumference) were taken. Appointments were made with individuals to obtain the fasting blood samples and urine samples. Quality control measures were introduced to complete the questionnaires and measurements and therefore ensured that all missing data was obtained.

3.3.2 Research tools

3.3.2.1 Questionnaires

Data collection for the PURE study occurred at provincial, community, household and individual levels. Provincial level data was collected at baseline in 2009-2010. Community level data include social and environmental factors that influence health. The Environmental Profile of a Community's Health (EPOCH) questionnaire was used to collect data regarding social and environmental factors affecting health. The family census questionnaire was used to collect socio-demographic data. The household questionnaire was used to collect data on the head of the household, available amenities, access to water and sanitation. The Adult Questionnaire was used to collect data on the nine

INTERHEART risk factors (diagnosed hyperlipidaemia, hypertension, diabetes, obesity, psychosocial stress disorders, as well as smoking and regular consumption of fruit, vegetables and alcohol).

The PURE Physical Activity questionnaire was used to collect data on individual physical activity. The PURE Quantified Food Frequency Questionnaire together with a food photo book was used to collect data on dietary intake. (Teo *et al*.,2009). Nutrient intakes were calculated using the MRC Foodfinder III software package (all research instruments used are attached as Addenda A to O).

3.3.2.2 Measurements

Weight was measured in minimal clothing to the nearest 0.1kg, using a digital scale (A & D Personal Precision scale UC 321, A&D Company Limited, Tokyo, Japan). Height was measured using a stadiometer (model: Seca 213) with the participant barefoot to the nearest 0.1cm. Body mass index (BMI) was calculated and presented by BMI category. Waist circumference was measured over minimal clothing at the narrowest part, between the ribcage and hip bone. Hip circumference was measured over minimal clothing at the widest part of the body, across the buttocks. Mid-upper arm circumference was measured at the mid-point of the right arm, all measured using a non-stretchable measuring tape (Dean, London UK). Two readings were taken at each site and mean measurements were recorded to the nearest 0.1cm. Blood pressure was measured on the right arm with the participant sitting relaxed, with the arm at heart level using a digital blood pressure monitor (Omron HEM-757, Omron Healthcare, Kyoto, Japan). Blood pressure and waist circumference data were used to describe the metabolic profile of the study participants, with systolic blood pressure >130mmHg or diastolic blood pressure >85mmHg defined as high blood pressure. A waist circumference cut-off point of >80cm in women or>94cm in men was used to define increased metabolic risk (Alberti *et al*., 2009).

3.3.3 Staff training

Fieldworkers were trained to complete the questionnaires correctly and on how to take the anthropometric and blood pressure measurements.

3.4 Section 2: Methodology of the current study

The current study was conducted in three phases as illustrated in Table 3.2.

3.4.1 Study design

The study designs utilised during the various phases of the study is listed below:

Phase 1: Cross-sectional study design, quantitative exploratory

Phase 2: Qualitative and quantitative study design

Phase 3: Qualitative study design

A cross-sectional study design was implemented. Even though this study had qualitative and quantitative components, it is not a mixed-methods study. A mixed methods study should be performed according to specific steps for the formulation of objectives, reflecting quantitative, qualitative and integration of quantitative and qualitative objects. The rationale for a mixed methods design and type of mixed methods design should be stated and used to present flow of data collection and integration of results. In this study there were no integrative objectives, although results were finally discussed and integrated.

3.4.2 Study population

For the current study only participants from the urban community (Langa) were included. Langa is a suburb in Cape Town, which was established in 1923 to house predominantly black Africans. This suburb spreads over a total area of 2.87 km^2 (Plak, 2012). The 2011 census report stated that Langa had a total population of 52,410 (City of Cape Town, 2011).

Phase 1: One thousand PURE participants

Phase 2: DoH officials

Phase 3: Three hundred PURE participants

Table 3.2: Summary of research methodology for different phases of the study

	Phase 1(Article 1)	Phase 2 (Article)	Phase 3 (Article 3)
Data collection phase	Secondary analysis of data from PURE study	Interviews with DoH officials	Focus group discussions with participants
Aims and objectives	To determine dietary adherence to a DASH-type diet by calculating a dietary adherence score To determine association between dietary adherence score, blood pressure and anthropometry	To determine participants' challenges with implementation of nutrition interventions To determine participants' needs regarding CNCD interventions To explore what courses of action DoH officials think would best address the CNCDs epidemic. To determine DoH officials' awareness and knowledge regarding existing CNCD policies	To explore perceived challenges regarding the implementation and adherence to nutrition intervention messages To gain an understanding of participants' expectations of CNCD interventions To explore acceptability of health message interventions To explore preferences for CNCD health message dissemination methods To determine participants' awareness of CNCD programmes and their willingness to participate in these programmes
Study design	Cross-sectional Quantitative exploratory	Qualitative and quantitative	Qualitative
Study population	1000 PURE participants	DoH officials	300 PURE participants
Sampling	Random selection of 300	Snowball effect	Convenience sampling
Instruments and analysis	Data collected at baseline (socio-demographics, dietary (QFFQ), physical activity, anthropometry and blood pressure) Medians Cross-tabulations Chi-square Correlations	Interviews MCM mapping	Focus group discussion Content analysis
Response rate	300	6/10 identified	47/48

3.4.3 Sampling

Phase 1: A sub-sample of 300 participants was drawn by means of selective random sampling from the existing PURE Langa cohort study participants. This sample size was determined based on similar studies in literature (Khan *et al.,* 2012).

Phase 2: Ten key officers at the Department of Health, who are involved in the treatment and prevention of persons with CNCDs and CNCD policy development, were identified and were recruited by means of the snowball effect.

Phase 3: The 47 PURE participants who participate in the FGDs were conveniently sampled afrom the 300 sub-sample who were recruited for face-to-face interviews.

3.4.4 Research tools

Phase 1: In order to assess the participants' dietary intakes and to determine whether they were in line with existing policy guidelines, the following was done:

- Baseline dietary data from the individual, food frequency questionnaires were analysed to present the participants' macronutrient intakes, as well as total fruit and vegetable intakes. The sodium intake, as well as the total fat, saturated fat, poly- and mono-unsaturated fat intakes, as a percentage of total energy, were also determined.

- To determine dietary adherence, a dietary adherence score was calculated, using a combination of a DASH-style diet and recommendations made by the South African Food-based Dietary Guidelines (SAFBDG) for the participants' dietary intake. The blood pressure and anthropometric measurements (waist circumference, body mass index, waist-hip ratio and waist-to-height ratio) of participants in the lowest tertile and highest tertile was then compared.

- Interviews were conducted at a local level with PURE study participants, using an open-ended and closed-ended questionnaire (The "*Challenges to Intervention Programmes" questionnaire)*. The aims of these interviews were to establish: (1) their awareness of intervention programmes in their community and (2) the reasons (if any) for resistance to intervention programmes. In addition this questionnaire was used to collect data on the participants' knowledge and awareness of CNCDs intervention programmes, offered in their community; their willingness to participate in these programmes; their reasons for not wanting to participate in existing CNCD intervention programmes as well as, how and by whom they would prefer CNCDs messages to be disseminated.

Phase 2: Interviews were conducted with key officers at the provincial Department of Health (DoH), using the MCM method and The *DoH questionnaire (*an open-ended and closed-ended questionnaire). The aims of the interviews, conducted at the DoH, were to determine: (1) whether they knew of any policies for CNCDs that existed, (2) what they perceived to be the challenges for the implementation of these policies, and (3) how frequently policies were reviewed.

Multicriteria mapping

Multicriteria mapping (MCM) was used to explore intervention options that key government officers, as programme managers and implementers, considered appropriate to address the four major CNCDs in SA. MCM is a computer-assisted interview process from which quantitative and qualitative data is generated. This method is used to assess or weigh up different courses of action to be taken regarding multifaceted and contentious policy issues (Deliberative mapping, 2004). MCM consists of a four-step process (Stirling, 2014).

- ***Step 1: Choose options***

MCM uses a set of core options (Table 3.3) that permit comparisons to be made between the positions taken by different participants, when the interviews are analysed. The interviewer developed a set of core options, in advance, through review of the literature (González-Zapata *et al*., 2008; Tromp & Baltussen, 2012; Stirling *et al*., 2007). The core options are variables, the performance of which should be assessed by all interviewees, in order to obtain a comparison.

Discretionary options were added to provide interviewees with the opportunity to assess the performance of additional factors, other than the core options provided (Stirling *et al*., 2007).

Table 3.3: Multicriteria Mapping (MCM) Interview Options: best way to address the CNCDs epidemic in SA

Core options	Discretionary options
1. Legislation and regulation for CNCDs (policies) 2. Control of food and drink advertisements 3. Control of food sales at public institutions and places 4. Compulsory food labelling 5. Fatty food tax ("sin tax") and healthy food subsidies 6. Cheaper prices of healthy foods 7. Improving inter-sectoral partnerships 8. Community participation	1. Improved health education of citizens 2. Improve training of health professionals in CNCDs 3. Integrated health service delivery 4. Skill-shifting among health professionals 5. Improve health information systems 6. Improve the school curriculum: include more health and nutrition education 7. Improve workplace health initiatives 8. Compulsory free annual medical check-up 9. Increase use of sugar and fat substitutes 10. Growing healthier foods such as genetically-modified (GM) foods 11. Control marketing terminology on food labels (e.g. use of "lite") 12. Healthier restaurant menus 13. Nutrient analysis of catering menus to show energy, sugar, salt and fat content

(Stirling *et al*., 2007; Holdsworth *et al.*, 2007)

The following option clusters were identified, in order to group/aid in the analysis process (Stirling *et al*., 2014):

Cluster 1: CNCDs prevention and management oriented

- Legislation and regulation for CNCDs

Cluster 2: Food supply control

- Control of food sales at public institutions and places
- Fatty food tax ('sin tax') and healthy food subsidies
- Cheaper prices of healthy foods
- Healthier restaurant menus

Cluster 3: Food information

- Control of food and drink advertisements
- Compulsory food labelling
- Control marketing terminology on food labels (e.g. use of "lite")
- Nutrient analysis of catering menus to show energy, sugar, salt and fat content

Cluster 4: Educational

- Improved health education of citizens
- Improve training of health professionals in CNCDs
- School curriculum to include more health and nutrition education

Cluster 5: Health care reform

- Integrated health service delivery
- Skill-shifting among health professionals
- Improve health information systems

Cluster 6: Innovative preventive initiatives

- Improve workplace health initiatives
- Compulsory free annual medical check-up

Cluster 7: Technological advances

- Increase use of sugar and fat substitutes
- Growing healthier foods, such as genetically modified (GM) foods

Cluster 8: Partnerships and collaboration

- Improving inter-sectoral partnerships
- Community participation

The core and discretionary options may be described as follows:

➢ *Legislation and regulation for CNCDs (policies)*

The development and implementation of policies for salt reduction and alcohol use could aid in decreasing the use of alcohol and salt. The development and implementation of environmental planning policies will aid in the improvement of community facilities, so that it is safe and conducive to physical activity. Policies to control the composition of processed foods, in terms of fat (type and amount), salt content and kilocalories, will aid in the control of overweight and obesity, as well as other CNCDs (Moodie *et al*., 2013; Stirling *et al*., 2007).

➢ *Control of food and drink advertisements*

This will entail the banning of food advertisements aired during children programmes, as well as in cinemas. It will also include the banning of advertisements of tobacco products, alcohol and unhealthy foodstuff aimed at adults on television, billboards, magazines and in cinemas (González-Zapata *et al*., 2008; Stirling *et al.,* 2007).

➢ *Control of food sales at public institutions and places*

This entails controlling food and drink items sold at schools, colleges, Technikons and universities. Young children are easily influenced, so only offering healthy food choices at school tuck shops, for example, could lay the foundation for them to continue making healthy food choices into adulthood

(Moodie *et al*., 2013; González-Zapata *et al*., 2008; Stirling *et al*., 2007).

- *Compulsory food labelling*

Compulsory food labelling would aid in the public making better food choices. The food labels should be easy to understand and standardised for all products, so that consumers could easily make better food choices (Liem *et al*., 2012; González-Zapata *et al*., 2008; Holdsworth *et al.,* 2007; Stirling *et al*., 2007).

- *Fatty food tax ("sin tax") and healthy food subsidies*

Taxing food-manufacturing companies for the production of food items, which contain fat and salt above the recommended levels, could encourage these companies to reformulate their recipes and therefore influence consumers' intake. On the other hand, the simultaneous decrease in healthy food prices (by means of subsidies) could encourage the purchasing of these healthier food items (Holdsworth *et al*., 2007; Stirling *et al*., 2007).

- *Cheaper prices of healthy foods*

Providing healthier foods at lower prices would encourage citizens to purchase these food items. This could be done by subsidising healthier food options (González-Zapata *et al*., 2008; Holdsworth *et al*., 2007; Stirling *et al*., 2007).

- *Improving intersectoral partnerships*

Joining forces with other government departments, the food industry, community associations and non-governmental organisations (NGOs) could aid in the pooling of resources and therefore result in a holistic approach to tackling the CNCDs epidemic (Alleyne *et al*., 2013; McDonald *et al*., 2011).

- *Community participation*

The community members know what their needs are. In order for an intervention to be successful, it must address the community's self-identified needs (Metta *et al*., 2014).

- *Improved health education of citizens*

Citizens will be provided with more information and a better understanding of CNCDs, including their risk factors, prevention and management. In this way, they will be aided in decreasing their risk for developing CNCDs. Teaching them how to make healthier food choices (teaching them how to read food labels) would play a role in combating CNCDs (Holdsworth *et al*., 2007; Stirling *et al*., 2007).

- *Improve training of health professionals in CNCDs*

Providing health professionals with the skills and knowledge to identify, counsel and care for persons with CNCDs could aid in reversing the CNCDs epidemic (Parker *et al.,* 2012; Stirling *et al.,* 2007).

- *Integrated health service delivery*

Integrating services, where individuals who are, for example, HIV-positive and suffering from a CNCD, could receive the necessary care for both conditions in one place, simultaneously (Atun *et al.,* 2013).

- *Skill-shifting among health professionals*

Training more assistant health professionals (e.g. nursing assistants) and community health workers to assist with the care of individuals with CNCDs, could play a role in alleviating the workload of existing health professionals, as well as address the current health human resource problems (Aikins *et al.,* 2014; Parker *et al*., 2012).

- *Improve health information systems*

Improved health information systems will aid in identifying and monitoring individuals at risk of, or diagnosed with CNCDs. In this way, better care can be provided to these individuals and help to end the CNCDs epidemic (Mayosi *et al*., 2009).

- *Improve the school curriculum: include more health and nutrition education*

Including health and nutrition education in the school curriculum will equip young children to make better food choices and will lay the foundation for their future health (Stirling *et al*., 2007).

- *Improve workplace health initiatives*

By providing incentives to their workforce, companies can encourage their employees to maintain better health. This may include the provision of health education workshops, annual health checks, or even installing a gym at the workplace, as well as the work cafeteria only providing healthy foods (Ismail *et al.,* 2014).

- *Compulsory free annual medical check-up*

Making it compulsory for all individuals, regardless of age, to go for an annual medical check-up, could aid in identifying individuals at risk of, or who suffer from, CNCDs, as well as provide the opportunity to impart information on the prevention of CNCDs (Rodic *et al*., 2008).

- *Increase use of sugar and fat substitutes*

Companies are developing new products regularly. The use of sugar and fat substitutes, such as modified starch, gums and pectins, could assist individuals with their weight control (González-Zapata *et al*., 2007; Stirling *et al*., 2007; Wylie-Rosett, 2002; Akoh, 1998; Miraglio, 1995).

- *Growing healthier foods, such as genetically modified (GM) foods*

Agriculture could find ways in which to produce healthier foods for the general public, which will have nutrient content (Alleyne *et al*., 2013; Holdsworth *et al.,* 2007).

- *Control marketing terminology on food labels (e.g. use of 'lite')*

Policies can control what items fulfil the criteria to be labelled 'lite', or 'low' in certain dietary constituents, such as fat, sugar and salt. In this way, the consumer is assured that s/he is making better food choices, without being misled (Holdsworth *et al.,* 2007; Stirling *et al*., 2007).

- *Healthier restaurant menus*

Restaurants can be provided with incentives to reformulate their recipes, so that they can offer healthier food to their patrons (Holdsworth *et al*., 2007).

- *Nutrient analysis of catering menus to show energy, sugar, salt and fat content*

More public eating-places should provide their patrons with nutritional information of all food items prepared on the premises. This will aid patrons in ordering the healthier food items (Sinclair *et al*., 2014; Ellison *et al*., 2013; Roberto *et al*., 2010).

- ***Step 2: Define criteria***

The interviewer asks the participant to make a personal judgement about issues of importance, when evaluating the relative merits of the options. These issues are then developed into a set of criteria (e.g. money, human resources, time) against which the options will be appraised.

- ***Step 3: Assess scores and explore uncertainty***

The participant assigns numerical scores (range of 0 to 10) to represent the performance of each option under each of the chosen appraisal criteria.

- ***Step 4: Assign a weight to each criterion***

The participant ranks each criterion according to what he/she considers the least, to the most important on a scale of 0-100. This is an approach designed to help specialists and members of the public weigh up evidence to reach a joint decision on the relative importance of complex policy issues, where there is no obvious way forward (Deliberative mapping, 2004).

Phase 3: Focus group discussions were performed with Langa residents, who were PURE study participants, to determine:

- what they perceived to be barriers to intervention programmes that address the four major CNCDs in their community;
- their views on what they considered appropriate methods of addressing the four major CNCDs in their community; and
- how, or in what form, they would prefer their health messages to be disseminated (including preferred illustrations and language).

The focus group discussion was used to obtain data regarding the participants' perceptions about health message dissemination and reasons for not wanting to participate in existing CNCD intervention programmes in their community. During the recruitment phase, the purpose of the focus group discussion was explained.

The researcher prepared a focus group discussion guide beforehand (Appendix L). At the start of the focus group discussions, the purpose of the discussion was once again revisited. The purpose of the voice recorder was also explained. The researcher facilitated the discussion and a trained fieldworker acted as the recorder. For the focus group discussions, the fieldworker signed a group confidentiality binding form, as did the participants. In fact, it was highlighted in the fieldworker employment contracts that they would be required to maintain confidentiality.

All focus group discussions were conducted primarily in English, with some questions translated into isiXhosa, when required, by the trained fieldworker. At the end of each group discussion, which was recorded, the main issues that were raised were summarised and the participants were asked to verify the summaries. The focus group discussions lasted between 25-50 minutes. Focus group discussions continued up to the point of data saturation.

3.4.5 Pilot study

A pilot study was conducted using the *Challenges to Intervention Programmes* questionnaire on a subsample of Langa residents who was not included in this study for the first phase of the study.

3.4.6 Staff training

Phase 1: The fieldworkers were trained to complete the *Challenges to Intervention Programmes* Questionnaire by the researcher.

Phase 2: The researcher was trained to conduct interviews using the MCM method.

Phase 3: The researcher also conducted the focus group discussions according to standard published methods (Krueger, 2008).

3.4.7 Integration of quantitative and qualitative methods

A literature study was carried out to investigate current/existing CNCDs intervention programmes in other countries. Recommendations were made using information from existing literature, as well as the results of this study on how gaps between government and communities could possibly be breached regarding the implementation of and adherence to nutrition interventions for CNCDs.

3.5 Ethical consideration

Ethical clearance for the Western Cape PURE study was obtained from the Research and Higher Degrees committee from the University of the Western Cape (Project number 13/3/5). Informed, written consent was obtained from each participant and confidentiality and anonymity were maintained by using participant numbers and no names on the study material.

The proposal for this study was submitted to the Higher Degrees Committee of the Faculty of Community and Health Sciences at the University of the Western Cape. Permission to interview the healthcare facility managers was obtained from the DoH. Additional informed, written consent was obtained from each participant for participation in focus group discussions and MCM interviews.

The study did not harm the participants in any way and participants were free to refuse to participate, whether or not they continued to participate in the broader PURE study. The participants were free to refuse to answer any particular question(s) and were not cajoled to answer them, if they did so. The participants were free to withdraw at any stage, without the need for an

explanation.

3.6 Validity and reliability

Phase 1: Only one fieldworker was employed for data collection. The questions were posed to all participants in the same manner. There were thus no inter-interviewee differences present which ensured that the data collected was reliable.

Phase 2: The focus group discussions were conducted by the researcher. All questions were posed in a standardised manner. There were thus no inter-interviewee differences present which ensured that the data collected was reliable.

Phase 3: The MCM interviews were conducted by the researcher. All questions were posed in a standardised manner. There were thus no inter-interviewee differences present which ensured that the data collected was reliable.

3.7 Statistical analysis

The researcher captured and analysed the data collected for this part of the study using Microsoft Excel 2009 and SPPS.

Phase 1: The socio-demographic data, anthropometric status, CNCD risk factor data (blood pressure), physical activity and dietary intake are presented as descriptive data. This data was also analysed according to the willingness to participate in intervention programmes.

Quantitative data was analysed using the Statistical Package for Social Sciences (SPSS) vs 24 software. Correlations were determined between BMI, CNCD risk factors (blood pressure) and physical activity level. Cross-tabulations with chi-square tests were used to assess associations between categorical variables (obese/non-obese, smoking status, willingness/not willing to participate in an intervention programme and adherence/non-adherence with existing programmes). Odds ratios and 95% confidence intervals were calculated to measure the strength of the associations.

Phase 2: The MCM method data was analysed using the MCM ANALYST software tool. The qualitative data (options which include the core and discretionary options; transcripts of audio recordings and notes made during the interviews) and quantitative data (scores, weights and ranks) were automatically loaded into the MCM-Analyst package.

Phase 3: Data was analysed using content analysis. After each focus group discussion, the researcher and recorder discussed the session and a full narrative report of the discussion was prepared that reflected the discussion as comprehensively as possible, taking verbal and non-verbal responses into account, as well as using participants' own words. After data had been transcribed, statements were coded by two independent coders. Codes were allocated to capture the essence of what was discussed. Inductive coding was done to interpret and understand the content of the discussions. After the first round of coding, the two coders met to discuss differences between their preliminary codes and to reach consensus about final codes. After each FGD was coded, the different groups were compared to assess, when no new codes emerged. This point is defined as the stage of data saturation. Codes were grouped together to combine similar responses and identify patterns in the discussions as different categories. Trends and main themes were identified from the patterns, issues, problems and questions that arose. Key statements, ideas and perceptions were highlighted for each topic discussed. Data was summarised as narrative. The most valuable themes/quotations were identified by counting the number of times the theme emerged and these were used to illustrate the main ideas of the focus group discussions (NOAA Coastal Services Center (online); Health and Safety Executive (online); Krueger, 1988).

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Addendum A: Letter of confirmation for ethical approval

OFFICE OF THE DEAN
DEPARTMENT OF RESEARCH DEVELOPMENT

UNIVERSITY of the
WESTERN CAPE

19 April 2013

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape has approved the methodology and ethics of the following research project by:
Prof T Puaone (School of Public Health)

Research Project:	Prospective Urban and rural Epidemiology Study (PURE) to track changing lifestyles and risk factors for Chronic Diseases.
Registration no:	13/3/5

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Private Bag X17, Bellville 7535, South Africa
T: +27 21 959 2988/2948 . F: +27 21 959 3170
E: pjosias@uwc.ac.za
www.uwc.ac.za

A place of quality,
a place to grow, from hope
to action through knowledge

Addendum B: Methodology for blood pressure and physical measurements (Kruger, 2005)

5.0 Instructions for physical measurements

5.1 General instructions

Ensure that written consent has been obtained from the subject prior to taking measurements

- Give concise and clear instructions
- Take your time
- Do not deviate from the standard instructions given in the manual
- Ensure all instruments are set to "0" (zero) prior to each measurement (weighing scales, dynamometer)

5.3 Sitting right arm blood pressure and heart rate

- Both measurements are done on the right arm, using the Omron automatic digital blood pressure monitor (Omron HEM-757)
- Make sure the batteries are charged. There is a Low Battery Indicator which appears on the display screen if the batteries need to be replaced
- Keep spare-charged batteries
- Ensure all necessary cuff sizes are present
- Subject must be resting and calm for □ 5 minutes, should not have smoked, exercised or eaten in the last 30 minutes, and should not have climbed the stairs in the last 15-30 minutes before taking this measurement
- Subject should be seated upright and relaxed with his/her right arm supported at heart level

Take the measurement using the brachial artery

- Record the readings for systolic and diastolic pressures and heart rate (read exact values, avoid "rounding") on page 12 of the Adult Questionnaire

5.5 Anthropometrical assessment

All anthropometric measurements will be made using the guidelines adopted at the NIH sponsored Arlie Conference. (Anthropometric standardisation Reference Manual, Eds TG Lohman, AF Roche, R Martorell. Human Kinetic Books: Champaign, Illinois. 1988.)

5.5.1 Waist circumference

- The subject stands erect with the abdomen relaxed and arms at the sides
- The measurement is taken over the minimally-clothed/unclothed abdomen at the smallest diameter between the costal margin and the iliac crest (the hip)
- This is best done with the measurer facing the subject and identifying the natural waist (i.e. the point of narrowing)
- The measurement is taken to the nearest 0.1 cm at the end of a normal expiration, using a nonstretchable standard tape measure attached to a spring balance exerting a force of 750 gm
- The tape must be kept horizontal
- Record the value on page 12 of the Adult Questionnaire

5.5.2 Hip circumference

- The measurement is taken over minimal/no clothing at the level of the greater trochanters (usually the widest diameter around the buttocks)
- The measurer squats by the side of the patient so that the level of maximum extension of the buttocks is seen □ □The measurement is taken to the nearest 0.1 cm using a nonstretchable standard tape measure attached to a spring balance exerting a force of 750 gm
- The tape must be kept horizontal
- Record the value on page 12 of the Adult Questionnaire

5.5.3 Weight

- The subject is measured in minimal/no clothing. The subject must be barefoot with arms hanging freely at the side

- Take care to ensure that the scale is ‘zeroed’ before taking any weight
- Weighing scales should be calibrated prior to each clinic using standard weights. Maintain a registry of these calibrations.
- Record the value on page 12 of the Adult Questionnaire (AQ)

5.5.4 Height (refer Figure 1a and 1b)

- Measure against a convenient, flat wall at the clinic site
- The subject must be barefoot with arms hanging freely at the side
- The heels of the feet must be together with the medial (inner) borders of the feet at an angle of 60 degrees
- The shoulder blades, buttocks and heels must be in contact with the measuring wall
- The head is held in the Frankfort plane (represented by a line between the margin of the orbit of the eye and the tragion)
- Height is recorded to the nearest 0.1 cm after the subject inhales fully and maintains the erect position without altering the load on the heels
- In this position, make a mark on the wall and record with a measuring tape. Enter the value on page 12 of the AQ.

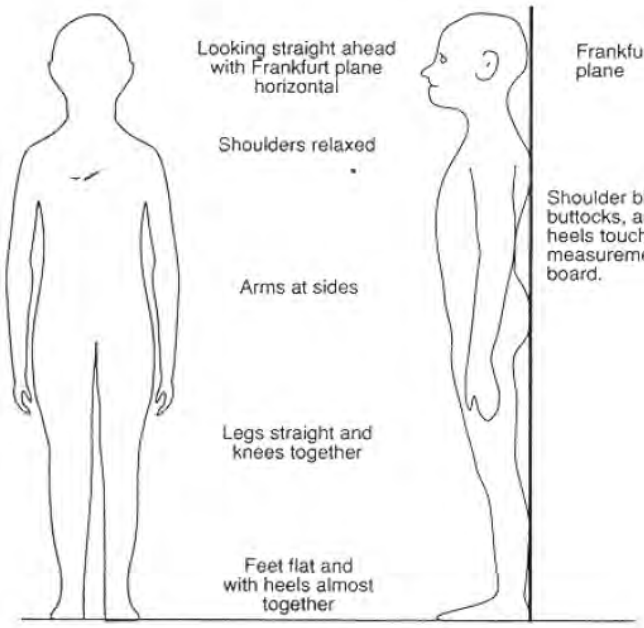
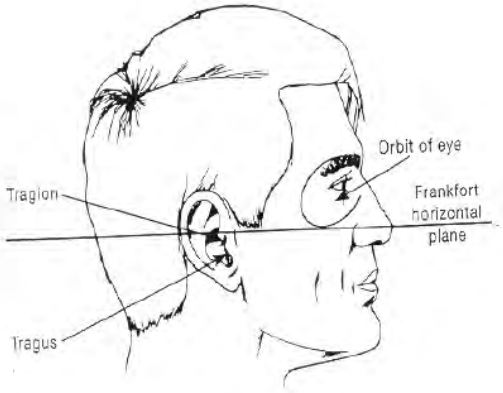


Figure 1a

Positioning of subject for height measurement

Figure 1b

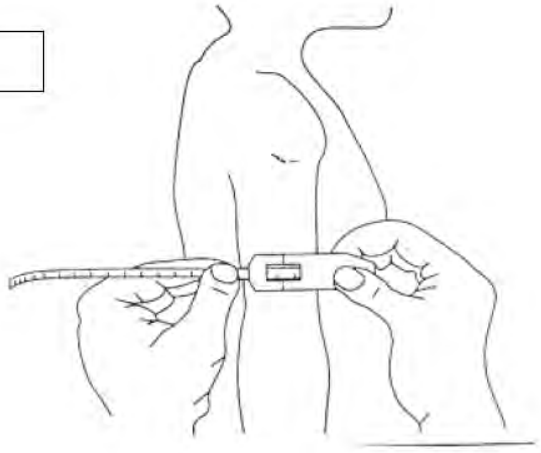
Length and stature are measured with the head in the Frankfort horizontal plane. This plane is represented by a line between the lowest point on the margin of the orbit (the bony socket of the eye) and the tragion (the notch above the tragus, the cartilaginous projection just anterior to the external opening of the ear).



5.5.5 Mid upper arm circumference (refer Figure 2a and 2b)

- Record at the mid-point of the right arm with the subject standing erect, arms hanging freely at the side and right elbow flexed 90 degrees
- Ensure that the subject's right palm is face down, with forearm held across the body, horizontally to the floor
- The mid-point of the arm is identified as the point between the lateral border of the acromion and the inferior border of the olecranon, with the elbow flexed to 90 degrees
- Record the circumference to the nearest 0.1 cm on page 12 of the Adult Questionnaire

Figure 2b



Measurements should be made taking a flexible, nonstretch tape made of fibreglass

Addendum C: Consent form: PURE

UNIVERSITY OF THE WESTERN CAPE

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Subject ID

☐☐ ☐☐☐ ☐☐☐ ☐☐

Centre# Community# Household# Subject#

Prospective Urban and Rural study
Iphepha Mvume Lomthathi nxaxheba/ Consent form

Ndixelelwe malunga nenjongo kwanendlela yoluphando. Ndiyaqonda ukuba yonke into endizakuyithethe izakungcinwa iyimfihlo. Xa ndifuna ukurhoxa koluphando ndinako. Ndinako ukurhoxa koluphando naliphi na ixesha ndingakhange ndanika sizathu. Ndinalo ilungelo lokurhoxa ekuphenduleni imibuzo nakulo oluphando kwaye oko akungeze kundichaphazele ngendlela embi.

Igama lomthathi nxaxheba:.....

Tyikitya:..... Usuku:.....

Igama omntu owenze udliwano-ndlebe.....

I have been informed about the purpose and the nature of the study. I understand that all information will be confidential. I understand that taking part in this study is voluntary. I can withdraw from participating in this study at anytime without giving any reasons and my doing so will have no negative repercussions. I also have the right to refuse answering questions when I feel uncomfortable.

Name of the participant:.....

Signature:..... Date:.....

Interviewer : .....

Addendum D: Adult questionnaire

PURE/South Africa

We are very grateful to you for your participation in this study. All information given by you will be held in strict confidence, and will be used for the purpose of this study only after removing any personal identifying information.

Adult Questionnaire

INSTRUCTIONS

Please answer EACH question by marking an X in ONE BOX on each line: (unless otherwise instructed)

[X]

OR

By writing number(s) in the spaces provided:

[1] [8]

OR

By specifying the answer on the line(s) provided

March, 2010

Adult Questionnaire

8. Occupation

Group 1: Legislators, senior officials and managers
- Legislators and senior officials
- Corporate managers
- General managers
- Businessman

Group 2: Professionals
- Physical, mathematical and engineering science professionals
- Life science and health professionals
- Teaching professionals
- Other professionals

Group 3: Technicians and associate professionals
- Physical, mathematical and engineering- science associate professionals/technicians
- Life science and health associate professionals/technicians
- Teaching associate professionals/technicians
- Other associate professionals/technicians

Group 4: Clerks
- Clerks
- Customer service clerks

Group 5: Service workers and shop and market sales workers
- Personal and protective services workers
- Models, salespersons and demonstrators

Group 6: Skilled agricultural and fishery workers
- Market-oriented skilled agricultural and fishery workers
- Subsistence agricultural and fishery workers

Group 7: Craft and related trade workers
- Extraction and building trade workers
- Metal, machinery and related trades workers
- Precision, handicraft, printing and related trades workers
- Other craft and related trades workers

Group 8: Plant and machine operators and assemblers
- Stationary plant and related operators Machine operators and assemblers Drivers and mobile plant operators

Group 9: Elementary occupations
- Sales and services elementary occupations
- Agricultural, fishery and related labourers Labourers in mining, construction, manufacturing and transport

Group 10: Armed forces
- Armed forces

Group 11: Homemaker
- Housewife/Househusband

PURE Adult Questionnaire

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

Today's date: year month day

1. Name: _____ (Given name) _____ (Surname)

2. National identity # or equivalent: _____ N/A ☐

3. DOB: year month day OR Age ☐☐ yrs

4. Sex: ☐ Female ☐ Male

5. Marital status: (check one only)

☐ Never married ☐ Currently married ☐ Common law/Living with partner
☐ Widowed Separated ☐ Divorced

6. What level of formal education have you completed? (check highest level only):

☐ None
☐ Primary
☐ Secondary/highschool/higher secondary
☐ Trade School
☐ College/University
☐ Unknown

7. Please indicate which group best describes your main occupation.
(Please refer to facing page for definitions of groups and instruction manual for detailed definitions)

☐ Group 1 ☐ Group 2 ☐ Group 3 ☐ Group 4
☐ Group 5 ☐ Group 6 ☐ Group 7 ☐ Group 8
☐ Group 9 ☐ Group 10 ☐ Group 11

a) What is your main source of income? _____

If occupation is group 11 (homemaker) go to question 10

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

8. Are you currently employed?

☐ No → answer 8a - 8d ☐ Yes → Go to #9

Are you not working due to (check one only)

a) Retirement/ Old age ☐
b) Illness ☐
c) Unemployed ☐
d) Housewife ☐

9. Current Habits

a) Are you currently smoking tobacco products regularly (at least once/day) for the last 6 months?
(Smoked tobacco = Cigarettes, Beedies, Cigars)
☐ No ☐ Yes → cigarettes/ beedies → Avg/day

b) Are you currently chewing tobacco regularly (at least once/day) for the last 6 months?
(Chewing tobacco also includes tobacco added to paan)
☐ No ☐ Yes → Avg/day

c) Are you currently consuming one drink of alcohol (at least once/month) for the last 6 months?
☐ No ☐ Yes → Avg number of drinks
Frequency: Daily ☐ Weekly ☐ Monthly ☐

10. Are you taking medications regularly to lower your blood pressure? ☐ No ☐ Yes

11. Are you taking medications regularly to lower your cholesterol? ☐ No ☐ Yes

12. Are you taking aspirin regularly to thin your blood? ☐ No ☐ Yes

13. Are you taking medications regularly for diabetes? ☐ No ☐ Yes

14. List all the medications you are currently consuming:

i) _____ Code ☐☐ ii) _____ Code ☐☐
iii) _____ Code ☐☐ iv) _____ Code ☐☐
v) _____ Code ☐☐ vi) _____ Code ☐☐
vii) _____ Code ☐☐ viii) _____ Code ☐☐
ix) _____ Code ☐☐ x) _____ Code ☐☐

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

15. Do you have hypertension/ high blood pressure? ☐ No ☐ Yes

16. Do you have diabetes? ☐ No ☐ Yes

a) If Yes, was it diagnosed in the last year ☐ No ☐ Yes → Complete Diabetes Report, CRF 85, only for New diagnoses

17. Did any of the following events/ new diagnoses occur since the last visit?

	No	Yes		Report No.	Report No.	Report No.
a) MI/ Heart Attack	☐	☐	→ Complete MI Report, CRF 50			
b) Stroke	☐	☐	→ Complete Stroke Report, CRF 53			
c) Angina	☐	☐	→ Complete Hospitalization Report, CRF 80			
d) Heart Failure	☐	☐	→ Complete Heart Failure Report, CRF 56			
e) Other Heart Disease	☐	☐	→ _____ Please Specify			
f) Cancer	☐	☐	→ Complete Cancer Report, CRF 68			
g) TB	☐	☐	→ Complete TB Report, CRF 59			
h) HIV/ AIDS	☐	☐	☐ Not Answered → Complete HIV/ AIDS Report, CRF 62, only for New diagnoses			
i) Malaria	☐	☐	→ Complete Malaria Report, CRF 65			
j) COPD	☐	☐	→ Complete COPD Report, CRF 77, only for New diagnoses			
k) Asthma	☐	☐	→ Complete Asthma Report, CRF 74, only for New diagnoses			
l) Pneumonia	☐	☐	→ Complete Pneumonia Report, CRF 71			
m) Other Lung Disease	☐	☐	→ _____ Please Specify			

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

18. During the past 12 months, have you had any injuries that were serious enough to limit your normal activities? (check all that apply)

☐ No → Go to #19 ☐ Yes → answer 18a – 18s

If yes, please provide details:

Please refer to facing page for Location and Type Codes

Cause of injury			Location	Type	Absence from work or usual activities (Days)
a) Motor vechicle accident (as a passenger)	☐ No	☐ Yes →			
b) Motor vehicle accident (as a pedestrian)	☐ No	☐ Yes			
c) Struck by an object	☐ No	☐ Yes			
d) Explosion	☐ No	☐ Yes →			
e) Natural/environmental factors (gales/cyclones/lightning, etc.)	☐ No	☐ Yes →			
f) Suffocation	☐ No	☐ Yes →			
g) Poisoning	☐ No	☐ Yes →			
h) Snake/scorpion bite	☐ No	☐ Yes →			
i) Fall	☐ No	☐ Yes →			
j) Fire/flames, resultant fumes	☐ No	☐ Yes →			
k) Physical assault (gun, kidnapping, etc.)/violent crime	☐ No	☐ Yes →			
l) Domestic violence (beaten by a family member)	☐ No	☐ Yes →			
m) Drowning/submersion	☐ No	☐ Yes →			
n) Hot or corrosive liquids/floods/substances	☐ No	☐ Yes →			
o) Crush injuries (boulders, building materials, etc.)	☐ No	☐ Yes →			
p) Accident caused by machinery	☐ No	☐ Yes →			
q) Attempted suicide	☐ No	☐ Yes →			
r) Armed conflict	☐ No	☐ Yes →			
s) Other(specify) _____	☐ No	☐ Yes →			

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

19. Have you been hospitalized for any other reason aside from the events/ diagnoses listed in Q17 and 18 ?

No ☐ Yes ☐ Complete Hospitalization Report, CRF 80 → Report No. ☐☐☐ Report No ☐☐☐

20. Have you ever fractured a bone? ☐ No → go to #21 ☐ Yes → answer a, b and c

a) Number of fractures ☐☐

b) Years since last fracture ☐☐ (yrs)

c) Bone (s) broken in the most recent fracture (if more than 3, list most severe sites) (location) If other, specify

Please refer to facing page for fracture locations

☐ → _____

☐ → _____

☐ → _____

For Women Only (Questions 21 - 24)

21. Are you currently pregnant ? ☐ No ☐ Yes → Go to #22

22. Do you still have periods? ☐ No → answer 22a ☐ Yes → Go to #23

a) How many years since you stopped menstruating? ☐☐ years

23. Have you ever used an oral/ injectable contraceptive? ☐ No ☐ Yes

24. a) How many live children have you given birth to? ☐☐ Boys ☐☐ Girls

b) Did you breast feed any of your children? ☐ No ☐ Yes

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

Tobacco

25. Which best describes your history of tobacco use?

a) ☐ Formerly used tobacco products ☐ Currently use tobacco products ☐ **Never used tobacco products** → Go to #26

b) At what age did you start? ☐☐ yrs

c) Have you ever regularly used any of the following tobacco products? (check all that apply)

	Average amount/day		Past users only: Duration (years)	When Stopped (years ago)	If less than 1 yr (months ago)
(i) Cigarettes (all kinds)	☐☐☐	number	☐☐	☐☐	☐☐
(ii) Beedies	☐☐☐	number	☐☐	☐☐	☐☐
(iii) Cigars	☐☐☐	number	☐☐	☐☐	☐☐
(iv) Pipes	☐☐☐	number	☐☐	☐☐	☐☐
(v) Sheesha/water pipe Hookah	☐☐☐	# of times	☐☐	☐☐	☐☐
(vi) Chewing tobacco	☐☐☐	# of times	☐☐	☐☐	☐☐
(vii) Snuff	☐☐☐	# of times	☐☐	☐☐	☐☐
(x) Other ____ *Specify*	☐☐☐		☐☐	☐☐	☐☐

Question 26 to be answered by non-smokers and former smokers only

26. During the past 12 months, have you been regularly (at least once per week) exposed to other people's tobacco smoke?
("Exposed" is defined as a minimum of 5 consecutive minutes, during which you inhale other people's smoke.)

☐ No → Go to #27 ☐ Yes → Please answer questions 26a

a) Over the past 12 months, what has been your typical exposure to other peoples smoke?
("Exposed" is defined as a minimum of 5 consecutive minutes, during which you inhale other peoples smoke)

Select ONE only

☐ 1-2 times/week ☐ 3-6 times/week ☐ at least once a day ☐ 2-3 times/day ☐ 4 or more times/day

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

27. **Are you a member of any of the following:**

			How often do you participate in the activities of this group? Per Month	OR	Per Year
(i) Self help group, Co-operative, Social club, Sports club,	☐ No	☐ Yes →	☐☐		☐☐
(ii) Religious Group (e.g: church group, etc.)	☐ No	☐ Yes →	☐☐		☐☐
(iii) Other _____ *Specify*	☐ No	☐ Yes →	☐☐		☐☐

28. **Please answer the following:** (choose only one option for each)

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(i) People are generally honest and want to help others.	☐	☐	☐	☐
(ii) If I do nice things for someone, I can anticipate that they will respect me and treat me just as well as I treat them.	☐	☐	☐	☐

29. a) The television, radio, newspaper or magazine advertisements help me decide to buy the type of: **(choose only one option or each)**

					Not applicable
(i) Cooking oil	☐	☐	☐	☐	☐
(ii) Flour	☐	☐	☐	☐	☐
(iii) Rice/ Maize meal	☐	☐	☐	☐	☐

b) The television, radio, newspaper or magazine advertisements influence whether I buy: **(choose only one option for each)**

(i) Soft drinks	☐	☐	☐	☐	☐
(ii) Snacks	☐	☐	☐	☐	☐
(iii) Cigarettes	☐	☐	☐	☐	☐
(iv) Alcohol	☐	☐	☐	☐	☐

30. **In a difficult situation, whose help can you count on from?** (Please see facing page for definitions)

(i) **Civic organizations:** specify _____

☐ none ☐ little ☐ moderate/average ☐ a great deal

(ii) **Religious organizations:** specify _____

☐ none ☐ little ☐ moderate/average ☐ a great deal

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

31. Have you experienced any of the following events during the last 12 months?

	No response	No	Yes	
(i) Loss of job	☐	☐	☐	
(ii) Retirement	☐	☐	☐	
(iii) Loss of crop/business failure	☐	☐	☐	
(iv) Household break in	☐	☐	☐	
(v) Marital separation/divorce	☐	☐	☐	
(vi) Other major intra-family conflict	☐	☐	☐	→ Please specify _____
(vii) Major personal injury or illness	☐	☐	☐	
(viii) Violence	☐	☐	☐	
(ix) Armed conflict/war	☐	☐	☐	
(x) Death of a spouse	☐	☐	☐	
(xi) Death/major illness of another close family member	☐	☐	☐	
(xii) Other major stress	☐	☐	☐	→ Please specify _____
(xiii) Wedding of family member	☐	☐	☐	
(xiv) New job	☐	☐	☐	
(xv) Birth in the family	☐	☐	☐	
(xvi) Separation from family	☐	☐	☐	
(xvii) Unavailability of food/ food insecurity	☐	☐	☐	

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

32. Please answer the following: (Choose only one option for each)

For the following question, stress is defined as feeling irritable or filled with anxiety, or as having sleeping difficulties as a result of conditions at work or at home.

	No response	Never Experienced Stress	Some Period of Stress	Several Periods of Stress	Permanent Stress
a) How often have you felt stress at work in the last 12 months? (Mark here if not applicable: i.e. no longer working ☐)	☐	☐	☐	☐	☐
b) How often have you felt stress at home in the last 12 months?	☐	☐	☐	☐	☐

33. What level of financial stress have you felt in the last 12 months?

☐ No response ☐ Little/none ☐ Moderate ☐ High/severe

34. During the past twelve months, was there ever a time when you felt sad, blue, or depressed for two weeks or more in a row?

☐ No ☐ Yes ⟶ **If yes, during those times, did you:**

	No response	No	Yes
a) Lose interest in most things like hobbies, work or activities that usually give you pleasure?	☐	☐	☐
b) Feel tired or low on energy?	☐	☐	☐
c) Gain or lose weight?	☐	☐	☐
d) Have more trouble falling asleep than you usually do?	☐	☐	☐
e) Have more trouble concentrating than usual?	☐	☐	☐
f) Think a lot about death (either your own, someone else's, or death in general)	☐	☐	☐
g) Feel down on yourself, no good or worthless?	☐	☐	☐

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

35. **Please answer the following:** (Choose only one option for each)

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
a) I can do most of my regular shopping (food, household necessities, etc.) at stores within easy walking distance (less than 15 minutes) of my home.	☐	☐	☐	☐
b) Walking or bicycling in my neighbourhood is difficult because of the speed and/or amount of traffic.	☐	☐	☐	☐
c) My neighbourhood is generally free from pollution (litter, air pollution and noise pollution).	☐	☐	☐	☐
d) My neighbourhood streets are well lit at night.	☐	☐	☐	☐
e) I can see other people when I am walking in my neighbourhood.	☐	☐	☐	☐
f) I can speak to other people when I am walking in my neighbourhood.	☐	☐	☐	☐
g) There is a high crime rate in my neighbourhood.	☐	☐	☐	☐
h) There is a problem with unattended dogs in my neighbourhood.	☐	☐	☐	☐

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

36. Please answer the following: (Please check all that apply)

i) Has your household been a victim of the following crime(s) in the last 12 months?

	No	Yes
1. Armed robbery	☐	☐
2. Violent attacks	☐	☐
3. Murder	☐	☐
4. Vehicle hijacking	☐	☐
5. House breaking	☐	☐
6. Theft	☐	☐
7. Rape	☐	☐
8. Women abuse eg. (beat,swear-words,sexual) please specify _____	☐	☐
9. Child abuse eg. (burn,swear-words,rejection) please specify _____	☐	☐
10. Child sexual abuse	☐	☐
11. Other, please specify _____	☐	☐

ii) Do you think that crime in your area has increased in the past 5 years? ☐ No ☐ Yes

if yes, which of the following crime(s)?

- ☐ Armed robbery
- ☐ Violent attacks
- ☐ Murder
- ☐ Vehicle hijacking
- ☐ House breaking
- ☐ Theft
- ☐ Rape
- ☐ Women abuse
- ☐ Child abuse
- ☐ Child sexual abuse
- ☐ Other, please specify _____

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

37. Questions on HIV:

(i) Do you know people who have HIV/AIDS? ☐ No ☐ Yes

if yes, which of these people: (please mark all that apply)

- ☐ Your children
- ☐ Your grandchildren
- ☐ Your spouse
- ☐ Your family members
- ☐ Your friends
- ☐ People in the community

(ii) What would you consider the mean age of the people who are ill/have died of HIV/AIDS? Tick only one block.

☐ Younger than 10 years ☐ Between 11-20 years ☐ Between 21-30 years

☐ Between 31-40 years ☐ Between 41-50 years ☐ Over 50 years

(iii) If someone in your household is HIV positive, who is the primary caregiver? Tick only one block.

- ☐ Spouse
- ☐ Parents
- ☐ Family member
- ☐ Child.children
- ☐ Friends
- ☐ Volunteer

38. Do you care for any orphans in your family? ☐ No ☐ Yes

39. Mark each answer with a X

J.1	Imagine that a hospital has only one free bed left, and two people with pneumonia need it. The one person is infected with HIV; the other is not infected with HIV. Who should get the bed?	1	The HIV positive person	
		2	The HIV negative person	
		3	It depends / other	
		9	Don't know	

Please respond to the following questions by answering "Yes" or "No".

If you are not sure, chose the "Probably Yes" or "Probably No" response.

If you are quite sure, Choose the "Definitely Yes" or "Definitely No" response.

		Definitely yes 1	Probably yes 2	Probably no 3	Definitely no 4	Don't Know 9
J.2	Do you think the government should provide free health care for people who need it?					
J.3	Do you think the government should provide free health care for people with AIDS?					
J.4	Would it be a good idea for the government to give job training to unemployed young people?					
J.5	Should youth who are infected with HIV get this job training?					
J.6	Should all people who are too sick to work get a welfare grant from the government?					
J.7	Should someone with AIDS who is too sick to work get a welfare grant from the government?					
J.8	Should a woman who got AIDS from sleeping around with many men get this welfare grant from the government?					
J.9	Would you be willing to look after a close family member with AIDS?					
J.10	Imagine that you find out that one of your friends is HIV infected. Would you still be friends with them?					
J.11	Would you drink from the same bottle of water as an HIV infected friend?					
J.12	If you knew that a shopkeeper had HIV/AIDS, would you buy fresh vegetables from him or her?					
J.13	Do you think it should be illegal for people with HIV/AIDS to put others at risk of infection through unprotected sex?					
J.14	Do you think people with HIV/AIDS should have to disclose their HIV status to the person they are going to have sex with *even if they use a condom*?					

		Definitely yes 1	Probably yes 2	Probably no 3	Definitely no 4	Don't Know 9
J.15	Imagine you meet someone you really like and he/she tells you that he/she is HIV positive, would you still go out on a "date" with him/her?					
J.16	If you loved an HIV positive person, would you have sex with them using a condom?					
J.17	Would you prefer to know who has HIV/AIDS in your community so that you can be careful not to get infected by them?					
J.18	Do you worry that HIV is much easier to catch than we are told?					
J.19	Would you rather not touch someone with HIV/AIDS because you are scared of infection?					
J.20	Do you think the names of people with HIV/AIDS should be made public?					
J.21	Do you think HIV/AIDS is a punishment for sleeping around?					
J.22	Do you think that a school pupil with HIV puts other pupils in their class at risk of infection?					
J.23	Do you think a school pupil with HIV should be allowed to attend school?					
J.24	Do you think that many people who get HIV infected through sex have only themselves to blame?					
J.25	Do you think that some people with HIV/AIDS want to infect other people with the virus?					
J.26	When you hear the word "AIDS" what community or group of people first comes to mind					

		Tick only one		
J.27	Between a rich and a poor person: Who is more likely to get HIV/AIDS?	1	A rich person	
		2	A poor person	
		3	Neither / the same	
		9	Don't know	
J.28	Between a black and a white person: Who is more likely to get HIV/AIDS?	1	A black person	
		2	A white person	
		3	Neither / the same / both	
		9	Don't know	
J.29	Between a man and a woman: Who is more likely to get HIV/AIDS?	1	A man	
		2	A woman	
		3	Neither / the same / both	
		9	Don't know	

		Tick only one		
J.30	*I am not going to ask you to tell me your result but:* Have you ever had an HIV test?	1	Yes	
		2	No	
		8	Refuse	
		9	Don't know	
J.31	Have you heard of any HIV positive people in this area?	1	Yes	
		2	No	
		9	Don't know	
J.32	Do you think people with HIV/AIDS often get treated unfairly or badly by others?	1	Yes	
		2	No	
		9	Don't know	
J.33	Have you met any HIV positive people yourself?	1	Yes	
		2	No	Skip to J.35
		9	Don't know	
J.34	If yes: What is your relationship with this person or people? Interviewer: do not read list. You can tick more than one	1	Partner (Husband/wife, boyfriend, girlfriend)	
		2	Sister/brother	
		3	Parent	
		4	Other relative	
		5	Friend	
		6	Neighbour	
		7	Classmate	
		8	Colleague at work/	
		9	Other / none of the above	
		10.	Refuse to answer	
J.35	If you knew you were infected with the HIV virus, would you keep it a secret from most people?	1	Yes	
		2	No	
		9	Don't know	
J.36	If you told someone, who would you tell? Interviewer: do not read list; multi-mentions possible You can tick more than one	1	Partner (Husband/wife, boyfriend, girlfriend)	
		2	Sister/brother	
		3	Parent	
		4	Other relative	
		5	Friend	
		6	Neighbour	
		7	Priest / someone in my church	
		8	School teacher	
		10	Anyone	
		11	Other	
		99	Don't know	
J.37	In your opinion, how at risk are *you* of HIV infection? Interviewer: read list Tick only one	1	No risk	
		2	Very small risk	
		3	Some risk	
		4	Great risk	
		9	Don't know	

J.38	Imagine you had unprotected sex yesterday. Would you would be more afraid of pregnancy or of infection with HIV? Interviewer: do not read list Tick only one	1	More afraid of pregnancy	
		2	More afraid of HIV infection	
		3	Afraid of both pregnancy and infection	
		4.	Afraid of neither	
		9	Don't know	
J.39	Who do you think is more likely to get HIV: someone with one sexual partner who does not use condoms or someone with many partners who always uses condoms? Interviewer: Tick only one	1	A person with one partner who does not use condoms.	
		2	A person with many partners who always uses condoms.	
		3	They are at equal risk	
		9	Don't Know	

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

40. Details on all members (enumerated at baseline) in the household:

Member # *Name*

Is this member a participant? ☐ No ☐ Yes

Is this member alive? ☐ No → Complete details below ☐ Yes → Go to Next Member #

If No, indicate cause of death: Date of death: YR Mo

If Cause of death =4, please indicate site

If Cause of death =7, please specify,

Member # *Name*

Is this member a participant? ☐ No Yes

Is this member alive? ☐ No → Complete details below ☐ Yes → Go to Next Member #

If No, indicate cause of death: Date of death: YR Mo

If Cause of death =4, please indicate site

If Cause of death =7, please specify,

Member # *Name*

Is this member a participant? ☐ No Yes

Is this member alive? ☐ No → Complete details below ☐ Yes → Go to Next Member #

If No, indicate cause of death: Date of death: YR Mo

If Cause of death =4, please indicate site

If Cause of death =7, please specify,

Member # *Name*

Is this member a participant? ☐ No ☐ Yes

Is this member alive? ☐ No → Complete details below ☐ Yes → Go to Next Member #

If No, indicate cause of death: Date of death: YR Mo

If Cause of death =4, please indicate site

If Cause of death =7, please specify,

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

40. Details on all members (enumerated at baseline) in the household:

Member # | Name

Is this member a participant? ☐ No ☐ Yes

Is this member alive? ☐ No → Complete details below ☐ Yes → Go to Next Member #

If No, indicate cause of death: ☐☐ Date of death: ☐☐ YR ☐☐ Mo

If Cause of death =4, please indicate site ☐☐

If Cause of death =7, please specify, _____

Name of Interviewer: (Please print) _____ Last Name _____ First Initial

Date ☐☐☐☐ year ☐☐ month ☐☐ day

Addendum E: Physical activity questionnaire

PURE/South Africa

We are very grateful to you for your participation in this study. All information given by you will be held in strict confidence, and will be used for the purpose of this study only after removing any personal identifying information.

Physical Activity Questionnaire

INSTRUCTIONS

Please answer EACH question by marking an X in ONE BOX on each line: (unless otherwise instructed)

[X]

OR

By writing number(s) in the spaces provided:

[1] [8]

OR

By specifying the answer on the line(s) provided

July, 2007

Subject ID

Centre # | Community # | Household # | Subject #

Subject Initials F M L

Today's date: year month day

1. During your working life, what has been or what was your main occupation?

_____

Part 1: Job-related physical activity

(paid or unpaid jobs outside of the home) *Do not include house or yard work*

2. **Do you currently have a job or do any unpaid work outside your home?**

☐ No → **If no, Go to PART 2** ☐ Yes → **If yes, Go to question # 2**

3. **During the *last 7 days*, on how many days did you do *heavy* physical actitivies for at least 10 min (eg. heavy lifting, digging, heavy construction) as part of your work?**

☐ Days per week → Usual time spent on one of those days doing heavy physical activities at work ☐☐ hrs. ☐☐ min.

☐ No vigorous activity at work

4. **During the *last 7 days*, on how many days did you do *moderate* physical activities for at least 10 min (eg. carrying light loads) as part of your work?** *Please do not include walking*

☐ Days per week → Usual time spent on one of those days doing moderate physical activities at work ☐☐ hrs. ☐☐ min.

☐ No moderate activity at work

5. **During the *last 7 days*, on how many days did you *walk* for at least 10 min at a time as part of your work?** *Please do not count any walking you did to travel to or from work*

☐ Days per week → Usual time spent on one of those days walking at work ☐☐ hrs. ☐☐ min.

☐ No walking at work

Subject ID

Centre #	Community #	Household #	Subject #

Subject Initials F M L

Part 2: Transportation related physical activity

6. During the *last 7 days*, on how many days did you *travel in a motor vehicle* to places like work, stores, movies, and so on?

☐ Days per week → Usual time spent on one of those days traveling in a motor vehicle ☐☐ hrs. ☐☐ min.

☐ No traveling in a motor vehicle

7. During the *last 7 days*, on how many days did you *bicycle* for at least 10 minutes at a time to go from place to place?

☐ Days per week → Usual time spent on one of those days bicycling from place to place ☐☐ hrs. ☐☐ min.

☐ No bicycling from place to place

8. During the *last 7 days*, on how many days did you *walk* for at least 10 min at a time to go from place to place?

☐ Days per week → Usual time spent on one of those days walking from place to place ☐☐ hrs. ☐☐ min.

☐ No walking from place to place

Subject ID

Centre #	Community #	Household #	Subject #
☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

Part 3: Housework, house maintenance, and caring for family

9. During the *last 7 days*, on how many days did you do *vigorous* physical activities for at least 10 min (eg. heavy lifting, chopping wood, shoveling snow or digging in the garden) in the garden or yard?

☐ Days per week → Usual time spent on one of those days doing vigorous physical activities in the garden or yard ☐☐ hrs. ☐☐ min.

☐ No vigorous activity

10. During the *last 7 days*, on how many days did you do *moderate* activities (eg. carrying light loads, sweeping, washing windows, and raking in the yard) in the garden or yard?

☐ Days per week → Usual time spent on one of those days doing moderate physical activities in the garden or yard ☐☐ hrs. ☐☐ min.

☐ No moderate activity

11. During the *last 7 days*, on how many days did you do *moderate* physical activities for at least 10 min (eg. carrying light loads, washing windows, scrubbing floors and sweeping) inside your home?

☐ Days per week → Usual time spent on one of those days doing moderate physical activities inside the home ☐☐ hrs. ☐☐ min.

☐ No moderate activity inside the home

Subject ID

Centre # Community # Household # Subject #

Subject Initials F M L

Part 4: Recreation, sport, and leisure-time physical activity

12. Not counting any walking you have already mentioned, during the *last 7 days*, on how many days did you *walk* for at least 10 minutes during in your leisure time?

☐ Days per week → Usual time spent on one of those days walking in leisure time ☐☐ hrs. ☐☐ min.

☐ No walking in leisure time

13. During the *last 7 days*, on how many days did you do *vigorous physical* activities (eg. aerobics, running, fast bicycling, or fast swimming) in your leisure time?

☐ Days per week → Usual time spent on one of those days doing vigorous physical activities in leisure time ☐☐ hrs. ☐☐ min.

☐ No vigorous activity in leisure time

14. During the *last 7 days*, on how many days did you do *moderate* physical activities for at least 10 min (eg. bicycling at a regular pace, swimming at a regular pace) in your leisure time?

☐ Days per week → Usual time spent on one of those days doing moderate physical activities in leisure time ☐☐ hrs. ☐☐ min.

☐ No moderate activity in leisure time

Part 5: Time spent sitting

15. During the *last 7 days*, how much time did you usually spend sitting on a *weekday*?

☐☐ hrs. ☐☐ min.

16. During the *last 7 days*, how much time did you usually spend sitting on a *weekend day*?

☐☐ hrs. ☐☐ min.

17. Name of Interviewer: *(please print)* _____ *First Initial* _____ *Last Name* Interviewer code: ☐☐☐

Addendum F: Quantitative food frequency questionnaire

PURE/South Africa 2010 Quantitative Food Frequency Questionnaire

☐☐☐☐ Name of fieldworker: _____

Subject Code

Subject ID **Subject Initials**

☐☐ ☐☐☐ ☐☐☐☐ ☐☐ ☐☐☐

Centre # *Community #* *Household #* *Subject #* *F M L*

Today's date: 2010 ☐☐ ☐☐ **Day of the week:** _____

year *month* *day*

1. Name of the PARTICIPANT: _____

2. Not applicable in South Africa

3. National identity # or equivalent _____ **N/A** ☐

4. DOB: ☐☐☐☐ ☐☐ ☐☐ **AND** Age ☐☐ years

5. Sex: ☐ Female ☐ Male

Please think carefully about the food and drink you have consumed during the ***PAST MONTH*** (four weeks). We have divided the foods into different groups for example all the porridges and cereals together. I will go through a list of food groups and drinks with you and I would like you to tell me:

- Which foods you eat in each of the different food groups
- How the food is prepared
- How much of the food you eat at a time
- How many times a day you eat it and if you do not eat it everyday, how many times a week or a month you eat it.

To help you to describe the amount of a food you eat, I will show you pictures of different amounts of the food as well as other food models, containers, etc.

There are no right or wrong answers.

Everything you tell me is confidential. Only your subject number appears on the form.

Is there anything you want to ask now?

Are you willing to go on with the questions?

1

Before we start I would like to find out what type of margarine, oil and milk you **USUALLY** use in your home.

1. What type of **MARGARINE** do you USUALLY use in your home? Give brand name if possible
   - ☐ Tub/Soft margarine (brand name) _____
   - ☐ Brick/Hard margarine (brand name) _____
   - ☐ Do not use margarine in home

2. What type of **OIL** do you USUALLY use in the preparation of food in your home?
   - ☐ Sunflower oil (give brand name)_____
   - ☐ Canola oil (give brand name) _____
   - ☐ Olive oil (give brand name) _____
   - ☐ Other (give brand name) _____
   - ☐ Oil previously used _____
   - ☐ Do not use OIL ever in the home

3. What type of **MILK** do you USUALLY use in your home? Mark only ONE
   - ☐ Full cream milk / Fresh cow's milk/ Box milk full cream
   - ☐ Low fat milk / 2% milk / Box low fat or 2% milk
   - ☐ Fat free milk / Skim milk / Box fat free or skim milk
   - ☐ Powder milk (eg Elite; give brand name) _____
   - ☐ Do not use milk

4. What type of **CREAMER** do you USUALLY use in your home?
   - ☐ Cremora, Ellis Brown, Coffee Mate, Tea Mate etc
   - ☐ Cremora Lite
   - ☐ Do not use creamer

Addendum F: Food frequency questionnaire

QUANTIFIED FOOD FREQUENCY QUESTIONNAIRE 2010

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

I shall now ask you about the type and the amount of food you have been eating in the **LAST MONTH**. Please tell if you eat the food, how much you eat and how often you eat it. We shall start with maize meal porridge.

PORRIDGE AND BREAKFAST CEREALS

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Maize-meal porridge	Stiff (pap)						4401	
Maize-meal porridge	Soft (slappap)						4400	
Maize-meal porridge	Crumbly (phutu)						4402	
Ting	Maize meal						4429	
	Mabella						4427	
	Other							
Mabella	Stiff						3437	
	Soft							
Morvite	Soft						4404	
Oats							3239	
Tastee wheat	Soft						3240	
Other cooked porridge	Type							
Breakfast cereals	All bran flakes						3242	
	Corn flakes plain						3243	
	Weetbix						3244	
	Rice crispies plain						3252	
	Other							

3

Do you pour milk on your porridge or cereal? Yes 1 No 2

If yes, what type of milk (whole fresh, sour, 1%, fat free, milk blend, etc) _____

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
If yes, how much milk	Whole milk/full cream milk/ fresh cow's milk						2718	
	Maas/sour milk						2787	
	Low fat / 2% milk						2772	
	Fat free / skim milk						2775	
	Other							

Do you put sugar on your porridge or cereal? Yes 1 No 2

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
If yes, how much sugar WHITE or BROWN	Cooked porridge						3989	
	Cereal						3989	
	Other porridge / cereal						3989	
	Other							

You are being very helpful. Can I now ask you about meat?

CHICKEN, MEAT, FISH

How many times do you eat meat (beef, mutton, pork, chicken, fish) per week? _____

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Chicken	Meat & skin, boiled						2926	
	Meat & skin, roasted/grilled/fried in chicken fat						2925	
	Meat ONLY, boiled (no skin)						1559	
	Meat ONLY, roasted (no skin)						1545	
	White meat only, cooked (NO Skin)						2964	
	Kentucky / Chicken Licken (Fried in batter/crumbs)						3018	
	Nando's						2925	
	Other							
Do you eat chicken skin?		Always 1		Sometimes 2		Never 3		
Chicken stew	With potato and onion WITH skin						4413	
	With tomato and onion WITH skin						2985	
	With vegetables WITH skin						3005	
	With tomato and onion NO skin						4379	
	With vegetables NO skin						4378	
Chicken BONE stew	With potato and onion and tomato						4414	
	Other							
Chicken feet	Nothing added						2997	
	Stew with potato, onion and tomato						4415	
Chicken head							2999	
Chicken offal	Stew with tomato and onion and sunflower oil						4416	
	Liver, cooked						2970	
	Other							

6

OTHER STARCH

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Samp	Bought Self ground						3250	
Samp and beans	Give ratio of samp:beans						3402 (1:1)	
Samp and peanuts	Give ratio of samp:peanuts						3250 (samp) 3458	
Rice	White						3247	
	Brown						3315	
	Maize Rice						3250	
	Any fat added?							
Pasta	Macaroni, plain						3262	
	Spaghetti, plain						3262	
	Spaghetti, canned in tomato sauce						3258	
	Macaroni & cheese Milk: Fat:							
	Other specify							
Pizza	Home made: Specify topping						3353 (base+ch)	
	Bought: Specify topping						3353 (base+ch)	

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
RED MEAT	**How do you like your meat?** With fat **OR** Fat trimmed							
Red meat **BEEF**	BRISKET, boiled/fried without added fat						4363	
	CHUCK, boiled/fried without added fat						2945	
	BRISKET, fried in added fat Type of fat:						4363	
	CHUCK, fried in added fat Type of fat:						2945	
	Beef, stewed with cabbage						3006	
	Beef, stewed with potato and onion and tomato						4417	
	Beef, stewed with vegetables						3020	
	Mince , nothing added						2921	
	Mince, tomato & onion added						2987	
	Beef **BONE** stew with potato and onion and oil						4419	
	Other							
MUTTON	Meat, with fat, cooked						2947	
	Mutton, no fat, cooked						3036	
	Mutton, chop, grilled						2927	
	Mutton, stewed with vegetables						2916	
	Other							

BRISKET: more fat and cheaper
CHUCK: less fat than the brisket, but more expensive

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Beef/mutton Offal	Offal, cooked						3003	
	Stewed with vegetables							
	Liver, beef, fried/cooked						2920	
	Liver, sheep, fried/cooked						2955	
	Kidney, beef, cooked						2923	
	Kidney, sheep, cooked						2956	
	Brain, sheep, cooked						2952	
	Lung, beef, cooked						3019	
	Lung, sheep, cooked						4337	
	"Gemaldes" (lung & fat)						4409	
	Heart, beef, cooked						2968	
	Heart, sheep, cooked						2969	
	Other							
Goat meat	Grilled/roasted/cooked						4281	
	Stewed with vegetables							
	Other							
Venison/ Wild buck							2913	
Horse/Donkey							4407	
Rabbit							4327	
Other type of meat	Specify							

What type of vegetables is usually put into meat stews?

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Wors / Sausage							2931	
Bacon							2906	
Patties	Beef, fried						2984	
	Chicken, fried						3011	
Cold meats AND Processed meats	Polony						2919	
	Ham						2967	
	Vienna						2936	
	Frankfurter, beef & pork						2937	
	Frankfurter/Sausage, chicken						3012	
	Russian/Salami						2948	
	Other							
Canned meat	Bully beef, plain						2940	
	Bully beef with potato & onion & oil						2994	
	Other							
Meat pie BOUGHT Or HOMEMADE	Beef						2939	
	Steak and kidney						2957	
	Sausage roll						2939	
	Cornish						2953	
	Chicken						2954	
	Other							
Hamburger	Bought						4418	
	Other							
Biltong	Beef (with fat OR without fat)						3021	
Dried wors Dried sausage	Beef						2949	

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Dried beans	Baked beans in tomato sauce						3176	
	Bean salad / Sousbone						3174	
	Soup with dried beans, beef and vegetables						3145	
	Sugar beans, cooked						3205	
	Other							
Lentils	Whole, cooked						3203	
	Lentil soup with beef and vegetables						3153	
Soya products eg. Imana, Knorr, Jileleke, Toppers	Cooked						3196	
	Soup/Gravy						4431	
	Stewed with extra potato, onion and tomato						4430	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Pilchards in tomato sauce or chilli or brine	Whole						3102	
	Mashed with fried onion						3102 (70%) 3730 (30%)	
	With tomato and onion						4420	
	Other							
Fish	Hake, fried with batter/crumbs						3072	
	Hake, fried in oil						3060	
	Hake, steamed						4373	
	Moddervis / Yellow fish fried in oil						3084	
	Moddervis / Yellow fish baked with onion (NO oil added)						3089	
	Other							
Other canned fish	Tuna in oil						3056	
	Other							
Fish cakes	Bought: Fried						3080	
	Home made with potato						3098	
Fish fingers	Bought						3081	
Eggs	Boiled/poached						2867	
	Scrambled (full cream milk & oil)						2890	
	Scrambled (NO milk, ONLY oil added)						2869	
	Scrambled (NO oil, ONLY full cream milk)						2872	
	Fried in oil						2869	
	Fried in brick margarine						2877	
	Other							

VEGETABLES

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Cabbage	**How do you cook cabbage?**							
	Boiled, nothing added						3756	
	Boiled with potato and onion and **oil**						3815	
	Boiled with potato and onion and **brick margarine**						3813	
	Fried in **oil**						3812	
	Fried in **brick margarine**						3810	
	Boiled with potato, onion and tomato and oil						4421	
	Raw with nothing added						3704	
	Other							
Spinach or morogo or beetroot leaves or other green leafy	**How do you cook spinach?**							
	Boiled, nothing added						3913	
	Boiled with **oil** added							
	Boiled with **brick margarine** added						3898	
	Boiled with **tub margarine** added						3899	
	Boiled with potato, onion and tomato and oil						4422	
	Other							
Tomato and onion gravy	With oil						4423	
	Without fat						3925	
	Canned						4192	
	Thickened with packet soup powder						4432	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Pumpkin (yellow) Butternut Hubbard squash Table Queen Etc	Boiled, nothing added						4164	
	Boiled with sugar only (NO fat)						3728	
	Boiled with **brick margarine** & sugar						3893	
	Boiled with **tub margarine** and sugar						4433	
	Boiled with **oil** and sugar						4428	
	Other							
Carrots	Boiled, nothing added						3757	
	Boiled with **oil** added							
	Boiled with **brick margarine** added						3816	
	Boiled with **tub margarine** added						3817	
	Boiled with **sugar** only						3818	
	Boiled with **oil** and sugar							
	Boiled with **brick margarine** and sugar						3819	
	Boiled with **tub margarine** and sugar						3820	
	Boiled with potato, onion and **oil**						3824	
	Boiled with potato, onion and **brick margarine**						3822	
	Boiled with potato, onion and **tub margarine**							
	Chakalaka						4412	
	Raw, nothing added						3709	
	Other							
Mealies/ Sweet corn	On cob – fat added **Fat**						3725	
	On cob – no fat added						3725	
	Creamed sweet corn / canned						3726	
	Whole kernel/canned						3942	
	Whole kernel, frozen, boiled						4132	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Beetroot	Salad						3699	
	Boiled, nothing added						3698	
How do you cook potatoes?								
Potatoes	Boiled/baked with skin						4155	
	Boiled/baked without skin						3737	
	Boiled with **oil** added						3873	
	Boiled with **brick margarine** added						3867	
	Boiled with **tub margarine** added						3868	
	Mashed with **whole milk** and **brick margarine**						3876	
	Mashed with **whole milk** and **oil**							
	Roasted in beef fat						3878	
	Roasted in oil						3979	
	French fries (chips) / Fried potatoes						3740	
	Other							
Sweet potatoes	**How do you cook sweet potatoes?**							
	Boiled/baked with skin						3748	
	Boiled/baked without skin						3903	
	Boiled with **sugar** and **oil** added						4434	
	Boiled with **sugar** and **brick margarine** added						3749	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Broccoli	Boiled						3701	
	Raw						3702	
Cauliflower	Boiled						3716	
Green beans	Boiled, nothing added						3696	
	Cooked with potato, onion and **oil**						3794	
	Cooked with potato, onion and **brick margarine**						3792	
	Other							
Mixed vegetables	Canned						4264	
	Frozen, boiled						3727	
	Other							
Salad vegetables	Mixed salad: tomato, lettuce and cucumber						3921	
	Raw tomato						3750	
	Cucumber, raw						4119	
	Coleslaw (cabbage) (mayonnaise)						3705	
	Coleslaw (cabbage) (commercial)						3707	
	Potato salad (mayonnaise)						3928	
	Baked bean salad						4424	
	Other salad vegetables							
Mayonnaise / salad dressing	Mayonnaise						3488	
	Vinegar, oil						3487	
	Other: Specify							
Other vegetables, specify + preparation								

Now we come to fruit

FRUIT

Do you like fruit? Yes 1 No 2

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Apples							3592	
Banana							3540	
Pears							3582	
Oranges							3560	
Naartjie							3558	
Grapes							3550	
Peaches	Fresh						3565	
	Canned						3567	
Apricots	Fresh						3534	
	Canned						3535	
Mangoes							3556	
Guavas	Fresh						3551	
	Canned						3553	
Watermelon	Fresh						3576	
Fruit salad	Fresh						3588	
	Canned						3580	
Fig (Vye)							3544	
Avocado							3656	
Wild fruit/berries	Specify type							

16

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Dried fruit	Apple, dried, raw						3600	
	Peach, dried, raw						3568	
	Mixed fruit, dried, raw						3593	
	Mixed fruit, dried and cooked with sugar						3590	
	Fruit roll, dried (all types)						3655	
	Other							
Other fruit	_____ _____							

If subject eats canned fruit: Do you have custard with the canned fruit or fresh fruit salad?

Yes 1 No 2

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Custard	Homemade, full cream milk or fresh cow's milk						2716	
	Homemade, lowfat milk						2779	
	Homemade, skim milk						2717	
	Commercial eg Ultramel						2716	
	Other							

BREAD AND BREAD SPREADS

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Bread / Bread rolls	White						3210	
	Brown						3211	
	Whole wheat						3212	
Do you spread anything on the bread?		Always 1	Sometimes 2	Never 3				
Margarine	What brand do you have at home now?							
	Tub, regular						3496	
	Tub, medium fat						4406	
	Tub, light/low fat						3524	
	Brick, regular						3484	
	Brick, medium fat						4405	
	Brick, lite/low fat						3528	
	Other							
Peanut butter							3485	
Jam/syrup/ honey							3985	
Marmite / Fray bentos / Oxo							4058	
Fish/meat paste							3109	
Cheese	Cheddar						2722	
	Gouda						2723	
	Other							
Sandwich spread							3522	
Achaar							3117	
Other spreads	Specify							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom /Never		
Dumpling	White flour						3210	
	Whole wheat flour						3212	
Vetkoek	White flour						3257	
	Whole wheat flour						3324	
Provita, crackers, etc	Provita						3235	
	Cream crackers						3230	
	Other savoury biscuits like Bacon kips, wheat crackers, etc						3331	

DRINKS								
FOOD	**DESCRIPTION**	**AMOUNT**	**TIMES EATEN** 2 columns to be completed				**CODE**	**AMOUNT / WEEK**
			Per day	**Per week**	**Per month**	**Seldom / Never**		
Tea	English (normal)						4038	
	Rooibos						4054	
Coffee							4037	
White sugar	Tea						3989	
	Coffee						3989	
Brown sugar	Tea						4005	
	Coffee						4005	
Milk per cup of TEA	**Do you use milk in your TEA?** Yes / No **If YES, What type of milk do you use in TEA?**							
	Fresh / long life whole/full cream						2718	
	Fresh/long life: 2%/low fat						2772	
	Fresh/long life: fat free / skim milk						2775	
	Creamer/whitener like Ellis Brown / Cremora						2751	
	Cremora **Lite**							
	Condensed milk						2714	
	Evaporated milk						2715	
	Other							
	None							
Milk per cup of COFFEE	**Do you use milk in your COFFEE?** Yes / No **If YES, What type of milk do you use in COFFEE?**							
	Fresh/long life: whole/full						2718	
	Fresh/long life: 2%/low fat						2772	
	Fresh/long life: fat free						2775	
	Creamer/whitener like Ellis Brown						2751	
	Cremora **Lite**							
	Condensed milk						2714	
	Evaporated milk						2715	
	Other							
	None							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Milk as such	**What type of milk do you drink milk as such?**							
	Fresh/long life: whole / full cream milk						2718	
	Fresh/long life: 2% milk / low fat milk						2772	
	Fresh/long life: fat free / skim milk						2775	
	Condensed milk						2714	
	Sour/maas						2787	
	Other							
Milk drinks	Flavoured milk						2774	
	Milo made with full cream milk						2735	
	Milo made with skim milk						2747	
	Drinking chocolate made with water						4287	
	Other							
Yoghurt	Drinking yoghurt low fat						2756	
	Plain low fat						2734	
	Low fat sweetened with fruit						2732	
Squash	Sweet O						4027	
	Six O							
	Oros/Lecol – with sugar or other						3982	
	- artificially sweetener						3990	
	KoolAid						4027	
	Other							
Fizzy drinks	Sweetened						3981	
Coke, fanta, etc	Diet							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Fruit juice	Fresh/Liquifruit/Ceres						2866	
	Tropica (Dairy –fruit juice mix)						2791	
	Other							
Mageu/Motogo							4056	
Home brew							4039	
Tlokwe							4039	
Beer							4031	
Cider	Sweet						4057	
Spirits Eg Brandy, gin, vodka, whisky, cane, etc							4035	
Wine red							4033	
Wine White							4033	
Other specify								
WATER	Tap, borehole, dam, river, etc						4042	
	Bottled						4042	

SNACKS AND SWEETS								
FOOD	**DESCRIPTION**	**AMOUNT**	**TIMES EATEN** 2 columns to be completed				**CODE**	**AMOUNT / WEEK**
			Per day	**Per week**	**Per month**	**Seldom / Never**		
Potato crisps							3417	
Peanuts	Raw						4285	
	Roasted						3458	
Cheese curls, Niknaks, etc							3267	
Raisins							3552	
Peanuts and raisins								
Chocolates	Milk chocolate, plain						3987	
	Kit Kat etc						4024	
	Chocolate coated bars like Bar One, TV bar, etc						3997	
	Other							
Candies/Sweets	Sugus, gums, hard sweets, etc						4000	
Toffees / Fudge / caramels							3991	
Biscuits/cookies	Potch cookies						4425	
	Homemade, plain						3233	
	Commercial, plain						3216	
	Commercial, with filling						3217	
	Other							
Cakes	Butter cake, homemade with **whole milk** and **brick margarine NO icing**						3288	
	Chocolate cake, homemade with **whole milk and brick margarine NO icing**						3289	
	Icing for cake made with **brick margarine**						4014	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Tarts	Apple tart with a batter made with whole milk and brick margarine						3327	
	Other							
Scones	Plain made with whole milk and brick margarine						3237	
	Other							
Muffin	Bran						3407	
	Plain						3408	
	Other							
Rusks	Buttermilk, commercial						3329	
	Homemade, white						3222	
	Other							
Savouries	Sausage rolls						2939	
	Samoosas: Meat filling						3355	
	Samoosas: Vegetable filling						3414	
	Biscuits eg bacon kips						3331	
	Other							

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Jelly							3983	
	Custard added made with whole milk						2716	
	Other							
Baked pudding	Baked in a syrup						3312	
	Baked without a syrup						3429	
	Custard added made with whole milk						2716	
	Other							
Instant pudding	Made with whole milk						3266	
	Made with low fat milk						3395	
	Other							
Ice cream	Regular						3483	
	Soft serve						3518	
	Other							
Sorbet							3491	
Other specify								

SAUCES, GRAVIES AND CONDIMENTS								
FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
Tomato sauce							3139	
Worcester sauce							4309	
Chutney							3168	
Pickles							3866	
White sauce	Made with whole milk and brick margarine						3142	
Packet soups	Dry powder (all types)						3158	
	Made with water (all types)						3165	
Gravy	Made from meat and thickened						3120	
Other								

WILD FRUITS, WILD BIRDS, ANIMALS OR INCECTS (hunted in rural areas or on farms)								
FOOD	DESCRIPTION	AMOUNT	TIMES EATEN 2 columns to be completed				CODE	AMOUNT / WEEK
			Per day	Per week	Per month	Seldom / Never		
MISCELLANEOUS: Please mention *ANY OTHER FOODS* used more than once/two times a week which we have NOT talked about								
INDIGENOUS/TRADITIONAL FOODS/PLANTS/ANIMALS Please tell me if you use any indigenous plants OR other indigenous foods like mopani worms, locusts ect to eat PLEASE GIVE FETAILS								

Addendum G: Information sheet for PURE participants

UNIVERSITY OF THE WESTERN CAPE

Private Bag X17, Bellville 7535, South Africa
Tel : +27 21- 959 2457, Fax : +27 21-959 3686
E-mail : nsolomons@uwc.ac.za

Information sheet

Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

Dear Participant

I am a student registered for a Doctoral degree at the University of the Western, and I would like to invite you to participate in my study. This study will help researchers identify the best manner in which to address the chronic non-communicable diseases (CNCDs) epidemic in South Africa.

What is this study about?

This research forms part of the Prospective Urban Rural Epidemiologic (PURE) study. The PURE study is a 15 year research study to understand the way in which environmental/societal factors influence the development of cardiovascular disease. The South African study is part of an international project being carried out in 15 countries. The research will be carried out in 2 urban sites and 2 rural sites in South Africa, involving 2,000 participants. The research will look at a number of factors to understand whether, and how, they influence the development of cardiovascular disease.

My study will focus on why persons do not participate in health programmes that are available in their community, and will also attempt to identify how community members would like health messages to be communicated to them.

Who can participate in this research?

All current PURE study participants

What will be expected from the participants?

Participants will be required to answer a questionnaire as well as participate in focus group discussions to obtain information regarding perceptions about health message dissemination and reasons for not wanting to participate in existing CNCD intervention programmes in Langa. All participants in the study will remain anonymous and all information will remain strictly confidential to the best of the researcher's ability. This means that your names will not be written on the questionnaire, only numbers will be used.

What are the risks of this research?

There are no risks associated with participating in this research project. You will not be harmed in any way.

What are the benefits of this research?

This research will not benefit you personally, however the findings of this research can be used to help prevent, treat and manage chronic non-communicable in South African people.

Can I withdraw from the study?

Your participation in this research is voluntary. You may choose to not take part at all. Should you decide to participate in this research, you may stop participating at any time without experiencing any repercussions. You may refuse to answer any questions and will not be cajoled to answer it.

Do you have any further questions?

More information may be obtained from Nasheetah Solomons (021) 959-2457.

If you would like to take part in this study, please read and sign the consent form.

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Dean of the Faculty of Community and Health Sciences

University of the Western Cape

Private Bag X17

Bellville 7535

This research has been approved by the University of the Western Cape's Senate research Committee and Ethics Committee.

Thank you very much.

Addendum H: Consent form for PURE participants

UNIVERSITY OF THE WESTERN CAPE
Private Bag X17, Bellville 7535, South Africa
Tel : +27 21- 959 2457, Fax : +27 21-959 3686
E-mail : nsolomons@uwc.ac.za

Subject ID

Centre ID

CONSENT FORM

I have been informed about the purpose and the nature of the study and I understand that all information will be confidential. I understand that taking part in this study is voluntary and that I can withdraw from participating in this study at anytime without giving any reasons and my doing so will have no negative repercussions. I also have the right to refuse answering questions when I feel uncomfortable.

Name of the participant: …….

Signature: …….. Date: …….

Interviewer: …….

Addendum I: Challenges to intervention programmes individual questionnaire

PURE **CODE** ☐☐☐

Community ID **Date:**

☐☐ ☐☐☐ ☐☐ ☐☐ ☐☐☐☐

Centre# Community

CHALLENGES TO INTERVENTION PROGRAMMES INDIVIDUAL QUESTIONNAIRE

CODE ☐☐☐

1. Are you happy with your weight? Y (1) ☐ N (2) ☐

2. Would you like to lose weight Y (1) ☐ N (2) ☐

a. If yes, why? (tick only 1 relevant box)

1.I want to be healthy	
2.My clothes are too tight	
3.My family and friends want me to lose weight	
4.My doctor told me to lose weight	
5.I am embarrassed by my weight	
6.I am diabetic	
7.I have high blood pressure	
8.I have heart disease	
9.I want to be a good example to my family	
10.Other, please specify	

b. If no, why not? (tick only 1 relevant box)

1.I do not need to lose weight	
2.I am healthy	
3.I am happy the way I am	
4.My weight will not cause me to get diseases	
5.Other, please specify	

1 2

3. Would you join a weight loss programme if it was offered in your community? Y ☐ N ☐

a. If yes, why? (tick only 1 relevant box)

1.It will encourage me to lose weight	
2.They will teach me how to lose weight	
3.I will not feel alone	
4.They can teach me how to cook food in a healthy way	
5.They can teach me what food and drinks to buy	
6.Other, please specify	

b. If no, why not? (tick only 1 relevant box)

1.It will not help me to lose weight	
2.I joined a group before and I did not lose any weight	
3.I do not eat the food they tell us to eat	
4.I cannot afford to buy the food they want us to eat	
5.The food they tell us to eat is not available at the shops here	
6.I am embarrassed	
7.Other , please specify	

4. What would you want from a weight loss program? (tick all that apply)

1.To be taught why I gain weight	
2.How to lose weight	
3.How to cook food to help me lose weight	
4.Recipes	
5.What food and drinks to buy	
6.Other, please specify	

5. The benefits of being a healthy weight are:

	Yes (1)	No (2)	Don't know (3)
1.It might help to prevent the development of high blood pressure			
2.It can help to control high blood pressure			
3.It might prevent the development of diabetes (sugar sickness)			
4.It can help to control blood glucose levels			
5.It might prevent the development of heart attacks			
6.It can help to control cholesterol levels			
7.It might help to prevent one from suffering a stroke			
8.It might help to prevent certain types of cancers			

1 2

6. Do you smoke? Yes ☐ No ☐

		1	2
7.	Would you like to stop smoking?	Y ☐	N ☐

a. If yes, why? (tick only 1 relevant box)

1.Smoking is expensive	
2.Smoking is bad for my health	
3.My family wants me to stop	
4.My doctor told me to stop	
5.Other, please specify	

b. If no, why not? (tick only 1 relevant box)

1.I enjoy smoking	
2.Smoking makes me happy	
3.Smoking is good for me	
4.Smoking does not make me ill	
5.Other, please specify	

1 2

8. Have you tried to stop smoking before? Yes ☐ ☐

a. If yes, why did you not succeed? (tick only 1 relevant box)

1.It was too difficult	
2.I had no support	
3.It made me gain weight	
4.Everyone I socialise with smokes	
5.Other, specify	

1 2

9. Would you join a group to help you to stop smoking? Yes ☐ No ☐

a. If yes why? (tick only 1 relevant box)

1.There will be support	
2.I will not feel like I am the only one trying to stop smoking	
3.Other, please specify	

b. If no, why not? (tick only 1 relevant box)

1.I am not interested in support groups	
2.I am to embarrassed	
3.It will not help me to stop smoking	
4.Other, please specify	

c. What would you want/expect from a “stop smoking” program to ensure you stop smoking?

_____
_____
_____
_____
_____
_____
_____

10. The benefits of not smoking are:

	Yes (1)	No (2)	Don’t know (3)
It might prevent the development of lung disease			
It might prevent the development of certain types of cancers			
It might prevent the development of high blood pressure			
It will help to control high blood pressure			
It might prevent one from suffering a stroke or heart attack			
It might prevent the development of diabetes			

11. Are you aware if any of following programs/clubs is available in your community?

	Yes (1)	No (2)	Don’t know (3)
Weight loss			
Exercise			
Stop smoking			
Stop drinking alcohol			
Diabetes			
Heart disease			
High blood pressure			
Other, please specify			

12. Would you join an exercise/ diabetic/ high blood pressure, heart disease programme if it was offered in your community?

	1	2
	Y ☐	N ☐

a. If yes, why? (tick only 1 relevant box)

1.It will help me to understand what is wrong with me	
2.It will teach me how to control my condition	
3.I will not feel I am the only one with problem	
4.An exercise program will help me to control my condition	
5.It will help to share my problems/worries with others	
6.Other, please specify	

b. If no, why not? (tick only 1 relevant box)

1.It will not help me to understand my condition	
2.It is not acceptable to share my problems with others	
3.I do not like to exercise	
4.Other , please specify	

13. What would make you decide to join/ attend any of the above-mentioned programmes should it be offered in your community? (Tick all relevant boxes)

	Yes (1)	No (2)
It is socially acceptable to me		
It respects my cultural beliefs		
It will help me with my health problem		
It is offered by someone who lives in the community		
It is close to my house		
It is safe to go there		
If the time during which these programmes are offered is suitable		
Other, please specify		

14. Do you do any of the following? (Tick the relevant box for each option)

	Never (1)	1-2 days a week (2)	3-4 times per week (3)	5-7 days a week (4)
1. Do some form physical activity for at least 30 minutes, which leaves you slightly out of breath?				
2. Do any type of physical activity that leaves you slightly out of breath that adds up to 30 minutes during the normal course of your day? (for example: walk at a moderately fast pace for at least 10 minutes three times a day as part of your usual daily activities?)				
3. Participate in sport for 30 minutes?				
4. Participate in sport for 60 minutes?				
5. Participate in exercise for 30 minutes?				
6. Participate in exercise for 60 minutes?				

15. How do you want to receive health messages? (Tick the relevant box for each option)

		Yes (1)	No (2)
1.	I prefer that my doctor explain health messages to me.		
2.	I prefer that the nurse at the clinic explain health messages to me.		
3.	I prefer to read a poster.		
4.	I prefer to read a pamphlet.		
5.	I prefer to watch a video which discusses health messages.		
6.	I prefer that a friend explain health messages to me.		
7.	I prefer a poster/pamphlet with colourful illustrations.		
8.	I prefer health messages to be spread in my home language.		

THANK YOU FOR YOUR TIME

Addendum J: Information sheet for Department of Health officials

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INFORMATION SHEET: Department of Health

Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

BACKGROUND INFORMATION

The PURE study is a worldwide study which is aimed at identifying social and environmental factors which contribute to the increased risk of individuals and population as a whole, developing the four major chronic non-communicable diseases (CNCDs) (cardiovascular diseases, cancer, diabetes and chronic respiratory diseases). The PURE study aims to use data gathered to develop an intervention programme which will address all risk factors which contribute to the development of non-communicable diseases in on a social, individual and community level.

In South Africa, the University of the Western Cape's School of Public Health has committed itself to gathering data for the PURE Study in Langa and Mount Frere. As part of the PURE study the researcher would like to determine what barriers exist to the successful implementation of intervention programmes aimed at addressing non-communicable diseases in the two study sites.

PURPOSE OF THIS STUDY

In order to implement effective, cost-effective and sustainable CNCDs, the researcher would like to ascertain:

1. Whether there are any existing policies in place to address the problem of increasing chronic non-communicable diseases.
2. How often these policies are evaluated and reviewed.
3. What the challenges are regarding the implementation of these policies.
4. To explore options to address the CNCDs epidemic

EXPECTATIONS FROM YOU

Should you agree to participate, I will set up an appointment to interview you at a time that is convenient for you. I will interview you according to a structured questionnaire that will take approximately 30 minutes to complete. The questionnaire will include questions about existing policies for chronic non-communicable diseases, their implementation, revision and monitoring, as well as challenges with regard to implementing these policies.

I will also require you to participate in an interview using the multicriteria mapping method, where best options top address the CNCDs epidemic will be explored. This interview will take approximately two hours will be audio-taped. I will provide you with a list of options prior to the interview date, so that you can **choose at least four options** which will be assessed for performance by you during the MCM method interview.

Your participation in the study is completely voluntary. You will not be harmed in any way whilst participating in this study. You can freely refuse to answer any particular questions and will not be cajoled to answer them if you do so. You can freely withdraw at any stage without the need for an explanation.

INFORMED CONSENT

You will be required to sign an informed consent form prior to being interviewed.

CONFIDENTIALITY AND ANONYMITY

Your identity will be kept anonymous, and confidentiality will be maintained to the best of the researcher's ability.

QUERIES

Should you have any questions or need more information regarding this study, my contact details are:

Nasheetah Solomons
Telephone (office hours): 021-959 2457
This research has been approved by the University of the Western Cape's Senate Research Committee and Ethics Committee.

THANK YOU!

Addendum K: Consent form DoH

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CONSENT FORM (Department of Health, CHC)

I am a Doctorate student who as part of the Prospective Urban Rural Epidemiology (PURE) study would like to establish:

- What policies are currently available to address the four major non-communicable diseases (NCDs) (cardiovascular diseases, diabetes, cancer and chronic respiratory diseases) epidemic in South Africa, specifically in Langa in the Western Cape Province and Mount Frere, in Eastern Cape Province.
- What intervention programmes are currently being implemented in the Western Cape and Eastern Cape Provinces which is targeted at the four major non-communicable diseases.
- How frequently these intervention programmes are being monitored and evaluated.
- What the challenges are regarding the implementation of these policies.
- To explore options to address the CNCDs epidemic

All information will be treated confidentially and anonymity will be maintained to the best of the researcher's ability. In order for me to obtain the above-mentioned information, I would like to schedule an interview with you.

I _____ hereby grant permission to be interviewed for the above-mentioned study. I fully understand what will be expected of me. I agree to be audio-taped during my participation in the study and I understand that I can withdraw from the study, at any time.

Signed: _____ on the _____ day of _____20___.

Witness: _____ Date: _____

Addendum L: Department of Health information package for MCM interview

ADDITIONAL INFORMATION REGARDINGTHE MULTICRITERIA MAPPING PROCESS

Thank you for taking the time to consider participating in my research project. The Interview will make use of the multicriteria mapping (MCM) process, which is a four-step process as described below:

1. Develop a set of 'options' (see below)

These distinguish a number of alternative ways to achieve a particular aim. Although some options may be specified for the purposes of comparison, participants are also free to define their own options in any way they choose.

2. Characterise a range of 'criteria'

These represent any issues that are seen to be relevant in appraising the options. They can reflect aspects that can be 'traded off' against each other. They can also reflect issues of principle, which cannot be traded off. Each participant is free to include whatever criteria and define these as they wish.

3. 'Score' each option under each criterion

These numbers address the relatively technical business of assessing options under criteria. The scale is flexible, allowing easy reflection of different datasets. The higher the score, the better the performance. Crucially, MCM allows specification of minimum and maximum scores, so key uncertainties can be taken into account.

4. Assign a 'weight' to each criterion

These reflect different ways of prioritising criteria, depending on the context or viewpoint. The higher the weight, the higher the priority. Assigning weights takes into account the relative importance of the difference between best and worst performance under individual criteria.



One end product of these four steps is the calculation of an overall **'rank'**, expressing - for the viewpoint in question - the relative performance of each option under all the criteria taken together. Here, MCM follows the well-established **linear additive weighting** procedure, in which the rank simply represents the weighted sum of normalized scores. Participants are free to cycle through the four steps as much as necessary, to arrive at a final picture with which they are satisfied

MULTICRITERIA MAPPING (MCM) INTERVIEW OPTIONS González-Zapata, et al. 2008

OPTIONS: Best way to address the CNCDs epidemic in SA

Core options	Discretionary options
1. Legislation and regulation for CNCDs (policies) 2. Control of food and drink advertisements 3. Control of food sales at public institutions and places 4. Compulsory food labelling 5. Fatty food tax ("sin tax") and healthy food subsidies 6. Cheaper prices of healthy foods 7. Improving intersectoral partnerships 8. Community participation	1. Improved health education of citizens 2. Improve training of health professionals in CNCDs 3. Integrated health service delivery 4. Skill-shifting among health professionals 5. Improve health information systems 6. Improve school curriculum: include more health and nutrition education 7. Improve workplace health initiatives 8. Compulsory free annual medical check-up 9. Increase use of sugar and fat substitutes 10. Growing healthier foods, such as genetically-modified (GM) foods 11. Control marketing terminology on food labels (such as "lite") 12. Healthier restaurant menus 13. Nutrient analysis of catering menus to show energy, sugar, salt and fat content

Option clusters

Cluster 1: CNCDs prevention and management oriented

- Legislation and regulation for CNCDs

Cluster 2: Food supply control

- Control of food sales at public institutions and places
- Fatty food tax ("sin tax") and healthy food subsidies
- Cheaper prices of healthy foods
- Healthier restaurant menus

Cluster 3: Food information

- Control of food and drink advertisements
- Compulsory food labelling
- Control marketing terminology on food labels (such as "lite")
- Food analysis of catering menus

Cluster 4: Educational

- Improved health education of citizens
- Improve training of health professionals in CNCDs.
- Improve school curriculum: include more health and nutrition education

Cluster 5: Health care reform

- Integrated health service delivery
- Skill-shifting among health professionals
- Improve health information systems

Cluster 6: Innovative preventive initiatives

- Improve workplace health initiatives
- Compulsory free annual medical check-up

Cluster 7: Technological advances

- Increase use of sugar and fat substitutes

- Growing healthier foods such as genetically-modified (GM) foods

Cluster 8: Partnerships and collaboration

- Improving intersectoral partnerships.
- Community participation

Description of options

1. Legislation and regulation for CNCDs (policies).

The development and implementation of policies to address tobacco use (existing) and alcohol use could aid in decreasing the use of alcohol and tobacco products. The development and implementation of environmental planning policies will aid in the improvement of community facilities so that it is safe and conducive to physical activity. Policies to control the composition of processed foods in terms of fat (type and amount), salt content and kilocalories will aid in the control of overweight and obesity as well as other CNCDs.

2. Control of food and drink advertisements

This will entail the banning of food advertisements aired during children programmes as well as in cinemas. This will also include the banning of advertisements of tobacco products, alcohol and unhealthy foodstuff aimed at adults on television, billboards, and magazines and in cinemas.

3. Control of food sales at public institutions and places.

This entails controlling food and drink items sold at schools, colleges, technikons and universities. Young children are easily influenced, so only offering healthy food choices at school tuck shops for example, could lay the foundation for them to continue making healthy food choices into adulthood.

4. Compulsory food labelling

Compulsory food labelling would aid in the public making better food choices. The food labels should be easy to understand and standardised for all products, so that consumers can easily make better food choices.

5. Fatty food tax ("sin tax") and healthy food subsidies

Taxing food manufacturing companies for the production of food items which contain fat and salt above the recommended levels, could encourage these companies to reformulate their recipes and thus influence consumers' intake. On the other hand, the simultaneous decrease in healthy food prices (by means of subsidies) could encourage the purchasing of these healthier food items.

6. Cheaper prices of healthy foods

Providing healthier foods at lower prices would encourage citizens to purchase these food items. This could be done by subsidising healthier food options.

7. Improving intersectoral partnerships

Joining forces with other government departments, the food industry, community associations and non-governmental organisations (NGOs) could aid in the pooling of resources and thus result in a holistic approach to tackling the CNCDs epidemic.

8. Community participation

The community members know what their needs are. In order for an intervention to be successful, it must address the community's self-identified needs.

9. Improved health education of citizens

Citizens will be provided with more information and a better understanding of CNCDs, including their risk factors, prevention and management, and in this way they will be aided in decreasing their risk for developing CNCDs. Teaching them how to make healthier food choices (teaching them how to read food labels) would play a role in combating CNCDs.

10. Improve training of health professionals in CNCDs.

Providing health professionals with the skills and knowledge to identify, counsel and care for persons with CNCDs could aid in reversing the CNCDs epidemic.

11. Integrated health service delivery

Integrating services where individuals who are for example HIV-positive, and who is also suffering from a CNCD would result in this person getting the necessary care for both conditions in one place at the same time.

12. Skill-shifting among health professionals

Training more assistant health professionals (e.g. nursing assistants) and community health workers to assist with the care of individuals with CNCDs could play a role in alleviating the workload of existing health professionals and also address the current health human resource problems.

13. Improve health information systems

Improved health information systems will aid in identifying and monitoring individuals at risk of, or diagnosed with CNCDs. In this way better care can be provided to these individuals and aid in decreasing the CNCDs epidemic.

14. Improve school curriculum: include more health and nutrition education

Including health and nutrition education in the school curriculum will equip young children to make better food choices and will lay the foundation for their future health.

15. Improve workplace health initiatives

By providing incentives to their workforce, companies can encourage their employees to maintain better health. This may include the provision of health education workshops, annual health checks, or even installing a gym at the workplace, and the work cafeteria only providing healthy foods.

16. Compulsory free annual medical check-up

Making it compulsory for all individuals regardless of age, to go for an annual medical check-up could aid in identifying individuals at risk of, or who suffers from CNCDs as well as provide the opportunity to impart information on the prevention of CNCDs.

17. Increase use of sugar and fat substitutes

Companies are developing new products regularly. The use of sugar and fat substitutes could assist individuals with their weight control.

18. Growing healthier foods, such as genetically-modified (GM) foods

Agriculture could find ways in which to produce healthier foods for the general public.

19. Control marketing terminology on food labels (such as “lite”)

Policies can control what items fulfil the criteria to be labelled “lite”, etcetera. In this way the consumer is assured that he/she is making better food choices without being misled.

20. Healthier restaurant menus

Restaurants can be provided with incentives to reformulate their recipes so that they can offer healthier food to their patrons.

21. Nutrient analysis of catering menus to show energy, sugar, salt and fat content

All public eating places are to provide their patrons with nutritional information of all food items prepared on the premises. This will aid patrons to order the healthier food items.

Addendum M: DOH questionnaire

PURE **CODE** | | | |

Date:

| | | | | | | | |

DEPARTMENT OF HEALTH QUESTIONNAIRE

1. Do you have policies in place to address the growing problem of CNCDs (Chronic non-communicable disease) (Cardiovascular Diseases [CVD], Diabetes type 2 [DM], Cancer and chronic respiratory disease)?

	Brief description of policy/ attach a copy	Yes (1)	No (2)
CVD			
DM			
Cancer			
Chronic respiratory disease			

2. When were these policies developed and implemented? (indicate the month and year)

	Developed	Implemented
CVD		
DM		
Cancer		
Chronic respiratory disease		

3. How often are these policies reviewed?

	Twice a year (1)	Annually (2)	Never been reviewed (3)	Other (please indicate) (4)
CVD				
DM				
Cancer				
Chronic respiratory disease				

4. What do you perceive to be the major problems/obstacles pertaining to addressing the CNCDs epidemic in South Africa?

Government level:

_____

_____

_____

Municipal level:

_____

_____

_____

_____

_____

_____

Community level:

_____

_____

_____

_____

_____

_____

5. What do you think would be the best way to address the CNCDs epidemic?

_____

_____

_____

_____

_____

6. Who do you think should all be involved in addressing the CNCDs epidemic in South Africa?

_____

_____

_____

_____

THANK YOU FOR YOUR TIME AND INPUT.

Addendum N: Focus group confidentiality binding form

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FOCUS GROUP CONFIDENTIALITY BINDING FORM

Title of Research Project: Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way. I understand that I may refuse to answer particular question and that I will not be cajoled to answer. I agree to be audio-taped during my participation in the study. I also agree not to disclose any information that was discussed during the group discussion.

Participant's name……..

Participant's signature……..

Witness's name……..

Witness's signature……..

Date……

Addendum O: Focus group discussion Guide

Focus group discussion guide: Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans

Introduction

Good Morning, I am Nasheetah and this is Kholiswa who will be helping me today. Thank you for coming on this cold and rainy morning.

Purpose of the focus group discussion

We have asked you to participate in this discussion because as PURE study participants your participation will be valuable in helping us to try to find the best way to help you to improve your health. You are the ones who can best provide us with information regarding the strengths and weaknesses of current health intervention programmes. We hope to use the information you provide us with to address shortcomings of current health intervention programmes. During this discussion, we learn from you – we are gathering information. Please remember there is no right or wrong answers!

Consent Process

- The information you give us is completely confidential, and we will not link your name with anything you say during the discussion.
- We would like to record the discussion, so that we can make sure to capture the thoughts, opinions and ideas we hear from the group. No names will be attached to the group and the recordings will be deleted as soon as they are transcribed.
- You may refuse to answer any question or withdraw from the study at any time.
- We understand that confidentiality is important and that this information is kept private and confidential. We thus ask that you respect each other's confidentiality.
- Please complete the consent sheet which shows you agree to participate in this discussion as well as your willingness to be tape recorded.

GROUND RULES

- Everyone must please participate
- One person speaks at a time – please do not interrupt anyone
- Please do not have side conversations
- Turn off your cellphone, if possible

These rules were written on a flip chart

I will be ensuring that we have a productive discussion. I will be asking the questions and moving us along so that we can discuss all the key questions. Should the discussion get side-tracked or I feel we are spending too much time on one point; I will step in to keep the discussion moving. Kholiswa will be helping me to take notes, in case I miss anything. She will also translate for me should you have a problem with language.

Let's begin by introducing ourselves to each other.

Ice breaker: "Tell us your name and which animal you think you are most like and why."

QUESTIONS

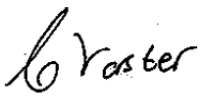
Questions and transcript	Themes
1. If a health programme or club is started in your area would you be willing to participate in/joining it?	
2. Health messages are everywhere in magazines, posters, pamphlets and even on radio, what are the reasons for not following/implementing health messages?	
3. Why do you not follow health advice?	
4. If you were to come to/join a health group/ programme if it was to be offered in your area, what would you want from a health program/group? In other words what would make you go to the group meetings regularly?	
5. Are you happy with how you are currently receiving your health messages?	
6. What can be done to assist you to follow the health messages?	
7. **Do you know if there is a health group in your area?**	
8. Where would you want to receive your health messages?	
9. Who do you want to receive your health messages from?	

Addendum P: Language editing certificate: Clarina Vorster

DECLARATION

I, C Vorster (ID: 710924 0034 084), Language editor and Translator and member of the South African Translators' Institute (SATI member number 1003172), herewith declare that I did the language and technical editing of a thesis written by Ms N Solomons from the North-West University (student number 20683006).

Title of the thesis: Challenges with implementation of nutrition interventions aimed at non-communicable diseases among black urban South Africans



16 November 2017

C Vorster | Date

CHAPTER 4: MANUSCRIPT 1

Association between dietary adherence, anthropometric measurements and blood pressure in an urban lack population, South Africa

Association between dietary adherence, anthropometric measurements and blood pressure in an urban Black population, South Africa

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4.1 ABSTRACT

Objectives: To determine participants' dietary adherence by calculating a diet adherence score based on the Dietary Approaches to Stop Hypertension (DASH)-style diet; (2) to determine if there was an association between dietary adherence score, anthropometric measurements (waist circumference, body mass index (BMI), waist-hip ratio, waist-to-height-ratio) and blood pressure (BP) in a South African urban black population.

Design: Secondary analysis of cross-sectional data collected for the PURE study.

Setting: Langa, the urban PURE Study site in the Western Cape Province, South Africa

Subjects: PURE study Western Cape urban cohort, 454 participants, aged 32-81 years.

Outcome measures: Dietary adherence scores were calculated and the BP and anthropometric measurements, respectively, of participants in the lowest and highest tertiles of dietary adherence scores were compared.

Results: Positive correlations were found between age, for both men and women and systolic and diastolic BP. A significant positive correlation between added sugar intake and systolic blood pressure (SBP) was only present in the women. A significant positive correlation was found between BMI, diastolic BP and SBP in men only. No significant differences existed between BP of men or women in the lowest and top tertile groups according to dietary adherence score, but a significant inverse correlation between the dietary adherence score and

SBP was found in women.

Conclusions: BMI was positively correlated with BP in men, while dietary adherence score was negatively correlated with SBP in women.

Strong message: Non-adherence to dietary guidelines presenting overconsumption of unhealthy foods may be associated with high blood pressure.

Keywords: dietary adherence, blood pressure, body mass index

4.2 Introduction

Chronic non-communicable diseases (CNCDs) which include cardiovascular disease, type 2 diabetes, certain cancers and respiratory diseases will be responsible for 69% of all global deaths by 2030 with greatest increases in low-income and middle-income countries.[1,2] Risk factors for CNCDs include alcohol and tobacco use, as well as an increased energy intake coupled with a decrease in physical activity.[1]

Guidelines such as the Dietary Approaches to Stop Hypertension (DASH) diet, Mediterranean diet and Dietary Guidelines for Americans have been proven to decrease risk for CNCDs when adhered to.[2,3] The South African Food-Based Dietary Guidelines (SAFBDG) were developed and first published in 2001 in an attempt to address malnutrition and diet-related diseases.[4] These guidelines, specifically developed for the South African population, were recently revised to include the latest scientific evidence and to address feedback received from users to reduce the risk of guidelines being misinterpreted.[5]

Over the years, researchers have developed and used various indices such as the Healthy Eating Index (HEI), Alternate Healthy Eating Index (AHEI), the Mediterranean-style pattern (MedDietScore), alternate Mediterranean score (aMed) and the DASH score to measure dietary guideline adherence in subjects.[6] Compliance with food-based dietary guidelines, Mediterranean and a DASH-style diet has also been shown to have a blood pressure lowering effect.[7, 8] Participants who had lower BP, WC and BMI tended to have higher dietary adherence scores.[8]

Various anthropometric measures, such as body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHtR) and waist-hip ratio (WHR) are used to identify persons at risk for CNCDs.[9] The World Health Organisation (WHO) proposed cut-off points to categorise adults according to underweight, normal weight and obese categories.[9] Waist circumference, WHtR and WHR are used to determine central obesity, a known risk factor for CNCDs.[10,11] International recommendations propose two WC cut-off values, namely >88cm and >102cm for substantially increased risk, for Sub-Saharan Africa women and men respectively.[10,12] A WHtR <0.5 has been

associated with minimal risk for CNCDs,[11] while a WHR measurements ≥ 0.85 in women and 0.90 in men are indicative of central obesity.[10]

The purpose of this study was two-fold, namely (1) to determine participants' adherence to dietary guidelines by calculating a dietary adherence score using an adapted version of the methodology developed by Fung and colleagues[2] and (2) to determine if there was an association between dietary adherence, anthropometric measurements (WC, BMI, WHtR, WHR) and blood pressure in a South African urban dwelling black population.

4.3 Methods

Study population and sampling

Secondary analysis of cross-sectional data collected for the Prospective Urban and Rural Epidemiological (PURE) study was performed. The PURE study aimed to recruit approximately 150,000 participants aged between 35 and 70 years living in more than 600 communities in 17 low-, middle-, and high-income countries around the world. The participating countries' selection was based on representativeness of different socioeconomic status (SES). The study sites included were based on commitment of investigators to collecting good quality data over the planned 10-year period.[13] The University of the Western Cape's (UWC) School of Public Health (SoPH) collected data in Langa (urban community) in the Western Cape Province and a rural community in the Eastern Cape Province. Data obtained for 1000 males and female participants recruited from the urban community site were available for this study. Dietary data was obtained for 968 participants by means of a quantified food frequency questionnaire. Physical activity data was available for 1023 participants and anthropometric measurements were available for 454 participants. Complete data was available for 454 participants which equates to a 45% response rate. Three development areas in Langa mirror the socioeconomic status (SES) of residents. A street map obtained from the City of Cape Town was used to select streets randomly in each of the three areas. Every second household was then approached for possible inclusion in the study.

Data collection

Data was collected during 2010. Demographic and smoking data were obtained by means of the PURE adult questionnaire during face-to-face interviews.[13] Trained fieldworkers also took participants' physical measurements (weight, height, waist and hip circumference and blood pressure). Weight was measured to the nearest 0.1kg, with subjects wearing minimal clothing, using a digital scale (UC-321 Precision scale, A&D Instruments, Oxford, UK). Height was measured using a stadiometer (3PHTROD, Detecto, Webb City, MO USA) with the participant standing with normal posture and barefoot. Measurements were read to the nearest 0.1cm with the subjects' head in Frankfort plane. Body mass index was calculated by taking the weight (kg) and dividing it by the height (m) squared and presented by BMI category.[14] Waist circumference was measured over minimal clothing at the narrowest part of the body between the ribcage and iliac crest to the nearest 0.1cm using a non-stretchable measuring tape (Dean, Cloth & Notions, London, UK).[14] Hip circumference was measured over minimal clothing at the widest part of the body over the buttocks, with the same measuring tape. Two readings for all anthropometric measurements were taken and the mean calculated.[14] Waist-hip-ratio and WHtR were calculated. Blood pressure was measured on the left arm with the participant sitting relaxed, with the arm at heart level using a digital blood pressure monitor (Omron, Kyoto, Japan).[12]

Trained fieldworkers conducted the interviews with the participants and completed the validated quantified food frequency questionnaires.[15] Participants estimated portion sizes by using a food-portion photograph book and other suitable tools (MRC Dietary Assessment and Education Kit [DAEK]). Portion sizes were converted to weights using standard tables[16] and nutrient and food intakes were calculated by using the South African food-composition database.[17] Food items were then divided into subgroups, namely dairy, fish, legumes, nuts and seeds, fruits and vegetables, fats and fibre. The dietary data was analysed using the MRC Foodfinder III software. A dietary adherence score was calculated based on nutrient and food group intakes as described under data analysis.[2]

Ethics approval

Ethical approval for the Western Cape PURE study was obtained from the Research and Higher Degrees committee from the University of the Western Cape (project number 13/3/5). Informed, written consent was obtained from each participant.

Data analysis

Due to the low response rate (45%), the age, QFFQ data and physical activity data from the available 454 participants were compared with the same data of those of whom physical measurements were not taken, to determine bias introduced by missing data. Data analysis indicated no significant differences in the participants' characteristics (age, gender, education level, and smoking status) between the study sample included for this paper and the rest of the cohort which was excluded due to missing data. Most data deviated from the normal distribution. Therefore, medians and interquartile range were calculated for continuous demographic, anthropometric, dietary and blood pressure data of men and women. Percentage and frequencies were calculated for categorical data.

Dietary adherence scores were calculated by dividing food intakes into quintiles. Intakes of foods (dairy, fish, legumes, nuts and seeds, and fruit and vegetables), fats (MUFA, PUFA, saturated fats) and fibre as recommended by the SAFBG[5] and DASH guidelines[2] were scored as follows: Q1 was allocated 1 point and quintile 5 equalled 5 points[2]. Thus participants who had intakes that fell into lowest quintile had the lowest intakes of the recommended foods. Total fat, saturated fat, meat, added sugar, alcohol and sodium were categorised as foods that need to be consumed in limited amount and was assigned a reverse score so that participants in Q1for these foods were assigned 5 points and those in Q5 were assigned 1 point. A maximum score of 65 points could thus be attained if participants consumed the identified foods as per the recommendations. Food group scores were then summed to calculate an overall score for each participant. A lower score indicated poorer dietary adherence. In addition those whose adherence scores were in the first

tertile group were classified as non-adherent. Those whose adherence scores was in the third tertile were classified as being adherent to the dietary guidelines. In addition those whose adherence scores were in the first tertile group were classified as non-adherent. Those whose adherent scores were in the third tertile were classified as being adherent to the dietary guidelines.

Spearman correlations were calculated between continuous variables (dietary intake variables, anthropometric variables and BP) for men and women. Differences between anthropometric variables and BP of men and women were determined using the Mann-Whitney test. The Kruskal-Wallis test was used to compare the same variables across the three tertile groups of dietary adherence score. The presence of associations between dietary adherence vs non-adherence and BMI (overweight/obese [BMI≥25kg/m^2] vs normal weight [BMI<25kg/m^2]),[14] WHtR (≤0.5 and > 0.5)[11], WHR (≤0.85 and ≥0.85 for females and ≤0.90 and ≥ 0.90 for males)[10] and WC (<102 and ≥102cm for males, <88cm and ≥ 88cm for females)[10] were determined by means of chi square tests.

Participants were classified as normotensive if their SBP was <140mmHg and their DBP was <90mmHg.[12] They were classified as hypertensive if their SBP was ≥140mmHg or DBP was ≥90mmHg, or if they were taking antihypertensive drugs.[12]

Logistic regression and odds ratios were used to determine associations between BP as the dependent variable (hypertensive vs. normotensive) and diet adherence score, age, smoking and physical activity as covariates. Data analysis was done using the Statistical Package for Social Studies (SPSS) version 23 (SPSS Inc., Chicago, IL, USA).

4.4 Results

Demographic characteristics

Table 4.1 depicts the demographic profile of the participants. Approximately 67% (n=306) of the participants had obtained secondary and six percent (n=19) obtained a tertiary education. The majority (n=338; 74%) of the participants were unemployed. Almost 22% (n=69) of the women and 20% (n=22) of the men currently used alcohol. More than half (53%, n=237) were moderately active.

Table 4.1: Sociodemographic, BMI and lifestyle profile of participants

Variable	Women n (%)	Men n (%)	Total n (%)	P*
Gender	341 (75.1%)	113 (25.2%)	454	
Median age and interquartile range (years)	50.00 (45.2-57.5)	52 (41.5-58.0)		0.38
Marital status				<0.0001
• Never married	184 (54)	45 (39.8)	229 (50.44)	
• Currently married	94 (27.6)	43 (31.1)	137 (30.18)	
• Common law/living with partner	10 (2.9)	8 (7.1)	18 (3.96)	
• Widowed	35 (10.3)	6 (5.3)	41 (9.03)	
• Separated	8 (2.3)	7 (6.2)	15 (3.3)	
• Divorced	9 (2.6)	2 (1.80	11 (2.4)	
• Missing	1(0.3)	2 (1.8)	3 (0.7)	
Education level				0.19
• No school education	8 (2.3)	5 (4.4)	13 (2.86)	
• Primary school	81 (23.8)	30 (26.5)	111 (24.4)	
• High school/secondary school	238 (69.8)	68 (60.2)	306 (67.4)	
• Trade school	1 (0.3)	2 (1.8)	3 (0.7)	
• College/university	12 (3.5)	7 (6.2)	19 (6.4)	
• Unknown	1 (0.3)	1 (0.9)	2 (0.4)	
Employment				0.96
• Currently Employed	59 (18.4)	20 (17.7)	79 (17.4)	
• Unemployed	253 (79.1)	85 (75.2)	338 (74.4)	
• Retired	8 (2.5)	8 (7.1)	36 (7.9	
• Missing			38 (8.4)	

Table 4.1: Sociodemographic, BMI and lifestyle profile of participants continued				
Type of Employment				0.43
• Legislators, senior officials and managers	0	1 (0.9)	1 (0.2)	
• Professionals	4 (1.2)	2 (1.8)	6 (1.3)	
• Technicians and associate professionals	3 (0.9)	1 (0.9)	4 (0.9)	
• Clerks	4 (1.2)	3 (2.7)	7 (1.5)	
• Service, shop and market sales workers	11 (3.4)	1 (0.9)	12 (2.6)	
• Craft and related trade workers	4 (1.2)	3 (2.7)	7 (1.5)	
• Plant and machine operators and assemblers	2 (0.6)	2 (1.8)	4 (0.9)	
• Elementary occupations	21 (6.6)	9 (8.3)	30 (6.6)	
• Armed forces	4 (1.2)	1 (0.9)	5 (1.1)	
• Homemaker	266 (83.4)	85 (78.7)	351 (77.3)	
• Missing			27 (5.9)	
Alcohol use history				0.03
• Formerly used alcohol products	6 (1.93)	8 (7.4)	14 (3.1)	
• Currently use alcohol products	69 (22.2)	22 (20.4)	91 (20.0)	
• Never used alcohol products	235 (75.8)	78 (72.2)	313 (68.9)	
• Missing			36 (7.9)	
Tobacco use history				0.90
• Formerly used tobacco products	7 (2.2)	3 (2.8)	10 (2.2)	
• Currently use tobacco products	62 (20.0)	20 (18.5)	82 (10.1)	
• Never used tobacco products	241 (77.7)	85 (78.7)	326 (71.8)	
• Missing			36 (7.9)	
Physical activity				0.40
• Low	59 (17.3)	18 (15.9)	77 (16.9)	
• Moderate	183 (53.7)	54 (47.8)	237 (52.2)	
• High	60 (17.6)	25 (22.1)	85 (18.7)	
• Missing			55 (12.1)	
Hypertension treatment				0.39
• No	162 (48.5)	52 (46.4)	214 (47.1)	
• Yes	172 (51.5)	60 (53.1)	232 (51.1)	
• Missing			8 (1.8)	

Data are number (%) or median (interquartile range)

**Difference between men andwomen by chi square test for categorical variables and Mann-Whitney test for age*

Anthropometric measurements, dietary intakes and blood pressure of participants

The women had a significantly higher median weight, WC and BMI measurements than the men. A significant difference in WHR (p=0.0001) and in DBP (p=0.013) between the two groups was also found. The median dietary intakes from the different food groups were very similar for the men and women (Table 4.2).

Most (85.6%; n=292) of the women were classified as overweight/obese in comparison to 45% (n=51) of the men (Table 4.2.). Almost 52% (n=172) of the women and 53% (n=60) of the men were classified as hypertensive (Table 4.1).

Table 4.2: Anthropometric measurements, blood pressure and mean dietary intakes of study population

	Women			Men			P#
	Median	**25th**	**75th**	**Median**	**25th**	**75th**	
Weight (kg)	84.0	69.5	100.0	70.0	59.0	84.0	<0.0001
Height (cm)	157.0	153.00	161.0	169.0	163.0	174.0	<0.0001
Body mass index (kg/m^2)	34.2	28.2	40.2	24.3	20.7	30.5	<0.0001
Waist circumference (cm)	100	89	110	86	79	100.5	<0.0001
Waist-hip ratio (WHR)	0.86	0.79	0.91	0.88	0.83	0.94	<0.001
Waist-height ratio (WHtR)	0.63	0.57	0.70	0.52	0.47	0.60	<0.0001
SBP (mmHg)	137.0	122.5	151.0	137.0	120.0	153.5	0.744
DBP (mmHg)	89.0	80.0	97.0	85.0	76.0	94.5	0.013
Dietary variable		**Women**			**Men**		
	Median	**25th**	**75th**	**Median**	**25th**	**75th**	**P#**
Energy intake (kJ)	6416.6	4719.4	8018.9	5932.5	4410.4	8108.1	NS
%total energy (protein)	15.1	13.3	16.8	15.0	13.2	16.8	NS
%total energy (fat)	27.0	21.8	31.6	26.6	21.0	31.5	NS
%total energy (satfat)	7.4	5.8	9.3	7.6	5.7	9.3	NS
%total energy MUFA	6.4	5.1	8.7	6.9	5.1	9.3	NS
%total energy PUFA	6.6	4.9	8.1	7	4.6	8.0	NS
%total energy (CHO)	54.1	48.8	60.3	52.9	49.8	60.9	NS
%total energy (added sugar)	8.4	5.6	12.2	8.3	5.6	13.4	NS
Total fibre intake (g)	19.4	14.6	23.7	18.8	13.5	23.5	NS
Diet score	41	37	44	42	36	46	NS

 # Comparison of variables of men and women by Mann-Whitney test
MUFA: monounsaturated fat PUFA: polyunsaturated fat Satfat: saturated fat CHO: carbojydrates

The dietary adherence scores assigned to the different food categories are depicted in Table 4.3. After the component score was computed the study sample had a total dietary adherence score which ranged from 21-58 out of a possible maximum of 65. The upper cut-point for the lower tertile group defined as non-adherent was a score of 31. Those whose adherence score was in the third tertile were classified as being adherent to the dietary guidelines, with a lower cut-point score of 40.

Significant differences between sodium (p=0.001), alcohol (p=0.006), total energy (p=0.01), saturated fat (p=0.001), and MUFA intakes (p=0.005) were present between tertile 1 and tertile 3 of the dietary adherence score groups. There were no differences in protein, fibre and carbohydrate intakes between tertile 1 and tertile 3 of the dietary adherence score groups. No significant differences were present between tertile groups for anthropometric measurements and blood pressure (Table 4.4).

Table 4.3: Scoring criteria for dietary recommendations and intake for quintiles 1 to 5

	Q1 (1 point)		Q2 (2 points)		Q3 (3 points)		Q4 (4 points)		Q5 (5 points)		DASH or SAFBDG Recommendation per day
	Median	Range	Median	Range	Median	Range	Median	Range	Median	Range	
MUFA (%TE)	4.36	2.97-4.89	5.30	4.93-5.76	6.41	5.78-7.20	8.31	7.2-9.28	11.8	9.3-12.1	10-12% of total energy
PUFA (%TE)	3.39	1.22-3.67	4.65	3.67-5.33	6.18	5.36-6.93	7.53	6.94-8.10	8.92	8.09-10.4	6 to <10% of total energy
Fibre (g)	10.6	2.12-13.7	15.4	13.7-17.7	19.5	17.8-21.5	23.4	21.6-26.0	28.9	26.0-47.2	20-35g
Dairy (g)	0	0-12.6	35.3	12.6-51.4	71.4	51.4-90	105.6	90-135.7	179.2	139-468	400-500ml per day
Fish (g)	0	0-0	0	0-6	12	6-16	21.8	16.4-30	44.3	30-120	30g per day (2-3 portions (80-90g per week)
Legumes, nuts & seeds (g)	0	0-0	0	0-0	2	0-8	20	8.33-35.7	60	35.7-252	100-200g per week (4-5 servings per week)
Fruit & vegetables (g)	103.9	0-160.3	213	161-260	298.5	261-336.7	390.1	337-452.8	560.4	458.7-886.3	400g
REVERSE SCORE											
	Q1 (5 points)		**Q2 (4 points)**		**Q3 (3 points)**		**Q4 (2 points)**		**Q5 (1 point)**		SAFBDG Recommendation per day
	Median	Range	Median	Range	Median	Range	Median	Range	Median	Range	
Total fat (%TE)	17.9	6.7-19.5	20.0	19.7-20.1	22.9	20.2-28.2	30.7	28.8-32.4	35.4	32.5-45.3	20-30%of total energy
Satfat (%TE)	4.52	1.08-5.29	6.21	5.34-6.83	7.39	6.85-7.94	8.81	7.95-9.69	11.0	9.72-15.0	7-10% of total energy
Meat (g)	21.6	0-41	55.0	41-67.6	81.0	67.8-98	115.4	98.7-140	182.8	140.5-569.8	80-90g per day
Added sugar (%TE)	3.04	0-4.55	5.79	4.57-6.8	7.97	6.81-9.30	10.7	9.33-12.8	17.0	12.9-33.7	≤10% of total energy
Alcohol (g)	0	0-0	0	0-0	0	0-0	14.9	0-60	142.9	61.2-33.7	≤24g (F) & ≤45g (M)
Sodium (mg)	2467.3	597.2-2941.7	3288.9	2982.3-3496.7	3650.4	3497.4-3776.3	3999.8	3784.6-4268.8	4652.3	4269.4-5966.6	<2300mg

MUFA: Mono-unsaturated fatty acids

PUFA: Poly-unsaturated fatty acids

TE: total energy

Satfat: Saturated fat

Table 4.4: Dietary intake and physical measurements according to tertiles of dietary adherence score

	Tertile 1 (n=151)			Tertile 3 (n=152)			*P-value
	Median	25th	75th	Median	25th	75th	
Dietary score	28	26	29	44	42	45	<0.0001
Total energy (kJ)	6944	5343	8181	5560	4436	7361	0.001
Protein (%TE)	15.3	13.2	17.3	15.6	14.1	17.2	0.496
Carbohydrates (%TE)	57.4	52.4	64.1	51.2	47.1	55.2	0.228
Fibre (g)	15.3	12.0	19.8	20.0	14.3	23.8	0.81
Sugar (%TE)	10.6	7.5	16.4	6.9	4.9	9.7	0.189
Fruit and vegetables (g)	32.8	0	77.9	383.3	312.4	494.8	<0.0001
Legumes (g)	0	0	14.3	15.2	2.1	36.2	<0.0001
Meat and meat products (g)	109	72.9	159.8	56.5	31	98.9	<0.0001
Fish and fish products (g)	0	0	14.3	19.6	8.7	35.9	<0.0001
Eggs (g)	0	0	22.1	51.4	26	71.4	<0.0001
Dairy products (g)	32.8	0	77.9	102.1	65.6	160	<0.0001
Alcohol (g)	189.1	115.3	291.9	0	0	11	0.006
Total fat (%TE)	27.0	21.8	31.6	26.1	21.0	30.8	0.28
Saturated fat (%TE)	7.92	6.38	10.24	7.6	5.7	9.3	0.001
MUFA (%TE)	5.90	5.02	7.68	5.3	4.5	6.9	0.005
PUFA (%TE)	5.1	3.5	6.98	7.7	6.5	9	0.079
Sodium (mg)	3842	3533	4362	3721	2658	3655	<0.001
Age (years)	52	42	60	48.5	40	54	0.771
Weight (kg)	82	65.2	100.7	83.5	66.5	101	0.262
BMI (kg/m^2)	31.9	25.9	39.2	31.4	25.3	39.0	0.187
WC (cm)	97	86	107	97	85.3	110	0.567
WHR	0.86	0.79	0.93	0.86	0.80	0.91	0.121
WHtR	0.61	0.53	0.68	0.61	0.53	0.69	0.186
SBP (mmHg)	138	124	155	133.5	120	146.8	0.560
DBP (mmHg)	89	80	98	86.5	78	93	0.413

*p-value compare first and third tertile group (Mann-Whitney U test)

MUFA: Mono-unsaturated fatty acids PUFA: Poly-unsaturated fatty acids BMI: Body mass index
WC: Waist circumference WHR: Waist-hip ratio WHtR: Waist-height ratio SBP: Systolic blood pressure
DBP: Diastolic blood pressure

A significant positive correlation was found between age and both DBP and SBP, in both men (0.422 and 0.312 respectively) and women (0.399 and 0.160, respectively). Significant negative correlations were found between dietary adherence score (r=-0.108), sodium intake (r=-0.124) and total energy intake (r=-0.11) and SBP in women only. A significant positive correlation was found between MUFA intake (r=0.154) and added sugar (r=0.116), respectively and SBP for

women only. Significant positive correlations were observed between WC, WHR and WHtR and both SBP and DBP in the men, as well as with DBP in the women (Table 4.5).

Logistic regression and odds ratios were used to determine associations between BP as the dependent variable (hypertensive vs. non-hypertensive) and dietary adherence score with age, current smoking, current alcohol use and physical activity as covariates. In the logistic regression model, only age was significantly associated with being hypertensive. Those with the highest level of physical activity tended to have lower odds of being hypertensive (OR = 0.49, 95% CI, 0.22 – 1.07, p=0.07). Dietary adherence score was not significantly associated with being hypertensive (OR=0.97, 95% CI, 0.91-1.04, p=0.38, Table 4.6).

Table 4.5: Correlation of anthropometric parameters and dietary intake with blood pressure

	Women		Men	
	SBP	**DBP**	**SBP**	**DBP**
Age	0.399**	0.160**	0.422**	0.312**
Total energy (kJ)	-0.11**	-0.075	-0.102	-0.115
%TE protein	0.023	-0.06	0.026	-0.025
%TE fat	-0.083	-0.61	0.088	0.012
% TE Saturated fat	-0.071	-0.059	0.083	0.022
% TE MUFA	0.154**	0.075	0.102	0.115
% TE PUFA	-0.106	-0.07	-0.049	-0.118
%TE Carbohydrate	0.048	0.066	-0.031	0.048
% TE Added sugar	0.116*	0.089	0.005	0.079
Total fibre intake	-0.107	-0.029	-0.156	-0.173
Sodium intake	-0.124*	-0.074	-0.053	-0.018
Dietary adherence score	-0.108*	-0.029	-0.065	-0.107
Tertile rank of dietary adherence score	-0.093	-0.070	-0.057	-0.069
Physical activity	-0.100	-0.85	-0.084	-0.134
Weight	0.009	0.079	0.210*	0.221*
Body mass index	0.037	0.085	0.219*	0.225*
Waist circumference	0.058	0.122*	0.340**	0.335**
Waist-hip ratio	0.077	0.126*	0.327**	0.234*
Waist-to-height ratio	0.089	0.151**	0.330**	0.313**

****Significant at 0.01 level (2-tailed test)** ***Significant at 0.05 level (2-tailed test)**

%TE: percentage of total energy %TE MUFA: percentage of total energy from monounsaturated fatty acids %TE PUFA: percentage of total energy from polyunsaturated fatty acids

Table 4.6: Variables associated with hypertension in the logistic regression model*

Variable	Odds ratio (OR)	95% confidence intervals (CI)		p
Constant	0.21			0.22
Age	1.06	1.03	1.09	<0.0001
Dietary adherence score	0.97	0.91	1.04	0.38
Physical activity: Inactive	 Reference			
Moderately active	0.95	0.50	1.81	0.88
Highest activity	0.49	0.22	1.07	0.07

*Model with best fit, Hosmer and Lemeshow test, p=0.826

4.5 Discussion

The main aim of this study was to assess whether diet quality as depicted by a dietary adherence score based on a combination of the DASH diet[2] and the SAFBDG[5] and anthropometric measurements was associated with blood pressure in an urban black population.

There was no significant difference in the distribution of the diet adherence scores between the men and women (Table 4.2.).

Participants with lowest adherence scores had significantly lower intakes of dairy products, fruit and vegetables, legumes and fish, and higher intakes of meat and meat products and sodium in comparison to those in the highest diet adherence group. Intakes of total fat, SFA, MUFA and PUFA did not differ significantly between the lowest and highest adherence groups.

A significant inverse association between the dietary adherence score and SBP in women was found. Studies support our finding that a low dietary adherence score (indicating an unhealthier dietary intake) was associated with higher blood pressure.[8]

Although sodium intake could not be quantified accurately in this study, participants categorised in the lowest tertile of dietary adherence scores had significantly higher sodium and saturated fat intakes than those in the top tertile of dietary adherence score. A high sodium intake has been

associated with hypertension, a risk factor for cardiovascular disease.[18] Consequently a public health call by various health professionals and organisations for reducing salt consumption has been made.[18] This advisory for reduced salt intake is supported by the findings of a systematic review by Lala and colleagues[19] which concluded that even though they could not find a dose response link, a decrease in salt intake resulted in lower systolic and diastolic blood pressure.[19] Another unexpected finding was a weak, but significant negative correlation between sodium intake and SBP in the women. However, since we did not assess 24-hour urinary sodium excretion or added salt intakes, we did not have an accurate measure of dietary sodium intakes and cannot draw conclusions from this negative correlation.[25]

Saturated fat intake has been linked to SBP and DBP.[20] The DASH diet guidelines, recommend a low saturated fat intake, which has been proven to reduce BP in a systematic review and meta-analysis.[21] Low intakes of polyunsaturated fatty acids (PUFA) have been associated with elevated blood pressure levels.[22] In our study even though the majority of participants had PUFA intakes below the SAFBDG recommendation of 6-10% of total energy, no association between intake of PUFA and SBP and DBP was found. In a recent study oily fish consumption of up to 5 servings per week resulted in a sustained decrease in SBP. This led the authors to conclude that the current recommendation for fish intake might be insufficient; they also found intakes of ≥6 servings per week did not have any additional benefits.[23] In the current study a positive correlation was observed between MUFA intake and SBP in the women's group. This finding is difficult to explain and different from the study of Rasmussen and colleagues[24], who found that an increase in MUFA intake and a decrease in saturated fat intake resulted in a decrease in DBP. Furthermore, they also found that the beneficial effect of MUFA was lost in the presence of a total fat intake >37%.[24]

In our study added sugar intake was positively correlated with SBP in the women. It has been suggested that an excessive intake of added sugar can result in increased blood pressure.[26] In addition an increased risk of stroke mortality has been associated with high carbohydrate intakes and high glycaemic index (GI) diets.[26] These findings resulted in recommendation from the American Heart Associations (AHA) of a reduction in added sugar and high GI carbohydrates

consumption.[26] The role of diet (high salt, high fat, low fibre, low fruit and vegetables intake) in the development of hypertension is well-documented.[2, 22, 27] This has led to a variety of dietary patterns such as the Mediterranean diet and DASH diet being developed in an attempt to prevent and treat hypertension.[5, 28] Adherence to food based-dietary guidelines and diets in general is affected by many factors including globalisation, cultural beliefs, acceptability of recommended foods, socio-economic status and level of education.[29] The indications of low adherence to dietary guidelines found in this study could be due to the fact that the majority of the participants were unemployed and of low SES which influences food purchasing behaviour.[30] Healthier food options are also perceived as being more costly in comparison to the less healthy options and often affordable healthier food options are not readily available in the community.[29] Lack of adherence to guidelines presents as overconsumption of unhealthy food leading to poor health outcomes. Adherence to guidelines has been shown to be effective in promoting general health reducing all-cause mortality.[7, 21, 29]

Significant differences were observed between the gender groups in terms of their DBP and most anthropometric measurements. In this study WC, WHR and WHtR measurement was positively correlated with SBP and DBP in men and with DBP in women. In their study, Sharaye and colleagues[29] found significant associations between WHtR and SBP and DBP in both men and women, and with WC and SBP in men only.[31]

Fifty-one percent of the study sample was classified as being hypertensive (BP ≥140/90mmHg). These findings corroborate a statement issued by the Heart and Stroke Foundation of South Africa (HSFSA) of a high prevalence of hypertension in South Africa.[27] The risk factors for the development of hypertension include obesity, especially central obesity, low levels of physical activity, a diet that is high in calories, fat, salt and refined carbohydrates, and low in fibre and fruit and vegetables, excessive alcohol use and tobacco use.[28]

In this study measures of abdominal obesity were positively correlated with SBP and DBP in men and with DBP in women. We used a WC cut-off value of 88cm and 102cm for females and males respectively, indicating substantially increased risk.[10,12] Recent studies in black South African

populations have shown that the International Diabetes Federation (IDF) recommendations of WC cut-off values for abdominal obesity of ≥80cm and ≥94cm for females and males respectively, overestimates prevalence of metabolic syndrome in Black populations.[32] Almost 85% of our study sample had a WC above the IDF cut-off values for women and men, 64% had WHR values above sex-specific cut-points and 48% had WHtR above the cut-off value of 0.5.

Seventy-six percent (n=343) of the study sample was classified as overweight/obese (BMI ≥25 kg/m^2). The link between hypertension and BMI has been established including in a recent four-country cross-sectional study which investigated the burden of hypertension in sub-Saharan Africa.[33] Recently it has been suggested that WHtR is superior to BMI as an indicator of obesity and cardiometabolic risk.[11] Sugasri and colleagues found that as WHR, BMI, waist and hip circumference, and WHtR increased, the level of hypertension increased in their study participants. [28] Bombelli and colleagues found that an increase in both BMI and WC indices was associated with increases in SBP and DBP.[34]

Black South African females associate being overweight with self-esteem, contentment, good health and wealth and consider obesity acceptable and desirable.[35] This perception presents a major challenge since it influences willingness to lose weight and possibly adherence to dietary guidelines. Healthier food options are also perceived as being more expensive in comparison to the less healthy options and often affordable healthier food options are not readily available in the community.[29] Langa, the community where this study was conducted has a high unemployment rate.[37] Only 17% of the study sample were employed which influenced the type of foods being purchased for consumption.

According to the SANHANES-1 report, the Western Cape Province has the highest prevalence of smoking in South Africa.[34] Approximately 10% of the participants smoked in this study. Men were more likely than women to be current smokers. Smoking has been positively linked with increased blood pressure.[25]

Current recommendations for PA is moderate-intensity physical activity of 30 minutes daily which is equivalent to an energy expenditure of 3-6 metabolic equivalents (METs).[37] In the current study 52% of the participants reported that they were moderately active and approximately 19% reported having high levels of PA. Self-reported physical activity is considered not to be very accurate compared to direct physical activity measurement,[38] although the IPAQ questionnaire used in this study is considered to be a reliable instrument to test self-reported PA.[39] Physical activity has been associated with lower blood pressure.[40]

A number of reasons could explain the lack of association between dietary adherence score, adiposity variables and blood pressure in the present study. Dietary adherence score was based on quintiles of the participants' actual self-reported intakes. This is not the ideal situation to assess the best adherence to the dietary guidelines. Therefore, even those with the highest scores could probably not be described as "adherent" to dietary guidelines. It is difficult to determine adherence, because adherence measures depend on self-report. We used a validated QFFQ and fieldworkers were trained on how to complete the QFFQ and determine portions sizes consumed with the highest accuracy possible in this setting. Self-reported intakes were then compared with dietary guidelines, modelled on methods proposed by Fung and colleagues.[2] Despite these carefully planned methods, it is still possible that participants with the highest adherence scores would not necessarily be the most adherent to dietary guidelines. Furthermore, a large proportion of the participants were on antihypertensive drugs, however, no information regarding their adherence to drug treatment was available. Non-adherence to antihypertensive drugs could have a more profound effect on their BP than adherence to a diet in line with the DASH guidelines. Obesity develops over time, thus recent adherence to dietary guidelines may not necessarily be associated with a more optimal body composition.

4.6 Limitations

The following limitations need to be considered. The high percentage of participants with missing values for physical measurements and the small number of male respondents might have influenced the results. The dietary adherence score was based on self-reported dietary intakes, which is considered to be relatively inaccurate. As the budget of this study was insufficient to

include biochemical measurements, we were unable to determine the levels of blood glucose or lipids. Finally, as this was a cross-sectional study no causal relationship can be inferred between any of the factors and hypertension.

4.7 Conclusion

This study revealed that even though the anthropometric measurements (BMI, WC, WHR and WHtR) of participants in the different adherence score tertile groups, BMI was positively associated with BP in men only. A significant negative correlation between the dietary adherence score and SBP was found in women.

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4.9 Conflict of Interest

The authors declare that there is no conflict of interest.

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CHAPTER 5: MANUSCRIPT 2

Adherence challenges encountered in an intervention programme to combat chronic non-communicable diseases in an urban black community, Cape Town

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Full Length Article

Adherence challenges encountered in an intervention programme to combat chronic non-communicable diseases in an urban black community, Cape Town

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ABSTRACT

Background: Chronic non-communicable diseases (CNCD) have become the greatest contributor to the mortality rate worldwide. Despite attempts by Governments and various non-governmental organisations to prevent and control the epidemic with various intervention strategies, the number of people suffering from CNCD is increasing at an alarming rate in South Africa and worldwide.

Objectives: Study's objectives were to explore perceived challenges with implementation of, and adherence to health messages disseminated as part of a CNCD intervention programme; to gain an understanding of participants' expectations of CNCD intervention programmes;, and to explore the acceptability and preference of health message dissemination methods. In addition, participants' awareness of, and willingness to participate in CNCDs intervention programmes in their community was explored.

Methods: Participants were recruited from the existing urban Prospective Urban Rural Epidemiology study site in Langa, Cape Town. Focus group discussions were conducted with 47 participants using a question guide. Summative content analysis was used to analyse the data.

Results: Four themes emerged from the data analysis: practical aspects of implementation and adherence to intervention programmes; participants' expectations of intervention programmes; aspects influencing participants' acceptance of interventions; and their preferences for health message dissemination. The results of this study will be used to inform CNCDs intervention programmes.

Conclusions: Our findings revealed that although participants found current methods of health message dissemination in CNCDs intervention acceptable, they faced real challenges with implementing and adhering to CNCDs to these messages.

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1. Introduction

Chronic non-communicable diseases (CNCD) – diseases that are non-transmissible and non-infectious – have been proven conclusively to be the main causes of adult morbidity and mortality, worldwide (Oli, Vaidya, & Thapa, 2013; Whiteside, 2014). These diseases include diabetes, cardiovascular diseases, certain cancers and chronic respiratory diseases (Ezzati & Riboli, 2012; Herrera-Cuenca, Castro, Mangia, & Correa, 2014; Li, 2013). Currently, CNCD are responsible for more than 50% of the global disease burden, with an estimated 80% of associated deaths (Hunter & Reddy, 2013; Isaacs et al., 2014; Levitt, Steyn, Dave, & Bradshaw, 2011; Rossier, Souri, Duthe, & Findley, 2014).

The rapid increase of CNCD in low- and middle-income countries is well documented. South Africa, however, is also experiencing this trend yet it is classified as an upper-middle-income country by the World Bank (2015) income classification (Alwan & MacLean, 2009; Teo, Chow, Vaz, Rangarajan, & Yusuf, 2009). According to Dalal et al. (2011), CNCD will be responsible for 46% of deaths in sub-Saharan Africa, with higher age-standardised death rates in four of these countries (DRC, Ethiopia, Nigeria and South Africa) compared to those in high-income countries.

Chronic non-communicable diseases which are attributable to modifiable risk factors including overweight, smoking, physical inactivity, high-fat energy-dense diets and alcohol use, hold serious consequences for national economic, socio-economic and developmental growth. Because of their chronicity, these diseases place an increased demand on the healthcare sector, with an increasing number of persons requiring specialised care. In addition, the fact that many of those affected by CNCD are of working-age, affects the country's economic growth through productivity losses and prolonged disability (Ezzati & Riboli, 2012; Muka et al., 2015).

The findings of the recent South African National Health and Nutrition Examination Survey (SANHANES-1) indicates that the South Africans surveyed, who had self-reported histories of CNCD, matched the CNCD profile – they were overweight or obese, consumed a high fat and refined carbohydrate diet, consumed excessive amounts of alcohol, smoked tobacco and were physically less active. The rates of self-reported history of CNCD were also the highest in formal urban areas (Shisana et al., 2013).

In 2006, the National Department of Health in South Africa developed national guidelines for the management and control of non-communicable diseases, comparable to international standards (Department of Health, 2006; Mayosi et al., 2009). However, these guidelines were not effectively implemented – they were not circulated widely enough, while the management of chronic diseases was not monitored, or reviewed (Mayosi et al., 2009). In addition, the efficacy of a number of community-based CNCD interventions that exist in South Africa is also unknown.

At a national Summit on Non-Communicable Diseases, organised by the South African Ministry of Health in September 2011, targets aimed at reducing CNCD in South Africa by the year 2020 were set (Mayosi et al., 2012). Despite the existence of various CNCD intervention strategies, implemented by government, or non-governmental organisations, to address the CNCD epidemic, the number of people becoming afflicted by CNCD is increasing (Mayosi et al., 2012).

Evidence in the literature reveals the success of interventions, such as weight control, dietary intake modification, increased physical activity and decreased use of, or cessation of the use of, alcohol and tobacco products, in combatting the development and management of CNCD (Drozek et al., 2014; Gortmaker et al., 2011; Merrill, Aldana, Greenlaw, Salberg, & Englert, 2008). However, many adults still struggle to implement and adhere to healthy lifestyle behaviours (Murray et al., 2013).

The present study is embedded in the ongoing Prospective Urban Rural Epidemiological (PURE) study of the Western Cape cohort. The PURE study is a global longitudinal study involving 25 high-, low-, and middle-income countries seeking to identify the population level factors that drive the development of known risk factors for CNCD in adults (Teo et al., 2009). Langa, the site of the Western Cape urban cohort is a suburb near the city of Cape Town, with an estimated population of 25,987 of which 99% is black African. This community has an unemployment rate of 40% while 72% of the household has an average monthly income of R3 200 (Census, 2011).

1.1. *Research problem statement and objectives*

The increase in CNCD in South Africa has been attributed to the country being in a "nutrition transition" which is characterised by a diet high in saturated fat, sugar and refined foods, together with decreased levels of physical activity (Lategan, van den Berg, & Walsh, 2014). The South African Government and non-governmental organisations are all striving to curb the spread of the CNCD epidemic by developing intervention programmes and creating awareness of these conditions. Information on how to prevent the development of CNCD is being disseminated by means of posters, pamphlets and various media [radio, television] (Puoane, Tsolekile, Sanders, & Parker, 2008).

Despite these various attempts, statistics indicate that the prevalence of CNCD is continuing to increase (Statistics South Africa, 2014). Possible reasons for this may be socio-cultural, environmental (space), language barriers, modes of health message dissemination or lack of knowledge (Ebrahim, de Villiers, & Ahmed, 2014; Ganiyu, Mabuza, Malete, Govender, & Ogunbanjo, 2013). Context-based challenges to the implementation of and adherence to CNCD intervention programmes' health messages, awareness of community-based CNCD intervention programmes and the acceptability of these health messages have not been explored in South African black populations.

The objectives of this study, therefore, were to explore perceived challenges with implementation of and adherence to health messages disseminated as part of a CNCD intervention programme; to gain an understanding of participants' expectations of CNCD intervention programmes, and explore the acceptability and preference of health message dissemination methods in CNCD intervention programmes. Additionally, participants' awareness of existing CNCD intervention programmes in their community and their

willingness to participate in these intervention programmes were also investigated. Results from this study will be presented at conferences and will serve to raise awareness for the need of health messages which are tailored to meet communities' context-based challenges.

2. Method and materials

2.1. Study design and context

This was a cross-sectional study which made use qualitative data collection methods. The focus group discussion (FGD) method was chosen for data collection, since this method encourages participants to express their personal views freely when conducted by a trained facilitator. In addition, a FGD is an efficient technique used for gaining a large amount of data regarding opinions and attitudes in the shortest amount of time (Masadeh, 2012).

This study was conducted in Langa. In the post-apartheid years Langa experienced a rapid population growth as a result of migration of people chiefly from the rural Eastern Cape (Census, 2011). The role of urbanisation and its consequent nutrition transition in the CNCD epidemic is well-documented and since Langa is considered to be a community in transition it was considered an ideal site for the study (Lategan et al., 2014).

2.2. Recruitment of study population

Participants were purposively sampled from the ongoing PURE study. Inclusion criteria were being a male or female Langa resident, aged 35–70 years. A research assistant (RA) approached potential participants during the PURE study follow-up interviews that were conducted in 2015 for possible participation in the study. During the recruitment phase (1–30 April 2015) the RA explained the purpose of the study as well as what would be expected from them during the FGDs. At this stage confidentiality was explained and the potential participants were also made aware of their right to decline to participate in the study at any time.

2.3. Data collection

Discussions were conducted over a period of three months (May–July 2015) at the community hall in Langa. This location was chosen, first, because it was easily accessible to the participants and, second, to ensure that the sessions would not be interrupted because of noise.

The Research team consisted of the principal researcher (PR) and a bilingual (English/isiXhosa) RA, who acted as an observer and recorded the verbal and non-verbal responses of the participants. The focus group sessions were conducted primarily in English, with some questions being asked in isiXhosa by the bilingual RA, when required.

At the start of each focus group session the PR, once again, explained the purpose of the focus group, confidentiality and the right to leave at any stage during the study. To ensure free and open discussion the PR also pointed out that there were no right or wrong answers. Thereafter, those who agreed to participate were requested to sign consent and group-binding confidentiality forms. The RA was also required to sign the group-binding confidentiality form at the start of each FGD session.

Four focus groups included ten (10) persons each, while the fifth group started out with eight (8) participants. However, 10 min into the discussion, one participant asked to be excused, leaving this fifth group with seven (7) persons. The PR developed a focus group guide to ensure consistency across all groups (Krueger, 2002). The questions included in the focus group guide are presented in Table 1.

Each session, which lasted between 45 min and 1 h, was audiotaped. The FGDs continued until data saturation was reached, and this was judged to have been reached after five sessions that included a total of 47 participants. At completion of each FGD session the PR and RA met for debriefing to compare and collate notes taken by the RA, consequently developing additional field notes (Krueger, 2002). Each participant received an amount of R20.00 for transport as compensation.

Ethical approval for the Western Cape PURE and this study was obtained from the Research and Higher Degrees committee of the University of the Western Cape (project number 13/3/5). Informed, written consent was obtained from each participant. Confidentiality and anonymity was maintained

Table 1 – Focus group discussion guide.

Ice breaker
Tell us your name and which animal you think you are most like, and why
Introductory question
If a health programme, or club, is started in your area, would you be willing to join it, and why?
Key questions
Health messages are everywhere in magazines, posters, pamphlets and even on radio, what are the reasons for not following/implementing health messages?
Why do you not follow health advice/messages?
If you were to join a health group in your area, what would you want from the health group/programme? In other words, what would make you go to group meetings regularly?
What are the different ways through which you currently receive your health messages, and what are your feelings about the messages?
What can be done to assist you to follow the health messages?
What health clubs/groups are available in your area?
Where would you want to receive your health messages?
Who do you want to receive your health messages from?

by using participant numbers, instead of participant names on all study material.

2.4. *Trustworthiness*

After completion of each FDG, the summary of the discussions was read to the participants to ensure the researcher had an accurate account and understanding of their views. The transcripts were reviewed by two trained research assistants who compared the transcripts with the respective audiotaped recordings to ensure accuracy in the translations. The field notes also assisted in augmenting the accuracy of the transcripts. The PR and the study supervisor (SS) independently reviewed the transcripts, data analysis process and the emerging themes. This was done to reduce the possibility of bias and to obtain additional insights into themes and interpretations. Once the PR and SS reached an agreement on the final codes and themes, these were reviewed by the study's co-supervisor to ensure that there were no inconsistencies between the PR and SS.

2.5. *Data analysis*

The data were transcribed verbatim and translated into English, where required. The data were analysed using the summative content analysis approach. Atlas ti software [ATLAS. ti 7 for Windows, Berlin, Germany] was used to facilitate the coding and organisation of themes for analysis (Krueger & Casey, 2000). The PR and SS independently read the transcripts and identified codes based on keywords and recurrent issues that emerged from the data. Then the PR and SS discussed any differences until consensus was reached on the codes. In total, 80 codes were identified. The codes were grouped into nine categories, and finally into four themes.

3. Results

The FGD participants ranged in age from 35 to 70 years, and were grouped according to their age and gender, to encourage free discussion. The groups predominantly comprised women. The four major themes identified were: practical aspects of implementation and adherence to intervention programmes; participants' expectations of intervention programmes; aspects influencing participants' acceptance of interventions; and participants' preferences for health message dissemination (Table 2).

3.1. *Practical aspects of implementation and adherence to intervention programmes*

3.1.1. *Challenges*

Healthy food was perceived to be expensive and since majority of the participants were unemployed, they lacked the financial means to purchase the recommended food and beverages:

> *Okay sisi... the problem is, it is because there is poverty in other houses, one cannot eat a special diet ...when there is a pot that is cooked, one cannot have another pot aside...as Black people we eat as a family.*

> *We are poor...many people in the house...all must eat...* [it is] *not right* [that] *only some eat and others don't have to eat... healthy food is expensive.*

Access to facilities where intervention programmes were being offered was limited, and personal safety was threatened:

> *Clinic is far and you have to walk over a field in the dark...* [one can] *get robbed and even raped ...here are more hospitals whereby* [so] *they can come closer; we talk about the distance...*

Peer pressure and the lifestyle modifications were considered to be too difficult:

> *It is difficult to do those things... stop smoking, drinking...*

> *You decide on your own if you want to stop smoking and drinking, you do not need a club for that...*

> *If you don't drink or smoke with your friends, then they will not let you join them*

A lack of education, food preferences and preferences by family members guided food intake:

> *You cannot read how are you going to see it?*

> *We are not used to the taste of whole-wheat breads and cottage cheese*

> *We like the junk foods... fatty food is mos* [indeed] *nice*

> *I sometimes cook with oil and water but then my family* [sic] *don't eat*

3.1.2. *Personal feelings*

Participants had a negative attitude towards making lifestyle changes, and questioned whether health messages were really beneficial to their health:

> *No, it's because we like to disagree to what the doctor says.* (This remark was made when participants were asked for their reasons for not following health messages imparted by doctors).

> *I was saying, if a person cannot follow those pamphlets s/he wants to experience what is going to happen if s/he eats what s/he is advised not to eat, understand?*

> *You get... you've got too much fruit and veggies at home... instead of eating that* [those] *fruit and veggies where does it* [sic] *go?... in the bin because you cannot see veggies and fruit as something that is nutritious* (This remark was made when participants were asked why do not follow health messages specifically related to food intake).

Table 2 – Identified themes, categories and subcategories (codes).

Themes	Categories	Subcategories (codes)
Practical aspects of implementation and adherence to intervention programmes	Challenges	• Access • Financial constraints • Time constraints • Lack of knowledge • Family preferences • Social belonging • Food preferences • Crime • Awareness of programmes • Food cost • Peer pressure • Literacy level
	(Personal)Feelings	• Entitlement • Helplessness • Hopelessness • Negative attitude toward health • Own responsibility • Lifestyle & behaviour modification • Not conforming/defiance/distrust • Lack of motivation • Credibility • Unrealistic expectations • Too much effort • False perception • Perceptions of healthy food • Culture • Practices • Eating habits • Cravings
	Physical needs	• Hunger • Acceptable taste • Want/desire for food (greed)
	Motivators	• Good health • Blood pressure control • Blood sugar control • Incentives • Value health • Weight control • Food garden • Seeds • Skills training for income generation • Health concern • Medication • Peer support • Healthy eating
Participants' expectations of intervention programmes	Perceived needs	• Exercise • Health education • Advice/guidance/information • Nutrition education • Empowerment • Group activities • Workshops
	Resources and aids	• Cooking lessons • Shopping lists • Recipes • Video • Audio messages • Books • Health club • Health service

Table 2 – (continued)

Themes	Categories	Subcategories (codes)
Aspects impacting participants' acceptance of intervention programmes	Acceptability	• Health professional (doctor, nurse, dietitian) • Home language • Trained community member • Pamphlets from credible source • Spoken, face-to-face by a trained person • Peer support • Sharing of problems • Resolution of problems
Participant preferences for health message dissemination	Mode of message dissemination	• Oral explanation of poster • Community newspaper • Magazine • Television • Radio • Internet • Cellphone applications
	Place of message dissemination	• Public places • Public transport • Supermarkets • Schools • Clinics • Health facilities • Health club

I grew up eating the meats, why must I stop now because they tell me to at the clinic? How can the doctor know me better than myself?

It is like vegetables are sometimes very cheap, but we don't want to eat vegetables...we are ignorant...just want to eat fries because that is nice...

Yes it is what the heart wants...greed, yes, it is greed

3.1.3. Motivators

A concern for their health was expressed by participants' receptiveness to having community-based CNCD health clubs:

It will help me with my weight... blood pressure

Actually, it's unwise not to go there, not to do that ... it's sort of guidance mos, [not so (?)] they are guiding you to do that for your health

Peer support was a great lure for attending a community-based CNCD health clubs, however, some expressed the desire for incentives to ensure their attendance/participation:

...and as a matter of fact, when you are at a club...share information... each shares advice with the other... you not the only one with the problem.

Most of us come from disadvantaged backgrounds... good if they bring soup and it's for free... cannot see why I would stay at home and not come to health club;

They can give us stuff to make us come, like food or maybe money

We can start a food garden...as long as you provide the seeds."

3.2. Participants' expectations of intervention programmes

3.2.1. Perceived needs

A great need for information, resources and aids, and exercise classes was expressed:

Information which is going to help you and help others

Exercise and information how to be healthy.

We want recipes and lists of food and drinks to buy

Show us how to cook the healthy food.

3.3. Aspects influencing participants' acceptance of interventions

3.3.1. Acceptability

A preference was indicated for CNCD intervention health messages to be disseminated face-to-face by health professionals, preferably in their home language:

Cause why, its eh-h, you can't see something on TV and you believe that. You must go to someone like... like you ...

There are many fakes now, why must I believe? I must believe when I see like this face-to-face"

I need it to be explained to me that it goes like this and this... another person will speak in English, I do not understand

English… how is it going to be clear when this person is speaking English?

3.4. *Participants' preferences for health message dissemination*

3.4.1. *Mode of message dissemination*

Even though some participants found all modes of health message dissemination in CNCD intervention acceptable, a preference for the oral/spoken format (one-on-one or group counselling, sessions and demonstrations) was expressed. The younger participants were keen to receive health messages via their cell phones:

No, if you think we are going to follow posters, to me it will be wrong you see, it will be wrong to me under [sic, for] *the reasons I have already mentioned.*

How will I believe that the person is a [for] *real or s/he is a fake?*

It will be better if someone show[s] *us than a poster.*

Posters are okay, but it is at the clinic and when you go home, you forget what it said" and "Pamphlets are better… take it home and read it again.

We can get videos of health on our phone

Someone should make APPS for phones; I would like to get health messages on my phone

3.4.2. *Place of message dissemination*

There was consensus that CNCD intervention health messages be disseminated ubiquitously:

Everywhere, bus, train, supermarket, schools… anywhere as long as you are going to get the message loud and clear.

Findings unique to this study were that some participants did not acknowledge health as their responsibility and expected incentives for attending health club meetings. A sense of entitlement and unrealistic expectations also featured strongly during the FGDs, with the participants expecting to be provided with food parcels, food and even money to encourage them to regularly participate in health club meetings. In addition, the participants' distrust of health messages disseminated via mass media (radio, television), questioning the source's credibility, because of a lack of proof of the health message disseminator's qualification, was also in stark contrast to other studies' findings.

4. Discussion

This study revealed that peer pressure, personal and family preferences and the perception that lifestyle changes are difficult resulted in participants being resistant to change their current diet and lifestyle habits. Similarly, previous research showed that the implementation of, and adherence to lifestyle changes are influenced by people's social environment and personal characteristics (Levesque, Li, & Pahal, 2012; Mayega, Etajak, Rutebemberwa, Tomson, & Kiguli, 2014; Muchiri, Gericke, & Rheeder, 2012; Steyl & Phillips, 2014).

Participants also questioned the benefits of health interventions probably because of clearly visible consequences of not conforming to recommended actions not being disseminated. Similar findings were reported in a recent study by Murray et al. (2013) where participants did not conform to health interventions because of their disbelief in health messages. Financial constraints, fear for personal safety, lack of transport and access to facilities where CNCD intervention programmes were offered also detracted from participants' ability to implement and adhere to CNCD intervention health messages.

Cultural and eating traditions were a challenge to participants because of the culturally-insensitive health messages which often recommend foods that they do not traditionally consume and also perceived as costly and not readily available in their community. These findings are in line with those reported in previous studies that healthy food is perceived to be costly and that readily available foods in an area influence eating behaviour (Farhamand, Tehrni, Amiri, & Azizi, 2012; Mayega et al., 2014; Muzigaba & Puoane, 2014; Verstraeten et al., 2014).

Besides information about CNCD, participants also expected resources (recipes), cooking lessons and exercise classes, to be part of a CNCD intervention programme. The participants were more likely to believe a health message, if this was delivered face-to-face by a health professional, or any other person they knew to be trained as a health professional. Their preferred health message disseminator was, in order of preference, a doctor, nurse, other health professional and trained community members (community health care workers). This may be as a result of the fact that these health professionals are regarded as having expertise in health matters confirming the findings of Parker, Steyn, Levitt, and Lombard (2012), Parajuli, Saleh, Thapa, and Ali (2014) and Levesque et al. (2012). These authors found that adherence to interventions worked better when the doctor is the source of the information as this allowed patients to build a relationship with the person disseminating the health messages and facilitated discussing their problems.

Although traditional modes of message dissemination (poster, pamphlets and billboards) were acceptable to most participants, they still expected a health professional to explain the content of these materials in their home language. This might be driven by the fact that many of the older participants, in particular, were illiterate and/or unable to communicate in or understand English. Previous studies reinforce this finding that language barriers impact on people's adherence to health interventions (Hu, Amirehsani, Wallace, & Letvak, 2013; Mumu, Saleh, Ara, Afnan, & Ali, 2014; Sentell & Braun, 2012).

The dissemination of health messages via television, radio, magazines and community newspapers were acceptable to many of the participants because of a lack of proof of the health message disseminator's qualification. This strongly influenced their preference for receiving their health

messages from a health professional (doctor, nurse) in their home language. Despite evidence in literature that mass media is regarded as an effective tool for health education, this mode for health message dissemination appears not to be effective in this particular study sample (Grilli, Ramsay, & Minozzi, 2008; Martin, 2014).

Interestingly, only the younger participants viewed receiving health messages via a cell phone as acceptable. This finding concurs with the finding of a recent study in Canada but is in sharp contrast with those of a recent South African study where most participants regarded receiving health messages via cell phones (SMS-text messages) quite acceptable, with some even crediting these messages for their adherence (Afshar et al., 2012; Leon, Surender, Bobrow, Muller, & Farmer, 2015).

5. Limitations and recommendations

Focus groups predominantly comprised females, which might have influenced the data collected. The researcher had difficulty recruiting men to participate in the focus group sessions, which might have been because they were at work when the FGDs were conducted. Meetings at night were not advised, because of the unsafe neighbourhood, and the men arriving home late from work. The study sample was isiXhosa-speaking participants, with many being unable to speak English. However, this issue was addressed by having a bilingual (English/isiXhosa) RA present.

Our study results cannot be generalised to other communities in the country since the research design possibly caused the study sample not be representative of the entire Langa community, and focussed only on one community. However, since each community is unique with its own contextual challenges, conducting similar studies in other communities could provide valuable information. These findings could inform interventions for CNCD.

Based on the findings of this study that resource-limited communities need education, access to culturally-sensitive recipes, shopping advice and instruction on healthy food preparation, future research could address the development of resources. Not only will this need be fulfilled, but its impact on implementation and adherence to CNCD intervention programme health messages will need to be evaluated.

6. Conclusions

This study revealed that although the participants found the methods and modes used to disseminate CNCD intervention programme health messages acceptable, they had difficulty with implementing and adhering to these messages for various reasons. New findings were that this study population had unrealistic expectations and showed distrust of health messages not disseminated face-to-face. Even though general guidelines are needed, community-based research should be done to design context-based intervention programmes with health messages tailored for the relevant population.

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Addendum R: HEALTHSAGESONDHEID Author Guidelines

HEALTH SA GESONDHEID

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AUTHOR INFORMATION PACK

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DESCRIPTION

Health SA Gesondheid - Journal of Interdisciplinary Health Sciences is an open access, peer-reviewed interdisciplinary and interprofessional scholarly journal that aims to promote communication, collaboration and teamwork between professions and disciplines within the health sciences to address problems that cross and affect disciplinary boundaries.

Health SA Gesondheid - Journal of Interdisciplinary Health Sciences publishes original articles on issues related to public health, including implications for practical applications and service delivery that are of concern and relevance to Africa and other developing countries. It facilitates the gathering and critical testing of insights and viewpoints on knowledge from different disciplines involved in health service delivery.

The journal offers the breadth of outlook required to promote health science education, research and professional practice.

Unique features distinguishing this journal:

Health SA Gesondheid - Journal of Interdisciplinary Health Sciences explores issues and posits solutions to current challenges existing in health care from an interdisciplinary perspective within Africa and other developing countries, including but not limited to:

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- health security, economics, policy and regulations.

The journal has a strong regional focus (South Africa) with abstracts published in English. It offers a nurturing environment for young and novice researchers to showcase their work whilst upholding the standards of health science education, research and professional practice.

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CHAPTER 6: MANUSCRIPT 3

Tackling the chronic non-communicable diseases epidemic in the Western Cape: Are health professionals on track?

Tackling the chronic non-communicable diseases epidemic in the Western Cape: Are health professionals on track?

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Keywords

Chronic non-communicable diseases, intervention programmes, multicriteria mapping

Authors' contributions

Ms Nasheetah Solomons was responsible for the research management, conception and design, acquisition, analysis and interpretation of data, drafting the work and critically revising the work for important intellectual content. Prof HS Kruger and Prof TR Pouane analysed and interpreted the data and critically revised the work for important intellectual content.

Conflict of interest: the authors declare no potential conflict of interest.

Significance for public health

There is general agreement that the chronic non-communicable disease (CNCD) epidemic should be addressed as a matter of urgency. Many organisations in the private and public sectors have responded by developing and implementing CNCD intervention programmes. Despite this, the number of persons being diagnosed with a CNCD continues to rise annually. This raises the question as to why existing CNCD nutrition-related messages currently being disseminated to address the CNCD epidemic are not achieving the desired effect. It could be that current health messages are not reaching the target populations, the health messages are being misunderstood or the health messages are not addressing the target populations' needs. A first step should be to determine what people with/or at risk of CNCDs require from CNCD intervention programmes and to determine what the Department of Health officials consider to be the best nutrition-related strategies to address the CNCD epidemic. This information may help to bridge the gap between what are viewed as effective strategies by officials in the DoH and what is needed from a community's perspective.

6.1 Abstract

Background

Chronic non-communicable diseases (CNCDs) are on the rise and are having grave consequences on mortality and morbidity as well as countries' socio-economic development. Different approaches have been employed to address this growing problem but it appears that existing interventions are not having the desired outcome. The purpose of this study was four-fold. Firstly, the study aimed to determine challenges that the community participants faced regarding CNCD interventions. The second aim was to determine community participants' willingness to join a CNCD intervention programme and to ascertain what they required from a CNCD intervention programme. Thirdly, the researchers explored what courses of action the Department of Health (DoH) officials involved in the prevention of the CNCD epidemic considered most effective. Fourthly, the study aimed to determine DoH officials' awareness of existing CNCD policies and to identify the factors that they perceived as obstacles to addressing the CNCD epidemic.

Design and methods

A subsample of 300 community participants from the Prospective Urban and Rural Epidemiological (PURE) study's Western Cape urban cohort and six key officers from the DoH were recruited to participate in this cross-sectional study. An open- and close-ended questionnaire was used in face-to-face interviews with the urban cohort to explore challenges with the implementation of CNCD interventions, willingness to participate in CNCD strategies and to investigate the cohort's expectations of CNCD interventions. A questionnaire was used to determine the DoH officials' awareness of existing CNCD policies. The multi-criteria mapper (MCM) interviewing method was used to explore the opinions of the DoH officials regarding the best strategies to address the CNCD epidemic. Data collection took place during July 2014 – July 2016.

Results

The community participants reported that they required education on foods associated with weight gain, the type of food and drinks to purchase, how to prepare healthy food and recipes from CNCD intervention programmes. Challenges that the community participants faced regarding CNCD interventions included access to facilities, cost and availability of recommended foodstuffs, family

responsibilities and peer pressure. Community participants were willing to join a CNCD intervention programme. The Department of Health officials regarded the integration of health services, community participation, improved inter-sectoral partnerships and food taxation as the most favourable options to address the CNCD epidemic. All of the DoH officials interviewed were aware of the existing policies for CNCDs.

Conclusion

At community level, both the challenges and needs focussed on practical aspects, such as education, shopping lists, cost of food items and healthy recipes. The need for education is being addressed by the DoH, but access to facilities, cost and availability of recommended foodstuffs, family responsibilities and peer pressure contribute to a lack of impact of the education. The DoH officials focussed on organisational and regulatory aspects, such as the integration of health services, community participation, food taxation and improving inter-sectoral partnerships as the most feasible options to address the CNCD epidemic. Current CNCD interventions should be adapted to include the context-based practical needs of communities.

6.2 Introduction

Chronic non-communicable diseases (CNCDs) which include cardiovascular disease, diabetes, certain cancers and chronic lung disease were responsible for more than two thirds of global deaths in 2010.[1,2] According to the Western Cape Government (2015), 40% of all deaths in South Africa are due to CNCDs whilst in the Western Cape Province, 17-25% of the disease burden can be attributed to CNCDs.[3] It has been estimated that approximately 950 000 people have hypertension and 330 000 have been diagnosed with diabetes in the Western Cape Province[4]. In addition, the number of deaths due to diabetes in 2014, was found to be higher in the Western Cape compared to those in developed countries.[4]

Modifiable risk factors for CNCDs include excessive alcohol use, long-term use of tobacco products, physical inactivity, consumption of foods high in sugar, salt, fat and low in fibre, as well as low fruit and vegetable intakes.[4,5,6]

The South African National Department of Health (DoH) developed its Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17 based on targets set at the South African Summit on the Prevention and Control of Non-communicable diseases held in September 2011. This document serves as a commitment to address the CNCDs epidemic in South Africa.[7] On 30 March 2015, the DoH launched its Western Cape on Wellness (WoW!) initiative which was enabled through a transversal Working Group comprised of the University of Cape Town, University of the Western Cape, Stellenbosch University, Biokinetics Association of South Africa (BASA), 44ten MEDIA, the Heart and Stroke Foundation of South Africa (HSFSA), Pharma Dynamics, SiyaGyma-Sa, Discovery Health and Eskom with Virgin Active and Ubuntu Trust as additional sponsors. This initiative aims to promote a culture of wellness at and across the workplace, community and school levels by means of health-related physical activities and healthy eating.[3]

It has been stated that, not only can mortality in South Africa be decreased by 20% by addressing harmful alcohol use, tobacco use, salt intake, high blood pressure, increased blood glucose and

diabetes and obesity, but an added benefit would be a decrease in early disability.[8] Strategies which have been implemented in an attempt to address CNCDs in South Africa include the Tobacco Products Control Act of 1993 which bans advertising and protects non-smokers from exposure to cigarette smoke and the Liquor Act (Act 59 of 2003) which bans advertising of alcoholic products to children and restricts trading hours. In addition "sin tax", i.e. tax on tobacco and alcoholic products is increased annually.[9] The reduction of industrial *trans*-fat content of all oils or fats in foods to a maximum of 2% of total calories which was legislated in 2011 and the step-wise reduction of the salt content of a range of highly salted foods were legislated in 2013 with the first phase of salt reduction coming into effect on the 30th of June 2016. [10, 11] In 2016, the Finance minister proposed a sugar tax on sugar-sweetened beverages which the state planned to implement on 1 April 2017, but this has been delayed for further consultation. The *Policy Paper and Proposals on the Taxation of Sugar-sweetened beverages was* opened for public comment until 22 August 2016.[12, 13]

The purpose of this study was four-fold. Firstly, the study aimed to determine challenges that the community participants faced regarding CNCD interventions. The second aim was to determine community participants' willingness to join a CNCD intervention programme and to ascertain what they required from a CNCD intervention programme. Thirdly, the researchers explored what courses of action the Department of Health (DoH) officials involved in the prevention of the CNCD epidemic considered most effective. Fourthly, this study aimed to determine the DoH officials' awareness of existing CNCD policies and to identify the factors that they perceived as obstacles to addressing the CNCD epidemic.

6.3 Design and methods

Research design

A cross-sectional observational study design was implemented in which both quantitative and qualitative data were collected.

Sampling and setting

The current study was conducted on a subsample of an existing cohort that was recruited for the The Prospective Urban and Rural Epidemiological (PURE) study.

The PURE study aimed to recruit approximately 150,000 participants aged between 35 and 70 years living in more than 600 communities in 17 low-, middle- and high-income countries around the world. The participating countries' selection was based on the representativeness of different economic levels and the study sites included are based on the commitment of investigators to collecting good quality data over the planned 10-year period.[14] The University of the Western Cape's (UWC) School of Public Health (SoPH) committed itself to carry out data collection in Langa (urban community) in the Western Cape Province and Mount Frere (rural community) in the Eastern Cape Province. The sample size of the University of the Western Cape's PURE urban study site consisted of 1000 males and females. For the purpose of this study, a sub-sample of 300 participants as determined by the sample size of similar studies[15] was randomly selected from the three areas (old Langa, the Zones and the Hostels) in the Western Cape urban cohort in Langa to complete the questionnaire on challenges to CNCD intervention programmes. Baseline demographic and anthropometric data (height, weight, waist and hip circumference, BMI) obtained for participants in 2010 were used.

Ten key officers from the DoH, who are involved in the prevention and treatment of CNCDs, were invited to participate in the study by means of snowball sampling. These potential interviewees were contacted by means of electronic mail in order to set up an initial meeting during which the purpose of the study was explained and information about the Multicriteria Mapping (MCM) interviewing method (by means of a demonstration) was provided.[16] In addition, anonymity was discussed, informed consent was obtained and a date was then set for the actual interview with those who agreed to participate in the study. In total, six of the ten officers identified, agreed to participate in the study.

Assessment instruments and multi-criteria mapping

Two questionnaires consisting of open-and-closed-ended questions were developed based on published information on challenges faced by study participants regarding CNCD interventions and expectations from CNCD intervention programmes. [15,17-20] The *Challenges to intervention programmes questionnaire* was used to assess challenges faced by community participants in intervention programmes. In addition, this questionnaire was also used to ascertain satisfaction with current CNCD intervention programmes and to determine what is desired from a CNCD intervention programme. [17,18,19] The *DoH questionnaire* was used to assess DoH officials' awareness of existing CNCD policies and what factors they perceived to be obstacles in addressing the CNCD epidemic.

To explore what courses of action DoH officials believed would perform best in CNCDs intervention programmes, a list of courses of action employed to address CNCDs identified from literature was drawn up prior to the initial meeting with potential interviewees.[20-39] These were grouped into "core options"- criteria that all participants were required to assess and "discretionary options"- from which interviewees could select three or more criteria if they felt the core options did not address all the criteria they deemed necessary to address the CNCD epidemic in South Africa (Table 6.1).

Table 6.1: Clusters, options and definitions of options to address nutrition-related CNCD

Clusters	Options	Definitions
	CORE OPTIONS	
CNCD prevention and management oriented	Legislation and regulation for CNCD (policies).	The development and implementation of policies to salt reduction and alcohol use could aid in decreasing the use of alcohol and salt. The development and implementation of environmental planning policies will aid in the improvement of community facilities so that it is safe and conducive to physical activity. Policies to control the composition of processed foods in terms of fat (type and amount), salt content and kilocalories will aid in the control of overweight and obesity as well as other CNCDs.[20,21]
Food information	Control of food and drink advertisements.	This will entail the banning of food advertisements aired during children's programmes as well as in cinemas. This will also include the banning of advertisements of tobacco products, alcohol and unhealthy foodstuff aimed at adults on television, billboards, and magazines and in cinemas.[21,22]
Food supply and control	Control of food sales at public institutions and places	This entails controlling food and drink items sold at schools, colleges, technikons and universities. Young children are easily influenced, so only offering healthy food choices at school tuck shops for example, could lay the foundation for them to continue making healthy food choices into adulthood.[20,21,22]
Food information	Compulsory food labelling	Compulsory food labelling would aid in the public making better food choices. The food labels should be easy to understand and standardised for all products, so that consumers can easily make better food choices.[21-24]
Food supply and control	Fatty and sugar-sweetened food tax ("sin tax") and healthy food subsidies.	Taxing food manufacturing companies for the production of food items which contain fat, sugar and salt above the recommended levels, could encourage these companies to reformulate their recipes and thus influence consumers' intake. On the other hand, the simultaneous decrease in healthy food prices (by means of subsidies) could encourage the purchasing of these healthier food items.[21,24]
Food supply and control	Cheaper prices of healthy foods	Providing healthier foods at lower prices would encourage citizens to purchase these food items. This could be done by subsidising healthier food options.[21,22,24]
Partnerships and collaboration	Community participation	Joining forces with other government departments, the food industry, community associations and non-governmental organisations (NGOs) could aid in the pooling of resources and thus result in a holistic approach to tackling the CNCDs epidemic.[27]
Partnerships and collaboration	Improving inter-sectoral partnerships.	The community members know what their needs are. In order for an intervention to be successful, it must address the community's self-identified needs.[26,27]

Table 6.1: Clusters, options and definitions of options to address nutrition-related CNCD (continued)

DISCRETIONARY OPTIONS		
Educational	Improved health education of citizens	Citizens will be provided with more information and a better understanding of CNCDs, including their risk factors, prevention and management, and in this way they will be aided in decreasing their risk for developing CNCDs. Teaching them how to make healthier food choices (teaching them how to read food labels) would play a role in combating CNCDs.[21,24]
Educational	Improve training of health professionals in CNCD.	Providing health professionals with the skills and knowledge to identify, counsel and care for persons with CNCDs could aid in reversing the CNCDs epidemic.[21,28]
Health care reform	Integrated health service delivery	Integrating services where individuals who are for example HIV-positive, and who are also suffering from a CNCD would result in this person getting the necessary care for both conditions in one place at the same time.[29]
Health care reform	Skill-shifting among health professionals.	Training more assistant health professionals (e.g. nursing assistants) and community health workers to assist with the care of individuals with CNCDs could play a role in alleviating the workload of existing health professionals and also address the current health human resource problems.[28,30]
Health care reform	Improve health information systems	Improved health information systems will aid in identifying and monitoring individuals at risk of, or diagnosed with CNCDs. In this way better care can be provided to these individuals and aid in decreasing the CNCDs epidemic.[31]
Educational	Improve the school curriculum by including more health and nutrition education.	Including health and nutrition education in the school curriculum will equip young children to make better food choices and will lay the foundation for their future health.[21]
Innovative preventive initiatives	Improve workplace health initiatives	By providing incentives to their workforce, companies can encourage their employees to maintain better health. This may include the provision of health education workshops, annual health checks, or even installing a gym at the workplace, and the work cafeteria only providing healthy foods.[32]
Innovative preventive initiatives	Compulsory free annual medical check-up.	Making it compulsory for all individuals regardless of age, to go for an annual medical check-up could aid in identifying individuals at risk of, or who suffer from CNCDs as well as provide the opportunity to impart information on the prevention of CNCDs.[33]
Technological advances	Increased use of sugar and fat substitutes	Companies are developing new products regularly. The use of sugar and fat substitutes could assist individuals with their weight control.[21,22,34-36]
Technological advances	Growing healthier foods such genetically-modified (GM) foods	Agriculture could find ways in which to produce healthier foods for the general public.[24,25]
Food information	Control marketing terminology on food labels (e.g. use of "lite")	Policies can control what items fulfill the criteria to be labelled "lite", etcetera. In this way the consumer is assured that he/she is making better food choices without being misled.[21,24]
Food supply and control	Healthier restaurant menus	Restaurants can be provided with incentives to reformulate their recipes so that they can offer healthier food to their patrons.[24]
Food information	Nutrient analysis of catering menus to show energy, sugar, salt and fat content	All public eating places are to provide their patrons with nutritional information of all food items prepared on the premises. This will aid patrons to order the healthier food items.[37-39]

The Multicriteria Mapping (MCM) interviewing method, a decision analysis tool[16] was used to collect data during face-to-face interviews which were audiotaped. This method makes use of a four-step approach: (1) interviewees choose the options they want to assess from the list disseminated during the initial meeting; (2) criteria are defined by each interviewee to assess the chosen options; (3) interviewees assign a score to each option against their defined criteria and (4) lastly, they assign a weight to each criterion according to importance. [21, 40]

Data collection

Secondary data analysis was done on demographic and anthropometric data collected in 2010 for the 300 PURE study community participants. Demographic data was obtained by means of the standardised PURE adult questionnaire[14, 41, 42] during face-to-face interviews by trained fieldworkers. Weight was measured with the subject wearing minimal clothing (and after subjects were asked to empty their pockets) to the nearest 0.1kg, using a digital scale (UC 321 Precision scale, A&D Medical, Oxford, UK). Height was measured to the nearest 0.1cm using a stadiometer (Detecto 3PHTROD, Detecto, Webb City, MO USA) with the participant standing with normal posture and barefoot. Measurements were read after ensuring the subject's head was in the Frankfort plane. Body mass index (BMI) was calculated by dividing the weight (kg) by the height (m) squared and presented by BMI category. Waist circumference was measured over minimal clothing at the narrowest part between the rib cage and iliac crest using a non-stretchable measuring tape (Dean, Cloth & Notions, London, UK). Hip circumference was measured over minimal clothing at the widest part of the body over the buttocks, with the same measuring tape (Dean, Cloth & Notions, London, UK). Two readings were taken and recorded to the nearest 0.1cm and the mean calculated. Waist-hip ratio (WHR) was calculated by taking the waist circumference (cm) and dividing it by the hip circumference (cm). Waist to height ratio (WHtR) was calculated by taking the waist measurement (cm) and dividing it by the height (cm).

One trained fieldworker conducted face-to-face interviews with study participants and completed the "*Challenges to intervention programmes*" questionnaire during the period 10 July 2015 to 25 November 2015.

The researcher used the MCM interviewing method as a decision analysis tool[16] to collect data during face-to-face interviews from DoH officials. Interviews took place over the period of 10 December 2015 to 1 July 2016. Interviews lasted between one and a half to two hours.

Ethics approval

Ethics approval for the Western Cape PURE study was obtained from the Research and Higher Degrees committee from the University of the Western Cape (project number 13/3/5). Informed, written consent was obtained from each participant and confidentiality and anonymity were maintained by using participant numbers and no names on all study material.

Data analysis

Most data deviated from the normal distribution as assessed by the Kolmogorov-Smirnov test. Therefore, medians and interquartile ranges were calculated for continuous demographic and anthropometric data of men and women. Percentages and frequencies were calculated for categorical demographic and anthropometric data. Participants were categorised as overweight/obese (BMI≥25kg/m^2) vs underweight/normal weight (BMI≤24.9kg/m^2]). Participants were also categorised according to their willingness to join a CNCD intervention programme (willing vs not willing). The associations between willingness to join an intervention programme and BMI category were determined by means of the chi square test. Differences between BMI, WC, WHR, WHtR of the two groups according to willingness to join an intervention programme were determined by the Mann-Whitney test. Frequencies and percentages were calculated for quantitative data collected using the '*Challenges to intervention programmes'* questionnaire. The results are depicted by means of charts. Data analysis was done using the Statistical Package for Social studies (SPSS) version 23 (SPSS Inc., Chicago, IL, USA) software programme.

The data obtained by means of the MCM interviewing method was prepared for analysis as described in the MCM manual Version 1.2.[43] For analysis, the predefined options were grouped into clusters (Table 2) and criteria identified by interviewees were categorised into groups termed

"issues" in MCM. Five sets of issues were identified and used to analyse the assessment of the performance of the predefined options (Table 3). The interviewees were categorised into two perspectives, i.e. management and implementers. Quantitative data is represented by means of bar charts generated by MC Mapper. Qualitative data was obtained from the transcripts of each interview and organised according to themes (Figures 6.1 and 6.2, Table 6.4) together with the textual data entered into MC Mapper during the interviews which provided information on the reasons for the scores given. The data was then analysed using the MCM analysis 2016 (University of Sussex, UK) software.

Table 6.2: Grouping of criteria into issues

Issue group		Criteria
1.	Resources	Human resources, funding, money, equipment, tools, internet, checklists
2.	Collaboration	Relationships, community participation, community-based participation, capacitation
3.	Awareness creation	Health promotion, knowledge
4.	Accountability	Policy and legislation, information, monitoring and governance
5.	Commitment	Policy and legislation, mental commitment

6.4 Results

The majority of the study sample was comprised of women (77.6%). Two-thirds (66.6%; n=200) of the study sample had a high school education and the majority (80.9%; n=243) was unemployed. Hypertension and type-2 diabetes were the CNCDs commonly reported by the study sample at 32.4% and 13.7%, respectively (Table 6.3). The majority (73.6%; n=221) of the study population were classified as overweight/obese (BMI $\geq$25kg/m^2). Concern for their health and their clothes being too tight were the reasons provided for wanting to lose weight (Figure 6.1). Interestingly, approximately 82% (n=245) of the participants, including those who stated that

they were happy with their weight, indicated that they were willing to join a weight loss programme, should one be offered in their community. Education on healthy food preparation and “not feeling alone” were some of the reasons for wanting to join a weight loss programme (Figure 6.2).

Table 6.3: Characteristics of the study sample (n, % or median, interquartile range)

Variable	Women n(%)	Men n(%)	P*
Number of participants#	225	65	
Age (years)	51 (42-57)	50 (40.5-57)	0.678
Body mass index (kg/m^2)	31.8 (25.3-40.3)	29.1 (22.8-39.9)	0.191
• Normal weight/underweight	26 (23.3)	13 (36.10	
• Overweight/obese	89 (76.8)	23 (63.9)	
Marital status			0.725
• Never married	110 (49.8)	32 (43.2)	
• Currently married	60 (27.1)	29 (39.2)	
• Common law/living with partner	10 (4.5)	4 (5.4)	
• Widowed	26 (11.8)	8 (10.8)	
• Separated	12 (5.4)	0 (0)	
• Divorced	3 (1.4)	1 (1.4)	
Education level			0.539
• No school education	5 (2.3)	2 (3.2)	
• Primary school	45 (20.3)	11 (17.5)	
• High school/secondary school	151 (68.0)	42 (66.7)	
• Trade school	6 (2.7)	1 (1.6)	
• College/university	14 (6.3)	6 (9.5)	
• Unknown	1 (0.5)	1 (1.6)	
Employment			0.715
• Currently Employed	55 (26.5)	11 (17.2)	
• Unemployed	138 (66.7)	44 (68.8)	
• Retired	14 (6.8)	9 (14.113.8)	
Type of Employment			0.209
• Legislators, senior officials and managers	1 (0.5)	0 (0)	
• Professionals	7 (3.4)	1 (1.6)	
• Technicians and associate professionals	2 (1.0)	0 (0)	
• Clerks	3 (1.4)	5 (8.1)	
• Service, shop and market sales workers	8 (3.9)	1 (1.6)	
• Craft and related trade workers	2 (1.0)	2 (3.2)	
• Plant and machine operators and assemblers	4 (1.9)	0 (0)	
• Elementary occupations	22 (10.6)	4 (6.5)	
• Armed forces	4 (1.9)	1 (1.6)	
• Homemaker	154 (74.4)	48 (77.4)	
Alcohol use history			0.765
• Formerly used alcohol products	16 (7.7)	3 (4.9)	
• Currently use alcohol products	39 (18.8)	15 (24.6)	
• Never used alcohol products	152 (73.4)	43 (70.5)	
Tobacco use history			0.159
• Formerly used tobacco products	9 (4.3)	3 (5.0)	
• Currently use tobacco products	38 (18.4)	16 (26.7)	
• Never used tobacco products	162 (78.3)	41 (68.3)	
Physical activity			0.397
• Low	37 (19.9)	14 (25.9)	
• Moderate	114 (61.3)	31 (57.4)	
• High	35 (18.9)	9 (16.7)	
Diagnosed with hypertension			0.935
• No	139 (65.6)	41 (66.1)	
• Yes	73 (34.4)	21 (33.9)	
Diagnosed with diabetes			0.624
• No	189 (89.2)	53 (86.9)	
• Yes	23 (10.8)	8 (13.1)	
Diagnosed with cancer			0.915
• No	208 (98.1)	60 (96.8)	
• Yes	4 (1.9)	2 (3.2)	
Diagnosed with coronary heart disease			0.275
• No	202(95.3)	61 (98.4)	
• Yes	10 (4.7)	1 (1.6)	
Suffered a stroke			0.350
• No	209 (98.6)	60 (96.8)	
• Yes	3 (1.4)	2 (3.2)	

*Comparison using Mann-U Whitney test for continuous data and chi-square test for categorical data

#Numbers varied due to missing data for some variables

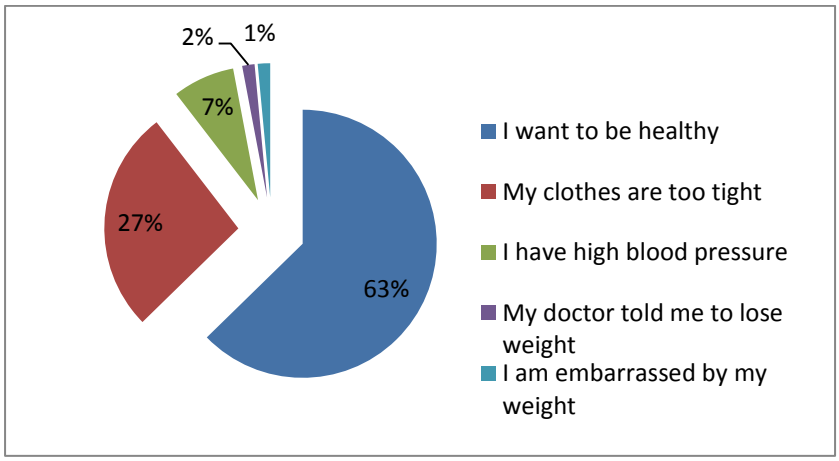


Figure 6.1: Reasons for wanting to lose weight

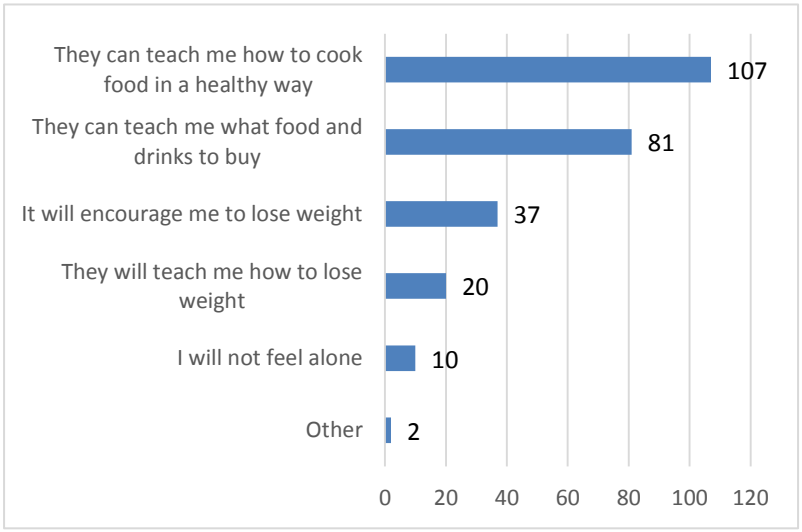


Figure 6.2: Reasons for willingness to join a weight loss programme

Education on what foodstuffs to purchase, reasons for weight gain and recipes were what community participants expected to gain from CNCD interventions (Figure 3).

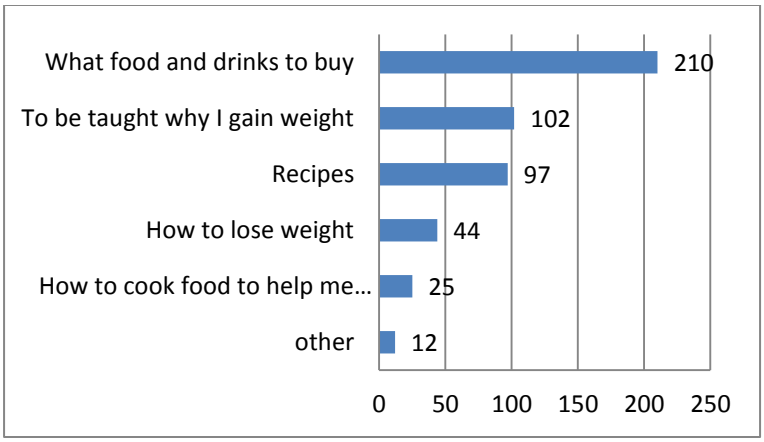


Figure 6.3: Participants' needs from an intervention programme

Challenges experienced by community participants with the implementation of and adherence with CNCD interventions included lack of access to facilities, high cost and availability of recommended foodstuffs, family responsibilities and peer pressure (Table 6.4).

Table 6.4: Challenges with implementation and adherence to CNCD interventions

Challenge	Number of respondents (%)
Lack of money to purchase foodstuffs recommended	255 (85)
Family responsibilities competing with adherence	220 (73)
Not liking the taste of recommended foodstuffs	216 (72)
Access to facilities where interventions are offered	189 (63)
Lack of availability of foods recommended by health workers in the community	155 (52)
Peer pressure to behaviour change	135 (45)
The perception that it is hard to quit smoking (smoker)	42 (72)

There was a significant association between willingness to join a weight loss programme and BMI classification (p=<0.0001), with overweight/obese participants less likely to join a weight loss programme. No differences were found between BMI (p=0.573), WC (p=0.282), WHR (p=0.822) and WHtR (p=0.434) in the group who wanted to lose weight and the group who did not want to lose weight (Mann-Whitney test).

As depicted in Figures 6.3-6.5, there was consensus among all DoH officials (both managers and implementers) that community participation and improving inter-sectoral relationships and collaboration were the two core options deemed the most important by all MCM interviewees. Community involvement was considered the most important for all MCM interviewees. Two interviewees in particular felt very strongly that interventions would not be successful unless the community was empowered and involved in all processes from start to finish.

Policy and legislation were also regarded as important by both groups since this was viewed as the "control" and accountability, but their effectiveness was viewed being dependent on the availability of human resources and budgetary constraints.

Food supply and control of food sales and advertisements were seen as less favourable options, since interviewees considered their efficacy to be reliant on the organisations' "policies" and industry. Although food taxes on high salt, sugar-sweetened and fatty foods were reported to be feasible options, it was felt that home industries and cheaper food items being imported would not be monitored effectively due to constraints on resources (human, laboratories and monetary). The efficacy of cheaper prices of healthy foods and healthy food subsidies were not considered feasible options.

Improving health information systems and the integration of health service delivery were ranked very highly by all, even though health service integration was considered to be a formidable task.

Improving the school curriculum was the one option implementers also regarded as important, however this was heavily dependent on the Department of Education and not within the scope of practice of the DoH officials.

The use of genetically-modified food, sugar and fat substitutes did not find favour with any of the interviewees.

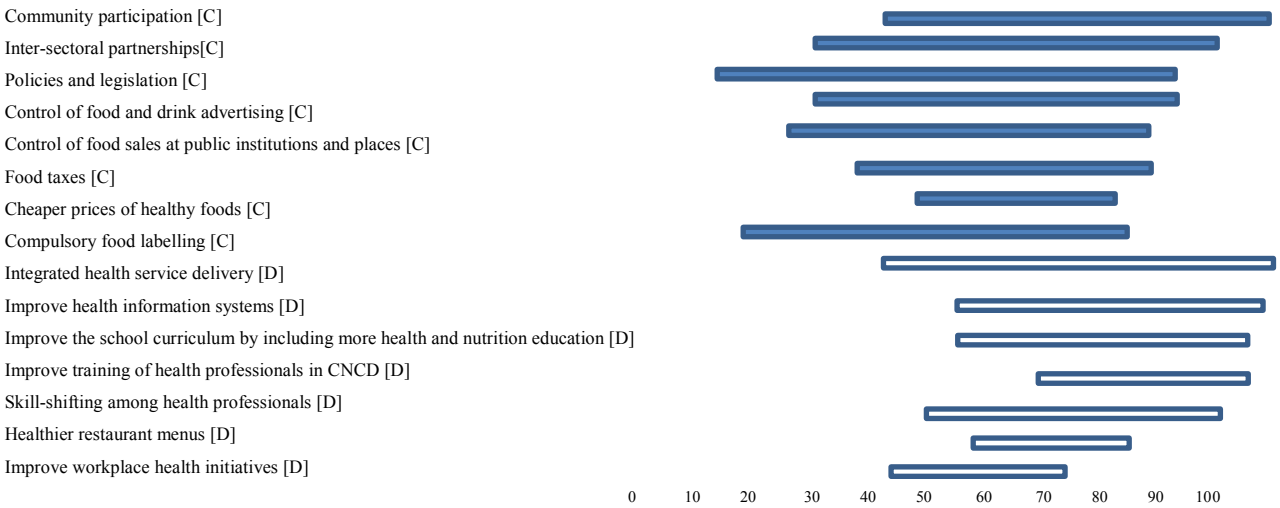


Figure 6.4: Range of ranks of options assessed by the total group of DoH officials (n=6)

[C]: core option [D]: Discretionary option

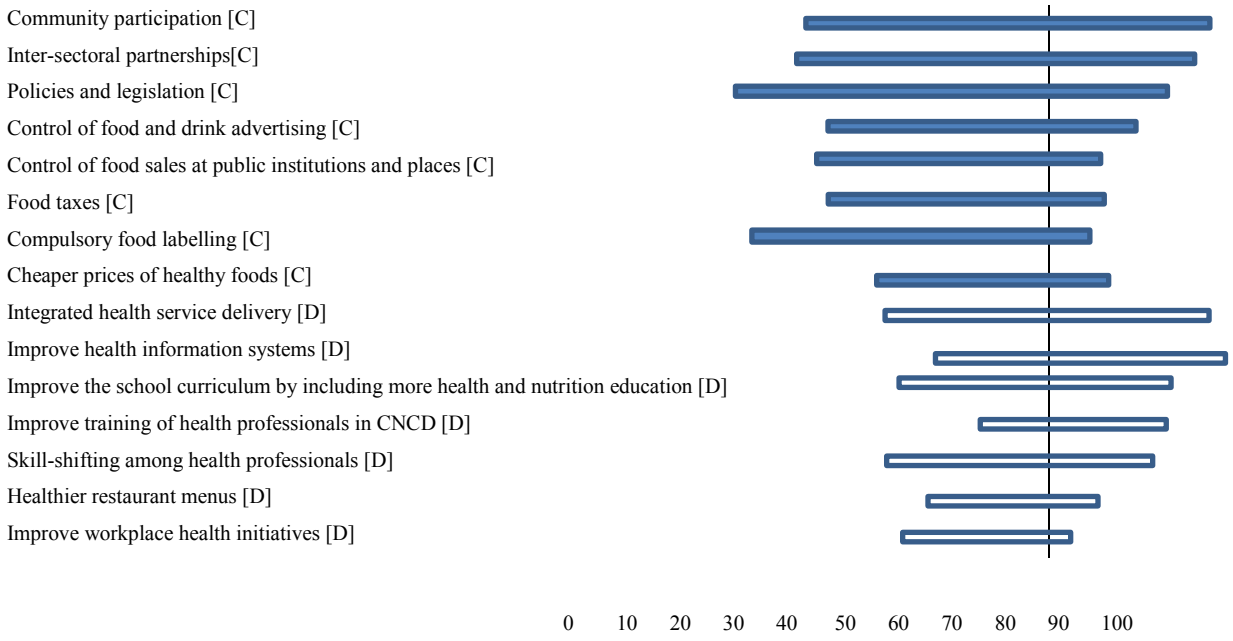


Figure 6.5: Range of ranks of issues assessed by DoH managers (n=3)

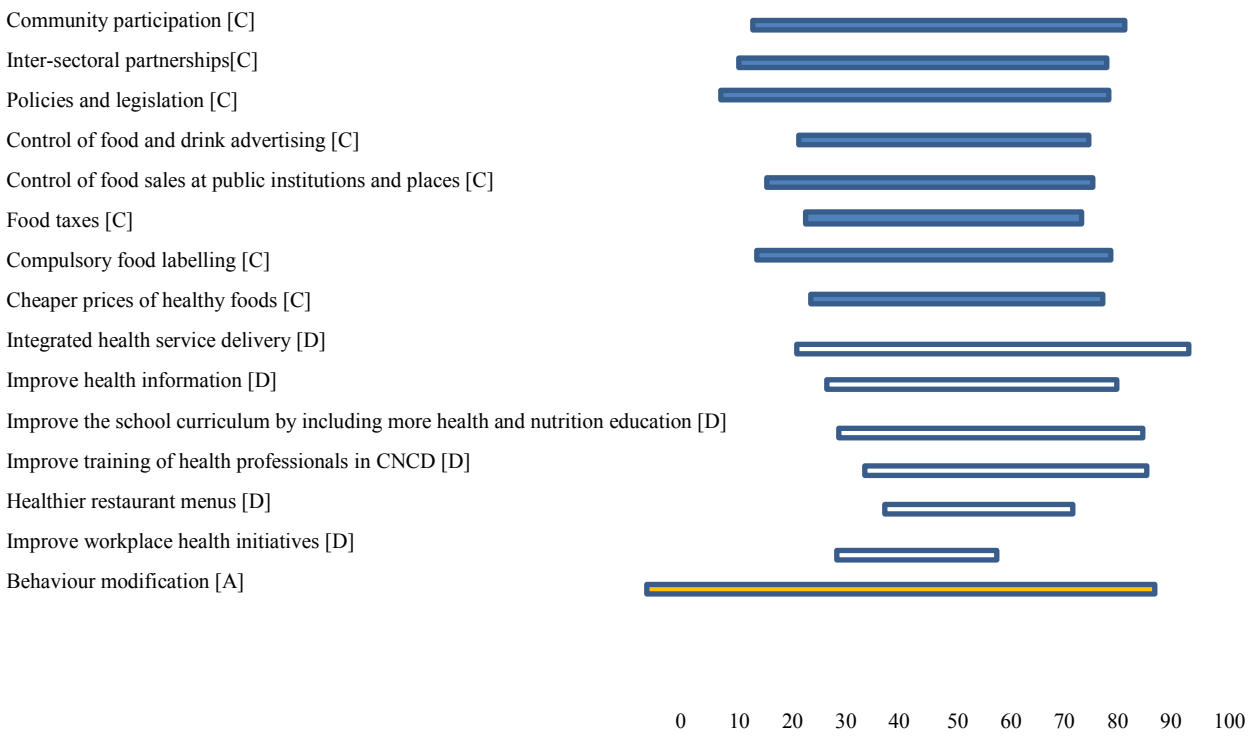


Figure 6.6: Range of ranks of issues assessed by DoH implementers (n=3)

[A]: additional option

Policies are available for DM, CVD, cancer and chronic respiratory diseases and all the DoH officials were aware of these policies.

Table 5 depicts obstacles that the DoH officials perceived to impact the CNCD epidemic. These obstacles include a lack of inter-sectoral collaboration at governmental level. Limited access to recreational resources in communities and a lack of community ownership were perceived to be obstacles at community level. Similarly, the community participants identified accessibility to facilities where CNCD intervention programmes are offered. In addition, community participants wanting incentive to attend CNCD intervention programmes could be interpreted as not taking ownership for their health.

Table 6.5: Obstacles to addressing the CNCD epidemic identified by DoH officials

Government level	Community level
• Lack of inter-sectoral collaboration with governmental departments • Not obtaining buy-in from business sector prior to drafting policy or legislation • Difficulty in finding a balance between developed countries' investment (e.g. Kentucky Fried Foods, McDonald's) and health • Poor literacy in majority of the population • Poor recreational resources in living environments • Poor control of crime	• Community not taking ownership of their health • Urbanisation; change in dietary intake, decreased physical activity due to easy access to different modes of transport • Limited access to recreational facilities in especially townships • Easy access to fast food in communities • Crime; unsafe communities for walking and outdoor activities

6.5 Discussion

The community participants' challenges and needs focussed on practical aspects, such as education on foods associated with weight gain, what foods and drinks to purchase, how to prepare food and recipes, while the DoH officials stated that integration of health services, community participation, improving inter-sectoral partnerships and food taxation would perform best to prevent the CNCD epidemic. The DOH officials also mentioned lack of community participation and low literacy as challenges, while the community participants identified lack of access to facilities and a need for information to be provided in their home language.

Even though the majority of the participants were classified as overweight/obese, less than 25% expressed a desire to lose weight, nor were they willing to join a weight loss programme. This could be due to cultural influences since black women often associate being overweight with social standing, health and beauty.[44-46] Another possible reason could be a lack of knowledge regarding the risk of CNCD associated with obesity. This could be inferred from participants' requirements from CNCD intervention programmes, amongst others, education on causes of weight gain and how to prepare healthy food. Overweight and obesity are known risk factors for the development of CNCDs.[47-49] Increased rates of overweight and obesity which are now on par with those seen in high-income countries, have been observed in low-and middle-income

countries and in SA[50]. This is a result of globalisation and urbanisation which lead changes in lifestyle and food consumption.[51-54]

More than half (60.7%) of the participants were unemployed. It has been previously reported that adherence to health messages and dietary guidelines is often poorer in persons of lower socio-economic status.[55] Additionally, cultural influences, costs, food availability and personal taste affects acceptability of foodstuffs recommended for a healthy lifestyle.[2,49,56-58] The majority of the community members interviewed expressed a need for education (cooking lessons, what foods to purchase). This could indicate that, even though there are health and nutrition education programmes, it does not reach everyone, or that the messages are not properly understood. It is known that health and nutrition education are crucial components of any health intervention.[59, 60] Low literacy was identified as a challenge by DoH officials, which was corroborated by the community participants' desire to receive health messages and health education in their home language.

Policy and legislation were considered by DoH officials to be very important to address the CNCD epidemic. Some "best buy" interventions suggested by the literature to address the CNCD epidemic are to reduce tobacco and alcohol use, reducing the *trans*-fat and salt content of foodstuffs, banning advertisements of "unhealthy" foods to children" and the promotion of physical activity.[61,62] South Africa has responded by setting specific targets in its strategic plan for the prevention and control of non-communicable diseases 2013-2017 and the implementation of the Tobacco Products Controls Act of 1993, the Regulations Relating to Trans fats in Foodstuffs No. R.249 (2010), the amendment to Foodstuffs, Cosmetics and Disinfectants (54/1972): Regulations relating to the reduction of sodium in certain foodstuffs and related matters No.3 35509 R. 533. [11, 63, 64]

Regarding the control of the food supply cluster (regulation of food sales at schools, food taxes, cheaper prices of healthy foods and food subsidies and healthier restaurant menus), food taxes received the most optimistic response. Taxes on alcoholic beverages and tobacco products have been in existence since 2002 and since the early 1990s respectively.[65-66] The South African

National treasury released a policy paper on taxation of sugar sweetened beverages in July 2016 for comment with the view to implement it in 2017.[67] Evidence to support a reduction in the consumption of sugar sweetened foods as a result of sugar tax exists. In Mexico for example, sugar tax resulted in a change in purchasing behaviour with a reduction in the purchasing of sugar taxed food items seen across all socio-economic levels.[68-70]

The majority of the DoH interviewees regarded food labelling (food information cluster) to be important. They however agreed that the labelling used is not user-friendly, especially to those who are illiterate. The South African government passed an amendment to the Foodstuffs, Cosmetics and Disinfectants Act relating to the labelling and advertising of foodstuffs No. R.429.[71] A recent review supports the opinion of the DoH officials that food labels are complex and do not always have the desired effect.[72]

The integration of health services was also considered favourable by the DoH interviewees, even though it was acknowledged that it would be a momentous task. A recent study investigating the integration of NCD, HIV/AIDS and mental health care by empowering chronically ill patients to take care of their own health, found that this option would be beneficial in improving the quality of health service delivery.[73]

Community participation was viewed overall as the best option to tackling the CNCD epidemic. The North Karelia project in Finland and the CORIS study in South Africa are two examples of projects where community participation was proven to be successful.[74, 75] In the current study, participants were faced with difficulty in accessing facilities where CNCD programmes were offered and this impacted their ability to implement and adhere to the interventions.

Despite the general view that industry is money driven, strengthening inter-sectoral partnerships was seen as a favourable option. As part of their social responsibility, many of the big retailers have implemented some form of health intervention programme.[11] The big South African supermarkets such as Pick' n Pay and Woolworths employ a dietitian and have nutrition education initiatives.[76, 77] In addition, some of these retailers have partnered with medical aid

companies to offer cashback when healthier food items are purchased at these retailers' stores.[78] These retailers are however not usually located in poorer communities.

The most important results of this study are that gaps were identified between the needs of the community participants and options deemed the most important by DoH officials for successful CNCD interventions and prevention programmes. Whilst community members viewed practical context-based advice necessary to aid them in the management of CNCD, the DoH officials considered policies and legislation, community participation and inter-sectoral partnerships as the best options to address the CNCD crisis. It appears that, even though the DoH has a holistic approach to address the CNCD epidemic, a gap exists in that their efforts (advice/ health messages) do not seem to be practical enough or acceptable for the community participants to implement them.

6.6 Limitations

The following limitations need to be considered. The small number of male respondents and DoH officials interviewed might have influenced the results. Finally, as this was a cross-sectional study, no causal relationship could be inferred. The small number of DoH officials was the only available ones, if there were more, the responses may have been more varied. A small number ofr men in South Africa have been encountered in several other studies, this could be due to men being less interested in participating or are unable to get time off from work. The results may thus not be generalised to SA men

6.7 Recommendations

The communities at which the CNCD programmes are aimed should be involved from the onset in the development of CNCD interventions. The DoH officials realised the importance of community participation, but the community participants mentioned a lack of access to health facilities and programmes as a challenge to participation. Improved access to health facilities where CNCD programmes are offered should thus be addressed. Contextual-based health

education should be provided in the language of the communities targeted. The provision of recipes for healthier versions of foods/dishes traditionally consumed should form part of CNCD intervention programmes. This study should be repeated with larger samples and preferably across all provinces of South Africa.

Buy-in should also be fostered from the food sector for the provision of affordable food that is low in salt, saturated fat, trans-fatty acids and high complex carbohydrates. Communities, community organisations and other stakeholders in communities where CNCD intervention programmes are to be implemented should be involved from the onset in the development of these CNCD interventions. Contextual-based health education should be provided in the language of the communities where it is to be offered. The provision of recipes or education on how traditional recipes can be made healthier should be provided as part of CNCD intervention programmes.

6.8 Conclusion

Integration of health service, community participation, food taxation and improving inter-sectoral partnerships were viewed by DoH officials as the most feasible options to address the CNCD epidemic. At community level, the needs for education, shopping lists and healthy recipes in their home language were expressed. Even though the need for education as identified at community level, is being addressed by the DoH as evidenced by the available education material (posters and pamphlets), these do not seem to have the desired effect. Current CNCD interventions should be adapted to include the context-based needs of communities.

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CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the summary of the thesis, the implications of the findings, the recommendations and the conclusions.

7.2 Objectives of the study and methods used

The goal of this study was to investigate challenges to the implementation of intervention programmes aimed at non-communicable diseases at government, community and individual levels in the Langa PURE study site in Cape Town, South Africa.

The study participants were part of the ongoing Prospective Urban and Rural Epidemiology (PURE) study which aims to identify social, individual and community factors that lead to populations developing risk factors for CNCDs, with the view to develop societal interventions and policies to address the CNCD epidemic worldwide. The cohort from the University of the Western Cape's urban study site Langa, participated in this study.

The study was undertaken in three phases to meet the objectives. The first phase determined if a relationship existed between dietary adherence score and blood pressure and body composition respectively. A cross-sectional secondary analysis of quantitative data collected for the Prospective Urban Rural Epidemiological (PURE) study was performed.

The second phase was undertaken to identify community members' needs from intervention programmes, to explore strategies that the Department of Health (DoH) officials viewed as best options to address the CNCD epidemic as well as to determine DoH officials' knowledge regarding existing policies for CNCD. Questionnaires and the multicriteria mapping (MCM) interviewing method were used to obtain data.

During the third phase of the study, the challenges to the implementation of and adherence to CNCD intervention programmes' nutrition messages were explored. This cross-sectional study made use of the focus group discussion method to obtain qualitative data.

The following objectives were formulated for the three phases of the study:

a) To determine participants' dietary adherence by calculating a diet adherence score according to a Dietary Approaches to Stop Hypertension (DASH)-style diet.
b) To determine if there was an association between dietary adherence score, anthropometric measurements (waist circumference, body mass index, waist-hip ratio, waist-to-height ratio) and blood pressure in a South African urban dwelling black population.
c) To investigate participants' awareness of existing CNCDs intervention programmes in their community and their willingness to participate in nutrition intervention programmes.
d) To determine challenges that the target groups faced regarding CNCD interventions and what they required from a CNCD nutrition intervention programme.
e) To explore what courses of action the Department of Health (DoH) officials involved in the prevention of the CNCD epidemic thought would perform best.
f) To determine DoH officials' awareness of existing CNCD policies and what factors they perceived as obstacles in addressing the CNCD epidemic.
g) To explore perceived challenges with the implementation of and adherence to health messages disseminated as part of a CNCD intervention programme.
h) To gain an understanding of participants' expectations of CNCD intervention programmes.
i) To explore the acceptability and preferences of health message dissemination methods in CNCD intervention programmes.

7.3 Summary of findings

7.3.1 Association between dietary adherence, anthropometric measurements and blood pressure in an urban black population, South Africa

The main findings of the first phase which are presented in a published manuscript format in Chapter 4, are as follows:

The first phase determined if a relationship existed between dietary adherence score and blood pressure and body composition respectively. There are no correlations between adherence and anthropometry, but correlations were made between adherence and BP and anthropometry

and BP. No significant differences were found between anthropometric measurements or blood pressure of men and women in the lowest and top tertile groups according to dietary adherence score. A significant inverse correlation between dietary adherence score and systolic blood pressure (SBP) was found in women only. A significant positive relationship between added sugar intake and SBP was only present in the women. This is an indication that women with better adherence to dietary guidelines had lower SBP. A significant positive relationship was found between SBP, DBP and body mass index for men only. The logistic regression model showed a significant association between hypertension and age only.

7.3.2 Adherence challenges encountered in an intervention programme to combat chronic non-communicable diseases in an urban black community, Cape Town

The main findings of the second phase are presented in a published manuscript format in Chapter 5 are as follows:

The challenges to the implementation of CNCD interventions identified in this study can be categorised as socio-cultural, environmental, personal and individual factors, resources and motivators and how and by whom health messages are disseminated. The *socio-cultural factors* are peer pressure, culturally-insensitive food recommendation, language barriers and family responsibilities. The *environmental factors* include a lack of recreational facilities, accessibility to healthcare facilities, long waiting times at healthcare facilities, safety concerns and having to contend with unfriendly staff at healthcare facilities. The *personal factors* are unrealistic expectations (wanting incentives), unemployment resulting in poverty, peer pressure, family responsibilities and taste preferences. The *individual factors* are personal taste, health status, motivation – wanting to be healthy, self-discipline/willpower since implementation and adherence to health messages were "hard to do", lack of family support, financial stress, lack of education (illiteracy), health illiteracy, language barriers and distrust of health message source. The *resources* category include poverty, unemployment, the cost of recommended foods, availability of recommended foods, large household size, transport costs and long waiting time at healthcare facilities. The *motivators* to improve adherence were incentives, being educated on their health/disease condition, support received from the healthcare professionals and others with similar health conditions, concern for their health, being taught how to cook healthy dishes (cooking lessons), recipes for healthy dishes and

shopping lists of what foods and beverages to purchase.

Regarding *health message dissemination,* a distrust of health message credibility, language barriers and health illiteracy resulted in traditional methods of health message dissemination (posters, pamphlets, billboards, and mass media) used, not to have the desired impact. Participants indicated that, even though they found posters and pamphlets acceptable, a need for oral explanations of posters and pamphlets bearing health messages was expressed. In addition, they also faced real challenges with the implementation of and adherence to these health messages. In this study population, only the younger participants indicated a preference for receiving health messages via electronic devices. This might be due to many of the older participants not owning a cell phone, not having money available to purchase airtime or being unable to read the messages due to poor eyesight. Health messages were perceived to be credible when it was disseminated by a health professional, such as a doctor or nurse.

7.3.3 Tackling the chronic non-communicable diseases epidemic in the Western Cape: Are health professionals on track?

The main findings of the third phase which are presented in a manuscript format in Chapter 6 are as follows:

At community level, unemployment, peer pressure, family responsibility, accessibility to facilities, taste preferences and availability of recommended foods and beverages were identified as barriers to the implementation of and adherence to CNCD programmes. Community participants also expressed a need for practical advice on what foods are associated with weight gain, healthy recipes and purchasing hints. Community participants were all aware of CNCD programmes (diabetes club, exercise class) offered in their community.

At government level, all the DoH officials interviewed were aware of and knowledgeable about the policies which have been developed for DM, CVD, cancer and chronic respiratory diseases. The DoH officials perceived amongst others, a lack of inter-sectoral collaboration, difficulty in finding a balance between health and developed countries' investments (e.g. Kentucky Fried Chicken, Burger King and McDonald's opening enterprises in the country) and not obtaining buy-in from the business sector prior to the drafting of policy and

legislation to be obstacles to addressing the CNCD epidemic. In addition, DoH officials perceived a lack of ownership by communities, crime and urbanisation to be obstacles in addressing the CNCD epidemic.

Community participation, improving inter-sectoral partnerships, integration of health services, food taxes and subsidies of healthy foods were viewed as the best options to address the CNCD epidemic by DoH officials.

7.4 Research hypotheses acceptance / rejection

Illiteracy, accessibility and lack of community ownership were perceived as barriers to CNCD interventions by both the community and government participants. Community participants expressed the need for recipes, health education and shopping lists for the prevention and/or management of CNCDs. In contrast, DoH officials indicated that community participation, improving inter-sectoral partnerships, integration of health services and food taxes were the best courses of action to address the CNCD epidemic. The subsidisation of healthy foods was also a course of action identified by DoH officials to best address the CNCD epidemic. Community participants however indicated that foods recommended by CNCD programmes were not readily available to them, not to their taste and they perceived these to be more expensive. Based on the findings, there was a difference in the perceptions between the DoH officials and the community members regarding what is required from an intervention programme. Community participants were aware of CNCD programmes available in their community. Those individuals who indicated a willingness to participate in CNCD intervention programmes cited concern for their health and the fact that there was support as reasons. In addition, the participants indicated that dietary health messages at the time were not culturally acceptable to them. The following hypotheses were thus accepted:

- Government and community participants have different perceptions of what is needed in intervention programmes.
- Individuals will be more willing to participate and adhere to advice provided by intervention programmes, if they perceive it to meet their needs.
- Individuals will be more willing to participate and adhere to advice provided by intervention programmes, if they find it to be culturally acceptable.

Community participants were aware of CNCD intervention programmes, although they faced challenges accessing these programmes. The following hypothesis is thus rejected:

- Individuals suffering from CNCDs are not aware of intervention programmes offered in their community.

7.5 Discussion and conclusion

The key study findings are that participants are faced with multifaceted challenges with the implementation of and adherence to CNCD intervention health messages. These were social, economic, personal (taste preferences), environmental and cultural factors. Participants in this study were also concerned about safety, peer pressure, family responsibility and accessibility to health facilities where CNCD interventions are offered. Despite these challenges, participants indicated that the support they would receive from peers and health professionals when participating in a CNCD intervention programme would motivate them and make them feel that they are not the only ones with this disease. This finding is supported by Bonilla and colleagues (2016), who identified that CNCD intervention programmes do not take into account the impact that socio-economic status, loneliness and poverty have on adherence to and management of CNCDs. In addition, the culturally-insensitive food recommendations, the cost and lack of availability of the recommended foods in the community also contributed to non-adherence. There is evidence showing that CNCDs are affecting more persons of lower socio-economic status than before (Verstraeten, *et al*., 2014). This could be attributed to, amongst others, urbanisation and the adoption of a non-traditional diet high in "unhealthy" foods which are cheaper than "healthy" foods and decreased physical activity (Verstraeten, *et al*., 2014; Muzigaba, *et al.,*2011; Pretorius, *et al.,* 2011; Winham, 2009). The need expressed for education is an indication that the health messages are either not reaching the target population, that these messages are misunderstood, or are that they had insufficient impact since they are not culturally-sensitive and not in the home language of the community. Results from two studies which investigated the role of culturally-acceptable education and adherence to hypertension treatment and another which investigated the link between health literacy and diet adherence in hypertensive persons, showed that culturally-adapted education aided in improved adherence to hypertension treatment (medical and lifestyle) recommendations (Meinema *et al*., 2015; Hutchinson, *et al.*, 2014).

Studies conducted on the acceptability of health message dissemination via cell phones found this mode of message dissemination to be acceptable to their study populations in Bolivia and India (Kamis, *et al.*, 2015; Hall, *et al.*, 2015; De Souza, *et al.* 2014). Regarding health message dissemination in the current study, only the younger participants indicated a preference for receiving health messages via their cell phones. This could indicate that modern technology (e.g. smartphones, internet) which notably makes the dissemination of health messages easier, might not be accessible to all, especially the older generations. Participants of this study indicated that they still preferred individual counselling by health professionals.

It has been reported that, in South Africa, black adult women tend to be more overweight compared to other South African race groups (Gitau *et al.,* 2014). In this study, 36% of the participants were categorised as overweight/obese, however, most of them indicated that they were satisfied with their weight and were not interested in enlisting with a weight loss group. This finding is supported by other studies (Okop, *et al.,* 2016; Gitau, *et al.,* 2014; Puoane, *et* al., 2010). Readiness of overweight and obese individuals to participate in CNCD intervention programmes remains a major challenge globally (Swinburn & Arrol, 2016).

The integration of health services was one of the options viewed as favourable to address the CNCD epidemic by most of the DoH officials. They were of the opinion that the integration of health services would enable better health care and decrease stress on health personnel. The most recent General Household Survey undertaken by the Census and Statistics Department (CSD) found that the majority of people surveyed were not satisfied with healthcare service provision (STATSSA, 2016). Much has been written regarding current health systems and their inability to address or cope with the CNCD epidemic (Bonilla, *et al.*, 2016; Kengne, *et al.,* 2014). Currently the main health priority for South Africa is the HIV/AIDS epidemic, but as pointed out by Mayosi*, et al*, (2009) the CNCDs problem is increasing. However, as spelled out in the South African declaration on the prevention and control of non-communicable diseases (2011), HIV/AIDS–afflicted persons tend to develop CNCDs either due to their pharmacological treatment or with their increased life expectancy. Research into the integration of HIV/AIDS and CNCD care has shown promise (Van Deventer, 2015; Van Olmen, *et al.,* 2012; Reid, *et al.,* 2012). Lithuania is an example of a resource-poor country which has successfully integrated its healthcare services resulting in a decreased mortality rate

due to stroke and heart attacks. In addition, this integration of healthcare services has resulted in greater outpatient services and improved management of hypertension and diabetes mellitus (WHO, 2016).

Another strategy viewed as favourable to address the CNCD epidemic by DoH officials was food taxation. Food taxation has been explored in literature as a viable option to reduce obesity (Niebylski, *et al.,* 2015; Lin, *et al,* 2011; González-Gapata, *et al.,* 2010). Excessive consumption of sugar and sugar-sweetened beverages and high fat intakes have been implicated with weight gain which consequently increases the risk for the development of CNCD (Mchiza, *et al.,* 2016, Vorster, *et al.*, 2014). Mexico implemented a sugar tax in January 2014 as a strategy to reduce its prevalence rate for diabetes, overweight and obesity which has resulted in a decrease in sales of and thus consumption of sugar-sweetened beverages (Colchero, *et al*., 2016). The South African government is aiming to introduce a sugar tax in 2017 in a strategy to address the obesity epidemic (Donnelly, 2016; National Treasury, 2016).

Diet quality has been shown to play a role in the development and prevention of CNCD (Phillips, *et al.,* 2013; Harrington, *et al.,* 2013; Fung, *et al.,* 2010; Fung, *et* al., 2008). In the current study, no significant differences were found between the blood pressure, or adiposity variables of participants who had the lowest and highest dietary adherence score, but a significant inverse correlation between the dietary adherence score and SBP in women was found.

Education is very important as evidenced by the community indicating that they had a need for it and by the various materials (posters and pamphlets) developed and made available by the DoH. It has been shown that primary healthcare (PHC) facilities, where the majority of people with CNCDs receive medical care, can play a crucial role in educating the population on lifestyle modification needed to assist them in the prevention and management of CNCDs. Healthcare staff based at PHC facilities are, however, often not knowledgeable about lifestyle modification and too little staff with expertise in lifestyle modification are based at PHC facilities (Swinburn, & Arroll, 2016; Parker, *et al.,* 2010).

The community participants identified accessibility to facilities where CNCD interventions are offered as a challenge, and the DoH officials identified a lack of recreational facilities as an obstacle to addressing the CNCD epidemic. Illiteracy was also identified as an obstacle in addressing the CNCD epidemic and this is evidenced by the community participants identifying the need for health education to be offered in their home language. Concern for safety was another challenge to the implementation and adherence to CNCD interventions identified by community participants. Likewise, DoH officials identified crime which resulted in communities being unsafe for walking and outdoor activities as an obstacle to addressing the CNCD epidemic. Community participants also expected to receive incentives to attend CNCD intervention programmes. This could be seen as not taking ownership of their health, which was also identified as an obstacle by DoH officials.

This study has succeeded in identifying context-based challenges associated with the implementation of and adherence to CNCD health messages. In addition, context-based expectations of CNCD intervention programmes were identified and acceptability of the different modes and location of health message dissemination were ascertained. The study also found that at community level there were a combination of reasonable (health education, recipes, shopping lists) and unrealistic (expecting incentives) expectations. At DoH level, some of the expectations expressed by the community have already been met in the government's *WoW*! and other programmes aimed at CNCDs, for example recipes for healthy dishes. Strategies that members of the DoH perceived to be best to combat the CNCD epidemic were identified, as well as the needs that community members had from CNCD intervention programmes. Integrating the health services could assist the community members in terms of accessibility and travelling costs. Food taxation could discourage the community from spending money on sugar-sweetened drinks with low nutrient density. This could thus result in decreasing their intake of sugar. Similarly, the community's salt intake can be reduced, if the levels of salt are decreased in the foodstuffs that they regularly consume.

In conclusion, the current study's findings have shown that the implementation of and adherence to CNCD interventions are complex and multifactorial and even though there is a place for generic CNCD health messages, these messages need to be adapted so that they are practical and context-based.

New contributions from this PhD study are that CNCD intervention programmes should be context-based. Additionally, although traditional methods of health message dissemination were found to be acceptable, there is a need for an oral explanation of the content. This could be due to low health literacy levels, illiteracy, language barriers and/or poor eyesight. In addition, the study population questioned the credibility of health messages disseminated by means of media (magazines, television, videos) since they did not have a personal interaction with the person imparting the advice. Health professionals might not have been aware that the credibility of the health message source was being questioned and this might have been the reason for the low adherence rates to CNCD interventions. Thus, a survey should preferably be done to determine the acceptability of these modes of message dissemination in communities prior to employing these modes of health message dissemination.

7.6 Recommendations

Based on the findings of this study, the following are recommended:

- Chronic non-communicable disease intervention programmes should be context-based.
- Culturally–adapted education on the role of nutrition in weight gain and loss and how to adapt recipes for food traditionally consumed to make them healthier, should be incorporated in CNCD intervention programmes.
- Support groups should be formed in communities to encourage adherence and provide motivation. This is evidenced by the finding that participants were willing to join a CNCD intervention group since the felt they will be provided with support and won't feel alone.
- The sociocultural perceptions of body image need to be addressed in a sensitive manner. This is evidenced by the finding that, even though more than half the community participants were overweight or obese, they indicated that they were happy with their weight and did not need to lose weight.
- Health message dissemination should occur via various modes and languages in order to reach as many people as possible.
- Future research should be carried out on the barriers to and acceptability of health message dissemination via cell phone in the older black community members.

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