Theory and evidence-based development and feasibility testing of a weight loss intervention (Health4LIFE) for overweight and obese primary school educators employed at public schools in low-income settings, Western Cape Province, South Africa

By

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Health4LIFE

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DECLARATION

I, Fatima Hoosen, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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ABSTRACT

Background:

Bearing in mind the prevalence of overweight/obesity found among educators (teachers) and their role modelling function, it is imperative that appropriate weight loss interventions are developed and implemented to control obesity in this target population, while ensuring that they model a healthy body size and lifestyle behaviours in their teaching environment. The United Kingdom (UK) Medical Research Council (MRC) state that best intervention development practice involves a systematic approach where best published research evidence and most suitable theories are combined, referred to as the 'theory and evidence-based approach'. Intervention development should inherently consider behaviour change theories to assist researchers in deciding which theoretical constructs to target to achieve behaviour change. The MRC guidance recommends that following the development of an intervention, the next step should focus on feasibility testing to advise full-scale evaluation and implementation in real world settings. A feasibility study allows an intervention to be refined by either making incremental or simultaneous adaptations throughout the feasibility study, as well as during all phases of the development of the intervention

Aim:

The aims of this research were to 1) conduct a theory and evidenced-based process to develop a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa and 2) to test the feasibility of the developed intervention in a mixed methods study design.

Intervention development

Methods:

This research firstly involved identification of an appropriate intervention development framework and then behaviour change theories for integration in the framework. The Behaviour Change Wheel (BCW) integrated with the Theory of Planned Behaviour (TPB) to gain insight in educator beliefs regarding dietary and physical activity behaviours and the Health Belief Model (HBM) to address the concept of health awareness (first step to behaviour change) were selected. The Step approach to Message Design and Testing (SatMDT) tool was chosen to underpin intervention message development. The systematic process approach applied in the development of the weight loss intervention in this research included five overarching stages, namely 1) identifying the target behaviours for weight loss, 2) understanding the behaviour, 3) identifying the intervention options, 4) identifying the content and implementation options, and 5) testing and refinement of the intervention

materials. Key considerations that emerged in various steps that determined decisions regarding delivery format, are as follows: target population specific factors, setting, affordability, access to electronic devices and internet, limited or no professional contact and preference regarding weight loss intervention delivery mode.

Outcome:

Step by step application of the BCW framework combined with the TPB, the HBM and the SatMDT resulted in the development of the self-help Health4LIFE weight loss intervention consisting of three elements: 1) a wellness day, 2) a hard copy self-help manual and 3) 80 text messages sent over a 16-week period. The discussion of this section of the thesis focuses on critiquing the use of a theory-based approach (BCW combined with the TPB, HBM and SatMDT) in intervention development.

Feasibility testing/assessment

Methods:

Feasibility outcomes that were identified for the purposes of this research included reach, applicability, acceptability, implementation integrity (primary outcomes), and signals of effect in terms of belief patterns (diet and physical activity beliefs), stage of change for dietary and physical activity behaviours, lifestyle behaviours (diet and physical activity) and weight (secondary outcomes). A cluster sampling method was used to randomly select public schools within the Metro North District in the Western Cape Province. These schools were contacted and educators were invited to participate in the wellness day and the subsequent intervention. Random sampling of schools was repeated until the target of 20 schools was achieved. Ten of these schools were then randomly assigned to the control and 10 to the intervention group. Three sub-studies were conducted to assess the feasibility outcomes. Sub-study 1 involved testing the intervention in a pilot randomised controlled trial. The intervention group received the Health4LIFE weight loss intervention, and the control group received a hard copy of the Department of Health's 'Choose a Healthy Lifestyle' booklet. Analysis to assess within group change and differences between groups for within group change over the 16-week period were done by protocol, thus using data for completers only. Sub-study 2 investigated the perceptions of educators who participated in the intervention arm and sub-study 3 the perceptions of principals of participating schools regarding reach, acceptability, applicability and implementation integrity.

Results:

Recruitment (n= 137) and drop-out (n=52) statistics indicated that reach was acceptable, with the exception of male educators who were underrepresented, and black African educators and educators who had attempted weight loss before who were more likely to drop-out. Barriers that may compromise school participation include interruption of teaching time, prior commitments by schools/educators, an already full school program and need to obtain permission from the Department of Basic Education (DoBE) for deviations from the normal school day. Qualitative inputs from principals and educators supported acceptability and applicability of the intervention They were positive about the wellness day, approved of implementation in the school setting, found the hard copy manual useful, enjoyable and easy to understand, and considered the text messages to be helpful and motivational for the day. It was evident that aspects that may need refinement include self-monitoring activities, low frequency of contact with interventionists and arrangement of visits to the school. The planned implementation procedure (wellness day, engagement with most sections in the manual and sending of text messages) went as intended, reflecting good implementation integrity, with the exception of the drop-out of three entire schools due to scheduling challenges.

Clear signals of effect were evident. The Health4LIFE intervention resulted in favourable shifts in belief patterns regarding dietary intake and physical activity; favourable shifts in stage of change for “increase fruit intake” and “decrease sugar intake”, significant changes in some lifestyle behaviours (increased intake of low fat food items, increased intake of vegetables, decreased intake of sugary food items, decreased frequency of adding fat and sugar to food, increase in physical activity and decreased time spent being sedentary) and a trend towards weight loss in the intervention group. The only significant changes in the control group related to dietary intake (increased intake of vegetables and increased intake of low-fat foods).

Overarching conclusions and recommendations:

Although the time and effort required to follow a systematic process using the BCW cannot be denied, at the end of this process a very clear understanding of the determinants of a specific behaviour and the mechanisms of action required to affect behaviour change is achieved. These insights are imperative for identification of the most appropriate intervention delivery mode and development of the intervention content. This research provides a comprehensive and systematic guide to using the BCW in a theory and evidence-based process for the development of a self-help weight loss intervention.

Results reflecting reach, acceptability, applicability, implementation integrity and potential effectiveness of the Health4LIFE intervention support feasibility of the intervention. Material signals

of effect in terms of shifts in belief patterns and stage of change, as well as improvements in lifestyle behaviours were evident. It is plausible that these shifts and changes could collectively result in weight loss, as a trend towards weight loss were found. These signals of effect warrant further evaluation of the intervention in a full-scale study and/or consideration for implementation by the DoBE.

Based on the feasibility outcomes it is recommended that the following minor refinements of the Health4LIFE intervention receive attention before next steps are taken: recruitment of male educators, drop-out of black African educators and those who have attempted weight loss before, lack of DoBE policies to address educator health and wellbeing, educator suggestions to improve the intervention manual and poor completion of self-monitoring activities. Major intervention refinements that emerged from the feasibility testing for consideration include more frequent in-person contact between educators and interventionists, extending intervention duration, and making use of eHealth options for contact sessions and self-monitoring. However, the feasibility of major refinements would require additional investigation, further extending the already lengthy intervention development process. Bearing this in mind, implementation of the Health4Life intervention in public schools in low-income settings in its current format, but with minor changes to the hard copy manual as recommended by educators, should be considered.

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LIST OF ABBREVIATIONS

ACC: American College of Cardiology
ADA: American Diabetes Association
AHA: American Heart Association
AIDS: Acquired Immunodeficiency Syndrome
AMDR: Acceptable Micronutrient Dietary Range
AND: Academy of Nutrition and Dietetics
ANGELO: Analysis Grid for Environments Linked to Obesity
APEASE: Affordability, practicality, effectiveness and cost-effectiveness
Apps: Applications
AT: Acceptance Therapy
BCT: Behaviour Change Technique
BCTT: Behaviour Change Technique Taxonomy
BCW: Behaviour Change Wheel
BDI: The Beck Depression Inventory
BMI: Body mass index
CALO-RE taxonomy: Coventry, Aberdeen & London – Refined taxonomy
CBT: Cognitive Behavioural Therapy
CDC: Centres for Disease Control and Prevention
cm: centimetres
CNS: Central Nervous System
COM-B model: Capability, Opportunity, Motivation – Behaviour model
DASH: Dietary Approaches to Stop Hypertension
DoBE: Department of Basic Education
DoH: Department of Health
DoHHS: Department of Health and Human Services
DoNT: Department of National Treasury
DPP: Diabetes Prevention Program
e.g.: for example
EDLN: energy dense low nutrient
eHealth: Electronic health
et al: and others
FBDG: Food Based Dietary Guidelines
GBD: Global Burden of Disease Study
GCP: Good Clinical Practice
GPAQ: Global Physical Activity Questionnaire

Health Belief Model (HBM)

HIV: Human Immunodeficiency Virus

HK: HealthKick

ICASA: Independent Communications Authority of South Africa

IM: Intervention Mapping

INDEX: IdentifyiNg and assessing different approaches to DEveloping compleX interventions

IQR: Interquartile range

ISHP: Integrated School Health Policy

Kcal: Kilocalories

Kg/m^2: Kilograms per square metre

Kg: Kilograms

LMICs: Low-and middle-income countries

LSM: Living Standards Measure

LTFU: Lost to follow-up

MAP-IT: Matrix Assisting Practitioner's Intervention Planning Tool

METs: Metabolic equivalents

mHealth: Mobile health

MI: Motivational Interviewing

Min: Minutes

mmHg: Millilitres mercury

MRC: Medical Research Council

N/A: Not applicable

NCD: Non-communicable diseases

NCD-RisC : The NCD Risk Factor Collaboration

NDP: National Development Plan

NPC: National Planning Commission

NPT: Normalisation Process Theory

OpenMRS: Open Medical Record System

PCA: Principal Components Analysis

PhD: Doctor of Philosophy

PRECEDE: Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation

PROCEED: Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development

R: South African Rand

RCT: Randomised Controlled Trial

SADHS: South African Demographic and Health Survey

SANHANES: South African National Health and Nutrition Examination Survey

SatMDT: Step approach to Message Design and Testing

SD: Standard deviation

SMS: Short message service

Social Cognitive Theory (SCT)

SSB: Sugar sweetened beverages

TDF: Theoretical Domains Framework

TOS: Task Force on Practice Guidelines and The Obesity Society

TPB: Theory of Planned Behaviour

Transtheoretical Stages of Change Model (TTM)

UCT: University of Cape Town

UK: United Kingdom

UNICEF: United Nations Children's Fund

US: United States

WC: Waist circumference

WHO: World Health Organisation

CHAPTER 1

INTRODUCTION, PROBLEM IDENTIFICATION AND AIMS OF THE STUDY

1.1 Introduction and problem identification

1.1.1 Overweight and obesity: A public health concern in South Africa

Overweight and obesity have been defined by the World Health Organisation (WHO) as the accumulation of an abnormal or excessive amount of fat mass which may directly or indirectly contribute to the development of serious metabolic disorders such as cardiovascular disease, (mainly stroke and heart disease which were the leading cause of death in 2012, worldwide), diabetes, musculoskeletal disorders and some cancers [WHO, 2020]. Overweight and obesity have been found to be problems of high-income countries, as well as low- and middle-income countries (LMICs), including sub-Saharan African countries [WHO, 2020]. An increase in body mass index (BMI) across the African regions has been noted from 1980 to 2014, with the highest mean BMI being recorded in Southern Africa [NCD Risk Factor Collaboration (NCD-RisC), 2017].

Since 2003 until 2016, national South African surveys have shown that the prevalence of overweight and obesity has been steadily increasing. The 2003 South African Demographic and Health Survey (SADHS), the 2012 South African National Health and Nutritional Examination Survey (SANHANES) and the 2016 SADHS reported that the combined prevalence of overweight and obesity in males was 29.2%; 30.7% and 31% respectively and in females it was 56.6%; 64.0% and 68% respectively [DoH, 2019; Shisana et al., 2013; DoH, 2007]. In addition, the mean BMI increased across all age categories, provinces and race groups from 2002 to 2012 [Shisana et al., 2013]. It has been estimated that among adults in South Africa, obesity was the cause of 78% of type 2 diabetes, 68% of hypertensive disease, 45% of ischaemic stroke, and 38% of ischaemic heart disease cases [Okop et al., 2015; Joubert et al., 2007].

Fundamentally obesity develops because of an energy imbalance where energy intake exceeds expenditure. According to Stipanuk (2019) important questions in this regard are why energy balance tends to err to a positive balance, and what predisposes some to this phenomenon. When considering available evidence, the most plausible answer lies in interactions between genetic/physiological and environmental/social factors [Stipanuk, 2019]. As interindividual variance in body composition, which can partly be explained by genetics, has always been present, the rapid increase in obesity over the past four decades can best be explained by involvement of societal and environmental factors that have contributed to changes in dietary and physical activity patterns [Stipanuk, 2019]. Key examples of these changes include increased intake of energy dense low nutrient (EDLN) foods and reduced physical activity owing amongst others to labour saving devices, motorized transport, as well as sedentary occupations and leisure time activities [WHO, 2021; Stipanuk, 2019; Ford et al., 2017].

The WHO developed a global action plan for the prevention and control of non-communicable diseases (NCDs), which included a focus on obesity prevention and control, in 2013. By signing onto

the strategy, member countries agreed to implement it with high priority. The first step of implementation of this action plan is typically the development of public policies by governments to influence health behaviour and improve obesogenic environments [WHO, 2013]. Three notable policies which governments have implemented to meet the agreed NCD prevention and control targets include taxes or levies implemented on sugar-sweetened beverages (SSB), clear labelling of the nutritional content of foods and beverages on the front packaging, and restricted marketing of specific foods and beverages to children [Lobstein et al., 2020]. Examples of policies that have been implemented in South Africa include the SSB tax in 2018 [Department of National Treasury (DoNT), 2016], which took years to implement due to protracted consultations with beverage manufacturers and the sugar industry. Another example includes the phased mandatory salt reduction across the main contributors of salt in processed foods which commenced in 2013 [Foodstuffs, Cosmetics and Disinfectants Act, 2013]. In 2010, the Department of Health (DoH) issued a National Development Plan (NDP) where "Outcome 2", commonly known as "Vision 2030", was focused on NCD control and prevention [National Planning Commission (NPC), 2012]. The South African government has had NCD policies in place since 1994 but it was only in 2012 that a comprehensive National Health Strategic Plan was developed which focused on all NCDs [DoH, 2013]. The first policy that specifically targeted obesity, the "South African Strategy for the prevention and control of Obesity: 2015-2020", was developed and released in 2015 [DoH, 2015]. One of the targets of this policy was reducing obesity prevalence by 10% by 2020. However, nothing has as yet been published on whether this goal was achieved or not. The latest National Health Survey has been planned for the current year (2022). To date (February 2022) the strategy has also not yet been updated.

1.1.2 Overweight and obesity: A public health concern among educators in South Africa

The focus in this study is specifically on educators as they were found to be a NCD risk group in research conducted by the South African Medical Research Council (MRC) since 2007. The MRC research focused on the development and implementation of a primary school-based nutrition and physical activity intervention in low-income settings aimed at reducing diabetes risk (HealthKick, HK) [Draper et al. 2010]. The programme did not only promote healthful eating habits and physical activity in children, parents, and educators, but also aimed to promote the development of an environment within the school and community that facilitates the adoption of healthy lifestyles [Draper et al. 2010]. The first phase of this research involved intervention mapping and formative assessments [Draper et al. 2010]. This included a situational analysis of the physical and policy environment relating to nutrition and physical activity at 100 urban and rural schools in low socio-economic settings in the Western Cape (50 schools in the Cape Metropole and 50 schools in the Overberg/Breede River districts). A further formative assessment study component included NCD risk assessment amongst

educators in a cross-sectional survey. Principals of the schools identified lack of physical activity (33%) and NCDs (24%) as the main health priorities of primary school educators [de Villiers et al., 2012].

Results from the survey amongst educators from 83 of the 100 HealthKick schools (n=517) confirmed that they were in a high-risk group for NCD development. Thirty seven percent and 35% of males were overweight and obese respectively, while 27% and 55% of females were overweight and obese respectively. In addition, 38% of males and 67% of females had a waist circumference in the risk range and 46% were hypertensive. High non-fasting cholesterol levels were found in 30% and high blood glucose levels in 29% of the educators [Senekal et al., 2015]. In addition, Adeniyi et al. (2017) found that the mean BMI [31.6 ± 7.0 kilogram per square metre (kg/m^2)] for a group of 489 educators recruited from the Metro South Education District of Cape Town fell into the obese class I category [Adeniyi et al., 2017]. The preliminary results of the KaziHealth study, a health intervention programme for primary school educators in disadvantaged communities in Gqeberha, Eastern Cape found that 42% of educators were pre-hypertensive or hypertensive; 26% had elevated blood glucose levels; 26% had slightly elevated or high cholesterol levels; 85% were overweight or obese and 74% were sedentary at baseline [KaziHealth, 2019].

It is a major concern that the health risk profile of educators seems to be worse than the profile found for adults in the SANHANES [Shisana et al., 2013], implying that educators teaching in low-income settings may be at a higher risk of NCDs than the general South African population. In addition to this, the survey conducted by Senekal et al. (2015) also found that many educators had an incorrect perception of their actual body weight and were also unaware of their personal health risks such as being overweight or having hypertension, high cholesterol or high blood glucose levels. Senekal et al. (2015) raised this as a concern as it may reflect a lack of interest in health by the educators, which may result in being uninformed about the need to change their lifestyle or seek the appropriate treatment for any of the NCD risk factors.

Draper et al. (2010) went on to apply insights gained from their HK formative study components in construction of matrices of change objectives for learners. This process involved identification of behavioural and environmental outcomes for the intervention, performance objectives (required actions for achievement of outcomes) and personal and external determinants for each performance objective to facilitate development of change objectives [Bartholomew et al., 2006]. Educators were identified as a potential influence in learners' environment that may impact on their dietary and physical activity patterns. The WHO School Policy Framework (2008) advised that health promotion targeted at educators is thus not only important for their own health, but also because they are role models for the learners [WHO, 2008].

Numerous studies have found that educators do not only promote learner motivation in aspects of education, but also life in general and that they are not simply providers of education but role models of healthy behaviours, a positive attitude, and providers of support to learners [Calder et al., 2019; Drummond et al., 2002; Kruger & Adams, 1998; McCombs, 1994; Mwamwenda, 1996; Olivier, 2006; Vrey, 1979]. Furthermore, a study by Olivier (2006) reported that students remarked that "teachers are supposed to be our role-models" when they were disappointed by unacceptable behaviour from the educators. It is therefore important that educators are aware of and responsible for the health messages they give to learners, whether these messages are actively passed on as part of the curriculum, or in a more passive manner as part of their personal health behaviour, such as healthy eating or being physically active.

1.1.3 Health interventions for educators

Despite the recognised importance of educators in shaping lifestyle and health behaviours of learners, there is a paucity of research regarding health risk related interventions for educators, which is a major gap and concern. A recent systematic review investigated the efficacy of workplace interventions that targeted educators to improve dietary and/or physical activity behaviours [Nathan et al., 2020]. The review identified a limited number of studies (six) and concluded that educators are a novel target group for the implementation of workplace-based health promotion initiatives and that research in this area is required to improve their health behaviours. A further important insight from the review is that half of the included studies targeted educators with the intention of impacting learner health behaviour, and thus educator health was not the primary focus.

Only four studies on interventions that target educator health in South Africa have been published. Two of the interventions focused on nutrition education [Kupolati et al., 2019; Oldewage-Theron & Egal, 2011], and one on health awareness [Joseph et al., 2018]. The KaziHealth intervention is an ongoing health and wellness intervention and the results remain pending [KaziHealth, 2019]. There is thus a dire need for research on feasible and sustainable nutrition-related health interventions targeted at educators. Considering the high prevalence of overweight and obesity among educators teaching in public schools in low-income settings [Joseph et al., 2018; Adeniyi et al., 2017; Senekal et al., 2015], and the inherent risk it holds for NCDs [Ford et al., 2017; Lee et al., 2008; Haslam & James, 2005], obesity control (weight loss) should be prioritized.

Achieving a normal weight (BMI<25 kg/m^2) should not necessarily be the goal of a weight loss programme. Weight reduction of as little as 5% to 10% in the overweight or obese has been shown to be associated with improved cardiovascular risk factors such as reduced blood pressure, reduced blood cholesterol, and improved glycemic control, even if individuals remain in the overweight or obese categories following weight loss [Zomer et al., 2016; Wing et al., 2011]. Although these benefits may be further increased with additional weight loss over an extended period of time, modest weight

loss is readily achievable and this should be the initial goal for obesity management [Sweeting & Caterson, 2017].

There seems to be consensus that the cornerstone of the treatment of overweight or obesity is a comprehensive lifestyle approach that focuses on integration of a healthy dietary intake, recommended levels of physical activity, as well as measures to support behavioural change [Wharton et al., 2020; Wadden et al., 2020; Kushner, 2018; Alamuddin et al., 2016; Bray et al., 2016; Raynor & Champagne 2016; Yumuk et al., 2015; Jensen et al., 2014]. Of note is that healthy eating patterns and achieving physical activity recommendations do not only contribute to weight loss and related health benefits, but also contribute directly to improving NCD risks such as hyperlipidemia, hypertension, hyperglycemia [Davis et al., 2014; Kontis et al., 2014; Ezzati & Riboli, 2012].

1.1.4 Intervention development

Within the context of the socio-ecological approach to health intervention development [McLeroy, 1988], it is important to emphasise from the outset that a suitable and sustainable weight loss intervention should not only target intra-individual influences such as food preferences, attitudes and beliefs that may impact on lifestyle behaviours. Influences at the interpersonal (e.g. family food and physical activity preferences, household food security), institutional (e.g. school setting), cultural (e.g. cultural and social norms and standards related to food and physical activity) and public policy (e.g. economic development, food policy, urbanisation) should also be considered.

The United Kingdom (UK) MRC framework for developing and evaluating complex interventions describes four phases and recommends that once an intervention has been developed in Phase 1, it should be tested for feasibility (Phase 2) before continuing to a full-scale evaluation (Phase 3) and the implementation of the intervention (Phase 4) [Skivington et al., 2021]. Of note is that the phases of the MRC framework are intended to be non-prescriptive and are considered neither linear nor cyclical. Once a feasibility study has been conducted and the intervention refined accordingly, the next step could be either Phase 3 or Phase 4 [Skivington et al., 2021].

Skivington et al. (2021) concluded that best intervention development practice (Phase 1) should involve a systematic approach where best published research evidence and most suitable theories are combined. This approach to intervention development was delineated as the ‘theory and evidence-based category’ by O’Cathain et al. (2019). Further potential approaches identified by these authors include: partnership (target population involved in decision making), target population-centred (based on the views and actions of the target population), implementation-based (focus on real world applicability) efficiency-based (intervention components tested experimentally), stepped or phased-based (focus on systemic overview of development processes), intervention-specific (approach is

constructed for a specific type of intervention) and a combination of these approaches [O'Cathain et al., 2019].

Systematic approaches to intervention development require application of an intervention development framework to guide researchers in a step-wise manner to translate behaviour change theory into practice. Examples of such frameworks include but are not limited to the MRC framework for developing and evaluating complex interventions, the Behaviour Change Wheel, Intervention Mapping, Matrix Assisting Practitioner's Intervention Planning Tool, Normalisation Process Theory and finally the Theoretical Domains Framework [O'Cathain et al., 2019]. A further important consideration in intervention development is integration of behaviour change theory with the chosen framework to assist researchers in deciding which theoretical constructs to target in order to achieve behaviour change. Commonly used behaviour change theories or models include the Health Belief Model [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958], Transtheoretical Model [Prochaska et al., 1992] and the Theory of Planned Behaviour [Azjen, 1991]. There is limited guidance regarding which framework or theories are most appropriate, therefore all available options should be considered and tailored to particular intervention development needs.

Feasibility testing (Phase 2) was either overlooked or rushed in the past, but the importance and value of this phase in intervention development is now widely accepted [Skivington et al., 2021]. A particular concern is that interventions in the public health sector often have tight timelines which do not allow for sufficient feasibility testing, resulting in failed intervention implementation [Kessler & Glasgow, 2011, Sanson-Fisher et al., 2007]. A feasibility study allows an intervention to be refined by either making incremental or simultaneous adaptations throughout the feasibility study, as well as during all phases of the development of the intervention [O'Cathain et al., 2015]. It is not necessarily a scale model of the planned main evaluation but should explore any uncertainties identified in the development phase [Skivington et al., 2021; Craig et al., 2008].

Implementation of the recommended intervention development processes could be time consuming, costly and delay policy development and implementation of actions to address urgent health problems [Hansen et al., 2017; French et al., 2012]. It is thus not surprising that many of the educator workplace interventions identified by Nathan et al. (2020) and the four published South African studies either did not make use of intervention development frameworks or consider behaviour change theory [Oldewage-Theron & Egal, 2011; O'Loughlin et al., 1996] or made very limited use of a framework and/or intervention theory [Kupolati et al., 2019; Wang et al., 2016; Chen et al., 2010; Siegel et al., 2010; Resnicow et al., 1998].

1.1.5 Problem statement

Despite the high prevalence of overweight and obesity reported among educators teaching in public schools in low-income settings, and the recognised importance of educators in shaping lifestyle and health behaviours of learners, there is a paucity of research regarding health risk related interventions for educators, which is a major gap and concern. Although guidance in the literature strongly emphasises the need to make use of an intervention development framework integrated with behaviour change theory when developing an intervention, this systematic approach is not evident in the few published interventions that targeted educator health.

1.2 Aims and objectives

The overarching aims of this study were to conduct a theory and evidenced-based process to develop a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa (Phase 1) and to test the feasibility of the intervention in a mixed methods study (Phase 2).

Phase 1: Theory and evidence-based development of a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa

Specific objectives

The specific objectives for Phase 1 of this research were the following:

- To select an appropriate intervention development framework that is systematic in its approach and theory and evidence-based;
- To identify and integrate appropriate behaviour theory(-ies) in the selected framework for the intervention development;
- To execute the framework in its entirety, following a systematic and step-wise approach;
- To test and refine the developed intervention materials, tools, messages and actions once developed before feasibility testing.

Phase 2: Feasibility testing of the Health4Life weight loss intervention in a sample of overweight and obese primary school educators employed at public schools in low-income settings in Cape Town, Western Cape province, South Africa in a mixed methods study

Specific objectives

The specific objectives of Phase 2 were the following:

- To identify and define feasibility outcomes for the present study;
- To test feasibility of the weight loss intervention in terms of the identified outcomes;
- To formulate recommendations for further refinement and evaluation.

Three sub-studies were executed to achieve the second specific objective of Phase 2:

Sub-study 1: Implementation of the weight loss intervention to test identified feasibility indicators (quantitative)

Sub-study 2: Investigation of the perception of educators on identified feasibility indicators (qualitative).

Sub-study 3: Investigation of the perception of principals of participating schools on identified feasibility indicators (qualitative).

1.3 Outline of thesis

Chapter 2 is a **"Literature review"** which provides perspectives on overweight and obesity prevalence and the sequelae thereof; the etiology of obesity; lifestyle change based management/treatment of obesity; delivery of lifestyle interventions for weight loss; predictors of weight loss and weight maintenance; the health and wellbeing of South African educators; intervention development and behaviour change theories and finally, feasibility testing of interventions.

Chapter 3 covers the "**Theory and evidence-based development of a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape province, South Africa"** (Phase 1 of the study).

Chapter 4 covers the "**Feasibility testing of the developed weight loss intervention in overweight and obese primary school educators employed at public schools in low-income settings in Cape Town, Western Cape Province, South Africa: A mixed methods study"** (Phase 2 of the study).

Chapter 5 provides an **"Overview of the development and feasibility testing of a weight loss intervention (Health4LIFE) for overweight and obese primary school educators employed at low socio-economic public schools in Cape Town, Western Cape Province, South Africa: The pilot study"** as well final conclusions and recommendations.

As Chapters 1, 3, 4 and 5 each commences with an introduction, as well as reference to the overarching or a particular aim of the study, there is unavoidable overlap in content.

Each chapter concludes with a reference list and Appendices are included after Chapter 5.

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CHAPTER 2

LITERATURE REVIEW

2.1 Overview of overweight and obesity prevalence and the sequelae thereof

The World Health Organisation (WHO) defines overweight and obesity as the accumulation of an abnormal or excessive amount of fat mass which may negatively impact health status [WHO, 2020a]. It further defines overweight as having a body mass index (BMI) ≥ 25 kilogram per square metre (kg/m^2) while a BMI ≥ 30 kg/m^2 is considered to be obese [WHO, 2020a]. Overweight and obesity may directly or indirectly contribute to the development of serious metabolic disorders such as cardiovascular disease (mainly stroke and heart disease which were the leading cause of death in 2012, worldwide), diabetes, musculoskeletal disorders and some cancers [WHO, 2020a; Yarahmadi et al, 2013].

The WHO estimates that globally in 2015 more than 1.9 billion adults, 18 years and older, were overweight with 650 million being obese. This equated to 39% of adults being overweight (39% men and 40% women) and 13% of adults being obese (11% men and 15% women). In general, the prevalence of obesity was higher in women than men in all age categories and the greatest sex difference was between ages 50 and 65 years of age. Overweight and obesity rates increased with age from 20 years old reaching its peak between the ages 50 and 65 years, slightly decreasing thereafter [WHO, 2020a]. Overweight and obesity are not only problems of high-income countries. Low- and middle-income countries (LMICs), especially those in urban settings and sub-Saharan African countries, also show increasing trends [WHO, 2020a].

The NCD Risk Factor Collaboration (NCD-RisC) – Africa Working Group reported that across Africa, from 1980 to 2014, the mean age standardised BMI increased in men (21.0 kg/m^2 to 23.0 kg/m^2) and women (21.9 kg/m^2 to 24.9 kg/m^2) [NCD-RisC, 2017]. Over time, the mean BMI increased across all African regions and although comparable to worldwide trends, there were suggestions of steeper curves in women. The highest BMI was recorded in northern Africa for men and in northern and southern Africa for women. When comparing the data to the global average, the highest mean BMI was in southern Africa [NCD-RisC, 2017].

In South Africa, overweight and obesity has been steadily increasing as is evident from the 2003 South African Demographic and Health Survey (SADHS), the 2012 South African National Health and Nutritional Examination Survey (SANHANES) and the 2016 SADHS where the prevalence in males was 29.2%; 30.7% and 31% respectively and in females it was 56.6%; 64.0% and 68% respectively [DoH, 2019; Shisana et al., 2013; DoH, 2007]. From 2002 to 2012 the mean BMI increased across all age categories, provinces and race groups [Shisana et al., 2013]. It has been estimated that among adults in South Africa, obesity was the cause of 78% of type 2 diabetes, 68% of hypertensive disease, 45% of ischaemic stroke, and 38% of ischaemic heart disease cases [Okop et al., 2015; Joubert et al., 2007].

These increasing trends in overweight and obesity and the risk it holds for increasing NCD prevalence, have given rise to the development of global and country specific obesity control policies and strategies. NCD policies have existed in South Africa since 1994 but it was only in 2012 that the South African government released a National Health Strategic Plan, outlining how these targets may be achieved [DoH, 2013]. In 2015, the Department of Health (DoH) further released a 57-page strategy specifically focused on the prevention and control of obesity in South Africa identifying six broad goals which included preventing childhood obesity and creating supportive environments which promote healthy food choices and physical activity [DoH, 2015]. This national strategy was aligned with the existing Strategic Plan for the Prevention and Control of NCDs and the Health Promotion Policy and Strategy. The goal was to reduce the prevalence of obesity by 10% by 2020.

It has however been found that despite these policy level initiatives the prevalence of overweight and obesity continues to increase, particularly in low-income countries [Ndinda & Hongoro, 2017; WHO, 2016a; WHO, 2016b].

2.2 Overview of the etiology of obesity

2.2.1 Theoretical framework for obesity in South Africa

It is well understood that weight gain results when the energy homeostasis of the body is chronically unbalanced, where energy intake exceeds energy expenditure (energy loss from metabolic and physical activity) [McCafferty et al., 2020; Wright & Aronne, 2012; Finkelstein et al., 2005]. However, the etiology of obesity remains complex and includes a range of factors which interact in varying degrees to contribute to the development of the condition [Aronne et al., 2009; McAllister et al., 2009]. Figure 2.1 depicts a theoretical framework of multilevel drivers of obesity in South African adults, involving a complex system of individual, socio-cultural and environmental factors, which impact individual behaviours that determine energy intake (food consumption and choice) and energy expenditure (physical activity and sedentary patterns) [Sartorius et al., 2015]. The 2015 framework was adapted from the ecological systems theory [Darling, 2007] and the sustainable prevention of obesity through integrated strategies conceptual framework [Lakerveld et al., 2012].

LMICs, such as South Africa, have been experiencing demographic, social and economic changes such as rapid urbanisation, increased industrialisation and increasing income in some sectors of the population over the past decade [Global Burden of Disease Study (GBD) 2015 Risk factors Collaborators, 2016]. These changes have been shown to contribute to obesogenic lifestyle transitions, mainly consumption of an energy dense Westernized diet, harmful use of alcohol and lower levels of physical, which have been identified as key drivers of the obesity epidemic [GBD 2015 Risk factors Collaborators, 2016; Zaman et al 2015.].

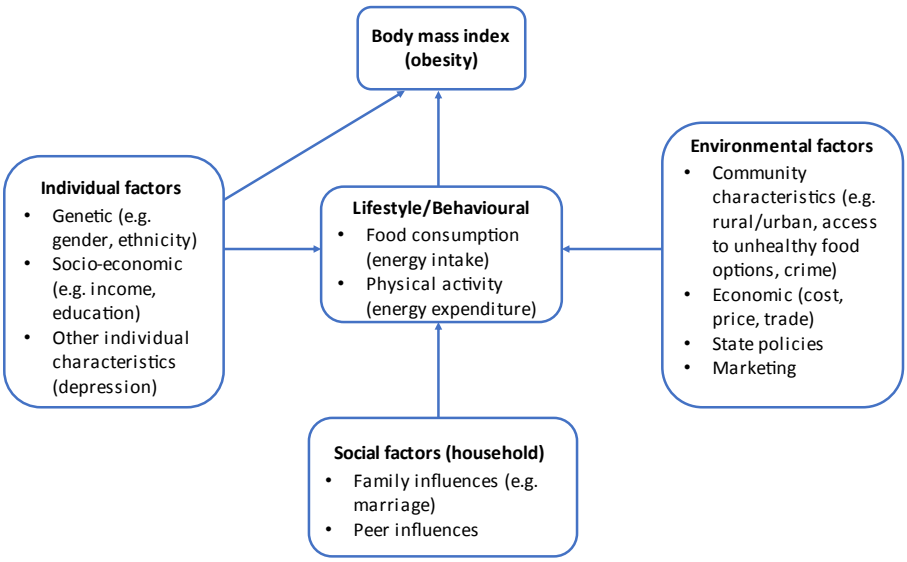

Figure 2.1: Adapted theoretical framework for available multilevel factors driving adult obesity in South Africa [Source: Sartorius et al., 2015]

2.2.2 Environmental factors

Food environmental factors: The home, school, workplace and community environment all play a role in food choices impacting on both the quantity and quality of energy consumed. As a result of technological advances in food processing, foods have become ultra-processed, low in fiber and high in fat, simple carbohydrates and salt [Apovian, 2016; Wright & Aronne, 2012]. These processed foods have been shown to be extremely palatable, easily available, affordable and accessible in large portion sizes, promoting excessive energy intake [Rolls, 2003].

Economic factors: Apartheid law created huge disparities between black and white South Africans in terms of education, access to healthcare and earning capacity. These disparities are still evident today and are reflected in the South African Living Conditions of Household Survey 2014/2015 where black African-headed households on average had household consumption expenditure levels five times less (R67 994, South African Rand) than white-headed (R350 937, South African Rand) households [Stats SA, 2018].

The economic inequalities may in part explain the difference in the prevalence of obesity amongst the ethnic groups [Myer et al., 2004]. Unlike the findings in developed countries, studies in South Africa and Sub-Saharan Africa have consistently demonstrated a positive association between economic-status and obesity [Shisana et al., 2013; Case & Menendez, 2009; DoH, 2007; Mfenyana et al., 2006; Kruger et al., 2001]. These studies indicate that factors which indicate a shift towards a more westernised lifestyle are positively associated with obesity. These factors include 1) access to clean

water and sanitation [Mfenyana et al., 2006], 2) reduced housing density [Kruger et al., 2001], 3) greater expenditure on food [Villamor et al., 2006], 4) higher energy intake [Steyn et al., 2011], 5) increased commuting with motor vehicles and a reduced physical activity or increased sedentary behaviour [Shisana et al., 2013; Delisle et al., 2012; Shayo et al., 2011; Baalwa et al., 2010; Kruger et al., 2002; Kruger et al., 2001]. In addition, Puoane et al. (2006) showed that food choices were affected by an increase in wealth and discretionary income as it was associated with consuming larger portion sizes, an increased intake of fast foods and a greater desire to eat meat products.

Level of education, closely associated with economic status, has also been positively associated with obesity in South African and Sub-Saharan African studies [Letamo, 2011; Dake et al., 2010; Mfenyana et al., 2006; Villamor et al., 2006]. However, this relationship appears not to be linear as women with no education and those with tertiary education had a lower BMI than those with some schooling [Puoane et al., 2002]. Micklesfield et al. (2013) suggest that this may be indicative of the huge disparities between education and economic status within the South African population, leading to the extreme disproportion between the wealthy and the poor.

Urbanisation: Urbanisation has been associated with a more westernised lifestyle where differences in diet have been identified as a potential cause of urban-rural differences in obesity prevalence, referred to as nutrition transition [Puoane & Mciza, 2009]. Dietary behaviours associated with obesity include high total energy intake, low fiber, fruit and vegetable intakes and high dietary sugar and fat intakes [Boggs et al., 2011]. Many of these behaviours represent the nutrition transition in developing countries and have therefore been associated with a more Westernised lifestyle [Micklesfield et al., 2013]. Sartorius et al. (2015) confirmed this to be the case within the South African population as well. National data from the 2012 SANHANES reported that males living in urban formal (13.2%) were 2.1 and 1.5 times more likely to be obese than those in urban informal (6.3%) and rural informal areas (8.7%). Females living in urban formal areas were found to have the highest prevalence of obesity (42.2%) and the highest mean BMI (29.4 kg/m^2) [Shisana et al., 2013]. Besides diet, physical inactivity and a greater sedentary lifestyle have also been cited as a major contributing factor to the high prevalence of obesity in urban vs rural communities in South Africa [Cook et al., 2018; Delisle et al., 2012; Kruger et al., 2002].

2.2.3 Social factors

Socio-cultural factors: In some cultures, providing/serving excessive amounts of food is associated with hospitality [van der Valk et al., 2018]. Moreover, in some communities, including those with black African heritage, a large female body size is associated with good health, beauty and wealth [Draper et al., 2016; Puoane et al., 2005; Mvo et al., 1999]. This further impacts on the perceived relationship between obesity and socio-economic status mentioned earlier [Micklesfield et al., 2013] and may make it more difficult to control and manage obesity.

2.2.4 Individual behavioural factors

Dietary patterns: A study in 2017 investigated dietary patterns in four sub-Saharan African countries, including South Africa, and identified two distinct patterns, a mixed diet pattern and a processed diet pattern. The mixed pattern consisted of high intakes of unprocessed foods such as vegetables and fresh fish, but also cold cuts and refined grains while the processed pattern consisted of high intakes of salad dressing, cold cuts and sweets and this pattern was shown to be associated with obesity [Holmes et al., 2018]. This relationship between dietary patterns and obesity is well-established where a prudent diet characterised by high intake of fruit, vegetables and fish has been shown to be inversely associated with obesity [Shab-Bidar et al., 2018; Rodríguez-Monforte et la., 2017] while a more western diet characterised by a high intake of processed and red meats, alcohol and fried foods are associated with an increased risk of obesity [Heidemann et al., 2011]. A systematic review by Mchiza et al. (2015) assessed all dietary studies in South African adults from 2000 to June 2015 and reported dietary patterns with inadequate intakes of fruit and vegetable and dairy, which was attributed to the lack of availability of these food groups in the poorer urban and township areas. Another finding from the review was that the dietary patterns of Black South Africans had the lowest diversity scores, while white South Africans had the highest diversity scores [Mchiza et al., 2015].

Physical activity: If energy intake seems unchanged in a person experiencing weight gain, an altered energy expenditure due to decreased physical activity or resting metabolism may be the reason for the weight gain [van der Valk et al., 2018]. According to the SANHANES results, one out of four males (27.9%) and one out of two females (45.2%) were found to be unfit [Shisana et al., 2013]. Moreover, there appears to be a rural-to-urban gradient where levels of physical activity decrease with increasing urbanisation [Sartorius et al., 2015; Micklesfield et al., 2013]. This effect is corroborated by SANHANES results where females living in urban informal (51.4%) areas had a significantly greater cardiovascular fitness compared to the those in urban formal settlements (33.9%). A similar pattern was found in males where 57.2% in urban formal settlements were found to be fit compared to 74.6% in urban informal areas (74.6%) [Shisana et al., 2013]. In developing countries, it has been found that physical activity related to occupation, domestic and transport activities (activities of daily living) may contribute more to total energy expenditure than leisure-time or recreational activity [Guthold et al., 2011; Armstrong & Bull, 2006].

A sedentary lifestyle does not only contribute to decreased energy expenditure through reduced physical activity but has also been shown to contribute to a reduced resting metabolism [Myers et al., 2017]. In addition, a sedentary lifestyle has also been associated with an increased energy intake [Brownson et al., 2005]. In a recent study investigating sedentary behaviour in six countries, the prevalence of high sedentary behaviour (≥8hours/day) amongst South African participants was 4.6%. Although this was not the highest prevalence, South Africa had the highest prevalence of participants

who were overweight and obese and those who had low levels of activity [Koyanagi et al., 2018]. Globally, as well as in South Africa, there has been a progressive decrease in energy expenditure accompanied with an increase in energy intake which collectively increases the risk of developing obesity [Theilade et al., 2021].

Inadequate sleep: Weight gain has also been associated with poor quality and/or inadequate quantity of sleep [Cappuccio et al., 2008]. This may cause: 1) an increased preference for high energy foods [Greer et al., 2013], hunger and satiety hormonal imbalances [Bayon et al., 2014] and increased cortisol levels which may contribute to obesity risk [van der Valk et al., 2018; Minkel et al., 2014; Manenschijn et al., 2012]. Obstructive sleep Apnea occurs more often in obese individuals but it also has been shown to affect sleep quality and may therefore contribute to obesity, with the resulting behavioural, metabolic and hormonal changes [Shechter, 2017; St-Onge & Shechter, 2016; Shechter, 2016; Drager et al., 2015]. Shift workers have a circadian misalignment which may contribute to obesity as it has been shown to be associated with an increased energy intake and decreased energy expenditure [McHill & Wright, 2017; Broussard & Van Cauter, 2016; Apovian, 2016].

2.2.5 Individual physiological factors

Genetics: A number of polymorphic gene products can cause obesity and more than 100 obesity-susceptible loci have been identified in genome-wide association studies which have been found to be associated with a high BMI and abdominal obesity [Silventoinen et al., 2016]. Bouchard states that there is a genetic component to obesity which accounts for 40% - 50% of the variation in BMI among individuals [Bouchard, 2021] and thus the role which environmental factors play in eating behaviours and levels of physical activity are very important [Theilade et al., 2021]. However, the heritability seems to vary across the BMI categories where it is lower in normal weight individuals (30%) and higher in obese individuals (60% - 80%) [Bouchard, 2021]. Other studies investigating polygenic associations with obesity conclude that genetics appear to determine who will become obese while the environment appears to determine the extent of the obesity [Schousboe et al., 2001; Price & Gottesman, 1991]. Only a small percentage of obese individuals have been found to have monogenic or syndromic obesity disorder [Bays & Scinta, 2015]. Examples of these include Prader-Willi syndrome, Bardet-Biedi syndrome and 16p11.2 deletion syndrome [Miller et al., 2015].

Gender: As previously mentioned, the SANHANES reported a significant difference between the prevalence of overweight and obesity in males (30.7%) and females (64.0%) [Shisana et al., 2013], This trend is corroborated by results of the 2002 (29.2% vs 56.6%) and 2016 (31% vs 68%) SADHSs [DoH, 2019; DoH, 2007]. There have been several explanations offered for this difference in obesity between the sexes. In countries with a low economic status, such as South Africa, studies have shown that females do not have equal access to nutritious food as men due to a lower earning potential, thus creating poverty disparities between the sexes, with females being more prone to obesity than men

[Micklesfield et al., 2013; Wells et al., 2012]. In 2015, nearly half of all households were headed by a female [Stats SA, 2018] which has been attributed to migrant labour and the high Human Immunodeficiency Virus (HIV)-related death rates [Bank, 2008]. In addition, female-headed households were nearly twice as likely to be poor (19.6%) than male-headed households (10.1%). Moreover, the poverty gap and extent of poverty measures were greater for female-headed households when compared to their male counterparts [Stats SA, 2018]. Another reason offered is that in South African households, it is not uncommon for females to be nutritionally deprived which has been shown to be significantly associated with adult obesity. In addition, a higher socio-economic status in adult women has also been shown to be significantly associated with obesity [Case & Menendez, 2009].

Endocrine/hormonal: The neuro-endocrine system which regulates appetite, satiety, food intake and metabolism includes a number of hormones in the brain, digestive system, pancreas and adipose tissue which interacts with peripheral nerves and receptors in the Central Nervous System (CNS) [Theilade et al., 2021; Apovian, 2016;]. Important areas in the CNS which control appetite are signalled by hormones such as leptin and cholecystokinin [Bataille & Dalle, 2014; Simpson et al., 2012]. The blood concentrations of the affected hormones are increased after a meal proportionately to the energy intake and the meal composition [Simpson et al., 2012]. Some individuals however have an increased feeling of hunger or lack of satiety caused by altered hunger hormones (e.g. ghrelin) or satiety hormones (e.g. leptin and peptide YY [PYY]) [Theilade et al., 2021; Apovian, 2016; Heymsfield et al., 2007]. These hormones are and can potentially be targeted by pharmacological management [McCafferty et al., 2020].

Medication: Medication can affect the energy balance by promoting the feeling of hunger or decreasing resting metabolism. It is recommended that medication with weight gaining effects be tapered, stopped or an alternative should be provided to prevent weight gain and improve weight loss when indicated [van der Valk et al., 2019; Apovian et al., 2016]. Commonly known drugs which have been associated with weight gain include corticosteroids, anti-psychotics and anti-depressants [van der Valk et al., 2019].

2.3 Lifestyle change based management/treatment of Obesity

2.3.1 Overview

The management and treatment of obesity includes weight loss as well as improving health and reducing health risks [Yumuk et al., 2015]. It is widely accepted that modest weight loss of only 5% to 10% is associated with significant clinical health benefits such as reduced triglycerides, blood glucose, risk of developing type II diabetes, low-density lipoprotein and blood pressure and may even reduce the need for medication to control type II diabetes and cardiovascular disease [Zomer et al., 2016;

Wing et al., 2011]. Numerous international guidelines therefore recommend a 5% to 10% weight loss over a 6-month period or 0.5 – 1.0 kilograms (kg) per week [Raynor & Champagne 2016; Yumuk et al., 2015; Jensen et al., 2014]. The recent Canadian guidelines suggest that interventions should focus on improving overall health and that its success should be determined by healthy behaviour change regardless of body size and weight [Wharton et al., 2020]. Accordingly, the goals of weight management should encourage realistic weight loss to attain the associated health benefits and must include the promotion of weight loss, maintenance and prevention of weight regain [Yumuk et al., 2015]. Obesity is a chronic disease and its management is therefore a lifelong challenge [WHO, 2011].

There appears to be consensus that the cornerstone of the treatment for overweight and obese individuals is a comprehensive lifestyle approach. This approach integrates a healthier dietary intake, increased physical activity components, as well as measures to support behavioural change (Table 2.1) [Wharton et al., 2020; Raynor & Champagne 2016; Yumuk et al., 2015; Jensen et al., 2014].

Table 2.1: Summary of the components of weight loss interventions, intensity and duration, as well as delivery methods proposed by leading health authorities

Component	AHA/ACC/TOS	AND	European	Canadian
Author	Jensen et al., (2014)	Raynor & Champagne (2016)	Yumuk et al., (2015)	Wharton et al., (2020)
Weight management intervention	Comprehensive lifestyle intervention: reduced calorie intake, increasing physical activity and behavioural strategies	Comprehensive lifestyle intervention: reduced calorie intake, increasing physical activity and behavioural strategies	Comprehensive lifestyle intervention: reduced calorie intake, increasing physical activity and behavioural strategies	Comprehensive lifestyle intervention: reduced calorie intake, increasing physical activity and behavioural strategies
Frequency and duration of treatment	14 individual or group encounters over 6-month period	14 individual or group encounters over 6-month period	Follow-up and continued supervision necessary	Not specified
Weight loss goals	5% - 10% weight loss in 6 months	1kg/week OR 3% to 5% of baseline weight OR up to 10% weight loss	5% - 15% body weight OR 0.5kg – 1.0kg/week	Obesity + prediabetes: 5% - 7% weight loss. Obesity + diabetes: 7% - 15% weight loss
Dietary management	1200kcal – 1500kcal for women; 1500kcal – 1800kcal for men OR 500kcal – 750kcal energy deficit OR evidence based diets which restrict certain food types to create energy deficit	1200kcal – 1500kcal for women; 1500kcal – 1800cal for men OR 500kcal – 750kcal energy deficit OR evidence based diets which restrict certain food types to create energy deficit	500kcal – 1000kcal/day deficit	Any of the multiple medical nutrition therapies to improve health outcomes can be considered which will support the best long-term adherence
Physical activity	Aerobic physical activity ≥150 min/week OR 30 min/day, most days of the week	150 – 420 min/week depending on intensity	Aerobic physical activity 150 min/week combined with 1 – 3 sessions/week of resistance exercise	Aerobic physical activity 30 – 60 min moderate to vigorous intensity exercise most days of the week
Behaviour therapy	Structured behaviour change program which includes self-monitoring,	Self-monitoring, motivational interviewing, structured meal plans and portion	Cognitive behaviour therapy	Combining behaviour modification (self-monitoring, problem-solving, goal setting),

		control, goal setting and problem solving		cognitive therapy and values-based strategies
Alternative modes of delivery	eHealth interventions should be considered if in-person individual or group sessions are not possible. Should include personalised feedback	eHealth interventions recognised as an emerging area and more research required before recommendations are made		eHealth interventions should be considered if in-person individual or group sessions are not possible. Should include personalised feedback. Wearable activity tracking technology should be included

AHA: American Heart Association; ACC: American College of Cardiology; TOS: Task Force on Practice Guidelines and The Obesity Society; AND: Academy of Nutrition and Dietetics; kg: Kilograms; kcal: kilocalories; min: minutes

More detailed perspectives on the elements summarized in Table 2.1 are set out in sections 2.3.2 to 2.4.5.

2.3.2 Diet

The specific composition of a diverse, healthy and balanced diet can vary depending on individual characteristics (such as age, gender etc.), social and cultural norms and foods which are locally accessible [WHO, 2020b]. The fundamental principles of a healthy diet were, however, reported to be consistent globally when the Food Based Dietary Guidelines (FBDG) of 90 countries were assessed for similarities and differences and compared to the WHO healthy eating guidelines [Herforth et al., 2019]. Universal guidelines include consuming a variety of foods; to consume fruit and vegetables, legumes and animal-sourced foods; to limit sugar, fat and salt [Herforth et al., 2019]. FBDG specific to South Africa include to make starchy food part of most meals, to have milk, maas or yoghurt daily and to drink lots of water. It also specifically advises to use vegetable oils rather than hard fats, like the WHO recommendations [WHO, 2020b; Vorster et al., 2013]. In addition, WHO also recommends the consumption of nuts and wholegrains [WHO, 2020b].

It is well accepted that energy restriction is required to achieve weight loss. The AHA (American Heart Association)/ACC (American College of Cardiology)/TOS (Task Force on Practice Guidelines and The Obesity Society) (2014) recommend an energy deficit of 500 to 750 kilocalories (kcal)/day which will yield an average weight loss of 0.5 to 0.75 kg per week. This equates to approximately 1200 to 1500 kcal/day for women and 1500 to 1800 kcal/day for men [Jensen et al., 2014]. The European guidelines also fall within this range, but also state that an appropriate dietary regimen can be obtained in a range of ways and that general healthy eating advice as well as more specific dietary advice may be provided [Yumuk et al.,2015].

Numerous recent and more dated studies have consistently shown that a balanced hypocaloric diet results in clinically significant weight loss, regardless of which macronutrient is emphasised [Hall and

Guo, 2017; Tobias et al., 2015; Larsen et al., 2010; Sacks et al., 2009; Shai et al., 2008]. The macronutrient composition can therefore be tailored to individual personal and cultural preferences within the Acceptable Micronutrient Distribution Ranges (AMDRs) [United States Department of Health and Human Services (US DoHHS), 2016], thus avoiding extremes such as low-carbohydrate-high-fat diets to have the best chance for long-term success [Wadden et al., 2020; Bray et al., 2018]. It is however important to consider any medical conditions an individual may have as their metabolic profile and risk factors may be better suited to specific dietary prescriptions [Wadden et al., 2020; American Diabetes Association (ADA), 2018; Bray et al., 2018]. Examples of this include the Dietary Approaches to Stop Hypertension (DASH) Diet which would be best suited to hypertensive individuals [Filippou et al., 2020; Blumenthal et al., 2010] while the Mediterranean diet may be better suited for those with metabolic syndrome [Rosato et al., 2019; Estruch et al., 2013; Nordmann et al., 2011].

Many guidelines recommend that as part of a hypocaloric diet, portion control and meal replacements or a structured meal plan should form part of the comprehensive lifestyle programme to decrease caloric intake [Bray et al., 2018; Ptomey et al., 2016; Raynor & Champagne 2016]. Very low-calorie diets (≤800 kcal/day) are not routinely recommended unless circumstances require faster weight loss and must be medically supervised [Bray et al., 2018; Mulholland et al., 2012; Tsai & Wadden, 2006].

For most, a hypocaloric diet of any macronutrient composition will result in short-term weight loss. However, weight loss maintenance becomes a challenge after the first three to six months when weight loss reaches a plateau [Jensen et al., 2014]. Thus, only some can achieve modest long-term weight loss with any hypocaloric diet. Bray et al. (2018) therefore concludes that further research investigating more than macronutrient composition of diets is required to identify dietary patterns, food quality and other factors which improve long-term compliance to ultimately establish the best dietary practices associated with weight control and long-term health.

2.3.3 Physical activity

Regular physical activity has been shown to be protective against the development of NCDs such as heart disease, Type II Diabetes and even some cancers. There are however a variety of other benefits associated with regular physical activity such as mental health benefits which include preventing intellectual impairment and symptoms of anxiety and depression; and promoting and maintaining a healthy weight and general wellness [WHO, 2020c; King et al., 2019; Powell et al., 2019].

The current WHO recommendations for adults are that they should aim for 150-300 minutes of moderate-intensity aerobic physical activity or 75-150 minutes of vigorous-intensity aerobic physical activity for significant health benefits. If lack of time is reported as a barrier to physical activity, multiple bouts of exercise (e.g. 10 minutes) are encouraged throughout the day to increase the level of activity [Jakicic et al., 2018]. Adults are also encouraged to reduce their sedentary time and replace it with

any intensity of physical activity for improved health and weight [WHO, 2020c]. In 2018 the Physical Activity Guidelines Advisory Committee conducted extensive reviews of the literature and found a direct relationship between sedentary behaviour and all-cause mortality, cardiovascular disease incidence and mortality, and type 2 diabetes incidence [King et al., 2019]. The reduced disease risk observed with an increased level of physical activity commences with the addition of any amount of activity and the least active individuals have the steepest slope of risk decline [King et al., 2019]. Recommended exercise programs must be tailored to the individual's health and ability and should gradually be increased to safe levels [Alamuddin et al., 2016; Yumuk et al., 2015].

Along with a reduced energy intake, physical activity forms an integral part of a weight loss intervention as it results in energy expenditure and additional health benefits that are independent of weight loss, as mentioned above [Wharton et al., 2020; Yumuk et al., 2015; Jensen et al.,2014;] Although most data regarding physical activity and weight loss are specific to aerobic exercise, some evidence indicates resistance exercise may hold some benefit for individuals wanting to lose weight [Swift et al.,2014; Willis et al., 2012]. Most scientific guidelines recommend at least 150 min/week or more of moderate to vigorous intensity aerobic exercise for weight loss [Wharton et al., 2020; Powell et al., 2019; Raynor & Champagne, 2016; Yumuk et al., 2015], with some further recommending additional sessions of resistance training to increase muscle mass which can result in fat loss, thereby contributing to weight loss [Wharton et al., 2020; Raynor & Champagne, 2016]. Swift et al. (2018) noted the expected weight loss an individual may experience based on the level of aerobic physical activity. No weight loss is expected with ≤ 150 min/week, 2 – 3 kg weight loss can be expected with 150 – 225 min/week while 5 – 7.5 kg weight loss can be expected with 225 – 420 min/week [Swift et al., 2018]. Higher levels of physical activity are recommended to maintain weight loss of 200 – 300 min/week, depending on the intensity [Swift et al., 2018; Raynor & Champagne, 2016].

A systematic review compared diet or exercise interventions versus comprehensive lifestyle interventions for overweight and obese individuals in randomised controlled trials with at least 12 months of follow-up [Johns et al., 2014]. Interventions included in the review advised moderate to high intensity physical activity three to five times per week. It was found that the exercise-only interventions were less effective than the comprehensive lifestyle interventions in both the short and long term [Johns et al., 2014]. At 6 months, the effect size of diet-only interventions was similar to comprehensive lifestyle interventions, however at 12 months comprehensive lifestyle interventions were more effective. The researchers concluded that physical activity may not be as important for initial weight loss as it is for the maintenance of weight loss [Johns et al., 2014]. These results are consistent with earlier systematic reviews [Söderlund et al., 2009; Avenell et al., 2004].

2.3.4 Psychological and behaviour therapy

The recent Canadian guidelines regard multicomponent psychological and/or behavioural therapy, which are theory-driven programs, as a core component of evidenced-based obesity management [Vallis et al., 2020]. Other international health authorities share this opinion and have thus included it in their respective obesity guidelines [Wharton et al., 2020; Raynor & Champagne 2016; Yumuk et al., 2015; Jensen et al., 2014]. Psychological therapy includes the application of but not limited to Cognitive Behaviour Therapy (CBT), Acceptance Therapy (AT) and Motivational Interviewing (MI), while behavioural therapy includes strategies such as goal setting, self-monitoring, stimulus control, problem solving, cognitive restructuring and relapse prevention [Vallis et al., 2020]. These behaviour strategies were first formalised by Michie et al. (2013) who created a taxonomy to categorise behaviour change techniques (BCTs), which they defined as "the smallest active ingredient" of an intervention [Michie et al., 2013]. An initial list of 26 BCTs were identified [Abraham & Michie, 2008], which were subsequently expanded to 93 BCTs that have been recognised internationally and are referred to as Behaviour Change Technique Taxonomy version1, BCTTv1 [Michie et al., 2013]. Michie et al. (2011a) identified BCTs specific to interventions aimed at improving physical activity and eating behaviours referred to as the Coventry, Aberdeen & London – Refined (CALO-RE) taxonomy.

There are several systematic reviews which have aimed to identify the most effective behaviour change strategies used in weight loss interventions. A summary of BCTs shown to be effective is provided in Table 2.2.

Table 2.2: Summary of effective BCTs/strategies associated with successful psychological and behavioural weight loss interventions in systematic reviews

Strategy/BCT	Description/principle (Michie et al., 2011a)	Systematic reviews identifying effective BCTs
Calorie counting	The energy content for each item consumed is noted and an individual tries to limit total intake to the recommended requirements.	Hartmann-Boyce et al., (2014)
Visiting a dietitian	Including a dietetic consultation provides an opportunity for feedback on progress and a review of behavioural goals and outcome goals.	Hartmann-Boyce et al., (2014)
Social comparison activities	Comparisons are drawn with others who exhibit positive behaviour to increase motivation.	Hartmann-Boyce et al., (2014)
Total number of BCTs	Interventions applying multiple BCTs were more successful than those with limited use of BCTs.	Samdal et al (2017)
Goal setting	An achievable behaviour or outcome goal is clearly identified.	Samdal et al (2017); Burgess et al., 2017a
Stimulus control (prompting use of cues)	Instruction is provided on the use of cues to act as reminders to perform a behaviour.	Samdal et al (2017); Burgess et al., 2017a; Olander et al., (2013)
Motivational interviewing	A clinical method which includes specific techniques to encourage changes by reducing resistance and removing doubts of a participant.	Samdal et al (2017); Burgess et al., (2017a)

Action planning	A clear plan is provided regarding when and where the individual should perform an action.	Olander et al., (2013)
Time management	Techniques are taught to assist with time management to ensure the desired behaviour is performed.	Olander et al., (2013)
Self-monitoring	A record is kept of behaviour or behavioural outcomes to monitor progress.	Olander et al., (2013); Teixeira et al., (2015); Zheng et al., (2015)
Prompting rewards (reinforcement management), including self-reinforcement, behaviour shaping	Providing rewards when a goal is achieved, or progress is made toward achieving a goal.	Burgess et al., 2017a; Samdal et al., (2017); Olander et al., (2013)
Problem-solving	After a clear plan is made, barriers to performing the desired behaviour are identified and solutions to the barriers are developed.	Burgess et al., (2017a)
Relapse prevention	Situations in which a changed behaviour may relapse are identified and methods to avoid a relapse are developed.	Burgess et al., (2017a)
Behavioural contracting	A written agreement is developed between the participant and the practitioner regarding the behaviour change.	Burgess et al., (2017a)

2.4 Delivery of lifestyle interventions for weight loss

2.4.1 Overview

Current obesity guidelines recommend that individuals participate in a comprehensive lifestyle intervention for at least 6 months to attain meaningful weight loss (≥5%) [Wadden et al., 2020; Jensen et al., 2014]. It is also strongly recommended that 14 in-person individual or group sessions are attended in this 6-month period [Raynor & Champagne, 2016; Jensen et al., 2014] as high intensity interventions have been associated with meaningful weight loss, as reported by Perri et al. (2014). Such programs should be delivered by trained individuals, such as dietitians, psychologists, health workers or trained laypersons, who use behavioural therapy to change dietary intake and physical activity behaviour [Jensen et al., 2014]. When compared to individual sessions, group sessions are favoured as it has shown to be more cost effective and yield similar weight loss results [Renjlian et al., 2001]. Wadden et al. (2020) also state that web-based interventions and evidenced-based commercial programs can be considered if it is comprehensive and similarly structured as the in-person sessions.

Several systematic reviews have reported that it is the intensity of an intervention (i.e. the frequency of sessions) rather than the mode of delivery, that is strongly associated with weight loss [Jensen et al., 2014; Wadden et al., 2014; LeBlanc et al., 2011]. However, intensive lifestyle interventions require healthcare providers who have been well-trained and have the time to deliver such interventions, while for the participants, this can also be costly and time-consuming and requires access to healthcare [Wadden et al., 2020]. Within the South African setting, there are huge wealth inequalities

where the bottom 70% of the population earn a meagre 17% of the total annual national income. In addition, South Africa bears a heavy burden of infectious disease with one of the worst tuberculosis infection rates in the world (737 per 100 000), as well as carrying 17% of the global burden of HIV infection. In the private sector, 70% of the country's doctors serve 17% of the population who have private health insurance, while 83% of the population are served by the public sector where only 30% of the doctors are employed. [Benatar & Gill, 2021]. Access to healthcare and healthcare providers in overburdened health facilities is therefore a challenge and the capacity to take on additional responsibilities and duties, such as conducting intensive lifestyle interventions, is limited. Considering various delivery options to ensure the delivery of sustainable and effective lifestyle interventions are therefore important.

2.4.2 Workplace interventions

In recent years, investigation of health programme delivery in the workplace has become a focus in research studies, mainly in high income countries, as it has been shown to be associated with improved employee health [Eng et al., 2016; Goetzel et al., 2014; Loeppke et al., 2008]; improved productivity [Eng et al., 2016; Gates et al., 2008], reduced medical costs [Goetzel et al., 2014; Hochart & Lang, 2011], reduced disease prevalence [Jung et al., 2012; Boshtam et al., 2010] and even more joyful and loyal employees [Fitzgerald & Danner, 2012].

Schneider et al. (2009) maintain that both wealthy and poor South Africans are affected by obesity and NCDs and that interventions aimed at treatment and prevention must be cost-effective, well-planned and feasible across all levels of society. Pratt et al. (2007) suggest that workplace interventions could reach a significant number of working adults from a range of socio-economic and cultural backgrounds. WHO and others have recommended that institutions improve their employee health and wellbeing by approving and enforcing health promotion and NCD prevention programmes in the workplace [Cahill et al., 2014; WHO, 2010].

Workplace interventions have shown positive results regarding psychosocial and behavioural effects on lifestyle factors such as physical activity, smoking and dietary behaviours [Cahill et al, 2014; WHO, 2009]. A 2014 systematic review investigated the effectiveness of workplace interventions which focused on diet and/or physical activity and found that 11 out of the 15 included studies showed small but significant changes in physical activity, fitness, dietary behaviour or weight [Schroer et al., 2014]. Similar findings were observed in an earlier systematic review which consisted of 9 studies [Verweij et al., 2011]. The workplace is considered an ideal site for lifestyle interventions as the number of employees remain constant over the period of the intervention and messengers and regular health check-ups can be included in the design of the intervention [Kim et al., 2015]. Additional benefits associated with workplace interventions include increased productivity, a decrease in absenteeism

and medical costs. The approach of implementing weight loss interventions at the workplace is considered highly effective [Jensen et al., 2014; Wang et al., 2011; Kumanyika et al., 2008].

Wadden et al. (2020) suggest that a community setting, such as a workplace, could be used to deliver a high intensity, comprehensive lifestyle intervention where group sessions could be used instead of individual sessions to reduce costs. High-intensity, community-based interventions have effectively been conducted by trained laypersons or community weight loss specialists [West et al., 2018].

2.4.3 Telephonic delivery

As previously mentioned, a systematic review found that high intensity lifestyle interventions yield meaningful weight loss (6%), whether the delivery mode is in-person or via the telephone [LeBlanc et al., 2011]. Schmittdiel et al. (2017) suggest that interventions delivered telephonically may be able to promote weight loss at a population level. Such interventions are often efficiently conducted by non-physician healthcare providers who provide support, information and skills to promote behaviour change and self-efficacy [Sangster et al., 2015; Tao et al., 2014; Hersey et al., 2012; Terry et al., 2011]. The telephonic mode of delivery can therefore be considered cost-effective with an extensive reach. These sentiments are also shared by Wadden et al. (2020) who describe interventions delivered via telephone as having many benefits such as increased reach to individuals in rural areas, greater convenience and being less expensive. Despite all the potential benefits a telephonic intervention may hold, it is not a widely adopted mode of delivery in weight loss interventions [Schmittdiel et al., 2017].

2.4.4 Self-help delivery

As mentioned above, high frequency, in-person interventions have been proven to be effective in promoting weight loss, but such interventions require specialist health worker inputs and resources, making it expensive. Self-directed interventions or self-help interventions may provide a low-cost delivery option as limited or no professional contact is required and its format may include print, the internet or mobile-delivered interventions [Hartmann-Boyce et al., 2015; Tang et al., 2014].

A systematic review by Tang et al. (2014) on individual-level self-help interventions included 20 reviews. Inclusion criteria were normal weight, overweight or obese adults as a target group, a focus on physical activity and or dietary behaviours and included at least one weight-related outcome such as weight or BMI. Results showed that the modes of delivery of the self-help interventions included the internet, mobile electronic devices, print media and a combination of these. The findings further suggest that self-help weight loss interventions can independently promote weight loss and can also enhance interventions that include a personal contact component [Tang et al., 2014]. BCTs such as self-monitoring, feedback, self-efficacy, enhancement and social and peer support were used in

successful self-help interventions that were reviewed. No conclusions could, however, be drawn by Tang et al. (2014) regarding the most effective BCTs or mode of delivery most strongly associated with weight loss.

In 2015, a similar review was conducted by Hartmann-Boyce et al. (2015), who reviewed randomised controlled trails of self-help interventions, focusing on the content of the interventions rather than the mode of delivery. The primary outcome of the investigation was mean difference in weight change between the study arms at six months after baseline. Twenty-three studies were included; 12 compared self-help interventions with minimal interventions (no additional contact with or without printed information on consequences of obesity), seven compared personalised or interactive programs with fixed interventions (non-tailored, non-interactive), and two compared tailored and interactive interventions with non-personalised, interactive interventions. The modes of delivery applied in the trials included print media, internet, mobile electronic devices that included self-monitoring devices such as pedometers. Self-monitoring and goal setting was the most commonly incorporated BCT amongst the included studies [Hartmann-Boyce et al., 2015].

Of interest is that most of the 23 studies included in this review preferentially included participants that were considered more advantaged by way of the formulated inclusion criteria [Hartmann-Boyce et al., 2015]. This is not surprising, as interventions with a digital component may require expensive equipment such as computers and smartphones as well as data and electricity. Moreover, only one study in the review investigated the association between socio-economic status and intervention outcomes and found that it was more effective in participants with a higher socio-economic status [Beeken et al., 2012]. Bearing in mind the huge wealth disparities in South Africa, self-help interventions that include tailoring and automated interactivity may not be effective for the large majority of the population. Whether minimal self-help options would be suitable for and effective in lower socio-economic groups is questionable. Results of the review suggest that these groups may require more support than what is provided by self-help interventions alone [Hartmann-Boyce et al., 2015].

2.4.5 Digital delivery

Interventions that utilise technology, often referred to as eHealth (electronic health) or mHealth (mobile health), have decreased the need for expensive in-person contact from a specialised healthcare provider. This delivery methods may therefore decrease the costs of interventions and have a much greater reach making it affordable and convenient [Raynor & Champagne, 2016]. Most eHealth interventions include features which assist with self-monitoring and goal setting and provide feedback on diet, physical activity and weight [Wadden et al., 2020]. Some form of personalised feedback has been identified as a critical component of effective eHealth interventions [Schippers et al., 2017; Jensen et al., 2014]. Many programmes use algorithms that generate automated,

personalised feedback based on analysis of self-monitoring data [Tate et al., 2006]. Although such platforms are generally costly, Joseph et al. (2018), in their health awareness intervention for overweight and obese educators found an inexpensive service provider which provides outreach to developing countries such as South Africa, making it a cost-effective option.

The first eHealth interventions were computer-based and included an intervention website (education material, tracking system, discussion board, chat room or email) or a predominantly email-based format where providers interacted with participants via email [Raynor & Champagne 2016]. Although computer-based interventions result in greater weight loss than minimal interventions lasting six months, face-to-face interventions result in greater weight loss than interventions delivered by the internet or email [Jensen et al., 2014; Wieland et al., 2012].

Mobile phone ownership has significantly increased globally and in South Africa, over the last few decades and more recently also ownership and use of smartphones. [ICASA, 2020]. According to the Independent Communications Authority of South Africa (ICASA)'s 2020 report, there were 78 million mobile cellular data subscriptions and more than 53 million smartphone subscriptions nationally [ICASA, 2020]. Stats SA's latest General Household Survey data also revealed that 60% of South African households had internet access using a mobile device in 2018 [Stats SA, 2018].

mHealth incorporating mobile devices and applications (apps) have become increasingly popular with more than 300 000 health apps available, of which nearly 30 000 reported to be weight loss apps [Jimenez et al., 2019; Nikolaou & Lean, 2017; Nichols, 2017], which were not typically developed with the guidance of healthcare professionals (only 0.05%) [Nichols, 2017]. However, there is consensus that smartphone apps can be used to administer weight loss interventions that are cost-effective, evidence-based and personalised [Siriwoen et al., 2018; Toro-Ramos et al., 2017]. In a recent systematic review consisting of 12 studies, smartphone app features such as self-monitoring, personalised goal-setting, feedback, as well as reward system, counselling and social support were found to increase self-regulation, which can promote healthy behaviours and subsequent weight loss [Wang et al., 2020]. Factors that could impact negatively on the effectiveness of smartphone apps include poor digital competence, data privacy concerns and restricted availability of technology [Fleming et al., 2020; Blenner et al., 2016].

Short message service (SMS) or text messaging is a messaging service on mobile phone devices and has been utilised in health and weight loss intervention delivery [Hall et al., 2015]. Messages can include up to 160 characters. Using text messages in intervention is not complex, cost-effective and can serve as a cue to action, making it a popular approach for eHealth interventions [Schippers et al., 2017; Atun & Sittampalam, 2006; Goggin, 2006; Ling, 2004; Rice & Katz, 2003]. Mobile phone usage has been found to be high in overweight population groups and those with a lower socio-demographic

status, making it an ideal delivery mode for weight loss interventions for these groups [Koivusilta et al., 2007; Lajunen et al., 2007; Koivusilta et al., 2005].

Seven out of 14 studies included in a 2012 systematic review reported on the feasibility and acceptability of text messaging as a delivery mode for weight loss interventions. All seven found that text messaging seemed to be feasible and acceptable and demonstrated a significant effect on weight loss, diet or exercise [Shaw & Bosworth, 2012]. Results from a 2014 systematic review support these findings, with participants in weight loss interventions that included a text messaging component, losing on average seven times more weight than participants who did not receive text messaging [Siopis et al., 2015]. Both reviews concluded that there were inconsistencies in timing and frequency of delivery of text messaging across reviewed studies and recommended that further research in this regard was needed [Siopis et al., 2015; Shaw & Bosworth, 2012]. However, Shaw and Bosworth (2012) concluded that at least one text message every day was necessary to motivate participants to engage in weight loss behaviours without it becoming a burden.

The effect of weight loss interventions delivered via mobile phones was also the focus of a 2017 meta-analysis consisting of 12 randomised controlled trials (RCTs) [Schippers et al., 2017]. Although this study demonstrated that trials resulted in significant weight loss, the greatest effect size was observed for weight loss interventions that combined mobile phone delivery with other delivery modes such as email, face-to-face contact or phone calls, to enable personal contact and frequent interactions. Schippers et al. (2017) recommend that further research is required to determine the best additional delivery modes and BCTs to combine with mobile phone delivery to create a greater sense of personal contact for example a personalised text or voice message.

2.5 Predictors of weight loss and weight maintenance

A recent systematic review [Chopra et al., 2021] investigated predictors of weight loss in adults with an average BMI of ≥ 30 kg/m^2 who had enrolled in lifestyle interventions with durations of between six and 12 months. The intensity of studies reviewed were considered comparable, nine studies were conducted in the form of group counselling sessions, seven in individual sessions, two were delivered via the internet and two provided a combination of any two of these options. Results showed that only 14.7% of individuals in short term weight loss programmes (duration of ≤ 6 months) achieved weight loss, 7% of those in mid-term studies (duration 6 - ≤ 12 months) and 43% of those in long-term studies (duration ≥ 12 months) [Chopra et al., 2021]. The lower weight loss in the long-term studies was attributed to weight regain as explained in previous research [Jiandani et al., 2016].

Chopra et al. (2021) further reported that being male, older, married, having a higher education and being retired or in a trade race) were associated with greater weight loss in short- and mid-term interventions. Implementation of lifestyle practices such as healthier dietary intake with a restricted

fat intake, increased dietary restraint and social support, was associated with consistent weight loss, as well as maintenance success [Chopra et al., 2021]. Fenton et al. (2021) also showed that at 6 months, reducing fat intake and the consumption of energy-dense, nutrient poor food were effective in decreasing energy intake in overweight or obese adults.

Early weight loss success, adherence and self-monitoring were also found to be predictors of weight loss [Chopra et al., 2021]. Barriers to adherence identified by Burgess et al. (2017b) in a systematic review included lack of motivation, environmental and social pressures, lack of time, health and physical limitations, unawareness, socio-economic constraints and not enjoying exercise. These researchers suggested that barriers to adherence should be identified early and addressed by the intervention to ensure success. If adherence is improved, the researchers postulate that intervention effectiveness will also improve.

Carraça et al. (2018) identified the most consistent pre-treatment predictor of weight loss to be fewer previous attempts at dieting in a systematic review. This review aimed to identify psychosocial pre-treatment predictors and postulated that habitual attempts at weight loss may be predictive of failure due to a low self-esteem or feeling helpless. Recurrent dieting may also result in the development of disordered eating, negatively impacting weight loss attempts [Carraça et al., 2018]. The researchers suggest that previous weight loss attempts should be assessed before an intervention commences to identify those at risk for poor outcomes so that self-confidence can be increased, and barriers can be addressed as part of the intervention [Carraça et al., 2018].

Insights in predictors of weight loss maintenance come from an earlier systematic review [Varkervisser et al., 2019]. Demographic characteristics were not found to be predictive of weight loss maintenance, while behavioural and cognitive determinants that promote a reduced energy intake and an increased energy expenditure were predictive factors. Recurrent attempts at weight loss causes physiological changes such as a decreased metabolism or loss of lean body mass, resulting in reduced energy needs and failed weight loss maintenance [Carraça et al., 2018].

2.6 The health and wellbeing of South African educators

2.6.1 Educator health status

Research shows that the health of South African educators, as reflected in NCD risk factors, is similar to that of other working adults in the country [Adeniyi et al., 2017; Zuma et al., 2016; Hill et al., 2015; Senekal et al., 2015; Peltzer et al., 2009]. Trends of changes in the health of educators over a 10-year period are evident from the 2004 survey conducted among educators across South Africa by Shisana et al. (2005) and a similar survey conducted in 2015 that was commissioned by the Department of Basic Education (DoBE) [Zuma et al., 2016]. When comparing some of the self-

reported NCD illnesses in these two data sets, it was found that there was an increase in hypertension (22.1% vs 15.6%), diabetes (9.0% vs 4.5%) and heart disease (3.1% vs 1.1%), respectively [Zuma et al., 2016; Shisana et al., 2005]. This increase is consistent with trends illustrated in the national SANHANES conducted in 2012 where females had a significantly higher self-reported prevalence than males for hypertension (20.6% and 12.0%), diabetes (6% and 4%) and heart disease (2.9% and 1.5%), respectively [Shisana et al., 2013].

Senekal et al. (2015) investigated the prevalence of specific NCD risk factors (weight status, blood glucose, blood cholesterol and blood pressure), perceived health and weight and parental NCD history in a group of educators in an urban and rural education district in the Western Cape. The findings indicated that the educators, who were mainly black African or of mixed ancestry, were a high-risk group for NCD development. It was found that 35% of males and 55% of females were obese (BMI ≥ 30 kg/m^2). In addition, 38% of males and 67% of females had a high waist circumference (WC ≥ 102 centimetres in men, WC ≥ 88 centimetres in women) and 46% were hypertensive [Blood Pressure ≥ 140/90 millimetres mercury (mmHg)]. High cholesterol levels were found in 30% and high blood glucose levels in 29% of the educators [Senekal et al., 2015]. The profile of NCD risks and disease found in this study was worse than that found in the SANHANES [Shisana et al., 2013]. In another study, Adeniyi et al. (2017) reported a mean BMI of 31.6 ± 7.0 kg/m^2, which falls in the obese class 1 category, in a group of 489 educators in Cape Town [Adeniyi et al., 2017].

The results of these studies imply that South African educators may be at a higher NCD risk than the general South African population. Research by Joseph et al (2018) in Gauteng and the Western Cape and preliminary results from the KaziHealth study in Gqeberha in 2019 [KaziHealth, 2019] confirmed that educators were a high-risk population for developing NCDs (specific study results provided in section 2.6.2). Zuma et al. (2016) recommended that schools needed to strengthen integrated Employee Health and Wellness programmes, which should include screening for NCDs and approaches, to effectively manage stress. In addition, they encouraged private health providers to partner with this initiative [Zuma et al., 2016].

2.6.2 Health interventions for educators within the South African school setting

For educators to perform optimally, like any other South African employee, they must be encouraged to manage their health. However, research on interventions that focus on health outcomes within the South African school setting is very limited. Two studies that tested health interventions were identified, one of which is still in progress [Müller et al., 2019], but results remain pending as the study is ongoing [KaziHealth, 2019].

Joseph et al. (2018) investigated whether educators who were exposed to a tailored print letter, SMS-text communication (8 tailored messages over a 5-month period) and standard-of-care feedback

would experience greater health benefits than educators who were exposed to a standard-of-care wellness day with targeted feedback. The study included twenty-seven schools in Gauteng and the Western Cape. Six were quintile 2 and eight were quintile 3 schools, which are the poorer schools, while seven were quintile 4 schools and six were quintile 5 schools, which are fee-paying schools. A total of 571 educators who attended the first wellness day and 349 (59.4%) who attended the second wellness day. This study confirmed that educators were a high-risk population for developing NCDs. The prevalence of overweight and obesity at baseline were 27.3% and 50.3%, respectively. At follow-up the intervention group had experienced a greater relative percentage decrease in body weight (0.4 kg vs 0 kg) and BMI (0.4 kg/m^2 vs 0 kg/m^2) than the control group. The percentage of overweight and obese educators also decreased more in the intervention than control group (8.9% vs 1.1% relative change). Furthermore, the intervention group were significantly more likely to have met the recommended physical activity guidelines and the time they spent doing physical activity almost doubled in relative percentage (21.3 minutes/week vs 12.3 minutes/week) when compared to the control group. The cost of sending more than 2000 SMSs in this intervention were kept to a minimum of R56, South African Rand. This was achieved by using a user-centred, open, and community-driven medical record software system (OpenMRS, Medical Record System), which has been specifically developed for use in resource-limited countries to implement health information technology in an attempt to decrease the disparities between wealthy and resource-limited environments. The intervention required participants to respond to messages by sending a “please call me” which is a free service to anyone with a mobile phone in South Africa. These results proved that an intervention within the school setting can be effective, appropriate and economical [Joseph et al., 2018].

The KaziHealth study is a cluster randomised controlled trial investigating the effect of a school-based lifestyle health intervention programme on blood pressure, blood glucose, blood cholesterol, BMI and level of physical activity in primary school educators in disadvantaged communities [Müller et al., 2019]. To date eight quintile 3 primary schools in Gqeberha, the Eastern Cape, with a total of 151 educators, have been recruited into in the study. The intervention consists of two group lifestyle coaching sessions of 90 minutes each, as well as a self-monitoring phase during which participants are sent text messages twice a week for 24 weeks. The preliminary results indicate that 42% were pre-hypertensive or hypertensive; 26% had elevated blood glucose levels; 26% had slightly elevated or high cholesterol levels; 85% were overweight or obese and 74% were sedentary at baseline. These results add to the body of evidence that a school health promotion programme is needed for South African educators. It has the potential to improve their overall health status, improve their morale and increase productivity and provide healthy role models for learners [Govender, 2019; KaziHealth, 2019].

2.6.3 Challenges educators experience within the South African schooling system

The DoBE recognises that the ability to deliver good quality education in South African public schools is linked to the health, wellbeing and productivity of the educators who are employed in this sector [Zuma et al., 2016; Acton & Glasgow, 2015; Roffey, 2012].

It is therefore concerning that South African educators have been shown to work under very stressful conditions. Studies by Marais (1992) and Buwalda and Kok (1991), prior to our democracy, already showed that a large proportion (84.2% and 63.7%, respectively) of South African educators considered teaching to be stressful. Since 1996, there have been extensive curriculum changes and the education sector has been restructured to meet the new education and economic demands of the country, resulting in major changes in the teaching environment [DoBE, 2001]. The effects of the changing environment and resulting increased demands in skill levels and motivation have contributed to increased levels of occupational stress in South African educators [Peltzer et al., 2009; Hall et al., 2005; Van Zyl & Pietersen, 1999]. A study that investigated 81 educators in the Cape Town area who were declared permanently medically disabled because of psychiatric disorders, found that the majority (66.8%) cited work-related stress as a major contributing factor to their illness [Emsley et al., 2009]. Educators are therefore exposed to high levels of stress which may result in premature retirement on psychiatric grounds.

The 2004 survey by Shisana et al. (2005) among educators across South Africa identified work dissatisfaction and overload, personal health issues, and exposure to violence as factors within the school environment which impact educator health and wellbeing [Shisana et al., 2005]. From the 2015 survey by Zuma et al. (2016) it was evident that just less than half of educators indicated they experienced job-related stress (49.7%), the highest stress levels being reported by educators of mixed ancestry (25.7%), those older than 55 years of age (22.3%) and those teaching in the Western Cape (26.8%). Educators who reported low job satisfaction and high job stress were also most likely to show intention to leave the profession (57.2% and 42.2%, respectively). The main reasons cited for wanting to leave the profession included poor salary, heavy workload, having too many demands and an increase in class size. These factors can result in reduced productivity and effectiveness in the classroom, increased absenteeism, increased cost of health care, low morale and a high staff renewal rate [Zuma et al., 2016].

Reddy et al. (2010) investigated educator leave taking patterns in the South African public schooling system in a study commissioned by The United Nations Children's Fund (UNICEF) and undertaken by the DoBE. The study found that on average, between 20 and 24 days per year of teaching time is lost by South African educators due to impaired health [Reddy et al., 2010]. This situation is concerning and goes against the commitment in South Africa to improve the quality of education, which cannot be achieved if teachers are not in schools and in their classrooms.

2.6.4 Educators as weight management role models for learners

The WHO School Policy Framework, (2008) advises that health promotion is important for educators as they are role models for the learners. WHO also states that it is important for educators to be aware of and responsible for the health messages they give to learners, whether these messages are actively passed on as part of the curriculum or in a more passive manner as part of their health behaviour [WHO, 2008].

In 2019 there were 24 998 schools served by 444 857 educators and attended by 13 041 198 learners in ordinary public and independent schools in South Africa [DoBE, 2020]. Schools and consequently educators can play a very important role in encouraging their learners to adopt healthy behaviours and a healthy lifestyle. Numerous studies have found that educators not only promoted learner motivation in aspects of education, but also life in general. Educators are not simply providers of education, but role models of healthy behaviours, a positive attitude and providers of support to learners [Calder et al., 2019; Drummond et al., 2002; Olivier, 2006; Kruger and Adams, 1998; Mwamwenda, 1996; McCombs, 1994, Vrey, 1979]. Olivier (2006) reported that students remarked that “teachers are supposed to be our role-models” when they were disappointed by unacceptable behaviour from the educators.

With the high prevalence of overweight/obesity amongst educators, learners may accept a larger body size as a weight norm, especially when family members are also overweight/obese or when learners live-in families where a larger body size is culturally acceptable. Currently educators may be establishing the acceptability of overweight/obesity, while reducing awareness of children the need to prevent or treat the condition [Senekal et al., 2015].

2.7 Intervention development

2.7.1 Intervention development and design defined

The literature appears to have varied definitions for intervention development and design and often researchers use these two terms interchangeably. Craig et al. (2008) defined the intervention development phase up to the point where a worthwhile effect can be reasonably expected. Sometimes the start and endpoints are not clearly defined [O’Çathain et al., 2019] and the feasibility phase can still form part of the development phase. Hoddinott (2015) suggests that an indicator of the end of the development phase is once a document has been developed describing the intervention and how it is meant to be implemented. O’Çathain et al. (2019) therefore uses the term ‘development’ to refer to the entire intervention development process while limiting ‘design’ to a point in the development phase where researchers make decisions regarding intervention content, format and delivery.

2.7.2 Approaches to intervention development

There are various approaches researchers may adopt when developing an intervention. O'Cathain et al. (2019) identified eight different categories of approaches in a systematic review of intervention development studies and outlined a taxonomy as tabulated In Table 2.3 according to the definitions provided by the IdentifyiNg and assessing different approaches to DEveloping compleX interventions (INDEX) team.

Table 2.3: Taxonomy of approaches to intervention development [O'Cathain et al., 2019]

Intervention development approaches	INDEX team definition
Partnership	The intervention target population work with the research team and have equal decision-making powers. They are involved throughout the intervention development process.
Target-population centred	The opinions and actions of the target population form the basis of the intervention development process.
Theory and evidence-based	Evidence-based research and validated theories or theories specific to the intervention form the basis of the development process.
Implementation-based	The focus of the entire intervention development process is to ensure that if effective, thus that it can be used in the real-world setting.
Efficiency-based	Elements of an intervention are tested with experimental designs to identify active components to optimize efficiency.
Stepped or phased based	This approach focuses on a systematic overview of the processes involved in intervention development.
Intervention specific	Purposely established approach for a specific type of intervention.
Combination	Using a combination of existing (the above) development approaches.

INDEX team: MRC funded study referred to as: IdentifyiNg and assessing different approaches to DEveloping compleX interventions

The United Kingdom (UK) Medical Research Council (MRC) advises that best intervention development practice is to follow a systematic approach combined with the best published research evidence and the most suitable theory. Thereafter, the intervention should be tested with a sequence of pilot studies before progressing to a final assessment [Skivington et al., 2021; Craig et al., 2008], thus a theory and evidence-based approach [O'Cathain et al., 2019].

2.7.3 Theoretical frameworks for intervention development

Intervention development frameworks provide guidance to researchers in a step-wise manner to translate behaviour change theory into practice. O'Cathain et al. (2019) identified six such frameworks within the theory and evidence-based approach, namely the MRC framework for developing and

evaluating complex interventions, the Behaviour Change Wheel (BCW), Intervention Mapping (IM), Matrix Assisting Practitioner's Intervention Planning Tool (MAP-IT), Normalisation Process Theory (NPT) and finally the Theoretical Domains Framework (TDF). A summary of each is provided below which includes strengths and limitations as identified by the designers themselves, other designers, as well as the MRC overview team in the INDEX study (IdentifyiNg and assessing different approaches to DEveloping compleX interventions).

A. UK MRC framework for developing and evaluating complex interventions

The 2008 UK MRC framework is an adaptation of the 2000 version after several papers identified limitations in it. Some of these included that greater detail regarding early phase piloting and development was needed [Hardeman et al., 2005], that a model of the evaluation process should be less linear [Campbell et al., 2007a], that the process and outcome evaluation should be more integrated [Oakley et al., 2006] and that tailored interventions are more successful than standardised ones [Campbell et al., 2007b]. A further updated UK MRC framework has since been released as considerable developments have occurred in the field of complex intervention research [Skivington et al., 2021]. The new framework identifies four main phases, along with key functions and activities that form part of each phase. Skivington et al (2021) state that the phases are often neither linear or cyclical in sequence, and that designers tend to go back and forth between the phases [Skivington et al., 2021]. The four phases as outlined by the MRC are as follows:

Phase 1: Developing or identifying a complex intervention

Researchers are encouraged to use the comprehensive guidance provided by O'Cathain et al. (2019) when developing an intervention. The steps include adequate planning, involving stakeholders, assembling an intervention development team with relevant expertise, reviewing existing literature and theories, testing and refining programme theory, drawing on primary data, making an effort to understand the context of the intervention, considering future implementation, refining the intervention as appropriate and ending the development phase [Skivington et al., 2021].

When using an existing intervention, it is important that the theoretical basis of the intervention or the programme theory (an understanding of how the intervention produced an intended or actual outcomes) is clearly identified, as researchers may not have been included during the development phase [Skivington et al., 2021].

Phase 2: Feasibility testing

Feasibility studies should address any uncertainties identified during the development of the intervention. Progression criteria should be used to guide the decision on whether or not to proceed

to the next phase and can include but are not limited to recruitment and retention rates, capacity to achieve intended sample size, feasibility of evaluation outcomes, feasibility to collect and analyse data, consideration of any unintended outcomes, acceptable intervention content and delivery and adherence. Qualitative and quantitative data may therefore be required for this phase, and more than one study may be needed before a full-scale intervention is implemented [Skivington et al., 2021].

Please refer to section 2.9 for further detail on feasibility testing.

Phase 3: Full scale evaluation

Full-scale evaluation involves a tailored approach which should be followed when selecting a study design. As there are a number of available study designs to select from, it is important that this decision is based on the proposed research question, which in turn should be determined by the identified uncertainties surrounding the intervention. The effectiveness alone of an intervention is not the only consideration when making this decision and other factors such as context and budget should also be evaluated [Skivington et al., 2021].

Step 4: Implementation

Implementation science is focused on ensuring that interventions which have already demonstrated effectiveness can be effectively implemented, maximising the impact of the intervention. The main outcomes in an implementation study can include reach, policy impact and utilization of a service [Skivington et al., 2021].

Strengths of the UK MRC framework

The MRC does not regard its framework as prescriptive but rather as a guide for researchers to make the appropriate choices regarding methodology and practicality, similar to the previous frameworks [Skivington et al., 2021; Craig et al., 2008]. Researchers consider the MRC framework as highly influential as it has been widely cited and used by researchers in primary research, as well as in grant proposals [INDEX, 2019; Craig & Petticrew, 2013; Campbell et al., 2000]. The previous MRC framework was found to encourage a practical, tailored approach when selecting evaluation methods, using randomised controlled trials vs observational methods, the use of qualitative and/or quantitative data and outlining the criteria upon which the decision is made [Craig & Petticrew, 2013]. This remains true for the 2021 framework.

The 2008 framework was criticised for not providing great detail regarding its use, which can make the approach difficult to incorporate in the development of interventions [Wight et al., 2016; French et al., 2012]. This has been attended to in the 2021 framework where case studies are presented,

demonstrating a variety of approaches. In addition, a checklist has been included to support and document application of the framework, with particular attention paid to the core elements and important considerations for each phase in the research development process [Skivington et al., 2021].

Limitations of the UK MRC framework

The developers of the framework, acknowledge that there were still many issues that were being debated regarding the evaluation of complex interventions at the time of the release in 2008 as well as in 2021 [Skivington et al., 2021; Craig et al., 2008]. Their recommendations for the future include that the selected perspectives and approaches should be those that are more likely to produce a clear and unbiased estimate and should not be limited to those that are less risky to commission [Skivington et al., 2021]. The 2008 framework was also found to be limited in terms of its ability to grasp the real complexity of interventions in health services and the settings in which they are implemented [Craig & Petticrew, 2013]. It appears that the researchers tried to address this issue in the revised framework, which can only be critiqued once the implementation of the new framework in intervention development is analysed.

B. Intervention mapping (IM)

IM is a six-step intervention planning approach which guides intervention designers from identifying a need or problem to finding a solution by integrating theory and evidence [Bartholomew et al., 2016]. Its designers, Bartholomew et al. (2016), do not consider the steps of IM as linear, but rather that designers move back and forth between tasks and steps. The product of each step informs and guides the subsequent step. The six steps of IM as outlined by Bartholomew et al. (2016) are outlined in Table 2.4.

Table 2.4: Description of the six steps and tasks associated with Intervention Mapping

Steps	Tasks
Step 1: Logic model of the problem	Establish and work with a planning group
	Conduct a needs assessment to create a logic model of the problem
	Describe the context for the intervention, including the population, setting and community
	State program goals
Step 2: Program outcomes and objective – Logic model of change	State expected outcomes for behaviour and environment
	Specify performance objectives for behavioural and environmental outcomes

	Select determinants for behavioural and environmental outcomes
	Construct matrices of change
	Create a logic model of change
Step 3: Program design	Generate program themes, components, scope and sequence;
	Choose theory and evidence-based change methods;
	Select or design practical applications to deliver change methods
Step 4: Program production	Refine program structure and organisation
	Prepare plans for program materials
	Draft messages, materials and protocols
	Pre-test, refine and produce materials
Step 5: Program implementation plan	Identify potential program users
	State outcomes and performance objectives for program use
	Construct matrices of change objectives for program use
	Design implementation interventions
Step 6: Evaluation plan	Write effect and process evaluation questions;
	Develop indicators and measures for assessment;
	Specify the evaluation design;
	Complete the evaluation plan

C. Matrix assisting practitioner's intervention planning tool (MAP-IT)

In 2017, MAP-IT was developed by Hansen et al. by integrating three existing frameworks resulting in a tool which combines research to practice and thereby assisting practitioners to design complex interventions. It is theory-driven, evidence-based, identifies environmental and individual mechanisms and links these mechanisms to behaviour change techniques. The frameworks integrated into MAP-it include the BCW (see section F for details), IM (see section B for details) and Analysis Grid for Environments Linked to Obesity (ANGELO). Hansen et al. (2017) found these frameworks to be helpful but also challenging to work with, time-consuming and extensive knowledge regarding motivational and voluntary processes were required. These frameworks were considered a product of intervention science and therefore not applicable for practitioners of health promotion. In contrast, MAP-IT was considered timesaving, easy to use and helpful to practitioners when selecting techniques to address relevant mechanisms, thereby reducing the need for in-depth knowledge of all available techniques.

The MAP-IT matrix recognises that personal and environmental mechanisms must be addressed to achieve behaviour modification. The matrix is therefore divided into two main categories; 1) *personal*

which refers to social-cognitive mechanisms and 2) *environmental* which includes the physical, political/economical and socio-cultural environments (Hansen et al., 2017]. The first column of the matrix outlines the mechanisms present in the personal and environmental categories as identified by theory and evidence-based mechanisms, using a consensus approach. Next, theories underlying the mechanisms and objectives regarding the mechanisms are identified, respectively. The rest of the matrix consists of nine columns, referred to as components, which include the intervention functions as outlined by Michie et al. (2011b) in the BCW. The rows of the matrix link a mechanism to an objective which is underpinned by a theory. Each mechanism is then linked to a BCT as categorised in one or more intervention component.

Strengths of MAP-IT

MAP-IT allows researchers to create a matrix of personal and environmental mechanisms with the aim of promoting positive behaviour. It uses relevant theories and functions of an intervention which are used to address each mechanism. Researchers can then use the matrix to develop an intervention which is underpinned by theory and evidence [Hansen et al., 2017]. The matrix focuses on one aspect of behaviour change when developing the intervention and therefore does not require researchers to have extensive knowledge regarding psychological theory. This knowledge is often lacking in the research team, resulting in the incorrect use of existing frameworks which require understanding thereof [INDEX, 2019]. The matrix also allows scientific research to be linked to practical real-life applications [Hansen et al., 2017]. The MAP-IT approach is considered feasible and low-cost approach to intervention development [Hansen et al., 2017]. Another strength is that it is a synthesis of three well-known and well-respected concepts, namely the BCW, IM and ANGELO [Hansen et al., 2017].

Limitations of MAP-IT

A significant limitation of the MAP-IT approach is that while IM is implemented in the development of an intervention, it only facilitates one aspect of IM, and therefore does not consider a complete approach to intervention development [INDEX, 2019]. The context within which the intervention is also to be implemented is not considered. This is important as an intervention which is systematic, well- designed and embedded in theory will not be effective if implemented in an inappropriate setting. It is therefore considered to be insufficient in its approach to intervention development [Hansen et al., 2017]. The designers also only offer a single matrix and additional matrices will have to be produced for other conditions or risk factors [Hansen et al., 2017].

D. Normalisation process theory (NPT)

The NPT was developed in 2010 by Murray et al. because of problems encountered in the design and implementation of complex interventions. The research group recognised that recruitment into trials was problematic. While identification of the reasons for this phenomenon remain difficult to ascertain, it is evident that trials which form part of existing clinical practice have a greater chance at successful recruitment [Murray et al., 2010]. The researchers also recognised three gaps between research and implementation that needed to be addressed, namely 1) the difficulties and barriers of moving from laboratory-based research to clinical medicine; 2) development of new treatments and dissemination of information regarding the treatments to ensure implementation thereof in practice, and 3) ensuring that the results of successful research are translated into wider health-related policy and practice [Murray et al., 2010].

NPT explains how interventions function from the early implementation thereof and beyond by identifying factors which promote and inhibit the incorporation of interventions into everyday practice. It has four main components which are considered to be non-linear and in a dynamic relationship with each other. It is an action theory where each construct is used to explain the work that people do rather than their attitudes and beliefs [Murray et al., 2010]. The four constructs are outlined in Table 2.5.

Table 2.5: Description of the Normalisation Process Theory and its four constructs

Constructs	Description
Construct 1: Coherence (meaning and sense-making of participants)	Differentiation: Understanding how a set of practices and their objects differ from each other.
	Communal specification: Participants work together to understand the aims, objectives and the expected benefits of a set of practices.
	Individual specification: Individual participants gain understanding in their specific tasks and responsibilities related to a set of practices.
	Internalisation: Participants understand the value, benefits and importance of a set of practices.
Construct 2: Cognitive participation (commitment and engagement by participants)	Initiation: Key participants need to work to drive a new or modified practice forward.
	Enrolment: Participants are required to organise themselves to collectively contribute to the work involved in new practices.
	Legitimation: Participants need to believe that it is right for them to be involved and that they can make a valid contribution.

	Activation: Collectively participants need to define the actions and procedures required to maintain a practice and for them to stay involved in it.
Construct 3: Collective action (work done by the participants that makes the intervention functional)	Interactional workability: Interactional work that the participants do with each other and with other components of a set of practices.
	Relational integration: Participants build accountability and maintain confidence in a set of practices, as well as in each other, as they use it.
	Skill set workability: Allocation of work or tasks involved in a set of practices as they function in a real-life setting.
	Contextual integration: Allocation of resources to manage a set of practices.
Construct 4: Reflexive monitoring (formal and informal appraisal of cost and benefits of intervention by participants)	Systematisation: Participants may need to determine how effective a set of practices are by performing a formal (such as a randomised clinical control trial) or an informal (such as a collection of anecdotal examples) systematisation.
	Communal appraisal: Participants work together in a formal or informal group to evaluate the value of a set of practices.
	Individual appraisal: Participants work as individuals to determine the effect of a set of practices on themselves and the context in which it is set.
	Reconfiguration: After the appraisal work of groups or individuals it may be necessary to refine or modify practices.

Strengths of NPT

The NPT components can help to describe the context within which the proposed intervention will be implemented and it uses qualitative and quantitative information to define the intervention [Murray et al., 2010]. The NPT recognises that healthcare involves a series of interactions between multiple individuals and it can help to identify the links between various participants (e.g. professionals, patients or managers) which may be affected by an intervention and can subsequently provide solutions to support these interactions [INDEX, 2019]. The NPT therefore does not only consider the needs of a single group or organisational level, but also takes into consideration the wider system issues [Murray et al., 2010], which is an often a neglected aspect of intervention development [INDEX, 2019].

Limitations of NPT

The primary focus of the NPT appears to be to ensure that an intervention can be successfully implemented in practice. It however does not provide detail and guidance regarding how to develop interventions per se [INDEX, 2019].

E. Theoretical domains framework (TDF)

In 2012, French et al. developed the TDF using a consensus process and validation. Psychological and organisational theory relevant to the clinical behaviour change of health practitioners was identified. The result was twelve domains which reflect the main contributing factors that impact the clinical behaviour and behaviour change of practitioners. These domains include knowledge; skills; social/professional and identity; beliefs regarding capability; beliefs regarding consequences; motivation and goals; memory, attention and decision processes; environmental context and resources; social influences; emotion; behavioural regulation; and nature of the behaviours [French et al., 2012].

The developers believe that the TDF, when compared to previously accepted models of intervention development, offers an extensive framework that identifies potential barriers to change more adequately and therefore results in a greater range of potential intervention components [French et al., 2012]. The TDF is underpinned by the UK MRC framework as well as two previously published intervention development methods which are theory-based.

The TDF comprises of a four-step approach:

1) Identifying the problem: This step identifies who is required to do what action differently.
2) *Assessing the problem*: This step utilises a theoretical framework to identify which barriers and enablers need to be targeted.
3) Forming possible solutions: This step requires the identification of the intervention components (BCTs and mode of delivery) that can enhance the enablers and overcome the modifiable barriers.
4) Evaluating the selected intervention: The final step seeks to identify how the behaviour change can be measured and understood.

Strengths of the TDF

The TDF is a four-step method to develop interventions; it is a systematic and theory-based. It is a streamlined approach that identifies the theoretical domains relevant to the problem and then identifies the appropriate BCTs. The TDF is considered a comprehensive guide to facilitate theory-informed intervention development. It is not intended to be prescriptive and allows for adjustment and

refinement in accordance with the context and setting of the planned intervention [French et al., 2012]. Researchers have used the TDF as part of their intervention development process to identify theories of behaviour change [French et al., 2012].

Limitations of the TDF

The developers of the TDF acknowledge that there is subjectivity in the TDF process which combines research evidence, matrix mapping and feasibility information. They also acknowledge that using the TDF to develop interventions requires considerable time and resources [French et al., 2012]. The amount of detail provided regarding how to undertake each action is limited [INDEX, 2019].

F. Behaviour Change Wheel (BCW)

In 2011, Michie et al. identified 19 different frameworks of behaviour change in a systematic review and evaluated each of these against a criterion of usefulness, namely; comprehensiveness (the ability to be applied to any intervention); coherence (all categories should be logical, appropriate and consistent in terms of specificity); and categories had to be linked to a model of behaviour (e.g. the Theory of Planned behaviour or the Health Belief Model). The systematic review showed that none of the existing frameworks were comprehensive, three were coherent and only seven could be clearly linked to a model of behaviour. As all the identified frameworks exhibited limitations, Michie et al. (2011b) developed a new framework namely the BCW which met the criteria of usefulness. Synthesis of the 19 frameworks formed the basis for the development of the BCW which addresses the identified limitations, integrates the common features of the frameworks and is linked to a model of behaviour.

The BCW consists of three layers. The focal point of the wheel comprises of the Capability, Opportunity, Motivation – Behaviour model (COM-B model) which incorporates existing behaviour change models as identified by Michie et al. (2011b) and is used to identify target behaviours for an intervention. The second layer of the BCW constitutes nine intervention functions which are described as activities that can be used to change target behaviours identified by application of the COM-B model. The outer rim of the BCW depicts a layer of seven policy categories that comprise actions responsible authorities may use to enable or support interventions.

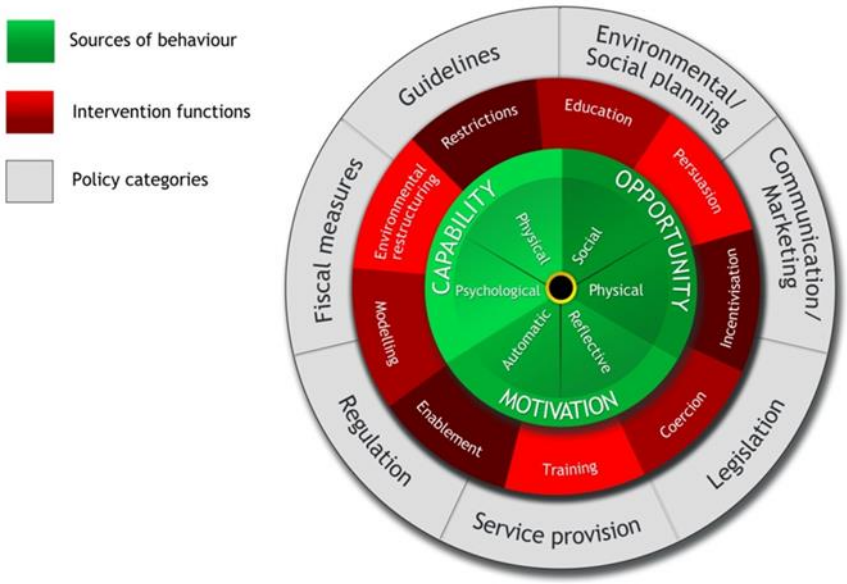

Figure 2.2: The Behaviour Change Wheel [Michie et al., 2011b, reproduced with permission]

The BCW provides researchers with an 8-step guide for designing behaviour change interventions. The process is executed in 3 stages: 1) understanding the behaviour, 2) identifying the intervention options and 3) identifying content and implementation options (Figure 2.2).

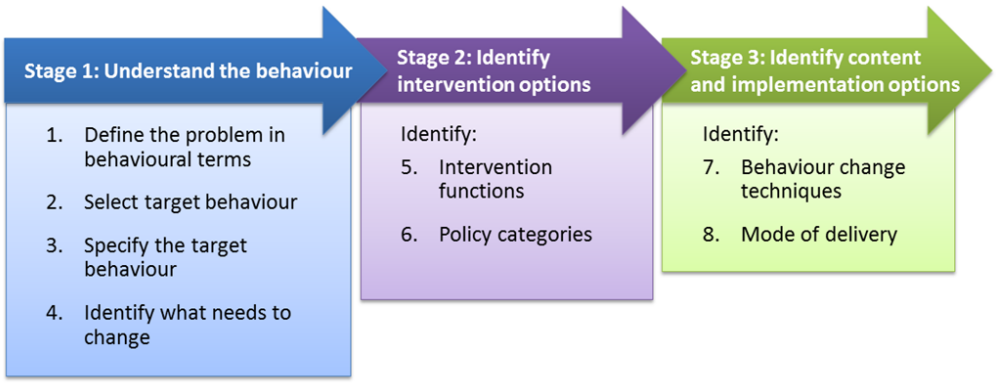

Figure 2.3: The 3-stages of the Behaviour Change Wheel [Michie et al., 2011b, reproduced with permission]

Stage 1: Understand the behaviour

Define the behaviour in behavioural terms: Steps 1 to 4 involve application of the COM-B model to understand the problem in behavioural terms. Defining the problem in behavioural terms involves specifying 1) the behaviour which needs to change, 2) the location where the behaviour occurs, and 3) the persons involved in the behaviour [Michie et al., 2014].

Select a target behaviour: Behaviours do not exist in isolation and therefore occur along with other behaviours, interacting as a system. Designers or researchers must consider all the relevant behaviours performed by the target population to decide which behaviours require intervention. An extensive list of all potential behaviours relevant to the problem is therefore generated and evaluated against a set of criteria: 1) the likely impact if the behaviour changed, 2) the ease with which the behaviour can be changed, 3) the spillover effect to other behaviours in a system, and 4) the ease with which the change in behaviour can be measured for evaluation. For each behaviour each of these four criteria are categorised as unacceptable, unpromising but worth considering, promising or very promising. Based on this evaluation the target behaviours are selected [Michie et al., 2014].

Specify the target behaviour: The target behaviour is further specified in terms of 1) who needs to perform the behaviour, 2) what needs to be done differently to achieve the desired change, 3) when does the behaviour need to be done, 4) how often must the behaviour be done and 5) with whom must it be done [Michie et al., 2014].

Identify what needs to change: This is the final step of stage 1 and requires the target behaviour to be assessed in terms of what needs to happen for the behaviour to occur, in relation to the COM-B constructs. What needs to change in terms of the target population and/or the environment to achieve the desired outcome can then be identified. Michie et al. (2011b) suggests that a behavioural analysis is required to inform the use of the COM-B model This analysis can make use of focus groups, questionnaires, observations and/or analysis of documentaries. Michie et al. (2011b) defined the components of the COM-B as follows:

1. Physical capability: the skill required to perform a behaviour;
2. Psychological capability: the capacity, such as knowledge, to engage the necessary thought processes to perform the behaviour;
3. Physical opportunity: the physical environment triggers, resources, time physical barriers to enable the behaviour;
4. Social opportunity: the social cues and cultural norms associated with the behaviour;
5. Automatic motivation: the emotions, wants, needs, reflex responses, habit formation associated with the behaviour;
6. Reflective motivation: self-conscious planning and evaluation to perform the behaviour, beliefs of the consequences and capabilities associated with the behaviour and what is good and bad about the behaviour.

According to Michie et al. (2014) three domains in the model interact to enable a behaviour to occur. If a more complex behavioural analysis is desired, the Theoretical Domains Framework (TDF) [Cane et al., 2012] can be used. It is considered an extended version of the COM-B model and Michie et al. (2014) provide a description of how the COM-B model links to the domains of the TDF.

Stage 2: Identify intervention functions

Identify intervention functions: Michie et al. (2011b) identified nine intervention functions which can be considered activities aimed at changing behaviour. Any number of these functions can be applied in a particular intervention. Michie et al. (2011b) defined the functions as follows:

1. Education: increasing knowledge or understanding;
2. Persuasion: using communication to induce positive or negative feelings or stimulate action;
3. Incentivisation: creating an expectation of reward;
4. Coercion: creating an expectation of punishment or cost;
5. Training: imparting skills;
6. Restriction: using rules to reduce the opportunity to engage in the target behaviour;
7. Environmental restructuring: changing the physical or social context;
8. Modelling: providing an example for people to aspire to or imitate;
9. Enablement: increasing means/reducing barriers to increase capability or opportunity.

While the COM-B model identifies what changes are needed to achieve a desired behaviour, the BCW identifies which intervention functions are likely to be effective in producing the desired behaviour [Michie et al., 2014]. Each component of the COM-B model has been linked to specific intervention functions which are likely to be effective in achieving the target behaviour [Michie et al., 2014].

The successful delivery of an intervention requires an understanding of the context in which the functions will be delivered. Once the likely effective intervention functions have been identified, the APEASE criteria (affordability, practicality, effectiveness and cost effectiveness, acceptability, side-effects/safety and equity) [Michie et al., 2014] can be used to guide this process. The APEASE criteria can be used by intervention designers to ascertain which intervention functions, policy categories, behaviour change techniques and modes of delivery are the most appropriate for its context and thus the most likely to be effective if implemented [Michie et al., 2014].

Identify policy categories: Policy categories help authorities make decisions that may support the delivery of intervention functions. The following seven policy categories were identified by Michie et al. (2014): 1) communication or marketing, 2) guidelines, 3) Fiscal measures, 4) regulation, 5) legislation, 6) environmental or social planning and 7) service provision. Michie et al. (2011b), also provide a matrix which links the intervention functions to the policy categories. The potential policy categories, as identified by the matrix, can once again be evaluated by designers, using the APEASE criteria, to decide which are the most appropriate for the intervention [Michie et al., 2014].

Stage 3: Identify content and implementation options

Identify behaviour change techniques: BCTs are defined as the active ingredients of an intervention. Several taxonomies of BCTs have been published [Abraham et al., 2012; Michie et al., 2012; Michie et al., 2011a; Michie et al., 2011c; Abraham & Michie, 2008). The most recent of these consists of 93 BCTs which are distinctive and non-over lapping and are referred to as BCTT v1 [Michie et al., 2013]. Michie et al. (2014) provide guidance for linking the BCTs to the intervention functions. The process starts by compiling an extensive list of potential BCTs that can then be reduced and refined using the APEASE criteria [Michie et al., 2014]. As previously mentioned, Michie et al. (2011c) identified BCTs specific to interventions aimed at improving physical activity and eating behaviours referred to as the CALO-RE taxonomy. As the best combination of BCTs to apply when managing obesity is unknown, it is best to use a variety of strategies [Spahn et al., 2010].

Identify mode of delivery: Finally, designers must consider the appropriate mode of delivery for the intervention by considering the target group and the setting. The APEASE criteria can be used to identify the most appropriate mode [Michie et al., 2014]. The delivery modes of interventions may include face-to-face in a group setting or individually, digitally, telephonically, self-help, or a combination.

Strengths of the BCW

The BCW is a helpful tool which supports design of interventions aimed at behavioural changes based on an integration of information from previous frameworks [Hansen et al., 2017]. The BCW is not only considered to be effective in aiding intervention design, but also enhances evaluation and theory development by providing understanding as to why interventions have failed or why they have worked [Michie et al., 2014]. In addition, the BCW clearly identifies at which levels an intervention is required to work in order for it to be successful [Michie et al., 2014]. The BCW provides very clear and detailed guidance on each action and multiple examples of interventions using the framework have been provided by the designers [INDEX, 2019; Hansen et al., 2017]. The BCW has become very popular amongst researchers and used in numerous primary research [INDEX, 2019; Hansen et al.,2017]. The practical application of the BCW was studied by Porcheret et al. (2014) and they concluded that it “proved to be a practical way of using theory to inform the development of complex interventions” [Porcheret et al., 2014].

Limitations of the BCW

The importance of including stakeholders in intervention design has been well documented [Hallingberg et al., 2018; O’Cathain et al., 2015] and although some reference is made to engaging with stakeholders, behaviour change is the primary focus of the BCW [INDEX, 2019]. In addition, Janols and Lindgren (2017) found that the BCW required a greater emphasis on the target population

being involved in the process of intervention design [Janols & Lindgren, 2017]. The INDEX overview team also documented that at certain points in the BCW process judgements were required, but that evidence to support decision-making was not necessarily available. An example of this was the application of the APEASE criteria, where there is no guidance as to who should be involved in making these judgements (e.g. do the stakeholders and/or the intervention developers make the decisions) and what evidence should be used when making the judgements. The designers of the MAP-IT framework commented that the BCW requires extensive knowledge of psychological processes to use it appropriately and adequately and therefore experts in psychology may need to be part of the design team [Hansen et al., 2017].

2.7.4 Examples of research that applied the BCW in intervention design

The BCW article by Michie et al. (2011b) has been cited more than four thousand times and there are numerous published studies where the BCW was used for its intervention design. It is therefore a well-researched and well-utilised intervention design. A review of researcher comments on the application of the BCW from seven recent studies that focused on the design of lifestyle interventions is presented in Table 2.4. Studies were included in this review if use of the BCW was clearly evident from the article, if the article was recent (between 2016 and 2019), if the study had a health behaviour component which was targeted, and if the researchers identified limitations and strengths of using the BCW.

Table 2.6: Summary of researcher comments regarding the usage of the BCW in intervention development

Study	Focus	Target population	Limitations	Strengths
Moore et al., (2019)	Improve healthy eating and physical activity	UK African Caribbean communities living in London; Type 2 Diabetics	Target behaviours for the intervention were limited and less specific than suggested by the BCW.	Simple, accessible method. Closely guides choice of intervention functions and BCTs. Clearly linked theoretical behaviour constructs with BCTs.
Mabweazara et al., (2019)	Increase physical activity	HIV positive Black African Xhosa-speaking women in a low-income community in the Western Cape Province in South Africa	Judgement was required to apply the APEASE criteria regarding intervention content and mode of delivery which requires an experienced research team.	Clear systematic guidance linking multiple theories to BCTs. Allows one to use tools without in-depth knowledge of behaviour change theories. Variety of intervention features. Clearly distinguishes between intervention function and policy categories.
Chiang et al., (2018)	Improve medication adherence	HIV and AIDS communities in Canada	BCTTv1 may be interpreted differently in eHealth	Useful to synthesise evidence from various interventions and

			interventions and may require its own taxonomy. Does not account for strong social support created by patient-provider relationship via phone. More research needed re: messaging frequency, barriers and facilitators to use of actual intervention.	identify mechanism of action to affect behaviour change Systematic approach.
Beleigoli et al., (2018)	Online weight loss program	Overweight and obese communities in Brazil	Was not a good framework for determining usage profile of eHealth intervention.	Systematic, evidence-based, theory-driven process Led to clear understanding of behaviour determinants
Munir et al., (2018)	Reduce sitting time to reduce sedentary time	NHS office workers in Lester, UK	Not specified	Comprehensive participatory approach, theory-driven process. Standardised methods, structured guidance.
Murtagh et al., (2018)	Improving physical activity	Mothers and teenage daughters who wanted increase physical activity in Ireland	Time-consuming. Thorough understanding of stages required.	Systematic, evidence-based, theory-driven process. In-depth consideration of target behaviour by collecting data from multiple sources. Able to skip step 1-3 as target behaviour well established in literature.
Fulton et al., (2016)	Increase attendance to stop smoking service	Smokers who attend the NHS Stop Smoking Services, UK	No specified	Theory-driven and evidence-based approach.

HIV: Human Immunodeficiency Virus; AIDS: Acquired Immunodeficiency Syndrome, UK: United Kingdom

One research group mentioned that they found application of the BCW time-consuming [Murtagh et al., 2018], while those who used it for the design of eHealth interventions mentioned very specific limitations related to the mode of delivery, namely the BCCTv1 may be interpreted differently in eHealth interventions and thus may require its own taxonomy; the patient-provider relationship is unaccounted for; and the framework was not useful to determine the usage profile of eHealth interventions [Chiang et al., 2018; Murtagh et al., 2018]. Each of the seven researcher groups represented in Table 2.4 found the BCW to be a theory-driven, comprehensive, systematic approach with clear guidelines (Mabweazara et al., 2019; Moore et al., 2019; Beleigoli et al., 2018; Chiang et al., 2018; Munir et al., 2018; Murtagh et al., 2018; Fulton et al., 2016]. As a result, it contributed to understanding of behaviour determinants without having in-depth knowledge of the various behaviour change theories.

In two of the studies the intervention designers adapted the application of the BCW to suit their specific needs and commented positively on the flexibility of the framework. Mabweazara et al. (2019) criticised the fact that judgement was required when using the APEASE criteria for the development of the intervention content and selecting the mode of delivery. No guidance regarding who would

make these judgements nor what evidence should be used to make these judgements is provided. The same study also commented that a thorough knowledge and understanding of the various stages of the BCW was required in order to apply it in the intervention design [Mabweazara et al., 2019].

2.7.5 Overarching critique on intervention development frameworks

Table 2.5 presents a summary of the various theory and evidence-based intervention development frameworks, as identified by O'Cathain et al. (2019), including the strengths and limitations of each framework.

Table 2.7: Summary of theory and evidence-based intervention development frameworks

	MRC Framework	Intervention Mapping	Matrix assisting practitioner's intervention planning tool	Normalisation Theory Process	Theoretical Domains Framework	Behaviour Change Wheel
Authors	Skivington et al., (2021); Craig et al., (2008)	Bartholomew et al., (2016)	Hansen et al., (2017)	Murray et al., (2010)	French et al., (2012)	Michie et al., (2011b)
Steps	4 phases, non-linear, iterative process	6 steps, non-linear, iterative process	Synthesises BCW, IM, ANGELO	**4** constructs explaining what action is required	**4** step approach consisting of 14 domains	8 stages including the COM-B Model
Strengths	Well cited Non-prescriptive	Well-cited Rigorous and elaborate Considers environmental and personal factors	Time-saving, easy to use, low cost, feasible Considers environmental and personal factors Scientific research linked to practical applications In-depth knowledge not needed motivational and voluntary processes	Context well described All stakeholders identified	Non-prescriptive Considered comprehensive Underpinned by MRC framework and 2 published theory-driven methods	Well-cited Clear and detailed guidance Summarises previous frameworks
Limitations	Ongoing debate regarding best evaluation approach Failure to grasp complexity of interventions and settings	Technical and prescriptive Time-consuming, not feasible Difficult to use Incomplete and incoherent	Incomplete as context not considered	Lacks detail and guidance	Detail not extensive Time-consuming, resource-heavy	Can be time-consuming Greater Stakeholder involvement required

MRC: Medical Research Council; IM: Intervention Mapping; BCW: Behaviour Change Wheel; ANGELO: Analysis Grid for Environments Linked to Obesity; COM-B Model: Capability, Opportunity, Motivation Behaviour Model

As mentioned, the UK MRC recommends that a theory and evidence-based approach is the golden standard when undertaking the task of intervention development [Skivington et al., 2021; Craig et al., 2008]. The MRC framework, NTP and the TDF provide a general plan to develop interventions but lack clear and specific guidance regarding how to implement the specific frameworks. The MRC framework does not provide any instruction on how to choose or apply theory. The NTP focus is on ensuring that interventions can be practically implemented but detail regarding how to develop interventions is lacking. Although the TDF is a 4-step approach, the amount of detail provided regarding how to undertake each step is limited and it requires considerable subjectivity in its application. The MAP-IT framework considers both environmental and personal factors but it does not take into account the context into which the intervention is to be implemented and is thus considered incomplete. In contrast, IM is regarded as comprehensive in its approach and prescriptive. It is however quite difficult to use and requires extensive training to use it adequately. Unfortunately, it is very time-consuming to the extent that it is not feasible for many designers to use this approach.

The BCW appears to be the most comprehensive and systematic framework, yet it remains simple to use. The BCW is detailed and each step is clearly explained and it is considered a practical way to use theory to develop interventions [Porcheret et al., 2014]. However, much like IM, the comprehensiveness of the BCW can make it time-consuming. The COM-B model is widely applicable to all voluntary behaviours making it very versatile and suitable for any health behaviour. The BCW is a standardised approach allowing for comparisons between interventions, as well as the identification of effective interventions. Its design also allows for parts of an intervention to be amended and the effect of the amendment can be measured. The BCW recognises in which settings an intervention will work and for whom. The designers of the framework acknowledge that the BCW is not a “magic bullet” but allows for the development of a behaviour change intervention by considering the leading available knowledge and understanding of behaviour change, together with the resources at hand [Atkins & Michie, 2015].

2.8 Behaviour change theories

2.8.1 Overarching perspectives

The ultimate goal of a weight loss intervention is to attain weight loss by producing the desired change in behaviour. Glanz et al. (1990) state that a theoretical understanding of behaviour change is required to develop interventions which are effective and evidence-based. According to Davis et al. (2014), theory refers to knowledge regarding mechanisms of action, moderators of change and the largely accepted assumptions about human behaviour and the factors which influence these assumptions.

As already stated, the UK MRC considers the application of theory into intervention development and evaluation as an integral step in intervention development [Skivington et al., 2021; Craig et al., 2008]. This approach allows for causal determinants of behaviour to be identified, which can then be targeted by the intervention using appropriate behaviour change techniques [Michie et al., 2008; Hardeman et al., 2005; Michie & Abraham, 2004]. Application of theory also allows researchers to determine whether an intervention failed because it had no effect on a hypothesised mediator, or whether the hypothesised mediator had no effect on behaviour, thus enabling efficient refinement of the intervention [Rothman, 2009, 2004; Michie & Abraham, 2004].

There are four major theories of behaviour change identified by Glanz et al. (2008), namely: The Social Cognitive Theory (SCT), The Transtheoretical (Stages of Change) Model (TTM), The Health Belief Model (HBM) and The Theory of Planned Behaviour (TPB). Continuum theories like the SCT and HBM, assume that variables such as intention and skills influence behaviour while stage theories, like the TTM, assume that behaviour change occurs in a process over several stages [Wang et al., 2019].

2.8.2 The Social Cognitive Theory (SCT)

Bandura's SCT developed from the Social Learning Theory in 1986 posits that external factor (personal and environmental) influence behaviour in a triadic interaction [Bandura, 1986]. (Figure 2.4).

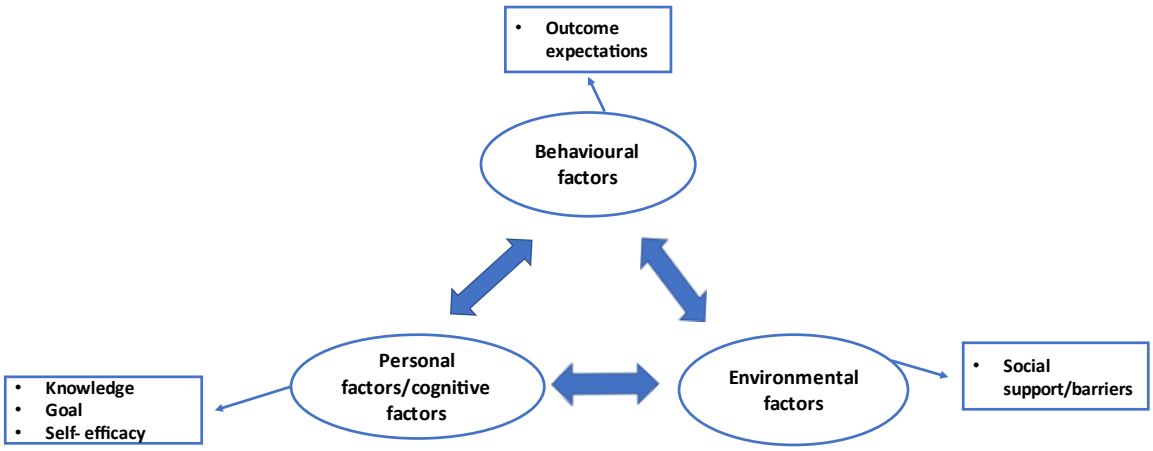

Figure 2.4: Bandura's Social Cognitive Theory model [Bandura, 1986]

This theory uniquely focuses on social influence and social reinforcement. The SCT is therefore useful to explain how behaviour is regulated through control and reinforcement so that the desired behaviour can be maintained over time. It consists of five constructs: reciprocal determinism (refers to the interaction between the person, environment and behaviour); behavioural capability (refers to the actual ability to perform a behaviour through knowledge and skills); observational learning

(reproducing actions after observing the behaviour being conducted by others); reinforcements (internal and external responses to a behaviour which affect the likelihood of it being continued); expectations (a judgement of the likely consequences produced by a behaviour); and self-efficacy (a judgement of one's ability to perform the behaviour) [Bandura, 1986]. The SCT places emphasis on the individual and the environment, making it's use widely acceptable for public health interventions.

There are however a few limitations associated with its use in intervention planning. The theory pays minimal attention to emotion or motivation and assumes that environmental changes will automatically lead to behavioural changes. The constructs of the theory are also loosely organised and the extent to which each one impacts behaviour is undefined [LaMorte, 2019].

2.8.3 The Transtheoretical Stages of Change Model (TTM)

The TTM [Prochaska, 1979; Prochaska and DiClemente, 1983; Prochaska et al., 1992] assumes that change occurs during a process of six stages (Figure 2.5).

Figure 2.5: Transtheoretical Stages of Change [Prochaska, 1979]

Precontemplation is the stage in which people are not intending to make a change in the near future (the next 6 months). The contemplation stage is when people intend to change but are not yet taking action to do so (within the next 6 months). Preparation is the stage in which people have a plan of action and intend to make the change within the next month. Action is the stage when the behaviour is performed and maintenance is the stage when work is performed to prevent a relapse. Termination is when total efficacy is attained and the behaviour can be maintained.

The TTM is often applied to interventions targeting addictive behaviour and it assumes that individuals at the same stage have similar barriers and problems and consequently, can be helped with the same type of intervention [Nisbet & Gick, 2008]. This model is more favoured by practitioners than

researchers as the constructs are not well defined and the model does not clearly explain how individuals change, or why some change more effectively or quickly than others [Morris et al., 2012].

2.8.4 The Health Belief Model (HBM)

The HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] proposes that behaviour is determined by a number of beliefs regarding the threats to an individual's wellbeing and the effectiveness of the recommended health behaviour (Figure 2.6).

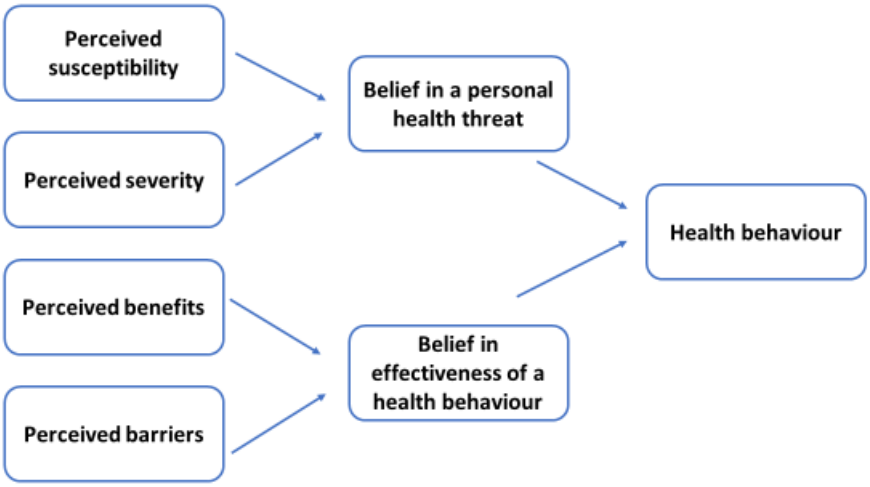

Figure 2.6: The Health Belief Model [Hochbaum, 1958]

Perceived threat is linked to how ready an individual is to take action and is at the core of the model. It is influenced by beliefs of individuals regarding their perceived susceptibility to a specific threat, as well as the perceived seriousness of the expected consequences associated with it. The extent to which a behaviour is beneficial is determined by weighing up the perceived benefits associated with the behaviour against the perceived costs and negative implications that may result from it (perceived barriers). Some constructions of the HBM include self-efficacy and, internal and external cues to action, which trigger adoption of the behaviour [Sharma & Romas, 2012; Becker, 1974; Rosenstock 1966; Hochbaum, 1958]. Researchers suggest that perceived barriers are the most influential construct of behaviour in the HBM [Janz & Becker, 1984].

There are two well established criticisms of this model which include the following: 1) the constructs of the model and the inter-relationships between them are not well defined; and 2) social, economic or unconscious influences on behaviour are not considered [Jackson, 2005].

2.8.5 The Theory of Planned Behaviour (TPB)

The TPB (Figure 2.7) is one of the most commonly applied theories of behaviour and most widely cited [Ajzen, 1985, 1991; Ajzen & Madden, 1986]. It started off as the Theory of Reasoned Action [Fishbein & Azjen, 1975].

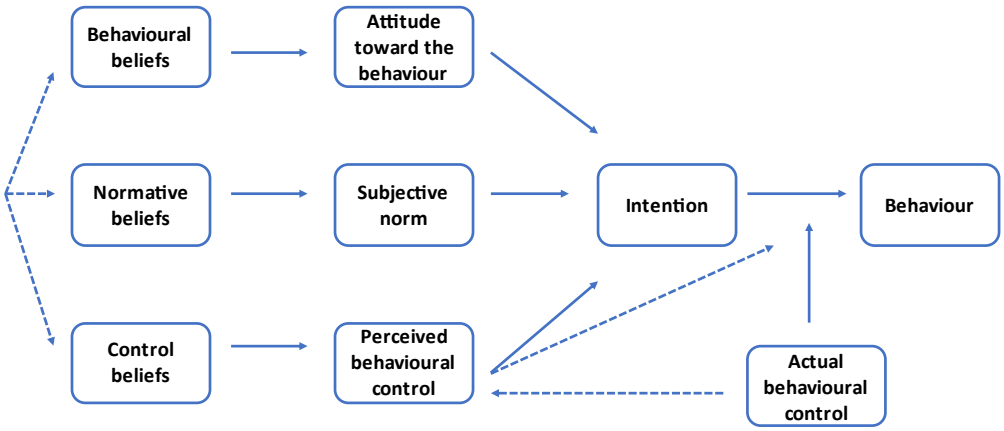

Figure 2.7: The Theory of Planned Behaviour [Ajzen, 1985, 1991]

The TPB posits that an individual's intention is the best predictor of behaviour; the core of this model is thus behavioural intent. According to the model intention is influenced by attitude toward a behaviour (beliefs and values regarding the outcome of a behaviour) and subjective norms (beliefs about what others think one should do and thus includes social pressure). Intention is also an outcome of perceived behavioural control (perceived ease or difficulty related to performing the behaviour). The TPB therefore suggests that achieving the behavioural outcome depends on motivation (intention) and self-efficacy (behavioural control) [Ajzen, 1985, 1991].

Limitations of the TPB that have been identified include the following: 1) variables such as fear, threat, mood or past experiences which can impact intention and motivation, are not accounted for; 2) environmental or economic factors are also not considered; 3) perceived behavioural control was an important addition to The Theory of Reasoned Action, however, no detail regarding actual control over behaviour is provided; 4) the theory does not address the time frame between "intent" and "behavioural action"; and 5) the theory assumes that opportunities and resources required to perform the behaviour have been acquired, regardless of intention [LaMorte, 2019].

Researchers in public health tend to prefer the TPB above the HBM, but because of the mentioned limitations, additional components from other behavioural theories are often integrated with the TPB constructs to make the model more comprehensive [LaMorte, 2019; Taylor et al., 2007; Armitage & Conner, 2001]. Some researchers conclude that the TPB should be used to explain and predict behaviour to identify specific contributing factors of behaviour to be targeted in interventions, rather

than designing and planning the type of intervention that will result in behaviour change [Webb et al., 2010; Taylor et al., 2007; Hardeman et al., 2002]. Hardeman et al. (2002:149) supports this with the following statement: “even when authors use the TPB to develop parts of the intervention, they seem to see the theory as more useful in identifying cognitive targets for change than in offering suggestions on how these cognitions might be changed”. The TPB is therefore specifically useful, and preferred by researchers, for intervention development that involves identification of components of a behaviour that need to be targeted to bring about behaviour change.

2.9 Feasibility testing

2.9.1 Overview

The MRC guidance for developing and evaluating complex interventions includes a feasibility stage after intervention development and describes it as the exploration of the feasibility and acceptability of the intervention design (e.g. mode of delivery) and the evaluation design (e.g. choice of outcome measures) to underpin decisions regarding the progression to a full effectiveness study [Skivington et al., 2021; Craig et al., 2008]. This has resulted in researchers and funders addressing feasibility issues when seeking and granting funding for studies [Hallingberg et al., 2018].

Feasibility testing was either overlooked or rushed in the past, but the importance and value of this phase in intervention development is now widely accepted [Skivington et al., 2021]. A particular concern is that interventions in the public health sector often have tight timelines which do not accommodate for sufficient feasibility testing, resulting in failed intervention implementation [Kessler & Glasgow, 2011, Sanson-Fisher et al., 2007]. However, not including this phase may increase problems related to 1) intervention delivery including compliance and acceptability, 2) recruitment and retention, and 3) smaller-than-expected effect sizes which may all contribute to an increased likelihood of a failed implementation and an inability to generate useful data [Skivington et al., 2021; Craig et al., 2008]. Feasibility studies can therefore help to ensure that money is not wasted on expensive studies which are found to be ineffective [Ioannidis et al., 2014]. A feasibility study allows an intervention to be refined by either making incremental or simultaneous adaptations throughout the feasibility study, as well as during all phases of the development of the intervention [O’Cathain et al., 2015]. It is not necessarily a scale model of the planned main evaluation but should explore any uncertainties identified in the development phase [Skivington et al., 2021; Craig et al., 2008].

Hallingberg et al. (2018), suggest that researchers use the terminology by Eldridge et al. (2016a) and “view feasibility as an overarching concept, with all studies done in preparation for a main study open to being called feasibility studies, and with pilot studies as a subset of feasibility studies” [Eldridge et al., 2016a]. A combination of qualitative and quantitative methods can be used to assess these processes [Moore et al., 2015; O’Cathain et al., 2015; Craig et al., 2008]. Moore et al. (2015) further

explain that feasibility studies have an important role when examining matters related to context, mechanism of impact and implementation. Therefore, insufficient exploration of the feasibility of interventions increases the likelihood of failed implementation as well as failure to generate useful information. A feasibility study is therefore imperative to identify the usefulness and the adaptations required to enhance the intervention design (e.g. the mode of delivery) and the evaluation design (e.g. choice of outcome measures).

2.9.2 Feasibility of the intervention design

After the development phase of an intervention, any uncertainties regarding 1) optimal intervention content and mode of delivery; 2) acceptability of the intervention to participants; 3) the ability to collect appropriate data for assessment; 4) cost-effectiveness and 5) ability of the providers to deliver the intervention within a specific setting should be explored before embarking on an effectiveness study [O'Cathain et al., 2015]. Depending on the findings, the intervention may require refinement before the full-scale study commences and some guidance suggests this occurs within the feasibility study on an ongoing basis [Fletcher et al., 2016; Levati et al., 2016; O'Cathain et al., 2015; Bowen et al., 2009]. The role of qualitative data collection to optimise or refine an intervention was highlighted by both Fletcher et al. (2016) and O'Cathain et al. (2015). In a recent systematic review investigating feasibility guidance, where thirty guidance papers were included, qualitative data was also suggested to obtain information regarding acceptability and implementation [Hallingberg et al., 2018]. Although focus groups are considered useful to obtain qualitative data, it does create potential for differing views to remain concealed in this setting, as noted by one paper included in the systematic review [O'Cathain et al., 2015].

2.9.3 Feasibility of the evaluation design

Feasibility testing of the evaluation design aims to provide useful data to improve the quality of a full-scale evaluation [Cook et al., 2018].The uncertainties regarding evaluation design that would be explored may relate to: 1) recruitment, retention and sample size; 2) acceptability of randomisation; 3) duration of follow-ups; 4) choice of outcome measures; 5) floor or ceiling effects (when responses on a measure or questionnaire cluster at the top or bottom); 6) potential harms; 7) attrition reasons; or 8) impact of the intervention on widening health inequalities (testing in a range of contexts) [Hallingberg et al., 2018]. It is widely recommended that both qualitative and quantitative data be used to assess these criteria [Hallingberg et al., 2018; Eldridge et al., 2016a; O'Cathain et al., 2015; Taylor et al., 2015]. Eldridge et al. (2016a) further explain that a randomised controlled trial is the best design feature for a pilot study to estimate potential impact However, as feasibility studies are often underpowered, the MRC guidance warns to interpret quantitative data with caution when assessing effectiveness. Randomisation as a design feature in feasibility studies was deemed unnecessary to

estimate cost or select outcomes but was thought to be useful to estimate recruitment, willingness to be randomised and retention rates for intervention and control groups [Taylor et al., 2015; Shanyinde et al., 2011] and to inform the sample size for the full-scale evaluation by estimating the effect size [Bowen et al., 2009; Campbell et al., 2000].

2.9.4 Progression criteria

Feasibility data should be tested against pre-determined progression criteria to establish if an intervention is feasible and acceptable and if the evaluation design is suitable to measure effectiveness in a full-scale study [Hallingberg et al., 2018]. Simpson et al. (2020) recommend that qualitative data be used to assess factors such as acceptability of the intervention content and mode of delivery while quantitative data be used to assess recruitment and retention rates {Simpson et al., 2020]. Other sources also recommend that qualitative findings should be considered more influential than quantitative findings [Westlund et al., 2017; O'Cathain et al., 2015].

Progression criteria should be used as guidelines where a traffic light system may be used indicating varying levels of acceptability where green indicates no issues identified; amber means amend where identified issues can be resolved and red means stop when issues cannot be resolved [Eldridge et al., 2016a; Eldridge et al., 2016b]. This system allows scope for discussion with a steering committee but the decision to continue with the study ultimately lies with the study team. Some sources suggest that if extensive changes are made to the intervention or the evaluation design, researchers should return to the feasibility or intervention development phase [O'Cathain et al., 2015; Shanyinde et al., 2011]. At this point however, there is no guidance when movement between these two phases should occur [Hallingberg et al., 2018].

Stakeholders should be included in the design of the feasibility study and the progression criteria to ensure that the data generated, upon which the future decisions of the study are being made, are appropriate [Hallingberg et al., 2018, O'Cathain et al., 2015].

2.10 References

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CHAPTER 3

THEORY AND EVIDENCE-BASED DEVELOPMENT OF A WEIGHT LOSS INTERVENTION FOR OVERWEIGHT AND OBESE PRIMARY SCHOOL EDUCATORS EMPLOYED AT PUBLIC SCHOOLS IN LOW-INCOME SETTINGS IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA

ABSTRACT

Background:

Bearing in mind the prevalence of overweight/obesity found among educators and their role modelling function, it is imperative that appropriate weight loss interventions are developed and implemented to control obesity in this target population. The United Kingdom Medical Research Council state that best intervention development practice involves a systematic approach where best published research evidence and most suitable theories are combined, referred to as the 'theory and evidence-based approach'. Intervention development should inherently consider behaviour change theories to assist researchers in deciding which theoretical constructs to target to achieve behaviour change.

Aim:

The aim of this research was to conduct a theory and evidence-based process to develop a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa.

Methods:

This research firstly involved identification of an appropriate intervention development framework and then behaviour change theories for integration in the framework. The Behaviour Change Wheel (BCW) integrated with the Theory of Planned Behaviour (TPB) to gain insight in educator beliefs regarding dietary and physical activity behaviours and the Health Belief Model (HBM) to address the concept of health awareness (first step to behaviour change) were selected. The Step approach to Message Design and Testing (SatMDT) tool was chosen to underpin intervention message development. The systematic process approach applied in the development of the weight loss intervention in this research included five overarching stages, namely 1) identifying the target behaviours for weight loss, 2) understanding the behaviour, 3) identifying the intervention options, 4) identifying the content and implementation options, and 5) testing and refinement of intervention materials. Key considerations that emerged in various steps that determined decisions regarding delivery format were as follows: target population specific factors, setting, affordability, access to electronic devices and internet, limited or no professional contact and preference regarding weight loss intervention delivery mode.

Outcome:

Step by step application of the BCW framework combined with the TPB, the HBM and the SatMDT resulted in the development of the self-help Health4LIFE weight loss intervention consisting of three

elements: 1) a wellness day, 2) a hard copy self-help manual and 3) 80 text messages sent over a 16-week period. The discussion of this section of the thesis focuses on critiquing the use of a theory-based approach (BCW combined with the TPB, HBM and SatMDT) in intervention development.

Conclusion:

Although the time and effort required to follow a systematic process using the BCW cannot be denied, at the end of this process a very clear understanding of the determinants of a specific behaviour and the mechanisms of action required to affect behaviour change is achieved. These insights are imperative for identification of the most appropriate intervention delivery mode and development of the intervention content. This research provides a comprehensive and systematic guide to using the BCW in a theory and evidence-based process for the development of a self-help weight loss intervention.

3.1 Introduction

Globally major causes of morbidity and premature mortality are non-communicable diseases (NCDs), with the main contributors being cardiovascular diseases, cancers, chronic respiratory diseases and diabetes [WHO, 2018]. It has been estimated that two-thirds of global deaths, 38 million annually, are attributable to NCDs, constituting 63% of all deaths. Four-fifths of these deaths occur in low- and middle-income countries [WHO, 2018]. The World Health Organisation (WHO) global statistics have warned that if nothing is done to prevent the increasing prevalence of NCDs, the number of deaths will increase to 55 million by 2030, with the greatest increase (24%) expected in the African region [WHO, 2018]. They have therefore urged governments to develop NCD targets and public health strategies aimed at improving health.

NCD causes have been designated to be non-modifiable such as genetic predisposition, gender, age and race, as well as modifiable such as unhealthy diet, physical inactivity, tobacco use and harmful use of alcohol [WHO, 2018; Zaman et al., 2015]. The combination of non-modifiable and modifiable risks give rise to intermediate risk factors of NCDs, including obesity, hypertension, hyperlipidaemia and insulin resistance [Ezzati & Riboli, 2013]. Obesity in itself increases the risk of hypertension, hyperlipidaemia and insulin resistance [Dwivedi et al., 2020].

The prevalence of overweight and obesity in South Africa has been steadily increasing as is evident from national data obtained from the 2003 South African Demographic and Health Survey (SADHS), the 2012 South African National Health and Nutritional Examination Survey (SANHANES) and the 2016 SADHS. The combined prevalence of overweight and obesity in men was found to be 29.2%, 30.7% and 31.3, while in females it was 56.6%, 64.0% and 67.6%, respectively in the three surveys [DoH, 2019; Shisana et al., 2013; DoH, 2007]. Research in the Western Cape highlighted that this problem may be even more pronounced among school level educators. Senekal et al. (2015a) reported that overweight was present in 37% of male and 27% of female primary school educators in lower socio-economic urban and rural areas, while 38% of the males and 55% of the females were obese [Senekal et al., 2015a]. Thus only 21% of the total group of 517 educators had a normal weight. Adeniyi et al. (2017) found that the mean BMI [31.6 ± 7.0 kilograms per square metre (kg/m^2)] for a group of 489 educators recruited from the Metro South Education District of Cape Town fell into the obese class I category [Adeniyi et al., 2017]. Joseph et al. (2018) (health awareness, Cape Town) and KaziHealth (2019) (preliminary unpublished results from an ongoing health intervention in Gqeberha in the Eastern Cape) found similar profiles of overweight and obesity in educator samples at baseline.

The high prevalence of overweight and obesity among educators does not only put their own health at risk and as a consequence negatively impact on their teaching capacity but may also jeopardize the development of healthy body size perceptions and a healthy lifestyle among learners. Numerous

studies have found that educators not only promote learner motivation in aspects of education, but also life in generally. They are thus not simply providers of education, but are also role models of healthy behaviours, positive attitudes and providers of support to learners [Calder et al., 2019; Olivier, 2006; Drummond et al., 2002; Kruger & Adams, 1998; McCombs, 1994; Mwamwenda, 1996; Vrey 1979]. This was confirmed by learners themselves in the qualitative study by Olivier (2006), where one learner remarked that "teachers are supposed to be our role-models" when they were disappointed by unacceptable behaviour from their educators. As role models, educators need to be responsible and cognisant of the health messages they are displaying to learners. The WHO recognises this and has emphasised the importance of health promotion by educators in their School Policy Framework [WHO, 2008].

Bearing in mind the prevalence of overweight/obesity found among educators [Joseph et al., 2018; Adeniyi et al., 2017; Senekal et al., 2015a] and their role modelling function, it is imperative that appropriate weight loss interventions are developed and implemented to manage the problem of overweight/obesity amongst educators, while ensuring that they model a healthy body shape and lifestyle behaviours in their teaching environment.

The United Kingdom (UK) Medical Research Council (MRC) concluded that best intervention development practice involves a systematic approach where best published research evidence and most suitable theories are combined. This approach to intervention development was delineated as the 'theory and evidence-based category' of intervention development approaches [O'Cathain et al., 2019a]. Further approaches identified by these authors include: partnership (target population involved in decision making), target population-centred (based on the views and actions of the target population), implementation-based (focus on real world applicability), efficiency-based (intervention components tested experimentally), stepped or phased-based(focus on systemic overview of development processes), intervention-specific (approach is constructed for a specific type of intervention) and a combination of approaches [O'Cathain et al., 2019a].

Several frameworks that support a systematic approach to intervention development, have been outlined and include, but are not limited to, the MRC framework for developing and evaluating complex interventions, the Behaviour Change Wheel (BCW), Intervention Mapping (IM), Matrix Assisting Practitioner's Intervention Planning Tool (MAP-IT), Normalisation Process Theory (NPT) and finally the Theoretical Domains Framework (TDF) [O'Cathain et al., 2019a]. Intervention development should further consider behaviour change theories or models such as the Health belief model (HMB) [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958], Transtheoretical Model [Prochaska et al., 1992] and the Theory of Planned Behaviour (TPB) [Azjen, 1991, 1985] to assist researchers in deciding which theoretical constructs to target to achieve behaviour change.

The aim of this research was to conduct a theory and evidenced-based process to develop a weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa (Phase 1) by 1) selection of an appropriate intervention development framework, 2) identifying and integrating appropriate behaviour theory in the selected framework, 3) executing the framework in its entirety, following a systematic and stepwise approach and 4)) testing and refining the intervention materials once developed before feasibility testing.

3.2 Methods and outcomes

The methods section covers the five stages of the intervention development, with the BCW at the core of the systematic approach being followed. The focus of each stage is outlined and detail on the tasks and example outcomes are delineated for each task.

3.2.1 Intervention development overview

For the purposes of this research intervention 'development' was defined as the entire intervention development process, while intervention 'design' was defined as decisions that are made regarding intervention content, delivery and format [O'Cathain et al., 2019a]

A group of experts in the field of research were identified to oversee and contribute expert inputs in the tasks executed as part of the intervention development process. Panel members included Professor M, Senekal (study supervisor, senior researcher and expert in behaviour theory); Professors N, Steyn and A, de Villiers (senior researchers and experts in behaviour theory); Professor M Faber (chief senior specialist scientist); Professor D Evans (external co-investigator, Professor of Prevention and Community Health and Global Health, The George Washington University Milken Institute School of Public Health from Washington University) and Mrs S, Booley (dietitian with master's level research and community level work experience). It is however important to note that not all panel members were involved at each step but the composition of the panel for each task is outlined in sections where relevant. The intervention was developed over a period of ten years, with formative assessments spanning eight years (2007 to 2015) and actual intervention development two years (2015 to 2016).

3.2.2 Selection of an intervention development framework

Potential theory and evidence-based intervention development frameworks, which included the MRC framework for developing and evaluating complex interventions, BCW, IM, MAP-IT, NPT and the TDF, were reviewed by the expert panel (Senekal, Faber, Steyn, Booley and the Doctor of Philosophy, PhD, candidate) to identify the most appropriate framework for application in the intervention

development process. The strengths and limitations of each were considered as well as relevant findings from researchers who applied the frameworks in intervention development (See Chapter 2, Section 2.7). Michie et al. (2011a) identified and evaluated 19 frameworks against the criterion of comprehensiveness, coherence and inclusion of a model of behaviour. As all the frameworks were found to be inadequate, a new framework, the BCW, was developed. It is a synthesis of the 19 frameworks which addresses the identified limitations, integrates the common features of the frameworks and is linked to a model of behaviour. [Michie et al., 2011a]. The authors of the BCW consider it to be the only framework that meets the criteria of coherence, comprehensiveness and links to a model of behaviour. The BCW is considered to be simple, comprehensive and practical and is underpinned by the capability opportunity motivation behaviour (COM-B) model which incorporates existing behaviour change models [Michie et al., 2011a]. The BCW identifies three layers of influences which must be considered in order to achieve behaviour change through intervention: 1) the determinants of behaviour which include Capability, Opportunity and Motivation-Behaviour (COM-B); 2) intervention functions which identify possible ways to intervene the determinants of behaviour and 3) the policy categories which identify the ways to support change on a structural level (Figure 3.1). The BCW was therefore selected as the intervention development framework.

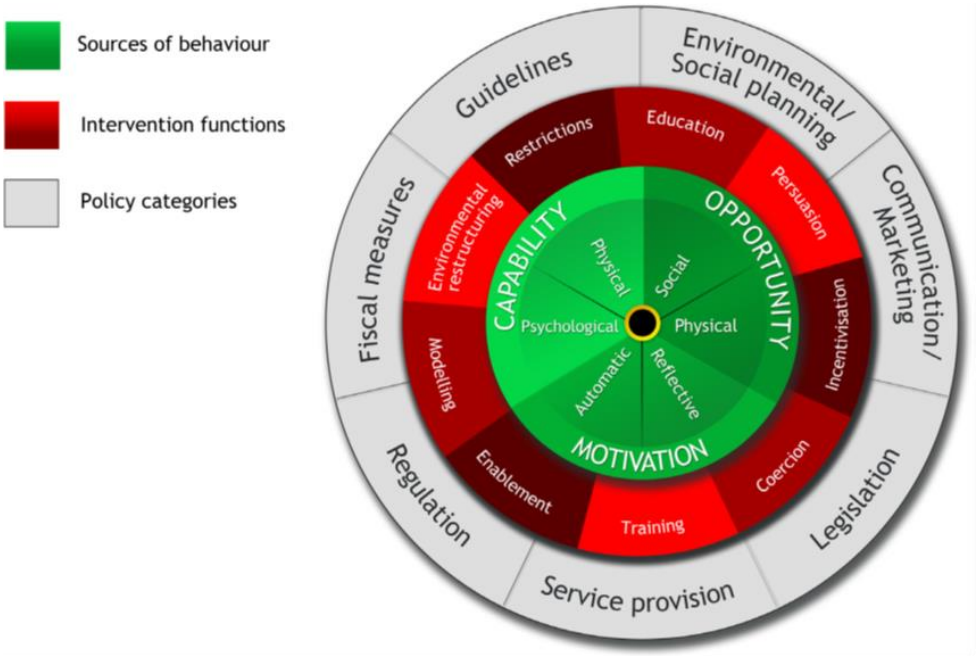

Figure 3.1: The behaviour change wheel (BCW) depicting the three layers which must be considered to attain behaviour change [Michie et al., 2011a, reproduced with permission]

It was further decided to make use of an expert panel that remained consistent across the steps and to conduct testing and refinement of the intervention before taking it forward into feasibility testing as recommended in the MRC framework.

3.2.3 Identification of behaviour change theories to be integrated in the selected intervention development framework

The TPB was selected for integration in the BCW to gain insights in salient educator beliefs regarding dietary and physical activity behaviours as to identify messageable beliefs as the model theorizes that behavioural, normative and control beliefs determine attitude toward the behaviour, subjective norms and perceived behavioural control, which in turn determine intention to perform the behaviour (Figure 3.2) [Ajzen, 1985, 1991]. The TPB has been commonly applied in the explanation of outcomes of and to some extent in the development of health interventions [Cheng et al., 2019; Godin et al., 2011; Andrews et al., 2010; Norman & Conner, 2005].

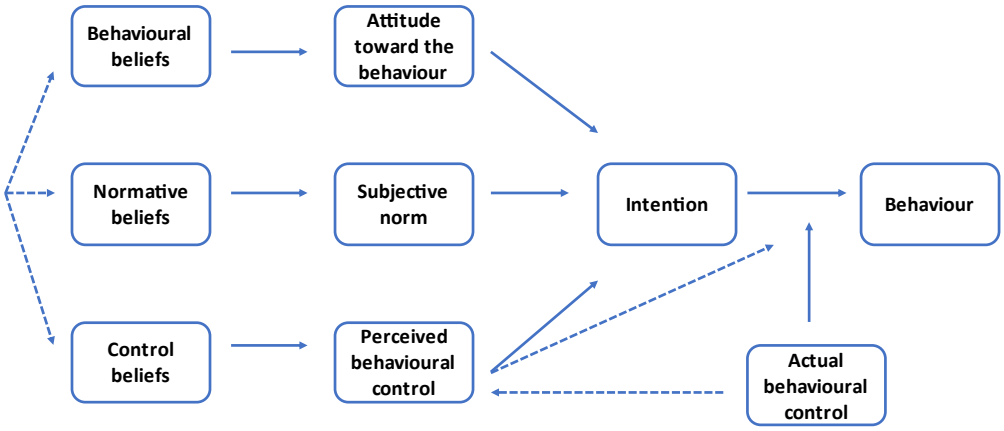

Figure 3.2: The Theory of Planned Behaviour [Ajzen, 1991, 1985]

The HBM was selected to address the concept of health awareness (first step to behaviour change). The HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] proposes that behaviour is determined by a number of beliefs regarding the threats to an individual's wellbeing and the effectiveness of the recommended health behaviour [Figure 3.3].

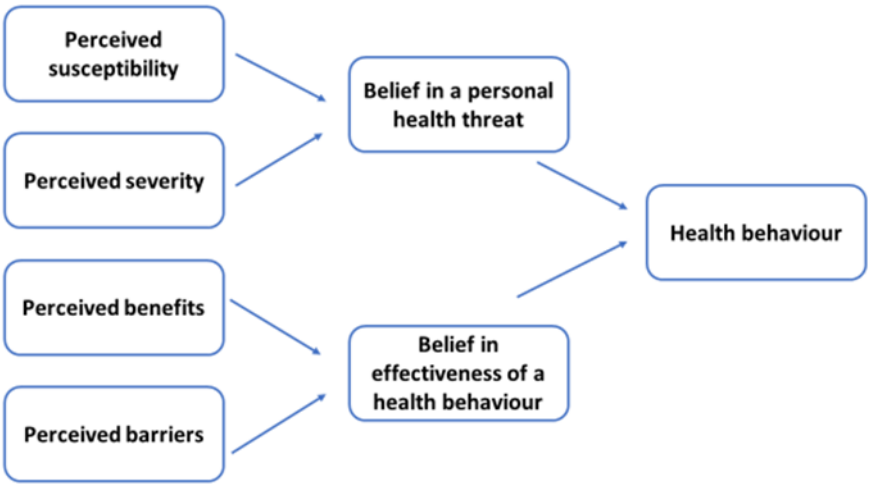

Figure 3.3: The Health Belief Model [Hochbaum, 1958]

3.2.4 Execution of the framework in its entirety

The systematic process applied in the development of the weight loss intervention in this research included five overarching stages, namely 1) identifying the target behaviours for weight loss, 2) understanding the behaviour, 3) identifying the intervention options, 4) identifying the content and implementation options, and 5) testing and refinement of the intervention (Table 3.1).

Table 3.1: The systematic approach applied in the development of the weight loss intervention in this research

Stage	Focus	Task(s)
1	Identify target behaviours for weight loss	Review of existing research for identification of target behaviours (behaviour problems) for weight loss in primary school educators employed at public schools in low-income settings in the Western Cape
		Review of existing research for identification of salient beliefs of primary school educators employed at public schools in low-income settings in the Western Cape relating to identified target behaviours (application of the TPB to understand educator beliefs related to dietary and physical activity behaviours)
2	Understanding target behaviours	Implementation of BCW Steps 1-4: BCW Step 1: Define the problem in behavioural terms BCW Step 2: Select potential target behaviours to address behaviour problems BCW Step 3: Specify the target behaviour BCW Step 4: Identify what needs to change
3	Identify intervention options and policy categories	Implementation of BCW Step 5 and 6: BCW Step 5: Identify intervention functions BCW Step 6: Identify policy categories
4	Identify intervention content and implementation options	Application of BCW Steps 7 and 8 BCW Step 7: Identify behaviour change techniques (BCTs) BCW Step 8: Identify mode of delivery

		Translate BCT into intervention content and actions
5	Testing and refinement	Testing and refinement of the weight loss manual content and text messages

3.2.5 Stage 1: Identify target behaviours for weight loss

A. Review of existing research for identification of target behaviours for weight loss in primary school educators employed at public schools in low-income settings in the Western Cape

Identification of studies

A literature search was conducted in May 2019 on PUBMED using the search terms school teachers [MeSH] OR teachers OR educators AND Weight reduction OR weight loss OR dietary OR diet OR nutrition OR smoking OR exercise OR physical activity OR health interventions OR health behaviour change OR health behaviour change OR health education OR health promotion OR health promoting behaviours OR health awareness OR health programs OR health programmes.

The only comprehensive research in South Africa that provides insights in not only the health and weight status of educators, but also their lifestyle behaviours and body shape perceptions, is the HealthKick (HK) survey conducted by the MRC. [de Villiers et al., 2012]. Only one other survey, conducted in Brazil, reported on the weight status of educators with limited insights on lifestyle behaviours [Serra et al., 2015] and therefore did not provide insights for consideration in the intervention development process.

The MRC HK study

Background: In 2007, the MRC initiated a primary school diabetes prevention programme called HK which was aimed at learners. As part of the HK study, a situational analysis was conducted at 100 urban and rural disadvantaged schools in low socio-economic areas in the Western Cape (50 schools in the Cape Metropole and 50 schools in the Overberg/Breede River districts). Results showed that educators constituted an important environmental influence on children. The HK study was therefore expanded to include a health risk survey of educators employed at the participating schools [de Villiers et al., 2012].

NCD risks and weight perceptions of educators: Participating school principals identified lack of physical activity (33%) and NCDs (24%) as the main health priorities of primary school educators [de Villiers et al., 2012]. Findings showed that they were a high-risk group for NCD development. More than a third (37%) of males and 27% of females were overweight, while 35% of males and 55% of females were obese. In addition, 38% of males and 67% of females had a high waist circumference

(WC ≥ 102 centimetres in men, WC ≥ 88 centimetres in women) and 46% were hypertensive [Blood Pressure ≥ 140/90 millilitres mercury (mmHg)]. High non-fasting cholesterol levels were found in 30% and high non-fasting blood glucose levels in 29% of the educators [Senekal et al., 2015a]. These figures exceed those reported for the general population in the South African National Health and Nutrition Survey (SANHANES) [Shisana et al., 2013]. It was further also evident that many educators were likely to underestimate their body weight, as well as being unaware of their personal health risks such as being overweight or having hypertension, high cholesterol or high blood glucose [Senekal et al., 2015a]. Senekal et al. (2015a) argue that this may reflect a lack of interest in health by the educators, which would need to be considered in the development of the weight loss intervention.

Dietary patterns of educators: The HK educator survey also investigated food choices of educators. These were identified using a non-quantified indicator food frequency questionnaire that reflected the frequency of consumption of poor and healthy food choices in the past "week". The food list was compiled to reflect foods/drinks/snacks associated with the development/prevention/management of obesity, diabetes and other NCDs, as well as cultural food choices (Seme et al., 2017). For data analysis purposes, the indicator foods were assigned to six food categories, namely fruit and vegetables (oranges/naartjies; apples; bananas; pears; green vegetables including spinach, peas, beans and broccoli; orange/yellow vegetables including sweet potato, pumpkin, butternut and carrots; mixed vegetables; cabbage; cauliflower and lettuce.); high fat foods (processed meats; tinned meat; chicken with skin; yellow cheese; margarine; fried foods, including chips, fat cakes, fish, chicken; take outs e.g. McDonalds; pies, sausage rolls, and samosas); energy-dense snacks/items (sugar, chocolate, sweets, cake, biscuits, doughnuts, crisps, jam, syrup, honey); white bread; cereal and legume fibre (breakfast cereals including all bran flakes, muesli, Weetbix, oats; brown bread and legumes) and processed (salty) foods (tinned meat/fish, margarine/butter, bread, cheese, peanut butter/peanuts, cakes, biscuits, doughnuts, crisp, take outs e.g. McDonald's, pies, sausages rolls, samosas). Of note is that the frequency of intake of some foods allocated to the salty food group may have also been counted in one of the other 5 groups [Seme et al., 2017].

Educators reported eating fruit and vegetables choices twice (combined; classified as healthy choices) a day; legumes, cereals once a day (classified as healthy choices), white bread 3-4 times a week (classified as unhealthy choice), high fat foods twice a day (classified as unhealthy choices), energy dense snack choices once a day (mostly sugar, and sugar containing items, thus classified as unhealthy choices) and salty food choices three times a day (classified as unhealthy choices). These food choices reflect a dietary pattern where unhealthy food choices seem to be made more frequently than healthy food choices, with specific concerns being low intake of fruit and vegetables and high intake of fat and sugar rich and salty foods [Seme et al., 2017]. Educators' understanding of healthy eating also seemed to be very limited. When asked what you need to eat to be healthy vegetables

was mentioned by 54%, fruits by 41.9%, proteins by 29%, fats by 14.6%, dairy by 8% and starches by 6% [Seme et al., 2017].

Physical activity levels of educators: Physical activity was assessed in the HK educator survey using the Global Physical Activity Questionnaire (GPAQ) that was developed by the WHO for the quantification of energy expenditure in subjects in developing countries [Armstrong & Bull, 2006]. The GPAQ focuses on physical activity which takes place in three settings (activity at work; travelling to and from places and recreational activities, as well as on sedentary behaviour. Metabolic equivalents (METs) per week were calculated and used to classify physical activity levels as high, moderate and low. Results show that the majority (86.7%) of educators were classified as being moderately active and 14.3% as having low levels of physical activity. Females and those older than 50 years were significantly more likely to be classified as having low levels of physical activity [Seme et al., 2017].

When interpreting these results, it should be noted that the major contributor to METs in the HK educator survey was activity in work time (1313 METs at work versus 224 METs for transport and 137 METs for recreational activity) [Seme et al., 2017]. Seme et al. (2017) argued that the high METs spent during work time could be explained by the possibility that educators spend a large part of their work time standing and walking (designated as moderate intensity activity in the GPAQ). The reported time spent by teachers in sedentary activity (3.4 hours per day) further supports the notion that physical activity levels, and thus classification of the majority as moderately active, could have been over estimated.

B. Salient beliefs of primary school educators employed at public schools in low-income settings in the Western Cape relating to healthy dietary and physical activity behaviours

As mentioned, it is essential that behaviour change theories should be considered in the development of interventions aimed at improving behaviours for weight loss. Many studies, including weight loss studies, have used the TPB to understand the individual decision-making processes that underpin behaviour change [McEachan et al., 2011]. Azjen (1991) asserted that if one understood beliefs, interventions or intervention components could be tailored to target salient beliefs to attain sustained behavioural change.

For these reasons Steyn et al. (2014; Unpublished data) conducted an elicitation study to gain insights into the beliefs primary school educators employed at public schools in low-income settings in the Western Cape hold regarding fruit and vegetable, sugar, fat and salt intakes, as well as physical activity. Salient beliefs that were identified were further investigated in a cross-sectional survey using a Theory of Planned Behaviour questionnaire (TPB-questionnaire). The elicitation study comprised five focus groups (total n= 53 educators from schools in the target areas). Questions in the focus group guide covered beliefs educators and their families may hold regarding the mentioned

behaviours, as well as their beliefs regarding facilitators of and barriers to the execution of these behaviours. An expert panel (Senekal, Steyn, de Villiers, Evans, Booley and the PhD candidate), considered the salient beliefs that emerged from the focus group data. A list of 50 beliefs for inclusion in the TPB-questionnaire was generated based on insights of the panel in cultural, dietary and physical activity practices and other considerations in the target communities. Frequency of reporting in the focus groups was also considered bearing in mind the recommendation by Kreuger and Casey (2009:121) that "Although we pay attention to how frequently something is said, it is a mistake to assume that what is said most frequently is most important. Sometimes a key insight might have been said only once in a series of groups. You have to know enough about what you are studying to know a gem when it comes along. One person may be a visionary thinker and identify something that no one else has spotted or thought about yet."

The expert panel familiar with the TPB and the development of TPB-questionnaires (Senekal, Steyn, de Villiers, Evans, Booley and PhD candidate), developed a belief-statement for each belief on the final list of 50, using the guidelines published by Azjen (2011). Beliefs were classified as behavioural, normative or control as outlined in the TPB [Azjen, 2011] (Addendum I, page 282).

The beliefs relating to the dietary and physical activity behaviours were mostly control beliefs relating to facilitators of and barriers to performing the behaviours. Behavioural beliefs that emerged related mostly to potential health benefits of the behaviours. Very few normative beliefs emerged and those that were identified mostly related to physical activity. The belief statements were pilot tested on five educators to ensure each statement was clearly written and understood as intended and it was then adapted accordingly if required. In the TPB-questionnaire respondents had to indicate their level of agreement with the statements on a Likert scale of 1-5 with 1 denoting the strongest disagreement, 3 being neutral and 5 denoting strongest agreement.

The final TPB-questionnaire was administered on 164 educators from schools in lower socio-economic areas in the Cape Metropole (median BMI was 30.5 kg/m^2) [Senekal et al., 2015b; Unpublished data]. The median interquartile range (IQR) score for each belief was calculated and considered in a final interactive session with the expert panel (Senekal, Steyn, de Villiers, Evans, Booley and PhD candidate), to identify messageable beliefs for targeting in a lifestyle weight loss intervention for primary school educators. Beliefs with a median score that allowed for a shift, either up or down, depending on whether the belief statement was formulated in a negative or positive format (scores of ≥ 4 or ≤ 1) and were deemed to have good potential to change, were retained. An example of this included the belief, 'I would eat vegetables even if at times they look unappealing,' which was deemed to have potential to change, while the belief, 'Most people who are important to me eat fruits and vegetables every day' was deemed to have little or no potential to change.

The final list of 24 beliefs that were considered messageable and could be targeted in the intervention was compiled (Table 3.2). Eighteen were control beliefs and 6 were behavioural beliefs. No normative beliefs remained after this final selection.

Table 3.2: Final list of messageable beliefs (24) regarding fruit and vegetable intake, sugar intake, fat intake and physical activity to be targeted by the intervention

Beliefs regarding fruit and vegetable intake (6 beliefs)		
Preparation of vegetables does not take a long time (Control).	Fruits and vegetables are affordable (Control).	I am confident that I can eat the recommended amounts of fruit and vegetables every day (Control).
Eating fruits and vegetables every day will help me lose weight/ control my weight (Behaviour).	I would eat vegetables even if at times, they look unappealing (Control).	Fruit and vegetables are easy to find in stores nearby (Control).
Beliefs regarding sugar intake (4 beliefs)		
I turn to sugary foods/snacks/drinks when I am stressed (Control).	Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired) (Behaviour).	I have poor awareness of the sugar content in the food/drinks I eat/drink (Control).
I can reduce the amount of sugary foods/snacks/drinks I eat and drink (Control)		
Beliefs regarding fat intake (7 beliefs)		
Eating less fat will help reduce the risk of diseases e.g. heart disease (Behaviour).	Low-fat/healthy fat options are expensive (Control).	It is easy to exclude high-fat foods from my daily diet (Control)
Decreasing the amount of fat I eat will help me lose/ control my weight (Behaviour).	Healthy takeaways and/or street foods are easy to find in my surroundings (Control).	I do not have enough time to prepare healthy meals regularly (Control).
Low fat/ fat-free foods taste good / are tasty (Behaviour).		
Beliefs regarding physical activity (7 beliefs)		
Being physically more active will make me feel better about my appearance (Behaviour).	I could increase my physical activity levels (be physically more active) even if I were tired (Control).	There are no accessible, safe, affordable opportunities for me to be physically active (Control).
Knowing more about different types of physical activity I can do will help me to be more active (Control).	Finding time to be physically more active is possible (Control).	I can increase my levels of physical activity (be physically more active) (Control)
Having an exercise “buddy” will help me to be physically more active (Control).		

C. Implications for intervention developments

There is consensus amongst leading health authorities that a comprehensive approach, which integrates healthy dietary intake, increased physical activity components and includes measures to support behaviour is the cornerstone of treatment for overweight or obese individuals [Wadden et al., 2020; Wharton et al., 2020; Kushner, 2018; Alamuddin et al., 2016; Bray et al., 2016; Raynor & Champagne 2016; Yumuk et al., 2015; Jensen et al., 2014;].

Results from the only relevant study, the HK educator survey clearly showed that the following dietary behaviours would need to be addressed in a weight loss programme for educators: low intake of fruit and vegetables and frequent intake of foods/snacks/drinks high in sugar and fat. It is evident that these poor food choices are not unique to educators. As part of the 2012 SANHANES, scores were generated for fruit and vegetable, sugar and fat intake to investigate quality of food choices. With regards to fruit and vegetables, a quarter of both males and females had a poor intake (25%) while only 29% had a high fruit and vegetable intake. Approximately 20% of participants had a high sugar score (19.3% males and 20% females), with similar findings for the fat intake (18.7% males and 18% females) [Shisana et al., 2013].

A further behaviour that evidently also requires attention in a weight loss programme for educators is the low to moderate levels of physical activity. Results from the 2012 SANHANES show that low levels of physical activity also characterise the general population, where one in four males (27.9%) and 45.2% of females were reported to be unfit [Shisana et al, 2013].

There is a paucity of information on beliefs educators hold relating to healthy lifestyle behaviours. The list of messageable beliefs was developed for integration as relevant in the BCW steps.

3.2.6 Stage 2: Understanding the behaviours

A. Overview

As indicated in Table 3.1, Stage 2 involved the implementation of Steps 1 to 4 of the BCW to contribute to understanding problem behaviours that educators need to address for weight loss, namely low fruit and vegetable intake, high intake of sugar and fat and low-to-moderate levels of physical activity, as identified in Stage 1.

The tasks that form part of each of the four BCW steps, including the BCW worksheets [Michie et al., 2015], were executed by the PhD candidate using her insights in the target population, as well as relevant published and unpublished research. The outcomes of each step were interrogated in interactive sessions with an expert panel working in this field as outlined in each step.

To facilitate understanding of the execution of the four steps, the outcomes of each task were illustrated using “decreasing fat intake” as the example behaviour. The complete set of outcomes for the remaining target behaviours (to increase fruit and vegetable intake, to reduce sugar intake and to increase physical activity) are presented in the same format in Addenda II to V.

B. BCW Step 1: Define the problem in behavioural terms

Background and tasks executed

To understand a behavioural problem, it must be defined in behavioural terms. The behaviour itself must be defined clearly. For example, an intervention may aim to promote weight loss, but weight loss is not a behaviour per se. Behaviours that need to change to facilitate weight loss would usually relate to food choices and physical activity [Semlitsch et al., 2019]. In the case of educators teaching at primary schools in the Cape Metropole, particular food choices and low-moderate physical activity levels were the behaviour problems under consideration [Seme et al., 2017]. In line with the stipulation of the BCW, the PhD candidate specified the behaviour problems in terms of 1) what behaviour needs to change to solve the problem, 2) where the behaviour occurs and 3) which individual, groups or population are involved, using her insights into the target population, as well as relevant published [Seme et al., 2017] and unpublished research. The expert panel (Senekal, Steyn, Faber and the PhD candidate) then considered the behaviour problems and finalised the outcomes in an interactive session.

Outcomes using 'decrease fat intake' as example

Table 3.3 illustrates the outcome of defining 'decrease fat intake' in behavioural terms.

Table 3.3: Defining the problem (high fat intake) in behavioural terms

What behaviour?	High fat intake
Where does the behaviour occur?	School, home, when socializing
Who is involved in performing the behaviour?	Educators, colleagues, their families, friends

Tables that provide detail and the outcomes of this step for the other three problem behaviours are included in Addendum II on page 283.

C. BCW Step 2: Select potential target behaviours to address behaviour problems

Background and tasks executed

Behaviours function as a system and occur alongside other behaviours. Therefore, when considering which behaviours should be targeted, a list of all potential target behaviours that may impact the problem should be generated. For the generation of the list of such behaviours for the four problem behaviours defined in Step 2, an expert panel (Senekal, Steyn, de Villiers, Faber and the PhD candidate), considered the sub-performance objectives identified in the formative assessment by Seme (2013), relevant literature [Vorster et al., 2013; Centres for Disease Control and Prevention (CDC), 2011a; CDC, 2011b] and their professional experiences to identify the potential target behaviours. These potential target behaviours were then prioritised using the following criteria as specified by Michie et al. (2011a), 1) the impact the potential target behaviour change was likely to

have on the outcome i.e. changing the behaviour problem, 2) how likely it was that the potential target behaviour could be changed, 3) the spill over effect of the potential target behaviour on other related target behaviours and 4) how easy it would be to measure the change in the potential target behaviour. Final behaviours to be targeted in the intervention were selected from the list of potential target behaviours for each of the four problem behaviours using the results of the prioritization process.

Outcomes using 'decrease fat intake' as example

Table 3.4 presents the target behaviours that the expert panel identified as having potential to contribute to decreasing fat intake by educators.

Table 3.4: Potential target behaviours for decreasing fat intake by educators

Intervention designer response (sub-performance objectives)
Choose to eat foods/snacks lower in fat
Select foods low in fat when purchasing foods
Add less fat when preparing foods
Reduce or avoid the intake of high fat snacks

Table 3.5 illustrates the process completed for the evaluation and prioritisation of the potential target behaviours for 'decreasing fat intake' listed in Table 3.4. The last row in the table presents the three behaviours the expert panel selected for targeting in the weight loss intervention.

Table 3.5: Evaluation and prioritization of potential target behaviours for reducing fat intake

Potential target behaviours	Impact of behaviour change	Likelihood of changing behaviour	Spill over score	Measurement score
	unacceptable, unpromising but worth considering, promising, very promising			
Choose to eat foods/snacks lower in fat	This target behaviour was considered not to be specific enough			
Select foods low in fat when purchasing foods	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: expense)	Promising (if replaces high fat foods makes target 2 easier)	Promising (24hr recall/Diet history)
Add less fat when preparing foods	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: taste, no choice, time)	Unpromising but worth considering	Promising (24hr recall/Diet history)

Reduce or avoid the intake of high fat snacks	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: taste, no choice, time)	Promising (replacing high fat food with lower energy food makes target easier)	Promising (24hr recall/Diet history)
Record selected target behaviour here:	Select foods low in fat when purchasing foods Add less fat when preparing foods Reduce or avoid the intake of high fat snacks			

Tables that provide detail and the outcomes of the evaluation and prioritization process for the other three problem behaviours are included in Addendum III on page 284. The selected target behaviours for decreasing increasing fruit and vegetable intake were: to purchase a variety of fruit and vegetables, to bring fruit and vegetables to school every day and to eat a variety of vegetables at mealtimes every day. For decreasing sugar intake the selected target behaviours were: to limit the purchases of sugar containing foods/drinks, to use less/no sugar when preparing food, to reduce or avoid sugar-containing cold drinks, to add less/no sugar to hot beverages and to avoid the intake of sugar-containing foods/drinks during times of stress. For increasing physical activity levels the selected target behaviours were: to be increase physical activity at work and to increase physical activity in free time.

D. BCW Step 3: Specify the target behaviours

Background and tasks executed

As outlined by Michie et al. (2013), the following detail of each selected target behaviour was specified by the PhD candidate using her insights in the target population, as well as relevant published [Vorster et al., 2013; CDC, 2011a; CDC, 2011b] and unpublished research: 1) who needed to perform the behaviour, 2) what needed to be done differently to achieve the desired outcome, 3) when it would be performed, 4) where it would be performed, 5) how often it would be performed, and 6) with whom the behaviour had to be performed. The expert panel (Senekal, Steyn, Faber and the PhD candidate) finalised the detail of each selected target behaviour during an interactive session.

Outcomes using 'select foods low in fat when purchasing foods' as example

Table 3.6 provides insights in how the selected target behaviour, 'select foods low in fat when purchasing foods' was further specified in terms of who must perform the behaviour, what needs to change, when and where it must be performed, how often and with whom.

Most of the target behaviours had to be performed by the educators themselves unless someone else was responsible for the purchasing of food or their meal preparation. Most actions had to be performed

at supermarkets, at home and at school. These behaviours had to be done consistently and the support of colleagues, family and friends was deemed to be important.

Table 3.6: Specifying the target behaviour 'Select foods low in fat when purchasing foods' in terms of who must perform the behaviour, what needs to change, when and where it must be performed, how often and with whom

Target behaviour: Select foods low in fat when purchasing foods	
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for purchasing food
***What* do they need to do differently to achieve the desired change?**	Replace high fat items with lower fat alternatives
***When* do they need to do it?**	When purchasing grocery items or ready-to-eat food items
***Where* do they need to do it?**	Shops, supermarkets, local vendors, tuck shop at school, restaurant
***How often* do they need to do it?**	With their usual grocery shop, weekly/monthly; daily at tuck shop or vendor, socialising
***With whom* do they need to do it?**	Family members, colleagues, friends

Tables that provide detail and the outcomes of this step for the other twelve target behaviours are included in Addendum IV on page 287.

E. BCW Step 4: Identify what needs to change

Background and tasks executed

The final step of Stage 2 is very important and involves conducting behaviour analysis using the COM.B model to identify what needs to change (in the individual and/or the environment) for the target behaviour to be achieved [Michie et al., 2011a].

Analysis of target behaviours in this research followed a comprehensive approach. The analysis firstly involved revisiting the information gathered in the first (section 3.2.2, A) and second formative assessments (section 3.2.2, B), more specifically the matrices of change objectives generated by Seme (2013) and the salient beliefs that emerged from focus groups. Consideration of this information in the context of the COM-B components (physical and psychological capabilities, social and physical opportunities as well as reflective and automatic motivation) resulted in identification of personal and external determinants of each target behaviour. This was executed by the PhD candidate and later finalized by the expert panel (Senekal, Steyn, Faber and the PhD candidate) during an interactive session.

Outcomes using 'select foods low in fat when purchasing foods' as example

Table 3.7 illustrates application of the COM-B components to identify what needs to change for the target behaviour, 'select foods low in fat when purchasing foods,' to occur in terms of capability, opportunity and motivation.

Table 3.7: Using the COM-B components to identify what needs to change for the target behaviour 'select foods low in fat when purchasing foods' to occur

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability Skill to perform behaviour	Skill to read food labels Know what low fat means	✓Educators may need knowledge: -regarding label reading -definition of low fat
Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the health consequences of eating too much fat in diet Identify different types of fat Describe the role of fat in the diet with specific reference to taste Skill to identify and replace high fat items with lower fat alternatives	✓ Knowledge of health implications of overweight ✓ Knowledge of types of fat ✓ Low-fat recipes which are still tasty ✓ Knowledge of low-fat replacements
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability of low-fat foods at purchase point – supermarket, vendor, school, restaurant Accessibility including money to purchase low fat foods	X Low-fat options are generally widely available ✓ Show how low-fat does not mean expensive
Social opportunity Social cues, cultural norms,	Acceptability and expectations of purchasing low fat foods (family)	✓ May need targeting
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe eating less fat will help reduce risk of heart disease Believe that decreasing fat intake will help me lose weight Believe that low fat options are affordable Believe that low fat foods are tasty/taste good Believe that it is easy to exclude high fat food from my daily diet	✓ belief needs targeting X already believed ✓ belief needs targeting ✓ belief needs targeting ✓ belief needs targeting
Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to purchase low-fat food within the budget Establish routines and habits to purchase low-fat food	✓ empower with knowledge ✓ change needed to establish routine and habit
Behavioural diagnosis: Change is required in all the COM-B components to achieve the target behaviour.		

Tables that provide detail and the outcomes of this step for the other twelve target behaviours are included as Addendum V on page 292.

3.2.7 Stage 3: Identify intervention options and policy categories

A. Overview

Stage 3 in the development of the weight loss intervention involved execution of Steps 5 and 6 of the BCW that involve evaluation and subsequent selection of suitable intervention functions and policy categories. The tasks that form part of Step 5 were executed by the PhD candidate using her insights in the target population, as well as relevant published and unpublished research. The outcomes of each step were interrogated in interactive sessions by the expert panel as outlined below. Regarding the policy categories (Step 6), the PhD candidate reviewed any existing school health services provided to educators and how these may be integrated with the weight loss intervention currently being developed.

B. BCW Step 5: Identify intervention functions

Background and tasks executed

Intervention functions broadly identify the mechanisms by which an intervention can change behaviour. The BCW clearly links the intervention functions to the COM-B model, thus identifying the functions which would most likely be effective to address the components identified in the behavioural analysis that need to be targeted for a behaviour to be performed [Michie et al., 2011a]. The nine intervention functions include education, persuasion, incentivisation, coercion, training, enablement, modelling, environmental restructuring and restriction.

The PhD candidate identified the suitable intervention functions which would most likely result in behaviour change in each of the COM-B components. The appropriateness and suitability of the identified functions were then considered using her insights into the target population, as well as relevant published [Burgess et al., 2017, Samdal et al., 2017; Atkins & Michie, 2015; Hartmann-Boyce et al., 2014; Michie et al., 2011c] and unpublished research, guided by the application of the APEASE criteria which are affordability, practicality, effectiveness, acceptability, side-effects and equity [Michie et al., 2011a]. The final selection was made by the expert panel (Senekal, Faber, Steyn and the PhD candidate) during an interactive session.

Outcomes of intervention function selection (applicable to all four problem behaviours and linked target behaviours)

Table 3.8 illustrates the process followed by the expert panel (Senekal, Steyn, Faber and the PhD candidate) for the evaluation of each intervention function. Seven out of the nine functions were

deemed to be potentially appropriate for application in the weight loss intervention for educators. Modelling and coercion were excluded as it failed to meet the APEASE criteria.

Table 3.8: Selection of the appropriate intervention functions using the APEASE criteria

Candidate intervention functions	**Does the intervention function meet the APEASE criteria of affordability, practicability, effectiveness/cost-effectiveness, acceptability, side-effects/safety and equity?** **A tick (✓)** indicates YES, a cross (X) indicates NO
Education: Increase knowledge and understanding	✓Educate about risks of non-compliance and benefits associated with lifestyle changes.
Persuasion: Using communication to induce positive or negative feelings or stimulate action	✓ Consider type of language used and method of delivery for messages.
Incentivisation: Creating expectation of reward	✓ Small benefits/rewards to be provided if goals achieved.
Coercion: Creating expectation of punishment or cost	X Deemed to be unsuitable because of the negativity of this approach, APEASE criteria of effectiveness, acceptability, side-effects not met.
Training: Imparting or developing skills	✓Although in-person training did not meet the APEASE criteria of affordability, practicability or cost-effectiveness, skills could be imparted indirectly.
Restriction: Rules to increase target behaviour by reducing opportunity to engage in competing behaviour	✓ Provide action plan to limit fat and sugar, increase fruit and veg and increase physical activity.
Environmental restructuring: Changing the physical or social context	✓Although limited, restructuring the pantry at home or the school environment is possible.
Modelling: Providing an example for people aspire to or imitate	X Although deemed to be a potentially effective function, the APEASE criteria of affordability, practicability and cost-effectiveness were questioned.
Enablement: Increasing means/ reducing barriers to increase capability or opportunity – beyond education and training or environmental restructuring	✓ Include evidenced based enablers such as goal setting.

C. BCW Step 6: Identify policy categories

Background and tasks executed

Once the intervention functions were identified, the next step of the BCW was to identify linked policies that could support implementation of the functions [Michie et al., 2011a]. The importance of policies and the role they can play in improving public health were recognised by McLeroy et al. (1988) who adapted the ecological model of social behaviour from Brofenbrenner (1977) and included policy at the outermost layer of its model, similar to the COM-B in the BCW. An example of such public health policy within the South African context is the 2018 Sugar Sweetened Beverage (SSB) tax, implemented by the government. This type of policy indirectly targets dietary behaviour by increasing the cost for SSBs [Department of National Treasury (DoNT), 2016].

The literature and government websites (Department of Health and Department of Basic Education) were reviewed to identify any existing policies regarding school health services where educators are the target group. The Deputy Director of Nutrition at the Department of Health (Dr H, Goeiman) was also contacted to provide inputs in this regard. The identified policy categories were then linked to the selected intervention functions, namely, communication/marketing, guidelines, regulation, fiscal measures and service provision. Next, the APEASE criteria were applied to each identified policy to determine the potential thereof each in supporting the delivery of the proposed weight loss intervention. Policy category selection is important because once an intervention has been proven to be effective, it is more feasible to implement and deliver it if it can be accommodated by or integrated in an existing policy.

Outcomes of identifying policy categories

It is evident that there is a paucity of policies that focus on this particular target group. This was confirmed in personal communication with the Deputy Director of Nutrition at the Department of Health (Dr H, Goeiman). The only potentially relevant policy that was identified, is the 2012 Integrated School Health Policy (ISHP) of which the stated goal is: "*To contribute to the improvement of the general health of school-going children as well as the environmental conditions in schools and addresses health barriers to learning in order to improve education outcomes of access to school, retention within school and achievement at school*". Although learners are identified as the primary target group, the policy states that the school community, including its educators, should also benefit from the programme [DoH, 2012a].

The ISHP replaced the failed 2003 National School Health Policy and the Departments of Health and Basic Education were made jointly responsible for the new policy to ensure an improved implementation thereof. While the policy provides clear legislation and implementation guidelines, monitoring and evaluation indicators seem to remain a challenge [Shung-King, 2013]. Although policies such as the ISHP rely upon educators to be the drivers of programmes /interventions aimed at learners, and they are mentioned as potential beneficiaries, provincial departments only allow educators leave and absence from classrooms when on official school business [Reddy et al., 2010]. Thus educators would not be allowed to participate in non-educational activities such as a weight loss intervention during school time. In addition, there is no documented evidence that educators have benefitted from this policy. However, despite these challenges, the expert panel concluded that the ISHP warrants further investigation to determine its potential to support establishment and implementation of a weight loss intervention for educators.

Table 3.9 illustrates the process followed by the expert panel (Senekal, Steyn, Faber and the PhD candidate) to evaluate the ISHP according to each of the seven policy categories indicated in the BCW using the APEASE criteria. Six out of the seven categories were deemed to be potentially

appropriate for the educator weight loss intervention. The only exception was regulation as it was not deemed practical or acceptable to enforce behaviour rules or principles related to dietary intake and exercise.

Table 3.9: Selection of the appropriate policy categories using the APEASE criteria

Policy categories	**Does the policy category meet the APEASE criteria of affordability, practicability, effectiveness/cost-effectiveness, acceptability, side-effects/safety and equity?** **A tick (✓)** indicates YES, a cross (X) indicates NO
Communications/marketing	✓Using print, electronic, telephonic or broadcast material
Guidelines	✓The development of new guidelines are not needed, rather existing guidelines should be used to address educator dietary intake and physical activity level
Fiscal measures	✓ Affordability could be an issue. Although Shung-King, (2013) states that the ISHP currently faces budgetary constraints, South Africa does have a big budget which is allocated to health. The current ISHP budget may therefore only require restructuring to include educators.
Regulation	X Although monitoring and evaluation is part of the ISHP, it is not practicable or acceptable to establish rules or principles of behaviour upon educators regarding their eating and physical activity practices
Legislation	✓Weight loss intervention could be integrated into existing ISHP
Environmental/social planning	✓Potential exists to implement workplace policies regarding food allowed on premises/sold at tuckshops
Service provision	✓Delivery of this weight loss intervention would be considered provision of a service

3.2.8 Stage 4: Identify intervention content and implementation options (intervention design)

A. Overview

Stage 4 of the development of the weight loss intervention involved execution of Steps 7 and 8 of the BCW. These two steps involve evaluation and consideration of behaviour change techniques (BCTs) and delivery modes for application in the intervention to identify the most appropriate options. This information is then used to translate the BCTs into intervention content and actions.

The tasks that form part of Steps 7 and 8, including the BCW worksheets [Michie et al., 2014], were executed by the PhD candidate using her insights in the target population, as well as relevant published and unpublished research. The outcomes of each step were interrogated in interactive sessions by an expert panel working in this field as outlined below.

B. BCW Step 7: Identify behaviour change techniques (BCTs)

Background and tasks executed

According to Michie et al. (2011a), the characteristics which define a BCT include the following: it must be observable, replicable, irreducible, a component of an intervention designed to change behaviour and a postulated active ingredient within the intervention. A BCT is therefore a systematic procedure which is included as the active component of an intervention with the aim of changing behaviour. Abraham and Michie (2008) developed an initial list of 26 BCTs, which was expanded in 2011 to include 43 BCTs [Michie et al., 2011b]. The most recent list includes 93 BCTs [Michie et al., 2013]. The BCT construct is recognised internationally and is referred to as Behaviour Change Technique Taxonomy version1, BCTTv1 [Michie et al., 2013]. Michie et al. (2011c) also delineated 40 BCTs that are specifically useful in the development of interventions aimed at improving physical activity and eating behaviours and is referred to as the Coventry, Aberdeen and London – Refined (CALO-RE) taxonomy.

In this research the 40 BCTs that form part of the CALO-RE taxonomy were considered for inclusion in the weight loss intervention. The expert panel (Senekal, Steyn, Faber and the PhD candidate) used the APEASE criteria to identify the most appropriate BCTs for this intervention, using their insights into the target population and published [Burgess et al., 2017; Samdal et al 2017; Hartmann-Boyce et al., 2014; Olander et al., 2013] and unpublished research.

Outcomes of BCT selection

A total of 21 out of the 40 BCTs were selected for application in the weight loss intervention. These include (numbers reflect the order of the BCT in the list of 40 BCTs that form part of the CALO-RE taxonomy): Information about consequences of behaviour in general (1), Information about consequences of behaviour specific to individual (2), Goal setting (behaviour) (5), Goal setting (outcome) (6), Action planning (7), Barrier identification or problem solving (8), Set graded tasks (9), Prompt review of behavioural goal (10), Prompt review of outcome goals (11), Prompt rewards contingent on effort or progress toward behaviour (12), Prompt rewards contingent on successful behaviour (13), Prompt self-monitoring of behaviour (16), Prompt self-monitoring of behavioural outcome (17), Provide information on where and when to perform behaviour (20), Provide instruction on how to perform behaviour (21), Teach to use prompts/cues (23), Environmental restructuring (24), Use of follow-up prompts (27), Relapse prevention/coping planning (35), Stress management (36), Time management (38).

BCTs which did not meet the APEASE criteria included the following: provide information about others' approval (3), provide normative information about others' behaviour (4), shaping (14), prompting generalisation of a target behaviour (15), prompting focus on past success (18), provide feedback on past success (19), model/demonstrate the behaviour (22), agree behavioural contract (25), prompt practice (26), facilitate social comparison (28), plan social support (29), prompt identification as role model (30), prompt anticipated regret (31), fear arousal (32), prompt self-talk

(33), prompt use of imagery (34), motivational interviewing (37), general communication skills training (39) and stimulate anticipation of future rewards (40).

The links between the selected 21 BCTs, the intervention functions and the COM-B model are set out in Addendum VI on page 305.

C. BCW Step 8: Identify mode of delivery

Background and tasks executed

This step requires consideration of the most appropriate mode or modes of delivery of the intervention taking the target population and their setting into account [Michie et al., 2011a].

In this research the following factors were considered by the expert panel (Senekal, Steyn, de Villiers, Faber, Booley and the PhD candidate) using their insights into the target population and the various literature as indicated, in interactive sessions to make a decision on the most suitable delivery mode(s) for the intervention in the target population:

1) Lack of national or local level policies that focus on the promotion of the health of educators. Current Department of Basic Education (DoBE) policy only allows educators leave from the classroom for official school business [Reddy et al., 2010]. It follows that school principals may not view an intervention as a priority and may be reluctant to allocate time for repeated contact sessions during school hours.
2) Educator workload that has generally been reported to be high [Zuma et al., 2016; Shisana et al., 2005], leaving little time for any other activities during school time.
3) Educator stress that has been reported to be high in South Africa by numerous researchers [Zuma et al., 2016; Emsley et al., 2009; Peltzer et al., 2009; Hall et al., 2005; Van Zyl & Pietersen, 1999]. Commitment to participate in a personal intervention should not add to this stress.
4) Educator access to and usage of e-based communication. It was found in a cross-sectional survey of 164 educators that while the majority of educators at primary schools in lower socio-economic areas in the Cape Metropole had a laptop/computer at home (77.3%) and mobile phone with internet access (84.5%), just more than a third (36.8%) did not have regular access to the internet [Senekal et al., 2015b; Unpublished data].
5) Educator preference for weight loss intervention delivery. While the majority of educators who participated in the above-mentioned survey indicated they would engage with a weight loss intervention if it was offered via the internet (81.9%), only a small percentage (28.9%) preferred to access information on an internet website. The majority preferred to access information via whats-app (or similar) (72.8%) [Senekal et al., 2015b; Unpublished data].

6) Educator education level (post grade 12 with many years of education experience).
7) Available literature on the effectiveness of various intervention delivery modes, including duration and intensity [Wadden et al., 2020; Schippers et al., 2017; Hartmann-Boyce et al., 2015; Jensen et al., 2014; Tang et al., 2014, Wadden et al., 2014; LeBlanc et al., 2011].
8) Applying the APEASE criteria to delivery modes identified as possible options for the intervention, as recommended by Michie et al. (2011a).

In summary, factors that needed to be considered in selection of the intervention delivery mode were that the intervention should require limited human and financial resources, should involve minimal interrupted teaching time, should not add to an already busy and stressful work environment, consider a WhatsApp (or similar) platform to access weight loss information and that a third did not have regular internet access.

Outcome of the process to decide on the mode of delivery

Taking the abovementioned factors into consideration, the expert panel (Senekal, Steyn, Faber and the PhD candidate) concluded that the intervention delivery mode that emerged as the best possible option for the target population was a self-help approach consisting of three elements: 1) a wellness day, 2) a hard copy self-help manual and 3) text messaging sent over a 16-week period. Table 3.10 illustrates the process followed by the panel to evaluate the selected delivery mode as indicated, using the APEASE criteria as indicated in the BCW.

Table 3.10: Selection of the intervention delivery mode using the APEASE criteria

Does the delivery mode meet the APEASE criteria of affordability, practicability, effectiveness/cost-effectiveness, acceptability, side-effects/safety and equity? **A tick (✓)** indicates YES, a cross (X) indicates NO	**Element**	**Delivery mode to be evaluated: self-help approach using a hard copy self-help manual combined with text messaging over a 16-week period**
Affordability	Wellness day	✓A once-off cost would be incurred for the health professional conducting the wellness day.
	Self-help manual and text messages	✓No in-person visits required during the intervention period, only costs related to the initial and final visit, printing of the manual and sending out text messages. There are no costs incurred by the educators to receive a text message.
Practicability	Wellness day	✓The wellness day will be arranged at a date and time convenient to schools, over a few hours, allowing for maximum attendance by educators.
	Self-help manual and text messages	✓Self-help interventions require minimal contact sessions during school hours which would be preferable for principals and educators. Self-help interventions would not add to an already stressful work environment and heavy workload and would allow educators to engage with the intervention at their convenience. Initial

		and follow-up visits to be arranged at a date and time convenient to schools.
Effectiveness/cost effectiveness	Wellness day	✓The panel considered this an effective strategy as an initial point of contact with educators.
	Self-help manual and text messages	✓The literature states that self-help interventions can be effective, affordable and requires limited or no professional contact [Hartmann-Boyce et al., 2015; Tang et al., 2014]. Text messaging is considered to be effortless, cost-effective and can serve as a cue to action, making it a popular approach for eHealth interventions [Atun & Sittampalam, 2006; Goggin, 2006; Ling, 2004; Rice & Katz, 2003]. Weight loss interventions delivered via mobile phone have been shown to be more effective if combined with other modes [Schippers et al., 2017].
Acceptability	Wellness day	✓The expert panel considered that a wellness day open to all educators would be more acceptable than singling out only overweight and obese educators. As anyone attending the wellness day will benefit from it, the intervention may also be more accepted by the educators and principals.
	Self-help manual and text messages	✓Self-help interventions require minimal contact sessions during school hours which would be preferable for principals and educators. A 16-week duration was selected as it would avoid the intervention running into the fourth quarter which is not allowed by the DoBE.
Side-effects/safety and equity	Wellness day	✓The wellness day will be open to all educators at the schools making it an equitable point of entry approach into the intervention.
	Self-help manual and text messages	✓Delivery modes that can be considered for self-help purposes include print, internet-based, mobile-delivered or combinations of these options [Hartmann-Boyce et al., 2015; Tang et al., 2014]. However, at the time, educator access to e-based communication and educator preference to access information did not support an internet-based intervention. Text messaging also does not require data or internet access making it accessible to anyone with a mobile phone. [Atun & Sittampalam, 2006; Goggin, 2006; Ling, 2004; Rice & Katz, 2003].

DoBE: Department of Basic Education

D. Development of the wellness day structure (first element of the intervention)

Background and tasks executed

The HBM is a behaviour change theory that proposes that one of the first steps in the journey of changing behaviour is awareness creation, thereby affecting perceived susceptibility [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958]. Application of this construct may include defining the population at risk, personalising the risk based on the characteristics or behaviour of an individual or aligning an individuals perceived susceptibility with their actual risk. The model further posits that awareness directly affects motivation (the internal processes which influence decision-making and behaviour) and self-efficacy (believing one can successfully execute the required to

achieve the desired outcome) [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958]. Bearing these factors in mind, the expert panel (Senekal, Steyn, Faber and the PhD candidate) decided that it was imperative that a wellness day be the initial point of contact the educators have with the intervention, as this is an opportune time where health awareness can be created, and educators can be inspired and motivated to participate in the intervention. All educators would be invited to the wellness day where an NCD risk health assessment will be performed, and the results relayed to the educators. This will allow eligible educators for the intervention to be identified in a non-confrontational manner and will also create an opportunity to introduce the intervention to these educators and obtain consent.

Outcomes of the process to develop the wellness day structure

A registered dietitian would be employed to administer the wellness day at the recruited schools. The duties of the dietitian would include:

1) Arranging a suitable date and time with the recruited schools for the wellness day.
2) Performing the NCD risk health assessments which will include measuring weight and height to determine body mass index, measuring blood pressure, measuring waist circumference and determining percentage body fat.
3) Providing each educator with a report and a brief explanation of their health indicators.
4) Providing all educators with an elevated blood pressure reading a referral letter to their nearest health facility.
5) Screening all educators against the pre-determined eligibility criteria, provide eligible educators with information related to the intervention and obtain consent to participate in the intervention.
6) Providing educators with the website details for the Association for Dietetics in South Africa if they require further information regarding diet and weight loss.

E. Development of the intervention manual content (second element of the intervention)

Background and tasks executed

Once the BCTs were identified, they had to be translated into a description of an intervention consisting of a printed weight loss manual and text messages, for each target behaviour in terms of content and executable tasks (Addendum VII, page 307). After expert consultation (Senekal, Steyn, Faber and the PhD candidate), it was decided that the manual content would be aligned with the evidence based South African Food Based Dietary Guidelines (SAFBDGs) (Table 3.11) [Vorster et al., 2013] and the food guide (Figure 3.4) [DoH, 2012b]. The motivation for the decision to use the SAFBDGs and Guide is as follows:

1) The guidelines have been specifically developed for the South African population taking into consideration food availability and cultural acceptability.
2) Most educators would already be familiar with it as it is included in the school curriculum.
3) The guidelines are described in terms of food making it easy to follow.
4) It is applicable to overweight, normal weight and underweight South Africans.

Table 3.11: The South African Food Based Dietary Guidelines

Revised South African Food Based Dietary Guidelines	
1	Enjoy a variety of foods.
2	Be active!
3	Make starchy foods part of most meals.
4	Eat plenty of vegetables and fruit every day.
5	Eat dry beans, split peas, lentils and soya regularly.
6	Have milk, maas or yoghurt every day.
7	Fish, chicken, lean meat or eggs can be eaten daily.
8	Drink lots of clean, safe water.
9	Use fats sparingly. Choose vegetable oils rather than hard fats.
10	Use sugar and foods and drinks high in sugar sparingly.
11	Use salt and food high in salt sparingly.

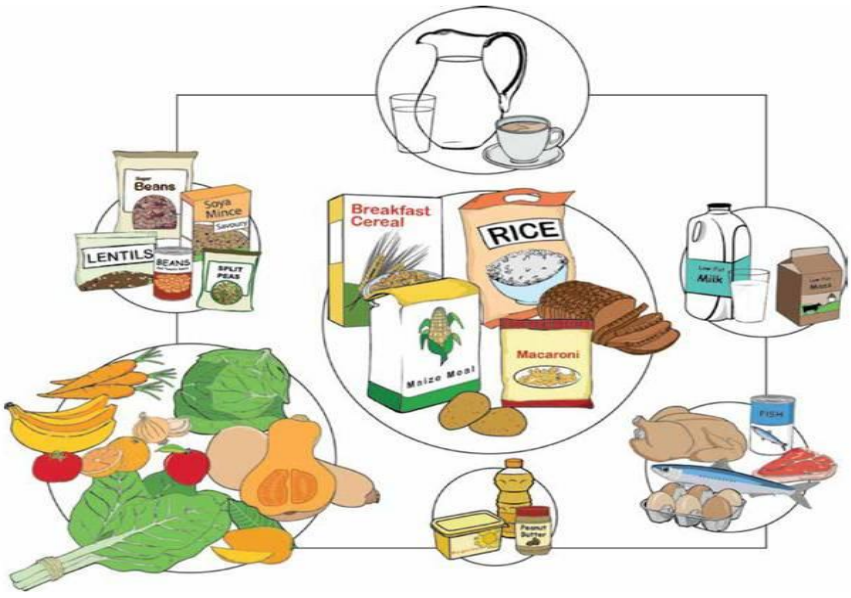

Figure 3.4: The South African Food Guide

The SAFBDGs were developed following the guidance provided by the WHO and the Food and Agriculture Organisation [FAO/WHO, 1998]. The SAFBDGs provide actions that are considered to be achievable, affordable and sustainable and can be performed by the people of the country [Vorster et

al., 2013]. The food guide provides a visual representation of the messages in the guidelines. The proportion of the food images in the figure is indicative of the ratios in which the various foods should be consumed. The guidelines together with the food guide represent foods eaten by a large proportion of the population in most parts of the country [Vorster et al., 2013].

The expert panel (Senekal, Steyn, Faber and the PhD candidate) decided that the first two chapters should comprise general information about weight balance and overarching perspectives on healthy eating (Table 3.10). The next four chapters were dedicated to each of the four behaviour problems identified, namely low fruit and vegetable intake, high sugar intake, food choices high in fat and low to moderate physical activity levels. The panel also decided that inclusion of a stress management component would add value to the intervention, as educators have been reported to experience significant amounts of stress in their work environment [Zuma et al., 2016; Emsley et al., 2009; Peltzer et al., 2009; Hall et al., 2005; Van Zyl & Pietersen, 1999]. Furthermore, research has shown that weight loss interventions that included stress management techniques have shown this combination may contribute to positive outcomes [Xenaki et al., 2018; Christaki, 2013; Wynd, 2006]. Christaki, (2013) reported that the inclusion of stress management techniques in an eight-week weight loss programme resulted in greater weight loss in a group of overweight or obese females, while Wynd, (2006) found greater compliance with a weight loss program when it was combined with muscle relaxation techniques for stress management. A more recent study showed a greater reduction in BMI in a group of obese adults who received standard instructions for a healthy lifestyle in combination with a stress management program [Xenaki et al., 2018].

The compilation of the manual content, activities and illustrations was an iterative process starting off with brainstorming sessions, followed by several drafts of the manual, which were interrogated and improved progressively by the expert panel. The Centers for Disease Control and Prevention developed a guide to create easy-to-understand materials which was consulted for this process [CDC, 2010]. Regarding the message content, the panel ensured it was clear, relevant and appropriate for the educators. The actions which the intervention targeted were clearly stated, the benefits associated with the target behaviours were highlighted and all information provided was considered to be concise and necessary. Readability of the text was ensured with the appropriate font size and style, while important words were highlighted and headings were a larger font size than the main text. The panel ensured visuals were clear, unambiguous, of a high quality, supported the written content, were culturally relevant and sensitive and enhanced the layout. The PhD candidate developed colour icons which guide the reader through the manual, making it easy to follow and understand. The cover page was colourful with illustrations focusing on a healthy lifestyle and the name of the intervention was included along with the logos of the associated university and research organisation. Regarding the layout and design, the information was presented in a logical order with headings to make it easy to follow. Technical language and jargon were avoided.

Outcomes of the process to develop the intervention manual content

A title for the intervention as well as a logo were created by the PhD candidate in consultation with a senior researcher (Senekal) and a colleague (Booley). The final title was 'Health4LIFE intervention', where the '4' refers to the four specific behaviours targeted by the intervention, while the acronym 'LIFE' refers to Lifestyle Intervention For Educators. The acronym also refers to the intervention being a way of life to be healthy.

The content of the manual is depicted in Table 3.11. The format of each chapter was consistent throughout, making it easy to follow. Each chapter started off with the food-based dietary guideline attached to the main topic followed by general information and the health benefits associated with following the guideline. There was an action plan section, which referred to the specific target behaviours, as well as a problem-solving section where potential barriers pertaining to the behaviours were addressed. Each section was linked to an icon to assist and guide the reader through the manual.

Addenda to the manual includes eating plans, useful tips as well as self-completion activities related to self-assessment, goal setting and self-monitoring. These activities are in accordance with the BCTs mentioned earlier that were selected because they have been reported to result in improving physical activity and eating behaviours. Table 3.12 provides an outline of the weight loss manual.

In addition to the manual, the intervention included text messages targeting various aspects of select beliefs. (See section E below).

Table 3.12: Summary of the content of the Health4LIFE weight loss manual and link to selected BCTs

Chapter	Title	Associated FBDG	Content outline	BCT (See Addenda V, VI)	Activities
1	Weight management	NA	Weight balance Energy balance Health benefits associated with weight loss for those who are overweight or obese	Information about consequences of behaviour in general Information about consequences of behaviour specific to individual	In text of Chapter 1: energy balance assessment Addendum 3: Assessment of BMI, WC, risk factors for disease and conditions associated with obesity Weight loss goal setting Weight monitoring chart
2	General healthy eating advice	All South African FBDG (see Table 3.9 and Fig 3.2)	South African FBDG and food guide DASH eating plan	N/A	In text of Chapter 2: Brief fruit and vegetable intake assessment; fat intake assessment; sugar intake assessment
3	Fruit and vegetables	Eat plenty of fruit and vegetables every day	FBDG (stating the guideline) General information (recommendations to increase fruit and vegetables intake, serving sizes, explaining eating a variety) Health benefits of eating fruit and vegetables Action plan (outlining the target behaviours: purchase a variety of fruit and vegetables, bring fruit and vegetables to school every day, eat a variety of vegetables at mealtimes every day) Problem solving (tips to buy fruit and vegetables on a restricted budget, lunchbox ideas, tips to meet the daily recommendation, cooking methods for vegetables)	<u>Applicable to Chapter 3- 6:</u> Provide instruction on how to perform behaviour Information about consequences of behaviour specific to individual Action planning Provide information on where and when to perform behaviour Barrier identification or problem solving Environmental restructuring	Addendum 3: Assessment of current fruit and vegetable intake and goal setting Weekly record sheet of variety of fruit and vegetables purchased and served at mealtimes
4	Fat	Use fats sparingly. Choose vegetable oils rather than hard fats.	FBDG (stating the guideline) General information (what are fats, the types of fat, fat intake and weight loss) Health benefits of controlling fat intake Action plan (outlining the target behaviours: select foods low in fat when purchasing foods, add less fat when preparing foods, reduce or avoid high fat snacks or processed foods)		Addendum 3: Assessment of current fat intake and goal setting Weekly record sheet of fat intake during meal preparation and selecting snacks

			Problem solving (shopping list for lower fat options, lower fat recipe substitutes, low fat options when eating out, tips to reduce fat when cooking, low fat snack ideas)		
5	Sugar	Use sugar and foods and drinks high in sugar sparingly.	FBDG (stating the guideline) General information (what is sugar) Health benefits of decreasing sugar intake Action plan (outlining the target behaviours: limit the purchase of sugar containing foods and drinks, reduce or avoid the intake of sugar-containing cold drinks, add less or no sugar to hot beverages, use less or no sugar when preparing foods, avoid the intake of sugary foods/snacks during times of stress) Problem solving (sugar content in breakfast cereals, hidden sugar in foods, reducing the sugar in cold drinks, rethink your drink, tips to add less sugar to hot beverages, side-effects related of decreasing sugar intake)		Addendum 3: Assessment of current sugar intake and goal setting Weekly record of sugar intake during meal preparation, in beverages and at times of stress
6	Physical activity	Be active!	FBDG (stating the guideline) General information (physical activity recommendations, types of physical activity, levels of intensity) Health benefits of physical activity Action plan (outlining the target behaviours: increase physical activity at work, increase physical activity in free time) Problem solving (getting started and staying active, practical tips to build activity into daily routine, typical excuses not to exercise and possible solutions, drinking during exercise)		Addendum 3: Assessment of current level of physical activity and goal setting Weekly record of physical activities at school and during free time
7	Stress management	N/A	General information (what is stress, health implications, typical stressors for educators) Action plan (9 actions to improve stress management skills including relaxation techniques and exercise)	Stress management	Addendum 3: Stress indicator checklist Goal setting Weekly record of management of stress

8	Addendum 1: Eating plans	N/A	Examples of various caloric eating plans: 1000kcal, 1200kcal, 1400kcal, 1600kcal, 1800kcal	Action planning	N/A	N/A
9	Addendum 2: Useful tips and information	N/A	Time-saving cooking tips and lunch tips Cooking tips to reduce added sugar Snacks containing sugar Food label reading	Barrier identification or problem solving Provide instruction on how to perform behaviour Time management	N/A	N/A
10	Addendum 3: Self-assessment, goal setting and self-monitoring activities	N/A	Assessment of current: Weight status and health risk Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress Goal setting for: Weight Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress management Weekly monitoring of: Weight Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress management	Set graded tasks Goal setting (outcome) Goal setting (behaviour) Set graded tasks	N/A	N/A

N/A: not applicable; DASH: Dietary Approaches To Stop Hypertension; FBDG: Food Based Dietary Guidelines; kcal: kilocalories, WC: waist circumference; BMI: Body Mass Index

F. Development of the content of the text messages (third element of the intervention)

Background and tasks executed

Text messaging was included in the intervention to facilitate change in beliefs regarding consumption of fruit and vegetables, sugar and fat and physical activity that were identified in a TPB based elicitation study [Steyn et al., 2014; Unpublished data] and confirmed in a cross-sectional survey among educators in the target area who completed the TPB-questionnaire [Senekal et al., 2015b; Unpublished data]. As per the TPB, behavioural, normative and control beliefs need to change to change attitude, subjective norm and perceived behaviour control to promote intention and the execution of the target behaviour [Ajzen, 1991].

As stated earlier, text messaging is considered unsophisticated, cost-effective and can serve as a cue to action [Atun & Sittampalam, 2006; Goggin, 2006; Ling, 2004; Rice & Katz, 2003]. Mobile phone usage has been found to be high in overweight population groups and those with a lower socio-demographic status, [Koivusilta et al., 2007; Lajunen et al., 2007; Koivusilta et al., 2005], making it an ideal delivery mode for this weight loss intervention. In a literature review that covered 14 studies that investigated text messaging as an intervention medium for weight loss, seven concluded that text messaging was feasible and acceptable as a mode of delivery and 11 showed a statistically significant effect on weight loss, diet or exercise. One study found that when goal and plan reminders were sent via text messages to participants, a 0.39kg greater weight loss was achieved over a one-month period in those who did receive the message compared to those who did not. Although there was inconsistency regarding the timing and frequency of text messages, it was found that at least one text message a day was adequate to motivate participants to engage in weight loss behaviours without becoming a burden [Shaw & Bosworth, 2012].

Fishbein et al. (2001) emphasises that message development should be theory-based. Evidence shows that campaigns where messaging was theory-based using for example the stages of change model, theories of persuasion and theories of behaviour change, were associated with a greater degree of intended behaviour change than campaigns that were atheoretical [Maibach & Parrott, 1995; Elliott, 1993;]. A theoretical approach was therefore undertaken in this research to develop the content of the messages. The conceptual framework referred to as the Step approach to Message Design and Testing (SatMDT) was used [Lewis et al., 2016]. The SatMDT was designed to incorporate the theories relating to the Persuasive Health Message Framework and the Theorists' Workshop Model of behaviour change [Fishbein et al., 2001; Armitage & Conner, 2000; Slater, 1999; Witte 1995]. Slater (1999) suggested that the "theories of persuasion and behaviour change are complementary because their foci and boundary conditions make them useful in solving different types of communication problems". The framework is therefore based on well-proven social

psychological models of persuasion, decision-making and attitude-behaviour relations, making it suitable for application development of the text messages in the Health4LIFE intervention.

The SatMDT is a four-step process as shown in Figure 3.5. The first two steps (Step 1 SatMDT and Step 2 SatMDT) are described in this section, while Step 3 SatMDT forms part of Stage 5 of intervention development (see Section 3.2.6) and Step 4 SatMDT is covered in Chapter 4 of this thesis (feasibility study).

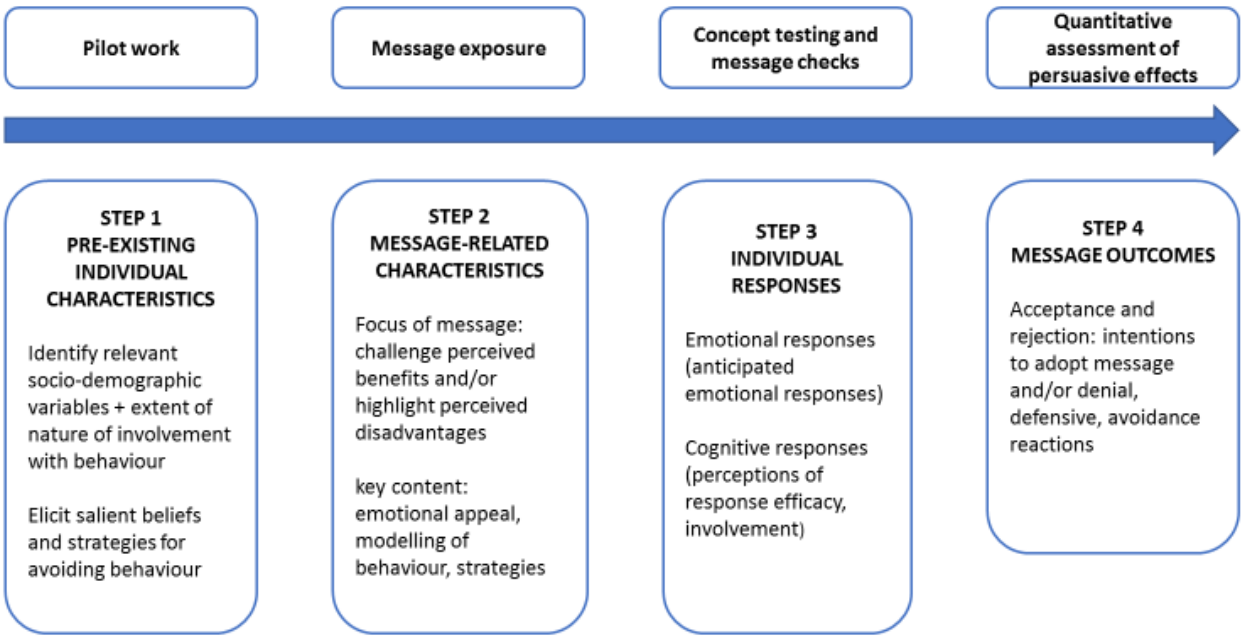

Figure 3.5: The SatMDT 4-step process to enhance message persuasiveness

Step 1 SatMDT: Pre-existing individual characteristics

This step includes identifying non-modifiable characteristics to persuasion, such as age and gender and then also potentially modifiable characteristics. The latter characteristics usually relate to an individual's involvement in a specific behaviour and related beliefs. Identification of 24 messageable beliefs based on TPB constructs [Azjen, 1991], which formed part of the formative assessment completed as part of Stage 1 of the Health4LIFE intervention development process (See section 3.2.2), was core to completion of Step 1 SatMDT. In this step the 24 beliefs were further considered by an expert panel (Senekal, Steyn, de Villiers, Faber, Booley and the PhD candidate), specifically how they related to the thirteen target behaviours identified via the BCW process (Section 3.2.3, E).

Outcomes of Step 1 SatMDT to develop text messages

As indicated in Section 3.2.2, B, beliefs with a median score that allowed for a shift, either up or down depending on whether the belief statement was formulated negative or positive (scores of ≥ 4 or ≤ 1) were retained for text message development. (Table 3.2).

Step 2 SatMDT: Message-related characteristics

Message-related characteristics outlined in the SatMDT refer to the following: 1) it should clearly address the target behaviour, 2) the content of a health message should relate to the predominant concerns of an individual [Rimer & Glassman, 1999; Weinstein et al., 1998; Prochaska et al., 1992], and 3) it should be delivered in a manner that enhances its impact on people's thoughts and ultimately their behaviour [Rothman et al., 2006]. Messages can either be framed in a manner which emphasise the benefits of performing a behaviour (gain-framed appeal) or the consequences of not performing it (loss-framed appeal) [Rothman et al., 2006]. Incorporating deliberate and thoughtful framing of messages may help improve the effectiveness thereof. The Text Messaging in Healthcare Research Toolkit developed by the Centre for Research in Implementation Science and Prevention (CRISP), University of Colorado School of Medicine, advises that use of a text messaging library matrix where each message is linked to a specific outcome and a theoretical construct, may strengthen an intervention [Schilling et al., 2013].

The PhD candidate started developing the content of each text message included in the Health4LIFE intervention by identifying the specific intended behaviour outcome it was linked to. Each week of the 16-week intervention had a specific outcome which related to a target behaviour, for example "select low-fat foods when buying foods". One message was to be sent daily from Monday to Friday, thus five messages a week.

The content of each of the 80 messages was constructed considering guidelines regarding framing, as well as best practices for text messaging as formulated by the CDC (2011). These best practices include: 1) keep messages short and concise; 2) make messages engaging; 3) make content readable; and 4) use abbreviations sparingly [CDC, 2011c]. Each message in the Health4LIFE intervention was linked to a theoretical construct or BCT identified in stage 4, step 7 of the BCW, as well as the relevant belief it was targeting. Messages were also linked to specific content or activities in the manual. Where necessary, the manual was expanded to ensure that every message, when combined with manual content and/or activities, promoted change of a target behaviour. The text message development process was an iterative process which consisted of several drafts of the text messages, which were interrogated and improved progressively by the expert panel [Senekal, Steyn, Faber and the PhD candidate].

Outcomes of Step 2 SatMDT to develop text messages

Table 3.13 provides an example of the library matrix that was generated to develop the message content for the target behaviour "Select low-fat foods when buying foods". The first message of the week clearly stated the intended outcome for the week, while the next message focused on the health benefits associated with the outcome. Irrespective of the overarching behaviour outcome of the week, one message per week specifically targeted physical activity. The final message of the week usually prompted self-monitoring and/or reward.

Table 3.13: The text messaging library matrix generated to develop the message content for the target behaviour 'Select low fat foods when buying foods'

Target behaviour	Message content	Theoretical construct/BCT	Belief targeted	Content to include in manual
Select low fat foods when buying foods	Week 3: Select low-fat foods when buying foods to help reduce your fat intake. A glass of fat free milk has nearly half the calories than full cream milk	Goal setting Action planning Barrier identification and problem solving	Low-fat/fat-free foods taste good/are tasty Low-fat/healthy fat options are expensive	**Fat section** List of low-fat alternatives which show they are not more expensive than full fat options
	Increasing your physical activity level to 150 min/week and decreasing your energy intake by eating less fat at the same time can assist with weight loss	Information about consequences of behaviour Action planning		**Physical activity section** Benefits of increasing physical activity **Fat section** Benefits of decreasing fat intake
	Use low-fat food options if available like low-fat yoghurt. This reduces your fat intake and your risk of heart disease with often little effect on taste	Information about consequences of behaviour	Eating less fat will reduce the risk of disease e.g. heart disease	**Fat section** Health benefits of reducing fat intake
	Buying low-fat foods like lite mayonnaise or reduced fat salad dressing means you can still enjoy these items despite having reduced your fat and energy intake	Action planning Barrier identification and problem solving	I do not have enough time to prepare healthy meals regularly	**Fat section** Recipe ideas which have replaced full fat foods with low fat options
	Well done to you if you managed to swop any full-fat food items for low-fat alternatives this week. Keep it up and you will soon see positive results!	Prompt self-monitoring of behaviour Prompt reward		

Min: minutes

Tables that provide detail of the library matrix that was generated to develop the message content for the other target behaviours are included as Addendum VIII on page 315.

3.2.9 Stage 5: Testing and refinement of intervention materials

Background and tasks executed

As stated earlier, intervention design refers to the more creative part of the development process focusing on content, delivery and format. O'Çathain et al. (2019b) advise that once a prototype of an intervention is available, rapid assessments to determine feasibility, acceptability and how engaging the intervention is should be performed to refine or optimise the intervention [O'Çathain et al., 2019b]. The time and effort spent doing this allows for problems to be identified and solutions to be found before an expensive feasibility or effectiveness study is conducted.

Before the intervention was finalised, the Health4LIFE intervention (manual and 80 text messages) was assessed by a group of seven educators (5 females and 2 males) from a primary school with a profile similar to the schools included in the HK study [de Villiers et al., 2012]. This assessment also contributed to meeting the requirement stated in Step 3 of the SatMDT framework that concept testing and message checks need to be conducted.

Educators were provided with the manual, a printout of the 80 text messages and a structured assessment sheet (Addendum IX, page 329) to record their feedback. They were requested to read and consider the manual content, complete the self-assessment, behaviour planning and self-monitoring activities included in the addenda of the manual and read and consider the text messages before completing the assessment sheet. The assessment sheet was divided into sections that covered each chapter in the manual with linked self-assessment, behaviour planning and self-monitoring activities, as well as text messages. Key aspects that were assessed for each chapter include liking of content of the manual, usefulness of the information, understanding of the information; interestingness and ease of completion of the self-assessment, behaviour planning and self-monitoring activities formulated; and liking of content of the text messages and perception of how well information in the messages was linked to the particular chapters in the manual. The assessment sheet included seven positively formulated statements for each chapter with response options being on a 5-point Likert scale, namely strongly disagree, disagree, neutral, agree and strongly agree. Later strongly disagree and disagree was collapsed to disagree and strongly agree and agree was collapsed to agree.

Outcomes following the testing and refinement of the Health4LIFE intervention manual and text messages

The responses of the educators are summarized in Table 3.14. It is evident that educators were mostly positive and complimentary. The PhD candidate and supervisor (Senekal) considered the documented feedback and a few minor changes were made. These included relooking all the activities

to confirm ease of understanding and completion. Furthermore, the DASH eating plan was amended to include information about serving sizes. A final list of the text messages is included in Addendum X on page 331. At this point the Health4LIFE weight loss intervention (the manual and the text messages), which was informed by theory, empirical evidence and practical considerations, ensuring that it was evidence-based, was considered to be ready for feasibility testing (Chapter 4 of this thesis).

Table 3.14: Summary of feedback provided by educators who were recruited for testing of the Health4LIFE intervention by chapter and addenda (n=7; 5.females, 2 males) (n varies due to missing values)

Statement in assessment sheet	Chapter 1 Weight management			Chapter 2 General healthy eating advice			Chapter 3 Fruit and vegetables			Chapter 4 Fat			Chapter 5 Sugar			Chapter 6 Physical activity			Chapter 7 Stress management			Addendum 1: Eating plans			Addendum 2: Useful tips and information		
	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D
I really liked the content	7			7			7			7			7			7			7			7			7		
Comments	It is interesting and an eye opener, relevant in the promotion of healthy living, it simply expresses importance of good health.			I really liked the DASH eating plan, it makes me aware of the variety of foods that needs to be consumed for general health.			Interesting in gaining insight to the value of fruit and vegetables, the content was good, very informative, it brings an awareness of how inadequate my fruit and vegetable intake is.			Very much informative, excellent information with regard to types of fat and how to make healthy changes, I liked the content, consolidated my fears regarding the intake of excessive fatty food.			Consolidated and added to my knowledge of dangers of sugar intake, brings about an awareness of hidden sugars that impact on our overall sugar intake, I liked the content.			Yes I liked the content, appreciate the general information provided. One forget the advantages due to pressures of daily life, I liked the other benefits of exercise like improved CV health are highlighted and not only weight loss.			I found the content good, especially identifying personal stress issues and the monitoring thereof.			I absolutely love the eating plans, the content was informative, the various options.			I liked the content, the provision of vital tips and hints in promoting healthy living.		
I really found the information useful	7			7			7			7			6			7			7			6	1		7		
Comments	In the past I tried to maintain weight by exercise only the information on calorie consumption is useful to me, it is useful as it provides insight on how to lose weight, energy			Especially the categories and values of consumable items, it made me realise my dietary shortcomings and overindulgence, the information			The colour-coded lists and advice to include these daily is excellent, the whole chapter is informative, especially the colour coding of fruits.			Extremely useful especially the benefit/disadvantages of various fats, I made use of this information in this chapter, made me realise how our			The information arranged on graphs highlights the sugar content in cereals and fizzy drinks was an eye opener, I used most of the information given, appreciate the			Made me realise I need to do something as far as exercise, extremely useful especially the health benefits, everything was useful.			I will use some relaxation techniques, realisation of how stress affects and promotes certain illness, very useful.			All eating plans are similar and some find it repetitive, the mere fact that the allowances and sample menu items were listed, I put the information into use and it was helpful.			Extremely useful, information so appropriate especially in todays lifestyle relating to time and economics, very useful, it saves times.		

	balance interesting.			was logical and useful.				diets have derailed.			graph indicating sugar content of various cereals.											
I really understood all the information	7			6	1		7			7			7			7			7			6	1		7		
Comments	The information is simple and hands-on, explanations were given in simple terms. It was not difficult to understand.			The Dash eating plan – number of servings by calorie seems tricky maybe examples of foods can be included, well set out and simply written for all to understand, Quite clear, relevant to the benefits of health living.			Especially the tips offered, well set out, easy to read and understand, no problem understanding the information.			It makes shopping and planning meals easier, no problems understanding the information, definitely and all the wiser and empowered when shopping for various food items.			Extremely informative, I understood the information.			Encourage one to make time for physical activity to eliminate the dangers of stress and ill health, no problems understanding the information.			Very easy to understand, especially the types of stressors eg typical and general stressors.			Cant wait to try one, the options given at the end of each menu, there were no problems understanding the content.			Everything was specific and clarified, relevant as regards a healthy lifestyle and as well as guidance in avoiding various illnesses and other health problems.		
I really found the activities interesting	7			6			6	1		7			7			6			7			N/A			N/A		
Comments	To have it as a weekly step by step plan it is something you have to do – something you can put to work, appreciation of the table as a source of guidance, it is good to have a baseline to monitor progress.			Though at times interesting some were time consuming, appreciation of the tables presented as a source of guidance			It will help you cut down on buying unnecessary things like luxuries, I learnt that I don't eat enough fruit, the self-assessment serves as a good baseline, it makes it easy to set achievable goals.			Yes, will definitely have to monitor my diet from now on, very interesting.			Made me aware of personal excessive sugar intake, most were interesting.			Especially how to combine moderate and vigorous exercise in one session, very informative, some activities were not interesting.			Quite easy and interesting, appreciate the tips given to combat stress, tried the various techniques and it works.			N/A			N/A		
I really found the	6	1		6	1		5		1	7			6			6	1		7			N/A			N/A		

activities easy to complete												
Comments	The activities are fairly easy but time-consuming, all the activities are easy to complete.	Eating plan challenging, not everything was easy to complete, opportunity provided for self-evaluation and analysis of steps toward healthy living.	The weekly record and fruit and vegetable list make it easy to plan shopping lists and menu, the shopping tis were quite a task.	Really thought provoking, they were easy.	Not all were easy, definitely useful especially when considering the danger of diabetes.	Goal setting what a nice way to keep track of your daily routine, was not easy to assess sedentary time, some were not so easy to complete.	Quite easy, provides an opportunity for self evaluation and work on weaknesses identified.	N/A	N/A
I really liked the content in these text messages	6	N/A	6	7	7	7	7	N/A	N/A
Comments	It links directly to the different themes of this program, maybe include the name of the person who managed to lose weight.	N/A	I would love to see how these messages will work, text messages related well with the content.	More motivating than other messages, absolutely, the content in the text messages were good.	The text message content was linked to the chapter.	The text messages were linked to the chapter.	Everything was linked, very valid messages.	N/A	N/A
I really think the information in the text messages are useful	5 1	N/A	6	7	7	7	7	N/A	N/A
Comments	The text messages were helpful in the completion of tasks, it is useful and will be helpful to keep the person motivated.	N/A	N/A	Found it useful.	Absolutely, especially in the promotion of healthy living, very useful.	Almost everything was useful, appreciate the information and tips.	I made use of everything, absolutely, consolidates tips given in the chapter.	N/A	N/A

N/A: Not applicable; A: Agree(strongly agree=agree); N: Neutral; D: Disagree (disagree=strongly disagree)

3.3 Discussion

This study set out to develop a weight loss intervention for overweight and obese primary school educators guided by the BCW. The Health4LIFE intervention is a behaviour change intervention targeting multiple behaviours, making it complex and challenging [Craig et al., 2008]. It is a self-help intervention consisting of a wellness day, a hard copy manual and text messaging. The intervention focuses on 13 behaviours related to dietary intake and physical activity, seven intervention functions (education, persuasion, incentivisation, training, environmental restructuring, restriction and enablement) and 21 BCTs (information about consequences of behaviour in general, information about consequences of behaviour specific to individual, goal setting (behaviour), goal setting (outcome), action planning, barrier identification or problem solving, set graded tasks, prompt review of behavioural goal, prompt review of outcome goals, prompt rewards contingent on effort or progress toward behaviour, prompt rewards contingent on successful behaviour, prompt self-monitoring of behaviour, prompt self-monitoring of behavioural outcome, provide information on where and when to perform behaviour, provide instruction on how to perform behaviour, teach to use prompts/cues, environmental restructuring, use of follow-up prompts, relapse prevention/coping planning, stress management, time management).

A major strength of the Health4LIFE intervention development process was the use of a comprehensive and coherent framework, namely the BCW, which is also underpinned with a behaviour change model (the COM-B model). The MRC guidelines of using a theory and evidence-based approach for intervention development was thus followed [Skivington et al., 2021; Craig et al., 2008.]. Unlike many other intervention development approaches, the steps of the BCW were found to be clear, detailed and systematic and facilitated its use, while providing a practical way of applying theory in the intervention development process in the present study. Each step was clearly outlined and was accompanied with a worksheet produced by Michie et al. (2015), which the developers completed as part of each task.

As part of the intervention development process, a group of experts in the field of research were identified to oversee and contribute expert inputs in the tasks executed. In total, there were eight panel members involved at various stages of the iterative process. Their inputs and experience proved to be invaluable, but the number of hours each member had to commit to the tasks they were involved in was considerable. Webb et al. (2016) also commented that a considerable number of hours had to be dedicated to the intervention development process by a much larger research team which consisted of 45 members.

When selecting the most appropriate intervention functions, BCTs, policy categories and the mode of delivery for the intervention, the BCW advises that the APEASE criteria are used [Michie et al., 2011a]. These steps required the use of judgement by the PhD candidate. As subjectivity can influence the

decision-making process during this stage it was helpful to confirm or revise the outcomes of these tasks as needed with the expert panel where their experience along with the appropriate evidence informed the judgement calls. Mabweazara et al. (2019) also mentioned the judgement calls when using the APEASE criteria as a limitation in the development of a physical activity intervention for people living with Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS). It is therefore recommended that an experienced panel is involved in applying the APEASE criteria, rather than on individual only. It is also recommended that these decisions are supported by appropriate evidence, including having in-depth knowledge and understanding of the target population and environment.

Once the capability, opportunity and motivation requirements to achieve a desired target behaviour had been analysed, the BCW easily linked the intervention functions and BCTs. Linking the COM-B model to the relevant intervention functions and then the BCTs was found to be seamless and although firmly grounded in theoretical behaviour constructs, its use did not require in-depth knowledge of behaviour change theory. These were also the findings of two other intervention designers who used the BCW to develop interventions aimed at improving dietary intake and physical activity for type II diabetics [Moore et al., 2019] and improving physical activity in people living with HIV and AIDS [Mabweazara et al., 2019]. The fact that the BCW utilises a standardised coding for its BCTS, namely the BCT taxonomy [Michie et al., 2011c], improves replicability of the intervention, as well as the evaluation thereof.

The comprehensiveness of the BCW made the process of using it labour-intensive and time-consuming. Stage 1 of the BCW involved four steps which aimed to increase understanding of the behaviour. This entire stage, especially using the COM-B model, required extensive formative assessment, which involved reviewing existing research for identification of target behaviours for weight loss in primary school educators. Focus group discussions were also conducted to identify salient beliefs regarding dietary intake and physical activity in the same group of educators. However, as the COM-B model is the core of the BCW and informed a better understanding of the 13 target behaviours, while identifying what needed to change for a behaviour to occur, this stage of the process could hardly be neglected. This is especially true for educators as existing literature on weight loss needs of interventions of this target group in South Africa and in the rest of the world was extremely sparse when the intervention development process commenced. The four steps in Stage 1 may seem repetitive, as each step must be repeated for every identified target behaviour. This was especially prominent in the development of the Health4LIFE intervention with 13 target behaviours to address. It is interesting to note that some studies skipped steps 1 to 3 completely, presumably to shorten the process, as the research teams felt that the target behaviours of their specific interventions were already well understood in existing literature [Murtagh et al., 2018; Webb et al., 2016].

The BCW was found to be expandable and did not restrict and limit the development process. It allowed for the integration of the TPB [Ajzen, 1991], and the HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] and use of the SatMDT [Lewis et al., 2016] in the development process, thereby strengthening the theory component and making this research unique in its approach. Using the TPB allowed a greater and deeper understanding of educator beliefs regarding their dietary intake (fruit, vegetables, fat and sugar) and physical activity by identifying which belief required reinforcement or changing. This information was used when completing the COM-B model, specifically when reflective motivation was being analysed as part of the behavioural analysis process. Belief results were subsequently also used during the message development phase to ensure effective and targeted messaging. As there is a paucity of information on beliefs educators hold relating to healthy lifestyle behaviours, there was great value in identifying these beliefs and integrating the information as relevant in the BCW steps. Research where integration of belief assessment in this manner in the intervention development process could not be traced, with this research thus making a novel contribution in this regard.

The HBM advised the development of the first element of the intervention, namely the wellness day. The importance of creation of health awareness among educators is emphasised by the findings of Senekal et al. (2015} that many educators were likely to underestimate their body weight. Health screening has good potential to create awareness, especially if it includes assessment, interpretation and feedback on a range of measures such weight status and NCD risk indicators such as blood pressure, glucose and lipid levels. Awareness creation effects of health screening among educators in Cape Town has been illustrated by Joseph et al. (2018) in this regard.

The BCW does not provide guidance as to how to translate the BCTs into text messaging features and it therefore became necessary to expand on the BCW again. The SatMDT [Lewis et al., 2016], which was specifically designed to guide the development and evaluation of health messages was therefore incorporated into the BCW. It is underpinned by the TPB but also considers the impact of individual characteristics of participants and message-related characteristics on the effectiveness of messages [Lewis et al., 2016]. It provided very clear guidance how to develop targeted messages that were appropriate and effective using a structured process. The messages could be related to an outcome, a BCT and a belief. The text messages and the manual content were checked to ensure they complimented each other. Curtis et al. (2015) developed a weight management app for the parents of overweight children and also had to expand the BCW when it failed to provide guidance on translating BCTs into mHealth app features. Although the theory component of the intervention development process was strengthened using the SatMDT, this process was further time-consuming to an already lengthy process.

3.4 Limitations

The time taken to develop the intervention is an important consideration as information obtained during the extensive formative assessment phase strongly influenced decisions made during the intervention development process. Consequently, by the time the intervention is ready to be tested, the information may have potentially changed. This is a factor which was also specifically mentioned by Curtis et al. (2015) who incorporated eHealth into their weight management intervention.

Another limitation may have been the presence of selection bias during the educator input of the intervention development process, specifically the focus groups during the formative assessment and during the testing and refinement phase, as convenience sampling was used and recruitment for this input was undertaken through the researchers' professional and social networks.

3.5 Conclusion and recommendations

Although the time and effort required to follow a systematic process using the BCW cannot be denied, at the end of this process a very clear understanding of the determinants of a specific behaviour and the mechanisms of action required to affect behaviour change is achieved. These insights are imperative for identification of the most appropriate intervention delivery mode and development of the intervention content. This research provides a comprehensive and systematic guide to using the BCW in a theory and evidence-based process for the development of a self-help weight loss intervention.

To achieve the desired outcome with the BCW, it is important that all the steps are completed as intended. To do this, significant resources in terms of time, researchers and funding is required. It is recommended that the leader of the research team have an in-depth understanding of the BCW and its components to ensure the correct application of the BCW process. It also further recommended that a panel of experts in the appropriate field is involved during this iterative process, especially when using the APEASE criteria where judgement calls are required, to confirm or revise the outcomes of the various tasks. It is important to involve appropriate stakeholders and incorporate their input throughout the intervention development process, but especially during the formative assessment, to gain a better understanding of the target population and their environment.

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CHAPTER 4

FEASIBILITY TESTING OF THE Health4LIFE SELF-HELP WEIGHT LOSS INTERVENTION FOR OVERWEIGHT AND OBESE PRIMARY SCHOOL EDUCATORS EMPLOYED AT PUBLIC SCHOOLS IN LOW-INCOME SETTTINGS IN CAPE TOWN, WESTERN CAPE PROVINCE, SOUTH AFRICA: A MIXED METHODS STUDY

ABSTRACT

Background:

Bearing in mind the prevalence of overweight/obesity found among educators (teachers) and their role modelling function, it is imperative that appropriate weight loss interventions are developed and implemented to control obesity in this target population. The United Kingdom Medical Research Council state that once an intervention was developed using the recommended systematic approach, it should be tested in a feasibility study before conducting a full-scale evaluation or implementing it in a real-world setting.

Aim:

The aim of this study was to test the feasibility of the Health4LIFE weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape Province, South Africa in a mixed methods study.

Methods:

Feasibility outcomes that were identified for the purposes of this research included reach, applicability, acceptability, implementation integrity (primary outcomes), and signals of effect in terms of belief patterns (diet and physical activity beliefs), stage of change for dietary and physical activity behaviours, lifestyle behaviours (diet and physical activity) and weight. A cluster sampling method was used to randomly select public schools within the Metro North District in the Western Cape Province. These schools were contacted and educators were invited to participate in the wellness day and the subsequent intervention. Random sampling of schools was repeated until the target of 20 schools was achieved. Ten of these schools were then randomly assigned to the control and 10 to the intervention group. Three sub-studies were conducted to assess the feasibility outcomes. Sub-study 1 involved testing the intervention in a pilot randomised controlled trial. The intervention group received the Health4LIFE weight loss intervention, and the control group received a hard copy of the Department of Health's 'Choose a Healthy Lifestyle' booklet (Addendum XX, page 368). Analysis to assess within group change and differences between groups for within group change over the 16-week period were done by protocol, thus using data for completers only. Sub-study 2 investigated the perceptions of educators who participated in the intervention arm and sub-study 3 the perceptions of principals of participating schools regarding reach, acceptability, applicability and implementation integrity.

Results:

Recruitment (n= 137) and drop-out (n=52) statistics indicated that reach was acceptable, with the exception of male educators who were underrepresented, and black African educators and educators who had attempted weight loss before who were more likely to drop-out. Barriers that may compromise school participation include interruption of teaching time, prior commitments by schools/educators, an already full school program and need to obtain permission from the Department of Basic Education (DoBE) for deviations from the normal school day. Qualitative inputs from principals and educators supported acceptability and applicability of the intervention They were positive about the wellness day, approved of implementation in the school setting, found the hard copy manual useful, enjoyable and easy to understand, and considered the text messages to be helpful and motivational for the day. It was evident that aspects that may need refinement include self-monitoring activities, low frequency of contact with interventionists and arrangement of visits to the school. The planned implementation procedure (wellness day, engagement with most sections in the manual and sending of text messages) went as intended, reflecting good implementation integrity, with the exception of the drop-out of three entire schools due to scheduling challenges.

Clear signals of effect (secondary outcomes) were evident. The Health4LIFE intervention resulted in favourable shifts in belief patterns regarding dietary intake and physical activity; favourable shifts in stage of change for “increase fruit intake” and “decrease sugar intake”, significant changes in some lifestyle behaviours (increased intake in low fat food items, increased intake of vegetables, decreased intake of sugary food items, decreased frequency of adding fat and sugar to food, increase in physical activity and decreased time spent being sedentary) and a trend towards weight loss in the intervention group. The only significant changes in the control group related to dietary intake (increased intake of vegetables and increased intake of low-fat foods).

Conclusions:

Results reflecting reach, acceptability, applicability, implementation integrity and potential effectiveness of the Health4LIFE intervention support feasibility of the intervention. Regarding the secondary outcomes, the Health4Life weight loss intervention showed material signals of effect in terms of shifts in belief patterns and stage of change, as well as improvements in lifestyle behaviours.

It is plausible that significant weight loss may be detected when implementing the 16-week Health4LIFE intervention in its current format, thus health screening and feedback (wellness day), hard copy manual and text messaging. However, implementing refinements to the intervention following the primary and secondary outcomes of this study may further improve its feasibility.

4.1 Introduction

Many African countries are facing widespread increases in obesity rates linked to the rapid demographic, socio-cultural and economic transitions occurring in these countries [WHO, 2020a]. The same picture can be seen in South Africa where the prevalence of overweight and obesity has been steadily increasing, as is evident from national data obtained from the 2003 South African Demographic and Health Survey (SADHS) [DoH, 2007], the 2012 South African National Health and Nutritional Examination Survey (SANHANES) [Shisana et al., 2013] and the 2016 SADHS [DoH, 2019]. The prevalence of overweight and obesity in men was found to be 29.2%, 30.7% and 31.3% and in females 56.6%, 64.0% and 67.6% across the three surveys respectively [DoH, 2019; Shisana et al., 2013; DoH, 2007]. Non-communicable diseases (NCDs) include cardiovascular diseases, diabetes, musculoskeletal disorders and some cancers and are the leading cause of mortality and premature disability [WHO, 2020a]. Obesity is a major risk factor for NCDs and mild obesity has been reported to be associated with the loss of one in ten, and severe obesity the loss of one in four potential disease-free years during middle and later adulthood [Nyberg et al., 2018].

Two surveys that were conducted amongst educators in the Western Cape found that prevalence of overweight and obesity was greater than reported for the general population in South Africa. Senekal et al. (2015a) reported that 37% of male educators teaching at public primary schools in rural and urban areas in the Western Cape were overweight and 35% obese, while 27% of female educators were overweight and 55% obese. Adeniyi et al. (2017) reported a mean BMI of 31.6 kilogram per square metre (kg/m^2), thus within the obese class I range, for educators (males and females combined) teaching in public primary, secondary and intermediate schools in Cape Town. Adding to this evidence, the preliminary results of the KaziHealth study, a lifestyle health intervention programme for primary school educators in disadvantaged communities in Gqeberha in the Eastern Cape, found that 85% of educators were overweight or obese [KaziHealh, 2019]

It is well established that modest weight reduction of as little as 5% to 10% in overweight or obese individuals is associated with improved cardiovascular risk factors such as reduced blood pressure, reduced blood cholesterol and improved glycemic control, even if individuals remain in the overweight or obese category [Wharton et al., 2020; Raynor & Champagne, 2016; Yumuk et al., 2015; Jensen et al., 2014; Goldstein, 1992]. Although this benefit is further increased with a greater amount of weight loss over an extended period of time, modest weight loss is readily achievable and should be the initial goal for obesity management [Sweeting & Caterson, 2017]. There appears to be consensus that the cornerstone of the treatment for overweight and obese individuals is a comprehensive lifestyle approach. This approach integrates a healthier dietary intake, physical activity components, as well as measures to support behavioural change [Wadden et al., 2020; Wharton et al., 2020; Kushner,

2018; Bray et al., 2016; Alamuddin et al., 2016; Raynor & Champagne, 2016; Yumuk et al., 2015; Jensen et al., 2014].

Hoosen (2022: Chapter 3 of this thesis) set out to develop a weight loss intervention for overweight and obese primary school educators in the Western Cape. To ensure that a comprehensive and systematic approach underpinned by behaviour theory was followed in the development of the intervention, the Behaviour Change Wheel (BCW) [Michie et al., 2011] integrated with the Theory of Planned Behaviour (TPB) [Ajzen, 1991], the Health Belief Model (HBM), as well as the Step approach to Message Design and Testing (SatMDT) [Lewis et al., 2016] were applied in the process. The outcome was a self-help weight loss intervention, the Health4LIFE weight loss intervention, that comprises an initial face-to-face contact session as part of a wellness day conducted at schools, a hard copy self-help manual to facilitate dietary pattern and physical activity change and a set of 80 text messages that were sent to educators over a 16-week period.

The MRC guidance for developing and evaluating complex interventions recommend that following the development of an intervention, the next step should focus on feasibility testing to advise full-scale evaluation and implementation in real world settings [Skivington et al., 2021]. A feasibility study allows an intervention to be refined by either making incremental or simultaneous adaptations throughout the feasibility study, as well as during all phases of the development of the intervention [O'Cathain et al., 2015]. It is not necessarily a scale model of the planned main evaluation but should explore any uncertainties identified in the development phase [Skivington et al., 2021; Craig et al., 2008].

Feasibility testing of a weight loss intervention in the school setting is of particular importance as a number of unique challenges may be encountered, including institutional approval required from the Department of Basic Education (DoBE) within the South African context, especially if wanting to enter the school during the fourth term [personal communication with Dr Wyngaard, Western Cape Education Department Directorate Research, 7 April 2017]; educator overload of daily work and a lack of time [Pérez-Jorge et al., 2021] and potential lack of national and provincial level policies focused on health promotion for educators [personal communication with Dr Goeiman, Western Cape Deputy Director of Nutrition at the Department of Health].

The aim of this study was therefore to test the feasibility of the Health4LIFE self-help weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in Cape Town, Western Cape, South Africa in a mixed methods study.

4.2 Methods

4.2.1 Identification and definition of feasibility indicators

Terminology and specific outcomes for feasibility testing vary across studies and guidelines. Hallingberg et al. (2018), suggested use of the terminology formulated by Eldridge et al. (2016)

namely to “view feasibility as an overarching concept, with all studies done in preparation for a main study open to being called feasibility studies, with pilot studies being a subset of feasibility studies” [Eldridge et al., 2016]. Eldridge et al. (2016) further explained that a randomised controlled trial would be the best design for pilot study to estimate potential impact. Duijzer et al. (2014) defined four elements of feasibility related to intervention implementation, namely reach, acceptability, applicability and implementation integrity. According to Duijzer et al. (2014) reach refers to the percentage of the intended target population that actually participated in an intervention, acceptability refers to the degree to which participants are happy with an intervention, applicability refers to the degree to which an intervention can be implemented in a real-life scenario and implementation integrity refers to how well an intervention was implemented compared to the plan. A combination of qualitative and quantitative methods can be used to assess these criteria [Moore et al., 2015; O’Cathain et al., 2015; Craig et al., 2008].

The definition of outcomes for the purposes of the present study (Table 4.1) are aligned with those described by Duijzer et al. (2014). Reach in the present study refers to the number of educators who 1) attended the wellness day, 2) were overweight or obese and opted to participate in the intervention, and 3) completed the intervention. Acceptability in the present study refers to the degree to which the educators and principals were happy with 1) a weight loss intervention within the school setting, 2) the wellness day at the school, 3) the content of the Health4LIFE intervention manual and text messages, 4) the mode of delivery and 5) the frequency of contact. Applicability in the present study refers to the degree to which an intervention such as the Health4LIFE intervention can be implemented within a school setting. Finally, implementation integrity in the present study refers to how well the intervention was implemented compared to the plan. Key considerations that were assessed to reflect potential (signal) of effect include diet and physical activity related to belief and stage of change, dietary and lifestyle behaviours and weight.

Table 4.1: Study variables and outcomes

Outcome category/priority of outcomes	Outcome variable/measure
Primary Outcomes	Reach
	Acceptability
	Applicability
	Implementation integrity
Secondary Outcomes	Weight
	BMI
	Dietary intake (food choices)
	Physical activity
	Waist circumference
	Blood pressure

	Modal beliefs relating to dietary behaviours
	Modal beliefs relating to physical activity behaviours
	Nutrition knowledge
	Weight loss readiness to change
	Perception of body image
	Psychological wellbeing
Baseline descriptive variables	Self-reported health, smoking
	Prior weight loss practices

4.2.2 Feasibility testing design

The feasibility of the Health4Life weight loss intervention was investigated in three sub-studies. Sub-study 1 investigated the reach and implementation integrity (primary outcomes as outlined in Table 4.1) and the potential impact (secondary outcomes as outlined in Table 4.1) of the intervention in a pilot randomised controlled trial. Educators were recruited during a wellness day that was conducted at selected schools and constituted the first element of the intervention. The intervention group received the remaining two elements of the Health4LIFE weight loss intervention (hard copy manual and text messages) and the control group received a hard copy of the Department of Health's (DoHs) 'Choose a Healthy Lifestyle' booklet (Addendum XX, page 368). Data were obtained using self-administered questionnaires at baseline and 16-week follow-up. The baseline questionnaire included socio-demographics, self-reported health, food choices (non-quantitative food frequency questionnaire), physical activity level (Global Physical Activity Questionnaire), psychological instrument (Beck Depression Inventory), nutrition knowledge, perception of body size, weight loss readiness to change and belief statements developed for this research. The follow-up questionnaire included all except the socio-demographics and health information collected at baseline. Anthropometric measurements (weight and height for calculation of BMI and waist circumference) and blood pressure measurements were taken at both time points. Analysis to assess within group change and differences between groups for within group change over the 16-week period were done by protocol, thus using data for completers only (Figure 4.1). Sub-studies 2 and 3 were qualitative using semi-structured in-depth interviews to investigate primary intervention feasibility outcomes. Sub-study 2 investigated the perceptions of educators who participated in the intervention arm and sub-study 3 the perceptions of principals of participating schools regarding reach, acceptability, applicability and implementation integrity (Figure 4.1).

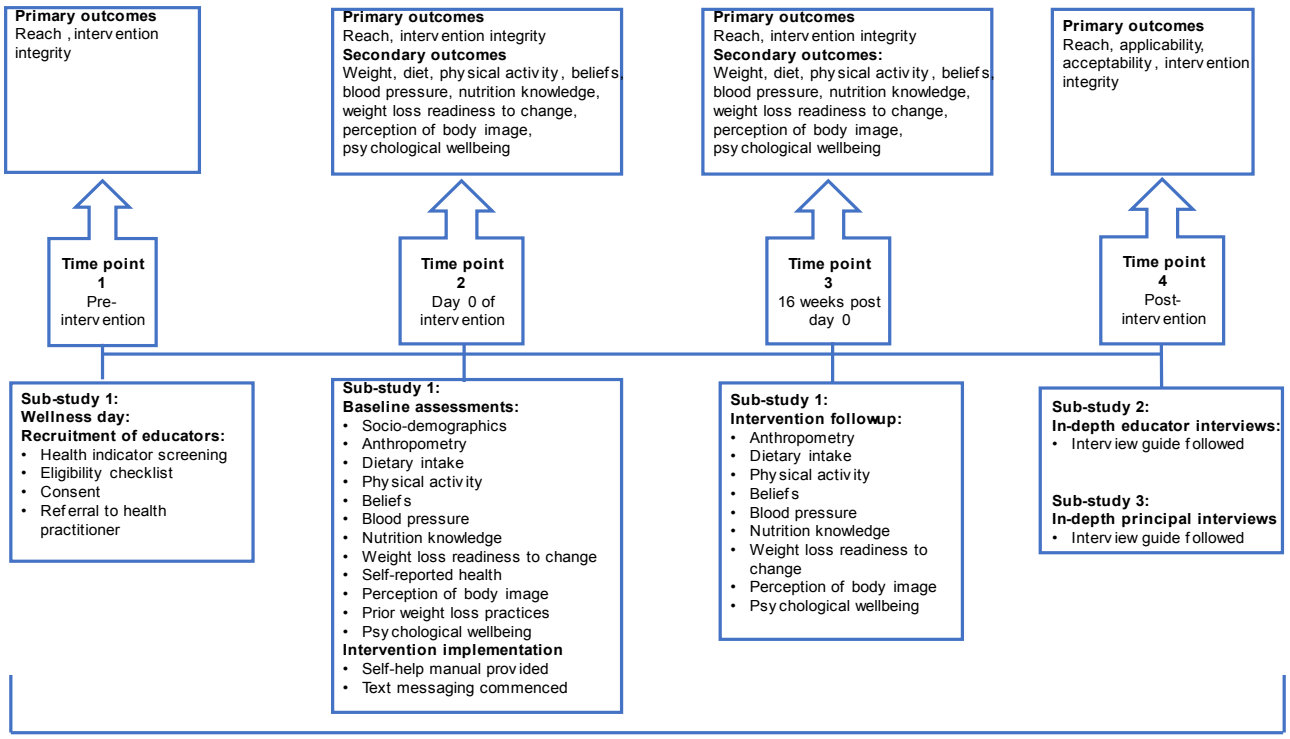

Figure 4.1: Summary of the feasibility testing design outlining assessments and associated primary and secondary outcomes

4.2.3 Sub-study 1

A. Study design

The study design was a clustered randomised controlled pilot trial which included a comparison between a control and an intervention group. Experts in the field of research were identified to oversee and contribute expert inputs in various sections of the methodology and included Professor M Senekal (study supervisor and senior researcher); Professor N Steyn (senior researcher); Professor M Faber (chief senior specialist scientist), Mrs M Theron (dietitian with master's level research experience) and the Doctor of Philosophy (PhD) candidate (dietitian with master's level research). The composition of the panel is outlined in sections as relevant.

B. Target population and setting

The target population was overweight and obese educators employed by the DoBE or the school governing body at selected public schools within the Metro North District in the Western Cape Province, South Africa. This district was selected as schools within the Metro North District formed part of the Healthkick study [de Villiers et al., 2012] and are therefore comparable to the schools included in the formative assessment on which the development of the Health4LIFE intervention was

based. Schools excluded from the study were 1) all 19 schools in circuit ten in the district for logistical reasons (more than 1-hour drive away from the MRC, and 2) Quintile one and two schools as there was only one school of each quintile within the specified district. Public schools across South Africa are grouped into five quintiles according to the demographics of the neighbourhood, where schools in quintile one are the poorest and those in quintile five the least poor [Grant, 2013].

C. Inclusion and exclusion criteria for educators

Inclusion criteria included the following: overweight and obese educators with a BMI ≥ 27 kg/m^2, employed either by the DoBE or the school governing body at selected public schools within the Metro North District of Cape Town, were English literate, between the ages of 20-60 years, owned their own personal mobile phone and agreed not to participate in any other weight loss interventions for the duration of the study. Educators who were following a weight loss diet at the time of data collection, women who were pregnant or trying to fall pregnant or were pregnant less than six months prior to data collection, lactating women, those with orthopaedic or joint problems which could be a barrier to physical activity, those with a history of major medical problems such as heart disease (including having had a pacemaker inserted) or those with recent weight loss greater than 10% in the previous six months, were excluded from the study.

D. Sample size and selection of schools

Orsmond and Cohn (2015) advise that when conducting a feasibility study, preliminary evaluations of participant responses to an intervention must be performed on a suitable sample size to establish if the intervention shows promise of being successful in the intended target population. There is no consensus on the appropriate sample size, some recommend 30 to 40 participants per group [Lewis et al., 2021; Browne, 1995] is adequate while others recommend 12 per group [Julious, 2005]. However, all agree that as there is no hypothesis testing, a smaller sample size than that required for a full effectiveness study is required [Lewis et al., 2021; Bowen et al., 2009]. Factors that need to be considered in selecting a suitable sample size for feasibility studies include 1) sample size recommendations as mentioned above, 2) sample size used in published feasibility studies such as Dujizer et al. (2014), and Sugimoto (2014) who used 31 and 20 participants respectively and 3) attrition rates reported in weight loss interventions that range between 10% and 80% [Moroshko et al., 2011; Teixiera et al., 2004]. For this feasibility study the aim was to recruit a total of 120 educators, 60 in the intervention arm and 60 in the control arm to accommodate a drop-out of up to 50%.

A cluster sampling method was used to randomly select public schools within the Metro North District in the Western Cape Province. Schools were stratified according to socio-economic status based on

respective quintiles. A school was regarded as eligible if it was situated in circuits one to nine, if it fell within quintiles three to five and if it had more than 20 educators employed at the school.

There was a total of 131 schools within the Metro North district, 129 were quintile three to five schools, 112 of which fell within circuits one to nine and 80 of which had more than 20 educators.

Of the 80 schools, 11 were classified as quintile three, 41 as quintile four and 28 as quintile five schools. During the initial recruitment phase, eight schools from each quintile, thus a total of 24 schools, were randomly selected using a computerised system by the study statistical advisor (Prof C Lombard, SAMRC, Tygerberg). These schools were contacted and invited to participate in the wellness day and the subsequent intervention. Random sampling of schools was repeated until the target of 20 schools was achieved. A total of 683 (150 male and 533 female) educators were employed across the 20 schools that were included in this study. Ten of these schools were then randomly assigned to the control and 10 to the intervention group by the statistician using a computerised system. The schools and educators were blinded to the randomisation.

E. Recruitment of educators in schools

The strategy used to recruit overweight and obese educators into the study involved the hosting of wellness days, at eligible schools that agreed to participate in the study approximately one month prior to commencing the study. The wellness days also constituted the first element of the intervention. An appropriate date and time for these wellness days were arranged with the principals and educators of the schools. All educators were invited to attend the session and were offered a free anthropometric assessment (weight, height, body mass index, percentage body fat), as well as screening for hypertension by a trained fieldworker. The educators were provided with a copy of their health readings, as well as the address of a website they could access to contact a dietitian if they were concerned about their dietary intake or weight (Addendum XI, page 337). If educators were found to have an elevated blood pressure reading, they were referred to their general health practitioner or primary health care facility for further treatment and management via a referral letter (Addendum XII, page 338). The wellness days were run by a registered dietitian (Addendum XIII, page 339).

Eligible educators were provided with information regarding the purposes of the study and the nature of the required assessments were explained. Written information regarding the study was also provided (Addendum XIV, page 341) and interested educators were invited to participate. A future date and venue were then confirmed with the principals and the volunteer educators for an initial introductory group session. Written informed consent and baseline data was collected at this meeting (Addendum XIV, page 341). Educators were made aware that they would be randomly allocated to receive one of two options, namely the Health4LIFE weight loss intervention (intervention group) or

the Department of Health's (DoHs) 10-page booklet: 'Choose a Healthy Lifestyle' (control group) (Addendum XX, page 368). They were also aware that they would be blinded to the randomisation.

A total of 137 educators were recruited, 79 across the 10 intervention schools and 58 across the 10 control schools (Figure 4.2). Three entire schools were lost to follow-up, two Intervention and one control school. Total loss to follow-up (LTFU) was 46.8% in the intervention group and 25.9% in the control group. Drop-out of the two intervention schools resulted in LTFU of 26 of the total number LTFU in the intervention group (32.9%), while the drop-out of the one control school resulted in LTFU of five of the total number LTFU in the control schools (8.6%).

A flow diagram of the study sample is presented in Figure 4.2.

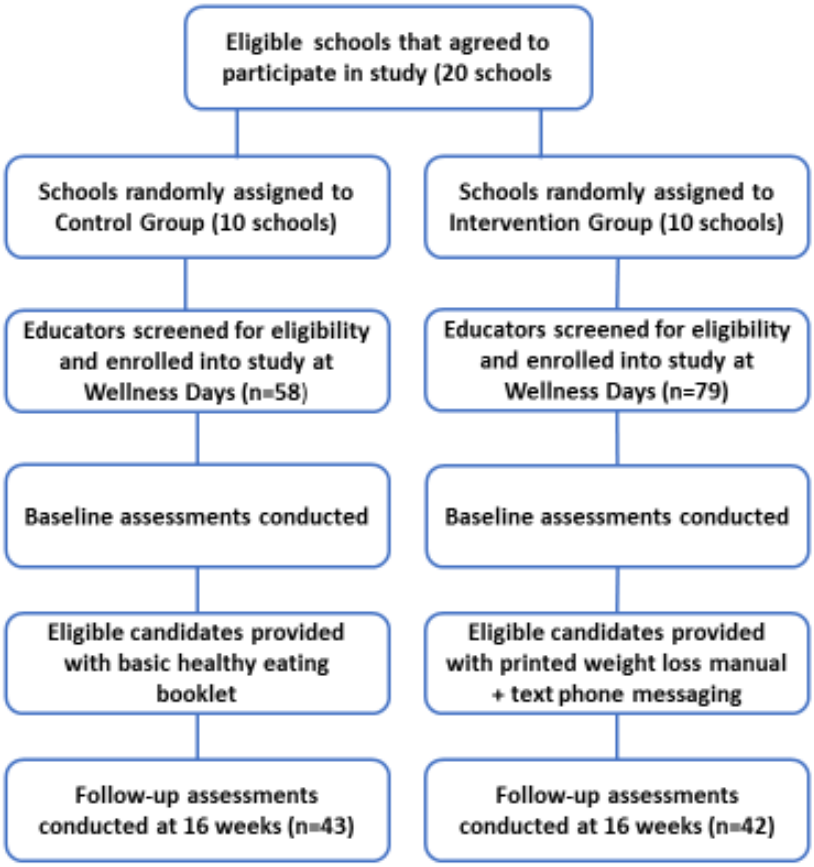

Figure 4.2: Randomisation of schools, recruitment of subjects and flow of assessments

F. Intervention: Health4LIFE weight loss intervention

The HEALTH4LIFE weight loss intervention consists of three elements, namely a wellness day, a hard copy manual to facilitate dietary pattern and physical activity for health and weight loss and short text messages, five per week for 16 weeks (text messages).

i) Intervention development

Detail of the development of the Health4LIFE intervention for primary school educators is provided in Chapter 3 of this thesis. In brief, a theory and evidence-based approach was used to develop the intervention, implementing the stages outlined in the BCW, which included completion of the prescribed worksheets [Michie et al., 2014]. While the BCW was the primary framework for the intervention development, the TPB [Ajzen, 1991] and the HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] and the SatMDT [Lewis et al., 2016] were integrated in the process to attain a greater understanding of educator beliefs regarding relevant dietary and physical activity behaviours and to address the concept of health awareness (first step to behaviour change) were selected, respectively. The Step approach to Message Design and Testing (SatMDT) tool was chosen to underpin intervention message development. The Behaviour Change Wheel (BCW) integrated with the Theory of Planned Behaviour (TPB) to gain insight in educator beliefs regarding dietary and physical activity behaviours and the Health Belief Model (HBM) to address the concept of health awareness (first step to behaviour change) were selected.

Key considerations that emerged in various steps that determined decisions regarding delivery format (in-person wellness assessment and a self-help manual combined with text messages), are as follows: target population specific factors (educator workload and stress), setting (schools that answer to the rules and regulations of the DoBE, affordability (some educators may have had a low socio-economic status), access to electronic devices and internet, the level of face-to-face intervention contact that could be achieved within the school setting (limited) and preferences regarding weight loss intervention delivery mode (majority of educators preferred to access information via whats-app or similar) [Senekal, 2015b: Unpublished Data].

ii) Element 1 of the intervention: Wellness assessment

The wellness day was the first point of contact with educators and the first element in the intervention, while also serving as an opportunity to recruit them for the study.

According to the HBM, one of the first steps in the journey of changing behaviour is awareness creation, which directly affects motivation, internal processes that influence decision-making behaviour and self-efficacy (believing one can successfully execute the required behaviours to achieve the desired outcome) [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958]. The wellness day provided the opportunity to create health awareness and to inspire and motivate educators to take action and participate in the intervention. All educators were invited to the wellness day where an NCD risk assessment was performed and the results relayed to them. This allowed eligible educators to be identified in a non-confrontational manner and also provided the opportunity to introduce the study to these educators and obtain consent from them. The NCD risk

assessment comprised the following: weight and height measures and calculation of the body mass index (BMI), measuring blood pressure, measuring waist circumference and determining percentage body fat using a Tanita Body Composition scale. Values were interpreted using cut-offs provided by Lee and Nieman (2013) where an acceptable range is 9-31% for females and 6-24% for males and an unhealthy range (too high) is ≥ 32% for females and ≥ 25% for males.

iii) Elements 2 and 3 of the intervention

The educators in the intervention group received a hard copy manual to facilitate dietary pattern and physical activity for health and weight loss along with five text messages a week, for 16 weeks, thus 80 messages in total. An outline of the content Health4LIFE manual and linked text messages is provided in Table 4.2. Development of the manual and messages included testing in the target sample, consisting of a group of seven educators (5 females and 2 males). These educators were provided with the manual, a printout of the 80 text messages and a structured assessment sheet (Addendum IX, page 329) to record their feedback. They were requested to read and consider the manual content, complete the self-assessment, behaviour planning and self-monitoring activities included in the addenda of the manual and read and consider the text messages before completing the assessment sheet. Educators were mostly positive and complimentary, and the PhD candidate and supervisor (Senekal) considered all the documented feedback, and a few minor changes were made. More detail on the results of this assessment is provided in Chapter 3, section 3.2.6 of this thesis.

Table 4.2: Outline of the Health4LIFE weight loss manual and linked text messages

Chapter title in manual	Content outline of manual	Self-directed activities in the manual	Text messages directed at manual content
Chapter 1: Weight management	Weight balance Energy balance Health benefits associated with weight loss for those who are overweight or obese	**Chapter 1:** Energy balance assessment **Addendum 3:** Assessment of BMI, WC, risk factors for disease and conditions associated with obesity; Weight loss goal setting; Weight monitoring chart	For the first week text messages focused on general weight management information
Chapter 2: General healthy eating advice	South African FBDG and food guide DASH eating plan	**Chapter 2:** Brief fruit and vegetable intake assessment; fat intake assessment; sugar intake assessment	N/A
Chapter 3: Fruit and vegetables	FBDG (stating the guideline) General information (recommendations to increase fruit and vegetables intake, serving sizes, explaining eating a variety) Health benefits of eating fruit and vegetables Action plan (outlining the target behaviours: purchase a variety of fruit and vegetables, bring fruit and vegetables to school every day, eat a variety of vegetables at mealtimes every day) Problem solving (tips to buy fruit and vegetables on a restricted budget, lunchbox ideas, tips to meet the daily recommendation, cooking methods for vegetables)	**Addendum 3:** Assessment of current fruit and vegetable intake and goal setting; Weekly record sheet of variety of fruit and vegetables purchased and served at mealtimes	There were three target behaviours related to fruit and vegetable intake which the text messages targeted over a three-week period: • Purchase a variety of fruit and vegetables • Bring fruit and vegetables to school every day • Eat a variety of vegetables at mealtimes
Chapter 4: Fat	FBDG (stating the guideline) General information (what are fats, the types of fat, fat intake and weight loss) Health benefits of controlling fat intake Action plan (outlining the target behaviours: select foods low in fat when purchasing foods, add less fat	**Addendum 3:** Assessment of current fat intake and goal setting; Weekly record sheet of fat intake during meal preparation and selecting snacks	There were three target behaviours related to fat intake which the text messages targeted over a five-week period: • Select food low in fat when purchasing foods • Add less fat when preparing food • Reduce or avoid the intake of high fat snacks

	when preparing foods, reduce or avoid high fat snacks or processed foods) Problem solving (shopping list for lower fat options, lower fat recipe substitutes, low fat options when eating out, tips to reduce fat when cooking, low fat snack ideas)		
Chapter 5: Sugar	FBDG (stating the guideline) General information (what is sugar) Health benefits of decreasing sugar intake Action plan (outlining the target behaviours: limit the purchase of sugar containing foods and drinks, reduce or avoid the intake of sugar-containing cold drinks, add less or no sugar to hot beverages, use less or no sugar when preparing foods, avoid the intake of sugary foods/snacks during times of stress) Problem solving (sugar content in breakfast cereals, hidden sugar in foods, reducing the sugar in cold drinks, rethink your drink, tips to add less sugar to hot beverages, side-effects related of decreasing sugar intake)	**Addendum 3:** Assessment of current sugar intake and goal setting; Weekly record of sugar intake during meal preparation, in beverages and at times of stress	There were five target behaviours related to sugar intake which the text messages targeted over a five-week period: • Limit the purchase of sugar-containing food/drinks • Reduce or avoid the intake of sugar-containing cold drinks • Use less or no sugar when preparing foods • Add less or no sugar to hot beverages • Avoid the intake of sugary foods/drinks during times of stress
Chapter 6: Physical activity	FBDG (stating the guideline) General information (physical activity recommendations, types of physical activity, levels of intensity) Health benefits of physical activity Action plan (outlining the target behaviours: increase physical activity at work, increase physical activity in free time) Problem solving (getting started and staying active, practical tips to build activity into daily routine, typical excuses not to exercise and possible solutions, drinking during exercise)	**Addendum 3:** Assessment of current level of physical activity and goal setting; Weekly record of physical activities at school and during free time	Each week one text message targeted the physical activity targeted behaviours: • Increase physical activity at work • Increase physical activity in free time
Chapter 7: Stress management	General information (what is stress, health implications, typical stressors for educators)	**Addendum 3:** Stress indicator checklist; Goal setting; Weekly record of management of stress	Text messages targeting stress management was incorporated into the week where the target behaviour “Avoid the intake of sugary

	Action plan (9 actions to improve stress management skills including relaxation techniques and exercise)		foods/drinks during times of stress" was addressed
Addendum 1: Eating plans	Examples of various caloric eating plans: 1000kcal, 1200kcal, 1400kcal, 1600kcal, 1800kcal	N/A	
Addendum 2: Useful tips and information	Time-saving cooking tips and lunch tips; Cooking tips to reduce added sugar; Snacks containing sugar; Food label reading	N/A	At least once a week, educators were referred to tips and information in the manual
Addendum 3: Self-assessment, goal setting and self-monitoring activities	Assessment of current: Weight status and health risk Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress Goal setting for: Weight Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress management Weekly monitoring of: Weight Fruit and vegetable intake Fat intake Sugar intake Physical activity Stress management	N/A	At the end of each week, the text message referred the educator to the activities related to the target behaviour which was the focus of the week

NA: Not applicable, DASH: Dietary Approaches To Stop Hypertension [Appel et al., 1997], FBDG: Food Based Dietary Guidelines [Vorster et al., 2013]; kcal: kilocalories; WC: Waist circumference

A reputable service provider was appointed to ensure that text messages were sent to the educators Monday to Friday afternoons over the 16-week period. The PhD candidate collated the names of the recipients and forwarded these to the service provider. The PhD candidate was also included as a recipient to ensure that messages were received as intended. Messages started on the first Monday after a group of educators at a school was recruited, with multiple groups receiving messages at different stages of the intervention. The PhD candidate performed a daily check to ensure that messages where indeed received and that the correct message was received at the correct time point.

G. Control

The educators in the control group received a hard copy of the DoHs 10-page booklet called 'Choose a Healthy Lifestyle' and provided brief detail on a healthy lifestyle. An outline of the booklet is provided in Table 4.3 while the booklet is provided in Addendum XX, page 368. The control group educators received a copy of the intervention manual at the conclusion of the study period.

Table 4.3: Outline of the content of the Department of Health's "Choose a healthy Lifestyle" booklet

Choose a Healthy Lifestyle Booklet A 10-page booklet covered the following:	
Page 2 Page 3 Page 4 Page 5 Page 7 Page 8 Page 9 Page 10	• The healthy lifestyle overview • Nutrition • What do the different guidelines mean • Physical activity • Sexual behaviour • Alcohol intake • Tobacco control • Help resources

H. Measures

All the assessments that were completed as part of Sub-study 1 are summarized in Table 4.4.

Table 4.4: Summary of all the measures and data collection time points

Assessment	Baseline	16-week follow-up
1. Socio-demographic information	Yes	No
2. Health information	Yes	No
3. Perception of body size	Yes	Yes
4. Weight loss readiness to change	Yes	Yes
5. Psychological wellbeing	Yes	Yes

6. Nutrition knowledge	Yes	Yes
7. Physical activity (exercise and sedentary behaviours)	Yes	Yes
8. Beliefs: Fruit and vegetable intake Sugar intake Fat intake Physical activity	Yes	Yes
9. Anthropometric measures: Height and weight for calculation of BMI* Waist circumference	Yes	Yes
10. Clinical measures Blood pressure measurement	Yes	Yes
11. Dietary intake: Indicator food choice assessment tool (non-quantified)	Yes	Yes

*BMI: Body Mass Index

i) Survey questionnaire

Variables one to eight in Table 4.3 were assessed using a self-administered questionnaire developed for the purposes of this research (Addendum XV, Section A, page 344).

Socio-demographic and health information data: Information obtained included date of birth, gender, ethnicity, address, marital status, years of teaching, smoking history, weight and height if known, family history of obesity and NCDs, prior weight loss practices and the use of medications for NCDs. In addition, living standards were also investigated using the Living Standards Measure (LSM), which is a widely used marketing research tool in Southern Africa [Ntloedibe & Ngqinani, 2020]. The LSM categorises the population into 10 LSM groups, where LSM 1-4 is categorised as 'least access to wealth' while LSM 8-10 is categorised as 'most access to wealth'. This tool uses criteria such as degree of urbanisation, ownership of cars or major appliances and access to basic services such as water and electricity [Ntloedibe & Ngqinani, 2020].

Perception of body size: Body image of educators was assessed at baseline and 16-week follow-up using perceptual and ideal body image questions which were validated in a South African population [Mciza et al., 2005] based on the age-adjusted figures from Stunkard et al. (1983). Educators had to select a body figure from a set of nine silhouettes they felt closely resembled their body size. The perceptual body image was compared with their actual body size based on body mass index (BMI) categories, as measured in the study, to determine the accuracy of their perceived body size.

Weight-loss readiness to change: The transtheoretical model stages of change framework as described by Prochaska et al. (1992) was used to assess weight loss readiness to change of educators at baseline and 16-week follow-up. The educators had to select one of five statements that best described their readiness to change for six weight-related target behaviours (pre-contemplative: no plans to change for the next 6 months, contemplative: thinking about changing in the next 6 months, preparation: thinking about changing in the next month, action: attempting change currently, and maintenance: changed behaviour and attempting to maintain change). The statements were adapted from a study by Logue et al. (2000) who investigated stage of change for six target behaviours: decreased dietary fat, decreased portion sizes, increased vegetable consumption, increased fruit consumption, increased daily physical activity and increased planned exercise. A stage of change profile for each behaviour was developed for the intervention and control groups based on the percentage of educators in each stage of change at baseline and follow-up.

Psychological wellbeing: The Beck Depression Inventory (BDI-II) was used to measure depression and anxiety in the educators at baseline and 16-week follow-up [Beck et al., 1961]. The inventory contains 21 questions where educators are asked to rate how they have been feeling in the past two weeks on a scale of 0-3. More depressive symptoms are allocated higher scores. Standardised cut-offs categorised educators into one of 4 categories, namely: 0–13: minimal depression; 14–19: mild depression; 20–28: moderate depression; and 29–63: severe depression [Beck et al., 1961].

Nutrition knowledge questionnaire: Nutrition knowledge of educators was assessed at baseline and 16-week follow-up using an existing questionnaire [Whati et al., 2005] that was adapted to meet the needs of the present study by the PhD candidate and Senekal. This questionnaire covered the key behaviour constructs targeted in the Health4LIFE intervention, namely the intake of fruit and vegetables, sugar and fat, as well as physical activity. The questionnaire was tested for face validity by Senekal and Theron.

Level of physical activity: In 2002, WHO developed The Global Physical Activity Questionnaire (GPAQ) as part of its WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance to quantify the energy expenditure of a subject [Armstrong & Bull, 2006]. The GPAQ consists of 16 questions and assesses physical activity in 3 main areas (work, transport and leisure), as well as time spent in sedentary behaviour. It is commonly used to classify the level of physical activity as high, moderate or low and quantifies it in terms of Metabolic Equivalents (METs). This tool has been found to be valid and reliable in its ability to measure and assess any changes in physical activity and sedentary behaviour in developing countries such as South Africa [Armstrong & Bull, 2006] and was therefore used to measure and assess physical activity and sedentary behaviour of the educators at baseline and 16-week follow-up.

Beliefs relating to key dietary and physical activity behaviours: Educators' beliefs relating to the consumption of fruit and vegetables (six beliefs, five control and one behavioural), sugar (four beliefs, three control and one behavioural) and fat (seven beliefs, four control and three behavioural), as well as physical activity (seven beliefs, six control and one behavioural), thus a total of 24 beliefs, were investigated at baseline and 16-week follow-up. Educators indicated whether they strongly disagreed, disagreed, are neutral, agreed or strongly agreed with each belief statement on a 5-point Likert scale. Negatively formulated statements were reverse scored. The belief statements were derived from the formative work of Senekal, Steyn, Musingwini and the PhD candidate [Senekal et al., 2015b; Unpublished data]. This work involved a survey amongst 164 educators from schools in lower socio-economic areas in the Cape Metropole to identify messageable beliefs to be targeted in the Health4LIFE intervention (see Chapter 3, section 3.2.2 for more detail on the identification of messageable beliefs).

ii) Anthropometric assessments

Weight: Body weight was measured with a calibrated digital scale to the nearest 0.1 kg. The scale (Seca, 813 Electronic Flat Scale) was placed on an even, uncarpeted area and the researcher zero calibrated it before each measurement. Educators were weighed barefoot, wearing light clothing (jackets and jersey were removed) and in an orthostatic position. This procedure was repeated and the average of the two readings recorded. If the two readings varied by more than 0.1 kg, a third reading was taken and the average of all three recorded [Lee & Nieman, 2013].

Height: Height measurements were done barefoot and read to the nearest 0.5 centimetre from a fixed standard stadiometer (Seca Leicester Height Measure, Deutschland) placed on an even, uncarpeted area. Educators were positioned facing the researcher. Their shoulder blades, buttocks and heels had to touch the measuring board and their arms had to be relaxed at their sides with their legs straight and knees together. Their heels had to be together with their feet flat on the ground. Educators had to look straight ahead and their heads had to be maintained in the Frankfort plane position. The head piece was lowered to the crown of the head and the reading taken. This procedure was repeated and the average of the two readings recorded. If the measurements differed by more than 0.5 cm, a third reading was taken and the average of all three recorded [Lee & Nieman, 2013].

Body mass index (BMI): Educators' BMI was calculated as weight/height^2 (kg/m^2) and classified according to WHO criteria as either pre-obese (25-29.9 kg/m^2), obese class I (30.0-34.9 kg/m^2), obese class II (35.0-34.9 kg/m^2) or obese class III (≥40.0 kg/m^2) [WHO, 2000].

Waist circumference (WC): Educators WC was measured using a Seca non-stretch tape measure to the nearest 0.1 cm. The tape was placed at the narrowest point between the tenth rib and the iliac crest, and the reading taken after at least three completed breadths-expirations. If there was no obvious narrowest point the measure was taken halfway between the two above-mentioned

landmarks [Lee & Nieman, 2013]. This procedure was repeated and the average of the two readings recorded. If the two measurements exceeded 1 cm, both measurements were repeated [WHO, 2011] WC was interpreted using the WHO cut-offs where WC >102 centimetres for males or >88 centimetres for females indicates a substantially increased risk for metabolic complications [WHO, 2011].

iii) Blood pressure assessment

Blood pressure was measured using a LAICA Automatic Arm Blood Pressure Monitor (BM2001, LAICA S.p.A. Italy). Guidelines as per the LAICA manual were followed to ensure the accuracy of blood pressure readings. Readings were taken twice while sitting and on the left arm to ensure consistency. Hypertension was defined as a systolic blood pressure ≥140 millilitres mercury (mmHg) or diastolic blood pressure ≥90 mmHg or on treatment [Seedat & Rayner, 2012].

iv) Dietary intake assessment

A panel of four expert dietitians followed a structured process to select the most appropriate and feasible method to obtain dietary intake data. The factors considered by the panel are outlined in Table 4.5.

Table 4.5: Factors considered for the assessment of dietary intake methodology

Factors considered	Research specific considerations
Aim of the study	The aim of phase 2 of this research is to test the feasibility of the developed intervention in a mixed methods study design.
Aim of dietary intake focus and statistical analysis	Measuring a change in food choices (secondary outcome of the study) Association of food choices in relation to beliefs and stages of change
Target population	A well-educated respondent (Educators)
Respondent burden	Tight time constraints within which to obtain data as it will be performed during a working day, during working hours
Accessibility	Access to educators will be limited as they are full time staff members who will only be able to attend the sessions when they are free during their usual working day, contact time limited
Logistical considerations	Limited budget needs to cover large sample size. The method utilized to obtain dietary intake data should consider the expertise and number of fieldworkers required for it; if repeated visits are required; cost of coding the data

Panel included Senekal, Steyn, Faber and the PhD candidate

Consideration of the respondent burden and the time and budget constraints indicated that assessment of usual intake of total energy and nutrients was not a feasible option. A food-based approach was therefore developed in the form of a short 59-item, non-quantified indicator food list to measure food choices at baseline and 16-week follow-up (Addendum XV, Section B, page 355). An existing food item list that was used to assess the food choices of educators in the Western Cape

with a similar socio-economic status background [Seme et al., 2017] was adapted to meet the needs of the present study. The indicator food choice assessment tool has a recall period of the past week.

The picture sort method was used for administering the indicator food choice assessment tool. This involved using food cards containing photos of the food items to assist the identification of the items [Steyn & Senekal, 2000]. Educators separated the cards into two piles: food items they had eaten in the last week and those they had not eaten. They were then asked to indicate the frequency of intake of each food item as 1-2 times per week (designated as 1.5 times per week for calculation of frequency of intake), 3-4 times per week (designated as 3.5 times per week for calculation of frequency of intake), 5-6 times per week (designated as 5.5 times per week for calculation of frequency of intake) , 1 time per day, 2 times per day, 3 times per day or 4 or more times per day. As part of data analyses the food items were categorised into eight indicator food categories: (Table 4.6). Daily frequency of intake from these indicator food groups was calculated.

Table 4.6: Indicator food categories

Indicator food categories	Assigned indicator foods
High fat foods	High fat red meat, processed meats, tinned meat, chicken with skin, full cream milk, cheese, margarine/butter, margarine/butter/oil, fried foods (chips), fried foods (other), pies, sausage rolls, fried samosas, take-outs, full fat salad dressing, full fat mayonnaise
Low fat foods	Low fat red meat, chicken without skin, eggs (prepared with no oil/butter/margarine),low fat milk, skim milk, fat-free cottage cheese, low fat salad dressing, low fat mayonnaise
Sugary foods	Sugar, chocolates, sweets, cakes, biscuits, juice, cordial, cold drinks, crisps, jam, tomato sauce
Refined carbohydrates	Bread or rolls, white
Fiber-rich carbohydrates	Legumes (sugar beans, baked beans, lentils), bread or rolls, brown
Fruit	Oranges and naartjies, apples, bananas, pears,
Vegetables	Green vegetables, yellow and orange vegetables, mixed vegetables, cabbage, tomato, salad,
Alcohol	Alcoholic coolers, Spirits, brandy, vodka with mixer e.g. lemonade, cola

I. Data collection procedures

Baseline assessment commenced once eligible educators had signed informed consent. Follow-up data collection took place on completion of the intervention, 16 weeks after baseline. To ensure privacy, all anthropometric, clinical and dietary intake assessments were conducted and recorded in a private area allocated by the school principal. The self-administered survey questionnaire was completed, and the food choice intake assessment interview conducted in a quiet area such as a staff

room or classroom, depending on availability. Data collection at each time point, baseline and at 16 weeks follow-up, took approximately 60 minutes.

Two teams of three fieldworkers each were trained and standardized to obtain the necessary anthropometric and clinical measures, conduct the food choice interview and facilitate completion of the self-administered questionnaires. Fieldworkers checked completed questionnaires for missing or incorrect information in the presence of educators, if time allowed. The data collection period commenced once the recruited schools indicated their availability and extended over a 6-month period in 2017, thus a staggered approach.

4.2.4 Sub-study 2

A. Study design

The study design for investigation of the perception of educators of the intervention was qualitative using goal directed, semi-structured in-depth interviews which were conducted face-to-face. In-depth interviews can provide context to other data (such as outcome data) by offering a more complete account of events during an intervention and exploring the reasons behind it, thereby creating a deeper understanding of the data [Guest et al., 2013; Boyce & Neal, 2006].

B. Study sample

The target population for Sub-study 2 was educators who had completed the 16-week Health4LIFE weight loss intervention across the eight schools, with gender (male and female) identified as a break characteristic. Forty females and three males completed the intervention arm and were eligible to participate in Sub-study 2. The intention was to recruit three male and three female educators, thus a minimum of six interviews in total. However, none of the male educators provided consent for participation and interviews were thus conducted with females only. To determine the final number of interviews, the principle of data saturation was applied [Nelson, 2017; Francis et al., 2010]. Data saturation was achieved after six interviews had been conducted.

C. Interview guide

The interview guide was developed by the PhD candidate and a senior research expert in qualitative data and weight management (Senekal). The outcomes of the assessment of the hard copy manual to facilitate dietary pattern and physical activity for health and weight loss and text messages by seven educators as part of the intervention development process (see Chapter 3, section 3.2.6 and Chapter 4, section 4.2.1 for more detail on the intervention development process), were considered in the development of the interview guide. The focus of the interview guide was on the experience of

educators of the intervention as a whole, and then more specifically the manual and the text messages (Addendum XVI, page 361). The interview guide was pilot tested with two educators who completed the 16-week Health4LIFE intervention before it was finalised as part of the training of the PhD candidate. As there were no changes to the interview guide, the pilot interviews were included in the analyses.

D. Data collection procedures

The in-depth interviews were conducted by the PhD candidate, who was trained and standardised for these purposes by the supervisor (Senekal), at a time and place convenient to the subject. Written informed consent was obtained from the educators once they agreed to be interviewed (Addendum XVII, page 363). Interviews were recorded with an audio digital recorder and the interviewer took notes on aspects such as non-verbal cues, while conducting the interviews. At the end of the interview, the interviewer provided the educator with a synopsis of the discussion to ensure that everything that was recorded was correct and to provide them with the opportunity to add any further perspectives. These interviews took approximately 45 minutes. The data collection period commenced after the 16-week intervention period ended.

4.2.5 Sub-study 3

A. Study design

The study design for investigating the perception of school principals was qualitative using goal directed, semi-structured in-depth interviews which were conducted face-to-face. In-depth interviews can provide context to other data (such as outcome data) by offering a more complete account of events during an intervention and exploring the reasons behind it, thereby creating a deeper understanding of the data [Guest et al., 2013; Boyce & Neal, 2006].

B. Study sample

The target population for this sub-study was school principals of participating intervention and control schools that provided permission for the 16-week follow-up assessment. Principals who did not provide permission for the follow-up assessments to take place at their schools were also targeted. The intention was to recruit two principals per school category, thus a minimum of eight interviews. However, consent was obtained from only four principals, two from intervention schools that completed the study and one each from a control school that completed the study and one that dropped out of the study. However, data saturation as described by Nelson (2017) and Francis et al. (2010) seemed to have been achieved after the four interviews had been conducted.

C. Interview guide

The interview guide was developed by the PhD candidate and a senior research expert in qualitative data and weight management (Senekal). The interview guide aimed to elicit information on how the principals experienced the implementation process of the intervention and the recruitment strategy used, as well as their perceptions of the intervention itself and how it was experienced by the educators (Addendum XVIII, page 365). Principals were also afforded an opportunity to suggest how the applied research approach could be improved. The interview guide was pilot tested with two principals of participating schools (intervention and control) before it was finalised as part of the training of the PhD candidate. As there were no changes to the interview guide, these interviews are included in the analyses.

D. Data collection procedures

The in-depth interviews were conducted by the PhD candidate, who was trained and standardised for these purposes by the supervisor (Senekal), at a time and place convenient to the subject. Written informed consent was obtained from the principals once they agreed to be interviewed (Addendum XIX, page 366). Interviews were recorded with an audio digital recorder and the interviewer took notes on aspects such as non-verbal cues, while conducting the interviews. At the end of the interview, the interviewer provided the principal with a synopsis of the discussion to ensure that everything that was recorded was correct and to provide them with the opportunity to add any further perspectives. These interviews took approximately 45 minutes. The data collection period commenced after the 16-week intervention period ended.

4.3 Data management and analysis

4.3.1 Quantitative data

Quantitative data was obtained for one primary feasibility outcome, namely reach. All secondary outcomes relating to potential impact were assessed using quantitative date and included change in weight; BMI; waist circumference; blood pressure; food choices; physical activity, sedentary behaviour; beliefs relating to fruit and vegetable, sugar and fat intakes and physical activity; as well as stage of change. Data were entered into a Microsoft Excel (2007) spreadsheet and was cleaned before being analysed using Statistica (Version 13.5.0.17). All numerical variables were checked for normality with the Shapiro Wilks test where $p \geq 0.05$ was considered to indicate a normal distribution.

Frequencies were tallied for categorical data. The mean standard deviation (SD) or median interquartile range (IQR) was calculated for numerical data depending on normality of the data. As the belief scores were count variables the median (IQR) was calculated and used in all analyses

involving beliefs. Out of a total 85 GPAQ questionnaires, 16 (18.9%) had to be discarded as it was incorrectly completed.

The Pearson's Chi Square test was performed to determine the difference between the control and intervention groups at baseline for 1) the total baseline group (control versus intervention), 2) the study completer sub-group (control completers versus intervention completers) and 3) the drop-out sub-group (control drop-outs versus intervention drop-outs) for categorical variables: gender, race, marital status, smoke, LSM category, health awareness and health characteristics, stage of change and body size perception. The t-test for independent samples or Mann-Whitney U test, depending on the normality of the data, was performed to test the differences between the control and intervention groups at baseline within the 1) total baseline group, 2) completer sub-group and 3) drop-out sub-group for numerical variables weight, blood pressure, hight, BMI, waist circumference dietary intake, physical activity indicators, belief scores and nutrition knowledge scores.

Change in secondary outcome variables, as well as psychological wellbeing, were tested by protocol, thus only data from control and intervention educators who completed the 16-week follow-up assessments were included in these analyses. Within group (control group and intervention group) change from baseline to 16-week follow-up for these variables was tested using the t-test for dependent samples or Wilcoxin matched pairs test, depending on the normality of the data. Comparison of within group change over the 16-week intervention period between the control and intervention groups was done using the independent samples t-test or Mann- Whitney U test depending on the normality of the data. The Pearson's Chi Square test was performed to determine the difference between the control and intervention groups at baseline and 16-week follow-up for stage of change for each of the four behaviours. A descriptive comparison of the stage of change profiles within the intervention and control groups at the two time points was also done.

Note that individual belief scores for the total baseline group and study completers and drop-outs are included in Addendum XXI, page 379. Median (IQR) belief scores that changed significantly are presented in the text in the results section, while results for the remaining beliefs are presented in Addendum XXII, page 381.

A principal component analysis (PCA) (SAS Version 9.4, SAS for Windows; SAS Institute, Cary, North Carolina, Unites States) was conducted to generate belief patterns regarding dietary intake (fruit and vegetable intake, sugar intake, fat intake) and physical activity for study completers only using the individual belief scores. The components were extracted using a principal axis method which was followed by a varimax rotation. Factors considered in determination of the number of belief patterns to be retained included: visual observation of the scree plot, an eigenvalue >1, factor loading, and the interpretability of patterns as performed by Sprake et al. (2018) to identify dietary patterns of university students in the United Kingdom. Beliefs with a factor loading of >0.40 on a belief pattern were retained

to interpret the pattern. Of note is that a universally accepted cut-off for factor loading does not exist. Pattern scores were calculated for further analyses.

Results with a p-value of <0.05 were deemed to be statistically significant and are presented in a red font colour in tables.

4.3.2 Qualitative data

The primary feasibility outcomes obtained from the qualitative data included reach, acceptability, implementation integrity and applicability. The PhD candidate collected and transcribed the data and together with an experienced researcher in qualitative data analysis (Senekal), thematically analysed the data by hand. This required repeated reading of the transcripts to become acquainted with the content. Each respondent (educator or principal) was then allocated a code and responses to each question in the interview guide were tabulated separately for the six educator and the four principal interviews. These responses to the questions were repeatedly read to identify potential themes and sub-themes. Finally, themes and sub-themes which emerged within each question, across all the questions, were considered to develop an integrated set of themes and sub-themes (coding list), which was used to code the interviews. The frequency of mentions of themes and sub-themes across the interviews were recorded. Themes and sub-themes and number of mentions are presented in tables, with an integrative interpretation across the six educator and four principal interviews following the tables. Illustrative quotes of the identified themes and sub-themes follow the tables.

4.4 Ethical and institutional approval

4.4.1 Ethical approval

Ethical approval was obtained from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (HREC REF112/2017). Two amendments to the protocol for sub-study 2 and sub-study 3 were approved on 06/02/2019 and 03/6/2019, respectively.

Signed informed consent was obtained from all educators who agreed to participate in the research (Addenda XIV, page 345; XV, page 348; XVII, page 367) before any data was collected. Educators were identified with a coding system to ensure their anonymity. The codes, as well as the questionnaires are being kept under lock and key in the office of the principal investigator for the required period of five years. The data is stored in a secure computer database in a manner that maintains subject confidentiality. Educators' and principals' participation in the study was completely voluntary and they were welcome to withdraw at any time without providing a reason. Failure to participate in the study was not held against them nor did it affect their current or future employment with the school or with the Department of Basic Education of the Western Cape.

There were no known risks associated with this study for any of the educators. Educators who participated in sub-study 1 received a stationary gift pack to the value of R75 at baseline and at follow-up to compensate them for their time spent completing the assessments. The educators also received sound scientific information regarding a healthy diet and exercise**,** which is in line with the South African food-based dietary guidelines [Vorster et al., 2013] and therefore had the potential to result in health benefits. Additional potential benefits were weight loss, as well as improved knowledge, behaviour and beliefs regarding health eating and physical activity. Moreover, educators also received a report on all their health readings as well as the link to a website where they could access contact details of dietitians if they were concerned about their dietary intake or weight (Addendum XI, page 337). If an educator was found to have an elevated blood pressure reading, they were referred to their general health practitioner or primary health care facility for further management and treatment via a referral letter (Addendum XII, page 338). The volunteers of the control group were provided with a hard copy of the manual to facilitate dietary pattern and physical activity for health and weight loss at the end of the study period.

Although educators who participated in sub-study 2 and principals who participated in sub-study 3 did not benefit directly, the information they provided added important insights in the feasibility of the Health4LIFE weight loss intervention, as well as recommendations for further refinement of the intervention for implementation.

The study was performed in accordance with the principles of The Declaration of Helsinki (2013), Good Clinical Practice (GCP) and the laws of South Africa.

4.4.2 Institutional approval

Once ethical approval was obtained, institutional approval was obtained from the Western Cape Department of Basic Education. Approval was then obtained from the respective principals of participating schools.

4.5 Results

4.5.1 Sub-study 1

A. Reach of the intervention

A total of 683 (22%, n=150 male and 78%, n=533 female) educators were employed across the 20 schools included in this study. Of this total, 349 attended the wellness days (51.2%). Of this number, 140 (40.1%) volunteered to participate in the study. After further screening, the final number of educators who took part in the present study was 137, thus 39.3% of those who attended the wellness day. The number of educators recruited for the intervention group was 79 and for the control group

58. There was a total drop-out rate of 38.0% (n=52), 46.8% (n=37) from the intervention group (42 completed the study) and 25.9% (n=15) from the control group (43 completed the study). Of the total drop-out group, 59.6% (n=31) were from three schools (2 intervention schools, n=26 and 1 control school, n=5) that did not allow a follow-up visit to be arranged.

B. Baseline profile of educators for the intervention and control groups within the total baseline sample and the study completer and study drop-put sub-groups

In this section of sub-study 1, results on the baseline profile of the intervention and control groups within the total recruited sample of 137 educators, as well as within the study completer (n=85) and study drop-out sub-groups (n=52) are presented. Results for the comparison of baseline profiles between the intervention and control groups within the total recruited sample of educators, as well as within the study completer and drop-out sub-groups are also presented. Furthermore, comparison of baseline profiles between the control study completers and drop-outs and between the intervention study completers and drop-outs are presented. Significant results are marked with a red asterisk next to the variable/indicator title and relevant results are presented in red font in tables. Detail of the statistical tests and p-values are given in footnotes to tables and interpreted in the text.

Baseline demographic and health profiles

The majority of educators in the total baseline group in both the intervention and control groups were female. This is also true within both the baseline study completer and study drop-out sub-groups. Within the total baseline group and the study completer sub-group, the intervention group was significantly more likely to include black educators than white educators than the control group. Within the study drop-out sub-group, the intervention group was significantly more likely to include black educators than coloured educators than the control group. The intervention group within the study drop-out sub-group was significantly more likely to include black educators than coloured educators than the intervention group within the study completer sub-group (Table 4.7).

The majority of educators in the total baseline control and intervention groups, as well as the study completer and study drop-out sub-groups were married and reportedly non-smokers. The majority of educators fell into the higher LSM category (8-10) across all groups. However, the intervention group within the total baseline group was significantly more likely to include educators who fell into the 6-7 LSM category than the control group (Table 4.7).

The median (IQR) age of the total baseline intervention group was 47.4(20.0-58.8) years, of the intervention group in the study completer sub-group 48.0(22.6-58.8) years and of the intervention group in the study drop-out sub-group 47.3(20.0-58.6) years (no significant differences). The median (IQR) age of the total baseline control group was 45.6(23.0-60.1) years, of the control group in the

study completer sub-group 45.6(23.0-60.1) years and of the control group in the study drop-out sub-group 46.5(24.4-59.0) years (no significant differences). There were no significant differences in age between the intervention and control groups in the total baseline group, or the study completer or study drop-out sub-groups (Mann Whitney U test: p>0.05).

The median (IQR) teaching years of the total baseline intervention group was 13.5(1.0-40.0) years, of the intervention group in the study completer sub-group 17.0(1.0-40.0) years and of the intervention group in the study drop-out sub-group 12.5(1.0-29.0) (no significant difference). The median (IQR) teaching years of the total baseline control group was 14.5(0.6-39.0), of the control group in the study completer sub-group 14.0(0.6-37.0) and of the control group in the study drop-out sub-group 20.0 (2.0-39.0) (no significant difference). There were no significant differences in teaching years between the intervention and control groups in the total baseline group, or the study completer or study drop-out sub-groups (Mann Whitney U test: p>0.05).

Table 4.7: Comparison of baseline demographic characteristics between the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicators	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Intervention	Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Gender	Male	7 (12.1)	6 (7.6)	5 (11.6)	3 (7.1)	2 (13.3)	3 (8.1)
	Female	51 (87.9)	73 (92.4)	38 (88.4)	39 (92.9)	13 (86.7)	34 (91.9)
**Race*, ** **	Black	11 (19.0)	40 (51.3)	9 (20.9)	17 (40.5)	2 (13.3)	23 (62.2)
	Coloured	31 (53.4)	34 (43.6)	20 (46.5)	21 (50.0)	11 (73.3)	13 (35.1)
	White	16 (28.0)	4 (5.1)	14 (32.6)	4 (9.5)	2 (13.3)	0 (0)
Marital status	Married	30 (51.7)	42 (53.8)	24 (55.8)	25 (59.5)	6 (40.0)	17 (45.9)
	Divorced	4 (6.9)	7 (9.0)	2 (4.7)	4 (9.5)	2 (13.3)	3 (8.1)
	Single	22 (37.9)	24 (30.8)	16 (37.2)	9 (21.4)	6 (40.0)	15 (40.5)
	Widowed	2 (3.4)	5 (6.4)	1 (2.3)	4 (9.5)	1 (6.7)	1 (2.7)
Smoker	Yes	6 (10.3)	5 (6.5)	4 (9.3)	3 (7.1)	2 (13.3)	2 (5.4)
	No	52 (89.7)	72 (93.5)	39 (90.7)	38 (90.5)	13 (86.7)	34 (91.9)
LSM Category* **	6 - 7	3 (5.2)	15 (19.0)	3 (7.0)	8 (19.0)	0 (0)	7 (18.9)
	8 -10	55 (94.8)	64 (81.0)	40 (93.0)	34 (81.0)	15 (100)	30 (81.1)

IQR: interquartile range; LSM: Living Standards Measure

Significantly different results are presented in red font

* Baseline total group and study completer sub-group: Intervention group significantly more likely to include black than white educators than the control group (Pearson's Chi Square p<0.001, p=0.018, respectively).

** Study drop-out sub-group: Intervention group significantly more likely to include black than coloured educators than the control group (Pearson's Chi Square p=0.001); intervention group significantly more likely to include black than coloured educators than the intervention completers within the study completer sub-group (Pearson's Chi Square p=0.042).

*** Baseline total group: Intervention group significantly more likely to include educators in the 6-7 LSM category than the control group (Pearson's Chi Square p=0.018).

The majority of educators in both the intervention and control groups within the total baseline group, as well as within the study completer and drop-out sub-groups reported that they did not have hypertension, heart disease, stroke, hypercholesterolemia or diabetes (Table 4.8). In keeping with this, the majority in both the control and intervention groups within the mentioned groupings reported that they were not taking any prescribed medication for hypertension, hypercholesterolemia, or diabetes. The intervention group within the study completer sub-group was significantly more likely to include educators who had hypercholesterolemia than the intervention group in the study drop-out group (Table 4.8).

The intervention groups within the total baseline group, as well as within the study completer sub-group were significantly more likely to include educators who had not attempted weight loss before when compared to the control groups in the total baseline group and study completer group. In addition, the intervention group within the study completer sub-group was significantly more likely to include educators who had not tried to lose weight previously than the intervention group within the study drop-out sub-group (Table 4.8).

The majority of educators in both the intervention and control groups within the total baseline group, as well as within the study completer and study drop-out sub-groups fell in the “minimally depressed” category and their median blood pressure was in the normal blood pressure range of below 140mmHg/90mmHg (Table 4.8).

There were no further significant differences between intervention and control groups within the total baseline groups nor in the study completer and study drop-out sub-groups. There were also no significant differences between the intervention group in the study-completer and the intervention group in the study drop-out group; the same is true for the control groups.

Table 4.8: Reported baseline health indicators of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicators	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Intervention	Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Awareness of following conditions							
Hypertension	Yes	16 (27.6)	18 (23.1)	12 (27.9)	10 (23.8)	4 (26.7)	8 (21.60
	No	37 (63.8)	54 (69.2)	29 (67.4)	30 (71.4)	8 (53.3)	24 (64.9)
	Not sure	5 (8.6)	6 (7.7)	2 (4.7)	2 (4.8)	3 (20.0)	4 (10.8)
Heart disease	Yes	1 (1.8)	2 (2.6)	1 (2.3)	2 (4.8)	0 (0)	0 (0)
	No	50 (89.3)	69 (89.6)	37 (86.0)	38 (90.5)	13 (86.7)	31 (83.8)
	Not sure	5 (8.9)	6 (7.8)	3 (7.0)	1 (2.4)	2 (13.3)	5 (13.5)

Stroke	Yes	0 (0)	5 (6.7)	0 (0)	3 (7.1)	0 (0)	2 (5.4)
	No	49 (90.7)	68 (89.5)	36 (83.7)	37 (88.1)	13 (86.7)	31 (83.8)
	Not sure	5 (9.3)	3 (3.9)	3 (7.0)	0 (0)	2 (13.3)	3 (8.1)
Hypercholestrolemia *	Yes	8 (14.8)	10 (13.0)	7 (16.3)	9 (21.4)	1 (6.7)	1 (2.7)
	No	38 (70.4)	56 (72.7)	26 (60.5)	25 (59.5)	12 (80.0)	31 (83.8)
	Not sure	8 (14.8)	11 (14.3)	6 (14.0)	6 (14.3)	2 (13.3)	5 (13.5)
Diabetes	Yes	5 (9.1)	7 (9.0)	3 (7.0)	4 (9.5)	2 (13.3)	3 (8.1)
	No	46 (83.6)	64 (82.1)	34 (79.1)	35 (83.3)	12 (80.0)	29 (78.4)
	Not sure	4 (7.3)	7 (9.0)	3 (7.0)	3 (7.1)	1 (6.7)	4 (10.8)
Prescribed medication							
Hypertension	Yes	17 (29.8)	15 (19.2)	13 (30.2)	7 (16.6)	4 (26.7)	8 (21.6)
	No	40 (70.2)	62 (79.5)	30 (70.0)	34 (90.9)	10 (66.7)	28 (75.7)
	Not sure	0 (0)	1 (1.3)	0 (0)	1 (2.4)	0 (0)	0 (0)
Hypercholestrolemia	Yes	9 (16.7)	6 (7.7)	7 (16.3)	4 (9.5)	2 (13.3)	2 (5.4)
	No	44 (81.5)	71 (91.0)	32 (74.4)	37 (88.1)	12 (80.0)	34 (91.9)
	Not sure	1 (1.9)	1 (1.3)	0 (0)	0 (0)	1 (6.7)	1 (2.7)
Diabetes	Yes	5 (9.1)	6 (7.7)	3 (7.0)	3 (7.1)	2 (13.3)	3 (8.3)
	No	49 (89.1)	71 (91.0)	37 (86.0)	39 (92.9)	12 (80.0)	32 (88.9)
	Not sure	1 (1.8)	1 (1.3)	0 (0)	0 (0)	1 (6.7)	1 (2.8)
Previously tried to lose weight **,*							
	Yes	34 (58.6)	31 (39.2)	26 (60.5)	12 (28.6)	8 (53.3)	19 (51.4)
	No	21 (36.2)	48 (60.8)	16 (37.2)	30 (71.4)	5 (33.3)	18 (48.6)
	Not sure	3 (5.2)	0 (0)	1 (2.3)	0 (0)	2 (13.3)	0 (0)
Depression Category							
	Minimal depression	41 (70.7)	48 (60.8)	30 (69.8)	25 (59.6)	11 (73.3)	23 (62.2)
	Mild depression	13 (22.4)	17 (21.5)	10 (23.3)	10 (23.8)	3 (20.0)	7 (19.0)
	Moderate depression	2 (3.4)	10 (12.7)	2 (4.7)	6 (14.3)	0 (0)	4 (10.8)
	Severe depression	2 (3.4)	4 (5.1)	1 (2.3)	1 (2.4)	1 (6.7)	3 (8.1)
Measured blood pressure		**Median (IQR) N=58**	**Median (IQR) N=79**	**Median (IQR) N=43**	**Median (IQR) N=42**	**Median (IQR) N=15**	**Median (IQR) N=37**
	Systolic (mmHg)	117.5 (102.5-164.0)	118.5 (92.0-184.5)	117.0 (106.0-164.0)	122.5 (92.0-184.5)	123.5 (102.5-150.5	118.5 (96.5-171.0)
	Diastolic (mmHg)	84.3 (69.0-108.5)	84.5 (60.5-120.5)	83.0 (69.0-108.5)	85.8 (60.5-120.5)	87.0 (71.0-104.5)	84.5 (66.0-118.5)
Blood pressure categories		**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**

	Systolic hypertension (≥140 mmHg)	7 (12.1)	14 (17.7)	4 (9.3)	9 (21.4)	3 (20.0)	5 (13.5)
	Diastolic hypertension (≥90mmHg)	19 (32.8)	23 (29.1)	13 (30.2)	14 (33.3)	6 (40.0)	8 (21.6)
	Essential hypertension (≥140/90mm Hg)	6 (10.3)	11 (13.9)	4 (9.3)	7 (16.4)	2 (13.3)	4 (10.8)

IQR: Interquartile range; mmHg: Millilitres mercury

Significantly different results are presented in red font

* Intervention group: Study completer sub-group significantly more likely to include educators who reported they suffered from hypercholesterolemia than the study drop-out sub-group (Pearson's Chi Square p=0.030).

**Baseline total group and study completer sub-group: Intervention group significantly more likely to include educators who previously did not try to lose weight than the control groups (Pearson's Chi Square p=0.005, p=0.005, respectively).

***Intervention group: Completer sub-group significantly more likely to include educators who previously did not try to lose weight than the study drop-out sub-group (Person's Chi Square p=0.039).

Baseline anthropometric profile

Approximately a quarter of educators in the total baseline group, as well as study completer and study drop-out subgroups were categorised as pre-obese; in the intervention groups this was less than a fifth. However, there were no significant differences between the intervention and control groups in the total baseline group nor in the study completer and study drop-out sub-groups. The balance in each group was either obese class I or class II (Table 4.9).

The waist circumference of the majority of educators in the intervention and control groups in the total baseline group, as well as the study completer and study drop-out sub-groups exceeded the cut-off for health (Table 4.9).

There were no significant differences between intervention and control groups for anthropometric indicators other than height within the total baseline group, nor in the study completer and study drop-out subgroups. There were also no significant differences between the intervention group in the study-completer and the intervention group in the study drop-out group for these indicators; the same is true for the control groups in these two sub-groups (Table 4.9).

Table 4.9: Baseline anthropometric measures of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicator	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Intervention	Control	Intervention	Control	Intervention
		Median (IQR) n = 58	Median (IQR) n = 79	Median (IQR) n = 43	Median (IQR) n = 42	Median (IQR) n = 15	Median (IQR) n = 37

Height (m)*		1.64 (1.48-1.95)	1.60 (1.43-1.74)	1.64 (1.48-1.95)	1.60 (1.43-1.74)	1.64 (1.52-1.79)	1.59 (1.48-1.74)
Weight (kg)		88.6 (66.1-148.7)	92.5 (64.7-146.4)	86.8 (72.5-148.7)	93.8 (64.7-146.4)	94.2 (66.1-132.5)	90.4 (70.1-120.3)
BMI (kg/m^2)		32.2 (27.1-54.3)	35.0 (27.6-54.1)	32.2 (27.1-54.3)	34.9 (27.6-54.1)	35.9 (28.4-48.7)	35.4 (28.0-46.4)
Waist circumference (cm)		99.5 (82.1-143.3)	101.0 (76.0-132.3)	99.8 (82.2-143.3)	101.0 (76.8-130.5)	98.0 (82.1-124.0)	101.5 (76.0-132.3)
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
BMI categories	Pre-obese	14 (24.1%)	11 (13.9%)	10 (23.3%)	6 (14.3%)	4 (26.7%)	6 (16.2%)
	Obese Class I	22 (37.9%)	27 (34.2%)	19 (44.2%)	15 (35.7%)	3 (20.0%)	12 (32.4%)
	Obese Class II	10 (17.2%)	23 (29.1%)	5 (11.6%)	11 (26.2%)	5 (33.3%)	12 (32.4%)
	Obese Class III	12 (20.7%)	18 (22.8%)	9 (20.9%)	10 (23.8%)	3 (20.0%)	7 (18.9%)
Waist circumference categories (cm)	Men ≥102cm Women ≥ 88cm	51 (87.9%)	71 (89.9%)	36 (83.7%)	36 (85.7%)	34 (91.9%)	35 (81.4%)

IQR: Interquartile range; cm: centimetres

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*Baseline total group and study completer sub-group: Intervention group significantly shorter than the control group (Mann -Whitney U test p=0.004 and p=0.023, respectively).

There were no significant differences between reported and measured weight within the intervention groups nor within the control groups in the total baseline group and in the study completer and drop-out sub-groups (Table 4.10).

Table 4.10: Reported weight versus measured weight of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups *

Indicators		**Baseline total group**		**Baseline study completer sub-group**		**Baseline study drop-out sub-group**	
Weight		**n**	**Median (IQR)**	**n**	**Median (IQR)**	**n**	**Median (IQR)**
Reported weight (kg)	Control	35	90.0 (68.0-140.0)	25	90.0 (68.0-140.0)	10	93.5 (76.0-120.0)
	Intervention	35	92.0 (60.0-145.0)	20	94.7 (60.0-145.0)	15	86.0 (70.0-116.6)
Actual Weight (kg)	Control	58	88.6 (66.1-148.7)	43	86.8 (72.5-148.7)	15	94.2 (66.1-132.5)
	Intervention	79	92.5 (64.7-146.4)	42	93.8 (64.7-146.4)	37	90.4 (70.1-120.3)

IQR: Interquartile range; kg=kilogram

*No significant differences between reported and measured weight were found within the intervention nor within the control group between any of the groupings (Mann Whitney U test)

Baseline physical activity profile

The majority of educators in the intervention and control groups within the total baseline group, as well as the study completer and study drop-out sub-groups did not meet the recommended total physical activity of 600 Metabolic Equivalent (MET) minutes per week (Table 4.11). Time spent being

sedentary was significantly lower in the intervention than in the control group within the total baseline group, as well as within the study drop-out sub-group. The intervention group within the study completer sub-group spent significantly more time being sedentary than the intervention group in the study drop-out sub-group (Table 4.11).

There were no further significant differences between intervention and control groups within the total baseline groups nor in the study completer and study drop-out subgroups. There were also no further significant differences between the intervention group in the study-completer and the intervention group in the study drop-out groups for these indicators; the same is true for the control groups in these sub-groups (Table 4.11).

Table 4.11: Baseline physical activity indicators of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicators	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Intervention	Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
MET min/week ≥600	Yes	22 (44.0)	27 (37.0)	16 (48.5)	11 (30.6)	5 (33.3)	16 (47.1)
	No	28 (56.0)	46 (63.1)	17 (51.5)	25 (69.4)	10 (66.7)	18 (52.9)
		Median (IQR) n=50	Median (IQR) n=73	Median (IQR) n=33	Median (IQR) n=36	Median (IQR) n=15	Median (IQR) n=34
Total MET min/week		160.0 (0.0-11280.0)	280.0 (0.0-18000.0)	300.0 (0.0-11280.0)	0.0 (0.0-8400)	0.0 (0.0-8640.0	450.0 (0.0-18000.0)
Sedentary time min/day *,**		240.0 (0.0-900.0)	150.0 (0.0-840.0)	240.0 (60.0-900.0)	180.0 (20.0-840.0)	180.0 (0.0-720.0)	120.0 (0.0-480.0)

MET: Metabolic Equivalent; min: minutes; IQR: Interquartile range

Significantly different results are presented in red font

*Baseline total group and drop-out sub-group: Intervention group significantly less sedentary than the control group (Mann -Whitney U test p=0.008; p=0.046, respectively).

**Intervention group: Study completer sub-group significantly more sedentary than the study drop-out sub-group (Mann-Whitney U test p=0.026).

Baseline food choice profile

The median frequency of intake of low-fat food items was less than once a day for the intervention and control groups within the total baseline group, as well as within the study completer and study drop-out sub-groups (Table 4.12). The median frequency of intake of high fat food items was three or more times a day for the intervention and control groups within the total baseline group, as well as the study completer and study drop-out sub-groups. The median frequency of intake of sugary food items ranged from once to twice a day for the intervention and control groups within the total baseline group, as well as the study completer and study drop-out sub-groups (Table 4.12).

The median frequency of intake of fibre-rich carbohydrates, refined carbohydrates and alcohol was less than once daily in all the groupings investigated. The median frequency of intake of fruit items was once a day and of vegetable items between once and twice a day in all the groupings investigated (Table 4.12).

The intervention group within the total baseline group, as well as within the study completer sub-group, added fat to food significantly more frequently than the control group. The intervention group within the total baseline group added sugar to food significantly more frequently than the control group (Table 4.12).

There were no further significant differences between intervention and control groups within the total baseline groups nor in the study completer and study drop-out subgroups. There were also no significant differences between the intervention group in the study-completer and the intervention group in the study drop-out group for these indicators; the same is true for the control groups (Table 4.12).

Table 4.12: Baseline food choices of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Food groups		Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		n	Median (IQR)	n	Median (IQR)	n	Median (IQR)
Low fat food items/day	Control	58	0.8 (0.0-4.7)	43	0.8 (0.0-3.9)	15	0.8 (0.0-2.3)
	Intervention	79	0.7 (0.0-9.8)	42	0.9 (0.0-5.2)	37	0.7 (0.0-9.8)
High fat food items/day	Control	58	2.8 (0.4-9.1)	43	3.1 (0.6-9.1)	15	3.4 (0.6-6.5)
	Intervention	79	2.9 (0.2-10.6)	42	3.2 (0.8-9.0)	37	3.2 (0.8-9.7)
Sugary food items/day	Control	58	1.5 (0.0-6.2)	43	1.7 (0.0-4.9)	15	2.1 (0.0-4.9)
	Intervention	79	1.6 (0.0-15.5)	42	1.9 (0.0-8.7)	37	1.7 (0.2-8.7)
Fiber-rich carbohydrates/ day	Control	58	0.2 (0.0-4.0)	43	0.4 (0.0-4.0)	15	0.7 (0.0-3.0)
	Intervention	79	0.4 (0.0-4.0)	42	0.4 (0.0-1.5)	37	0.4 (0.0-4.0)
Refined carbohydrates/ day	Control	58	0.0 (0.0-3.0)	43	0.0 (0.0-3.0)	15	0.0 (0.0-3.0)
	Intervention	79	0.0 (0.0-4.0)	42	0.2 (0.0-4.0)	37	0.2 (0.0-4.0)
Fruit items/day	Control	58	0.8 (0.0-6.0)	43	1.0 (0.0-6.0)	15	0.4 (0.0-3.5)
	Intervention	79	1.0 (0.0-4.5)	42	1.0 (0.0-4.5)	37	1.0 (0.0-4.5)
Vegetable items/ day	Control	58	1.6 (0.0-6.0)	43	1.6 (0.0-4.7)	15	1.6 (0.4-4.7)
	Intervention	79	1.4 (0.0-7.0)	42	1.4 (0.0-3.3)	37	1.5 (0.2-4.0)
ETOH items/ day	Control	58	0.0 (0.0-1.0)	43	0.0 (0.0-1.0)	15	0.0 (0.0-1.0)
	Intervention	79	0.0 (0.0-4.0)	42	0.0 (0.0-4.0)	37	0.0 (0.0-4.0)
Fat added to food/day*	Control	58	1.0 (0.0-4.0)	43	1.0 (0.0-4.0)	15	1.0 (0.4-2.1)
	Intervention	79	1.4 (0.0-7.2)	42	1.5 (0.2-7.0)	37	1.5 (0.2-6.3)
	Control	58	0.9 (0.0-4.2)	43	1.0 (0.0-4.2)	15	1.0 (0.0-4.2)

Sugar added to food/day**	Intervention	79	1.4 (0.0-9.0)	42	1.5 (0.0-6.2)	37	1.5 (0.0-6.2)

IQR: Interquartile range

Low fat food items: Low fat red meat, chicken without skin, low fat milk/sour milk/yoghurt, fat free/low fat cheese/cheese spreads and low fat salad dressing/mayonnaise; **High fat food items**: High fat read meat, processed meats, tinned meats, chicken with skin, organ meats, full cream milk/sour milk/yoghurt, full fat cheese, peanut butter/peanuts, full fat salad dressing/mayonnaise, pies/sausage rolls/samosas, crisps, crackers, take-outs, roasted or fried potatoes or chips, other fried food, margarine/butter on bread, margarine/butter in porridge and margarine/butter/oil added to vegetables; **Sugary food items**: chocolates, sweets, cakes/biscuits/doughnuts, juice nectar, juice other, canned fruit or stewed fruit, fizzy drinks, energy drinks, milky drinks, jam/marmalade/chutney, sugar/honey in tea/coffee, sugar/honey on cereal/porridge, and sugar/suryp added to vegetables; **Fiber-rich carbohydrates**: legumes and bread/rolls bown/wholewheat; **Refined carbohydrates**: bread/rolls white; **Fruit items:** Oranges/naartjies, any other fruit items apples/pears/bananas, dried fruit; **Vegetable items**: Orange/yellow vegetables, green vegetables, mixed vegetables, cabbage/cauliflower/lettuce/cucumber, salad and tomato; **ETOH items**: Alcoholic coolers and spirits/brandy/vodka with mixer.

Significantly different results are presented in red font

*Baseline total group and study completer sub-group: Intervention group added fat to food significantly more frequently than the control group (Mann-Whitney U test p=0.023, and p=0.018, respectively).

**Baseline total group: Intervention group added sugar to food significantly more frequently than the control group (Mann-Whitney U test p=0.008).

Baseline weight loss readiness to change profile

For the behaviours “increase fruit intake”, “increase vegetable intake” and “decrease fat intake”, at least 65% of the control and intervention groups within the total baseline group and study completer and study drop-out sub-groups were either “thinking about change in the next 6 months”, “currently attempting change” or “changed behaviour and attempting to maintain change” (Table 4.13). The intervention group within the total baseline group and within the study completer sub-group was significantly more likely to be “attempting change currently” for the behaviour “decrease sugar intake” than the control group. The intervention group within the study drop-out sub-group was significantly more likely to be “attempting change currently” for the behaviour “Increase physical activity” than the control group. There were no further significant differences between intervention and control groups within the total baseline groups nor in the study completer or study drop-out subgroups (Table 4.13).

Table 4.13: Baseline weight loss readiness to change of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicators	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Interven-tion	Control	Interven-tion	Control	Interven-tion
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Increase fruit intake	No plans to change for the next 6 months	6 (10.3)	4 (5.1)	5 (11.6)	2 (4.8)	1 (6.7)	2 (5.4)
	Thinking about changing in the next 6 months	9 (15.5)	11 (13.9)	9 (20.9)	7 (16.7)	0 (0)	4 (10.8)
	Thinking about changing in the next month	16 (27.6)	19 (24.1)	10 (23.3)	13 (31.0)	6 (40.0)	6 (16.2)

	Attempting change currently	15 (25.9)	31 (39.2)	10 (23.3)	14 (33.3)	5 (33.3)	17 (45.9)
	Changed behaviour and attempting to maintain change	12 (20.7)	14 (17.7)	9 (20.9)	6 (14.3)	3 (20.0)	8 (21.6)
Increase vegetable intake	No plans to change for the next 6 months	5 (8.6)	3 (3.8)	3 (7.0)	1 (2.4)	2 (13.3)	2 (5.4)
	Thinking about changing in the next 6 months	10 (17.2)	7 (8.9)	10 (23.3)	3 (7.1)	0 (0)	4 (10.8)
	Thinking about changing in the next month	14 (24.1)	16 (20.3)	10 (23.3)	11 (26.2)	4 (26.7)	5 (13.5)
	Attempting change currently	16 (27.6)	38 (48.1)	11 (25.6)	18 (42.9)	5 (33.3)	20 (54.1)
	Changed behaviour and attempting to maintain change	13 (22.4)	15 (19.0)	9 (20.9)	9 (21.4)	4 (26.7)	6 (16.2)
Decrease fat intake	No plans to change for the next 6 months	3 (5.2)	4 (5.2)	2 (4.7)	3 (7.3)	1 (6.7)	1 (2.8)
	Thinking about changing in the next 6 months	12 (20.7)	11 (14.3)	11 (25.6)	6 (14.6)	1 (6.7)	5 (13.9)
	Thinking about changing in the next month	13 (22.4)	17 (22.1)	10 (23.3)	9 (22.0)	3 (20.0)	8 (22.2)
	Attempting change currently	20 (34.5)	37 (48.1)	12 (27.9)	19 (46.3)	8 (53.3)	18 (50.0)
	Changed behaviour and attempting to maintain change	10 (17.2)	8 (10.4)	8 (18.6)	4 (9.8)	2 (13.3)	4 (11.1)
Decrease sugar intake*	No plans to change for the next 6 months	4 (7.0)	4 (5.1)	3 (7.0)	3 (7.1)	1 (7.1)	1 (2.8)
	Thinking about changing in the next 6 months	10 (17.5)	10 (12.8)	10 (23.3)	5 (11.9)	0 (0)	5 (13.9)
	Thinking about changing in the next month	11 (19.3)	11 (14.1)	8 (18.6)	5 (11.9)	3 (21.4)	6 (16.7)
	Attempting change currently	16 (28.1)	46 (59.0)	10 (23.3)	26 (61.9)	6 (42.9)	20 (55.6)
	Changed behaviour and attempting to maintain change	16 (28.1)	7 (9.0)	12 (27.9)	3 (7.1)	4 (28.6)	4 (11.1)
Increase physical activity **	No plans to change for the next 6 months	4 (6.9)	4 (5.1)	1 (2.3)	4 (9.5)	3 (20.0)	0 (0)
	Thinking about changing in the next 6 months	12 (20.7)	11 (14.1)	12 (27.9)	4 (9.5)	0 (0)	7 (19.4)
	Thinking about changing in the next month	19 (32.8)	21 (26.9)	13 (30.2)	13 (31.0)	6 (40.0)	8 (22.2)
	Attempting change currently	17 (29.3)	32 (41.0)	13 (30.2)	17 (40.4)	4 (26.7)	15 (41.7)
	Changed behaviour and attempting to maintain change	6 (10.3)	10 (12.8)	4 (9.3)	4 (9.5)	2 (13.3)	6 (16.7)

Significantly different results are presented in red font

*Baseline total group and study completer sub-group: Intervention group significantly more likely to be “attempting change currently” for the behaviour “decrease sugar intake” than the control group (Pearson’s Chi Square Test: p=0.004, p=0.005, respectively).

**Study drop-out sub-group: Intervention group significantly more likely to be “attempting change currently” for the behaviour “Increase physical activity” than the control group (Pearson’s Chi Square Test p=0.017).

Baseline nutrition knowledge profile

The mean nutrition knowledge score in was approximately 10 out of 20 (50%) for the intervention and control groups within the total baseline group, as well as within the study completer and study drop-out sub-groups. There were no significant differences between intervention and control groups within the total baseline group nor in the study completer and study drop-out subgroups for nutrition knowledge. There were also no significant differences between the intervention group in the study-completer and the intervention group in the study drop-out group; the same is true for the control groups (Table 4.14).

Table 4.14: Nutrition knowledge scores of the intervention and control groups in the total baseline groups and the study completer and study drop-out sub-groups *

Indicator		Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		n	Mean±SD (%)	n	Mean±SD (%)	n	Mean±SD (%)
Nutrition knowledge score (out of 20)	Control	58	10.57±2.71 (52.84±13.54)	43	10.74±2.42 (53.72±12.11)	15	10.07±3.45 (50.33±17.27)
	Intervention	79	9.90±2.77 (49.50±13.83)	42	9.69±2.57 (48.45±12.85)	37	10.14±2.99 50.68±14.96)

SD: standard deviation

* No significant difference between control and intervention groups within the total baseline group and the baseline study completer or study drop-out sub-group (Students t-test). Also, no differences between the intervention group in the study-completer and the intervention group in the study drop-out group; the same is true for the control groups (Students t-test).

Baseline body size perception profile

At least 70% of educators in the control and intervention groups within the total baseline group, as well as the study completer and study drop-out sub-groups correctly identified themselves as either overweight or obese. There were no significant differences between the control and intervention groups within the total baseline group, study completer sub-group or study drop-out sub-group for perception of body size (Table 4.15).

Table 4.15: Baseline body size perception of the intervention and control groups in the total baseline groups and the study completer and study drop-out sub-groups*

Indicator	Category	Baseline total group		Baseline study completer sub-group		Baseline study drop-out sub-group	
		Control	Intervention	Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)

Body size perception category	Underweight	1 (1.7)	2 (2.5)	1 (2.3)	2 (4.8)	0 (0)	0 (0)
	Normal weight	9 (15.5)	15 (19.0)	6 (14.0)	7 (16.7)	3 (20.0)	8 (21.6)
	Overweight	39 (67.2)	53 (67.1)	31 (72.1)	27 (64.3)	8 (53.3)	26 (70.3)
	Obese	9 (15.5)	9 (11.4)	5 (11.6)	6 (14.3)	4 (26.7)	3 (8.1)

*No significant difference between control and intervention groups within the total baseline group and study completer sub-group or study drop-out sub-group (Pearson's Chi Square Test). Also, no differences between the intervention group in the study-completer and the intervention group in the study drop-out group; the same is true for the control groups (Pearson's Chi Square Test).

C. Change from baseline to 16-week follow-up in secondary outcome variables

Potential impact analyses (secondary feasibility outcomes) were conducted by protocol, thus including only the study completer intervention group (referred to as the intervention group in the results) and study completer control group (referred to as the control group in the results). Results are firstly presented for the comparison between the intervention and control groups at baseline and 16-week follow-up, then for change within each of the two groups from baseline to 16-week follow-up, and then the comparison of change within the intervention group and within the control group between the two groups. Significant results are marked with a red asterisk next to the variable/indicator title and the relevant results presented in red font in the table. Detail of the statistical tests and p-values are given in the footnotes to tables and interpreted in the text.

Anthropometric measures and blood pressure

There were no significant differences between the intervention and control groups at baseline or 16-week follow-up for any of the anthropometric measures. There were also no significant changes within the intervention and control groups from baseline to 16-week follow-up for these variables. Moreover, there were no significant differences between the intervention and control groups for within group change from baseline to 16-week follow-up for these measures. However, there was a strong trend for the intervention group to have lost weight (Wilcoxin matched pairs test: p=0.093) and have a reduced BMI (Wilcoxin matched pairs test: p=0.086), which was not evident in the control group. Wilcoxin matched pairs test: p=0.299 and 0.320, respectively) (Table 4.16).

There were no significant differences between the intervention and control groups at baseline or 16-week follow-up for any blood pressure variables. There were also no significant differences at baseline or follow-up between the intervention and control groups for percentage of educators with high systolic or diastolic blood pressure. The median systolic blood pressure increased significantly from baseline to 16-week follow-up in both the control and intervention groups (Table 4.16).

Table 4.16: Change in anthropometric and blood pressure measures in the intervention and control groups from baseline to 16-week follow-up

Indicator	Category	Baseline		16-week follow-up		Follow-up – baseline (within group change over time)	
		Control	Intervention	Control	Intervention	Control	Intervention
		Median (IQR) n = 43	Median (IQR) n = 42	Median (IQR) n = 43	Median (IQR) n = 42	Median (IQR) n = 43	Median (IQR) n = 42
Anthropometry							
Height (m)		1.64 (1.48-1.95)	1.60 (1.43-1.74)	N/A			
Weight (kg)**		86.8 (72.5-148.7)	93.8 (64.7-146.4)	87.5 (72.6-147.0)	93.5 (64.0-145.4)	-0.50(-13.35-6.00)	-0.51 (-3.82-3.78)
BMI kg/m²**		32.2 (27.1-54.3)	34.9 (27.6-54.1)	32.4 (26.9-54.6)	34.9 (27.6-54.3)	-0.19 (-4.50-2.63)	-0.21 (-1.70-1.49)
Waist circumference (cm)		99.8 (82.2-143.3)	101.0 (76.8-130.5)	98.5 (81.4-144.5)	103.0 (80.6-135.3)	-1.15 (-11.20 -14.50)	-0.58 (-12.85 - 13.25)
Blood pressure	Systolic (mmHg)*	117.0 (106.0-164.0)	122.5 (92.0-184.5)	126.0 (102.0-193.5)	126.3 (100.5-192.0)	10.00 (-26.50 -50.50)	8.00 (-17.50-49.50)
	Diastolic (mmHg)	83.0 (69.0-108.5)	85.7 (60.5-120.5)	86.0 (65.0-119.0)	84.8 (66.5-119.5)	1.00 (-20.00-25.50)	1.75 (-25.50-22.00)
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
BMI categories	Pre-obese	14 (24.1%)	11 (13.9%)	8 (18.6%)	5 (11.9%)	N/A	
	Obese Class I	22 (37.9%)	27 (34.2%)	21 (48.8%)	16 (38.1%)		
	Obese Class II	10 (17.2%)	23 (29.1%)	6 (14.0%)	11 (26.2%)		
	Obese Class III	12 (20.7%)	18 (22.8%)	8 (18.6%)	10 (23.8%)		
Waist circumference categories (cm)	Men ≥102cm Women ≥ 88cm	51 (87.9%)	71 (89.9%0	35 (81.4%)	37 (88.1%)		
Blood pressure categories	Systolic hypertension (≥140 mmHg)	4 (9.3)	9 (21.4)	10 (23.3)	10 (23.8)		
	Diastolic hypertension (≥90mmHg)	13 (30.2)	14 (33.3)	16 (37.2)	15 (35.7)		
	Essential hypertension (≥140/90mmHg)	4 (9.3%)	7 (16.7%)	6 (14.0%)	8 (19.0%)		

IQR: Interquartile range; cm: centimetres; kg/m²: kilograms per square metre; mmHg: millimetres mercury, N/A: not applicable

Significantly different results indicated are presented in red font, trend towards a difference results are presented in green font

* Significant increase in systolic blood pressure in intervention and control groups: from baseline to 16-week follow-up (Wilcoxin matched pairs test: p=0.009; p<0.001 respectively).

**Strong trend for the intervention group to have lost weight (Wilcoxin matched pairs test: 0,093) and have a reduced BMI (Wilcoxin matched pairs test: p=0.086) from baseline to 16-week follow-up.

Physical activity and time spent being sedentary

There were no significant differences between the intervention and control groups at baseline or 16-week follow-up for total MET minutes per week or moderate recreational MET minutes per week. However, there was a significant increase in moderate recreational MET minutes per week from baseline to 16-week follow-up within the intervention group (Table 4.17). The majority of educators in both the intervention and the control groups did not meet the required 600 MET minutes per week at baseline or 16-week follow-up.

There was no significant difference at baseline between the intervention and control groups for time per week spent being sedentary. However, although there was no significant within group change in time spent being sedentary in either the intervention or control group over the intervention period, at 16-week follow-up the intervention group spent significantly less time being sedentary than the control group.

Table 4.17: Change in physical activity and time spent being sedentary in the intervention and control groups from baseline to 16-week follow-up

Indicators	Baseline		16-week follow-up		Follow-up – baseline (within group change over time)	
	Control	Intervention	Control	Intervention	Control	Intervention
	N (%)	n (%)	n (%)	n (%)	NA	
MET minutes ≥600/week	16 (48.5)	11 (30.6)	15 (45.5)	13 (36.1)		
	Median (IQR) n=33	Median (IQR) n=36	Median (IQR) n=33	Median (IQR) n=36	Median (IQR) n=33	Median (IQR) n=36
Total MET min/week	300.0 (0.0-11280.0)	0.0 (0.0-8400)	240.0 (0.0-19200.0)	340.0 (0.0-18840.0)	0.0 (-8400.0-8400.0)	0.0 (-8400.0-18840.0)
Sedentary time min/day *	240.0 (60.0-900.0)	180.0 (20.0-840.0)	300.0 (0.0-720.0)	180.0 (10.0-480.0)	0.0 (-540.0-330.0)	0.0 (-360.0-360.0)
Moderate recreational MET min/week**	0.0 (0.0-1920.0)	0.0 (0.0-240.0)	0.0 (0.0-1440.0)	0.0 (0.0-2000.0)	0.0 (-600.0-840.0)	0.0 (0.0-2000.0)

MET: Metabolic Equivalent; min: minutes; IQR: Interquartile range; N/A: not applicable

Significantly different results are presented in red font

*At 16-week follow-up, the intervention group spent significantly less time being sedentary than the control group (Mann-Whitney U test p=0.043).

**Significant increase in moderate recreational MET minutes per week within the intervention group from baseline to 16 -week follow-up (Wilcoxin matched pairs test, p=0.003).

Food choices

There were no significant differences between the intervention and control groups for frequency of intake of any of the investigated food groups at baseline or 16-week follow-up. However, there were significant increases in frequency of intake of low-fat food items, as well as vegetables within both the intervention and control groups from baseline to 16-weeks follow-up. There were no significant within group changes for frequency of intake of high fat food items, fruit, fibre-rich carbohydrates and refined carbohydrates (Table 4.18).

There was a significant decrease in the frequency of consumption of sugary food items, the frequency of adding fat to foods and the frequency of adding sugar to foods within the intervention group, but not within the control group, from baseline to 16-week follow-up (Table 4.18).

Table 4.18: Change in dietary indicators in the intervention and control groups from baseline to 16-week follow-up

Food groups		Baseline		16-week follow-up		Follow-up – baseline (within group change over time)	
		N	Median (IQR)	N	Median (IQR)	N	Median (IQR)
Low fat food items/day*	Control	43	0.8 (0.0-3.9)	43	1.2 (0.0-15.0)	43	0.6 (-1.5-12.8)
	Intervention	42	0.9 (0.0-5.2)	42	1.3 (0.2-6.8)	42	0.4 (-1.5-5.0)
High fat food items/day	Control	43	3.1 (0.6-9.1)	43	2.7 (0.0-9.8)	43	-0.5 (-5.9-8.3)
	Intervention	42	3.2 (0.8-9.0)	42	2.8 (1.0-11.3)	42	0.1 (-7.3-7.2)
Sugary food items/day**	Control	43	1.7 (0.0-4.9)	43	1.5 (0.0-4.0)	43	-0.2 (-3.0-2.6)
	Intervention	42	1.9 (0.0-8.7)	42	1.6 (0.2-4.3)	42	-0.2 (-7.4-1.0)
Fiber-rich carbohydrates/day	Control	43	0.4 (0.0-4.0)	43	0.2 (0.0-1.8)	43	0.0 (-4.0-0.7)
	Intervention	42	0.4 (0.0-1.5)	42	0.4 (0.0-3.2)	42	0.0 (-1.1-1.8)
Refined carbohydrates/day	Control	43	0.0 (0.0-3.0)	43	0.2 (0.0-4.0)	43	0.0 (-3.0-4.0)
	Intervention	42	0.2 (0.0-4.0)	42	0.2 (0.0-2.0)	42	0.0 (-3.5-1.8)
Fruit items/day	Control	43	1.0 (0.0-6.0)	43	0.7 (0.0-4.8)	43	-0.1 (-3.0-2.0)
	Intervention	42	1.0 (0.0-4.5)	42	1.0 (0.0-4.0)	42	0.0 (-3.0-2.2)
Vegetable items/ day***	Control	43	1.6 (0.0-4.7)	43	1.8 (0.2-8.0)	43	0.4 (-2.9-4.6)
	Intervention	42	1.4 (0.0-3.3)	42	1.9 (0.4-10.5)	42	0.7 (-1.4-7.8)
ETOH items/ day	Control	43	0.0 (0.0-1.0)	43	0.0 (0.0-0.8)	43	0.0 (-0.6-0.4)
	Intervention	42	0.0 (0.0-4.0)	42	0.0 (0.0-4.0)	42	0.0 (-3.8-3.8)
Fat added to food/day****	Control	43	1.0 (0.0-4.0)	43	0.7 (0.0-4.7)	43	-0.2 (-2.8-3.4)
	Intervention	42	1.5 (0.2-7.0)	42	0.8 (0.0-14.0)	42	-0.5 (-5.6-12.3)
Sugar added to food/day*****	Control	43	1.0 (0.0-4.2)	43	0.4 (0.0-8.0)	43	-0.2 (-4.2-6.0)
	Intervention	42	1.5 (0.0-6.2)	42	0.8 (0.0-8.0)	42	-0.3 (-3.4-8.0)

IQR: Interquartile range

Low fat food items: Low fat red meat, chicken without skin, low fat milk/sour milk/yoghurt, fat free/low fat cheese/cheese spreads and low fat salad dressing/mayonnaise; **High fat food items**: High fat read meat, processed meats, tinned meats,

chicken with skin, organ meats, full cream milk/sour milk/yoghurt, full fat cheese, peanut butter/peanuts, full fat salad dressing/mayonnaise, pies/sausage rolls/samosas, crisps, crackers, take-outs, roasted or fried potatoes or chips, other fried food, margarine/butter on bread, margarine/butter in porridge and margarine/butter/oil added to vegetables; **Sugary food items**: chocolates, sweets, cakes/biscuits/doughnuts, juice nectar, juice other, canned fruit or stewed fruit, fizzy drinks, energy drinks, milky drinks, jam/marmalade/chutney, sugar/honey in tea/coffee, sugar/honey on cereal/porridge, and sugar/syrup added to vegetables; **Fiber-rich carbohydrates**: legumes and bread/rolls bown/wholewheat; **Refined carbohydrates:** bread/rolls white; **Fruit items:** Oranges/naartjies, any other fruit items apples/pears/bananas, dried fruit; **Vegetable items**: Orange/yellow vegetables, green vegetables, mixed vegetables, cabbage/cauliflower/lettuce/cucumber, salad and tomato; **ETOH items**: Alcoholic coolers and spirits/brandy/vodka with mixer.

Significantly different results are presented in red font

*Significant increase in frequency of intake of low-fat food items from baseline to 16-week follow-up within the intervention and control groups (Wilcoxin matched pairs test: p=0.002, p<0.001, respectively).

**Significant decrease in frequency of intake of sugary food items from baseline to 16-week follow-up within the intervention group (Wilcoxin matched pairs test: p=0.010) .

*** Significant increase in frequency of intake of vegetables from baseline to 16-week follow-up within the intervention and control groups (Wilcoxin matched pairs test: p=0.002, p=0.043, respectively).

**** Significant decrease in frequency of adding fat to food from baseline to 16-week follow-up within the intervention group (Wilcoxin matched pairs test: p=0.011).

***** Significant decrease in frequency of adding sugar to food from baseline to 16-week follow-up within the intervention group (Wilcoxin matched pairs test: p<0.001).

Change in belief scores regarding food choices and physical activity

Results for beliefs for which significant changes from baseline to 16-week follow-up were found are presented below. Belief scores for non-significant results are included in Addendum XXII on page 381.

Belief: Preparation of vegetables does not take a long time. There was no significant difference between the median (IQR) scores for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(1.0-5.0)] at baseline. At 16-week follow-up there was also no significant difference in the score for this belief between the intervention [4.0(1.0-5.0)] and control group [4.0(1.0-5.0)]. However, there was a significant within group decrease in the score over the intervention period in the control group [0.0(-4.0-4.0) Wilcoxin matched pairs test: p=0.032], but not in the intervention group.

Belief: I can eat the recommended amount of fruits and vegetables every day: The median (IQR) score for this belief was significantly lower in the intervention [4.0(2.0-5.0)] than the in control group [4.0(2.0-5.0)] (Mann Whitney U test: 0.046) at baseline. At 16-week follow-up there was no significant difference between the score for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(2.0-5.0)]. There were no significant within group changes in the score for this belief over the intervention period.

Belief: Low fat/healthy food options are expensive. There was no significant difference between the median (IQR) scores for this belief between the intervention [4.0(2.0-5.0)] and control groups [4.0(2.0-5.0)] at baseline. At 16-week follow-up the score for this belief was significantly lower in the intervention [3.0(1.0-5.0)] than the control group [4.0(1.0-5.0)] (Mann-Whitney U test: p=0.044). The score decreased significantly within the intervention group over the intervention period [-1.0(-4.0-2.0)]

(Wilcoxin matched pairs test: p<0.001), but not in the control group. The within group change was significantly greater in the intervention than in the control group (Mann-Whitney U test: p=0.005).

Belief: Healthy take-aways and/or street foods are easy to find in my surroundings. There was no significant difference between the median (IQR) scores for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(1.0-5.0)] at baseline. At 16-week follow-up the median (IQR) score for this belief was significantly lower in the intervention [3.0(1.0-5.0)] than the control group [4.0(1.0-5.0)] (Mann-Whitney U test: p=0.026). There were no significant within group changes in the score for this belief over the intervention period (Wilcoxin matched pairs test).

Belief: I turn to sugary foods/snacks/drinks when I am stressed. There was no significant difference between the median (IQR) scores for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(1.0-5.0)] at baseline. At 16-week follow-up there was also no significant difference in the score for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(1.0-5.0)]. There was a significant within group decrease in the score for this belief in the control group [0.0(-4.0-2.0)] (Wilcoxin matched pairs test: p=0.009) but not in the intervention group.

Belief: Being physically more active will make me feel better about my appearance. The median (IQR) score for this belief was significantly lower for the intervention group [4.0(1.0-5.0)] than the control group [4.5(2.0-5.0)] (Mann Whitney U test: 0.038) at baseline. At 16-week follow-up there was no significant difference in the score for this belief between the intervention [4.0(1.0-5.0)] and control groups [4.0(3.0-5.0)]. There were no significant within group changes in the score for this belief over the intervention.

Change in belief patterns regarding food choices and physical activity

The scores for all 24 beliefs were included in the principal components analyses that was conducted firstly for the intervention and control groups using the baseline data set, and secondly for both groups using the 16-week follow-up data set to generate belief patterns for each group at each time point.

Baseline belief patterns for the ***intervention group*** are presented in Table 4.19.

Pattern 1: Focus on:

A. Physical activity and facilitators (I can increase my levels of physical activity: Having an exercise 'buddy' will help me to be physically more active; Knowing more about different types of physical activity I can do will help me to be more active; I could be physically more active even if I were tired; Finding time to be physically more active is possible).

B. Healthy food choices and facilitators (Fruit and vegetables are easy to find in stores nearby; I can reduce the amount of sugary foods/snack/drinks I eat and drink).

C. Healthy lifestyle: Benefits (Decreasing the amount of fat I eat will help me lose/control my weight; Being physically more active will make me feel better about my appearance; Eating fruits and vegetables every day will help me lose weight/control my weight; Eating less fat will help reduce the risk of diseases e.g. heart disease).

Pattern 2: Focus on:

A. Healthy food choices and facilitators (Healthy takeaways and/or street foods are easy to find in my surroundings; Fruits and vegetables are affordable; I would eat vegetables even if at times they look unappealing; Low fat/healthy fat options are not expensive).

B. Healthy food choices: Barriers (I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink; Preparation of vegetables takes a long time).

Pattern 3: Focus on:

A. Healthy food choices: Facilitators (Low fat/ fat-free foods taste good/ are tasty; It is easy to exclude high-fat foods from my daily diet).

B. Healthy food choices: Barriers (I do not have enough time to prepare healthy meals regularly; Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell).

Baseline belief patterns for the ***control group*** are presented in Table 4.20.

Pattern 1: Focus on:

A. Healthy food choices and facilitators: (it is easy to exclude high-fat foods from my daily diet; Low fat foods taste good/are tasty; Preparation of vegetables does not take a long time; I can reduce the amount of sugary foods/snack/drinks I eat and drink; I can eat the recommended amount of fruits and vegetables every day; Fruits and vegetables are affordable; Fruit and vegetables are easy to find in stores nearby).

Pattern 2: Focus on:

B. Healthy food choices and facilitators: (I would eat vegetables even if at times they look unappealing; I do not have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink).

C. Health food choices: Barriers (low fat options are expensive; I do not have enough time to prepare healthy meals regularly).

D. Healthy food choices: Health benefits (Decreasing the amount of fat I eat will help me lose/ control my weight; Eating less fat will help reduce the risk of diseases e.g. heart disease).

Pattern 3: Focus on:

A. Physical activity and facilitators (I can increase my levels of physical activity; Finding time to be physically more active is possible; I could be physically more active even if I were tired; knowing more about different types of physical activity I can do will help me to be more active).

B. Physical activity: Health benefit (Being physically more active will make me feel better about my appearance).

Table 4.19: Baseline belief patterns retrieved from the belief data for the intervention group

Belief statement	Pattern 1	Pattern 2	Pattern 3
24. I can increase my levels of physical activity (be physically more active)	0.85 *	-0.03	0.05
8. Decreasing the amount of fat I eat will help me lose/ control my weight.	0.85 *	-0.18	0.02
23. Having an exercise 'buddy' will help me to be physically more active.	0.82 *	-0.16	0.06
21. Knowing more about different types of physical activity I can do will help me to be more active.	0.77 *	0.00	0.27
6. Fruit and vegetables are easy to find in stores nearby	0.73 *	0.23	-0.10
19. Being physically more active will make me feel better about my appearance.	0.72 *	0.02	0.36
17. I can reduce the amount of sugary foods/snack/drinks I eat and drink	0.64 *	-0.09	-0.12
22. I could be physically more active even if I were tired.	0.64 *	0.16	0.40 *
14. I turn to sugary foods/snacks/drinks when I am stressed.	0.60 *	0.48 *	0.10
20. Finding time to be physically more active is possible.	0.58 *	0.24	0.39 *
2. Eating fruits and vegetables every day will help me lose weight/ control my weight.	0.55 *	0.08	0.06
7. Eating less fat will help reduce the risk of diseases e.g. heart disease.	0.53 *	-0.12	-0.18
10. Healthy takeaways and/or street foods are easy to find in my surroundings.	0.17	0.68 *	-0.05
15. I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink	-0.03	0.54 *	0.21
3. Fruits and vegetables are affordable.	0.03	0.53 *	-0.33
5. I would eat vegetables even if at times, they look unappealing.	-0.08	0.50 *	0.07
4. I can eat the recommended amount of fruits and vegetables every day.¥	0.06	0.23	0.07
1. Preparation of vegetables does not take a long time.	0.30	-0.45 *	0.11
9. Low fat/healthy fat options are expensive.	0.09	-0.45 *	0.19
13. Low fat/ fat-free foods taste good/ are tasty.	0.21	-0.11	0.62 *
12. I do not have enough time to prepare healthy meals regularly.	-0.13	-0.13	0.59 *
18. There are no accessible, safe, affordable opportunities for me to be physically active.	0.02	-0.05	0.58 *
16. Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired).	0.01	0.33	0.55 *
11. It is easy to exclude high-fat foods from my daily diet.	0.31	0.39	0.53 *

¥ Indicates beliefs which did not load on any factor

Beliefs: Fat intake; Fruit and vegetable intake; Sugar intake; Physical activity; **H**ealth effects of healthy lifestyle; Generic beliefs

Variance Explained by Each Factor: Factor1 6.1355342 Factor2 2.4943530 Factor3 2.4593532

Table 4.20: Baseline belief patterns retrieved from the belief data for the control group

Belief statement	Pattern 1	Pattern 2	Pattern 3
11. It is easy to exclude high-fat foods from my daily diet.	0.78 *	-0.09	-0.12
13. Low fat/ fat-free foods taste good/ are tasty.	0.72 *	0.07	0.02
2. Eating fruits and vegetables every day will help me lose weight/ control my weight.	0.62 *	0.18	0.16
1. Preparation of vegetables does not take a long time.	0.60 *	0.02	-0.32
17. I can reduce the amount of sugary foods/snack/drinks I eat and drink	0.56 *	0.04	0.42 *
4. I can eat the recommended amount of fruits and vegetables every day.	0.56 *	0.32	0.01
3. Fruits and vegetables are affordable.	0.55 *	0.09	-0.37 *
6. Fruit and vegetables are easy to find in stores nearby	0.50 *	-0.22	0.13
10. Healthy takeaways and/or street foods are easy to find in my surroundings.¥	0.28	0.00	0.15
16. Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired).¥	0.12	-0.02	0.09
9. Low fat/healthy fat options are expensive.	-0.18	0.78 *	0.15
8. Decreasing the amount of fat I eat will help me lose/ control my weight.	0.26	0.72 *	0.03
5. I would eat vegetables even if at times, they look unappealing.	0.19	0.61 *	0.08
7. Eating less fat will help reduce the risk of diseases e.g. heart disease.	0.29	0.56 *	-0.09
23. Having an exercise 'buddy' will help me to be physically more active.	-0.05	0.53 *	0.24
18. There are no accessible, safe, affordable opportunities for me to be physically active.	-0.19	0.52 *	0.15
12. I do not have enough time to prepare healthy meals regularly.	-0.43 *	0.44 *	0.21
15. I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink	0.03	-0.41 *	0.30
24. I can increase my levels of physical activity (be physically more active)	0.02	-0.06	0.77 *
19. Being physically more active will make me feel better about my appearance.	0.06	0.23	0.73 *
20. Finding time to be physically more active is possible.	0.41 *	-0.31	0.61 *
22. I could be physically more active even if I were tired.	-0.4	0.23	0. 46 *
21. Knowing more about different types of physical activity I can do will help me to be more active.	0.11	0.21	0.41 *
14. I turn to sugary foods/snacks/drinks when I am stressed.¥	-0.03	0.02	0.21

¥ Indicates beliefs which did not load on any factor

Beliefs: Fat intake; Fruit and vegetable intake; Sugar intake; Physical activity; **H**ealth effects of healthy lifestyle; Generic beliefs

Variance Explained by Each Factor: Factor1 3.7777126 Factor2 3.1809832 Factor3 2.6974636

Belief patterns for the ***intervention group*** **at 16-week follow-up** are presented in Table 4.21.

Pattern 1: Focus on:

A. Healthy food choices and facilitators (Fruit and vegetables are affordable; I would eat vegetables even if at times they look unappealing; It is easy to exclude high-fat foods from my daily diet; I can eat the recommended amount of fruits and vegetables every day; Fruit and vegetables are easy to find in stores nearby; The preparation of vegetables does not take a long time; Healthy takeaways and street food are easy to find in my surroundings; Reducing the amount of sugary foods/snacks/drinks I eat and drink will not make me feel unwell; Low fat/healthy fat options are not expensive);

Pattern 2: Focus on:

A. Physical activity and facilitators (I can increase my levels of physical activity; Knowing more about different types of physical activity I can do will help me to be more active; I could be physically more active even if I were tired; having an exercise 'buddy' will help me to be physically more active; Finding time to be physically more active is possible);

Pattern 3: Focus on:

A. Healthy lifestyle: Health benefits (Eating fruits and vegetables every day will help me lose weight/ control my weigh; Decreasing the amount of fat I eat will help me lose/ control my weigh: Eating less fat will help reduce the risk of diseases e.g. heart disease; Being physically more active will make me feel better about my appearance).

Belief patterns for the ***control group*** **at 16-week follow-up** are presented in Table 4.22.

Pattern 1: Focus on:

A. Physical activity and facilitators (Knowing more about different types of physical activity I can do will help me to be more active; I can increase my levels of physical activity; Having an exercise 'buddy' will help me to be physically more active; Finding time to be physically more active is possible).

B. Health benefits: Healthy lifestyle (Being physically more active will make me feel better about my appearance; Eating fruits and vegetables every day will help me lose weight/ control my weight; Decreasing the amount of fat I eat will help me lose/ control my weigh).

Pattern 2: Focus on:

A. Healthy food choices and facilitators (Fruit and vegetables are easy to find in stores nearby; I would eat vegetables even if at times they look unappealing; Healthy takeaways and/or street foods are easy to find in my surroundings; Preparation of vegetables does not take a long time; I do not have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink).

B. Healthy food choices: Health benefits (Eating less fat will help reduce the risk of diseases e.g. heart disease; Decreasing the amount of fat I eat will help me lose/ control my weight).

Pattern 3: Focus on:

A. Healthy food choices and facilitators (Fruit and vegetables are affordable; I can eat the recommended amount of fruits and vegetables every day; It is easy to exclude exclude high-fat foods from my daily diet; Low- fat/ fat-free foods taste good/ are tasty; Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell; I do not turn to sugary foods/snacks/drinks when I am stressed).

Table 4.21: Change in belief patterns from baseline to 16-week follow-up retrieved from the belief data for the Intervention completers

Belief statement	Pattern 1	Pattern 2	Pattern 3
3. Fruits and vegetables are affordable.	0.69 *	0.35	-0.01
5. I would eat vegetables even if at times, they look unappealing.	0.61 *	0.02	0.04
11. It is easy to exclude high-fat foods from my daily diet.	0.57 *	-0.17	0.12
4. I can eat the recommended amount of fruits and vegetables every day.	0.51 *	0.36	0.09
6. Fruit and vegetables are easy to find in stores nearby	0.50 *	0.14	0.23
1. Preparation of vegetables does not take a long time.	0.48 *	-0.47 *	-0.34
10. Healthy takeaways and/or street foods are easy to find in my surroundings.	0.39 *	0.11	0.16
15. I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink¥	-0.32	0.00	0.09
16. Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired).	-0.41 *	0.07	-0.23
18. There are no accessible, safe, affordable opportunities for me to be physically active.	-0.51 *	0.03	-0.14
9. Low fat/healthy fat options are expensive.	-0.63 *	-0.31	-0.15
24. I can increase my levels of physical activity (be physically more active)	0.32	0.76 *	0.08
21. Knowing more about different types of physical activity I can do will help me to be more active.	0.19	0.70 *	-0.06
22. I could be physically more active even if I were tired.	-0.17	0.62 *	-0.06
23. Having an exercise 'buddy' will help me to be physically more active.	0.09	0.54 *	0.27
20. Finding time to be physically more active is possible.	0.41 *	0.50 *	-0.12
17. I can reduce the amount of sugary foods/snack/drinks I eat and drink¥	0.28	0.30	0.10
13. Low fat/ fat-free foods taste good/ are tasty.	0.21	-0.45 *	0.20
2. Eating fruits and vegetables every day will help me lose weight/ control my weight.	0.02	-0.13	0.80 *
8. Decreasing the amount of fat I eat will help me lose/ control my weight.	0.29	0.10	0.74 *
7. Eating less fat will help reduce the risk of diseases e.g. heart disease.	0.44 *	0.06	0.67 *
19. Being physically more active will make me feel better about my appearance.	0.14	0.28	0.64 *
12. I do not have enough time to prepare healthy meals regularly.	-0.23	-0.01	0.54 *
14. I turn to sugary foods/snacks/drinks when I am stressed.¥	0.18	-0.14	0.33

¥ Indicates beliefs which did not load on any factor

Beliefs: Fat intake; Fruit and vegetable intake; Sugar intake; Physical activity; **H**ealth effects of healthy lifestyle; Generic beliefs

Variance Explained by Each Factor : Factor1 Factor2 Factor3

3.8487307 3.0469208 2.9203950

Table 4.22: Change in belief patterns from baseline to 16-week follow-up retrieved from the belief data for the control completers

Belief statement	Pattern 1	Pattern 2	Pattern 3
19. Being physically more active will make me feel better about my appearance.	0.82 *	-0.02	-0.10
21. Knowing more about different types of physical activity I can do will help me to be more active.	0.78 *	-0.20	0.00
24. I can increase my levels of physical activity (be physically more active)	0.59 *	0.02	0.05
23. Having an exercise 'buddy' will help me to be physically more active.	0.59 *	0.24	-0.34
20. Finding time to be physically more active is possible.	0.57 *	-30.3	-0.01
2. Eating fruits and vegetables every day will help me lose weight/ control my weight.	0.49 *	0.28	0.32
12. I do not have enough time to prepare healthy meals regularly.	0.45 *	0.09	0.12
18. There are no accessible, safe, affordable opportunities for me to be physically active.¥	-0.24	0.17	-0.09
9. Low fat/healthy fat options are expensive.	0.05	0.73 *	-0.12
6. Fruit and vegetables are easy to find in stores nearby	-0.01	0.67 *	0.35
7. Eating less fat will help reduce the risk of diseases e.g. heart disease.	0.57 *	0.60 *	0.21
5. I would eat vegetables even if at times, they look unappealing.	-0.20	0.54 *	-0.06
10. Healthy takeaways and/or street foods are easy to find in my surroundings.	0.07	0.53 *	-0.08
8. Decreasing the amount of fat I eat will help me lose/ control my weight.	0.50 *	0.50 *	0.36
1. Preparation of vegetables does not take a long time.	0.10	0.40 *	0.36
15. I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink	0.08	-0.46 *	0.15
3. Fruits and vegetables are affordable.	-0.25	0.01	0.70 *
4. I can eat the recommended amount of fruits and vegetables every day.	0.41 *	0.10	0.59 *
11. It is easy to exclude high-fat foods from my daily diet.	0.41 *	0.18	0.55 *
13. Low fat/ fat-free foods taste good/ are tasty.	0.06	-0.16	0.40 *
17. I can reduce the amount of sugary foods/snack/drinks I eat and drink¥	0.30	-0.01	0.33
16. Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired).	0.02	-0.30	-0.39 *
14. I turn to sugary foods/snacks/drinks when I am stressed.	0.18	0.13	-0.41 *
22. I could be physically more active even if I were tired.	-0.26	0.10	-0.42 *

¥ Indicates beliefs which did not load on any factor

Beliefs: Fat intake; Fruit and vegetable intake; Sugar intake; Physical activity; **H**ealth effects of healthy lifestyle; Generic beliefs

Variance Explained by Each Factor: Factor1 Factor2 Factor3

4.0378982 3.0492900 2.6328405

A summary of the belief focusses of the intervention and control group belief patterns at baseline and 16-week follow-up is presented in Table 4.23. It is clearly evident that the intervention group belief pattern focusses in changed from including two or three components each to having one clear component per pattern, namely healthy food choices and facilitators (strongest pattern), physical activity and facilitators and health benefits of a healthy lifestyle. Of note is that while beliefs relating to barriers to healthy eating were components on belief patterns 3 and 4 at baseline in the intervention group, no healthy food choice barrier beliefs loaded on any one of the three patterns at 16-week follow-up. A similar improvement in the focusses of belief patterns was not evident for the control group, where two of the three patterns still included two components. The strongest pattern in the control group at baseline involved food choices and facilitators, which changed to a focus on physical activity and health benefits of a healthy lifestyle at 16-week follow-up. Healthy food choice components were only part of patterns 2 and 3 in this group. In addition, the control group still had one healthy food choice barrier belief loaded on pattern 2 and one physical activity barrier belief loaded on pattern 3

Table 4.23: Summary of belief pattern focusses for the Intervention and control groups at baseline and 16-week follow-up

Intervention group			
Pattern	**Baseline**	**Pattern**	**16-week follow-up**
	Pattern focusses		**Pattern focus**
1	A. Physical activity and facilitators B. Healthy food choices and facilitators C. Healthy lifestyle: Benefits	**1**	A. Healthy food choices and facilitators
2	A. Healthy food choices and facilitators B. Healthy food choices: Barriers	**2**	A. Physical activity and facilitators
3	A. Healthy food choices: Facilitators B. Healthy food choices: Barriers	**3**	A.Healthy lifestyle: Health benefits
Control group			
Pattern*	**Baseline**	**Pattern**	**16-week follow-up**
	Pattern focuseses		**Pattern focuses**
1	A. Healthy food choices and facilitators	**1**	A. Physical activity and facilitators B. Health benefits: Healthy lifestyle
2	A. Healthy food choices and facilitators B. Health food choices: Barriers C. Healthy food choices: Health benefits	**2**	A. Healthy food choices and facilitators B. Healthy food choices: Health benefits
3	A. Physical activity and facilitators and its related health benefits B. Physical activity: Health benefit	**3**	A.Healthy food choices and facilitators

*First pattern is the strongest

Change in weight loss readiness to change categories

The percentage of educators in the intervention group who were either “attempting change currently” or had “changed behaviour and attempting to maintain change” for the behaviour

"*increase fruit intake"* increased from 52% at baseline to 80.9% at 16-week follow-up. For the control group this was similar at baseline and 16-week follow-up (44.5% and 48.9% respectively). At 16-week follow-up the intervention group was significantly more likely to be "attempting change currently" than the control group for this behaviour (Table 4.24).

The percentage of educators in the intervention group who were either "attempting change currently" or had "changed behaviour and attempting to maintain change" for the behaviour "*decrease sugar intake"* increased from 69% at baseline to 76.1% at 16-week follow-up. For the control group there was an increase from 51.2% at baseline to 70.2% at 16-week follow-up. At 16-week follow-up the intervention group was significantly more likely to be "attempting change currently" than the control group for this behaviour (Table 4.24).

As far as stage of change for vegetable and fat intake and physical activity is concerned it is evident that there were no significant within groups differences between time points, with more than 60% in both intervention and control groups contemplating change in the next month or currently attempting to change at both time points.

Table 4.24: Change in weight loss readiness to change (fruit, vegetable and fat intake, as well as physical activity) profiles in the intervention and control completer sub-group from baseline to 16-week follow-up

Indicators	Category	Baseline		16-week follow-up	
		Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)
Increase fruit intake*	No plans to change for the next 6 months	5 (11.6)	2 (4.8)	4 (9.3)	3 (7.1)
	Thinking about changing in the next 6 months	9 (20.9)	7 (16.7)	13 (30.2)	3 (7.1)
	Thinking about changing in the next month	10 (23.3)	13 (31.0)	5 (11.6)	2 (4.8)
	Attempting change currently	10 (23.3)	14 (33.3)	15 (34.9)	26 (61.9)
	Changed behaviour and attempting to maintain change	9 (20.9)	6 (14.3)	6 (14.0)	8 (19.0)
Increase veg intake	No plans to change for the next 6 months	3 (7.0)	1 (2.4)	4 (9.3)	1 (2.4)
	Thinking about changing in the next 6 months	10 (23.3)	3 (7.1)	9 (20.9)	4 (9.5)
	Thinking about changing in the next month	10 (23.3)	11 (26.2)	3 (7.0)	3 (7.1)
	Attempting change currently	11 (25.6)	18 (42.9)	16 (37.2)	24 (57.1)
	Changed behaviour and attempting to maintain change	9 (20.9)	9 (21.4)	11 (25.6)	10 (23.8)
Decrease fat intake	No plans to change for the next 6 months	2 (4.7)	3 (7.3)	3 (7.0)	0 (0)

	Thinking about changing in the next 6 months	11 (25.6)	6 (14.6)	7 (16.3)	5 (12.2)
	Thinking about changing in the next month	10 (23.3)	9 (22.0)	7 (16.3)	5 (12.2)
	Attempting change currently	12 (27.9)	19 (46.3)	15 (34.9)	23 (56.1)
	Changed behaviour and attempting to maintain change	8 (18.6)	4 (9.8)	11 (25.6)	8 (19.5)
Decrease sugar intake**	No plans to change for the next 6 months	3 (7.0)	3 (7.1)	4 (9.3)	0 (0)
	Thinking about changing in the next 6 months	10 (23.3)	5 (11.9)	4 (9.3)	5 (11.9)
	Thinking about changing in the next month	8 (18.6)	5 (11.9)	5 (11.6)	5 (11.9)
	Attempting change currently	10 (23.3)	26 (61.9)	13 (30.2)	24 (57.1)
	Changed behaviour and attempting to maintain change	12 (27.9)	3 (7.1)	17 (40.0)	8 (19.0)
Increase physical activity	No plans to change for the next 6 months	1 (2.3)	4 (9.5)	5 (11.6)	2 (4.8)
	Thinking about changing in the next 6 months	12 (27.9)	4 (9.5)	10 (23.3)	3 (7.1)
	Thinking about changing in the next month	13 (30.2)	13 (31.0)	7 (16.3)	13 (31.0)
	Attempting change currently	13 (30.2)	17 (40.4)	14 (32.6)	20 (47.6)
	Changed behaviour and attempting to maintain change	4 (9.3)	4 (9.5)	7 (16.3)	4 (9.5)

Significantly different results are presented in red font

*Intervention group significantly more likely to be "attempting change currently" for the behaviour "increase fruit intake" than the control group at 16-week follow-up (Pearson's Chi Square Test: p=0.028).

**Intervention group significantly more likely to be "attempting change currently" for the behaviour decrease sugar intake" than the control group at 16-week follow-up (Pearson's Chi Square Test: p=0.031).

Change in nutrition knowledge scores

The mean nutrition knowledge score out of 20 for the intervention and control groups at 16-week follow-up was just above 10 (50%). There was no significant change in the nutrition knowledge score from baseline to 16-week follow-up within either the intervention or control group (Table 4.25).

Table 4.25: Change in nutrition knowledge score in the intervention and control groups from baseline to 16-week follow-up *

Indicator		**Baseline**		**16-week follow-up**		**Follow-up – baseline (within group change over time)**	
		n	**Mean±SD**	**n**	**Mean±SD**	**n**	**Mean±SD**
	Control	43	10.74±2.42 (53.7±12.1)	43	10.72±2.74 (53.6±13.7)	43	-0.02±2.43 (-0.12±12.17)

Nutrition knowledge score (out of 20)	Intervention	42	9.69±2.57 (48.5±12.9)	42	10.48±2.93 (52.4±14.7)	42	0.78±2.76 3.93±13.82)

SD: Standard deviation

*No significant changes in nutrition knowledge within the intervention and control groups from baseline to 16-week follow-up (Stats Test: Students t-test).

Change in depression indicators

At baseline and 16-week follow-up the majority of educators in the intervention and control groups were in the minimal depression category (Table 4.26). There were no significant changes in within in group change over time depression scores between the intervention and control groups. There were also no significant differences in depression score category profiles between the intervention and control groups either at baseline or 16-week follow-up (Table 4.26).

Table 4.26: Change in depression score and category profiles in the intervention and control groups from baseline to 16-week follow-up*

Indicator	**Category**	**Baseline**		**16-week follow-up**		**Follow-up – baseline (within group change over time)**	
		Control	**Intervention**	**Control**	**Intervention**	**Control (n=43)**	**Intervention (n=42)**
		n (%)	**n (%)**	**n (%)**	**n (%)**	**Median (IQR)**	**Median (IQR)**
Depression category	Minimal depression	30 (69.8)	25 (59.6)	36 (83.7)	29 (69.0)	-4.00 (-12.0-8.0)	-1.00 (-14.0-18.0)
	Mild depression	10 (23.3)	10 (23.8)	5 (11.6)	8 (19.0)		
	Moderate depression	2 (4.7)	6 (14.3)	1 (2.3)	3 (7.1)		
	Severe depression	1 (2.3)	1 (2.4)	1 (2.3)	2 (4.8)		

IQR: Interquartile range

*No significant changes in within in group change over time depression scores between the intervention and control groups (Stats Test: Mann Whitney U test, p=0.185). No significant differences in depression category profiles between the intervention and control groups at baseline or 16-week follow-up (Stats Test: Pearson's Chi Square Test p=0.486 and p=0.429, respectively).

Change in body size perception categories

There were no significant differences in body size perception category profiles between the intervention and control groups either at baseline or 16-week follow-up. At both baseline and follow-up the majority of educators in the intervention and the control groups identified themselves as overweight or obese. A few educators in the intervention and control groups perceived themselves to be underweight at baseline, but none at 16-week follow-up. The percentage of educators who perceived their weight to be normal increased with 4.6% from

baseline to 16-week follow-up in the control group, while it decreased in the intervention group from 16.7% to 11.9% (Table 4.27).

Table 4.27: Change in body size perception profiles of the intervention and control groups from baseline to 16-week follow-up*

Indicator	Category	Baseline		16-week follow-up	
		Control	Intervention	Control	Intervention
		n (%)	n (%)	n (%)	n (%)
Body size perception category	Underweight	1 (2.3)	2 (4.8)	0 (0)	0 (0)
	Normal weight	6 (14.0)	7 (16.7)	8 (18.6)	5 (11.9)
	Overweight	31 (72.1)	27 (64.3)	31 (72.1)	29 (69.0)
	Obese	5 (11.6)	6 (14.3)	4 (9.3)	8 (19.0)

*No significant differences in body size perception category profiles between the intervention and control groups at baseline or 16-week follow-up (Stats Test: Pearson's Chi Square Test).

4.5.2 Sub-study 2

In this sub-study, the qualitative data obtained from the six interviews with female educators who completed the Health4LIFE intervention are described. Results are presented as themes, subthemes and sub-subthemes that emerged during the thematic analysis of the interviews. The total number of mentions of subthemes and illustrating quotes, as well as salient issues extracted from themes are presented.

Nine themes emerged from the educator interview data, namely 'Wellness Day', 'School environment', 'Barriers', 'Facilitators', 'Goals', "Manual critique', 'Text message critique', Contact frequency' and 'Delivery'.

Results for the theme relating to 'educators' perception of the wellness day' are presented in Table 4.28.

Table 4.28: Perceptions of educators who completed the Health4LIFE weight loss intervention of the wellness day

Theme	Subtheme	Sub-subtheme	Total mentions
Wellness day (WD)	Feeling (WD Feel)	Good (WD FeelG)	7
		Pampering (WD Feel Pamp)	2
		Exciting (WD Feel Exc)	5
	Health awareness (WD HealthA)	No sub-subtheme*	4
		Blood pressure (WD HealthA BP)	2
		Weight (WD HealthA W)	4
		Wakeup call (WD HealthA W/Call)	2
		Informative (WD HealthA Info)	4

*Participant mentioned a subtheme but not a sub-subtheme

Subthemes regarding the wellness day which emerged include feelings educators had about the day as such, as well as the promotion of health. Perceptions focused mostly on it being good and exciting, but feeling pampered was also mentioned. Quotes which illustrated these sub-subthemes include:

Good:

"I think it was something good and for some teachers it was an eye opener"

Exciting:

"Educators were very excited when they heard about the wellness day"
"..It set the mood for what is going to happen it made you excited and you actually looked forward to the program."

The wellness day also made educators more aware of their health in general. Themes regarding awareness of specific medical conditions also emerged. These subthemes are best illustrated by the following quote:

"…many were not aware of their health status and health readings. Many educators were previously unaware and many had high blood pressure readings and received letters for a health facility or doctor, the wellness day was a wakeup call, it was very informative. Some people were kind of aware of their health but have never been told by anyone. Screening was a big plus. Therefore many welcomed the program."

Results on the theme relating to educators' perception on having a weight loss intervention implemented in the school setting, as well as stressors experienced in the school environment are presented in Table 4.29.

Table 4.29: Perceptions of educators who completed the Health4LIFE weight loss intervention of the school environment

Theme	Subtheme	Sub-subtheme	Total mentions
School environment (S)	Value of weight loss intervention (V)	Peer support (SV PSup)	10
		Positively seen (SV Pos)	7
		Convenience (SV Convenience)	2
		Easy (SV Easy)	1
	Stressors (SS)	No sub-subtheme*	1
		Workload (SS Work)	5

*Participant mentioned a subtheme but not a sub-subtheme

It is evident that perceptions of educators regarding having a weight loss intervention in the school setting focused on the usefulness of such a program in the workplace. Specific factors mentioned involve peer support, convenience, easiness and it being positively viewed, as is illustrated by the following quotes:

Peer support:

"Being part of a program with colleagues – we could share the experience as a team"

Convenience:

"This is my workplace I am here most of the day."
"*And it is convenient having it at school. If it is out of school, then really…I would not be able to do it."*

Easy:

"It makes things easier because now you are in a group and you not alone on your own because if you are on your own then you think Aghh you not going to do it."

Positively viewed:

"I think it's something great you know…for teachers just to follow or to participate in .."

The workload of educators emerged as a sub-subtheme of stress in the workplace. Quotes which describe this include:

"we are so stressed up with work at school and we are so loaded with lots of work that we need to do"

"you are so rushed to get everything done and we have got lots of due dates for everything"

Results on the theme relating to educators' perception of barriers to the Health4LIFE weight loss intervention are presented in Table 4.30.

Table 4.30: Perceptions of educators who completed the Health4LIFE weight loss intervention of intervention barriers

Theme	Subtheme	Sub-subtheme	Total mentions
Barriers (B)	Time (BT)	Self (BT Self)	4
		Health checks (BT HealthC)	3
		Meal plan (BT M/Plan)	4
		Meal prep (BT M/Prep)	1
		Program (BT Prog)	8
		Physical activity (BT PA)	3
		Activity completion (BT AC)	1

	Budget (B Budget)	Meal plan (B Budget M/Plan)	2
		Program (B Budget Prog)	5
	Reducing unhealthy snacks (B USnacks)	No sub-subtheme*	2
	Dislike Physical activity (B Dislike PA)	No sub-subtheme*	1
	Lifetime dietary changes (B LC)	No sub-subtheme*	1
	Lack of family Support (B no FSup)	No sub-subtheme*	2
	Challengers (BC)	Activity completion (BC AC)	5
		Tips (BC Tips)	1
		Physical activity (BC PA)	1

*Participant mentioned a subtheme but not a sub-subtheme

Time emerged as an important barrier to following the weight loss intervention. Specific time related sub-subthemes that emerged include the following:

Time to follow the intervention in general:

"When we spoke about it more or less everybody was saying the same thing, they didn't have time to follow the program"

"No, it was mostly time that was my problem."

"Time frame yes, mostly time, it is the greatest challenge."

Time for themselves:

"It's difficult to set time aside to look after yourself."

"But because I find out that I don't have time like I told you to set aside for whatever I need to do for myself…"

Time specifically to follow the meal plan:

"It's difficult to sit down and plan your meals you going to eat for the day."

"In the beginning I used the eating plans, but as I tell you time is always a factor in my life so ya...it's difficult to follow the eating plans, preparing the meals and so on…"

Time to get health checks:

"Sometimes you postpone your check-ups that you need to go to the doctor for because you are loaded with all this stuff you have to get done for whatever time"

Time was also mentioned as a barrier for other sub-subthemes which included meal preparation, physical activity and completing the activities in the manual.

Budget was another subtheme of the barrier theme in general. As well as to follow the proposed meal plan. Quotes which capture these notions include the following:

"I really don't have the time to errm..the budget and the time. Those are the two things that made me stop."

"The difficulty was in the budget. It did not allow me all the time"

Educators also mentioned that it was challenging to complete the activities in the manual. Other challengers mentioned include following the tips and doing the physical activity. Quotes which illustrate these challenges include the following:

"Shew I think I did the first few…. it's too much"

"I didn't complete all of them."

Results on the theme relating to educators' perception on facilitators of the Health4LIFE weight loss are presented in Table 4.31.

Table 4.31: Perceptions of educators who completed the Health4LIFE weight loss intervention of intervention facilitators

Theme	Subtheme	Sub-subtheme	Total mentions
Facilitators (F)	Support (FS)	Peer (FS Peer)	5
		Family (FS Fam)	11
	SMS (F SMS)	No sub-subtheme*	1
		Motivation (F SMS Motiv)	5
		Helpful (F SMS Help)	4
		Reminder (F SMS Remin)	6
	Self meal prep (F SMP)	No sub-subtheme*	1
	Health awareness (F HealthA)	No sub-subtheme*	1
		Weight loss (F HealthA WL)	1
		Diet (F HealthA Diet)	1
		Physical activity (F HealthA PA)	2
	Budget (F Budget)	No sub-subtheme*	1
	Ease of meal prep (F M/Prep)	No sub-subtheme*	1
	Improved knowledge (F IK)	No sub-subtheme*	1
	Improved health (F IHealth)	Less tired (F IHealth Ener)	2
		Felt good (F IHealth Good)	3
	Seeing results (F results)	No sub-subtheme*	2
	Minor changes (F MC)	Diet (F MC Diet)	5
		Physical activity (F MC PA)	1

*Participant mentioned a subtheme but not a sub-subtheme

The strongest subthemes which emerged as facilitators to following the intervention included support (which referred to family and peer support), the text messages (which was seen as a motivator, helpful and a reminder), an improved feeling of health (which included feeling good and less tired), while minor changes to the diet was also mentioned. Quotes which illustrate these perceived facilitators include:

Peer support:

"*…the fact that we did it as a staff as a group. We had a few people. And that made it easier."*

"Being part of a program with colleagues – we could share the experience as a team. I saw it as a sign to get more healthy. Team support was important to me."

"It was also nice to have my colleagues at work in the same situation as me. We motivated each other."

Family support:

"*My husband was very supportive. He exercised with me, bought me exercise clothes and he was ok with the food changes. …My sister in law even ran with me once."*

"My husband's support also helped a lot -he found an online exercise program for us and started."

Minor changes to diet and exercise:

"*No dramatic changes were needed I previously did diets and it was very restrictive. So only minor changes to the diet and exercise were needed."*

"…there weren't too many changes in your diet or daily eating plan."

Text messages:

"A message just for the day to encourage you, to follow, whatever you know"

"Of couse! Of course! by all means. ! having that reminder"

"…you doing something new so that reminder is totally useful."

Subthemes relating to facilitators of following the weight loss intervention which were less frequently mentioned include being able to prepare meals themselves, being more aware of their health (such as weight loss, diet and physical activity), inexpensive food items suggested, the ease of meal preparation, having an improved knowledge and seeing results.

Health awareness:

"I think just the mere fact that I am aware of the fact that I must lose some weight made it a bit easier, trying to follow the program, doing some exercise and whatever"

Seeing results:

"I monitored my weight and found it helpful and got excited when progress was made."

Results on the theme relating to the health goals of the educators immediately after the wellness day, as well as at the time of the interview are presented in Table 4.32.

Table 4.32: Perceptions of educators who completed the Health4LIFE weight loss intervention of health goals

Theme	Subtheme	Sub-subtheme	Total
Goals (G)	Post wellness day (G PostWD)	Fat loss (G PostWD FL)	1
		Weight loss (G PostWD WL)	1
		Healthy diet (PostWD HDiet)	1
	Current (GC)	Weight loss (GCWL)	3
		Healthy diet (GC HDiet)	1
		Healthy lifestyle (GCHL)	4
		Not weight loss (GCNWL)	3
		Feel healthy (GC FHealth)	1
		Feel more energetic (GC Energy)	1

Educators mentioned fat loss, weight loss and a healthy diet as being their goals immediately after the wellness day. The following quotes describe these goals:

"Errm I realised that day (wellness day) that I was actually overweight and ya overweight for my height ya and ermm, yes, I wanted to lose fat because I learnt that being overweight has medical implications in the long run so ya"

"I know I have horrible eating habits. So that was my reason. I wanted to improve my eating habits."

Goals which emerged at the time of the interview include a healthy lifestyle and weight loss, but also not wanting to lose weight. Other goals which were also mentioned include following a healthy diet, feeling healthy and feeling more energetic. Quotes illustrating these sub-subthemes include the following:

"I would like to lose some weight (laugh) I would love to. But errm I think more for me it's about living a healthy life, not actually, my focus mustn't be on losing weight but living a healthy life. Spending more time looking after myself. Focus is more on living a healthier life than losing weight. I don't want my focus to be on losing weight."

"I am past the age where I want to have a good figure but you know feeling more energetic, feeling more healthy."

"I would still like to lose weight."

Results on the theme regarding educators' critique of the Health4LIFE weight loss manual are presented in Table 4.33.

Table 4.33: Perceptions of educators who completed the Health4LIFE weight loss intervention of the intervention manual

Theme	Subtheme	Sub-subtheme	Total mentions
Manual critique (MC)	Positive experience (PosExp)	No sub-subtheme*	2
	Useful (MC Useful)	No sub-subtheme*	1
		Portions (MC Useful Por)	1
		Meal plan (MC Useful M/Plan)	4
		Tips (MC Useful Tips)	6
		Sugar in food (MC Useful Sugar)	1
		Vegetable colour (MC VegColour)	1
		Food groups (MC Food grps)	1
	Helpful (MC Help)	Activities (MC Help Act)	1
		Tips (MC Help Tips)	1
	Easy to follow (MC Easy M/Plan)	No sub-subtheme*	2
	Minor changes (MC Min Chan M/Plan)	No sub-subtheme*	2
	Understandable (MC Under)	No sub-subtheme*	6
	Readily available (MC RAvail M/Plan)	No sub-subtheme*	2
	Affordable (MC Afford M/Plan)	No sub-subtheme*	1
	Improved knowledge (MC Know)	No sub-subtheme*	2
	Enjoyed (MC Enjoy)	No sub-subtheme*	2
		Tips (MC Enjoy Tips)	1
		Self-assessment (MC Enjoy S/Ass)	1
		Meal plan (MC Enjoy M/Plan)	2
	Adequate information (MC Ade Info)	No sub-subtheme*	1

	Prefer book format (MC Book)	No sub-subtheme*	1
	Too much writing (MC Writ)	No sub-subtheme*	2
	Add more information (MC Info)	Eating plan (MC Info EP)	1
		Physical activity (MC Info PA)	1
		Structured program (MC Info SP)	1
	Different languages (MC Diff Lang)	No sub-subtheme*	1
	Smaller size (MC Size)	No sub-subtheme*	1

*Participant mentioned a subtheme but not a sub-subtheme

A strong subtheme which was mentioned by the educators as critique of the manual related to its usefulness, in particular the sections on the tips and the meal plans. The usefulness of the manual in general was also mentioned, as well as the usefulness of the sections on portion size, the sugar content found in food, the relevance of consuming various coloured vegetables and the different food groups. Quotes reflecting these notions include the following:

Meal plan:

"*I think it was useful"*

"I found it very useful and easy to follow"

Tips:

"*I also found this useful and helpful – having the alternatives helped a lot."*

"That was very useful. I don't remember everything. I know that I read through it and it was very useful. Knowing that you can umm there are things that you can do at home to reduce fats, not overeat or over indulge in certain foods. So it was very useful."

Sugar, vegetables, food groups:

"The information about the different food groups you have to eat; also the colours of the vegetables. I liked that. Also the information about how many spoons of sugar is in everything."

Another strong subtheme which emerged was regarding the ease of understanding the manual, as evident from the following quotes:

"No I think it was user friendly."

"No that was easy enough."

In addition, it emerged that the manual was enjoyable, with specific reference to the manual in general, the sections on tips, the self-assessment exercises, and the meal plans. Quotes which illustrate these notions include:

General:

"I am a reader so I enjoyed that. I didn't have a problem with it."

"The book was just fine, it was just fine, I enjoyed it."

Tips and self-assessment exercises:

"The tips and the self-assessment I liked"

Meal plan:

"Because of budget mos it was difficult to follow but I actually enjoyed it."

"..everything that was at hand at the shops. Nothing was really difficult. I enjoyed it"

The meal plans were further said to be affordable, that they included readily available items, were easy to follow and required only minor changes of usual meal plans. A further point of critique that emerged was that the manual improved knowledge.

Suggestions for improvement of the manual which were mentioned include considering other languages, reducing the size of the manual, improving the structure of the manual, and adding more information to the eating plan and physical activity sections.

Results on the theme regarding educators' critique of the text messages included in the weight loss intervention are presented in Table 4.34.

Table 4.34: Perceptions of educators who competed the Health4LIFE intervention of the intervention text messages

Theme	Subtheme	Sub-subtheme	Total mentions
Text message critique (SMS)	Preferred Time (SMS PTime)	Morning (SMS PTime M)	4
		After school (SMS PTime ASchool)	1
		Personal choice (SMS PTime Personal)	1
	Time received (SMS Time)	Too late (SMS Time Late)	1

As far as the timing of the text messages is concerned, receiving it in the morning was most commonly mentioned as illustrated in the following quotes:

"I am an early in morning – early in the morning before I get to work then I check that is what I do then I see how my day goes, so first thing in the morning helps for me."

"In the morning is perfect"

It was also mentioned that educators should be given the opportunity to indicate their preferred time for receiving text messages, that the messages should be sent after school and that messages in the existing intervention were sent too late in the day.

Results on the theme regarding educators' critique of the frequency of contact they experienced during the weight loss intervention are presented in Table 4.35.

Table 4.35: Perceptions of the frequency of contact during the intervention of educators who completed the Health4LIFE intervention

Theme	Subtheme	Sub-subtheme	Total mentions
Contact frequency (CF)	Regular health visits needed (CF RHV)	No sub-subtheme*	12
		Even in 4th term (CF RHV 4)	5
		Motivate (CF RHV Motivate)	4
		Health Check (CF RHV HCheck)	7
		Feedback (CF RHV Feedback)	1
	Inadequate (CF I)	No sub-subtheme*	7

*Participant mentioned a subtheme but not a sub-subtheme

A very strong subtheme which emerged regarding the frequency of contact educators experienced was that more health visits were needed. Some mentioned that these visits should occur quarterly at least, even in the fourth term. It was also felt that more regular health visits would provide motivation as well as an opportunity to get another health check that should include feedback. The frequency of contact of the Health4LIFE weight loss intervention was said to be inadequate. Quotes which describe these notions include:

Inadequate:

"*It was too long,… Because 16 weeks is like you started and then after 4 months you came back."*

Regular health visits:

"*I think if you can come back perhaps every 2 weeks and check on us I think that would be great. Or once a month at least"*

"I think in future they must be more hands on."

Health checks at regular health visits:

"No, I would say through the year you need to come and check , especially when it is so hectic you need to have time out just to check your health you know to see is your heart ok, is whatever, is you blood pressure ok, some have diabetes, just check your diabetes to see what is your score or whatever."

Motivation:

"*I think definitely. If your weight is checked regularly you will perhaps try to improve on your weight like your health,*"

Results on the theme regarding the perception of educators on the possibility of delivering a weight loss intervention online are presented in Table 4.36.

Table 4.36: Perceptions of educators who completed the Health4LIFE intervention of the delivery format for a weight loss intervention

Theme	Subtheme	Sub-subtheme	Total mentions
Delivery format (DF)	Online Value (DF O V)	Positive feeling (DF OV FeelPos)	4
		Appealing to young (DF OV Young)	3
		Short hints (DF OV hints)	2
		Easier to monitor (DF OV Ease)	2
	Prefer Combination (DF preferComb)	No sub-subtheme*	1

*Participant mentioned a subtheme but not a sub-subtheme

There were four positive responses to the possibility of an online weight loss intervention as is reflected in the following quotes:

"Online will be great but it must not be a big thing"

"But I would use it"

"No I will prefer on my phone. I use my phone a lot."

It was also mentioned that an online weight loss intervention may be more appealing to a younger generation. Quotes illustrating this point include the following:

"I think it's the younger generation now mostly they are on social media and whatever"

"it also depends on who your clientele are because an older person may not like it."

Salient issues

It emerged from the in-depth interviews with intervention completers that the wellness day evoked feelings of wellbeing, excitement and even feeling pampered in some. A further strong subtheme that emerged was that the wellness day served to increase awareness of personal health as it included health screening (weight and blood pressure were specifically mentioned); two educators described it as a wake-up call. At the time of the interview, it emerged that educators felt that they would like to lead a healthy lifestyle, while some wanted to focus specifically on weight loss as a goal.

It became apparent that educators saw great value in having a weight loss intervention implemented at their place of work. They expressed positive feelings about such an intervention, specifically citing the value of peer support and the convenience and ease of

accessing an intervention at the workplace. Workload emerged as a big contributor to educators' stress levels.

Several factors emerged as barriers to a self-help weight loss intervention of which time seemed to be one of the strongest barriers. Specific time related aspects included time to follow the intervention in general, not having enough time for themselves and not having time to follow a meal plan. Finances (budget) also emerged as a barrier to following the intervention in general, as well as following the meal plans. It was also mentioned that completing the activities in the manual was challenging.

A strong facilitator of following the weight loss intervention that emerged was support from family and peers. The text messages were indicated to be motivational, helpful and serve as a reminder to follow the intervention. It was further mentioned by some that they felt that the intervention recommendations involved only minor changes to the diet which could facilitate compliance.

As far as critique of the hard copy manual to facilitate dietary pattern and physical activity for health and weight loss is concerned it emerged that some educators found it useful, specifically the sections relating to tips and the meal plans which were provided, easy to understand and enjoyable (specifically the sections regarding tips, meal plans and the self-assessment exercises). Suggestions to improve the manual which were mentioned included considering providing it in other languages, reducing the size of the manual, improving the structure of the manual and adding more information to the eating plan and physical activity sections. While the text messages were sent in the afternoon, most of the educators indicated that mornings would be better.

It emerged that most educators felt that the frequency of contact that formed part of the self-help weight loss intervention (one contact session in the form of the wellness day) was inadequate. Suggestions relating to frequency of contact that emerged included that quarterly visits should be included, that such visits could serve for checking health indicators and providing relevant feedback, and that such visits could potentially motivate educators to follow the intervention.

It appeared that educators viewed the possibility of an online delivery format of a weight loss intervention positively, specifically the younger generation.

4.5.3 Sub-study 3

In this sub-study, the qualitative data obtained from four principal interviews are described. Two principals were from intervention schools that completed the Health4LIFE intervention, one principal was from a control school that completed the study and one principal was from

a control school that dropped out of the study. Results are presented as themes, subthemes and sub-subthemes that emerged during analysis of the principal interviews. The total number of mentions of subthemes are presented. In addition, quotes illustrating subthemes and salient issues extracted from the themes are presented.

Six themes emerged from the principal interview data, namely 'Educator wellness', 'Wellness day', 'Barriers', 'Facilitators', 'School-based weight loss interventions' and 'Contact Frequency'.

Results on the theme related to principals' perceptions on educator wellness are presented in Table 4.37.

Table 4.37: Perceptions of principals of educator wellness

Theme	Subtheme	Sub-subtheme	Total mentions
Educator wellness (EW)	Affected by environment (EW Envir)	No sub-subtheme*	4
		Economic conditions (EW SE Eco)	1
		Social conditions (EW SE Soc)	5
		Heavy Workload (EW SE HWork)	3
		Under-performing learners (EW SE UnderPerfor)	5
		Stress (EW Envir Stress)	3
	Negative implications if not addressed (EW Neg)	Quit job (EW Neg Quit)	1
		Diet (EW Neg Diet)	1
		Absenteeism (EW Neg Absent)	3
		Poor curriculum delivery (EW Neg PCD)	1
	Important (EW Imp)	No sub-subtheme*	7
	Improved by (EW Improv)	Knowledge of diet (EW Improv DietK)	2
		Part of curriculum (EW Improv Curr)	3
	Associated with improved outcomes (EW IO)	No sub-subtheme*	3
		Educators (EW IO Edu)	9
		Learners (EW IO Lear)	3
		School (EW IO Schl)	4
	Not addressed (EW NAddress)	No sub-subtheme*	1
		Limited by medical aid (EW N Addres MAid)	1

*Participant mentioned a subtheme but not a sub-subtheme

A strong subtheme regarding principals' perceptions of the wellness of educators which emerged is environmental factors they believe affect educator wellness negatively (economic

conditions, social conditions, a heavy workload, underperforming leaners and stress). Quotes which illustrate these factors include:

Economic and social conditions:

"I think that the physical condition of teachers is of importance. For doing what they need to do, by producing their best for our kids, measuring it against the economic and also the social conditions that we are teaching in."

"And I think these social ills that we have, drugs, and FAS, alcohol syndrome kids, TB… So then I say a wellness program is for us, for our school, critically important."

Heavy workload:

"Because the curriculum that we have is a very high level paper trailed ..you can't even look, smell the roses around you. So busy you can get in a day. That just breathing, have space for a breather during the daytime would be so much influence, positive"

Underperforming leaners:

"we are too busy man and we don't care about ourselves, we are so taken up ..some of our teachers with the kids. The nitty gritty of kids under performing"

Stress:

"but stress is is is almost like it's revealing this illness and it makes it worse."

It also emerged that principals associated educator wellness with improved outcomes (in general, for the educators, learners as well as the school) and they also felt that the wellness of educators was important. Quotes which illustrate these include:

Improved outcomes in general:

"for me it's critically important to make provision because in the end it will give better results. My outcomes will be even better."

Educators:

"you can do more with a healthier person than people that are burnt out or people that are demoralised."

"If you want to get the best out of educators I feel looking after the wellness of educators is also important."

Learners and school:

"if the teachers benefit then the children will benefit and eventually the school."

"If teachers feel better about themselves they will feel better about standing in front of learners and if they feel better about themselves and their health and they feel their health is great then I think they will be more positive about teaching"

Importance of educator wellness:

"I think that the physical condition of teachers is of importance"

"But ya, for this I say wellness is a must in our schools. There is too much happening man."

Principals also mentioned that educator wellness may be improved if the Department of Education ran health interventions as part of the school curriculum for educators. It was also felt that educators required knowledge regarding a healthy dietary intake for them to be healthy. These are illustrated in the following quotes:

Part of curriculum:

"So these interventions at the school is part of curriculum. We must see it as that and I think the department must make it as a must to have say twice per year teachers have to be stopped for an hour or so just to look at their wellbeing."

Knowledgeable of diet:

"So it is of utmost importance that teachers are knowledgeable about their diet:

Another subtheme which emerged was that there were negative implications if the wellness of educators was not addressed. Sub-subthemes mentioned include an increase in absenteeism, poor delivery of the curriculum, resigning from current employment and resorting to a poor dietary intake.

Although not a strong subtheme, it was mentioned that educators often do not address their health problems and one sub-subtheme which emerged was that this was because medical aid benefits limited medical visits.

Results on the theme related to principals' perceptions of the wellness day that was conducted at the school are presented in Table 4.38.

Table 4.38: Perceptions of principals of the wellness day conducted at the school

Theme	Subtheme	Sub-subtheme	Total mentions
Wellness day (WD)	Educators thoughts (WD Edu)	Appreciative (WD Edu Appre)	1
		Pampered	1
		Positively seen (WD Edu Pos)	7
		Beneficial (WD Edu B)	3

		Created health awareness (WD Edu HA)	2
	Roll out positively seen (WD RO Pos))	No sub-subtheme*	4
	Created health awareness (WD HA)	No sub-subtheme*	4
		Positive feeling if good health (WD HA PosFee)	1
		Otherwise not sought (WD HA ONS)	1

*Participant mentioned a subtheme but not a sub-subtheme

Subthemes regarding the wellness day which emerged include what the principals believe the educators' thought about the day i.e. that educators mostly saw it as a positive event, that it was beneficial to them, that it created health awareness and they were appreciative of the day and felt pampered. Quotes which illustrate these notions include the following:

Positively seen:

"But at the end they feel very positive about it and it was a good intervention at the best time"

"when we announced that there is going to be a wellness day our teachers were actually very excited"

Beneficial:

"They immediately realised that yes I have a problem I have this or the other. So ya I definitely think it benefitted us."

Created health awareness:

"that people became so aware of their intake their diets because yes there is a number of overweight people"

"They immediately realised that yes, I have a problem I have this or the other."

Another subtheme which emerged was that using the wellness day to roll out the intervention was positively seen by the principals. It also emerged that that the principals felt that the wellness day created health awareness, as illustrated in the following quotes.

Roll out positively seen:

"Like I previously said we have an annual wellness day together with other schools. So I like the idea."

"That's why I'm saying I think the way you started it was, the roll out was really good for me."

Created health awareness:

"I think that day was an eye opener, starting with myself."

"It's good for everybody because at that wellness day you actually evaluated where you were"

Results on the theme regarding principals' perceptions of barriers and facilitators to a weight loss intervention are presented in Table 4.39.

Table 4.39: Perceptions of principals of barriers to and facilitators of a weight loss intervention within a school setting

Theme	Subtheme	Sub-subthemes	Total mentions
Barriers to program (B)	Interruption of teaching time (B TeachTime)	None	2
	Educators deem as extra work (B EWork)	None	1
	After school scheduling (B ASS)	None	1
	Apply to DoBE to deviate (B AtoDev)	None	1
	Attendance affected by Prior commitments (B PCommit)	None	1
	Full program (B FProg)	None	1
Facilitators of teaching time lost (F)	Carefully planned visits (F Plan)	None	4
	Class invigilation by others (F Invig)	None	6

The interruption of teaching time emerged as a perceived barrier to having a weight loss intervention at the school. Other barriers principals mentioned include educators seeing the intervention as another activity added to their workload, scheduling the intervention after school hours when personal commitments await, the school itself has to apply to the Department of Education if they wanted permission to deviate from the normal school day, if educators had prior commitments which could not be re-scheduled they were unable to attend and finding it difficult to schedule the intervention as the school program was so full. Quotes which illustrate some of these notions include the following:

Interruption of teaching time

"Anything which takes away from teaching time can be a barrier"

"the department is not keen towards interfering with contact time"

Full program

"Yes we had.we normally have a full week. We are pressurised by ourselves by the poor results of learners. We are giving learning intervention, we are having sport, we are having culture and we need to prepare ourselves and have meetings. So during the course of the week every day is filled to capacity. So when you came we had to cancel some of these things"

Subthemes which emerged regarding principals' perceptions of factors that could contribute to minimising teaching time to accommodate roll out of the intervention include carefully planned visits, as well as the possibility of schools organising class invigilation by persons other than the teaching staff, as illustrated in the following quotes:

Carefully planned visits:

"But then also let's say you can come on a more regular basis then we can plan it much better"

"Anything which takes away from teaching time can be a barrier – time management is there for important so as not to interrupt teaching time too much."

Class invigilation by others:

"we can make use of our parents, our school governing body, even our – I'll say my helpers around because we have a disabled group. They are invigilating my classes when a teacher has to come in later or even perhaps absent."

"But if you for instance come now, we have a few students (Student teachers) at the school but we also have a few SGB appointed teachers and support staff that can actually at least be in the class while the teachers is gone"

Results on the theme regarding principals' perception of having a weight loss intervention at their school are presented in Table 4.40.

Table 4.40: Perceptions of principals of having a school-based weight loss intervention

Theme	Subtheme	Sub-subtheme	Total
School-based Weight loss intervention (SBI)	Affordable (SBI Affor)	No sub-subtheme*	1
	Convenient (SBI Conv)	No sub-subtheme*	3
	Positively seen (SBI Pos)	No sub-subtheme*	3
		Influence learners (SBI Pos Leaner)	1
		Influence parents (SBI Pos Paren)	1
	Accessible (SBI Access)	No sub-subtheme*	1
	Peer support (SBI PS)	No sub-subtheme*	1
		Encourage (SBI PS Encour)	1
		Overcome barriers (SBI PS OBarr)	1

	Accompany own wellness program (SBI OWP)	No sub-subtheme*	1

*Participant mentioned a subtheme but not a sub-subtheme

Principals perceived a school-based weight loss intervention in a positive light and felt that it was convenient. Other subthemes which emerged regarding school-based weight loss interventions were that it was affordable, accessible and that it could enhance an existing wellness program at the school. Peer support was another subtheme mentioned, in general that it could encourage peer support during an intervention and also that it could help overcome any barriers educators encountered with the weight loss intervention. Quotes illustrating these perceptions include:

Positively seen, affordable, accessible, convenient:

"I think it will be a good additive. And something that they know is available to them. Because you think in terms of moneywise, you must make an effort to get if you can get on your own. Here it is a normal, you must be here so you can as well partake in a program"

"So yes, I am very positive and I was positive about it then also. Same with the staff."

Peer support:

"The mere fact that they are 10 and not 1 they encourage each other. So with that encouragement it means they support each other. You see. I think that will help whatever barriers we have to overcome that."

Results on the theme regarding principals' critique on the frequency of contact educators experienced during the weight loss intervention are presented in Table 4.41.

Table 4.41: Perceptions of principals of the frequency of contact during the weight loss intervention

Theme	Subtheme	Sub-subtheme	Total
Contact frequency (CF)	Regular quarterly health visit needed (CF RHV)	No sub-subtheme*	8
		Remind group of focus (CF RHV Remin)	1
		Not in 4th term (CF RHV Not4)	2
		Even in 4th term (CF RHV 4)	3
	16 weeks too long (CF Inadeq)	Focus lost (CF Inadeq Lost)	1
		Greater assistance needed (CF Inadeq Assis)	2

*Participant mentioned a subtheme but not a sub-subtheme

A very strong subtheme which emerged regarding the frequency of contact experienced was that regular quarterly health visits were needed. Some principals mentioned that these visits could occur in the fourth term, while others thought it was too busy. It was also felt that the 16-week period of no contact in the existing weight loss intervention was too long and that during this time focus was lost and greater assistance was needed. Quotes which describe these notions include:

Regular quarterly health visits:

"perhaps every 4 weeks someone can come and remind the group as to what the focus is"

"I think you should come more"

"Best to not come in 4th term"

"You must be more visible. More visible"

16 weeks too long:

"I think 16 weeks is too long without any contact – the focus is lost"

"if you start a program you must assist the person to get into this thing. and develop it and become used to what he or she is doing to make it a lifestyle. Now that didn't happen."

Salient issues

It strong subtheme that emerged was that principals thought that environmental factors play a huge role in the wellness of educators. The environment was mentioned in general, but more specific factors were also mentioned and included economic and social conditions, a heavy workload, under-performing students and stress. Another strong subtheme which emerged was that principals considered educator wellness to be important and that educator wellness was associated with improved outcomes (in general, for the educators, learners, and the school). Principals mentioned that educator wellness may be improved if educators had knowledge of a nutritious dietary intake and if a school considered educator wellness to be part of its curriculum. Principals perceived that if educator wellness was not addressed, negative implications could result such as absenteeism, poor curriculum delivery, eating a non-nutritious diet and educators wanting to resign from their positions.

Principals felt that educators were mostly positive about the wellness day, that they felt pampered, that it was beneficial, that they were appreciative of it and that it created health awareness. The principals themselves also found that the wellness day created health awareness and they regarded the strategy of using the wellness day to implement the intervention in a positive light.

Several factors were mentioned by principals as barriers to a weight loss intervention. Subthemes included the interruption of teaching time, educators perceiving the intervention as another task for them to complete within the context of already having a full school program, while after school scheduling of the intervention would also be problematic as it could coincide with personal responsibilities or prior commitments that cannot be rescheduled, A further barrier that emerged was the fact that schools have to apply to the Department of Education if they want to deviate from the normal school day. To address potential barriers to implementing the intervention, especially the possible loss of teaching time, carefully planned visits and organising class invigilation by non-teaching staff were mentioned.

It emerged that principals mostly viewed a school-based weight loss intervention in a positive light, and that they thought it was convenient and contributed to peer support and may assist educators with overcoming any barriers to engaging with the intervention successfully.

It clearly emerged that principals felt that frequency of contact in the Health4LIFE intervention was not sufficient and that regular quarterly health visits were needed. Principals mentioned that no contact during the 16-week intervention was not good as educators lost their focus in this time; it was also mentioned that educators needed more assistance during the intervention period.

4.3.1 Summary assessment of feasibility outcome measures

Table 4.42 presents a summary of the assessment of the feasibility outcome measures of the Health4LIFE intervention to inform recommendations for a future full-scale study.

Table 4.42: Summary of findings on primary and secondary outcome measures for feasibility testing of the Health4LIFE intervention

Feasibility outcome measures	Indicators	Findings
Reach (quantitative and qualitative data)	Recruitment statistics (secondary outcome)	Two cycles of random selection of 24 schools per cycle to achieve the target of 20 participating schools because of reluctance of principals to consent to the research.
	Principals' opinions* (primary outcome)	Principals mentioned the following potential barriers to participation: interruption of teaching time; prior commitments of educators which cannot be rescheduled; an already full school program and the need to apply to the (DoBE) for deviations from the normal school day.
	Attendance of wellness day and recruitment	The wellness day worked well to recruit the target number required for the purpose of this study.

	statistics (secondary outcome)	
	Gender representation (secondary outcome)	Male recruitment was particularly poor with only 20% of educators recruited being male.
	Retention statistics (secondary outcome)	The workplace-based intervention worked well to retain educators with a 38% total drop-out rate.
		Schools that allowed baseline and follow-up visits had good retention rates. However, three schools did not allow a follow-up visit as it was not convenient for them and accounted for 59% of the drop-out rate.
	Comparison of study completers with study drop-outs (secondary outcome)	African black educators were more likely to drop out. Educators who had attempted weight loss before were more likely to drop out.
Acceptability (qualitative data)	Educator** and principal* critique of a wellness day to recruit educators into the intervention (primary outcome)	Principals and educators perceived the wellness day to be an acceptable strategy to recruit volunteers and create awareness of the intervention.
	Educator** and principal* critique of a weight loss intervention within a school setting (primary outcome)	Principals and educators perceived the school setting to be acceptable for implementation of a weight loss intervention for educators.
	Educator** health goals (primary outcome)	Educators mentioned that a healthy lifestyle and weight loss was still a goal for them.
	Principal* critique of a weight loss intervention (primary outcome)	Principals were accepting of implementing a weight loss intervention for educators, acknowledged the importance of educator wellness and mentioned that it was their perception that educators were also positive about the possibility of implementing a weight loss intervention in the school setting.
	Educator** critique of the intervention content (primary outcome)	Educators perceived the information provided in the manual and text messages to be acceptable. Recommendations to improve the manual included considering providing it in other languages, improving the structure of the manual and adding more information to the eating plan and physical activity sections. Educators also indicated they would like to select their preferred time to receive text messages.
	Educator** critique of mode of intervention delivery (primary outcome)	Educators perceived the intervention delivery (wellness day, hard copy manual to facilitate dietary pattern and physical activity for health and weight loss and text messages) to be acceptable.

	Educator** and principal* critique of frequency of contact during the intervention period (primary outcome)	Educators and principals felt that only one point of in-person contact during the 16-week intervention period was not acceptable.
Applicability (qualitative data)	Principal* critique of the implementation of the intervention within their school (primary outcome)	Principals perceived that implementation of a weight loss intervention within a school setting that has a full academic calendar could be challenging. Principals mentioned that support from the DoBE and flexibility when researchers arrange visits would facilitate implementing the intervention.
	Educator** critique of the implementation of the intervention (primary outcome)	Educators mentioned that an intervention could be perceived as another task for them to add to their already full schedules.
	Educator** and principal* critique of frequency of contact during the intervention period (primary outcome)	Educators and principals mentioned that despite the challenges associated with an intervention within the school setting, they would prefer frequent health visits, even during the fourth school term.
Implementation integrity (quantitative and qualitative data)	Recruitment statistics at the wellness day (secondary outcome)	Eligible educators were identified at the wellness days and 40.1% of those who attended agreed to participate in the intervention.
	Educator** critique of engagement with intervention manual and text messages (primary outcome)	Educators mentioned that they engaged with the manual and the text messages. Completing the self-monitoring activities was reported to be a challenge.
	Lost to follow-up (drop-out) statistics (secondary outcome)	The 16-week follow-up visit was not possible at three schools as a suitable time could not be arranged resulting in 31 educators lost to follow-up.
	Measures implemented to ensure text messages were sent as intended	A service provider was sourced to send out the text messages over the 16 weeks. The PhD candidate was included on the recipient list to ensure that messages were received as intended.
Potential effectiveness (quantitative data)	Changes in secondary outcomes (weight, diet, physical activity, beliefs, readiness to change, nutrition knowledge and body weight perception)	A trend towards weight loss within the intervention-, but not in the control group, was evident. Significant positive lifestyle changes within the intervention-, but not in the control group (decreased intake of sugary food items, decreased frequency of

		adding fat and sugar to food, increased physical activity and decreased sedentary time). Positive changes in belief patterns regarding dietary intake and physical activity within the intervention-, but not in the control group. Significant positive changes in readiness to change within the intervention- but not control group for the behaviours “increase fruit intake” and “decrease sugar intake” (movement to attempting change currently or attempting to maintain change from contemplation of change). There were no significant changes in nutrition knowledge scores in either the intervention or control group. There were no significant differences in body size perception category profiles between the intervention and control groups.

DoBE: Department of Basic Education

*From in depth interviews with 4 principals of participating schools

**In depth interviews with 6 study intervention completers

4.6 Discussion

This study set out to test the feasibility of a self-help weight loss intervention that was developed for overweight and obese primary school educators employed at public schools in low-income settings in Cape Town. Results reflecting reach, acceptability, applicability and implementation integrity (primary or process outcomes) and potential impact on weight, lifestyle (food choices, physical activity and associated beliefs), readiness to change, nutrition knowledge and body size perception (secondary or impact outcomes) of the Health4LIFE intervention support feasibility of the intervention. Some aspects that should be addressed to refine the feasibility of the intervention and ensure smooth implementation of the Health4LIFE intervention were also identified.

Baseline participants (educators) in this research were mostly female, black African or coloured (African black educators in the intervention arm were more likely to drop-out than their coloured counterparts), in their mid-forties, in a higher living standard category (8-10), non-smokers and experienced low levels of depression, which was also the case in the follow-up groups. The majority were obese class I or class II and had a correct perception of their

weight status. Two thirds in the total baseline control group and just more than a third in the total intervention baseline group had attempted weight loss before. Of note is that study drop-outs were significantly more likely to have attempted weight loss before than study completers. Almost 90% of the total group of educators had a waist circumference above the cut-off for health. Approximately 10% had high blood pressure at baseline, while less than 15% reported having hypercholesterolaemia (study intervention completers were more likely to report having hypercholesterolaemia than study drop-outs), less than 3% having heart disease, 5% or less having had a stroke and less than 10% having diabetes. Similar numbers of educators reported using medications for these conditions.

The profile of the educators at baseline reflects the profile of educators on the Department of Basic Education (DoBE) personnel (PERSAL) database, as well as the national 2015/2016 educator survey where educators were found to be mostly female, African, older than 45 years of age, married, non-smokers and either came from households which had “most of the important things, but few luxury goods” or households “with money for food and clothes, but short of many other things” [Zuma et al., 2016]. The psychological wellbeing of educators in the present study was good (65.8% were minimally depressed) and comparable to that found in the national 2015/2016 educator survey where 71.3% of educators reported that their emotional and mental health was not a problem [Zuma et al., 2016]. With the exception of hypertension, the NCD risk profile is comparable to that obtained in the 2015/2016 national educator survey [Zuma et al., 2016] and that reported by Senekal et al. (2015a) for educators teaching in schools in lower socio-economic areas in the Western Cape [Senekal et al., 2015a]. The prevalence of measured essential hypertension in the present study (12.1%) at baseline was lower than that found by Senekal et al. (2015a) (46%) and the 2015/2016 national educator survey (22.1%) [Zuma et al., 2016], but similar to the national findings in the 2012 SANHANES (10.2%; including all weight categories) [Shisana et al., 2013]. This is an unexpected finding as hypertension is known to be more prevalent amongst overweight and obese individuals, as shown by Ware et al. (2019) who investigated predictors of hypertension in South African adults who were recruited as part of a WHO country-wide population survey [Ware et al., 2019]. Those with hypertension had a BMI of 29 kg/m^2 and a waist circumference of 96 cm while those without hypertension had a BMI of 28 kg/m^2 and a waist circumference of 89 cm.

At baseline, the food choices of the intervention and control groups reflected an undesirable diet which was low in healthy food choices such as fruit (once a day), vegetables (1-2 times a day) and low-fat options (less than once a day), with consumption of high fat foods and adding sugar and fat to foods being prevalent. These results are in line with national dietary intake data [DoH, 2019; Shisana et al., 2013] and educator dietary intake data [Seme et al., 2017]

which also reflected an inadequate fruit and vegetable intake and a daily intake of sugary food items and high fat foods.

Nutrition knowledge of the educators seemed to be poor at baseline (51.2%) and was even lower than that found by Oldewage-Theron and Egal (2012) (63.3%), who investigated nutrition knowledge in a group of Life Orientation educators teaching at public schools across South Africa. Oldewage-Theron and Egal (2012) concluded that the nutrition knowledge of educators in their study was poor despite them teaching a subject in which nutrition was a major focus.

Inadequate physical activity was a further characteristic of the baseline sample, with the study intervention completers spending significantly more time being sedentary than study intervention drop-outs. Joseph et al. (2018) reported a similar prevalence of inactivity amongst South African educators in a recent weight loss intervention where 62.5% of educators did not meet the recommended physical activity level. However, the number of educators in the intervention group who met the physical activity guidelines post intervention was significantly greater compared to those in the control group (14.7% versus. 8.3%). In the study by Seme et al. (2017) it was found that female educators and those older than 50 years were significantly more likely to be classified as having low levels of physical activity, which may explain the low levels of activity in the present study who were mostly female and older than 45 years of age. A similar trend was found in the national data where females were more likely to be unfit and this prevalence increased with age [Shisana et al., 2013].

Primary (process) outcomes

Reach:

In this feasibility study reach was assessed in terms of recruitment statistics, principals' opinions and perceptions, attendance of the wellness day by educators, gender representation, retention statistics and comparison of study completers with study drop-outs using quantitative and qualitative results.

Achieving a target sample of educators for a weight loss intervention would depend on the prevalence of overweight and obesity in the target population. With evidence showing that up to 80% of educators teaching at public schools in the Western Cape were either overweight or obese [Joseph et al., 2018; Senekal et al., 2015a], availability of overweight or obese educators at schools was not foreseen to be and was not a problem. The weight status profile of the total group of educators who attended the wellness day in the 20 schools could not be

determined as those who declined participation or were not eligible (had a normal weight) did not provide consent for use of their information.

During the initial recruitment phase 24 schools were randomly drawn from a list of eligible schools. These schools were contacted and invited to participate in the wellness day and the intervention. As many principals were reluctant to provide consent for the intervention, a further 24 schools had to be sampled to achieve the target sample of 20 schools. In a much earlier study where an educator wellness program was implemented at schools, a similar trend was found. In the latter study 82 primary school principals were invited to participate. Twenty-two schools immediately indicated that they were not interested, with a further twenty-eight later refusing to participate [Resnicow et al., 1998]. Barriers mentioned by principals of schools included in the present study at the conclusion of the 16-week intervention period regarding their experience of their school's participation in the research, may provide some insights why so many principals were initially reluctant to approve participation. These include the possibility that teaching time may be interrupted, prior commitments made by schools/educators that could not be rescheduled, an already full school program and also that schools had to apply to the DoBE for any deviation from the normal school day.

Once schools were recruited, a wellness day was held as the first element of the Health4LIFE intervention for creation of health awareness along the lines of the HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958]. All educators in the schools were invited to take part in the NCD risk health assessment, which provided the opportunity to recruit eligible educators for the feasibility study. Workplace wellness days have been reported to be popular [Jung et al., 2012; Boshtam et al., 2010] and well attended [Joseph et al., 2018]. There are more than 60 million staff employed globally across all educational areas, thus the potential exists to deliver a wide-reaching behaviour change intervention [Roser, 2017]. Results of the present study show that 51.2% of educators in the 20 recruited schools opted to complete the wellness assessment, which supports the notion that the wellness day, which included an in-person health assessment, is an effective "entry-into-care" approach in the school setting as also found by Joseph et al. (2018). A baseline sample of 137 overweight and obese educators was recruited, of whom 79 were randomised to the intervention and 56 to the control group; the target was a total sample of 120 to be randomised to the two arms of the study. Of note is that at baseline, up to a fifth of intervention and control study completers reported that they considered themselves to be under- or normal weight. Despite this misconception of their actual weight status, they still agreed to participate in the intervention that was focused on weight loss and complete it, after having attended the wellness day. This may reflect that educators have an interest in the concept of a healthy lifestyle and the trust educators had in the validity of the health assessment that was done, especially then also the

weight assessment. The wellness day was clearly an effective and non-confrontational approach to recruit educators without singling out those who were overweight and obese and can therefore be recommended as an appropriate “entry-into-care” approach.

Upscaling the Health4LIFE intervention testing to a full randomised controlled trial would require a sample of approximately 300 educators to be recruited. Besides the strategy of increasing the number of schools recruited for research to recruit a larger sample, greater attendance of educators of the wellness day should be achieved. Endorsement by the DoBE would go a long way to ensure that it forms part of the school calendar and thereby “freeing up” educators and allowing them to attend such events. Principals also play an important role in encouraging educator participation as was shown by Joseph et al. (2018) and Pretorius and De Villiers (2009) who reported that school initiatives were better supported by educators when endorsed by principals. It may have been useful to interview educators who did not attend the wellness day, as well as educators who were eligible to participate in the study but did not do so, to gain further insights as to their reasons for not attending or participating.

Senekal et al. (2015a) showed that male educators in the Western Cape (n=517) were as likely as female educators to be overweight or obese (BMI ≥25) (72% male educators and 82% female educators in the Western Cape), emphasising the importance of targeting male educators with weight loss interventions. However, reach in terms of male educators in the present study was found to be limited. As mentioned, the large majority of educators recruited into this study was female, which is in keeping with the fact that only 23% of educators employed across the twenty schools included in the study were male [WCED, 2016]. If the results of the Senekal et al. (2015a) study are extrapolated to the sample of this feasibility study, one could have expected that 72%, thus 108 of the male educators in the total sample across the 20 schools, would have been overweight or obese. However, the study sample included only 13 males, thus 9.5%. This is not a unique finding and seems to be a global phenomenon. In a recent systematic review, which investigated the efficacy of workplace interventions to improve lifestyle behaviours of educators, it was reported that all of the included studies (six) had higher proportions of females than males, up to 98% [Nathan et al., 2020]. Franz et al. (2007) also reported that less than a fifth of weight loss participants are typically male. Further insights in this situation can be gained from a recent review of weight management interventions targeted at overweight or obese males by Kim and Shin (2020). The review showed that males appeared less concerned about their weight or less likely to attempt weight loss than females. As a result, they were less likely to partake in weight loss interventions. In addition, the review found that males considered weight loss interventions to be a part of the “female world”, especially as there are so few weight loss interventions that have specifically been designed for them [Kim & Shin, 2020]. Another point of consideration

is that the wellness day, which was the entry point of the intervention, was run by a female dietitian. In Sub-Saharan Africa it has been shown that males are more likely to be recruited into interventions when the health service provider is a male [Beia et al., 2021]. It is thus imperative that intervention delivery mode, materials and content of a weight loss intervention speak to and are attractive to male educators. Furthermore, the team involved in wellness days and potential follow-up should include male fieldworkers and/or intervention facilitators.

The retention rate achieved in the present study (53.2% in the intervention group and 74.1% in the control group) was good, which is not uncommon for interventions occurring in the workplace, including schools [Joseph et al., 2018]. The recent systematic review which investigated the efficacy of workplace intervention in the school setting reported a retention rate ranging from 30.3% to 100%. Davis et al. (2014) reported that retention rates in weight loss programmes delivered in the workplace could be twice as high as achieved by commercial weight loss interventions. Reasons that have been highlighted to explain the higher retention rates include participants being actively followed-up if a session was missed [Davis et al., 2014], the close proximity of sessions being held at the worksite [Davis et al., 2014], the development of a "trusted clinician relationship" [Davis et al., 2014; Frazee et al., 2008] and a low employee turnover rate which makes it possible to incorporate regular follow-up visits in the intervention [Kim et al., 2015]. Educators who participated in the in-depth interviews expressed that they valued having the intervention within the school setting, specifically mentioning factors such as peer support, convenience and ease of access, which may have contributed to the retention rate.

Retention rates in the present study could have been even higher if three entire schools did not drop out (two intervention schools and one control school). The principals of these schools refused to allow the follow-up visit to take place as the suggested time was not convenient for them. As the follow-up visit had to be conducted 16 weeks post commencement of the intervention, flexibility as to when the follow-up visit could occur was limited. For future reference it is therefore important that all proposed health visits are arranged in advance with the schools at a date and time which is convenient to them, and to also send reminders at set time points. It was evident that black African educators, who were mostly female, were more likely to drop out from the study. Research has found that black African women in South Africa positively associate obesity with health, wealth and beauty [Draper et al., 2016; Puoane et al., 2005; Mvo et al., 1999].]. It is therefore important that these community and cultural perceptions are considered when planning and implementing a weight loss intervention. Another factor that seems to have affected retention rates is previous weight loss attempts, which was significantly more likely in the intervention drop-out sub-group than the completer group. A systematic review identified the most consistent pre-treatment predictor of weight

loss to be fewer previous attempts at dieting [Carraca et al., 2018]. These researchers suggested that previous weight loss attempts should be assessed before educators commence an intervention to identify those at risk for poor outcomes to ensure that they get assistance with increasing self-confidence and addressing barriers [Carraca et al., 2018].

To ensure that an intended target sample of educators for interventions such as Health4LIFE can be achieved, endorsement by the DoBE and principals is important so that principals and educators are not reluctant to participate and that health visits are accommodated.

Acceptability:

Acceptability of the Healt4LIFE intervention, including the wellness day, manual content, text messages, delivery mode and frequency of contact during the intervention was assessed using qualitative results from in-depth interviews with educators and principals. It was evident that principals were very concerned about educator wellness, which they felt was negatively affected by environmental factors (including economic and social conditions), a heavy workload, under-performing learners and stress. These concerns are corroborated by the findings of a 2004 survey among educators across South Africa, which identified work dissatisfaction, work overload, personal health issues and exposure to violence as factors within the school environment that impact educator health and wellbeing negatively [Shisana et al., 2005]. The negative health implications of stressful working conditions are further evident from a study conducted in Cape Town among educators who opted for permanent retirement due to psychiatric disorders. The majority of retirees in the study cited work-related stress as a major contributing factor to their illness [Emsley et al., 2009].

Principals acknowledged that educator wellness was associated with improved outcomes, in general, for educators themselves, for learners and for the school. They recognised that not addressing educator wellness may lead to negative implications such as educators resigning from employment, absenteeism, poor curriculum delivery and eating a non-nutritious diet. The potential benefit the Health4LIFE weight loss intervention may hold for educator wellbeing was acknowledged by principals. For example, they felt that educator wellness could improve if they had knowledge of a nutritious dietary intake. This is in keeping with the results of other workplace interventions that showed improvement of employee health [Eng et al., 2016; Goetzel et al., 2014; Loeppke et al., 2008]; improved productivity [Eng et al., 2016; Gates et al., 2008], reduced medical costs [Goetzel et al., 2014; Hochart & Lang, 2011], reduced disease prevalence [Jung et al., 2012; Boshtam et al., 2010] and even happier and more loyal employees [Fitzgerald & Danner, 2012]. Wider-ranging benefits which have been associated with improved lifestyle behaviours in educators include significantly reduced costs associated with absenteeism related to lifestyle medical conditions [Virtanen et al., 2018; Fitzgerald et al.,

2016] and presenteeism (impaired functioning at work related to a medical condition) [Hemp, 2004] Principals were clearly accepting of having the Health4LIFE intervention in their schools and also mentioned that educator wellness should form part of the school curriculum. Educators themselves felt that they would like to lead a healthy lifestyle and some specifically wanted to focus on weight loss as a goal, thus also indicating acceptance of the intervention. Similarly, Duijzer et al. (2014) reported that maintaining a healthy lifestyle and knowing how to achieve it was important to the participants of a lifestyle intervention.

Educators and principals in the present study expressed very positive feelings about the wellness day. Educators stated that it made them feel pampered and that the experience evoked feelings of wellbeing and excitement. They also emphasised that it was a wake-up call in terms of their health problems, thus contributing to health awareness creation that is key to initiating behaviour change (HBM) [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958]. Goetzel et al. (2014) similarly listed "Make workers aware of their health and how being in good health improves quality of life" as the first expected outcome of a workplace health promotion program. These results show that the wellness day was a much appreciated, accepted element of the intervention, while as mentioned above, being a successful entry-point for recruitment of educators.

Educators who participated in the in-depth interviews expressed that they found the manual content to be useful. They made specific reference to the value of tips (e.g. buying fruit and vegetables on a budget and how to decrease sugar and fat intake) and meal plans provided. They also mentioned that the information was easy to understand and that it was enjoyable to work through the manual. An important point mentioned was that they felt that the dietary recommendations in the manual were not arduous, thus feasible to implement, facilitating compliance. Educators made some suggestions for improvement of the manual which included: 1) provision of the materials in other languages as well, as English was not necessarily educators' first language, even though they taught at English medium schools; 2) adding more information to the eating plan and physical activity sections (e.g. provide additional meal plans and more examples of exercises one can do) and 3) ensuring that meal plans and tips considered budget constraints. Some educators mentioned that completing the activities linked to each of the chapters was a challenge. As these activities include amongst others self-monitoring of dietary intake and physical activity, which has been shown to be associated with greater weight loss in a recent review of predictors of weight loss [Chopra et al., 2021], finding innovative solutions to overcome this challenge is imperative. This may involve incorporating eHealth into the intervention such as an electronic self-monitoring feature, which is reportedly more commonly used and quicker than the paper and pencil diary [Harvey et al., 2019] used in the present study which may have relevance to its acceptability.

Educator feedback in the in-depth interviews on the text messages was positive. They mentioned that the messages were helpful, that they contributed to motivation and served as a daily reminder of behaviour change activities to be completed. The text messages included in the Health4LIFE intervention are therefore deemed to have been acceptable and that they facilitated engagement with the intervention. The value of messaging has been demonstrated in other studies where text message interventions generated good engagement with the intervention, resulting in behaviour change [Cartujano-Barrera et al., 2019; Zhang et al., 2018]. Interventionists should be cognisant of appropriate timing of messages to meet participants' preferences. Some educators in the present study mentioned that they preferred to receive text messages in the morning rather than the afternoon, while being provided with the opportunity to choose a time that suits them best also emerged as an option. The importance of the timing of text messages was also reported in a recent smoking cessation study: if timing was judged to be optimal by participants, the messages provided support and motivation, but if judged to be suboptimal, it caused irritation [Thomas et al., 2020]. Tailoring timing of messages to educator preference should therefore be considered, however, practicality of implementation of such a system by the service provider needs to be reviewed.

Various delivery modes were considered for the Health4LIFE weight loss intervention. A self-help approach that had an initial in-person point of contact in the form of a wellness day conducted at schools, emerged as the most viable option. The reasoning behind this was that it was a potentially effective option, requiring limited human and financial resources and would result in the least amount of interrupted teaching time. Acceptability of this delivery format is reflected in the findings that educators and principals thought that having a weight loss intervention implemented within the school setting was convenient. An important point that was mentioned is that the school setting promotes peer support, which facilitates dealing with barriers to behaviour change via mutual support. Results show that the self-help approach in terms of receiving the necessary education- self-assessment- and self-monitoring monitoring tools, and then using these to change behaviour, was not mentioned as a constraint to completing the intervention. However, it was evident that both educators and principals did not approve of only one point of in-person contact. Nearly all interviewees indicated that more regular contact during the intervention period was preferred and that educators lost focus and/or motivation during the 16-week intervention period. It was mentioned that more regular follow-ups would provide the opportunity for monitoring of health indicators, providing feedback and motivation of educators. Nathan et al. (2020) reviewed the efficacy of workplace interventions for educators and found that 70% of educators attended activities in one study while 72% of educators attended at least a quarter of lectures associated with the intervention in another study, indicating good acceptability of regular contact. Duijzer at al. (2014) also

reported that participants in their study cited monitoring and repeated measurements during the intervention as important to them, as it contributed to their motivation. Tang et al. (2014) concluded in their systematic review of self-help interventions that personal contact was an important component of the interventions reviewed that resulted in weight loss. Of note is that consideration of inclusion of more frequent contact points is only feasible if endorsed by the DoBE.

The potential acceptability of an online platform for weight loss intervention delivery was also explored in the in-depth interviews with educators; interviewees expressed positive feelings in this regard. However, delivery via an online platform should address the need expressed for more contact, follow-up assessments and relevant feedback. In a recent systematic review of 12 studies, smartphone app features such as self-monitoring, personalised goal setting, feedback and reward systems, counselling and social support were found to increase self-regulation, and potentially promoted healthy behaviours and subsequent weight loss [Wang et al., 2020]. The current Coronavirus pandemic has also changed the way the world views communication over online platforms, which has now become an acceptable means of communication [Wiederhold, 2020]. Alternative modes of delivery such as eHealth interventions, which support the online delivery of an intervention, should therefore be considered when in-person contact is limited or not possible, as recommended by leading health authorities [Wharton et al., 2020; Raynor and Champagne, 2016; Jensen et al., 2014].

Applicability:

The extent to which the Health4LIFE weight loss intervention could be implemented within the school setting was investigated using school recruitment statistics, as well as results from in-depth interviews with educators and principals.

Research shows that intervention delivery in the school setting does not come without educator specific challenges. In South Africa factors that may reduce willingness of educators to sign up for an intervention, thus reducing applicability, include work dissatisfaction, personal health issues, exposure to violence and job-related stress [Zuma et al., 2016; Shisana et al., 2005]. In the present study educators mentioned that an intervention, even if targeted at themselves, could be considered to be another task to add to their already full schedules. This is corroborated by findings from a 2004 survey among educators across South Africa that work overload was a factor within the school environment that impacted negatively on educator health and wellbeing [Shisana et al., 2005]. Zuma et al. (2016) further reported that one of the main reasons cited by educators for wanting to leave the profession was a heavy workload. The reluctance of many principals in the present study to agree to participation could also be interpreted as reflecting negatively on applicability; 48 schools needed to be contacted before

the target of twenty schools was achieved. Aspects here that may need to be addressed to improve applicability include the full academic timetable, accommodating prior school and educator commitments and the fact that schools need permission from the DoBE to deviate from the normal school day. However, there are also factors within the school setting which may support applicability such as available facilities in these settings (e.g. sports fields which many schools may have) as well as regular opportunities to engage in healthy behaviours (e.g. actively participating in sports lesson or activities aimed at learners) which may promote the long-term implementation of interventions at schools [Pelletier, 2011].

Applicability of the weight loss intervention further seems to be highly dependent on flexibility of the research team in terms of arrangement of visits to the schools. Moreover, visits should be arranged timeously to prevent schools from dropping out, as was the case with three schools in the present study where a suitable date and time could not be agreed upon. Flexibility in terms of fieldworkers (or then health care workers in the real-life setting) being stationed at schools for a full school day that would allow educators to attend as and when they have free time in their schedules needs to be considered. This would also allow principals more flexibility in terms of including the visits in the formal school programme without disrupting teaching activities. The possibility of scheduling health visits to occur after school was mentioned by principals and they considered this option to be potentially less disruptive to the teaching day. However, they pointed out that scheduling health visits after school hours may coincide with personal responsibilities or prior commitments of educators which they may not be able to reschedule. This may result in educator resistance to the intervention, or else for them to be unable to participate even if they wanted to do so.

The developers of the Health4LIFE weight loss intervention considered a self-help approach with only one point of in-person contact at the start of the 16-week intervention as most appropriate. Repeated contact sessions would contravene the current DoBE policy which only allows educators to leave the classroom for official school business [Reddy et al., 2010]. However, many educators and most principals indicated that they preferred regular health visits, which reflects negatively on the applicability of the once-off point of in-person contact. Principals supported more regular visits despite the implications this may have on the school; they regarded the implications of ignoring educator health as potentially having far worse outcomes for the school. In fact, educators and principals supported scheduling visits in the fourth term even though the DoBE does not allow school visits to occur during this term (personal communication with Dr Wyngaard, Western Cape Education Department Directorate Research on 7th April, 2017). Interviewees' motivation for recommending visits during the fourth term was that they needed a greater focus on ensuring their health during this stressful time of the year.

Applicability at this point in time within the context of DoBE is highly questionable as a result of lack of relevant policies that speak to health promotion amongst educators.

Implementation integrity:

The degree to which the implementation of the Health4LIFE weight loss intervention was aligned with the implementation plan was assessed using quantitative (recruitment and retention statistics, as well as records on text messages sent) and qualitative results from educator and principal in-depth interviews. Results show that the implementation plan mostly proceeded as intended. First, eligible educators were identified and recruited at the wellness day. Next, baseline data was obtained at a time convenient to schools and the Health4Life manual or DoH pamphlet was provided to the educators, and finally, follow-up assessments were conducted 16 weeks after baseline. However, implementation integrity was seriously affected by the fact that three schools opted out of the study, resulting in a material LTFU of educators. Further constraints experienced were DoBE regulations that do not allow school visits during the fourth term that typically starts early October (see 2022 example of the South African school calendar in Figure 4.3). Educators are not at schools during school holidays (Figure 4.3), prohibiting scheduling of follow-up assessments during these times. Recruitment of schools for a 16-week intervention that includes baseline and follow-up assessments must thus be scheduled around these school holidays. Baseline assessments can also not be scheduled later than July to avoid running into the fourth school term.

Figure 4.3: Example DoBE academic school calendar: 2022

Lee et al. (2018) explain that successful completion of intervention activities reflects appropriate engagement with, and thus integrity of an intervention. Integrity of the self-help materials that were provided as part of the Health4LIFE weight loss intervention is reflected in some of the educator responses in the in-depth interviews. They mentioned that they had engaged with the content in the manual and that they had enjoyed working through it. However, educators mentioned that they found the self-monitoring activities challenging to complete and engagement with this element may thus have been sub-optimal. As mentioned, self-monitoring improves adherence and consistently predicts weight loss success [Harvey et al., 2019]. Non-compliance with self-monitoring activities by educators in self-help weight loss interventions is not uncommon [Hartmann-Boyce et al., 2019]. A paper and pencil diary, as was included in the Health4LIFE weight loss intervention, is reportedly less commonly used in behavioural weight loss interventions at this point in time than electronic forms of self-monitoring which require less time to complete [Harvey et al., 2019]. As mentioned, incorporating eHealth into the Health4LIFE weight loss intervention such as the addition of an electronic self-monitoring feature may not only improve acceptability but also implementation integrity and should therefore be considered.

Integrity of delivery of the text messages was satisfactory. A reputable service provider was appointed to send out the messages. For these purposes contact numbers of the educators recruited during a particular week were sent to the service provider at the end of the week in question to initiate sending of the first week's messaging to those week's recruits. A system was also put in place to check that messages had actually been sent, that they had indeed been received and that the correct message was received at the correct time point by each educator.

Secondary (effect) outcomes

When considering results on secondary outcomes in a feasibility study it is important to bear in mind that the study sample is not powered to determine effectiveness of the intervention, thus whether it resulted in for example significant behaviour change and weight. Rather, feasibility testing insights in whether there is potential to achieve specified secondary outcomes [Eldridge et al., 2016].

Weight loss results in the present study show that the Health4LIFE weight loss intervention possibly has the potential to result in weight loss in overweight and obese educators, as a non-significant trend toward weight loss was observed in the intervention group (weight loss p=0.093, reduction in BMI p=0.086), but not in the control group. This trend towards weight loss may be explained by the potential of the intervention to contribute to creating health awareness as specified in the HBM [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] and result in changes in beliefs, intention to change and performing target behaviours along the TPB pathway [Azjen, 1991].

Educators in both groups had a good perception of their weight status, namely being overweight or obese at baseline. This may be attributable to them being classified as overweight or obese at the wellness day by a dietitian (first element of the intervention), which may have contributed to health (weight) awareness and initiation of the process of change.

The notion of effecting behaviour change by improving relevant beliefs is underpinned by the COM-B model of the BCW [Michie et al., 2011] and the TPB [Ajzen, 1991], both of which were used in the development of the Health4LIFE weight loss intervention. The COM-B model posits that motivation, which relates to internal processes including beliefs, is one of three factors that influences decision making and behaviour [Michie et al., 2011], with the other two factors being capability and opportunity. The TPB postulates that salient behavioural, normative and control beliefs influence attitude, subjective norm and behaviour control, which in turn influence behavioural intention and eventually performance of the target behaviour

[Azjen, 1991]. It follows that improvement of beliefs/belief patterns is fundamental in achieving target behaviours.

Globally research on the assessment of lifestyle behaviour beliefs is very limited. In the present study messageable beliefs relating to the target dietary and physical activity behaviours were identified thought a comprehensive research process (Chapter 3, page 91) and subsequently targeted in the Health4LIFE weight loss intervention. A novel approach to investigation of healthy lifestyle related beliefs was applied by focusing on shifts in belief patterns rather than changes in individual beliefs. It is postulated that beliefs regarding health lifestyle behaviours do not exist in isolation and that investigation of individual beliefs may not allow for the identification of synergistic effects between them, nor reflect how beliefs relating to particular behaviours may improve or become more appropriately integrated as a result of an intervention. In the present study belief patterns were derived from scores for the 24 beliefs on fruit, vegetable, sugar and fat intakes, as well as physical activity that were included in the baseline and follow-up questionnaires, using principal components analysis (PCA).

At baseline the belief patterns in the intervention and control groups included a mixture of two or three focuses per pattern, which shifted to a single, clear focus per pattern in the intervention group (Pattern 1: healthy food choices and facilitators thereof, Pattern 2: physical activity and facilitators thereof and Pattern 3: health benefits of a healthy lifestyle), but not in the control group. The shifts in the intervention group reflect the emphasis that was placed on the four dietary (greater part of the manual content, activities and messaging) and physical activity behaviours, as well as benefits of a healthy lifestyle in the Health4LIFE intervention. Patterns in the control group were clearly not as well crystallised at follow-up, with the strongest pattern focusing on physical activity and facilitators thereof, as well as health benefits of a healthy lifestyle. A possible explanation for this is that the 10-page DoH booklet (Addendum XX, page 368) they received was less comprehensive, did not target specific beliefs and proportionally covered physical activity guidance in more depth than dietary.

Although both healthy food choices and physical activity are considered to be key to the treatment of overweight and obese individuals, evidence shows that energy intake restriction is the most important facilitator of weight loss interventions [Johns et al., 2014; Söderlund et al., 2009; Avenell et al., 2004]. It could thus be argued that the HEALTH4Life intervention has the potential to shift relevant beliefs towards beneficial patterns that may contribute to increasing intension to change dietary and physical activity behaviours. A further reflection of the potential effect of the Health4LIFE intervention on improvement of lifestyle related beliefs is that in the intervention group beliefs relating to potential barriers that loaded on belief patterns at baseline fell away after the 16-week period. This may reflect improvement in perceived behaviour control and self-efficacy in the intervention group. Two barrier beliefs still

loaded strongly on the second pattern (believing that 'low fat/healthy fat options are expensive') and third pattern (not believing that 'I could be physically more active even if I were tired'), indicating that an intervention that provides more basic information on healthy eating as included in the DoHs "Choose a Healthy Lifestyle" booklet (Addendum XX, page 368) may not be effective in changing barrier beliefs.

Intention to change behaviour that is necessary for behaviour change to occur as posited in the TPB (Azjen, 1991) was not assessed directly in the present study but could arguably be reflected by shifts in stage of change for behaviours under investigation. Support for this contention comes from a Norwegian study in a South Asian population where the relationship between a lifestyle intervention and stages of change for healthy eating [Johansen et al., 2010] and weight loss were investigated [Kjøllesdal et al., 2011]. The intervention received a combination of group and individual sessions over a 7-month period where lifestyle advice was offered, while the control received one short version session. The upward movement through the stages found in the Norwegian study reflected in changes made in dietary intake [Johansen et al., 2010]. In addition, Kjøllesdal et al. (2011) showed that being in action stages for several healthy dietary habits at follow-up were related to weight loss, regardless of stage at baseline. The "action" phase is thus the desired point in the cycle of change to achieve during an intervention.

The combined fruit and vegetable intake of educators in the present study was less than the recommended five-a-day [Vorster et al., 2013], with a fruit intake of less than once a day and a vegetable intake of less than twice a day in both the intervention and control groups at baseline. Stage of change for the behaviour *'increase fruit intake'* shifted from *'no plans to change'* or *'thinking about changing in the next six months or next month'* towards *'currently attempting to change'* or *'having changed'* with 33.3% in the intervention group, but only 4.7% in the control group. As a result, the intervention group was significantly more likely to be in the *'action phase'* at follow-up (61.9% versus 34% respectively). The shift in stage of change in the intervention group was, however, not accompanied by an increased frequency of consumption of fruit (there was also no change in the control group). It is, however, important to ensure that the intervention does not create a perception that 'the more fruit intake, the better' as this could compromise energy intake restriction. For the behaviour *'increase vegetable intake'* the shift in stage of change was similar in the intervention and control groups (16.6% and 16.3% respectively), with profiles not being significantly different at follow-up. The shift in stage of change was accompanied by a significant increase in frequency of vegetable intake in both groups. It is possible that the shifts in stage of change for especially fruit intake in the intervention group, reflect the shift in belief patterns. The majority of beliefs that loaded on the strongest belief pattern in the intervention group related to fruit and vegetable intake,

while the majority of fruit and vegetable related beliefs in the control group only loaded on the second and third patterns.

Baseline results in both the intervention and control groups show that high fat foods were consumed three times more frequently than low-fat foods (less than once a day) and fat was added to food between once to twice a day, potentially reflecting a dietary pattern with poor food choices in terms of fat content. For '*decrease fat intake'* the shift in stage of change from *'no plans to change'* or *'thinking about changing in the next six months or next month'* towards *'currently attempting to change'* or *'having changed'* was similar in the intervention and control groups (19.5% and 14.0%, respectively), with profiles not being significantly different at follow-up. The shift in stage of change was accompanied by a significant increase in frequency of intake of low-fat food items in both groups as well as a significant decrease in frequency of adding fat to food in the intervention group only. There was also a non-significant decrease in the frequency of intake of high-fat food items in both groups. It is possible that the shifts in stage of change for fat intake especially in the intervention group, reflect the shift in belief patterns. Two beliefs loaded on the strongest belief pattern in the intervention group which relate positively to improving fat intake, while in the control group two beliefs which relate positively to fat intake only loaded on pattern 3. In addition, one barrier belief relating to fat intake loaded on pattern 2 in the control group. Johansen et al. (2010) also found an increase in the proportion in the action stages observed from baseline to follow-up, only in the intervention group for amount and type of fat, which translated into an improved dietary change regarding the consumption of healthier types of fat.

Baseline results in both the intervention and control groups show that sugary food items were consumed nearly twice a day and sugar was added to food between one and one and a half times a day, potentially reflecting a dietary pattern with poor food choices in terms of sugar intake. For '*decrease sugar intake'* the shift in stage of change from *'no plans to change'* or *'thinking about changing in the next six months or next month'* towards *'currently attempting to change'* or *'having changed'* was less prominent in the intervention than control group (7.1% versus 19% respectively). However at follow-up, the intervention group was significantly more likely to be in the "action phase" than the control group (57.1% versus 30.2% respectively) which was accompanied by a significant decrease in intake of sugary food items and a significant decrease in frequency of adding sugar to food, only observed in the intervention group. It is possible that the shifts in stage of change especially in the control group, reflect the shift in belief patterns. No beliefs relating to sugar intake loaded on any pattern for the intervention group. Of note is that two of the three beliefs relating to sugar intake were barrier beliefs. However, two beliefs relating positively to sugar intake loaded on patterns 2 and 3 for the control group. Johansen et al. (2010) also found an increase in the proportion in the action

stages observed from baseline to follow-up, only in the intervention group for sugar, which translated into an improved dietary change regarding sugar intake.

Carbohydrate intake per se and more specifically, quality of carbohydrate, were not targeted in the intervention as this did not come up as a key concern in the formative assessments (Seme et al. 2017). A review of seven dietary surveys from 2000 to 2015 on the adult South African population revealed that the percentage energy from carbohydrates ranged from 47% to 69%, and thus fell within the Acceptable Minimum Nutrients Distribution Ranges of the Dietary Reference Intake [Mchiza et al., 2015]. Unfortunately, none of the studies reported on the quality of the carbohydrate intake. It is thus interesting to note that there were no changes in indicators of either refined or unrefined carbohydrate intakes in the present study.

It is generally acknowledged that understanding of particular health behaviours may contribute to changing relevant control beliefs to increase perceived control, intention to change and ultimately actual change in target behaviours [Azjen, 1991]. As mentioned earlier in this discussion the nutrition knowledge of educators at baseline was poor. The expectation was that this would improve as one of the strategies include in Health4LIFE weight loss intervention involved improving nutrition knowledge to contribute to achieving capability along the lines of the COM-B model [Michie et al., 2011]. However, the nutrition knowledge score did not improve in the intervention or control groups. However, because the nutrition knowledge assessment tool that was used in this research was not specifically designed to reflect information imparted in the Health4LIFE intervention, it may not have been sufficiently sensitive to measure change in knowledge relating to the specific behaviours targeted in the intervention. A further consideration is also that research has shown that improvements in nutrition knowledge are not necessarily associated with improvements in relevant attitude and behaviour [Kupolati et al., 2019; Bravo et al., 2006; Byrd-Bredbenner et al., 1984].

The physical activity levels of the majority of educators in the intervention and control groups at baseline did not meet the recommended 600 MET minutes per week [WHO, 2020b]. The intervention group was also significantly less sedentary than the control group. For 'increase physical activity' the shift in stage of change from *'no plans to change'* or *'thinking about changing in the next six months or next month'* towards *'currently attempting to change'* or *'having changed'* was similar in the intervention and control groups (7.2% versus 9.4% respectively), with profiles not being significantly different at follow-up. The shift in stage of change was accompanied by a significant increase in moderate recreational MET minutes per week in the intervention group only as well as a significantly lower sedentary time than the control group at follow-up. The intervention group therefore had an improved level of physical activity and spent less time being sedentary, as recommended by the WHO [WHO, 2020b]. It is possible that the shifts in stage of change for physical activity in both groups, reflect the shift

in belief patterns. Most of the physical activity beliefs in the intervention group loaded on pattern 2 while in the control group, these loaded on pattern 1. In addition to this, the control group maintained a barrier belief relating to physical activity which loaded on pattern 3. Studies have showed that an employee's stage of readiness to change predicts physical activity levels where employees in the "action" or "maintenance" phase are nearly twice as likely to participate in workplace physical activity challenges than those in the "non-action" phase [Walker et al., 2017; Rozenkranz et al., 2015; Horiuchi et al., 2013]. Regarding physical activity loading on the strongest belief pattern for the control group, it is important to ensure that the intervention does not create a perception that physical activity is more important than dietary behaviour. Research has shown that although both healthy food choices and physical activity are the cornerstones of the treatment of overweight and obese individuals, a hypocaloric intake is the most important factor in weight loss interventions [Johns et al., 2014; Söderlund et al., 2009; Avenell et al., 2004]. When interpreting the self-reported physical activity data it should however be noted that nearly a quarter of data relating to physical activity was discarded due to the incorrect completion of the GPAQ questionnaire by educators.

4.7 Limitations of the study

A pilot study was used to investigate the secondary outcomes of the Health4LIFE intervention in a sample size that was sufficient for the feasibility study, but not powered to test changes in beliefs, stage of change lifestyle and weight changes. However, results do provide preliminary insights in the potential of the intervention to bring about the required changes.

Nearly 20% of control and intervention completers either completed the GPAQ questionnaire incorrectly or incompletely, resulting in a substantial loss of physical activity data. The physical activity results therefore need to be considered with caution.

Self-reported data should always be interpreted with caution as information provided on socio-demographic data, health status, dietary intake, physical activity, stage of change and beliefs regarding dietary intake and physical activity may not be accurate. Subjects may recall information incorrectly, may respond in line with socially accepted norms rather than the truth or questions may be misunderstood.

Dietary intake, nutrition knowledge and stages of change sections in the questionnaire were not validated in the target population. However, as these questions/sections were used consistently (repeated at baseline and at 16-week follow-up) to investigate signals of an effect, it is plausible that changes that were noted reflect true changes.

No male educators consented to participate in sub-studies 2 and no representative of an intervention drop-out school could be recruited for sub-study 3. The insights provided in the

feasibility testing of the Health4Life weight loss intervention may therefore not reflect the perceptions of male educators and drop-out schools.

Educators mentioned that completing the activities in the manual was challenging. However, no further exploration regarding these challenges was conducted. The activities which were avoided and those that were competed could be determined and inform the development of any future activities.

4.8 Conclusions and recommendations

Results reflecting reach, acceptability, applicability and implementation integrity (primary outcomes) and signals of effect (secondary outcomes) of the Health4LIFE intervention support feasibility of the intervention. Signals of effect included favourable shifts in belief patterns regarding dietary intake and physical activity; favourable shifts in stage of change for "increase fruit intake" and "decrease sugar intake", significant changes in some lifestyle behaviours (increased intake in low fat food items, increased intake of vegetables, decreased intake of sugary food items, decreased frequency of adding fat food, decreased frequency of adding sugar to food, increase in physical activity and decreased time spent being sedentary) and a trend towards weight loss in the intervention group. The only significant changes in the control group related to dietary intake (increased intake of vegetables and increased intake of low-fat foods).

It is recommended that the following receive attention in refinement of the Health4LIFE intervention before it is either tested in a full-scale evaluation study or implemented in real world settings: recruitment of male educators, drop-out of black African educators and those who have attempted weight loss before, lack of DoBE policies to address educator health and wellbeing, educator suggestions to improve the intervention manual and poor completion of self-monitoring activities.

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CHAPTER 5

FINAL OVERVIEW, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview of the development and feasibility testing of a weight loss intervention (Health4LIFE) for overweight and obese primary school educators employed at low socio-economic public schools in Cape Town, Western Cape Province, South Africa: The pilot study

Background

Previous studies conducted in educators in the Western Cape [Senekal et al 2015; Adeniyi et al., 2017] reported a prevalence of overweight and obesity that was higher than the national data obtained from the 2003 South African Demographic and Health Survey (SADHS) [DoH, 2007], the 2012 South African National Health and Nutritional Examination Survey (SANHANES) [Shisana et al., 2013] and the 2016 SADHS [DoH, 2019]. The prevalence of overweight and obesity combined in men was found to be 29.2%, 30.7% and 31.3% and in females 56.6%, 64.0% and 67.6% across the three surveys respectively [DoH, 2019; Shisana et al., 2013; DoH, 2007]. The majority of educators in schools in low socio-economic rural and urban areas in the Western Cape, 72% of males and 82% of females, were overweight or obese [Senekal et al., 2015], and the mean BMI (31.6 ± 7.0 kg/m^2) fell into the obese class I category in the study by Adeniyi et al. (2017) among educators employed in the Metro South District. As a result, educators employed at public schools in low socio-economic areas in the Western Cape may be at a higher NCD risk than the general South African population.

Furthermore, despite the recognised importance of educators in shaping lifestyle and health behaviours of learners, there is a paucity of research regarding health risk related interventions for educators, which is a major gap and concern. This is also illustrated by the results of a recent systematic review that investigated the efficacy of workplace interventions to improve dietary and/or physical activity behaviours targeted at educators [Nathan et al., 2020]. Only six studies were identified, and Nathan et al. (2020) concluded that educators are a novel target group for the implementation of workplace-based health promotion initiatives and also that research in this area is required to improve their health behaviours. A further important insight from the review is that half of the included studies targeted educators with the intention of impacting learner health behaviour, and thus educator health was not the primary focus. Only four studies on interventions that target educator health in South Africa have been published. Three of these include nutrition education interventions by Kupolati et al. (2019) and Oldewage-Theron and Egal (2011), and the health awareness intervention by Joseph et al. (2018). The KaziHealth intervention is an ongoing health and wellness intervention among educators in the Eastern Cape, and the results remain pending [KaziHealth, 2019]. There is thus a dire need for research on feasible and sustainable nutrition-related health interventions targeted at educators. Considering the high prevalence of overweight and obesity among

educators [Senekal et al., 2015, Adeniyi et al., 2017], and the inherent risk it holds for NCDs [Ford et al., 2017; Lee et al., 2008; Haslam & James, 2005], obesity prevention and control (weight management) should be prioritized.

The present research aimed to address this gap within the South African context by 1) conducting a theory and evidenced-based process to develop a weight loss intervention for overweight and obese primary school educators employed at low socio-economic public schools in the Western Cape Province and 2) to test the feasibility of the developed intervention in a mixed methods study design.

Figure 5.1 depicts the research process followed for the development and feasibility testing of the Health4LIFE intervention within the context of the MRC framework for developing and evaluating complex interventions [Skivington et al., 2021]. The focus of the present research was on Phase 1 (intervention development) and Phase 2 (feasibility), while perspectives on and considerations for a full-scale evaluation (Phases 3) and implementation in the real-world scenario (Phase 4) are also presented in the overarching recommendations.

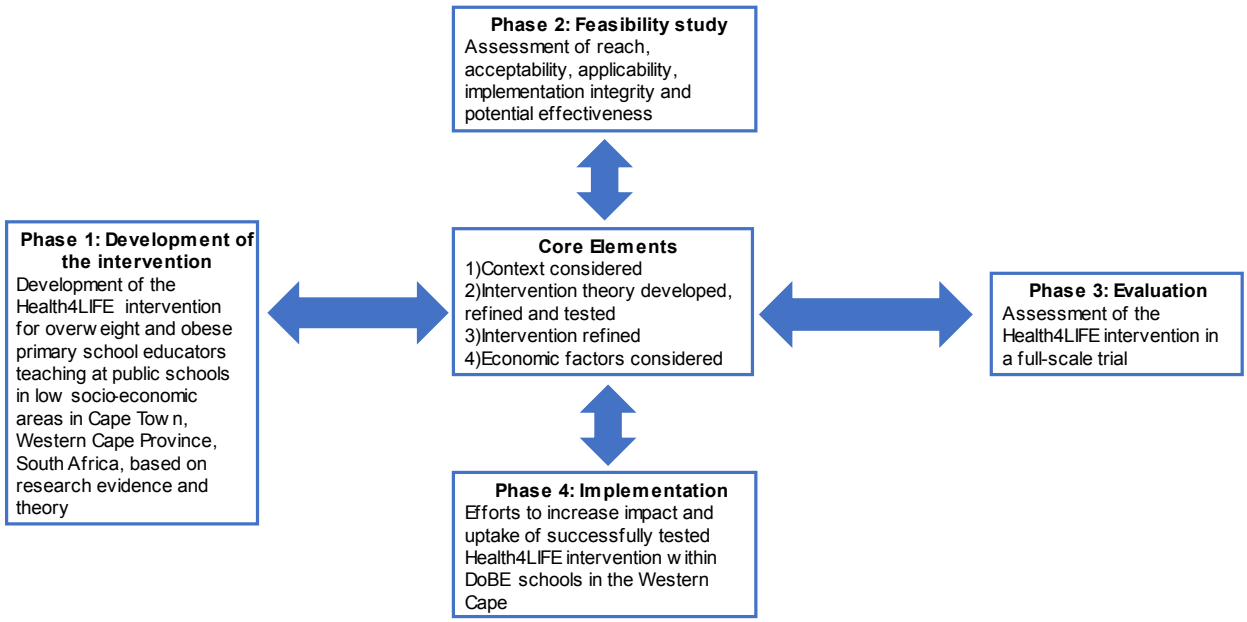

Figure 5.1: Research phases for the development of the Health4LIFE intervention:
Adapted from: MRC framework for developing and evaluating complex interventions [Skivington et al., 2021]; DoBE: Department of Basic Education

Phase 1: Intervention development: Overview, outcomes, limitations and lessons learned (Chapter 3)

In line with the recommendations of the MRC guidelines to apply a theory and evidence-based approach in the development of an intervention [Skivington et al., 2021; Craig et al., 2008], the Behaviour Change Wheel (BCW) was selected for the development of a novel self-help weight loss intervention for primary school educators (Health4LIFE). It was further decided to make use of an expert panel across the steps and to conduct testing and refinement of the intervention before taking it forward into feasibility testing as recommended in the MRC framework. The BCW framework is unique in its approach as it links theory with behaviour change techniques, it provides researchers with the tools to develop an intervention without the need for extensive knowledge about behaviour change theories and it provides a range of intervention features [Michie et al., 2011]. The focal point of the BCW comprises of the Capability, Opportunity, Motivation – Behaviour model (COM-B model) which incorporates existing behaviour change models as identified by Michie et al. (2011) and is used to identify target behaviours for an intervention.

The steps of the BCW were found to be clear, detailed and systematic and facilitated use thereof, while providing a practical way of applying theory in the intervention development process in the present study. However, the need to engage stakeholders in the design of feasibility testing as advised by Hallingberg et al. (2018) and O'Cathain et al. (2015), to ensure that appropriate data is generated, is not sufficiently supported by the BCW process [INDEX, 2019; Janols & Lindgren, 2017]. In the present study special attention was given to actively involve stakeholders, the educators, especially during the formative assessments and the initial testing of the intervention before commencing the feasibility testing.

While the BCW was the primary framework used for intervention development, the Theory of Planned Behaviour (TPB) [Ajzen, 1991], the Step approach to Message Design and Testing (SatMDT) [Lewis et al., 2016] and the Health Belief Model (HBM) [Rosenstock et al., 1988; Rosenstock, 1960, 1966, 1974; Hochbaum, 1958] were integrated in the process. This was to attain a greater understanding of educator beliefs regarding dietary and physical activity behaviours, to guide the development and evaluation of messages that targeted the beliefs, and to create initial health awareness as part of the first element of the intervention at the wellness day, respectively. Although the TPB has been commonly applied in the development of health interventions [Cheng et al., 2019; Godin et al., 2011; Andrews et al., 2010; Norman & Conner, 2005], there is a paucity of research on identification, and specific consideration of salient behaviour, normative and control beliefs relating to dietary intake and physical activity in intervention development and specific targeting of messaging.

Stages and steps executed in the intervention development process in the present study, as well as key outcomes of each step, are presented in Table 5.1

Table 5.1: Stages and steps executed in the Health4LIFE weight loss intervention development process, including key outcomes of each step

Stage	Focus	Task(s)	Key outcomes/perspectives
1	Identify target behaviours for weight loss	Review of existing research for identification of target behaviours (behaviour problems) for weight loss in primary school educators employed at low socio-economic public schools in the Western Cape	The only study conducted in South Africa that included information on the health, weight status and lifestyle of educators at the time, the HealthKick study, was identified and used to gain insights into educator dietary patterns and level of physical activity.
		Review of existing research for identification of salient beliefs of primary school educators employed at low socio-economic public schools in the Western Cape relating to identified target behaviours (application of the TPB to understand educator beliefs related to dietary and physical activity behaviours)	Twenty-four educator beliefs relating to diet and physical activity behaviours that were considered messageable, and could be targeted in the intervention were identified
2	Understanding target behaviours	BCW Step 1: Define the problem in behavioural terms	Behavioural problems were identified in terms of what the behaviour was, where it occurred and who was involved in performing it. The 4 behaviours were low fruit and vegetable intake, high sugar intake, high fat intake and low levels of physical activity.
		BCW Step 2: Select potential target behaviours to address behaviour problems	Potential target behaviours were identified, evaluated and prioritised: • Target behaviours to *increase fruit intake* were: "*purchase a variety of fruit and vegetables*", "*bring fruit and vegetables to school every day*" and "*eat a variety of vegetables at mealtimes every day*". • Target behaviours to *decrease sugar intake* were: *"limit the purchase of sugar-containing foods and drinks*", *"reduce or avoid the intake of sugar-containing cold drinks*", "*add less or no sugar to hot drinks*", "*add less or no sugar to hot beverages*" and "*avoid the intake of sugary foods/snacks during times of stress*". • Target behaviours to *decrease fat intake* were: "*select foods low in fat when purchasing foods*", "*add less fat when preparing foods*" and "*reduce or avoid high fat snacks and processed foods*". • Target behaviours to *increase physical activity* were "*increase physical activity at work*" and "*increase physical activity in free time*".
		BCW Step 3: Specify the target behaviour	Each target behaviour was specified in terms of *who* needs to perform the behaviour, *what* needs to be performed, *when* it should be performed, *where* it should be performed, how *often* it should be performed and with *whom* it should be performed.

		BCW Step 4: Identify what needs to change, with application of the TPB in reflective motivation component of the COM-B model	The COM-B model was applied to each target behaviour to identify the elements which needed to change.
3	Identify intervention options and policy categories	BCW Step 5: Identify intervention functions	The following intervention functions were deemed suitable for the intervention: education, persuasion, incentivisation, training, restriction, environmental restructuring and enablement.
		BCW Step 6: Identify policy categories	No national or local level policies regarding school health services targeting educators were found. A potentially relevant policy that was identified is the *Integrated School Health Policy* where learners are identified as the primary target group, but educators could potentially benefit from the programme. The BCW policy categories identified as appropriate for this policy include communications/ marketing, guidelines, fiscal measures, legislation, environmental/social planning and service provision.
4	Identify intervention content and implementation options	BCW Step 7: Identify behaviour change techniques (BCTs)	A total of 21 out of the 40 potential BCTs were selected for application in the weight loss intervention: • Information about consequences of behaviour in general and consequences of behaviour specific to individual, • Information about Goal setting (behaviour), Goal setting (outcome), • Prompt review of behavioural goal, Prompt review of outcome goals, • Action planning, Barrier identification or problem solving, • Setting graded tasks, Prompt rewards contingent on effort or progress toward behaviour, • Prompt rewards contingent on successful behaviour, • Prompt self-monitoring of behaviour, Prompt self-monitoring of behavioural outcome, • Provide information on where and when to perform behaviour, • Provide instruction on how to perform behaviour, teach to use prompts/cues, • Environmental restructuring, Use of follow-up prompts, • Relapse prevention/coping planning, Stress management, and Time management.
		BCW Step 8: Identify mode of delivery	Factors identified that needed to be considered in selection of the delivery mode were that: • Human and financial resource requirements should be minimal • Interruption of teaching time should be minimal, and the intervention should not add to an already busy and stressful work environment,

			• WhatsApp (or similar) platforms would be an option for dissemination of intervention message, but a web-based delivery mode not, as more than a third did not have regular internet access. Delivery mode selected (three elements): • A wellness day conducted at schools for first point of contact and health and weight status awareness creation (element 1) • A hard copy self-help manual to facilitate dietary pattern and physical activity change (element 2) • Text messages targeted at dietary and physical activity beliefs (element 3).
		Translate BCT into intervention content and actions (application of the HBM in development of the first element of the intervention and application of SatMDT in text message development process)	The three elements of the intervention were further defined in terms of structure and content. Element 1: In person face-to-face contact session as part of a wellness day conducted at schools where a NCD risk assessment and feedback to educators would be performed, and educators would be recruited into the study. Element 2: An intervention manual which was based on the South African FBDG, consisting of the following chapters: Chapter 1: Weight management; Chapter 2: General healthy eating advice; Chapter 3: Fruit and vegetables; Chapter 4: Fat; Chapter 5: Sugar; Chapter 6: Physical activity; Chapter 7: Stress management; Addendum 1: Eating plans; Addendum 2: Useful tips and information and Addendum 3: Self-assessment, goal setting and self-monitoring activities. Element 3: The text messages (80 in total sent over the 16-week intervention period, 5 per week) targeted beliefs relating to increasing fruit and vegetable intake (12 messages), decreasing sugar intake (20 messages), decreasing fat intake (20 messages), increasing physical activity (16 messages).
5	Testing and refinement	Testing and refinement of the weight loss manual content and text messages	The intervention manual and text messages were assessed by a group of 7 educators (5 females and 2 males) from a primary school with a profile similar to the schools included in the HealthKick study. Educators were mostly positive and complimentary. Considering the educator feedback, the following minor changes were made: • All the recommended activities in Addendums 1 to 3 were reviewed and revised to confirm ease of understanding and completion; • The DASH eating plan was amended to include information about serving sizes.

TPB: Theory of Planned Behaviour; HBM: Health Belief Model; SatMDT: Step approach to Message Design and Testing; FBDG:Food Based Dietary Guidelines; BCW: Behaviour Change Wheel; BCT: Behaviour Change Technique

Limitations of the Health4LIFE weight loss intervention development process that need to be considered include the following:

- The intervention was developed over a period of ten years, with formative assessments spanning eight years (2007 to 2015) and actual intervention development (using theory and an evidenced based approach) and feasibility testing occurring over two years (2015 to 2016). Over this period of time some community environmental, institutional, interindividual and intraindividual influences and factors that advised decisions in this process may have therefore changed. The South African policy frameworks in terms of educator health, or lack thereof, has not changed.
- As educators who were involved in the intervention development process were conveniently recruited through the researchers' professional and social networks, there may have been selection bias.

Lessons learned from application of the BCW integrated with behaviour change theory in the development of the Health4LIFE weight loss intervention for educators include the following:

- To achieve the desired outcomes, it is important that all the prescribed stages and steps of the BCW are completed as intended. To do this, significant resources in terms of time, researchers and funding is required. Furthermore, an in-depth understanding of the BCW and its components is essential.
- A panel of experts must be established for providing inputs and perspectives during the iterative process that forms part of applying the BCW, especially when using the APEASE criteria where judgement calls are required and also when confirming or revising the outcomes of the various tasks.
- Involving the stakeholders and incorporating their input throughout the intervention development process, to gain a better understanding of the target population, (intra- and inter individual factors and perceptions of intervention options, mode of delivery, barriers and facilitators), as well as their setting (institutional, community and policy level environment) is essential.
- Applying the BCW in its entirety is a lengthy and extensive process, resulting in large intervals between identifying a need and implementing the intervention, thus leaving the target population in limbo, with the identified weight problems and associated NCD risk continuing unabated for long periods of time before receiving the needed attention. This situation would be further exacerbated in the event of a decision to continue to Phase 3 (full-scale evaluation) of the MRC model [Skivington et al., 2021] which would further extend the time period from intervention development to implementation.

Phase 2: Feasibility testing: Overview, feasibility outcomes and limitations (Chapter 4)

Feasibility testing was either overlooked or rushed in the past, but the importance and value of this phase in intervention development is now widely accepted [Skivington et al.,2021]. A particular concern is that interventions in the public health sector often have tight timelines which do not accommodate for sufficient feasibility testing, resulting in failed intervention implementation [Kessler & Glasgow, 2011, Sanson-Fisher et al., 2007]. Of note is that the phases of the UK MRC framework are intended to be non-prescriptive and are considered neither linear nor cyclical. Once a feasibility study has been conducted and the intervention refined accordingly, the next step could be either Phase 3 or Phase 4 [Skivington et al., 2021]. Early consideration of real-world related factors that may impact on successful implementation across the phased is important to increase/ensure wide adoption and maintenance of the intervention in real world settings [Skivington et al., 2021].

Hallingberg et al. (2018), suggest that researchers use the terminology by Eldridge et al. (2016) and "view feasibility as an overarching concept, with all studies done in preparation for a main study open to being called feasibility studies, and with pilot studies as a subset of feasibility studies" [Eldridge et al., 2016]. A combination of qualitative and quantitative methods can be used to assess these processes [Moore et al., 2015; O'Cathain et al., 2015; Craig et al., 2008]. Outcomes that are investigated as part of feasibility testing vary across recommendations from research bodies and published feasibility testing of health interventions. In the present study the outcomes defined by Duijzer et al. (2014) for testing the feasibility of a health intervention were adopted. These include reach, acceptability, applicability, implementation integrity and potential effects. The latter has also been referred to as signals of effect [McVay et al., 2021].

Feasibility outcomes of the self-help Health4LIFE weight loss intervention were tested using three sub-studies. Sub-study 1 was a pilot randomised controlled trial (RCT) where the Health4LIFE weight loss intervention was tested against a control (Department of Health's 'Choose a Healthy Lifestyle' booklet, Addendum XX, page 368) to provide insights in reach and implementation integrity (primary outcomes), as well as signals of an effect in terms of belief patterns, stage of change, lifestyle behaviours and weight (secondary outcomes). A sample of primary school educators employed at public schools in low-income settings in Cape Town was recruited for these purposes. Sub-study 2 involved in-depth interviews with educators who completed the intervention arm of the RCT and Sub-study 3 in-depth interviews with principals of participating schools (schools that allowed the final follow-up assessments and those that did not) to provide further insights in reach and implementation integrity, but also acceptability and applicability (primary outcomes).

The integrated outcomes of the three sub-studies for the primary and secondary outcomes are the following:

Reach (primary outcome): Two cycles of random selection of 24 schools per cycle needed to be done to achieve the target of 20 participating schools as principals were reluctant to provide consent for the intervention. During the in-depth principal interviews, perceived barriers to the weight loss intervention were mentioned and included the possibility that teaching time may be interrupted, prior commitments by schools/educators that could not be rescheduled, an already full school program and that schools had to apply to the Department of Basic Education (DoBE) for any deviation from the normal school day. Once schools were recruited, a wellness day was held where educators received a NCD risk assessment, and they were informed about their health readings and whether or not they were eligible to participate in the intervention. It was considered an effective "entry-into-care" approach to access educators and allow eligible educators for the intervention to be identified and recruited. Recruitment of educators at the wellness day conducted at the 20 schools was adequate to meet the target number of 120 for this study, however, reach in terms of male educators was limited. The retention rate was high and was mainly affected when entire schools refused to allow the follow-up visit to be conducted as the suggested time was not convenient for them. African Black educators and educators with previous weight loss attempts were more likely to drop-out of the study.

Acceptability (primary outcome): Principals acknowledged the benefits of a weight loss intervention and even thought that schools should consider educator wellness to be part of its curriculum. Educators themselves felt that they would like to lead a healthy lifestyle and some specifically wanted to focus on weight loss as a goal, implying that educators and principals were accepting of a weight loss intervention such as Health4LIFE. The educators and principals were very positive about the wellness day and found that it created health awareness. They were also very accepting of the wellness day as an entry point into the intervention. Having a weight loss intervention implemented within the school setting was seen as convenient and the peer support enabled in the workplace was seen as beneficial by educators and principals. The manual was found to be useful, enjoyable, and easy to understand, while the text messages were considered helpful and provided motivation for the day. Educators did, however, find that completing the self-monitoring activities was challenging.

It appears that both educators and principals did not approve of the fact that there was only one point of in-person contact at the start of the 16-week intervention period. However, it is important to emphasise that the self-help approach in terms of receiving the necessary education- self-assessment- and self-monitoring monitoring tools, and then using these to

change behaviour, was not mentioned as a constraint. The potential acceptability of an online platform for a weight loss intervention delivery was also explored in the in-depth interviews with educators; interviewees expressed positive feelings in this regard.

Applicability (primary outcome): Many principals approached for participation in the present study were not keen to allow an intervention to be delivered within their schools. Some principals mentioned that interventions within the school setting may be difficult to arrange due to a full academic timetable and prior educator commitments. Another barrier cited by educators themselves was that an intervention was considered another task for them to add to their already full schedule. It proved imperative that the wellness day and health visits be arranged at a date and time convenient for the school. This was especially evident when three schools opted out of the intervention when a suitable date and time for the follow-up assessments could not be agreed upon. Applicability of an intervention within a school setting would also be affected by the lack of current relevant policies that speak to health promotion amongst educators.

Implementation integrity (primary outcome): The planned implementation procedure of the intervention mostly proceeded as intended. Although educators reported engagement with the manual, completing the self-monitoring activities, which reflects intervention engagement, was reportedly challenging. A loss of a significant number of educators resulted when schools could not accommodate the follow-up visit. The DoBE rule where no visits are allowed in the fourth term also made visits difficult to arrange. As far as the text messaging is concerned, measures that were put in place to monitor fidelity showed that messages were received as intended.

Signals of an effect (secondary outcomes): As far as the secondary outcomes are concerned, the Health4LIFE intervention resulted in favourable shifts in belief patterns regarding dietary intake and physical activity; favourable shifts in stage of change for “increase fruit intake” and “decrease sugar intake”, significant changes in some lifestyle behaviours (increased intake in low fat food items, increased intake of vegetables, decreased intake of sugary food items, decreased frequency of adding fat food, decreased frequency of adding sugar to food, increase in physical activity and decreased time spent being sedentary) and a trend towards weight loss in the intervention group. The only significant changes in the control group related to dietary intake (increased intake of vegetables and increased intake of low-fat foods).

Table 5.2 provides key perspectives for consideration, as well as recommended actions and refinements of the Health4LIFE weight loss intervention that were derived from the feasibility testing results for execution of either Phase 3 of the UK MRC framework (full-scale evaluation)

or Phase 4 (implementation of the Health4LIFE intervention) [Skivington et al., 2021] within the Western Cape DoBE school setting.

Table 5.2: Summary of key findings on primary and secondary outcome measures for the assessment of the feasibility of the Health4LIFE intervention and recommended actions and refinements

Perspectives for consideration	Factors to consider for full-scale evaluation	Factors to consider for implementation within the Western Cape DoBE
Two cycles of random selection of 24 schools per cycle needed to be done to achieve the target of 20 participating schools because of reluctance of principals to consent to the research. Principals mentioned the following potential barriers to participation: interruption of teaching time; prior commitments of educators which could not be rescheduled; an already full school program and the need to apply to the DoBE for permission deviations from the normal school day. Eligible educators were identified at the wellness days; 40.1% of attendees agreed to participate in the intervention Male recruitment was however poor with only 20% of educators recruited being male. The wellness day thus worked mostly well to recruit the target required sample for the purposes of the feasibility testing.	DoBE approval and endorsement of the research School principal approval of the research Male educator interest in and engagement with a work-based weight loss programme	DoBE endorsement and funding for the implementation School principal engagement to 'play their role' in ensuring the sustained implementation of the intervention Male educator interest in and engagement with a work-based weight loss programme .
The workplace-based intervention worked reasonably well to retain educators (38% total drop-out rate). Schools that allowed baseline and follow-up visits had good retention rates. However, three schools did not allow a follow-up visit as it was not convenient for them and accounted for 59% of the drop-out rate.	School principal approval of health visits	DoBE endorsement of health visits School principal approval of health visits
African black educators were more likely to drop out. Educators who had attempted weight loss before were more likely to drop out.	Demographic characteristics and weight loss history of educators	Demographic characteristics and weight loss history of educators
Principals and educators perceived the school setting to be acceptable to implement a weight loss intervention for educators. Educators mentioned that a healthy lifestyle and weight loss was still a goal for them. Principals were accepting of implementing a weight loss intervention for educators, acknowledged the importance of educator wellness and mentioned that it was their perception that educators were also positive about the possibility of implementing a weight loss intervention in the school setting.	No refinements required	No refinements required
Principals and educators perceived the wellness day to be an acceptable strategy to recruit volunteers and create awareness of the intervention.	No refinements required	No refinements required
Educators perceived the information provided in the manual and text messages to be acceptable.	Implementation of suggestions made by educators for the manual Tailored timing for text messages	Implementation of suggestions made by educators for the manual

Recommendations to improve the manual included considering providing it in other languages, reducing the size of the manual, improving the structure of the manual and adding more information to the eating plan and physical activity sections. Educators also indicated they would like to select their preferred time to receive text messages.		DoBE funding for the manual and service provider Tailored timing for text messages
Educators mentioned that they engaged with the manual and the text messages. Completing the self-monitoring activities was however reported to be a challenge.	Consider eHealth to facilitate self-monitoring	N/A if the intervention is implemented in its current format, but if possible, add e-health to facilitate self-monitoring
Educators perceived the intervention delivery (wellness day, hard copy manual to facilitate dietary pattern and physical activity for health and weight loss and text messages) to be acceptable.	No refinements required	No refinements required
Educators and principals felt that only one point of in-person contact during the 16-week intervention period was not acceptable. Educators and principals mentioned that despite the challenges associated with an intervention within the school setting, they would prefer frequent health visits, even during the fourth school term.	Engagement with DoBE to amend current regulations to allow health visits in the fourth term Consider eHealth communication options to increase contact	N/A if the intervention is implemented in its current format, but, if more contact is possible, then engagement with DoBE to amend current regulations to allow health visits in the fourth term.
Principals perceived that implementation of a weight loss intervention within a school setting that has a full academic calendar could be challenging. Educators mentioned that an intervention could be perceived as another task for them to add to their already full schedules.	DoBE approval and endorsement of the research School principal approval of the research.	DoBE endorsement of implementation of the intervention
Principals mentioned that support from the DoBE and flexibility when researchers arrange visits would facilitate implementing the intervention.	DoBE approval and endorsement School principal approval of health visits	DoBE endorsement School principal approval of health visits
Signals of an effect were evident in terms of shifts in belief patterns and stage of change (increase fruit intake, reduce fat intake); and improvement in actual lifestyle behaviours (increased intake in low fat food items, increased intake of vegetables, decreased intake of sugary food items; decreased frequency of adding fat and sugar to food, increase in physical activity and decreased time spent being sedentary) and a trend towards weight loss. Of the questionnaires/instruments that were used to assess secondary outcomes, it was evident that educators found the GPAQ challenging to complete. The nutrition knowledge questionnaire may not have been sufficiently aligned with the nutrition content of the manual and may thus not have been appropriate for use in this study.	Refinement of intervention elements as indicated above and longer duration of intervention that may increase the impact on weight loss Sample size powered to test efficacy Consider replacing the GPAQ and nutrition knowledge questionnaires with instruments that are more aligned with the core concepts covered in the intervention.	Implementation in current format could be considered as there is a clear signal of effect If possible, first refine intervention and ensure with longer duration

DoBE: Department of Basic Education; ISHP: Integrated School Health Policy; N/A: Not applicable ; GPAQ: Global Physical Activity Questionnaire

Limitations that need to be considered when interpreting the outcomes of the feasibility study include the following:

- A pilot study was used to investigate the secondary outcomes of the Health4LIFE intervention in a sample size that was sufficient for the feasibility study, but not powered to test changes in beliefs, stage of change lifestyle and weight changes. However, results do provide preliminary insights in the potential of the intervention to bring about the required changes.
- Nearly 20% of control and intervention completers either completed the GPAQ questionnaire incorrectly or incompletely, resulting in a substantial loss of physical activity data. The physical activity results therefore need to be considered with caution.
- Self-reported data should always be interpreted with caution as information provided on socio-demographic data, health status, dietary intake, physical activity, stage of change and beliefs regarding dietary intake and physical activity may not be accurate. Subjects may recall information incorrectly, may respond in line with socially accepted norms rather than the truth or questions may be misunderstood.
- Dietary intake, nutrition knowledge and stages of change sections in the questionnaire were not validated in the target population. However, as these questions/sections were used consistently (repeated at baseline and at 16-week follow-up) to investigate signals of an effect, it is plausible that changes that were noted reflect true changes.
- No male educators consented to participate in sub-studies 2 and no representative of an intervention drop-out school could be recruited for sub-study 3. The insights provided in the feasibility testing of the Health4Life weight loss intervention may therefore not reflect the perceptions of male educators and drop-out schools.

5.2 Final conclusions

The BCW was successfully implemented to develop a theory and evidence-based weight loss intervention for overweight and obese primary school educators employed at public schools in low-income settings in the Western Cape, namely Health4LIFE. The BCW was expanded to include the HBM, TPB and SatMDT resulting in further strengthening of the theoretical component of the intervention development process. The self-help intervention consisted of a wellness day, hard copy manual and text messages. In addition to this, an expert panel was used across all the steps of the intervention development process and testing and refinement of the intervention was also included.

Feasibility testing of the Health4Life weight loss intervention showed material signals of effect in terms of shifts in belief patterns and stage of change, as well as improvements in lifestyle behaviours. It is plausible that these shifts and changes could collectively result in weight loss, as a trend towards

weight loss was found. It is concluded that these signals of effect warrants further evaluation of the intervention in a full-scale study and/or consideration for implementation by the DoBE.

Primary feasibility outcomes, reach, acceptability, applicability and implementation integrity show that full-scale evaluation of the Health4Life weight loss intervention would be possible if DoBE endorses the research, changes are made to the hard copy manual as recommended, the duration of the intervention is extended to a 6-month period with more frequent contact, eHealth options are considered for contact sessions and self-monitoring activities and instruments used to assess nutrition knowledge and physical activity are reconsidered. However, the feasibility of implementing recommendations regarding more frequent contact and increasing the duration of the intervention would need further investigation. This is especially important when considering that decisions on the format and content (wellness day, hard copy manual and messaging) and delivery mode of the Health4LIFE weight loss intervention were made in a rigorous iterative process (BCW steps and integrated behaviour change theory) that included first line testing of the intervention materials.

However, as mentioned, full-scale evaluation of an intervention may span a number of years, during which the health of educators, specifically overweight and obesity, would receive no attention and may deteriorate further. Bearing this in mind implementation of the Health4Life intervention in its current format, but with minor changes to the hard copy manual as recommended by educators, in public schools in low-income settings should be considered.

5.3 Recommendations

Recommendations for implementation and/or further evaluation of the Health4LIFE intervention firstly focus on intervention refinement and secondly on addressing the policy environment relating to educator health to facilitate implementation/further evaluation of the intervention.

5.3.1 Intervention refinement

Recommendations for refinement of the Health4LiIFE intervention can be classified as level 1, level 2 and level 3 (Table 5.3). In the event that the DoBE does not have the resources to implement all recommendations, it is suggested that at least level 1 refinements should be completed/implemented. If more resources are/become available level 2 and level 3 refinements can be added incrementally.

Table 5.3: Recommendations for refinement and related actions and resources of the Health4LIFE intervention

Recommendations for refinement	Actions	Resources needed
Level 1		
Edit manual content to include more on the following: - Eating plans	Development team to review content, revise/add as necessary.	Refinement process -Development team (no cost)

- Physical activity	Educator panel (representative of cultures and genders) to review changes recommended by the development team for approval. (Iterative process)	-Educator panel (compensation for time e.g. gift) *If rolled out in real-world setting, thus DoBE will be directly responsible for the following costs on an ongoing basis:* *-Printing and distribution of the self-help manual* *-A service provider to send text messages as scheduled*
Check ease of completion of self-monitoring sections and improve	Development team to review content, revise/add as necessary. Educator panel (representative of cultures and genders) to review changes recommended by the development team for approval. (Iterative process)	
Check manual content and text messages for gender and cultural coverage/appropriateness	Educator panel (representative of cultures and genders) to review and make recommendations Development team to revise recommendations made by the educator panel. (Iterative process)	
Level 2		
Complete minor refinements	See above	See above
Add a simple eHealth component for self-monitoring e.g. website or App	Development team in collaboration with the educator panel to: 1) formulate the aim and outcomes of the eHealth component 2) consider delivery options (e.g. web-based linked in with DoBE website, mobile phone App, combination) 3) assess options using APEASE criteria and which one/combination to use 4) revise/develop content as necessary 5) eHealth technician to develop the eHealth component Testing options for the eHealth component: 1) informal testing with educators **OR** 2) feasibility testing in a pilot study (full protocol, ethics review etc.) (recommended by research team)	Refinement process -Development team (no cost) -Educator panel (compensation for time e.g. gift) -eHealth component development costs (costs would vary depending on eHealth delivery format) -Educators for informal testing of the eHealth component (compensation for time e.g. gift) **OR** grant to cover costs of pilot study for feasibility testing. *If rolled out in real-world setting, thus DoBE will be directly responsible for the following costs on an ongoing basis:* *-Printing and distribution of the self-help manual* *-A service provider to send text messages as scheduled* *-On-going costs related to maintenance of eHealth component*
Level 3		
Complete minor and moderate refinements	See above	See above
Add more frequent contact with intervention facilitators (either researcher appointed or DoBE appointed health care workers)	Development team in collaboration with the educator panel to: 1) formulate the aim and outcomes of more frequent contact 2) consider delivery options (e.g. in-person face-to-face contact at schools, in-person group session,	Refinement process -Development team (no cost) -Educator panel (compensation for time e.g. gift)

	web based platforms, mobile phone App) 3) assess options using APEASE criteria and decide which one/combination to use 4) develop implementation protocol for the contact sessions (dependant on the Testing options for the eHealth component: 1) informal testing with educators **OR** 2) feasibility testing in a pilot study (full protocol, ethics review etc.) (recommended by research team)	--eHealth component development costs (costs would vary depending on eHealth delivery format) Educators for informal testing of the eHealth component (compensation for time e.g. gift) **OR** grant to cover costs of pilot study for feasibility testing. *If rolled out in real-world setting, thus DoBE will be directly responsible for the following costs on an ongoing basis:* *-Printing and distribution of the self-help manual* *-A service provider to send text messages as scheduled* *-On-going costs related to maintenance of eHealth component* *-Health care worker to interact in-person (one-on-one or in a group session with educators in the school setting) or with eHealth communication*

DoBE: Department of Basic Education

Implementation of the level 1 refinement option may be doable within the current DoBE context, bearing in mind their limited resources that weighed strongly on the decision to have a single point of contact in the form of a wellness day and then a self-help manual with text messages for delivery of the intervention. This may therefore be the best route to go in the short term to address the urgent need for a weight loss intervention for educators. Completion of actions for level 2 and level 3 refinements would clearly need considerable more time and financial and research resources, as it may involve further cycles of implementing steps in the BCW, feasibility testing and full-scale evaluation.

It is recommended that the DoBE be briefed on the Health4LIFE weight loss intervention – the development process, feasibility testing, outcomes and then specifically the recommendations presented in Table 5.3. for their consideration and decision making on the best way forward.

5.3.2 Advocacy for DoBE endorsement

The potential success of the Health4LIFE weight loss intervention (with minor, moderate or major refinements of the tested format) ultimately depends on the DoBE for the following reasons:

- National and/or local polices are required to establish and fund the implementation of the Health4LIFE intervention in the DoBE school setting.

- Any non-curricular activities such as research or health visits conducted in DoBE schools requires pre-approval from the DoBE.
- Current DoBE regulations do not allow non-curricular activities such as research or health visits during the fourth school term.

The following actions are recommended to achieve DoBE endorsement:

- Advocacy for policy development and/or restructuring of the existing Integrated School Health Policy to establish and fund the implementation of the Health4LIFE intervention.
- Amendment of the current DoBE research agenda to include and address educator health.
- Amendment of the current DoBE regulations to allow research and health visits during the fourth school term.

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ADDENDA

Addendum I: Potentially messageable beliefs (50) regarding fruit and vegetable intake, sugar intake, fat intake and physical activity derived from the elicitation study

Beliefs regarding fruit and vegetable intake (13)		
Preparation of vegetables does not take a long time.(Control)	Fruits and vegetables are affordable. (Control)	I would eat fruit and vegetables even if they were expensive. (Control)
It is up to me to eat fruit and vegetables every day(Control)	I am confident that I can eat the recommended amounts of fruit and vegetables every day. (Control)	Most people who are important to me eat fruits and vegetables every day. (Normative)
Eating fruits and vegetables every day will help me lose weight/ control my weight. (Behavioural)	I would eat vegetables even if they take a long time to prepare. (Control)	I would eat vegetables even if at times, they look unappealing. (Control)
Vegetables sometimes look unappealing.	Fruit and vegetables are easy to find in stores nearby. (Control)	Eating fruit and vegetables every day will make me feel better. (Behavioural)
Being able to control my weight is important to me. (Behavioural)		
Beliefs regarding sugar intake (8)		
Eating/drinking less sugary foods/snacks/drinks is up to me. (Control)	I am confident that I can reduce the amount of sugary foods/drinks I eat & drink. (Control)	I have poor awareness of the sugar content in the food/drinks I eat/drink. (Control)
I want to reduce the amount of sugary foods/snacks/drinks I eat. (Control)	I would reduce the amount of sugary foods/snacks/drinks I eat and drink even without the support of people who are important to me. (Normative)	Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired). (Behavioural)
People around me eat/serve sugary foods/snacks/drinks at most events. (Normative)	I turn to sugary foods/snacks/drinks when I am stressed. (Control)	
Beliefs regarding fat intake (13)		
Eating less fat will help reduce the risk of diseases e.g. heart disease. (Behavioural)	Low-fat/healthy fat options are expensive. (Control)	It is easy to exclude high-fat foods from my daily diet. (Control)
Decreasing the amount of fat I eat will help me lose/ control my weight. (Behavioural)	Healthy takeaways and/or street foods are easy to find in my surroundings. (Control)	I do not have enough time to prepare healthy meals regularly. (Control)
I am confident that I can reduce the amount of fat in my diet. (Control)	When I am at events, I am expected to eat the food that is being served. (Normative)	Low fat/ fat-free foods taste good / are tasty. (Behavioural)
I have no choice about / control over the fat content in the foods I eat. (Normative)	Satisfying my hunger is important to me. (Control)	It is important to me to cook with less fat even if food does not taste good. (Behaviour)
Eating less fat makes me stay hungry. (Behavioural)		
Beliefs regarding physical activity (16)		
Being physically fit is important to me. (Control)	Being physically more active will improve my mental wellbeing. (Behavioural)	People who are important to me will support me to be physically more active. (Normative)

I do not want to be physically more active. (Control)	Meeting the recommended levels of physical activity is hard for me. (Control)	Having an exercise "buddy" will help me to be physically more active. (Normative)
Being tired from work makes it hard for me to do extra physical activity. (Control)	People who are important to me are physically active. (Normative)	Knowing more about different types of physical activity I can do will help me to be more active. (Control)
There are no accessible, safe, affordable opportunities for me to be physically active. (Control)	I am confident that I can increase my levels of physical activity (be physically more active). (Control)	I could increase my physical activity levels (be physically more active) even if I were tired. (Control)
Being physically more active will make me feel better about my appearance. (Behaviour)	Finding time to be physically more active is possible. (Control)	I could increase my physical activity levels (be physically more active) even it cost me more money. (Control)
I could increase my physical activity levels even if I have no exercise buddy. (Normative)		

Addendum II: – Define the problem in behavioural terms

Table 1: Defining the problem (Eat 5 fruit and vegetables every day) in behavioural terms

What behaviour?	Eat 5 fruit and vegetables every day
Where does the behaviour occur?	School, home, socializing
Who is involved in performing the behaviour?	Educators, colleagues, their families

Table 2: Defining the problem (Consume less sugar and sugar containing foods/drinks) in behavioural terms

What behaviour?	Consume less sugar and sugar containing foods/drinks
Where does the behaviour occur?	School, home, socializing
Who is involved in performing the behaviour?	Educators, colleagues, their families

Table 3: Defining the problem (Decrease fat intake) in behavioural terms

What behaviour?	Decrease fat intake
Where does the behaviour occur?	School, home, socializing
Who is involved in performing the behaviour?	Educators, colleagues, their families, friends

Table 4: Defining the problem (Increase the level of physical activity) in behavioural terms

What behaviour?	Increase level of physical activity
Where does the behaviour occur?	School, home

Who is involved in performing the behaviour?	Educators, colleagues, their families

Addendum III: Selecting the target behaviour

Table 5: Selecting the target behaviours related to 'Eat 5 fruit and vegetables every day'

Intervention designer response (sub-performance objectives)
Choose to eat a variety of fruit and vegetables every day
Purchase a variety of fruit and vegetables
Bring fruit and vegetables to school every day
Eat a variety of vegetables at meal times every day
Prepare vegetables in a healthy way

Table 6: Evaluating the target behaviours related to 'Eat 5 fruit and vegetables every day'

Potential target behaviours	**Impact of behaviour change (unacceptable, unpromising but worth considering, promising, very promising)**	**Likelihood of changing behaviour (unacceptable, unpromising but worth considering, promising, very promising)**	**Spillover score (unacceptable, unpromising but worth considering, promising, very promising)**	**Measurement score (unacceptable, unpromising but worth considering, promising, very promising)**
Purchase a variety of fruit and vegetables	Promising (more likely to meet target)	Promising (formative beliefs re: cost)	Very promising (very nb to target behaviour 2 and 3)	Unpromising but worth considering
Bring fruit and vegetables to school every day	Promising (more likely to meet target)	Promising (formative beliefs)	Promising (if replaces high fat snacks)	Promising (24hr recall/Diet history)
Eat a variety of vegetables at meal times every day	Promising (more likely to meet target)	Promising (formative beliefs)	Very promising (if protein and carb portions decreased)	Promising (24hr recall/Diet history)
Prepare vegetables in a healthy way	(include as a skill in 3rd target behaviour)			
Choose to eat a variety of fruit and vegetables every day	(not specific enough)			
Record selected target behaviour here:	Purchase a variety of fruit and vegetables Bring fruit and vegetables to school every day Eat a variety of vegetables at meal times every day			

Table 7: Selecting the target behaviours related to 'Decrease sugar intake'

Intervention designer response (sub-performance objectives)
Choose to eat foods/drinks containing small quantities/no sugar
Reduce or avoid the intake of sugar-containing cold drinks
Limit the purchase of sugar-containing foods/drinks
Use less/no sugar when preparing food
Add less/no sugar to hot beverages
Avoid the intake of sugary foods/drinks during times of stress

Table 8: Evaluating the target behaviours related to 'Decrease sugar intake'

Potential target behaviours	**Impact of behaviour change (unacceptable, unpromising but worth considering, promising, very promising)**	**Likelihood of changing behaviour (unacceptable, unpromising but worth considering, promising, very promising)**	**Spillover score (unacceptable, unpromising but worth considering, promising, very promising)**	**Measurement score (unacceptable, unpromising but worth considering, promising, very promising)**
Choose to eat foods/drinks containing small quantities/no sugar	(not specific)			
Reduce or avoid the intake of sugar-containing cold drinks	Promising (more likely to meet outcome – good evidence)	Promising (most of beliefs pertaining to sugar)	Promising (could have more money to purchase healthy foods)	Promising (24hr recall/Diet history)
Limit the purchase of sugar containing foods/drinks	Promising (more likely to meet outcome – good evidence)	Promising (most of beliefs pertaining to sugar)	Promising (could have more money to purchase healthy foods)	Promising (24hr recall/Diet history)
Use less/no sugar when preparing food	Promising (more likely to meet outcome – good evidence)	Promising (most of beliefs pertaining to sugar)	Unpromising but worth considering	Promising (24hr recall/Diet history)
Add less/no sugar to hot beverages	Unpromising but worth considering (limited evidence)	Promising (most of beliefs pertaining to sugar)	Unpromising but worth considering	Promising (24hr recall/Diet history)
Avoid the intake of sugary foods/drinks during times of stress	Promising (more likely to meet outcome – good evidence)	Unpromising but worth considering (formative beliefs re: sugar intake at times of stress)	Promising (could find other ways like exercise to manage stress)	Promising (24hr recall/Diet history)
Record selected target behaviour here:	Reduce or avoid the intake of sugar-containing cold drinks Limit the purchase of sugar containing foods/drinks			

	Use less/no sugar when preparing food Add less/no sugar to hot beverages Avoid the intake of sugary foods/drinks during times of stress

Table 9: Selecting the target behaviours related to 'Decrease fat intake'

Intervention designer response (sub-performance objectives)
Choose to eat foods/snacks lower in fat
Select foods low in fat when purchasing foods
Add less fat when preparing foods
Reduce or avoid the intake of high fat snacks

Table 10: Evaluating the target behaviours related to 'Decrease fat intake'

Potential target behaviours	**Impact of behaviour change (unacceptable, unpromising but worth considering, promising, very promising)**	**Likelihood of changing behaviour (unacceptable, unpromising but worth considering, promising, very promising)**	**Spillover score (unacceptable, unpromising but worth considering, promising, very promising)**	**Measurement score (unacceptable, unpromising but worth considering, promising, very promising)**
Choose to eat foods/snacks lower in fat (not specific enough)				
Select foods low in fat when purchasing foods	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: expense)	Promising (if replaces high fat foods makes target 2 easier)	Promising (24hr recall/Diet history)
Add less fat when preparing foods	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: taste, no choice, time)	Unpromising but worth considering	Promising (24hr recall/Diet history)
Reduce or avoid the intake of high fat snacks	Promising (more likely to meet outcome)	Unpromising but worth considering (formative beliefs re: taste, no choice, time)	Promising (replacing high fat food with lower energy food makes target easier)	Promising (24hr recall/Diet history)
Record selected target behaviour here:	Select foods low in fat when purchasing foods Add less fat when preparing foods Reduce or avoid the intake of high fat snacks			

Table 11: Selecting the target behaviours related to 'Increase physical activity levels'

Intervention designer response
Increase physical activity at work Increase physical activity in free time Participate in organised sport and physical activity events held at school, e.g fun walks

Table 12: Evaluating the target behaviours related to 'Increase physical activity levels'

Potential target behaviours	**Impact of behaviour change (unacceptable, unpromising but worth considering, promising, very promising)**	**Likelihood of changing behaviour (unacceptable, unpromising but worth considering, promising, very promising)**	**Spillover score** **(unacceptable, unpromising but worth considering, promising, very promising)**	**Measurement score** **(unacceptable, unpromising but worth considering, promising, very promising)**
Increase physical activity at work	Promising (can easily add to the goal of 30 min/day)	Promising (beliefs of formative Ax)	Promising (replaces sedentary time and perhaps even snacking)	Promising (GPPAQ)
Increase physical activity in free time	Promising (can easily add to the goal of 30 min/day)	Promising (Beliefs of formative Ax)	Promising (if replaces snacking)	Promising (GPPAQ)
Participate in organised sport and physical activity events held at school, e.g fun walks	Unacceptable (Since usually once off events – not huge impact)	Promising (social norm)	Unacceptable (Since usually once off events – not huge impact)	Unacceptable (Since usually once off)
Record selected target behaviour here:	Increase physical activity at work Increase physical activity in free time			

Addendum IV: Specifying the target behaviour

Table 13: Specifying the target behaviour 'Purchase a variety of fruit and vegetables'

Target behaviour	Purchase a variety of fruit and vegetables
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for purchasing food

***What* do they need to do differently to achieve the desired change?**	Replace unhealthier items on shopping list with fruit and veg Include a variety of fruit and veg on the shopping list
***When* do they need to do it?**	When purchasing food items
***Where* do they need to do it?**	Shops, supermarkets, local vendors, tuck shop at school,
***How often* do they need to do it?**	With their usual grocery shop, weekly/monthly; daily at tuck shop or vendor
***With whom* do they need to do it?**	Family members, colleagues

Table 14: Specifying the target behaviour 'Bring fruit and vegetables to school every day'

Target behaviour	Bring fruit and vegetables to school every day
***Who* needs to perform the behaviour?**	Educators
***What* do they need to do differently to achieve the desired change?**	Include fruit and vegetables as snacks or lunchbox items Replace unhealthy snack or lunchbox items with fruit and veg
***When* do they need to do it?**	Break times or lunch time
***Where* do they need to do it?**	At school
***How often* do they need to do it?**	5 days a week (mon – Fri)
***With whom* do they need to do it?**	Colleagues

Table 15:Specifying the target behaviour 'Eat a variety of vegetables at meal times every day'

Target behaviour	Eat a variety of vegetables at meal times every day
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for preparing food
***What* do they need to do differently to achieve the desired change?**	Include vegetables in daily meals Reduce the portions of protein and carbs
***When* do they need to do it?**	At supper time
***Where* do they need to do it?**	Home
***How often* do they need to do it?**	Daily
***With whom* do they need to do it?**	Families

Table 16:Specifying the target behaviour 'Limit the purchase of sugar-containing foods/drinks'

Target behaviour	Limit the purchase of sugar-containing foods/drinks

***Who* needs to perform the behaviour?**	Educators and/or family member responsible for purchasing food
***What* do they need to do differently to achieve the desired change?**	Replace high sugar items with healthier alternatives
***When* do they need to do it?**	When purchasing food items
***Where* do they need to do it?**	Shops, supermarkets, local vendors, tuck shop at school,
***How often* do they need to do it?**	With their usual grocery shop, weekly/monthly; daily at tuck shop or vendor
***With whom* do they need to do it?**	Family members, colleagues

Table 17:Specifying the target behaviour 'Use less/no sugar when preparing food'

Target behaviour	Use less/no sugar when preparing food
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for preparing food
***What* do they need to do differently to achieve the desired change?**	Decrease the amount of sugar used or remove sugar completely from recipes
***When* do they need to do it?**	At mealtimes
***Where* do they need to do it?**	Home
***How often* do they need to do it?**	Daily
***With whom* do they need to do it?**	Families

Table 18: Specifying the target behaviour 'Add less/no sugar to hot beverages'

Target behaviour	Add less/no sugar to hot beverages
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for preparing hot beverages
***What* do they need to do differently to achieve the desired change?**	Decrease the amount of sugar added to beverages or remove it completely
***When* do they need to do it?**	Whenever they drink a hot beverage
***Where* do they need to do it?**	Home/ school /socializing
***How often* do they need to do it?**	Daily
***With whom* do they need to do it?**	Families/colleagues

Table 19: Specifying the target behaviour 'Reduce or avoid the intake of sugar-containing cold drinks'

Target behaviour	**Reduce or avoid the intake of sugar-containing cold drinks**

***Who* needs to perform the behaviour?**	**Educators**
***What* do they need to do differently to achieve the desired change?**	**Select water instead of sugar-containing cold drinks or drink options with artificial sweetners**
***When* do they need to do it?**	**Whenever they select a cold drink**
***Where* do they need to do it?**	**Home/ school /socializing**
***How often* do they need to do it?**	**Daily**
***With whom* do they need to do it?**	**Families/colleagues/friends**

Table 20: Specifying the target behaviour 'Avoid the intake of sugar foods/drinks during times of stress'

Target behaviour	**Avoid the intake of sugar foods/drinks during times of stress'**
***Who* needs to perform the behaviour?**	**Educators**
***What* do they need to do differently to achieve the desired change?**	**Find alternate methods to manage stress such as exercise or relaxation techniques**
***When* do they need to do it?**	**Whenever they feel stressed and want to snack**
***Where* do they need to do it?**	**Home/ school /stressful situations**
***How often* do they need to do it?**	**Daily**
***With whom* do they need to do it?**	**Families/colleagues/friends**

Table 21: Specifying the target behaviour 'Select foods low in fat when purchasing foods'

Target behaviour	Select foods low in fat when purchasing foods
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for purchasing food
***What* do they need to do differently to achieve the desired change?**	Replace high fat items with lower fat alternatives
***When* do they need to do it?**	When purchasing food items
***Where* do they need to do it?**	Shops, supermarkets, local vendors, tuck shop at school,
***How often* do they need to do it?**	With their usual grocery shop, weekly/monthly; daily at tuck shop or vendor
***With whom* do they need to do it?**	Family members, colleagues

Table 22: Specifying the target behaviour 'Add less fat when preparing foods'

Target behaviour	Add less fat when preparing foods
***Who* needs to perform the behaviour?**	Educators and/or family member responsible for preparing food

***What* do they need to do differently to achieve the desired change?**	Use low fat items when cooking Use low fat cooking methods
***When* do they need to do it?**	At mealtimes
***Where* do they need to do it?**	Home
***How often* do they need to do it?**	Daily
***With whom* do they need to do it?**	Families

Table 23: Specifying the target behaviour 'Reduce or avoid the intake of high fat snacks

Target behaviour	**Reduce or avoid the intake of high fat snacks**
***Who* needs to perform the behaviour?**	**Educators**
***What* do they need to do differently to achieve the desired change?**	**Replace high fat snack items with lower fat/ healthier options**
***When* do they need to do it?**	**At mealtimes/snack time**
***Where* do they need to do it?**	**Home, school, social events**
***How often* do they need to do it?**	**Daily**
***With whom* do they need to do it?**	**Family, friends, colleagues**

Table 24: Specifying the target behaviour 'Increase physical activity at work'

Target behaviour	Increase physical activity at work
***Who* needs to perform the behaviour?**	Educators
***What* do they need to do differently to achieve the desired change?**	Find time at school where physical activity can be performed
***When* do they need to do it?**	During 'free' time
***Where* do they need to do it?**	At school
***How often* do they need to do it?**	5 days a week
***With whom* do they need to do it?**	Alone or with colleagues

Table 25: Specifying the target behaviour 'Increase physical activity in free time'

Target behaviour	Increase physical activity in free time

***Who* needs to perform the behaviour?**	Educators
***What* do they need to do differently to achieve the desired change?**	Be physically active outside of school time
***When* do they need to do it?**	After school, weekends
***Where* do they need to do it?**	Home, sport clubs, community club
***How often* do they need to do it?**	5 days a week
***With whom* do they need to do it?**	Family, colleagues, friends

Addendum V: Using the COM-B components to identify what needs to change for the target behaviour

Table 26: Using the COM-B components to identify what needs to change for the target behaviour 'Purchase a variety of fruit and vegetables'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability Skill to perform behaviour	Skill to purchase fruit and veg cost-effectively/within budget Skill to identify and replace unhealthy items on shopping list with fruit and veg	✓ ✓
Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the benefits of eating a variety of fruit and veg Identify seasons in which fruit and veg are available Knowledge of unhealthy items Knowledge of what variety means	✓ ✓ ✓ ✓
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability of fruit and veg at purchase point – supermarket, vendor, school Accessibility including money to purchase fruit and veg	✓ ✓
Social opportunity Social cues, cultural norms,	Acceptability and expectations of purchasing fruit and veg (family)	✓
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe fruit and veg are affordable Believe that eating fruit and veg every day will help me lose weight Believe that I can eat the recommended amounts of fruit and veg every day Intend to and prioritize purchasing of fruit and veg	✓ ✓ ✓ ✓ ✓

Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to purchase fruit and veg within the budget Establish routines and habits to purchase fruit and veg	✓ ✓

Table 27: Using the COM-B components to identify what needs to change for the target behaviour 'Bring fruit and vegetables to school every day'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	Skill of how to easily incorporate fruit and vegetables as part of snack or lunch box items Skill to replace unhealthy snacks items with fruit or veg	✓ ✓
Psychological capability	Understand the benefits of eating a variety of fruit and veg Knowledge of unhealthy snack items Knowledge of how fruit and vegetables can be used as snacks or lunch box items	✓ ✓ ✓
Physical opportunity	Availability of fruit and veg at home Time to prepare veg	✓
Social opportunity	Acceptability and expectations of bringing fruit and veg to school every day. (Colleagues supportive)	✓
Reflective motivation	Believe preparation of vegetables does not take a long time Believe that eating fruit and veg every day will help me lose weight Believe that I can eat the recommended amounts of fruit and veg every day Intend to and prioritize bringing fruit and veg to school every day	✓ ✓ ✓ ✓
Automatic motivation	Feel confident that it is possible to eat fruit and veg during the school day Establish routines and habits to bring fruit and veg to school daily	✓ ✓

Table 28: Using the COM-B components to identify what needs to change for the target behaviour 'Eat a variety of vegetables at mealtimes'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability Skill to perform behaviour	Skill to purchase veg cost-effectively/within budget Skill to identify and replace unhealthy items on shopping list with veg Skill to healthy cook vegetables	✓ ✓
Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the benefits of eating a variety of veg Identify seasons in which veg are available Knowledge of healthy cooking methods for vegetables Knowledge of what variety means	✓ ✓ ✓ ✓
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability of vegetables at purchase point – supermarket, vendor, school Accessibility including money to purchase vegetables Time to prepare vegetables	✓ ✓
Social opportunity Social cues, cultural norms,	Acceptability and expectations of including a variety of vegetables at mealtimes (family)	✓
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe veg are affordable Believe that eating veg every day will help me lose weight Believe that I can eat the recommended amounts of veg every day Intend to and prioritize eating vegetables at mealtimes	✓ ✓ ✓ ✓ ✓
Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to eat a variety of vegetables at mealtimes Establish routines and habits to include a variety of vegetables at mealtimes	✓ ✓

Table 29: Using the COM-B components to identify what needs to change for the target behaviour 'Limit the purchase of sugar containing foods/drinks'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	Skill to read food labels	✓

Skill to perform behaviour	Know which foods/drinks contain small quantities of sugar	✓
Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the health consequences of eating too much sugar in diet Identify different types of foods/drinks containing sugar Understand the role of sugar in the diet Skill to identify and replace high sugar items with healthier alternatives which can still satisfy need for sweetness	✓ ✓ ✓ ✓
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability of low sugar foods//drinks at purchase point – supermarket, vendor, school Accessibility including money to purchase low sugar foods/drinks	✓ ✓
Social opportunity Social cues, cultural norms,	Acceptability and expectations of purchasing foods/drinks containing small quantities of sugar (family)	✓
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe reducing intake of sugar foods/drinks is beneficial for health (not from formative Ax) Believe that reducing the amount of sugary foods/drinks will not make me feel unwell Believe that I have good awareness of sugar content of food/drinks I eat /drink Believe that I do not need to turn to sugary foods/drinks when I am stressed Intend to and prioritize reducing purchase of sugary foods/drinks	✓ ✓ ✓ ✓ ✓
Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to identify and purchase foods/drink lower in sugar Establish routines and habits to purchase foods/drinks low in sugar	✓ ✓

Table 30: Using the COM-B components to identify what needs to change for the target behaviour 'Use less/no sugar when preparing food'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**

Physical capability	Capable of incorporating cooking methods which are low in sugar but still tasty	✓
Psychological capability	Understand the health consequences of eating too much sugar in diet Identify different types of foods/drinks containing sugar Understand the role of sugar in the diet Knowledge of methods to cook with less sugar	✓ ✓ ✓ ✓
Physical opportunity	Availability of food/drink with low sugar content at home Recipes which are low in sugar	✓ ✓
Social opportunity	Acceptability and expectations of adding less sugar when preparing meals (family)	✓
Reflective motivation	Believe reducing intake of sugar foods/drinks is beneficial for health (not from formative Ax) Believe that reducing the amount of sugary foods/drinks will not make me feel unwell Believe that I have good awareness of sugar content of food/drinks I eat /drink Intend to and prioritize adding less sugar when preparing foods	✓ ✓ ✓ ✓
Automatic motivation	Feel confident that it is possible to add less sugar when preparing foods Establish routines and habits to add less sugar when preparing foods	✓ ✓

Table 31: Using the COM-B components to identify what needs to change for the target behaviour 'Add less/no sugar to hot beverages'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**
Physical capability	Ability to exclude or reduce sugar from beverages	✓
Psychological capability	Understand the health consequences of eating too much sugar in diet Strategies to change taste preference for sweetened beverages	✓ ✓

	Knowledge of alternatives to sweeten beverages	✓
Physical opportunity	Availability of sugar alternatives at home Accessibility of sugar alternatives including cost	✓ ✓
Social opportunity	Acceptability and expectations of adding less sugar to beverages (family)	✓
Reflective motivation	Believe reducing intake of sugar foods/drinks is beneficial for health (not from formative Ax) Believe that reducing the amount of sugary foods/drinks will not make me feel unwell Believe that I have good awareness of sugar content of food/drinks I eat /drink Believe that I do not need to turn to sugary foods/drinks when I am stressed Intend to and prioritize adding less sugar to beverages	✓ ✓ ✓ ✓ ✓
Automatic motivation	Feel confident that it is possible to add less sugar to beverages Establish routines and habits to add less sugar to beverages	✓ ✓

Table 32: Using the COM-B components to identify what needs to change for the target behaviour 'Reduce or avoid the intake of sugar-containing cold drinks'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**
Physical capability	**Ability to exclude or reduce sugar from cold drinks**	✓
Psychological capability	**Understand the health consequences of eating too much sugar in diet** **Strategies to change taste preference for sugar-sweetened cold drinks** **Knowledge of alternatives to sugar-containing cold drinks**	✓ ✓ ✓

Physical opportunity	**Availability of sugar free cold drinks or artificially sweetened cold drinks** **Accessibility of sugar free cold drinks or artificially sweetened cold drinks**	✓ ✓
Social opportunity	**Acceptability and expectations of sugar free cold drinks or artificially sweetened cold drinks (family)**	✓
Reflective motivation	**Believe reducing intake of sugar foods/drinks is beneficial for health (not from formative Ax)** **Believe that reducing the amount of sugary foods/drinks will not make me feel unwell** **Believe that I have good awareness of sugar content of food/drinks I eat /drink** **Believe that I do not need to turn to sugary foods/drinks when I am stressed** **Intend to and prioritize reducing or avoiding sugar-containing cold drinks**	✓ ✓ ✓ ✓ ✓
Automatic motivation	**Feel confident that it is possible to reduce or avoid sugar-containing cold drinks** **Establish routines and habits to reduce or avoid sugar-containing cold drinks**	✓ ✓

Table 33: Using the COM-B components to identify what needs to change for the target behaviour 'Avoid the intake of sugar foods/drinks during times of stress'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	**Ability to avoid the intake sugar-containing foods/drinks during times of stress**	✓
Psychological capability	**Understand the health consequences of eating too much sugar in diet** **Strategies to change taste preference for sugar-sweetened food or drink at times of stress**	✓ ✓ ✓

	Knowledge of alternatives to sugar-containing food or drink at times of stress such as exercise or relaxation techniques	
Physical opportunity	**Availability of places to exercise or perform relaxation techniques** **Accessibility of places to exercise or perform relaxation techniques**	✓ ✓
Social opportunity	**Acceptability and expectations of performing exercise or relaxation techniques(family)**	✓
Reflective motivation	**Believe reducing intake of sugar foods/drinks is beneficial for health (not from formative Ax)** **Believe that reducing the amount of sugary foods/drinks will not make me feel unwell** **Believe that I have good awareness of sugar content of food/drinks I eat /drink** **Believe that I do not need to turn to sugary foods/drinks when I am stressed** **Intend to and prioritize avoiding the intake of sugar-containing foods/drinks at times of stress**	✓ ✓ ✓ ✓ ✓
Automatic motivation	**Feel confident that it is possible to avoid the intake of sugar-containing foods/drinks at times of stress** **Establish routines and habits to avoid the intake of sugar-containing foods/drinks at times of stress**	✓ ✓

Table 34: Using the COM-B components to identify what needs to change for the target behaviour 'Select foods low in fat when purchasing foods'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**
Physical capability Skill to perform behaviour	Skill to read food labels Know what low fat means	✓ ✓

Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the health consequences of eating too much fat in diet Identify different types of fat Describe the role of fat in the diet with specific reference to taste Skill to identify and replace high fat items with lower fat alternatives	✓ ✓ ✓ ✓
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability of low fat foods at purchase point – supermarket, vendor, school Accessibility including money to purchase low fat foods	✓ ✓
Social opportunity Social cues, cultural norms,	Acceptability and expectations of purchasing low fat foods (family)	✓
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe eating less fat will help reduce risk of heart disease Believe that decreasing fat intake will help me lose weight Believe that low fat options are affordable Believe that low fat foods are tasty/taste good Believe that it is easy to exclude high fat food from my daily diet Intend to and prioritize purchasing of fruit and veg	✓ ✓ ✓ ✓ ✓ ✓
Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to purchase low fat food within the budget Establish routines and habits to purchase low fat food	✓ ✓

Table 35: Using the COM-B components to identify what needs to change for the target behaviour 'Add less fat when preparing foods'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	Capable of incorporating low fat cooking methods and still preparing tasty meals	✓
Psychological capability	Understand the health consequences of eating too much fat in diet Identify different types of fat	✓ ✓ ✓

	Describe the role of fat in the diet with specific reference to taste Skill to identify and replace high fat items with lower fat alternatives Knowledge of low fat cooking methods Strategies to change taste preference for fat	 ✓ ✓ ✓
Physical opportunity	Availability of low fat food items/alternatives at home Availability of utensils or equipment to prepare low fat meals Time to prepare healthy meals	✓ ✓ ✓
Social opportunity	Acceptability and expectations of adding less fat when preparing meals (family)	✓
Reflective motivation	Believe eating less fat will help reduce risk of heart disease Believe that decreasing fat intake will help me lose weight Believe that low fat foods are tasty/taste good Believe that it is easy to exclude high fat food from my daily diet Believe that I have enough time to prepare healthy meals regularly Intend to and prioritize adding less fat when preparing foods	✓ ✓ ✓ ✓ ✓ ✓
Automatic motivation	Feel confident that it is possible to add less fat when preparing foods Establish routines and habits to add less fat when preparing foods	✓

Table 36: Using the COM-B components to identify what needs to change for the target behaviour 'Reduce or avoid the intake of high fat snacks'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**
Physical capability	Capable of identifying high fat snacks Capable of replacing high fat snacks with healthier options	✓
Psychological capability	Understand the health consequences of eating too much fat in diet Identify different types of fat Describe the role of fat in the diet with specific reference to taste	✓ ✓ ✓

	Skill to identify and replace high fat items with lower fat alternatives Knowledge of low-fat cooking methods Strategies to change taste preference for fat	✓ ✓ ✓
Physical opportunity	Availability of low-fat food items/alternatives at home Availability of utensils or equipment to prepare low fat meals Time to prepare healthy meals	✓ ✓ ✓
Social opportunity	Acceptability and expectations of replacing high fat snack items with healthier options (family)	✓
Reflective motivation	Believe eating less fat will help reduce risk of heart disease Believe that decreasing fat intake will help me lose weight Believe that low fat foods are tasty/taste good Believe that it is easy to exclude high fat food from my daily diet Believe that I have enough time to prepare healthy meals regularly Intend to and prioritize adding less fat when preparing foods	✓ ✓ ✓ ✓ ✓ ✓
Automatic motivation	Feel confident that it is possible to add reduce or avoid the intake of high-fat snacks Establish routines and habits to reduce or avoid the intake of high-fat snacks	✓

Table 37: Using the COM-B components to identify what needs to change for the target behaviour 'Increase physical activity at work'

COM-B Components	**What needs to happen for the target behaviour to occur?**	**Is there a need for change?**
Physical capability Skill to perform behaviour	Physical ability to partake in appropriate physical activities	✓
Psychological capability Capacity to engage in necessary thought processes (knowledge)	Understand the health benefits of being physically active Understand the risks of not being physically active Ability to prioritize physical activity despite other commitments Knowledge of the different types of activities which are age-appropriate or fitness level appropriate	✓ ✓ ✓ ✓

	Knowledge of how to perform appropriate physical activities Understand that physical activity is not just sport	✓ ✓
Physical opportunity Physical environment: triggers, resources, physical barriers, time	Availability and accessibility of resources at school Making time during the school day to be active Workload must accommodate for physical activity during the day	✓ ✓ ✓
Social opportunity Social cues, cultural norms,	Acceptability and expectations of performing physical activity at school (colleagues, principals, students) Having an exercise buddy at school	✓ ✓
Reflective motivation Self-conscious planning, evaluation, beliefs of consequences and capabilities, what is good and bad	Believe being physically fit is important to me Believe there are accessible, safe, affordable opportunities for me to be physically active Believe that being physically active will make feel better about appearance Believe that improve mental wellbeing Believe it is possible to find time for physical activity Intend to and prioritize increasing physical activity at school	✓ ✓ ✓ ✓ ✓ ✓
Automatic motivation Emotions, wants, needs, reflex responses, habit formation	Feel confident in ability to increase level of physical activity at school Establish routines and habits of performing physical activity at school	✓ ✓

Table 38: Using the COM-B components to identify what needs to change for the target behaviour 'Increase physical activity in free time'

COM-B Components	What needs to happen for the target behaviour to occur?	Is there a need for change?
Physical capability	Physical ability to partake in appropriate physical activities	✓
Psychological capability	Understand the health benefits of being physically active Understand the risks of not being physically active Ability to prioritize physical activity despite other commitments	✓ ✓ ✓

	Knowledge of the different types of activities which are age-appropriate or fitness level appropriate	✓
	Knowledge of how to perform appropriate physical activities	✓
	Understand that physical activity is not just sport	✓
	Knowledge that increasing level of physical activity can decrease fatigue	✓
Physical opportunity	Availability and accessibility of facilities, equipment in community or home	✓
	Transport to events in community	✓
	Making time to be physically active	✓
	Safety in community	✓
Social opportunity	Acceptability and expectations of participating in physical activities out of school time (family, friends)	✓
	Having an exercise buddy outside of school	✓
Reflective motivation	Believe being physically fit is important to me	✓
	Believe there are accessible, safe, affordable opportunities for me to be physically active	✓
	Believe that being physically active will make feel better about appearance	✓
	Believe it is possible to find time for physical activity	✓
	Intend to and prioritize increasing physical activity in free time	✓
Automatic motivation	Feel confident that it is possible to increase physical activity in free time	✓
	Establish routines and habits to increase physical activity in free time	✓

Addendum VI: Selected behaviour change techniques, intervention functions, and COM-B model

BCT	FUNCTION	CAPABILITY				OPPORTUNITY		MOTIVATION					
		Physical	Psychological			Social	Physical	Reflective					Auto
		Skills	Knowledge	Memory, attention, & decision processes	Behavioural regulation	Social influences	Environmental context and resources	Beliefs about capabilities	Beliefs about consequences	Social professional role and identity	Optimism	Goals	Emotion
1.Information about consequences of behaviour in general	Education, persuasion		■						■				
2.Information about consequences of behaviour specific to individual	Education, persuasion		■						■				
5.Goal setting (behaviour)	Enablement				■							■	
6.Goal setting (outcome)	Enablement				■							■	
7.Action planning	Education, Enablement	■	■	■								■	
8.Barrier identification or problem solving	Education, Enablement	■	■		■			■					
9.Set graded tasks	Education, Enablement	■	■	■	■			■			■	■	
10.Prompt review of behavioural goal	Enablement										■	■	

11.Prompt review of outcome goals	Enablement												
12.Prompt rewards contingent on effort or progress toward behaviour	Incentivization												
13.Prompt rewards contingent on successful behaviour	Incentivization												
16.Prompt self-monitoring of behaviour	Enablement												
17.Prompt self-monitoring of behavioural outcome	Enablement												
20.Provide information on where and when to perform behaviour	Enablement												
21. Provide instruction on how to perform behaviour	Education												
23.Teach to use prompts/cues	Education, Environmental restructuring												
24.Environmental restructuring	Environmental restructuring												
27.Use of follow-up prompts	Education, Environmental restructuring												
35.Relapse prevention/coping planning	Enablement												
36.Stress management	Education, Enablement												

38.Time management	Education, Enablement												

Addendum VII: Description of the intervention for each target behaviour

BCT	Description of Intervention			
	Weight loss	**Fruit and veg intake**	**Fat intake**	**Sugar intake**
1.Information about consequences of behaviour in general	Educators are informed about health benefits of weight loss (general information based on epidemiological data)			
2.Information about consequences of behaviour specific to individual	Provide information around the costs and benefits to individual or educators	Specific information around benefits of increasing fruit and veg intake	Specific information around the benefits of decreasing fat intake	Specific information regarding the benefits of decreasing sugar intake
5.Goal setting (behaviour)		Eat 5 or more fruit and veg every day (limit fruit to 2/day)	Decrease fat intake	Decrease intake of sugar and sugar containing foods and drinks
6.Goal setting (outcome)	Weight loss goal set for each individual			
7.Action planning	Meal plans provided to reduce calorie by 500 – 100kcal	Eat 5 or more fruit and veg every day (limit fruit to 2/day)	Decrease fat intake at school, home and when socializing	Decrease intake of sugar and sugar containing foods and drinks at home, school and when socializing
8.Barrier identification or problem solving		Plan snacks and mealtimes for week so you know what fruit and veg requirements for week are Provide budget showing cost of commonly eaten unhealthy items vs fruit and veg + tips to cut costs	Tips on how to identify high fat items and replace it with lower fat alternatives as well as healthier fats Compare prices showing low fat options are affordable	Taste: strategies to change taste preference for sugar Tips on healthier alternatives to eat/do if sugar is consumed in response to stress

BCT	Description of Intervention			
	Weight loss	**Fruit and veg intake**	**Fat intake**	**Sugar intake**
		Time: tips to cut down on cooking time and still include veg, quick recipes Ease: easy recipes for meals, snacks and lunchbox ideas Taste/appearance: strategies to make veg more appealing Social support: form support group at work with colleagues + ways to get family on board Specific beliefs	Time: quick recipes incorporating low fat cooking methods Ease: recipes must be easy – testimonials may be included Taste: strategies to change taste preference for fat	
9.Set graded tasks	Weekly goal weight	Incremental weekly increases in fruit and veg intake		Incrementally decrease sugar intake in hot beverages
10.Prompt review of behavioural goal		At the end of each week – a review of extent of which previous set goals were achieved	Review goal of selecting foods low in fat when purchasing food; add less fat when preparing foods	Review goal of limiting purchase of sugar-containing foods/drinks; using less/no sugar when preparing meals; adding less/no sugar to hot beverages
11.Prompt review of outcome goals	Prompt to review weight loss goal			
12.Prompt rewards contingent on effort or progress toward behaviour		Non-food reward ideas for each week if attempt made to achieve weekly goals	Non-food reward ideas for each week if attempt made to achieve weekly goals	Non-food reward ideas for each week if attempt made to achieve weekly goals
13.Prompt rewards contingent on successful behaviour		Non-food reward ideas for each week if weekly goals achieved	Non-food reward ideas for each week if weekly goals achieved	Non-food reward ideas for each week if weekly goals achieved

BCT	Description of Intervention			
	Weight loss	**Fruit and veg intake**	**Fat intake**	**Sugar intake**
16.Prompt self-monitoring of behaviour		Prompt to keep record of number of fruits eaten each day Prompt to keep track of no of days fruit taken to school Prompt to keep track of no of days veg included with meals	Prompt to keep track of: purchase of low fat foods and adding less fat when preparing meals	Prompt to keep track of: limiting purchase of sugar-containing food/drinks; using less or no sugar when preparing meals; adding less or no sugar to beverages
17.Prompt self-monitoring of behavioural outcome	Prompt to keep track of weight loss			
20.Provide information on where and when to perform behaviour		When doing grocery shop at supermarket/vendor or if at school tuck shop buying snack purchase fruit and veg Bring fruit and veg to school every day Eat a variety of veg at meal times every day	When purchasing food items at shops, supermarkets, vendors, tuck shops, replace high fat items with lower fat alternatives When at home and preparing any meal, snack or lunchbox items, add less fat during preparation	When purchasing food items at shops, supermarkets, vendors, tuck shops replace high sugar items with healthier alternatives Decrease the amount of sugar used or remove sugar completely from recipes when preparing meals at home Decrease the amount of sugar added or remove it completely whenever consuming beverages
21. Provide instruction on how to perform behaviour		Explain how to do the following: Identify fruit in season Swop out unhealthy food items on grocery list for fruit and veg Buy fruit and veg within budget	Explain how to do the following: Identify different types of fat, high fat and low fat options Swop out higher fat options for lower fat alternatives (at shops and in recipes)	Explain how to do the following: Identify food and drinks high in sugar Swop out high sugar items for healthier alternative, which may even still satisfy need for sweetness Cooking methods with less or no sugar – recipes/alternatives

BCT	Description of Intervention			
	Weight loss	**Fruit and veg intake**	**Fat intake**	**Sugar intake**
		Meal ideas to incorporate fruit and veg into snacks and lunch box items Recipes or meal ideas to incorporate veg at mealtimes – quick and easy Healthy cooking options for veg with appropriate cooking times	Purchase lower fat alternatives within budget Low fat cooking options Tips to decrease fat when preparing meals Low fat recipes which are quick and easy and acceptable	Gradually decrease sugar intake in all beverages or remove completely OR provide alternatives to sweeten drinks
23.Teach to use prompts/cues		Sms to remind to perform target behaviour – can be used together with goal setting and action planning	Sms to remind to perform target behaviour – can be used together with goal setting and action planning	Sms to remind to perform target behaviour – can be used together with goal setting and action planning
24.Environmental restructuring		Prompted to keep fruit and veg available at home and school every day	Only keep low fat food items in home	Don't purchase and stock sugar containing drinks at all in home
27.Use of follow-up prompts	Sms messaging may use this technique			
29.Plan social support/social change		Plan to gather support from work colleagues to bring fruit and veg to school Gather support from family members to both buy fruit and veg and include veg at mealtimes	Will require support from family members	Will require support from family members
35.Relapse prevention/coping planning	Participant prompted to identify in advance situation where changed behaviour may not be maintained and develop strategies to avoid or manage those situations			

BCT	Description of Intervention			
	Weight loss	**Fruit and veg intake**	**Fat intake**	**Sugar intake**
36.Stress management	Specific techniques to reduce anxiety and stress and facilitate performance of behaviour			
38.Time management		Ways to facilitate educators in preparing meals and snacks with fruit and veg for school as well as mealtimes everyday	Time management tips to ensure healthy meals can be prepared	

BCT	Description of Intervention	
	Weight loss	**Physical activity**
1.Information about consequences of behaviour in general	Educators are informed about health benefits of weight loss (general information based on epidemiological data)	
2.Information about consequences of behaviour specific to individual	Provide information around the costs and benefits to individual or educators	Specific information around benefits of increasing level of physical activity
5.Goal setting (behaviour)		Educators to do a self-assessment of current level of physical activity and weekly goal with aim of reaching recommendation
6.Goal setting (outcome)	Weight loss goal set for each individual	

BCT	Description of Intervention	
	Weight loss	**Physical activity**
7.Action planning	Meal plans provided	Increase physical activity at school, after school and decease sedentary time after school
8.Barrier identification or problem solving		Plan physical activity into day, at school, home Take appropriate clothing/shoes to school Knowledge of all different types of activities which can be performed at school, home, in community Provide e.g. of schedule depicting how 10 min activities can help reach daily recommendation Find an exercise buddy at school and home to perform physical activities with
9.Set graded tasks		Plan to incrementally increase physical activity until recommendation reached and then focus on intensity
10.Prompt review of behavioural goal		At the end of each week – a review of extent of which previous set goals were achieved Review goal of increasing level of activity each week until reach recommendation
11.Prompt review of outcome goals	Prompt to review weight loss goal	
12.Prompt rewards contingent on effort or progress toward behaviour		Non-food reward ideas for each week if attempt made to achieve weekly goal
13.Prompt rewards contingent on successful behaviour		Non-food reward ideas if weekly goal achieved
16.Prompt self-monitoring of behaviour		Prompt to keep record of number of days of physical activity, type of activity and time

BCT	Description of Intervention	
	Weight loss	**Physical activity**
17.Prompt self-monitoring of behavioural outcome	Prompt to keep track of weight loss	
20.Provide information on where and when to perform behaviour		Meet the recommendation of 15 min exercise per week by: Participate in physical activity during discretionary time at school, free period, break time Participate in physical activity outside of school Decrease sedentary time out of school time
21. Provide instruction on how to perform behaviour		Explain how to do the following: Start physical activity from not doing anything Provide instruction on how to perform easy activities, at school, home, community Provide a programme how physical activity can be increased each week
23.Teach to use prompts/cues		Sms to remind to perform target behaviour – can be used together with goal setting and action planning
24.Environmental restructuring		Take or keep appropriate clothing or shoes at school Have dedicated time for physical activity Limit screen time Place TV/computers in inconvenient places in home
27.Use of follow-up prompts	Sms messaging may use this technique	
29.Plan social support/social change		Plan to gather support from work colleagues – exercise buddy at work

BCT	Description of Intervention	
	Weight loss	**Physical activity**
		Gather support at home from family or friends –exercise buddy at home
35.Relapse prevention/coping planning	Participant prompted to identify in advance situation where changed behaviour may not be maintained and develop strategies to avoid or manage those situations	
36.Stress management	Specific techniques to reduce anxiety and stress and facilitate performance of behaviour	Exercise can be strategy to relieve stress
38.Time management		Time management tips to ensure exercise is prioritized despite other commitments Schedule showing how exercise can be broken up with aim of reaching daily recommendation

Addendum VIII: Text messaging library matrix

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
1. Welcome participants to programme and introduce the broad target behaviours and set a weight loss goal	Welcome to week 1 of an exciting 16 week weight loss program. You will be guided along this journey by a manual and 5 weekly messages. This program will focus on 4 main themes: decreasing your intake of fat and sugar, increasing your intake of fruit and veg and increasing your physical activity. Best of luck to you!	317	Welcome message		Introduction to the program
	If you are overweight, weighing 100kg, losing as little as just 5kg (5% of your weight) is associated with health benefits, if you manage to keep it off.	152	Information of consequence of goal outcome		Introduction to the program Health benefits of weight loss; Energy balance
	Determine and record your weekly goal weight for the next 16 weeks bearing in mind that 0.5-1kg/week is healthy weight loss. See pg X for a step-by-step guide	158	Goal setting (outcome) Prompt self-monitoring		Introduction to the program BMI calculation; Determining weight loss goal; Record sheet for weight loss
	Reduce your energy intake to help you lose weight. See pg X for meal plan examples and general healthy eating tips to guide you	127	Goal setting (outcome and behaviour)		Introduction to the program Meal plans FBDG
	Increase your energy use to help you lose weight by increasing your level of physical activity to 150	158	Action planning Goal setting (behaviour)		Physical activity Section Guidelines and tips

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	minutes/week. See pg X for more exercise advice and tips				
2. Purchase a variety of fruit and veg	Week X: Purchase a variety of fruit and veg to help meet your 5 portions/day. Tip: different coloured fruit and veg indicates good variety.	140	Goal setting action planning;	I am confident that I can meet the recommended amounts of fruit and vegetables every day	Fruit and veg section Guideline for fruit and veg; Record chart for purchasing a variety of fruit and veg; Explanation of variety
	Did you know physical activity can be broken up into 10 min periods throughout the day if the recommended 30 min/day is too much at one go? See pg X for more tips	160	Action planning Barrier identification/problem solving	Finding time to be physically active is possible I can increase my levels of physical activity	Exercise Section Physical activity tips for getting started
	Fruit and veg can help you lose weight if it replaces high-energy snacks like chips or chocolates. These snacks also tend to be more expensive than fruit or veg	160	Information about consequences of behaviour Action planning Barrier identification/problem solving	Eating fruit and veg everyday will help me lose weight/control my weight Fruit and veg are affordbale	Fruit and veg section Health benefits of meeting recommended fruit and veg intake; Prices of commonly eaten high energy snack items vs prices of fruit and veg
	Worried about the cost of fruit and veg? Buy fruit and veg which is in season as it is more affordable. See pg x for more fruit and veg cost-saving tips	152	Problem solving Barrier identification/problem solving	Fruit and veg are affordable	Fruit and veg section Chart with seasonal veg General cost-saving tips when buying fruit and veg

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	Well done if you managed to purchase a variety of fruit and veg this week. Continue to purchase a variety and keep a record of your purchases on pg X	149	Prompt self-monitoring of behaviour		Fruit and veg section Record charts of fruit purchased
3. Bring fruit and veg to school every day	Week X: Pack fruit and veg into your lunchbox every day to make it easier to meet your goal of 5/day. See pg X for lunchbox ideas that are quick and easy	153	Goal setting; action planning; barrier identification/problem solving	I am confident that I can meet the recommended amounts of fruit and vegetables every day Preparation of veg does not take a long time	Fruit and veg section Lunchbox ideas which include fruit and veg – quick and easy
	Pack in extra fruit or veg into your lunchbox as a snack before or after physical activity, if you feel hungry and plan to exercise immediately after school	156	Action planning barrier identification/problem solving		Physical activity section Tips when exercising – snack ideas
	Did you know increasing your fruit and veg intake increases your fiber intake? This helps you feel fuller for longer and may therefore help with weight loss	156	Information about consequences of behaviour	Eating fruit and veg everyday will help me lose weight/control my weight	Fruit and veg section Health benefits of increasing fruit and veg intake
	Fruit and veg like carrot or cucumber sticks in your lunchbox make great “on the go snacks” during a busy school day. It also requires little or no preparation	159	Action planning Barrier identification/problem solving	Preparation of veg does not take a long time	Fruit and veg section Quick and easy fruit an veg snack ideas
	How many days this week did you manage to include fruit and veg in your lunchbox? Record this on page X. Also remember to record your weekly weight on pg X	155	Prompt self-monitoring of behaviour		Fruit and veg section Record chart of how many days fruit and veg were included in lunchbox

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
4. Eat a variety of veg at mealtimes every day	Week X: Aim to eat a variety of veg at mealtimes every day. See pg X for quick and easy meal ideas that taste and look amazing even your family will enjoy it	157	action planning; Barrier identification and problem solving	Preparation of veg does not take a long time I would eat vegetables even if at times they look unappetising	Fruit and veg section Meal ideas which include variety of veg – must be quick and include pics of how appealing veg can look
	Too tired to exercise? Eat a variety of veg at mealtimes every day to increase your vitamin and mineral intake. This can help boost your energy levels	151	Information about consequences of behaviour Barrier identification and problem solving	I could increase my physical activity even if I were tired	Fruit and veg section Benefits of eating variety of veg every day
	Include different coloured veg when preparing your meals. This makes your meal look appetising and is also an indication of good variety	136	Action planning Barrier identification and problem solving	I would eat vegetables even if at times they look unappetising	Fruit and veg section Tips to increase appeal of veg: diff coloured veg on plate
	Use the correct cooking methods and cooking times when preparing veg. This ensures it looks appetizing and can shorten preparation time. See pg x for more tips	159	Action planning Barrier identification and problem solving	I would eat vegetables even if at times they look unappetising Preparation of veg does not take a long time	Fruit and veg section Various cooking methods one can utilise to prepare veg with a table of different cooking times for different types of veg
	On average, on how many days this week did you manage to include a variety of veg at mealtimes? Record this on pg X and set your goal for next week	147	Prompt self-monitoring of behaviour Goal setting		Fruit and veg section Record chart of days variety of veg eaten at mealtimes
5. Select foods low in fat when purchasing foods (week 1)	Week X: Select low fat foods when purchasing foods to help reduce your fat intake. See pg X for a list of	147	Goal setting; action planning;	Low fat/fat-free foods taste good/are tasty	Fat section List of low fat alternatives which show they are not

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	affordable and tasty low-fat alternatives		Barrier identification and problem solving	Low-fat/healthy fat options are expensive	more expensive than full fat options
	Increasing your physical activity levels to 150min/wk and decreasing your energy intake by decreasing fat intake at the same time can assist with weight loss	157	Information about consequences of behaviour Action planning		Physical activity section Benefits of increasing physical activity Fat section Benefits of decreasing fat intake
	Replace high fat food with low fat food to reduce your total fat intake and help reduce your risk of heart disease. Give it a taste, see and feel the benefits	158	Information about consequences of behaviour	Eating less fat will reduce the risk of disease e.g. heart disease	Fat section Health benefits of reducing fat intake
	Use low fat food options in recipes. The fat content of the meal is reduced without affecting preparation time. See pg x for more tips on how to adapt recipes	158	Action planning Barrier identification and problem solving	I do not have enough time to prepare healthy meals regularly	Fat section Recipe ideas which have replaced full fat foods with low fat options
	Well done to you if you managed to swop any full fat food items for low fat alternatives this week. Keep it up and you will soon see positive results!	151	Prompt self-monitoring of behaviour Prompt reward		
6. Select foods low in fat when purchasing foods (week 2)	Week X: Continue to reduce your fat intake by selecting low fat food when purchasing food. Revise the list on pg X of affordable and tasty low fat alternatives	**159**	Goal setting; action planning; Barrier identification and problem solving	Low fat/fat-free foods taste good/are tasty Low-fat/healthy fat options are expensive	Fat intake section List of low fat alternatives which show they are not more expensive than full fat options

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	Increase your physical activity during your school day by using the stairs available as much as possible. See pg X for more activities you can do at school	155	Action planning Barrier identification/problem solving	Finding time to be more physically active is possible Knowing more about different types of physical activity I can do will help me to be more active.	Physical activity section Activities to do at school
	Be smart! Select low fat options when eating out. You can enjoy the occasional treat without any guilt and your goals remain intact. See pg X for guidance	156	Barrier identification and problem solving		Fat section Low fat options when eating out
	Myth: low fat foods are expensive! Compare the pricelist of low fat foods to full fat foods on pg X and see how this is definitely NOT true!	140	Barrier identification and problem solving	Low fat food options are expensive	Fat section List of low fat food options with price list compared to full fat products + other unhealthy commonly bought foods
	Well done if you managed to select low fat foods when purchasing food. Continue making these changes and see the difference. Record your weekly weight on pg X	158	Prompt self-monitoring of behaviour		Fat section Weight record chart
7. Add less fat when preparing meals (week 1)	Week X: Add less fat when preparing meals to help reduce your total fat intake. See pg X for delicious meals which are prepared using low fat cooking methods	157	Goal setting; action planning	Low fat/fat-free foods taste good/are tasty	Fat section Low fat cooking methods Meal ideas using low fat cooking methods
	Increase your level of physical activity while teaching a lesson by walking around in class instead of	157	Action planning	Finding time to be more physically active is possible	Physical activity section

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	sitting. See pg x for more activities to do at school		Barrier identification/problem solving	Knowing more about different types of physical activity I can do will help me to be more active.	Activities to do at school
	Add less fat during meal preparation to decrease your energy intake and help you lose weight. See pg X for easy tips to reduce fat when preparing meals	151	Information about consequences of behaviour (health benefit) Action planning	Decreasing the amount of fat I eat will help me lose/control my weight It is easy to exclude high fat foods from my daily diet	Fat section Tips to reduce fat when cooking
	Save time! When purchasing chicken ask the butcher to remove the skin. This saves you from the task later. See pg X for more useful time-saving tips	149	Action planning Barrier identification and problem solving	I do not have enough time to prepare healthy meals regularly	Fat section Time-saving tips for preparing healthy meals
	Were you able to reduce the amount of fat you used during meal preparation this week? If yes, well done! Record your strategies on pg X and your weight on pg X	159	Prompt self-monitoring of behaviour		Fat section Record chart
8. Add less fat when preparing meals (Week2)	Week X: Continue to reduce your energy intake by adding less fat when preparing meals. Revisit the meals on pg X which utilize low fat cooking methods	150	Goal setting (behaviour); action planning		Fat section Low fat cooking methods Meal ideas using low fat cooking methods
	Increase your physical activity and look great. Go for a short, brisk walk before breakfast or after supper. Start with 5-10 minutes and work up to 30 minutes	158	Goal setting action planning	Knowing more about different types of physical activity I can do will help me to be more active Being more physically active will make me feel better about my appearance	Physical activity section List of activities

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	Substitute half your mince quantity in a recipe with soya mince to reduce the fat content of a meal with little/no effect on taste. See pg X for more tips	154	Action planning; Barrier identification and problem solving	Low fat/fat-free foods taste good/are tasty	Fat section Tips to reduce fat when cooking
	Do you feel that preparing healthy low fat meals takes too long? Try some of our quick and easy recipes on pg X and be amazed at how little time it takes	154	Barrier identification and problem solving	I do not have enough time to prepare healthy meals regularly	Fat section Quick and easy low fat recipes
	Congratulations! You have completed X weeks on your weight loss journey. Remain focused on your goal and remember to record your weekly weight on pg X	150	Prompt self-monitoring of behaviour		Fat section Record chart
9. Reduce or avoid the intake of high fat snacks	Week X: Reduce or avoid the intake of high fat snacks to help reduce your energy intake. See pg X for a list of commonly eaten snacks to avoid	143	Goal setting action planning		Fat section List of high fat snacks to avoid
	Find an exercise buddy who can exercise with you at the times you are available. It makes exercise fun and it is a means of support and encouragement	149	Action planning; Barrier identification and problem solving	Having an exercise buddy will help me to be more physically active	Physical activity section Strategies to stay motivated
	Reducing or avoiding high-fat snacks can help to lower your cholesterol levels and your risk of heart disease as most contain a large amount of the bad fats	157	Information about consequences of behaviour (health benefit)	Eating less fat will reduce the risk of disease e.g. heart disease	Fat section Health benefits of reducing fat intake
	Save money and lose weight at the same time! Compare the prices of	139	Action planning	Decreasing the amount of fat I eat will help me lose/control my weight	Fat section

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	high fat snacks to healthier, low fat foods on pg X and make the change		Information about consequences of behaviour (health benefit)	Low fat/healthy options are expensive	High fat snack pricelist vs healthy options
	Record the healthier snacks you managed to include in your diet instead of the high fat snacks you used to have on pg X.	121	Prompt self-monitoring of behaviour		Fat section Record chart
10. Limit the purchase of sugar-containing food/drinks	Week X: Limit the purchase of sugar-containing food/drinks. Review the list of foods with a high sugar content and find alternatives on pg X to choose instead	158	Goal setting action planning	I have poor awareness of the sugar content in food/drinks I eat/drink	Sugar section List of high sugar containing foods and drink with alternatives
	Physical activity not only helps with weight loss if part of a low calorie diet but it is also a great stress reliever. See pg X for more stress relievers	154	Information about consequences of behaviour		Physical activity section + stress management section Activities to relieve stress
	Did you know reducing your sugar intake can help reduce your total energy intake and can therefore help with weight loss.	121	Information about consequences of behaviour		Sugar section Health benefits of reducing sugar intake
	Craving something sweet? Instead of purchasing a sugary snack, try a piece of fruit which contains its own natural sugar as well as fiber, vitamins and minerals	160	Action planning; Information about consequences of behaviour	I can reduce the amount of sugary foods/drink I eat or drink	Sugar section Healthier Sweet alternatives to sugar

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	Well done if you successfully reduced your sugar intake this week by avoiding the purchase of sugar-containing food/drink. Don't forget to weigh yourself today	159	Prompt self-monitoring of behaviour		
11. Reduce or avoid the intake of sugar-containing cold drinks	Week X: Reduce or avoid the intake of sugar-containing cold drinks. See pg X for a list of drinks to avoid as well as healthier alternatives	140	Goal setting (behaviour); action planning;	I have poor awareness of the sugar content in food/drinks I eat/drink	Sugar section Drinks list with high sugar content (include information regarding sugar content) + alternatives
	It is important to stay hydrated when exercising and water is the best drink to do this. It is also refreshing and has no calories	130	Information about consequences of behaviour Action planning		Physical activity section Tips when exercising – stay hydrated
	Reduce your energy intake drastically by reducing the intake of sugar-containing cold drink: an average can contains at least 7 teaspoons of sugar	146	Information about consequences of behaviour	I have poor awareness of the sugar content in food/drinks I eat/drink	Sugar section Sugar content of cold drinks
	For a refreshing cold drink why not flavour ice water with lemon, mint or any freshly cut fruit. This delicious drink keeps you hydrated with no extra calories	159	Action planning	I can reduce the amount of sugary foods/drinks I eat or drink	Sugar section Healthy cold drinks
	How many 250ml glasses of sugar-containing cold drink did you avoid this week? For each glass you didn't drink you reduced your intake by 110 calories. Awesome!	160	Prompt self-monitoring of behaviour; Information about consequences of behaviour	I have poor awareness of the sugar content in the food/drink I eat/drink	Sugar section Sugar content of cold drink

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
12. Use less or no sugar when preparing foods	Week X: Use less or no sugar when preparing foods. It is unnecessary and adds extra calories to a meal. See pg x for healthy recipes	132	Goal setting; action planning;	I can reduce the amount of sugary foods/drinks I eat or drink	Sugar section Healthy recipes with no sugar added
	Have fun with your family! Be active on family outings by walking, hiking and swimming. See pg X for more great ideas to help keep you active	141	Action planning	Knowing more about different types of physical activities I can do will help me be more active	Physical activity section Physical activity ideas
	Sugar is referred to as 'empty calories' as it provides no nutrients to your body. It is therefore a non-essential and reducing it can help with weight loss	156	Information about consequences of behaviour	Reducing the amount of sugar y food/drink I eat and drink will make me feel unwell.	Sugar section Health benefits of reducing sugar
	Add fresh or dried fruit (banana/raisins) to porridge instead of sugar. It has natural sweetness and can help you meet your 5/day intake of fruit and veg	153	Action planning; Barrier identification and problem solving	I can reduce the amount of sugary foods/drinks I eat and drink	Sugar section Healthy Sweet alternatives
	Did you manage to avoid adding sugar when preparing meals? If yes, great and continue to do so. Please also weigh yourself and record your weight on pg X	153	Prompt self-monitoring of behaviour		Weight chart
13. Add less or no sugar to hot beverages	Week X: Aim to add less or no sugar to hot beverages. It all adds up: if you have 3 teaspoons of sugar/cup, and 5 cups/day it equals 15 teaspoons of sugar/day	158	Goal setting; action planning;	I have poor awareness of the sugar content in the food/drink I eat/drink	Sugar section Addition of how sugar intake in beverages add up
	Join a club in your area and play a team sport. This can be great fun and	131	Action planning;	Knowing more about different types of physical activity I can do will help me be more active	Physical activity section

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	having a structured programme can help keep you motivated		Barrier identification and problem solving	Having an exercise buddy will help me to be more physically active	Different types of exercises available Strategies to stay motivated
	Reducing or avoiding your sugar intake will not make you feel moody or unwell. Regular and nutritious meals ensure your body receives all it needs to be healthy	160	Information about consequences of behaviour	Reducing the amount of sugary food/drink I eat and drink will make me feel unwell.	Sugar section Health benefits
	Did you know you can train your tongue to become used to less sugar by decreasing the amount of sugar you use slowly over time? See pg X for more tips	150	Action planning Barrier identification and problem solving	I can reduce the amount of sugary foods/drinks I eat and drink	Sugar section Tips to become used to less sugar – taste strategies
	If you are unable to get used to little or no sugar in your drinks, try an artificial sweetener. These are safe to use and contain little to no calories in it	158	Action planning; Barrier identification and problem solving	I can reduce the amount of sugary foods/drinks I eat and drink	Sugar section No-nutritive Sweet alternatives
14. Avoid the intake of sugary foods/drinks during times of stress	Week X: Avoid the intake of sugary food/drink during times of stress. See pg X for effective stress relief strategies you can use instead of turning to sugar	157	Goal setting; action planning stress management	I turn to sugary foods/drinks when I am stressed	Stress management section Stress relief strategies
	Breathing exercises can help relax you during stressful times. See pg X for more information on how to perform these and other relaxation techniques	149	Stress management	I turn to sugary foods/drinks when I am stressed	Stress management section Stress relief strategies: breathing exercises
	Improve your ability to cope with stress by eating a healthy diet,	129	Stress management	I turn to sugary foods/drinks when I am stressed	Stress management section

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	having regular sleep and performing regular physical activity		Information about consequences of behaviour		Stress relief strategies: diet, sleep, exercise
	Good time management is important if you want a more relaxed lifestyle. Prioritizing tasks can help to achieve this. See pg X for more time management tips	155	Stress management Action planning	I turn to sugary foods/drinks when I am stressed	Stress management section Stress relief strategies: Time management
	If the suggested stress management strategies did not work for you, you may need to find professional help. See pg X for a list of practising psychologists	155	Stress management Action planning		Stress management section List of psychologists
15. Consolidation	Week 15: You have almost reached the end of the 16 week weight loss programme. Stay focused on your goal weight and all the changes you have successfully made	158	Goal setting (outcome)		Staying motivated
	You and a few interested educators can start a small gym at school by making use of school sport equipment like hoola hoops, skipping ropes and netball courts	158	Environmental restructuring Plan social support/social change		
	Make sure you get enough support! Ask family and friends to join you in changing your eating and exercise habits. They may also benefit from this	145	Plan social support/social change		Seek support from family and friends
	Recognise stressful situations so that you can manage it effectively	108	Stress management		Stress management section

Message Type/ Outcome	Message content	Character count	Theoretical construct/BCT	Belief targeted	Content to include in manual
	and not turn to food during these times				Recognising when you are stressed
	Reward yourself for the eating and exercise changes you have made. It gives you something to look forward to and keeps you motivated	132	Prompt rewards contingent on successful behaviour		Incentives
16. Consolidation of main changes	Week 16: Eat a variety of veg at mealtimes every day to help you meet the recommended 5/day of fruit and veg	108	Action planning		Fruit and veg section Eat a variety of veg
	Aim to increase your level of physical activity to at least 30 min/day for 5 days a week	88	Action planning		Physical activity section Aim for 30min/day
	Reduce or avoid high fat snacks to reduce your total energy intake. This can help with weight loss and decrease your risk of heart disease	139	Action planning		Fat section Benefits of reducing fat
	Reduce or avoid the intake of sugar containing cold drinks. You will be shocked at the amount of calories in each glass	119	Action planning		Sugar section Sugar content of cold drinks
	Well done! You have reached the end of the weight loss programme. Continue with the changes you made to keep the weight off and refer to the manual if needed	157			

Addendum IX: Intervention assessment tool for each chapter in the manual, the associated text messages and activities

When completing the evaluations below, consider the information in the attached chapter and text messages. Indicate your level of agreement with the statements and record any comments that you would think would provide us with important insights.

Statement 1: I really liked the content in this chapter				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				
Statement 2: I really found the information in this chapter useful				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				
Statement 3: I really understood all the information in this chapter				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				
Statement 4: I really found the activities in this chapter interesting				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				
Statement 5: I really found the activities in this chapter easy to complete				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments (if applicable, refer to specific activities):				

Statement 6: I really liked the content in these text messages linked to this chapter				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				
Statement 7: I really think the information in the text messages linked to this chapter is useful				
Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Your comments:				

Addendum X: Final list of text messages of the 16-week weight loss intervention

Week		Message content
Week 1	Monday	Dear educator, welcome to an exciting weight loss program consisting of a manual and 5 weekly text messages focusing on diet and physical activity. Best of luck to you!
	Tuesday	If you are overweight, losing as little as 5% of your weight is associated with health benefits, if you manage to keep it off.
	Wednesday	Determine your weekly goal and record your weight for the next 16 weeks bearing in mind that 0.5-1kg/week is healthy weight loss. See pg 60 for a step-by-step guide
	Thursday	Reduce your energy intake and follow a healthy eating plan to help you lose weight.
	Friday	Increase your energy expenditure to help you lose weight by increasing your physical activity slowly over time until you reach the recommended 150 minutes/wk
Week 2	Monday	Week 2: Buy a variety of fruit and vegetables to help meet your 5 portions/day. Tip: different coloured fruit and vegetables indicates good variety
	Tuesday	Did you know physical activity can be broken up into 10 min periods throughout the day if the recommended 30min/day is too much at one go? More tips on pg 38
	Wednesday	Eating fruit and vegetables can assist with weight loss if it replaces high-energy snacks like chips or chocolates which also tend to be more expensive
	Thursday	Worried about the cost of fruit and veg? Cut costs by buying fruit and veg in season and buying in bulk if possible
	Friday	Well done if you managed to buy a variety of fruit and vegetables this week. Remember to eat a dark-green leafy vegetable or a deep-yellow vegetable every day
Week 3	Monday	Week 3: Select low-fat foods when buying foods to help reduce your fat intake. A glass of fat free milk has nearly half the calories than full cream milk
	Tuesday	Increasing your physical activity level to 150min/wk and decreasing your energy intake by eating less fat at the same time can assist with weight loss
	Wednesday	Use low-fat food options if available like low-fat yoghurt. This reduces your fat intake and your risk of heart disease with often little effect on taste
	Thursday	Buying low-fat foods like lite mayonnaise or reduced fat salad dressing means you can still enjoy these items despite having reduced your fat and energy intake
	Friday	Well done to you if you managed to swop any full-fat food items for low-fat alternatives this week. Keep it up and you will soon see positive results!

Week		Message content
Week 4	Monday	Week 4: Limit buying sugar-containing food items. On pg 54 review the list of foods with a high sugar content and alternatives to choose from instead
	Tuesday	Physical activity not only helps with weight loss if part of a low calorie diet but it is also a great stress reliever
	Wednesday	Did you know reducing your sugar intake can help reduce your total energy intake and can therefore help with weight loss
	Thursday	Craving something sweet? Instead of purchasing a sugary snack, try a piece of fruit which contains its own natural sugar as well as fiber, vitamins and minerals
	Friday	Well done if you successfully reduced your sugar intake this week by avoiding buying sugar-containing food items. Don't forget to weigh yourself today
Week 5	Monday	Week 5: Pack fruit and veg into your lunchbox every day to make it easier to meet your goal of 5/day. See pg 18 for lunchbox ideas that are quick and easy
	Tuesday	Plan and structure your day to include at least 30 minutes of physical activity. If planned for immediately after school, take your clothes with you to school
	Wednesday	Increasing your fruit and vegetable intake increases your fiber intake. This keeps you feeling fuller for longer and may therefore help with weight loss
	Thursday	Vegetables like carrots or cucumber sticks or fruit in your lunchbox make great “on the go snacks” during a busy school day and require little or no preparation
	Friday	How many days this week did you manage to include fruit and veg in your lunchbox? Record this and your weekly weight on your self-monitoring charts
Week 6	Monday	Week 6: Continue to select low-fat food when buying foods to reduce your fat intake. Low-fat milk and yoghurt are not more expensive than the full-fat versions
	Tuesday	Increase your physical activity during your school day by using the stairs available as much as possible. See pg 38 for more activities you can do at school
	Wednesday	Be smart when eating out! Order low-fat options like baked potato or green salad instead of chips or grilled skinless chicken instead of fried chicken with skin
	Thursday	The initial taste of low-fat milk may take time to get used to if changing from full-fat milk. This is usually short-lived while the benefits are long-lasting
	Friday	Well done if you managed to select low-fat foods when buying food. Continue making these changes and see the difference. Remember to record your weekly weight

Week		Message content
Week 7	Monday	Week 7: Reduce or avoid the intake of sugar-containing cold drinks. See pg 32 for a list of cold drinks and its sugar content
	Tuesday	It is important to stay hydrated when exercising and water is the best drink to do this. It is also refreshing and has no calories
	Wednesday	Reduce your energy intake drastically by reducing the intake of sugar-containing cold drink: an average can contains at least 7 teaspoons of sugar
	Thursday	For a refreshing cold drink why not flavour ice water with lemon, mint or any freshly cut fruit. This delicious drink keeps you hydrated with no extra calories
	Friday	How many 250ml glasses of sugar-containing cold drink did you avoid this week? For each glass you didn't drink you reduced your intake by 110 calories. Awesome!
Week 8	Monday	Week 8: Aim to eat a variety of vegetables at mealtimes every day. Remember different coloured vegetables are an indication of good variety
	Tuesday	Too tired to exercise? Did you know that exercising regularly and following a healthy meal plan can boost your energy levels? Try it!
	Wednesday	Use different coloured vegetables when preparing your meals. This makes your meal look appetising and is also an indication of good variety
	Thursday	Cook vegetables only until tender. This avoids over-cooking, ensures the vegetables look appealing and that nutrients are not lost. More cooking tips on pg 20
	Friday	On average, how many different coloured vegetables did you include at mealtimes this week? Record this and your weekly weight on your self-monitoring charts
Week 9	Monday	Week 9: Add less fat when preparing meals to reduce your total fat intake and help you lose weight
	Tuesday	Increase your level of physical activity while teaching a lesson by walking around in class instead of sitting down
	Wednesday	Use low-fat cooking methods like stewing, stir-frying or steaming instead of frying or roasting to decrease the fat and total energy content of a meal
	Thursday	Substitute high fat food with lower fat alternatives in recipes like low-fat white yogurt for cream. The fat content is reduced and preparation time is the same
	Friday	Well done if you were able to reduce the amount of fat you used during meal preparation this week? Record the strategies you found useful as well as your weight

Week		Message content
Week 10	Monday	Week 10: Use less or no sugar when preparing foods. It is unnecessary and adds extra calories to a meal
	Tuesday	Have fun with your family! Be active on family outings by walking, hiking and swimming. See pg 38 for more great ideas to help keep you active
	Wednesday	Sugar is referred to as 'empty calories' as it provides no nutrients to your body. It is therefore non-essential and reducing it can help with weight loss
	Thursday	Add fresh or dried fruit (banana/raisins) to porridge instead of sugar. It has natural sweetness and can help you meet your 5/day intake of fruit and veg
	Friday	Did you manage to avoid adding sugar when preparing meals? If yes, great and continue to do so. Please also weigh yourself and record your weight
Week 11	Monday	Week 11: Continue to reduce your fat intake by adding less fat when preparing meals. Use low-fat cooking methods such as boiling, steaming and stewing
	Tuesday	Increase your physical activity and look great. Go for a short, brisk walk before breakfast or after supper. Start with 5-10 minutes and work up to 30 minutes
	Wednesday	Substitute half your mince quantity in a recipe with soya mince to reduce the fat content of a meal with little to no effect on taste
	Thursday	Do you think that preparing healthy meals takes too long? Simply add less oil when sautéing your onions to reduce the fat. No extra time or effort needed!
	Friday	Congratulations! You have completed 11 weeks on your weight loss journey. Remain focused on your goal and remember to record your weekly weight
Week 12	Monday	Week 12: Aim to add less or no sugar to hot beverages. It all adds up: if you have 3 teaspoons of sugar/cup, and 5 cups/day it equals 15 teaspoons of sugar/day
	Tuesday	Join a club in your area and play a team sport. This can be great fun and having a structured programme can help keep you motivated
	Wednesday	Reducing or avoiding your sugar intake will not make you feel moody or unwell. Regular and nutritious meals ensure your body receives all it needs to be healthy
	Thursday	Did you know you can train your tongue to become used to less sugar by decreasing the amount of sugar you use slowly over time? See pg 32 for more tips
	Friday	If you are unable to get used to little or no sugar in your drinks, try an artificial sweetener. These are safe to use and contain little to no calories in it

Week		Message content
Week 13	Monday	Week 13: Reduce or avoid the intake of high fat snacks such as biscuits or doughnuts to reduce your fat and energy intake and help you to lose weight
	Tuesday	Find an exercise buddy who can exercise with you at the times you are available. It makes exercise fun and it is a means of support and encouragement
	Wednesday	Reducing or avoiding high-fat snacks can help to lower your cholesterol levels and your risk of heart disease as most contain a large amount of the bad fats
	Thursday	Reduce your fat intake while getting value for your money. Buy a 1kg bag of apples to last a few days for R13,99 instead of a 125g packet of crisps for R15,99
	Friday	Record the healthier snacks you included in your diet instead of the high fat snacks you used to have on your self-monitoring chart
Week 14	Monday	Week 14: Avoid the intake of sugary food items during times of stress. Meditation can be an effective stress reliever instead
	Tuesday	Breathing exercises can help relax you during stressful times. See pg 42 for more information on how to perform these and other relaxation techniques
	Wednesday	Improve your ability to cope with stress by eating a healthy diet, having regular sleep and performing regular physical activity
	Thursday	Good time management is important if you want a more relaxed lifestyle. Prioritizing tasks can help to achieve this
	Friday	If the suggested stress management strategies did not work for you, you may need to find professional help. See pg 47 to find a practising psychologist
Week 15	Monday	Week 15: You have almost reached the end of the 16 week weight loss programme. Stay focused on your goal weight and all the changes you have successfully made
	Tuesday	You and a few interested educators can start a small gym at school by making use of school sport equipment like hoola hoops, skipping ropes and netball courts
	Wednesday	Make sure you get enough support! Ask family and friends to join you in changing your eating and exercise habits. They may also benefit from this
	Thursday	Recognise stressful situations so that you can manage it effectively and not turn to food during these times
	Friday	Reward yourself for the eating and exercise changes you have made. It gives you something to look forward to and keeps you motivated

Week		Message content
Week 16	Monday	Week 16: Eat a variety of vegetables at mealtimes every day to help you meet the recommended 5/day of fruit and vegetables
	Tuesday	Aim to increase your level of physical activity to at least 30 min/day for 5 days a week
	Wednesday	Reduce or avoid high fat snacks to reduce your total energy intake. This can help with weight loss and decrease your risk of heart disease
	Thursday	Reduce or avoid the intake of sugar containing cold drinks. You will be shocked at the amount of calories in each glass
	Friday	Well done! You have reached the end of the weight loss program. Continue with the changes you made to keep the weight off and refer to your manual when needed

Addendum XI: EDUCATOR COPY OF HEALTH INDICATORS

Randomised controlled trial to evaluate a weight loss intervention for overweight and obese primary school educators at selected schools within the Metro North District in Western Cape Province, South Africa

Educator Wellness Day Assessment (Educator copy)

School Name: _____

Educator Name: _____

Weight: _____

Height: _____

BMI (normal: 18.5 – 25): _____

Waist circumference (normal: WC <102 cm for males or <88 cm for females): _____

Percentage body fat (acceptable if 6-24% for males and 9-31% for females): _____

Blood pressure (normal: systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg):_____/_____

If you are concerned about your dietary intake and weight you can contact a registered dietitian on the following website: www.ADSA.org.za.

Addendum XII: REFERRAL LETTER TO HEALTH PRACTITIONER OR HEALTH CARE FACILITY

Dietitian Name: _____

DT number: _____

Date: _____

Dear Colleague

Re: Mr/Miss/Mrs _____

Request for further medical management

The above-mentioned person was seen on the ___/__/__ at a Wellness Day held at their place of work namely, _____.

The following assessments were performed:

Weight: _____

Height: _____

BMI (normal: 18.5 – 25): _____

Waist circumference (normal: WC <102 cm for males or <88 cm for females): _____

Percentage body fat (acceptable if 6-24% for males and 9-31% for females): _____

Blood pressure (normal: systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg):_____/_____

He/she was therefore found to have an elevated blood pressure reading and I would be most grateful if you could please manage further.

Kind Regards

_____

(Name and surname)

(Signature)

Addendum XIII: ELIGIBILITY CHECKLIST

Randomised controlled trial to evaluate a weight loss intervention for overweight and obese primary school educators at selected schools within the Metro North District in Western Cape Province, South Africa

Educator Wellness Day assessment and eligibility screener (Researcher copy)

School Name: _____

Educator Name: _____

Weight: _____

Height: _____

BMI (normal: 18.5 – 25): _____

Waist circumference (normal: WC <102 cm for males or <88 cm for females): _____

Percentage body fat (acceptable if 6-24% for males and 9-31% for females): _____

Blood pressure (normal: systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg):_____/_____

Referral letter provided for abnormal blood pressure reading YES/NO/NOT APPLICABLE

Eligibility criteria

Inclusion Criteria:

BMI ≥27kg/m^2	YES	NO
Between the ages of 18-60 years	YES	NO
In possession of a self-owned cellular phone	YES	NO

Exclusion Criteria:

Currently on a weight loss intervention	YES	NO
Pregnant or trying to fall pregnant	YES	NO
Has been pregnant in the last 6 months	YES	NO
Currently breastfeeding	YES	NO
Orthopaedic or joint problems which will be a barrier to physical activity	YES	NO
History of major medical problems such as heart disease (including having had a pacemaker inserted)	YES	NO

Recent weight loss greater than 10% over the last 6 months.	YES	NO

Eligible for the study:	YES	NO
Educator interested in participating in the study	YES	NO
If you were to receive text messages, what time of day would best suite you		
If you were provided with a weight loss book as part of the study, what time of day would suite you best to engage with the book		

Randomised controlled trial to evaluate a weight loss intervention for overweight and obese primary school educators at selected schools within the Metro North District in Western Cape Province, South Africa

Investigators: Fatima Hoosen, Prof Nelia Steyn, Prof Mieke Faber, Prof Marjanne Senekal

Division of Human Nutrition, Department of Human Biology, Faculty of Health Sciences

University of Cape Town

Non Communicable Diseases Unit, South African Medical Research Council

Dear Educator,

In 2007 a health risk survey was conducted amongst primary school educators in the Western Cape where it was discovered that educators were a high risk group for obesity and developing non-communicable diseases (NCDs), such as heart disease. Many of the educators were found to be overweight or obese, had elevated blood pressure readings as well as elevated levels of blood glucose and cholesterol. Further studies were conducted which found that lifestyle choices amongst the educators, namely an unhealthy diet and lack of physical activity, may be contributing factors to the development of obesity and NCDs. You will receive one of two interventions that can help to lower your risk of NCDs. Information will be collected at the beginning of the study, after 16 weeks and then again at 20 weeks.

You may partake in this study if you have a BMI ≥27kg/m^2, between the ages of 18-60 years and have a self-owned cellular phone. You may **not** partake in this study if you are currently following a weight loss intervention, are pregnant or trying to fall pregnant or have been pregnant less than 6 months ago, are breastfeeding, have orthopaedic or joint problems which will be a barrier to physical activity, have a history of major medical problems such as heart disease (including having had a pacemaker inserted) or have had recent weight loss greater than 10% over the last 6 months. We aim to include about 300 educators from schools in the Western Cape in this study.

This is a unique opportunity to partake in a wellness programme at no cost to you and we believe that following the programme will greatly benefit your health. This is a randomised controlled trial and there will therefore be 2 groups of participants who will receive different wellness programmes. Group A will receive access to written information while Group B will receive access to written information and text messaging. It is however important to note that at the end of the study period, each group will be given access to both programmes.

If you choose to participate in our study we would like to:

- Measure your height, weight and waist circumference at 3 time points (baseline, week 16 and week 20): you will only be required to remove your shoes and jackets/jerseys for these measurements;
- Measure your body fat content at 3 time points (baseline, week 16 and week 20). For this you will be required to stand on a scale and adhere to the following:
    - Not perform strenuous exercise 12 hours before these measurements are taken;
    - To avoid caffeine and alcohol the day before these measurements are taken;
    - To have an empty bladder and be fully hydrated when measuring body fat content.
- Measure your blood pressure at 3 time points (baseline, week 16 and week 20);
- Complete a survey questionnaire on the following:
    - Socio-demographic information
    - health information (baseline and week 16),
    - Questions about your weight ,
    - Psychological well-being,
    - Nutrition knowledge at 3 time points (baseline, week 16 and week 20),
    - Physical activity status at 3 time points (baseline, week 16 and week 20) ,
    - Food choices at 3 time points (baseline, week 16 and week 20),
    - Beliefs about fruit and vegetables, fat and sugar intake, as well as beliefs about physical activity at 3 time points (baseline, week 16 and week 20).

The measurements as well as the interview will be conducted in a private room at the school by a trained fieldworker. Data collection at the three time points (at the beginning of the study, 16 weeks and 20 weeks) will take approximately 60 minutes of your time.

Please note that there are no known risks involved in taking part in this study. You may benefit as you will receive sound scientific information regarding a healthy diet and exercise, which is in line with the South African food-based dietary guidelines, as well as a report of your health readings. You will be referred to your general health practitioner or primary health care facility if an abnormal blood pressure reading is detected. You may gain further from participation in the intervention in that you will gain insights in healthy eating and may experience weight loss. If the intervention is found to be effective in assisting educators in improving their dietary intake and physical activity, the programme will be made available to the Department of Education for roll out at schools across the country. A summary report on the findings of the study will be sent to the principal of each school for dissemination to staff.

Your participation is completely voluntary and you do not have to take part if you do not wish to. Furthermore, you are welcome to withdraw at any time should you wish to do so, without giving any reason. Failure to take part in this study will not influence your current or future employment with the school or with the Department of Basic Education of the Western Cape. However, we hope that you will be willing to participate for the full 20 weeks in order to fully benefit from the programme.

All information provided by participants will remain confidential and names will not be used on the questionnaire for your anonymity (each participant will be assigned a code). During the survey and data capture period questionnaires will be kept under lock and key by the principal investigator, Professor Nelia Steyn. All questionnaires will be destroyed after the required five years.

This research was approved by the University Of Cape Town Faculty Of Health Sciences Human Research Ethics Committee (FHS-HREC) (REF 112/2017). Should you have any questions about the research please feel free to contact Professor NP Steyn 082 449 8057 at any time. If you have any questions or concerns about the ethics of this research you can contact the Faculty of Health Sciences Human Research Ethics Committee (FHS-HREC) on 021 4066496.

Declaration by participant:

By signing below, I…….. agree to take part in this study on '**The development, implementation and evaluation of the impact of a self-help weight loss intervention for primary school educators at selected schools within the Western Cape, South Africa'.** The study has been explained to me, I have had the opportunity to ask questions about it and my questions have been answered well. I know that I am free to ask questions at any time during the study, that I am free to withdraw from the study at any time, and that it will not count against me in any way if I do withdraw. I have carefully read/listened to the information and understand the study and what will be expected of me. The decision to be a part of this study is my own.

Signature……Date…….

Declaration by the investigator:

I declare that I did not force the participant to take part in this study and that I will do no harm to the participant. I will ensure that his/her personal information is kept confidential and that his/her privacy is protected.

Investigator/fieldworker name…….

Investigator/fieldworker signature……Date……

Addendum XV: PARTICIPANT QUESTIONNAIRE FOR Health4LIFE INTERVENTION

Randomised controlled trial to evaluate a weight loss intervention for overweight and obese primary school educators at selected schools within the Metro North District in Western Cape Province, South Africa

Section A: Self-Administered Questionnaire

Date of interview: _____ School name: _____

Interviewer name: _____Interviewer code:_____

Participant code: _____ Indicate data set: Baseline / Week 16 / Week 20

1 SOCIO-DEMOGRAPHIC QUESTIONS			
1.1 Date of birth e.g. 10-04-66			
1.2 Gender- Male=1; Female=2			
1.3 Race-Black=1; Coloured =2; White=3; Indian=4			
1.4 Marital status: married=1, divorced=2, single=3, widowed=4, other=5			
1.5 Years of teaching	years		
1.6 Smoker	Yes	No	
1.7 Weight if known	Kg		
1.8 Height if known	cm		

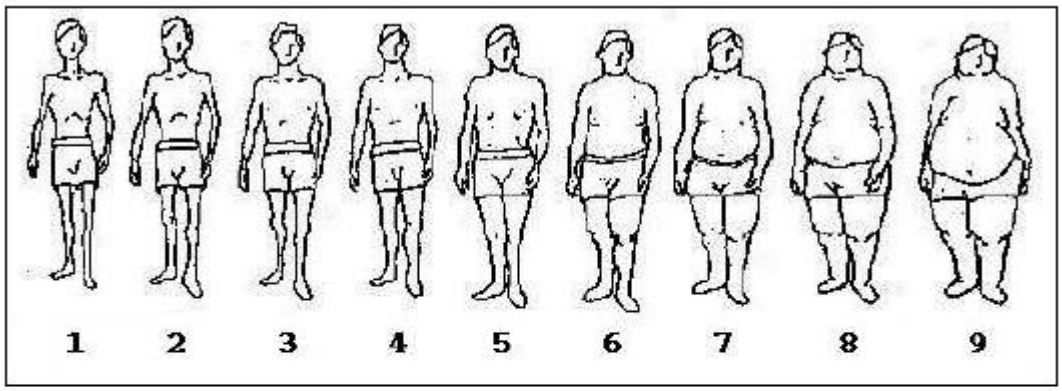
2 MEDICAL QUESTIONS	**Yes**	**No**	**Not sure**
2.1 Are you aware if you have (or have had) any of these conditions?			
2.1.1 High blood pressure			
2.1.2 Heart disease			
2.1.3 Stroke			
2.1.4 High blood cholesterol			
2.1.5 Diabetes or sugar			
2.2 Have you tried to lose weight in the past 12 months?			
2.3 Are you taking any medication for the following:			
2.3.1 High blood pressure			
2.3.2 High blood cholesterol			
2.3.3 Diabetes or sugar			

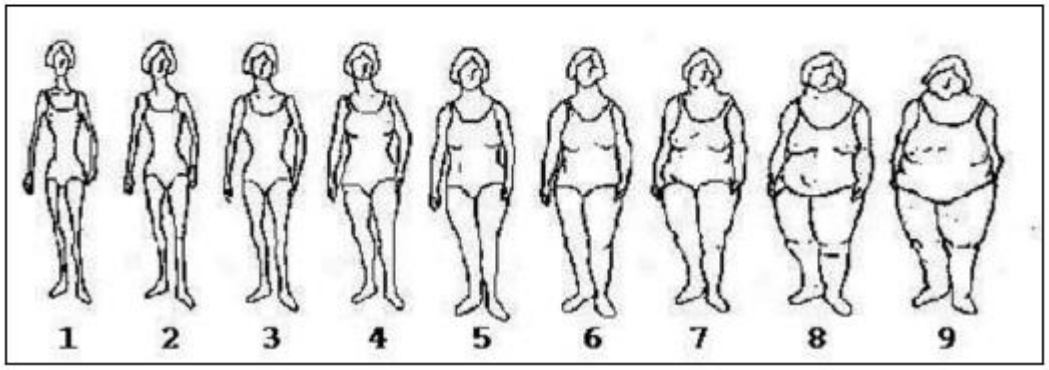
3 Living Standards Measure: Please tick as applicable	**Yes**	**No**
I have the following in my household :		
· TV set		
· Swimming pool		
· DVD player/ Blu Ray Player		
· Pay TV (M-Net/DStv/Top TV) subscription		
· Air conditioner (exl. fans)		
· Computer /Desktop/ Laptop		
· Vacuum cleaner/floor polisher		
· Dishwashing machine		
· Washing machine		
· Tumble dryer		
· Home telephone (excluding a cell)		
· Deep freezer –free standing		
· Refrigerator or combined fridge/freezer		
· Electric stove		
· Microwave oven		
· Built-in kitchen sink		
· Home security service		
· 3 or more cell phones in household		
· 2 cell phones in household		
· Home theatre system		
I have the following amenities in my home or on the plot:		
· Tap water in house/on plot		
· Hot running water from a geyser		
· Flush toilet in/outside house		
There is a motor vehicle in our household		
I am a metropolitan dweller		
I live in a house, cluster or town house		
I live in a rural area outside the Western Cape		
There are no radios, or only one radio (excluding car radios) in my household		
There is no domestic workers or household helpers in household (incl. both live-in & part time domestics and gardeners)		

4 Look at the pictures below and answer the following questions

Select the man/woman you feel you look like the most. _____

PICTURES OF MEN AND WOMEN





5 Indicate (with a tick) how you would best describe how you feel about implementing the following actions (answer each question only once).

	No plans to change for the next 6 months	Thinking about changing in the next 6 months	Thinking about changing in the next month	Attempting change currently	Changed behaviour and attempting to maintain change
5.1 Increasing fruit consumption					
5.2 Increasing vegetable consumption					
5.3 Decreasing dietary fat consumption					
5.4 Decreasing sugar consumption					
5.5 Increasing planned physical activity					

6 BECK DEPRESSION INVENTORY

Instructions for completion of this section: This section consists of 21 groups of statements. Please read each group of statements carefully and then pick out the **one statement in each group** which best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the biggest number for that group. Be sure that you do not choose more than one statement for any group, including item 16 (changes in sleeping patterns) and item 18 (changes in appetite)

6.1 Sadness	**6.12 Loss of Interest**
0 I do not feel sad **1** I feel sad much of the time **2** I am sad all the time **3** I am so sad or unhappy that I can't stand it	**0** I have not lost interest in other people or activities **1** I am less interested in in other people or things than before **2** I have lost most of my interest in other people or things **3** It's hard to get interested in anything
6.2 Pessimism	**6.13 Indecisiveness**
0 I am not discouraged about my future **1** I feel more discouraged about my future than I used to **2** I do not expect things to work for me **3** I feel my future is hopeless and will only get worse	**0** I make decisions about as well as ever **1** I find it more difficult to make decisions than usual **2** I have much greater difficulty in making decisions than I used to **3** I have trouble making decisions
6.3 Past Failure	**6.14 Worthlessness**
0 I do not feel like a failure **1** I have failed more than I should **2** As I look back, I see a lot of failures **3** I feel I am a total failure as a person	**0** I do not feel I am worthless **1** I don't consider myself as worthwhile and useful as I used to **2** I feel more worthless as compared to other people **3** I feel utterly worthless
6.4 Loss of Pleasure	**6.15 Loss of Energy**
0 I get as much pleasure as I ever did from the things I enjoy **1** I don't enjoy things as much as I used to **2** I get very little please from the things I used to enjoy **3** I can't get any pleasure from the things I used to enjoy	**0** I have as much energy as ever **1** I have less energy than I used to have **2** I don't have enough energy to do very much **3** I don't have enough energy to do anything
6.5 Guilty Feelings	**6.16 Changes in Sleeping Pattern**
0 I don't feel particularly guilty **1** I feel guilty over many things I have done or should have done **2** I feel quite guilty most of the time **3** I feel guilty all of the time	**0** I have not experienced any change in my sleeping pattern **1** **a.** I sleep somewhat more than usual **b.** I sleep somewhat less than usual **2** **a.** I sleep a lot more than usual **b.** I sleep a lot less than usual **3** **a.** I sleep most of the day **b.** I wake up 1-2 hours early and can't get back to sleep
6.6 Punishment Feelings	**6.17 Irritability**
0 I don't feel I am being punished **1** I feel I may be punished **2** I expect to be punished **3** I feel I am being punished	**0** I am no more irritable than usual **1** I am more irritable than usual **2** I am much more irritable than usual **3** I am irritable all the time
6.7 Self-Dislike	**6.18 Changes in Appetite**
0 I feel the same about myself as ever **1** I have lost confidence in myself **2** I am disappointed in myself **3** I dislike myself	**0** I have not experienced any change in my appetite **1** **a.** My appetite is somewhat less than usual

	b. My appetite is somewhat more than usual **2** **a.** My appetite is much less than before **b.** My appetite is much more than before **3** **a.** I have no appetite at all **b.** I crave food all the time
6.8 Self-Criticalness	**6.19 Concentration Difficulty**
0 I don't criticize or blame myself more than usual **1** I am more critical of myself than I used to be **2** I criticize myself for all of my faults **3** I blame myself for everything bad that happens	**0** I can concentrate as well as ever **1** I can't concentrate as well as usual **2** It's hard to keep my mind on anything for very long **3** I find I can't concentrate on anything
6.9 Suicidal Thoughts or Wishes	**6.20 Tiredness or Fatigue**
0 I don't have any thoughts of killing myself **1** I have thoughts of killing myself, but I would not carry them out **2** I would like to kill myself **3** I would kill myself if I had the chance	**0** I am no more tired or fatigued than usual **1** I get more tired or fatigued more easily than usual **2** I am too tired or fatigued to do a lot of the things I used to do **3** I am too tired or fatigued to do most of the things I used to do
6.10 Crying	**6.21 Loss of Interest in Sex**
0 I don't cry any more than I used to **1** I cry more than I used to **2** I cry over every little thing **3** I feel like crying but I can't	**0** I have not noticed any recent change in my interest in sex **1** I am less interested in sex than I used to be **2** I am much less interested in sex now **3** I have lost interest in sex completely
6.11 Agitation	
0 I am no more restless or wound up than usual **1** 1 I feel more restless or wound up than usual **2** I am so restless or agitated that it's hard to stay still **3** I am so restless or agitated that I have to keep moving or doing something	

7 NUTRITION KNOWLEDGE QUESTIONS

Please answer all the questions.

Please choose only <u>one</u> answer (thus either letter a or b or c or d or e). <u>Clearly circle the letter of the answer you choose.</u>

7.1. Which one of the following spreads is the best at protecting against heart disease?

a) Soft margarine which is sold in a tub.
b) Pure butter which is sold in a brick.
c) Solid/hard margarine which is sold in a brick.
d) Butter spread which is sold in a tub.

7.2. Which one of the following oils should not be allowed in a diet that is used for the treatment of heart disease?

a) Sunflower oil
b) Olive oil
c) Coconut oil
d) Canola oil

7.3. What is the recommended amount of fruit and vegetables that you should aim to eat in a day?

a) 1 fruit and vegetable a day.
b) 3-4 fruit and vegetables a day.
c) 5 or more fruit and vegetables a day.
d) Any amount, but the more the better.

7.4. The recommended amount of physical activity for the week is:

a) 30 minutes of moderate-intensity exercise.
b) 60 minutes of moderate-intensity exercise.
c) 120 minutes of moderate-intensity exercise.
d) 150 minutes of moderate-intensity exercise.

7.5. Which one of the following statements regarding the benefits of physical activity is not true?

a) It can help control your weight.
b) It may reduce your risk of cardiovascular disease.
c) Physical activity turns fat into muscle.
d) It can help strengthen your bones and muscles.

7.6. A healthy alternative to meat includes:

a) Dry beans, peas, lentils
b) Eggs
c) Soya mince
d) All of the above

7.7. Which one of the following statements regarding fruit is true?

a) Fruit should be limited to one a day because it contains high amounts of natural sugar.
b) As fruits are low in energy (calories) you can eat as many as you like.
c) Drinking one glass of orange nectar is the same as eating one fresh orange.
d) A heaped tablespoon of raisins equals one fruit portion.

7.8. Which one of the following statements regarding sugar is true?

a) It is necessary to eat a lot of sugar as it provides the body with energy.
b) Limiting your sugar intake can assist with weight loss.
c) Sugar contains a lot of vitamins and minerals.
d) Brown sugar is healthier than white sugar.

7.9. Identify a healthier alternative to replace sugar in your tea or coffee.

a) Honey
b) Brown sugar
c) Artificial sweetener
d) All of the above

7.10. How many teaspoons of sugar does an average can (330ml) of fizzy drink contain?

a) < 4 teaspoons
b) Between 4 and 6 teaspoons
c) Between 6 and 8 teaspoons
d) > 8 teaspoons

7.11. Reducing the total amount of fat you eat may benefit you in the following way(s):

a) It can assist with weight loss
b) It can be protective against heart disease
c) It can reduce the risk of certain cancers
d) All of the above

7.12. Which one of the following statements about physical activity is true?

a) Overweight people first have to lose weight before they can start exercising.
b) If you cannot meet the recommended amounts of exercise a week, there is no point in exercising at all
c) Being physically active is too expensive as you require special clothing, shoes and a gym membership.
d) If you cannot meet the recommendation for physical activity at one time you can accumulate the minutes over the course of the day.

7.13. Which one or more of the following condiments contain sugar?

a) Mustard sauce
b) Tomato sauce
c) Chutney
d) All of the above

7.14. A healthier alternative to full fat milk is:

a) Condensed milk
b) Coconut milk
c) Ideal “evaporated” milk
d) Low fat milk

7.15. Which one of the following combinations indicates a good variety of vegetables?

a) Broccoli, green beans, spinach
b) Potatoes, cabbage, cauliflower
c) Beetroot, peas, carrots
d) Butternut, pumpkin, sweet potato

7.16. Which one of the following statements regarding fruits and vegetables is true?

a) Eating adequate amounts of fruit and vegetables can reduce your risk of many diseases such as high blood pressure and heart disease.
b) The amount of vitamins and minerals in fruit and vegetables are so little that it provides little to no benefit to you.
c) Organic sources of fruit and vegetables are more nutritious.
d) Fresh fruit and vegetables are healthier than frozen, canned, or dried forms.

7.17. Being physically active means:

a) Going to the gym.
b) Walking briskly regularly.
c) Vigorously performing cleaning tasks in the home.
d) All of the above.

7.18. **If one wants to lose weight you need to:**

a) Be physically active.
b) Eat a lower energy (calorie) diet.
c) Eat smaller portions.
d) All of the above.

7.19. **A healthy diet contains the following:**

a) Fruit and vegetables only.
b) Breads, cereals, fruit and vegetables only.
c) Lean meat/legumes, fruit and vegetables, low fat dairy products, breads and cereals.
d) Low fat dairy products and lean meats only.

7.20. **Which one of the following combinations contains a lot of fibre?**

a) Oats, apples, beans.
b) Milk, yoghurt, cheese.
c) Beef, chicken, mutton.
d) Butter, margarine.

8 Physical Activity Questionnaire (Global Physical Activity Questionnaire (GPAQv2)

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. *[Insert other examples if needed].* In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Questions		Response	Code
Activity at work			
8.1	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work*] for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 If No, go to P 4	P1
8.2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days ⌊__⌋	P2
8.3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes ⌊__⌋⌊__⌋ : ⌊__⌋⌊__⌋ hrs mins	P3 (a-b)
8.4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads*] for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 7*	P4
8.5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days ⌊__⌋	P5
8.6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes ⌊__⌋⌊__⌋ : ⌊__⌋⌊__⌋ hrs mins	P6 (a-b)
Travel to and from places			
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship. [insert other examples if needed]			
8.7	Do you walk or use a bicycle (*pedal cycle*) for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If No, go to P 10*	P7
8.8	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days ⌊__⌋	P8

8.9	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes ⌊_⌊_⌋ : ⌊_⌊_⌋ hrs mins	P9 (a-b)

Questions	Response	Code
Recreational activities		
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure), [insert relevant terms].		
8.10 Do you do any vigorous-intensity sports, fitness or recreational (*leisure*) activities that cause large increases in breathing or heart rate like [*running or football,]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 13*	P10
8.11 In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (*leisure*) activities?	Number of days ⌊_⌋	P11
8.12 How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes ⌊_⌊_⌋ : ⌊_⌊_⌋ hrs mins	P12 (a-b)
Physical Activity (recreational activities) contd.		
8.13 Do you do any moderate-intensity sports, fitness or recreational *(leisure*) activities that causes a small increase in breathing or heart rate such as brisk walking,(*cycling, swimming, volleyball*)for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P16*	P13
8.14 In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (*leisure*) activities?	Number of days ⌊_⌋	P14
8.15 How much time do you spend doing moderate-intensity sports, fitness or recreational (*leisure*) activities on a typical day?	Hours : minutes ⌊_⌊_⌋ : ⌊_⌊_⌋ hrs mins	P15 (a-b)
Sedentary behaviour		
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping. *[INSERT EXAMPLES] (USE SHOWCARD)*		
8.16 How much time do you usually spend sitting or reclining on a typical day?	Hours : minutes ⌊_⌊_⌋ : ⌊_⌊_⌋ hrs min s	P16 (a-b)

9 BELIEF QUESTIONS

Please circle the number that represents how you feel about the following statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	**2**	**3**	**4**	**5**
Fruit and vegetable intake					
9.1 Preparation of vegetables does not take a long time.	1	2	3	4	5
9.2 Eating fruits and vegetables every day will help me lose weight/ control my weight.	1	2	3	4	5
9.3 Fruits and vegetables are affordable.	1	2	3	4	5
9.4 I can eat the recommended amount of fruits and vegetables every day.	1	2	3	4	5
9.5 I would eat vegetables even if at times, they look unappealing.	1	2	3	4	5
9.6 Fruit and vegetables are easy to find in stores nearby	1	2	3	4	5
Fat intake					
9.7 Eating less fat will help reduce the risk of diseases e.g. heart disease.	1	2	3	4	5
9.8 Decreasing the amount of fat I eat will help me lose/ control my weight.	1	2	3	4	5
9.9 Low-fat/healthy fat options are expensive.	1	2	3	4	5
9.10 Healthy takeaways and/or street foods are easy to find in my surroundings.	1	2	3	4	5
9.11 It is easy to exclude high-fat foods from my daily diet.	1	2	3	4	5
9.12 I do not have enough time to prepare healthy meals regularly.	1	2	3	4	5
9.13 Low fat/ fat-free foods taste good/ are tasty.	1	2	3	4	5
Sugar intake					
9.14 I turn to sugary foods/snacks/drinks when I am stressed.	1	2	3	4	5
9.15 I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink.	1	2	3	4	5
9.16 Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired).	1	2	3	4	5
9.17 I can reduce the amount of sugary foods/snack/drinks I eat and drink	1	2	3	4	5
Physical activity					
9.18 There are no accessible, safe, affordable opportunities for me to be physically active.	1	2	3	4	5
9.19 Being physically more active will make me feel better about my appearance.	1	2	3	4	5
9.20 Finding time to be physically more active is possible.	1	2	3	4	5
9.21 Knowing more about different types of physical activity I can do will help me to be more active.	1	2	3	4	5
9.22 I could be physically more active even if I were tired.	1	2	3	4	5
9.23 Having an exercise 'buddy' will help me to be physically more active.	1	2	3	4	5
9.24 I can increase my levels of physical activity (be physically more active)	1	2	3	4	5

Section B: Fieldworker-administered assessments

10 Anthropometric Data:

Parameter	Reading 1	Reading 2	Reading 3 (if required)
10.1 Weight (Kg)			
10.2 Height (cm)			
10.3 Waist circumference (cm)			

11 Blood pressure Data:

Parameter	Reading 1	Reading 2
Diastolic reading		
Systolic reading		

12 Indicator food choice assessment (non-quantified)

Code	Food item	How often during the past week did you drink/ eat the following:							
		Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	≥4 per day
	Low Fat Red meat (beef, pork without fat, steak, lean mince)								
	High Fat Red meat (beef mince, mutton, lamb, bacon)								
	Processed meats Sausages: Vienna, boerewors, pork sausages, Russians Sliced cold meats: ham, polony, salami, bully beef								
	Fish or seafood, fresh, frozen or tinned								
	Chicken, with skin								
	Chicken, without skin								
	Organ meats like liver, kidneys, tripe								
	Full cream milk/sour milk								
	Low fat milk/sour milk								
	Fat-free milk/sour milk								
	Coffee creamer (Ellis Brown, Cremora)								
	Full cream yoghurt								

Code	Food item	How often during the past week did you drink/ eat the following:							
		Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	≥4 per day
	Low fat yoghurt								
	Fat free yoghurt								
	Full fat cheese (yellow, spreads or cream cheese)								
	Fat free/ low fat cheese or cheese spreads								
	Legumes (sugar beans, baked beans, lentils)								
	Bread or rolls, white								
	Bread or rolls, brown or wholewheat								
	Oranges and naartjies								
	Any other fresh fruit (apples, pears, bananas)								
	Dried fruit								
	Orange or yellow vegetables like sweet potato, pumpkin, butternut, carrot								
	Green vegetables like spinach, peas, green beans, broccoli								
	Mixed vegetables								
	Cabbage, cauliflower, onions, mushrooms								
	Salad (lettuce, cucumber)								

Code	Food item	How often during the past week did you drink/ eat the following:							
		Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	≥4 per day
	Tomato (raw, cooked, puree, tinned, relish)								
	Peanut butter/ Peanuts, nuts/seeds								
	Full fat salad dressing, full fat mayonnaise								
	Low fat salad dressing, low fat mayonnaise								
	Pies, sausage rolls, samosas								
	Crisps (lays, nik-naks, papas, pretzels)								
	Crackers (Ritz, Salticrax)								
	Take outs (KFC, McDonalds)								
	Roasted or fried potatoes or chips								
	Other fried foods, (fat cakes, fish, chicken)								
	Chocolate								
	Cake, biscuits, doughnuts								
	Sweets e.g. boiled, lollipops, jelly								
	Canned fruit or stewed fruit								
	Juice, nectar								
	Juice (mixed, bunny licks, Oros, iced tea)								
	Milky drinks (hot chocolate, milkshake, Milo)								

Code	Food item	How often during the past week did you drink/ eat the following:							
		Did not eat	**1-2 per week**	**3-4 per week**	**5-6 per week**	**1 per day**	**2 per day**	**3 per day**	**≥4 per day**
	Energy or sports drinks (Energade, Powerade, Red Bull)								
	Fizzy Drinks - Coke, Cream Soda, Double-O								
	Diet fizzy drinks – Coke Light, Sprite Zero								
	Alcoholic coolers								
	Spirits, brandy, vodka with mixer e.g. lemonade, cola								
	Jam or marmalade								
	Condiments (tomato sauce, chutney, mustard)								

		Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	≥4 per day
	How often in the past week did you use fat or oil for cooking?								
	How often in the past week did you add margarine or butter on bread								
	How often in the past week did you add margarine or butter in porridge								
	How often in the past week did you add margarine, butter or oil to vegetables								
	How often in the past week did you add sugar or honey in tea or coffee								

	How often in the past week did you add sugar or honey on cereal or porridge								
	How often in the past week did you add sugar or syrup to vegetables								
	How often in the past week did you add sugar or syrup to stews								

Addendum XVI: INTERVIEW GUIDE FOR THE IN-DEPTH SEM-STRUCTURED INTERVIEWS WITH EDUCATORS

Topic	Discussion
Introduction	Interviewer's name
Topic of interview	Today I would like to discuss the weight loss intervention you participated in.
Aim of interview and responses	There are no right or wrong answers to any of the questions. I am wanting to gain insights and information about your experience with this weight loss intervention in order to modify and improve future interventions of this nature.
Explaining note-taking and tape recording	I (interviewer's name) will be taking notes during our discussion to help with the understanding of the information provided by you. I also would like to use a tape recorder to ensure that your answers are accurately recorded. Are you happy with this?
Check understanding	Do you understand?
Clarification needed	Do you have any questions?
Elicitation questions	
1. Why were you interested in this intervention?	
2. What would it mean to you if you lost weight?	
3. What did the people around you (eg. Family, friends, colleagues) think about you trying to lose weight?	
4. What made it easy for you to follow the intervention?	
5. What made it difficult for you to follow the intervention?	
6. What did you like about the content of the manual? -Content layout, writing size (font) and amount of information?	
7. What did you not like about the content of the manual? Prompts -content layout, writing size (font) and amount of information?	
8. What information in the manual did you find useful? Prompt -Why?	
9. What information in the manual was not useful? Prompt-Why?	
10. Was there anything in the content of the manual which you did not understand? Prompt-What made it difficult to understand?	
11. What did you think about the activities (examples: self-assessment, goal setting and self-monitoring) that were included in the manual? Prompts -Did you complete any of the activities? If no, why? -If yes, which ones did you complete, why did you complete them and how helpful were they	
12. What did you think about the eating plans provided in the manual? Prompt-Useful, appropriate?	

13. What did you think about the tips and information provided in the manual? Prompt-Useful, appropriate, give examples?	
14. What did you think about the text messages you received? Prompts –The content? The timing? -To what extent do you think the messages contributed to participation in the intervention -How did it encourage you OR why did it not encourage you?	
15. Explain how you experienced the intervention as a whole? -Are there any tips you can give us to improve the intervention?	
Closing points	So in summary you are saying …… Is there anything more you would like to add? Thank you for your time!

Addendum XVII: PARTICIPANT INFORMATION AND INFORMED CONSENT FORM FOR EDUCATOR INTERVIEWS

Assessment of the perception of educators who participated in the intervention arm of the Health4Life randomised controlled trail of the actual intervention

Investigators: Fatima Hoosen, Prof Marjanne Senekal, Prof Nelia Steyn

Division of Human Nutrition, Department of Human Biology, Faculty of Health Sciences

University of Cape Town

Dear Educator,

As you have completed our 16-week weight loss intervention program we would like to gain further insights from you regarding your experiences of the program. This will allow us to adapt and refine the intervention in order to improve future interventions of this nature.

If you choose to participate in this part of our study we would like you to participate in a face-to-face one-on-one interview at a time and place which is convenient to you. The interview will take approximately 45 minutes of your time. The interview will be tape recorded to ensure that all the information you provide is accurately documented. The interviewer will also take notes during the interview.

Please note that there are no known risks involved in taking part in this study. Your participation is completely voluntary and you do not have to take part if you do not wish to. Furthermore, you are welcome to withdraw at any time should you wish to do so, without giving any reason. Failure to take part in this study will not influence your current or future employment with the school or with the Department of Basic Education of the Western Cape. You will not benefit directly from this study however, the information generated will be used to adapt and refine the current weight loss intervention.

All information provided by participants will remain confidential and names will not be used on the recordings for your anonymity (each participant will be assigned a code). Tape recordings and notes taken during the interview will be kept under lock and key by the principal investigator, Professor Marjanne Senekal. All documentation will be destroyed after the required five years.

This research was approved by the University Of Cape Town Faculty Of Health Sciences Human Research Ethics Committee (FHS-HREC) (REF 112/2017). Should you have any questions about the research please feel free to contact Professor Marjanne Senekal 0214066784 at any time. If you have any questions or concerns about the ethics of this research you can contact the Faculty of Health Sciences Human Research Ethics Committee (FHS-HREC) on 021 4066496.

Declaration by participant:

By signing below, I…….. agree to take part in an interview regarding the study 'Assessment of the perception of educators who participated in the intervention arm of the Health4Life randomised controlled trail of the actual intervention**.** The study has been explained to me, I have had the opportunity to ask questions about it and my questions have been answered well. I know that I am free to ask questions at any time during the study, that I am free to withdraw from the study at any time, and that it will not count against me in any way if I do withdraw. I have carefully read/listened to the information and understand the study and what will be expected of me. The decision to be a part of this study is my own.

Signature……Date……..

Declaration by the investigator:

I declare that I did not force the participant to take part in this interview and that I will do no harm to the participant. I will ensure that his/her personal information is kept confidential and that his/her privacy is protected.

Investigator/fieldworker name…….

Investigator/fieldworker signature……Date…….

Addendum XVIII: INTERVIEW GUIDE FOR THE IN-DEPTH SEM-STRUCTIRED INTERVIEWS WITH PRINCIPALS

Topic	Discussion
Introduction	Interviewer's name
Topic of interview	Today I would like to discuss the weight loss intervention your school participated in.
Aim of interview and responses	There are no right or wrong answers to any of the questions. I am wanting to gain insights and information about your experience with how this weight loss intervention was implemented in order to modify and improve future interventions of this nature.
Explaining note-taking and tape recording	I (interviewer's name) will be taking notes during our discussion to help with the understanding of the information provided by you. I also would like to use a tape recorder to ensure that your answers are accurately recorded. Are you happy with this?
Check understanding	Do you understand?
Clarification needed	Do you have any questions?
Elicitation questions	
1. Why were you interested in allowing your school to participate in this intervention?	
2. What did you think about having the wellness day at your school?	
3. What did the educators think about having the wellness day at your school?	
4. What made it easy for you to say yes to the wellness day?	
5. What made it difficult for you to say to the wellness day?	
6. What did you think about having the intervention at your school?	
7. What did the educators think about having the intervention at your school?	
8. What made it easy for you to say yes to the intervention?	
9. What made it difficult for you to say yes to the intervention? Prompt – did you allow the 16-week follow-up? If no, why?	
10. Explain how you experienced the intervention as a whole? -Are there any tips you can give us to improve the implementation process of the intervention?	
Closing points	So in summary you are saying ……. Is there anything more you would like to add? Thank you for your time!

Addendum XIX: PARTICIPANT INFORMATION AND INFORMED CONSENT FORM FOR PRINCIPAL INTERVIEWS

Assessment of the perception of the principals of participating schools of the Health4Life randomised controlled trial of the actual intervention

Investigators: Fatima Hoosen, Prof Marjanne Senekal, Prof Nelia Steyn

Division of Human Nutrition, Department of Human Biology, Faculty of Health Sciences

University of Cape Town

Dear Principal,

As your school participated in our 16-week weight loss intervention program we would like to gain further insights from you regarding your experiences of the program, specifically regarding the implementation process of the program. This will allow us to adapt and refine the intervention in order to improve future interventions of this nature.

If you choose to participate in this part of our study we would like you to participate in a face-to-face one-on-one interview at a time and place which is convenient to you. The interview will take approximately 45 minutes of your time. The interview will be tape recorded to ensure that all the information you provide is accurately documented. The interviewer will also take notes during the interview.

Please note that there are no known risks involved in taking part in this study. Your participation is completely voluntary and you do not have to take part if you do not wish to. Furthermore, you are welcome to withdraw at any time should you wish to do so, without giving any reason. Failure to take part in this study will not influence your current or future employment with the school or with the Department of Basic Education of the Western Cape. You will not benefit directly from this study however, the information generated will be used to adapt and refine the current weight loss intervention.

All information provided by participants will remain confidential and names will not be used on the recordings for your anonymity (each participant will be assigned a code). Tape recordings and notes taken during the interview will be kept under lock and key by the principal investigator, Professor Marjanne Senekal. All documentation will be destroyed after the required five years.

This research was approved by the University Of Cape Town Faculty Of Health Sciences Human Research Ethics Committee (FHS-HREC) (REF 112/2017). Should you have any questions about the research please feel free to contact Professor Marjanne Senekal 0214066784 at any time. If you have any questions or concerns about the ethics of this research you can contact the Faculty of Health Sciences Human Research Ethics Committee (FHS-HREC) on 021 4066496.

Declaration by participant:

By signing below, I…….. agree to take part in an interview regarding the study 'Assessment of the perception of principals of participating schools of the Health4Life randomised controlled trial of the actual intervention**.** The study has been explained to me, I have had the opportunity to ask questions about it and my questions have been answered well. I know that I am free to ask questions at any time during the study, that I am free to withdraw from the study at any time, and that it will not count against me in any way if I do withdraw. I have carefully read/listened to the information and understand the study and what will be expected of me. The decision to be a part of this study is my own.

Signature……Date…….

Declaration by the investigator:

I declare that I did not force the participant to take part in this interview and that I will do no harm to the participant. I will ensure that his/her personal information is kept confidential and that his/her privacy is protected.

Investigator/fieldworker name…….

Investigator/fieldworker signature……Date……

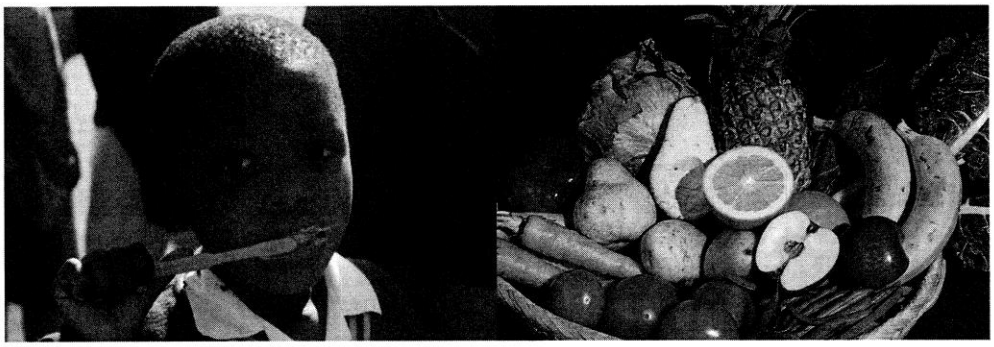
Addendum XX: Department of Health's "Choose a Healthy Lifestyle" Booklet

CHOOSE A HEALTHY LIFESTYLE

health

Department:
Health
REPUBLIC OF SOUTH AFRICA

Index



The Healthy Lifestyle Overview

It is acknowledged that the lifestyles of populations around the world are changing rapidly, impacting upon the health of individuals, families and communities.

Amongst others, this is because of what people eat and drink, what they do with their bodies and environmental factors they get exposed to.

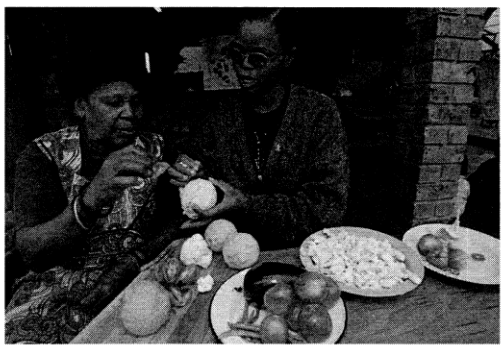
This booklet addresses five important areas that contribute to what is popularly known as diseases of lifestyle. These areas are - nutrition, physical activity, sexual behavior, controlling alcohol and smoking. All these factors contribute to diseases such as hypertension, diabetes, cancers, heart disease and many more.

Even the most unhealthy people usually have some healthy habits, and even the most healthy people often have some unhealthy habits.

Adopting healthy lifestyles means engaging in 'habits or behaviors' that will enhance your health, thus reducing the risk of becoming ill and dying early.

Some unhealthy lifestyle habits are very hard to break, but others are very easy. It's hard to stop smoking immediately (so people choose a phased approach to quitting smoking), but it isn't that hard to choose a piece of fresh fruit instead of a bag of sweets or to put less salt on your food. The best method is not to view a healthy lifestyle as one big change, but rather a series of smaller steps to be achieved over time.

Start with steps that you can manage easily. Once you have made one small positive change towards a healthier lifestyle, then the bigger changes will be easier. Also, remember that every little bit helps. Even if you can only cut down from twenty cigarettes a day to ten, or grill one out of every five meals that you used to fry, you have taken a small step towards better health.



Each of these small steps is a building block towards a healthy lifestyle. With each step comes the reward of knowing that you have made a choice that leads to better health, and will help you to get more out of our life. A healthy lifestyle is a better choice.

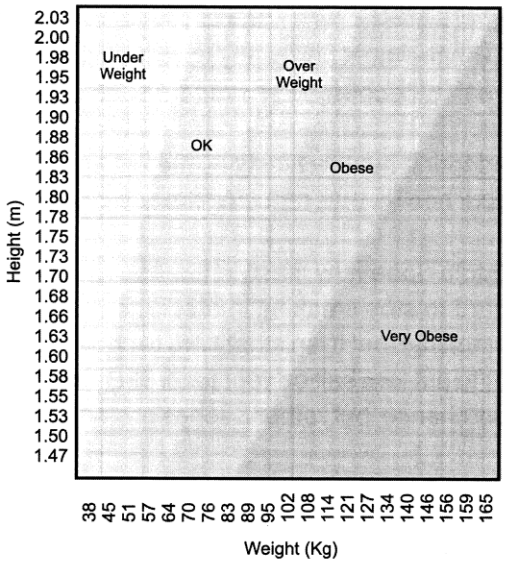
Nutrition

"You are what you eat" is a very true saying. People who are too fat put a lot of strain on their hearts and muscles, while those who don't eat enough of the right foods are not giving their bodies enough fuel. They get tired more easily, have less energy, and take longer to recover from sickness or injury. A healthy lifestyle starts with making the right choices about nutrition.

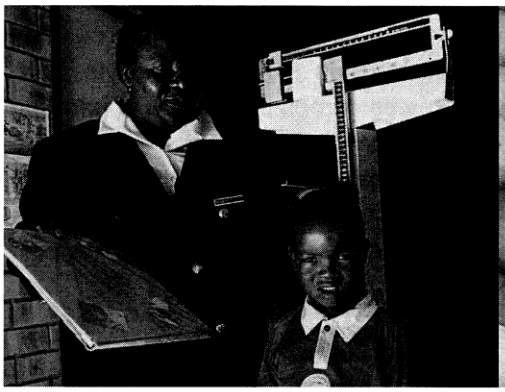
Most people want to be thinner, but it is almost as unhealthy to be too thin as too fat. The chart to the right will help you to check if of are too fat, too thin or at the right weight for your height.

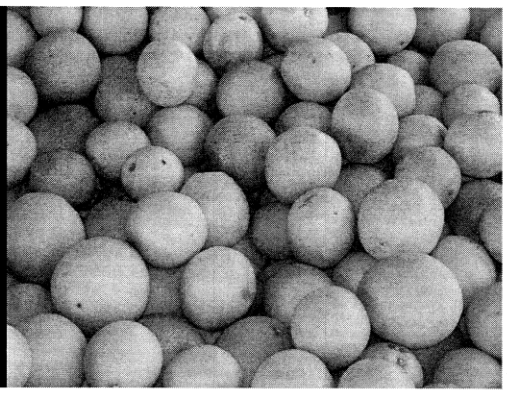
Use the dietary guidelines below to help you and your family to take action for good health

1. Enjoy a variety of foods
2. Be active
3. Eat plenty of vegetable and fruit every day
4. Eat dry beans, split peas, lentils and soya regularly
5. Chicken, fish and milk may be had daily
6. Eggs and red meat should not be eaten more than three times a week
7. Eat fats sparingly
8. Use salt sparingly
9. Drink lots of clean, safe water
10. 1If you drink alcohol, drink it sensibly
11. Use food and drinks containing sugar sparingly and not between meals



Health education authority 1994, Reproduced by permission





What do the different guidelines mean?

1 When you eat a variety of foods the chances are that you will meet all your nutritional requirements (vitamins, minerals, proteins, etc). If your diet comprises only a few of the same foods every day, the chances are that you may be deficient in a particular nutrient.

2 Being physically active means regularly (at least 5 times a week) doing active work or sport, which increases your heartbeat rate above normal.

3 Starchy foods (rice, maize, bread, pasta) should always be the main component of your meal since this is the main source of your energy and it contains little or no fat. Use the unrefined starch products (such as brown rice and brown bread) whenever possible since this provides you with fibre, which supports healthy bowel functioning.

4 Eating many vegetables and fruits is an important part of having a healthy diet. We recommend at least 5 portions of these in total per day. A high fruit and vegetable intake will protect you against hypertension, obesity, constipation and even certain kinds of cancers. Of course it also protects you against certain vitamin (vitamin A, vitamin C, folic acid) and mineral deficiencies (iron and calcium).

5 Eat dry beans and other legumes regularly. Firstly this replaces red meat and other high fat animal foods. Secondly, legumes are economical and contain no undesirable fats such as cholesterol and saturated fats. They are a good source of protein and iron so they add value to your meals.

6 Chicken, fish, red meat, eggs and dairy foods can be eaten every day but should be used in the following manner: Use low fat or skim milk diary products, use lean meat not more than 3 times a week and use fish or chicken as alternate sources. Additionally, alternate meat with dry beans, peas, lentils and soy. If you use meat use lean meat and cut off the visible fat. Do not fry in oil, rather grill or roast or stew.

7 Eating fats sparingly means eating the healthier type of fats from fish and vegetable sources (such as canola and olive oil) avocados, nuts, margarine in a tub and avoiding the unhealthy fats (such as saturated fats), which come from animal products (meat, chicken, butter, cheese from whole milk, cream, ice cream and chocolates). Also remember to keep your total fat intake as low as possible. Use fish, soya and legumes as a healthy substitute for red meat.

8 Eating salt sparingly is based on the principle that certain people are more susceptible to an increase in blood pressure when they have a regular high intake of salt.

9 Drinking alcohol sensibly means not more that 1-2 standard drinks (wine in a wine glass) a day for women and 2-3 drinks for men. It is recommended that children, pregnant and breast feeding women abstain from using alcohol.

10 Clean water is an absolutely essential requirement of a healthy balanced diet.

11 Food and drinks containing sugar are fine as treats but should not form part of daily meals. Together with highly fatty foods these can lead to an increase in weight. They are also responsible for dental caries when taken in large amount over time, particularly when taken between meals. In younger children, a high sugar intake may be the result of replacing healthier foods in the diet with treats containing sugar. For example, research has shown that when children drink a lot of soft drinks, they drink less milk and eat less healthy foods.

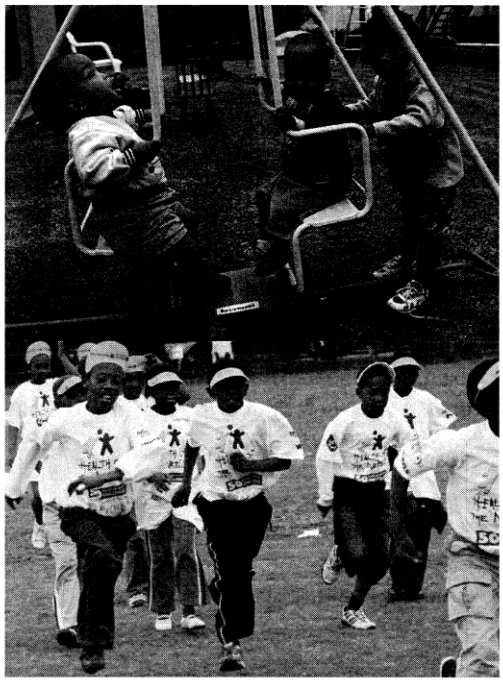
By eating better, you will also be a role model. When others see you eating healthily, they will be inspired to copy you. Not only will you be helping your own health, but their health too.

Physical Activity

We all expect Bafana-Bafana and other professional sportsmen to exercise regularly and to be fit. But how often do you participate in physical activity? Those individuals who include regular physical activity as part of their lifestyle get more enjoyment out of life, and are able to cope better with life's demands and problems than those who are inactive. They are able to work better and for longer, they recover quicker when tired, they sleep better and are less likely to injure themselves when performing tasks such as stretching or lifting heavy loads. Most importantly, physically active people are less likely to suffer from heart problems. This is partly due to the more active people having stronger hearts, which make better use of the oxygen which we breath to work our muscles efficiently. In addition, physical activity plays an important role in weight management because the energy derived from food is also used during exercise as fuel, instead of being stored on the body as fat.

Before choosing to become fitter and healthier, here are some simple guidelines to think about:

Check first with your doctor, particularly if you are currently inactive or have a condition such as high blood pressure, diabetes or heart problems. Always check with your doctor before starting a fitness programme.

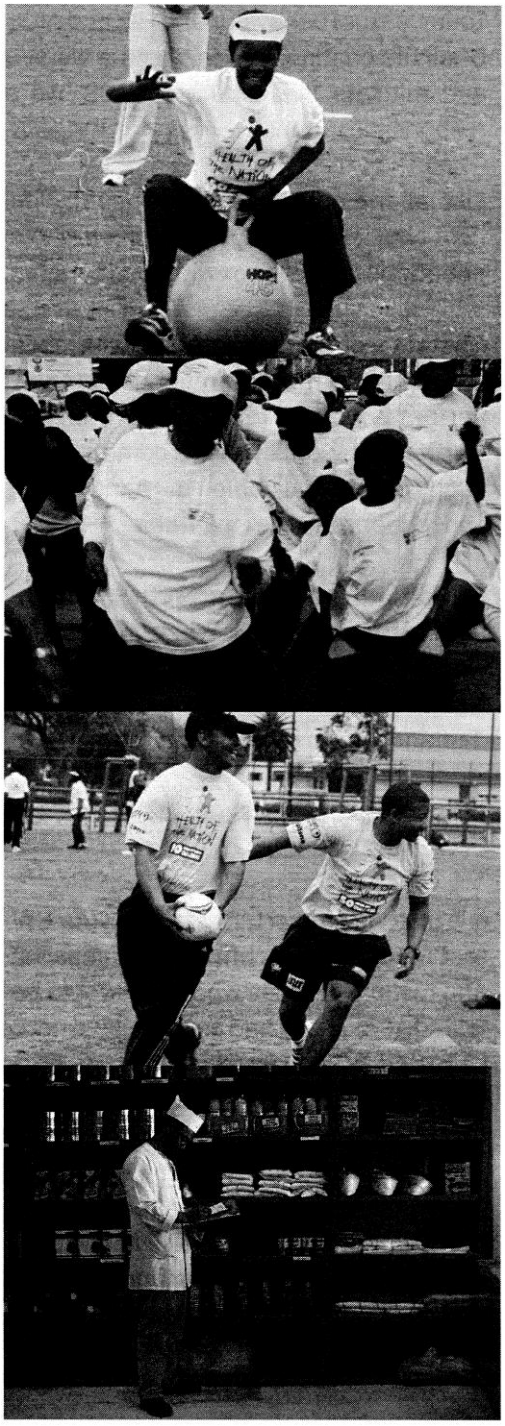


Don't rush. It takes time for your muscles, heart and lungs to become fit. Exercise moderately on most days of the week, and for about 30 minutes a day. Moderate exercise means exercising hard enough so that your breathing rate increases. This means that when you are participating in an exercise such as walking, you should walk fast enough so that you huff and puff. If you can't talk at all while walking, it means you are going too fast, but if you can sing a song, it means that you are walking too slowly. Don't try to run a marathon immediately. Give you body time to get used to your new exercise routine.

Use exercise opportunities. Exercise doesn't always have to be part of a formal fitness plan. Use other opportunities as well. If you're visiting a neighborhood friend or a nearby store, walk instead of driving. If you're bored on a weekend afternoon, go jogging, swimming or play soccer with your friend rather than lying on the couch watching TV. Help around the house and garden instead of expecting other family members or the maid to do everything. Other opportunities could be walking to work, to school, playing games during breaks at school, jumping, and many more.

Stretch. Being supple is an important component of fitness and helps to prevent you from pulling or straining muscles. Stretch your limbs and muscles for at least 30 seconds after each exercise session.

As you increase your levels of physical activity, you will find that you are able to cope better with daily tasks such as housework or playing with the kids. You may even find that you are able to work harder and for longer, and recover more quickly when you are tired. You will also serve to inspire those around you. When they see how being stronger, fitter and more supple helps you to cope better with life's demands, they will want those benefits for themselves, and will start to copy your example.



Sexual Behaviour

Today, sexual behaviour and HIV and AIDS are major threats to our health and our lives. Of all the continents, Africa is the worst affected. If we want to stop the spread of HIV and mitigate the impact of AIDS, we all have a duty to behave in a caring and responsible manner.

Like all the other aspects of healthy lifestyles, responsible sex is about making the right choices. Nobody has to sleep with every potential sexual partner they meet, and nobody has to have sex without a condom. There are choices to make:

Abstain - don't rush into sex with each and every partner you meet. If your new partner is worth a relationship, then it is worth waiting until you are committed to each other and able to handle the consequences of sex together.

Be faithful - choose a partner and be faithful to that partner. When you respect your partner by not cheating on them and sleeping with others, then you can demand the same respect in return.

Condomise - protect yourself during sex by wearing a condom.

It is also very important to **know your HIV test results**. Clinics offer free counseling and testing for those who volunteer to be tested. If you have had sex and have not been tested for HIV, then your best choice is to be tested as soon as possible. If you do not have HIV, then make every effort to remain HIV negative. If you do have HIV, know that this is not a death sentence, that you need to take steps to look after your health and to prevent passing the virus on to others and getting re-infected. HIV testing is confidential, the clinic staff are not allowed to tell your family, friends or employer about your test result. The clinic staff are also trained to counsel, and to help those living with HIV to make good choices in dealing with the virus. If these choices are made, people living with HIV can continue to lead productive and healthy lives for much longer.

Alcohol Intake

In moderation, drinking alcohol can be a sociable and fun activity. It can even have the health benefit of helping against heart disease in some cases. Drinking up to two beers or two glasses of wine per day poses little risk to your health. Once you drink more than this, alcohol starts affecting our health. And the more you drink, the worse the effect. Alcohol can damage nearly every organ and system in the body. This use is associate with more than 60 diseases and illnesses including chronic conditions like hypertension, diabetes and liver cirrhosis. There is also a financial cost. More money spent on alcohol means less money for food, clothing and other necessities. Unfortunately, too many people drink excessively. Alcohol abuse can lead to addiction. Alcohol use increases your risk of injuries and accidents. Also, it is not just the drinker whose health is at risk. When tested, the majority of people who die in road accidents (including pedestrian) are found to have alcohol levels above the legal limit of 0,05g/100ml.

Alcohol abuse puts people at risk of violence, suicide and injuries. Research reveals that the majority of people who commit suicide, injure and kill others, or are involved in fights, have alcohol levels above the legal limit of 0,05g/100ml

Most people who have a drinking problem will often deny that they have a drinking problem. The most common excuses given by alcohol abusers are "it helps me to deal with stress" and "it helps me to forget my problems". Yet there are millions of people who deal with stress and solve their problems without needing to drink. Alcohol abusers can be empowered to control their drinking.

If you are a heavy drinker, you can decide to take control of your health and your life. It is a choice and it is yours to make. Monitor your drinking. Watch how much you drink, when you drink and why you drink. Then make the choice to drink less, and to drink less often. If your family and friends notice your efforts and support you, it will become easier to cut down and even to stop drinking alcohol completely.

When you start seeing the positive effects no more hangovers, more energy, being more alert, more money to spend on useful things - you will know the reward and enjoyment of a

Tobacco Control

Smoking is one of the biggest risks to health and, every year, smoking is responsible for thousands of South Africans dying early from heart disease and cancers. Furthermore, smoking increases the risk of lung disease, is dangerous to unborn babies and reduces fertility.

It is addictive and it affects the health of not only smokers but non-smokers around them as well. Addiction causes smokers to give up control of their lives and health and hand it over to tobacco.

How often have you seen smokers rushing to light up when they come out of a no-smoking area like a cinema, or showing signs of anxiety if they are prevented from smoking for even just a few hours? We value personal freedom highly, and freedom means not being a slave to anyone or anything. Yet smokers give upthis freedom when they become slaves to their habit.

With smoking, the best choice is never to start. However, even those who have been smoking for a long time are advised to stop. There are many immediate benefits:

- Less risk of cancer, heart disease and breathing problems
- A better appetite, and food tastes better
- Better skin complexion, no more stained teeth, no more tobacco smell on breath, hair and clothing
- More energy, less shortness of breath
- More money to spend on education, food and other necessities

It is recognized that giving up smoking is very hard to do. However, the smoker doesn't need to quit completely at once. Just cutting down from thirty cigarettes per day to ten will have a good effect on health. Once the body has become used to smoking just ten a day, it then becomes easier to cut down to five, and from there to stopping completely. The urge to smoke only lasts for a few minutes. Chewing some gum, drinking a glass of water or going for a walk will take the smoker's mind off smoking.
Smokers are particularly influenced by role models. If two people decide to stop smoking together, each helps the other to stop by serving as a role model. Millions of people have become tobacco addicts, but millions have also stopped smoking successfully. Few, if any, of these have ever regretted the decision to stop smoking because of the health benefits they are now enjoying.

For help to quit smoking, you can contact the National Council Against Smoking at (011) 720 3145

Help Resources

We have compiled some useful numbers and contact details of people who can help you to follow a healthy lifestyle:

Mpumalanga
Heila Jooste
Phone: (013) 766 3286
Fax: (013) 766 3456

Eastern Cape
Nosisa Tshangana
Phone: (040) 609 4307
Fax: (040) 609 4256

Gauteng
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Addendum XXI: Baseline belief scores of the intervention and control groups in the total baseline group and the study completer and study drop-out sub-groups

Indicator: Beliefs		Baseline total group		Baseline completer sub-group		Baseline drop-out sub-group	
		N	Median (IQR)	N	Median (IQR)	N	Median (IQR)
Preparation of vegetables does not take a long time	Control	58	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	79	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	37	4.0 (1.0-5.0)
Eating fruits and vegetables every day will help me lose weight/ control my weight	Control	58	4.0 (2.0-5.0)	42	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	79	4.0 (1.0-5.0)	42	4.0 (2.0-5.0)	37	4.0 (1.0-5.0)
Fruits and vegetables are affordable*	Control	58	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	79	4.0 (2.0-5.0)	42	4.0 (2.0-5.0)	37	4.0 (2.0-5.0)
I can eat the recommended amount of fruits and vegetables every day**	Control	57	4.0 (2.0-5.0)	41	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (2.0-5.0)	36	4.0 (1.0-5.0)
I would eat vegetables even if at times, they look unappealing***, ****	Control	56	3.0 (1.0-5.0)	41	3.0 (1.0-5.0)	14	2.0 (1.0-4.0)
	Intervention	79	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	37	4.0 (1.0-5.0)
Fruit and vegetables are easy to find in stores nearby	Control	56	5.0 (1.0-5.0)	41	5.0 (1.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	36	4.0 (1.0-5.0)
Eating less fat will help reduce the risk of diseases e.g. heart disease	Control	58	5.0 (3.0-5.0)	43	5.0 (3.0-5.0)	15	5.0 (4.0-5.0)
	Intervention	79	5.0 (3.0-5.0)	42	4.5 (3.0-5.0)	37	5.0 (4.0-5.0)
Decreasing the amount of fat I eat will help me lose/ control my weight	Control	58	4.0 (2.0-5.0)	43	4.0 (3.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	79	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	37	5.0 (1.0-5.0)
Low-fat/healthy fat options are expensive*****	Control	58	4.0 (2.0-5.0)	43	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	41	4.0 (2.0-5.0)	36	4.0 (1.0-5.0)
Healthy takeaways and/or street foods are easy to find in my surroundings	Control	57	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	14	3.0 (1.0-5.0)
	Intervention	76	4.0 (1.0-5.0)	40	4.0 (1.0-5.0)	35	4.0 (1.0-5.0)
It is easy to exclude high-fat foods from my daily diet	Control	58	3.0 (1.0-5.0)	43	3.0 (1.0-5.0)	15	3.0 (2.0-5.0)
	Intervention	79	3.0 (1.0-5.0)	42	3.0 (2.0-5.0)	37	3.0 (1.0-5.0)
I do not have enough time to prepare healthy meals regularly	Control	58	3.5 (1.0-5.0)	43	4.0 (1.0-5.0)	15	3.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	36	4.0 (1.0-5.0)
Low fat/ fat-free foods taste good/ are tasty	Control	58	3.0 (1.0-5.0)	43	3.0 (1.0-5.0)	15	3.0 (2.0-5.0)
	Intervention	78	3.0 (1.0-5.0)	40	3.0 (1.0-5.0)	37	3.0 (1.0-5.0)
I turn to sugary foods/snacks/drinks when I am stressed	Control	58	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	15	4.0 (1.0-5.0)
	Intervention	79	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	37	4.0 (1.0-5.0)
I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink	Control	58	3.0 (1.0-5.0)	42	4.0 (1.0-5.0)	15	3.0 (1.0-5.0)
	Intervention	79	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	37	4.0 (1.0-5.0)
Reducing the amount of sugary foods/snacks/drinks I	Control	58	2.5 (1.0-5.0)	43	2.0 (1.0-5.0)	15	2.0 (1.0-4.0)
	Intervention	78	3.0 (1.0-5.0)	42	2.0 (1.0-5.0)	36	3.0 (1.0-5.0)

eat and drink will make me feel unwell (moody or have a headache or tired)							
I can reduce the amount of sugary foods/snack/drinks I eat and drink	Control	58	4.0 (2.0-5.0)	43	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	79	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	37	4.0 (1.0-5.0)
There are no accessible, safe, affordable opportunities for me to be physically active	Control	57	2.0 (1.0-5.0)	43	2.0 (1.0-5.0)	14	2.0 (1.0-4.0)
	Intervention	79	2.0 (1.0-5.0)	42	3.0 (1.0-5.0)	37	2.0 (1.0-5.0)
Being physically more active will make me feel better about my appearance******, *******	Control	57	4.0 (2.0-5.0)	42	4.5 (2.0-5.0)	15	4.0 (3.0-5.0)
	Intervention	77	4.0 (1.0-5.0)	40	4.0 (1.0-5.0)	37	5.0 (1.0-5.0)
Finding time to be physically more active is possible	Control	57	4.0 (2.0-5.0)	42	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	41	3.0 (1.0-5.0)	37	4.0 (1.0-5.0)
Knowing more about different types of physical activity I can do will help me to be more active	Control	58	4.0 (2.0-5.0)	43	4.0 (2.0-5.0)	15	4.0 (2.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	36	4.0 (1.0-5.0)
I could be physically more active even if I were tired	Control	57	3.0 (1.0-5.0)	43	3.0 (1.0-5.0)	14	3.5 (2.0-4.0)
	Intervention	77	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	35	3.0 (1.0-5.0)
Having an exercise 'buddy' will help me to be physically more active********	Control	58	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	15	4.0 (3.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	36	4.0 (1.0-5.0)
I can increase my levels of physical activity (be physically more active)*********	Control	58	4.0 (1.0-5.0)	43	4.0 (2.0-5.0)	15	4.0 (1.0-5.0)
	Intervention	78	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	36	4.0 (1.0-5.0)

IQR=interquartile range

Significantly different results different between groupings are presented in red font

*Intervention group: Significantly higher median score for the belief 'Fruits and vegetables are affordable' in the drop-out sub-group than the completer sub-group (Mann-Whitney U Test: p=0.042).

**Completer sub-group: Significantly lower median score for the belief 'I can eat the recommended amount of fruits and vegetables every day' in the intervention group than the control group (Mann-Whitney U Test: p=0.046.).

***Drop-out sub-group: Significantly higher median score for the belief 'I would eat vegetables even if at times they look unappealing' in the intervention group than the control group (Mann-Whitney U Test: p=0.003).

****Intervention group: Significantly higher median score for the belief 'I would eat vegetables even if at times they look unappealing' in the drop-out sub-group than the completer sub-group (Mann-Whitney U Test: p=0.005).

*****Intervention group: Significantly higher median score for the belief 'Low fat/healthy options are expensive' in the completer sub-group than the drop-out sub-group (Mann-Whitney U Test: p=0.013).

******Completer sub-group: Significantly lower median score for the belief 'Being physically more active will make me feel better about my appearance' in the intervention group than the control group (Mann-Whitney U Test: p=0.038).

*******Intervention group: Significantly higher median score for the belief 'Being physically more active will make me feel better about my appearance' in the drop-out sub-group than the completer sub-group (Mann-Whitney U Test: p=0.034).

********Drop-out sub-group: Significantly higher median score for the belief 'I can increase my levels of physical activity' in the intervention group than the control group (Mann-Whitney U Test: p=0.028).

Addendum XXII: Change in belief scores in the intervention and control groups from baseline to 16-week follow-up

Indicator: median (IQR)		Baseline		Follow-up		Follow-up – baseline (within group change over time)	
		N	Median (IQR)	N	Median (IQR)	N	Median (IQR)
Preparation of vegetables does not take a long time*	Control	43	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-4.0-4.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
Eating fruits and vegetables every day will help me lose weight/ control my weight	Control	42	4.0 (2.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-1.0)
	Intervention	42	4.0 (2.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-2.0-2.0)
Fruits and vegetables are affordable	Control	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
	Intervention	42	4.0 (2.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
I can eat the recommended amount of fruits and vegetables every day**	Control	41	4.0 (2.0-5.0)	41	4.0 (2.0-5.0)	41	0.0 (-2.0-2.0)
	Intervention	42	4.0 (2.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-2.0-3.0)
I would eat vegetables even if at times, they look unappealing	Control	41	3.0 (1.0-5.0)	41	3.0 (1.0-5.0)	41	0.0 (-3.0-2.0)
	Intervention	42	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
Fruit and vegetables are easy to find in stores nearby	Control	41	5.0 (1.0-5.0)	41	4.0 (1.0-5.0)	41	0.0 (-4.0-3.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-4.0-3.0)
Eating less fat will help reduce the risk of diseases e.g. heart disease	Control	43	5.0 (3.0-5.0)	43	5.0 (1.0-5.0)	43	0.0 (-4.0-2.0)
	Intervention	42	4.5 (3.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-1.0)
Decreasing the amount of fat I eat will help me lose/ control my weight	Control	43	4.0 (3.0-5.0)	43	4.0 (4.0-5.0)	43	0.0 (-1.0-2.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
Low-fat/healthy fat options are expensive***, ****	Control	43	4.0 (2.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-2.0-1.0)
	Intervention	41	4.0 (2.0-5.0)	41	3.0 (1.0-5.0)	41	-1.0 (-4.0-2.0)
Healthy takeaways and/or street foods are easy to find in my surroundings*****	Control	43	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-4.0-4.0)
	Intervention	40	4.0 (1.0-5.0)	40	3.0 (1.0-5.0)	40	0.0 (-4.0-3.0)
It is easy to exclude high-fat foods from my daily diet	Control	43	3.0 (1.0-5.0)	43	3.0 (1.0-5.0)	43	0.0 (-2.0-4.0)
	Intervention	42	3.0 (2.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-3.0-2.0)
I do not have enough time to prepare healthy meals regularly	Control	43	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-3.0-4.0)
	Intervention	42	4.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-4.0-3.0)
Low fat/ fat-free foods taste good/ are tasty	Control	43	3.0 (1.0-5.0)	43	3.0 (2.0-5.0)	43	0.0 (-3.0-3.0)
	Intervention	40	3.0 (1.0-5.0)	40	3.0 (1.0-5.0)	40	0.0 (-3.0-2.0)
I turn to sugary foods/snacks/drinks	Control	43	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-4.0-2.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)

when I am stressed******							
I have poor awareness of the sugar content in the foods/snacks/drinks I eat and drink	Control	42	4.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-3.0-2.0)
	Intervention	42	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
Reducing the amount of sugary foods/snacks/drinks I eat and drink will make me feel unwell (moody or have a headache or tired)	Control	43	2.0 (1.0-5.0)	43	2.0 (1.0-4.0)	43	0.0 (-3.0-2.0)
	Intervention	42	2.0 (1.0-5.0)	42	2.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
I can reduce the amount of sugary foods/snack/drinks I eat and drink	Control	43	4.0 (2.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-4.0-2.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-2.0)
There are no accessible, safe, affordable opportunities for me to be physically active	Control	43	2.0 (1.0-5.0)	43	2.0 (1.0-5.0)	43	0.0 (-3.0-4.0)
	Intervention	42	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-3.0-4.0)
Being physically more active will make me feel better about my appearance *******	Control	42	4.5 (2.0-5.0)	42	4.0 (3.0-5.0)	42	0.0 (-2.0-2.0)
	Intervention	40	4.0 (1.0-5.0)	40	4.0 (1.0-5.0)	40	0.0 (-3.0-3.0)
Finding time to be physically more active is possible	Control	42	4.0 (2.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-2.0)
	Intervention	41	3.0 (1.0-5.0)	41	4.0 (1.0-5.0)	41	0.0 (-4.0-2.0)
Knowing more about different types of physical activity I can do will help me to be more active	Control	43	4.0 (2.0-5.0)	43	4.0 (2.0-5.0)	43	0.0 (-2.0-2.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-3.0)
I could be physically more active even if I were tired	Control	43	3.0 (1.0-5.0)	43	3.0 (1.0-4.0)	43	0.0 (-3.0-2.0)
	Intervention	42	3.0 (1.0-5.0)	42	3.0 (1.0-5.0)	42	0.0 (-4.0-2.0)
Having an exercise 'buddy' will help me to be physically more active	Control	43	4.0 (1.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-2.0-4.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-3.0-2.0)
I can increase my levels of physical activity (be physically more active)	Control	43	4.0 (2.0-5.0)	43	4.0 (1.0-5.0)	43	0.0 (-2.0-2.0)
	Intervention	42	4.0 (1.0-5.0)	42	4.0 (1.0-5.0)	42	0.0 (-4.0-3.0)

IQR=interquartile range

Significantly different results different between groupings are presented in red font

*Control group: Significant decrease in scores for the belief 'Preparation of vegetables does not take a long time' from baseline to 16-week follow-up (Wilcoxin Matched Pairs Test: p=0.032)

**At baseline, the median scores for the belief 'I can eat the recommended amount of fruits and vegetables every day' was significantly lower in the intervention group than the control group (Mann-Whitney U Test: p=0.046).

***At follow-up, the median scores for the belief 'Low-fat/healthy food options are expensive', was significantly lower in the intervention group than the control group (Mann-Whitney U Test: p=0.044.)

****Intervention group: Significant decrease in scores for the belief ‘Low-fat/healthy food options are expensive’ from baseline to 16-week follow-up (Wilcoxin Matched Pairs test: $p<0.001$).

*****At follow-up, the median scores for the belief ‘Healthy take-aways and/or street foods are easy to find in my surroundings’ was significantly lower in the intervention group than the control group (Mann-Whitney U Test: $p=0.026$).

******Control group: Significant decrease in scores for the belief ‘I turn to sugary foods/snacks/drinks when I am stressed’ from baseline to 16-week follow-up (Wilcoxin Matched Pairs Test: $p=0.009$).

*******At baseline, the median scores for the belief ‘Being physically more active will make me feel better about my appearance’ was significantly lower for the intervention group than the control group (Mann-Whitney U Test: p=0