THE SOUTH AFRICAN NATIONAL EDUCATOR WELLNESS STUDY (SA-NEWS)

By

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DECLARATION

I, Lester Ezra Joseph, 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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BARUCH HASHEM

MAP OF SOUTH AFRICA HIGHLIGHTING THE TWO PROVINCES USED IN THIS STUDY

ABSTRACT

Background:

Previous studies have shown that South African (SA) teachers are a population at risk for non-communicable diseases. Health screening, primarily through wellness days, is a popular strategy to improve health by identifying risk factors or disease. In addition, studies show the effectiveness of tailored letters and SMS text message-based interventions for weight loss, physical activity (PA), glycaemic control and hypertension management.

Aim:

To investigate whether the addition of a tailored print letter and SMS-text communication intervention, in addition to the standard-of-care feedback following a wellness day, would result in greater changes in health risk factors than the standard-of-care. The feasibility and acceptability of the SMS-text messages was explored and the school health environment analysed to ascertain the impact of school environments and policies on teachers' health risk status. Finally, the feasibility and helpfulness of employing an adapted intervention mapping (IM) approach to a complex health behaviour change intervention was reported.

Methods:

Twenty seven schools were selected from a list provided by the Department of Basic Education's provincial educational authorities. Schools were grouped according to socio-economic status and geographic location and randomly assigned to either intervention (n=13) or control (n=14) groups. A total of 571 teachers participated in the first set of the wellness days. At the completion of the wellness day, teachers in the intervention schools were asked to select one of 5 health goals they wanted to manage and to rank their top 3 (of 6) barriers preventing them from achieving the goal. In addition to the targeted wellness day feedback, teachers in the intervention group received a single printed tailored letter with advice relating to their goal and barriers. This was followed by at least 8 tailored advice SMS-text messages over 5 months. All teachers were invited to attend

the second wellness day after the 5-month intervention. Three hundred and forty nine teachers (59.4%) attended the second set of wellness days. Teachers in the intervention group were asked to evaluate the acceptability of the SMS-text messages. Principals at all schools were also asked to complete an audit of the schools' policies and built environment. The intervention was developed using an adapted IM approach.

Results:

This study confirmed that SA teachers are an 'at risk' population for developing NCDs. Overweight and obesity rates were found to be 27.3% and 50.3% respectively. Overall 82% of teachers did not meet the recommended PA guidelines and only 11% consumed the recommended 5 fruit and vegetable servings per day. Employing an as per protocol (APP) analysis, the use of a tailored print letter and SMS campaign resulted in significantly greater ($p=0.004211$) reductions in the proportion of teachers who were overweight and obese as well as those who were hypertensive. The intervention group showed a greater relative percentage decrease in body mass, BMI and in the percent who were overweight or obese compared to the control group (8.9% vs. 1.1% relative change). The intervention also resulted in a significantly higher ($p=0.000793$) proportion of individuals meeting PA guidelines and an almost double relative percentage increase compared to the control group (21.3 minutes/week vs. 12.3 minutes/week). Due to the high dropout rate in both groups, an intention to treat (ITT) analysis was conducted, only time effects for self-reported physical activity and Kessler Psychological Distress Scale scores remained, all group and time interaction effects were no longer significant ($p>0.05$). A high degree of acceptability of the SMS-text messages was found. The standard-of-care wellness day with immediate feedback also resulted in significant changes ($p<0.05$) in most of the clinical and anthropometric measures as well as lifestyle risk factors. This study found that generally, school environments, particularly in the lower quintiles, are not conducive to healthy eating, sufficient physical activity or the promotion of health intervention. The SMS campaign was found to be effective and had a high level of acceptability, with an overwhelming number of participants perceiving the messages to be of use and the level of contact to be appropriate. The findings of this study suggest that SMS-text based interventions are feasible, efficacious and have a high degree of acceptability to the recipients. However, the cost of upscaling the SMS messages to all teachers in SA may be a barrier. The study also highlighted the need to find strategies to minimise dropout in future interventions. Lastly, applying an adapted IM approach is a feasible and helpful method for providing an evidence based and theoretical structure to a complex health behaviour change intervention.

Conclusion:

Overall, the results appear to indicate that individuals who were exposed to the tailored letter and SMS campaign showed greater health benefits and improved health risk status compared to individuals who were exposed to the standard-of-care wellness day with targeted feedback. Results of this study also highlighted that a wellness day is an effective entry-into-care intervention.

As these types of interventions are scalable, low-cost, behaviourally appropriate, autonomously supportive, and exert effects on multiple risk factors, the potential for population health benefit is apparent for policy makers and publicly or privately run health and education systems. An opportunity exists to roll out wellness days to all schools as an entry into care intervention. Including an ongoing SMS communication strategy to the wellness day could provide a simple, low-cost means of providing an additional support programme and perceived continuation of care.

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GLOSSARY OF TERMS

ADSL (Asymmetric digital subscriber line) is a type of broadband communication technology used for connecting to the Internet. ADSL allows more data to be sent over existing copper telephone lines, when compared to traditional modem lines.

Educator denotes a teacher or a person who facilitates the acquisition of knowledge and skills by learners in a public school

eHealth refers to "tools and services using information and communication technologies that can improve prevention, diagnosis, treatment, monitoring and management"[1].

mHealth may be defined as ''medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices (e.g., heart rate monitors), personal digital assistants (PDAs), and other wireless devices''[2]

Road shows – presentations were given to the Gauteng and Western Cape Departments of Education in order to explain the purpose of the study and to request their assistance in sourcing appropriate schools for the study.

National School Nutrition Programme (NSNP) – a large government sponsored programme reaching over 8 million learners in primary and secondary schools. The emphasis of the programme is on the provision of the daily balanced and diverse cooked meal, with nutrition education and sustainable food production being the other two pillars of the programme. The Department of Basic Education (DBE) have had full responsibility for the NSNP since 2004.

Quintile - The quintile system splits all public schools in South Africa into one of five categories, with quintile 1 schools designating the poorest 20% schools while quintile 5 denoted the least poor 20% public schools in each province. The quintile to which a school is assigned is based on the rates of income, unemployment and illiteracy within the school's catchment area.

The Care and Support for Teaching and Learning (CSTL) - supports Education Ministers fulfil their commitments and intentions of providing quality education to all children. It provides a comprehensive approach to addressing barriers to teaching and learning that are associated with health- and poverty-related challenges.

Wellness days – may be defined as "an organised, employer-sponsored program that is designed to support employees (and, sometimes, their families) as they adopt and sustain behaviours that reduce health risks, improve quality of life, enhance personal effectiveness, and benefit the organisation's bottom line"[3]

LIST OF ABBREVIATIONS

APP	As per protocol
BCI	Behaviour Change Interventions
BP	Blood pressure
CDC	Center for Disease Control and Prevention
CHD	Coronary Heart Disease
DBE	Department of Basic Education
eHealth	Electronic health
GSM	Global System for Mobile technology
ICT	Information and communication technologies
ITT	Intention to treat
LMIC	Low to middle income countries
LVCF	Last value carried forward
mHealth	Mobile health
MVPA	Moderate to vigorous physical activity
NCD	Non-communicable disease
NSNP	National Schools Nutrition Programme
PA	Physical activity
SES	Socioeconomic status
SMS	Short message services
SSB	Sugar sweetened beverages
TTM	Transtheoretical Model
USSD	Unstructured Supplementary Service Data
WHO	World Health Organisation

Chapter 1 **REVIEW OF THE LITERATURE**

1.1. SEARCH STRATEGY

The PubMed, Africa Journals Online, EBSCO Host and Africa Wide databases were searched to retrieve relevant articles. In addition to empirical studies, grey literature sources, systematic reviews and meta-analyses were also included as references. Additional studies were retrieved through citation alerts and scientific social media allowing study inclusion. The CONSORT checklist was used to assess the risk of bias of the included studies.

As much as possible, the search for publications pertaining to the topics below was limited to the last ten years. Terms and keywords used in the search strategy included:

1.1.1 NON COMMUNICABLE DISEASE (NCD)

Global *burden of NCDs;* screening and NCD *risk factors; coronary heart disease; cardiovascular disease; hypertension; diabetes; dyslipidaemia; obesity; burden of NCDs in LMICs; burden and risk factors of NCDs in the general South African population; NCD risk factors in the employed South African population; and NCD risk in South African educators.*

1.1.2 HEALTH BEHAVIOUR CHANGE INTERVENTIONS

Health behaviour interventions; Health communication; Lifestyle change; communication in HBI; customisation of communication; Theory of Planned Behaviour; Transtheoretical Model; targeted and tailored communication for HBI; print communication; mHealth communication; tailored print-letter communication for HBI; mHealth; mobile phone use for HBI; SMS messages for HBI; text messages; mHealth; short message service; SMS; cell phone; mobile phone; web 2.0 and social media; smartphone apps; wearable health devices in HBI; HBI to combat NCDs; physical inactivity; unhealthy eating; smoking; stress; obesity

1.1.3 ECOLOGICAL MODEL FOR HEALTH BEHAVIOUR CHANGE

Socio-ecological model of behaviour change; socio-ecological model health promotion; socio ecological model health behaviour; socio- ecological model physical activity; worksite and school environments in behaviour change.

1.2. NON-COMMUNICABLE DISEASES

Non-communicable diseases (NCDs) are the leading causes of mortality globally as well as one of the major health and development challenges of the 21st century, in terms of both the human suffering they cause and the harm they inflict on the socioeconomic fabric of countries, causing more deaths than all other diseases combined[4]. In the absence of evidence-based actions, the human, social and economic costs of NCDs will continue to grow and overwhelm the capacity of countries to address them[5]. The burden is growing - the number of people, families and communities affected is increasing[6]. Ageing populations, rapid unplanned urbanisation and the globalisation of markets that promote tobacco use, physical inactivity and unhealthy diets have all been shown to contribute to the growing burden[7]. No government can afford to ignore the rising burden of NCDs[8]. Four out of five NCD deaths today are in low- to-middle income countries (LMICs)[9]. People in these countries tend to develop diseases at a younger age, suffer longer – often with preventable complications – and die sooner than those in high-income countries[10]. Many interventions and strategies have proven to reduce the risk of NCDs, however, interventions that modify lifestyle factors are among the most effective but are often poorly adhered to[4].

1.2.1 DETERMINANTS OF NCDS

Cardiovascular disease, chronic obstructive pulmonary disease (COPD), certain cancers and diabetes are a subset of NCDs that are an important and increasing cause of morbidity and mortality in LMICs[11]. These disorders share common risk factors such as smoking, alcohol abuse, poor diet, and physical inactivity[12]. They also share common interventions at the clinical, public health, and policy levels[11]. Addressing NCDs also fits in with the Sustainable Development Goals that focus on reducing poverty and improving health, particularly through mechanisms (such as universal health care coverage) that can address the rise in NCD risk factors and the potential impoverishing effects of chronic illness[8]. The concept that current or past exposure to specific factors increases the risk of future cardiovascular disease was first established in the Framingham Heart study in the United States[13], but it has been validated extensively in LMICs[14,15]. These risk factors are now well established globally, not only for cardiovascular disease[15,16], but also for stroke[14], diabetes[17], chronic lung disease [18], and other chronic NCDs[19]. These risk factors may be strongly influenced by socioeconomic and environmental determinants, policy and legislative interventions, lifestyle and behavioural choices, and familial and genetic predisposition[11]. Among modifiable risk factors, reducing the level of individual or population risk or discontinuing the exposure may lead to corresponding reductions in the magnitude of morbidity and mortality[11]. An in-depth knowledge of these relationships as well as the distribution of risk factors in the population could provide an important basis for developing preventative strategies at the individual and population levels[8].

1.2.2 GLOBAL BURDEN OF NCDS

Noncommunicable diseasescaused 38 million deaths in 2012[20]. Almost three quarters of these deaths (68%) occurred in LMICs[8] . Of the total deaths, 52% were in people under the age of 70 years, with most of these occurring in LMICs[5]. Globally, deaths due to NCDs are projected to increase by 17% over the next ten years, but the greatest increase (24%) is expected in the African region[21]. It is estimated that by 2030 NCDs will contribute 75% of global deaths[5].

The leading causes of mortality from NCDs is cardiovascular disease (CVD), which claimed 17.5 million lives in 2012 (46% of all NCD deaths). Coronary heart disease resulted in 7.4 million deaths and 6.7 million were a result of strokes. Cancers killed around half as many people as CVD (8.2 million), while chronic respiratory disease and diabetes accounted for 4 million and 1.5 million deaths, respectively. Diabetes is also a risk factor for CVD, with about 10% of cardiovascular deaths caused by higher-than-optimal blood glucose[8].

LMICs carry a disproportionate burden of NCDs[22]. The economic cost of the NCD burden for LMICs are estimated to reach US$21 trillion by 2030[23]. Health systems in LMICs are facing a critical shortage of health professionals and resources making health services for persons with ncds unavailable or low quality, which results in decreased life expectancy and quality of life[22].

A. Management of NCDs in LMICs

Ideally, community-based interventions should be comprehensive and multifaceted[24]. The HEALTHY Study Group recommend programmes in schools to encourage healthy life-styles and programmes for children and educators[25] to reduce cardiovascular risk factors by encouraging physical activity, healthy eating and tackling obesity and diabetes[25]. Focusing on nutrition for pregnant mothers and babies could produce long-term benefits, as both under- and over-nutrition have been shown to have long-term consequences, particularly in the context of NCDs[26].

A primary care approach based on trained primary care teams may provide an efficient and equitable solution and has shown some promising results in certain countries[27-29]. The combination of generalist and specialist care physicians in the planned delivery of care for patients with NCDs is widely advocated[30-32]. A Cochrane systematic review identified 20 studies, 19 of which were randomized clinical trials, of shared care interventions for chronic disease management, with mixed results[33]. There is evidence for the role of community health workers in increasing the capacity of over-burdened health care systems by using resources more effectively and so increasing access, coverage, and the quality of care[34]. In rural settings, primary care systems with trained community health workers and well-established guidelines can be effective in the prevention and management of cardiovascular disease[35]. These community health workers have been shown to reduce the barriers to blood pressure control and medication adherence resulting from cultural, educational, and language differences between patients and the health care system in Cape Town, South Africa[36].

i Primary prevention

The main approaches for NCD primary prevention are promoting and maintaining a healthy lifestyle and blood pressure control, which applies to both ischemic and haemorrhagic strokes[37]. A healthy lifestyle includes not smoking (and smoking cessation for smokers), no binge drinking, being physically active, and a healthy diet characterized by adequate fruit and vegetable intake, reduced intake of dietary trans fats, and reduced sodium intake[38]. Healthy lifestyles are closely linked to prevention and control of overweight and obesity, which can also affect a large number of NCDs. This is achieved mainly through behavioural interventions targeting diet and physical activity[39].

ii Secondary prevention

According to Checkley *et al.*, there is an urgent need to develop robust strategies for early identification, acute care, and rehabilitation of patients with NCDs that can be implemented on a large scale[37]. Involvement of community health workers to raise NCD awareness and offer psychological support is an important aspect that requires more investigation as they have not shown significant improved clinical outcomes[40]. Improving general awareness of the need to adopt a healthier lifestyle and adhere to medications can significantly lower the risk of NCDs[41].

B. Established risk factors

Hypertension, type 2 diabetes, overweight and obesity, dyslipidaemia, and other established risk factors have become the leading determinants for assessing and treating NCDs[8]. Traditionally these risk factors have received the bulk of attention since they predicted cardiovascular events. Their treatment and monitoring are major emphases of clinical care, research investigation, treatment guidelines, organisation position papers and measures of physician and hospital performance[42].

i Hypertension

Hypertension contributes significantly to the burden of cardiovascular diseases, strokes and ischaemic heart disease[43]. In 2010, an estimated 1.39 billion people, approximately 31.1% of the world's adult population, had hypertension; 28.5% in high-income countries and 31.5% in LMICs[44]. Elevated blood pressure has been shown to increase the risk of deaths by 10% globally compared to individuals who control their high blood pressure effectively[45].

ii Diabetes

The prevalence of diabetes in adults has been increasing in the last three decades[46]. The International Diabetes Federation estimated that 8.3% (381.8 million) of adults worldwide had diabetes in 2013[47]. The vast majority of people with diabetes live in

LMICs[48]. People with diabetes in high-income countries are predominantly over the age of 50 (74%) while those in LMICs are mostly under the age of 50 (59%). Particularly for developing countries, demographic patterns are expected to change substantially over the next few generations with an increase in life expectancy, decreases in the infectious disease burden, and higher rates of urbanisation[48]. These changes will also drive increases in diabetes prevalence in those countries[48]. In 2013, 382 million people had diabetes; this number is expected to rise to 592 million by 2035[48].

iii Overweight and obesity

Excess body weight is an important risk factor for NCDs and mortality worldwide[49]. In 2015, 107.7 million children and 603.7 million adults were obese worldwide. The overall prevalence of obesity was 5.0% among children and 12.0% among adults. Among adults, the prevalence of obesity was generally higher among women than among men in all age brackets[50]. A high body mass index (BMI) contributed to approximately 4.0 million deaths, which represented 7.1% of the deaths from any cause; it also contributed to 120 million disability-adjusted life-years (DALY), which represented 4.9% of DALYs from any cause among adults globally[50].

iv Dyslipidaemia

Dyslipidaemia includes elevated total serum cholesterol level, elevated triglyceridemia (TG), elevated low-density lipoprotein cholesterol (LDL-C), reduced high-density lipoprotein cholesterol (HDL-C), and increased atherogenic index. Although they often exist in clusters, each of them can exist independently and contribute significantly to increased cardiovascular risk[51]. Dyslipidaemia (total cholesterol > 200 mg/dl, triglycerides > 150 mg /dl, LDL–C > 130 mg/l, HDL-C < 40 mg/dl; male, HDL–C < 50 mg/d; female) is one of the most important modifiable risk factors for the development of coronary heart disease[52]. According to a WHO estimate, globally the prevalence of raised total cholesterol is estimated to be 39%, and a third of ischemic heart disease is attributable to this risk factor[53]

C. Lifestyle risk factors

Traditional treatment of NCDs has focused on dyslipidaemia, hypertension and diabetes mellitus since they are strong predictors of death and disability[42]. Although dyslipidaemia, hypertension and diabetes mellitus clearly predict NCD risk, and efforts to combat these established risk factors with pharmacological treatments have proven effective and should therefore continue, more focus should also be placed on lifestyle risk factors[54]. Lifestyle risk factors strongly influence not only blood pressure, cholesterol levels and glucose-insulin homeostasis but also novel risk factors such as endothelial function, oxidative stress, inflammation, thrombosis/coagulation, arrhythmia, and psychosocial stress[42]. Patients with drug-treated hypertension, high cholesterol, or diabetes mellitus are therefore often still at higher risk for cardiovascular events than individuals who do not have these conditions[42]. Moreover, unhealthy lifestyle habits continue to increase cardiovascular risk even among individuals receiving drug treatment for blood pressure or cholesterol levels[55]. In the past few years, these lifestyle behaviours (lack of physical activity, obesity and poor eating habits, smoking and drug and alcohol use) have therefore begun to receive more attention in lowering NCD incidence[42]. It is now estimated that 80% of heart disease, stroke, and type 2 diabetes and around 40% of cancers could be prevented by the adoption of healthy lifestyle behaviours[56].

Lifestyle risk factors strongly influence not only blood pressure, blood lipid levels (including low- and high-density lipoprotein cholesterol, and triglycerides), and glucose-insulin homeostasis but also intermediary novel risk factors such as endothelial function, oxidative stress, inflammation, thrombosis, arrhythmia, and other intermediary pathways (for example, psychosocial stress)[42]. Further, more than 70% of total cardiovascular events, 80% of coronary heart disease events, and 90% of new cases of diabetes mellitus appear to be attributable lifestyle factors[57].

Patient treatment traditionally focussed on blood pressure and cholesterol cut-off points or glucose levels and was rarely based on physical activity, body weight, or dietary habits[42]. According to Mozaffarian *et al.*, patients often asked their health care practitioners about their blood pressure and cholesterol levels, whereas smoking, physical activity, and dietary habits were insufficiently discussed[42]. These imbalances were driven by many main factors including: the relative ease of measuring and writing prescriptions for pharmacotherapy NCDs compared to assessing and managing lifestyle behaviours, the impression that improved lifestyle behaviours are often more difficult to sustain than lifelong use of drugs[42], poor adherence and long-term success have been modest because of significant barriers both on the part of affected individuals and health care professionals responsible for the treatment[58]. The evidence for behaviour modification and specifically how to implement behaviour modification is relatively poor compared to the overwhelming strong evidence for the effectiveness of medical therapy. Health care professionals report that they perform lifestyle counselling during approximately 34% of clinic visits[59]. Patients, in turn, report an even lower frequency of physician lifestyle counselling. For example, obese patients reported receiving physical activity and dietary counselling from their primary care providers during 20% and 25% of clinic visits, respectively[60]. There are many factors which contribute to this situation. Health care professionals often report they lack the necessary knowledge about how various physical activity and diet regimens affect specific medical conditions[61]. Many physicians also say they lack the competencies needed to perform lifestyle counselling effectively[62]. Although a large and convincing body of scientific evidence supports the benefits of a healthy diet, physical activity, and non-smoking in NCD prevention and management, dissemination of this knowledge during medical training and continuing medical education is marginal compared with the time and resources devoted to pharmacological treatment[63]. Ironically, a large proportion of healthcare expenditure, including costs to individuals, businesses, and society, is attributable to poor lifestyle behaviours[23]. These costs have been shown to decrease by initiatives that promote healthy lifestyles[64]. Substantial resources should be directed towards investigating effects of lifestyle risk factors, their personal and environmental determinants, and the effective interventions to change them[42]. Health care providers should be encouraged to prescribe exercise and healthy dietary habits in the same way as they prescribe drugs to combat NCDs[65].

i Physical activity

Physical inactivity is associated with approximately 3 million, or 8%, of all NCD-related deaths per year[12]. Regular physical activity is well recognised as an important lifestyle behaviour for the development and maintenance of individual and population health and well-being[66]. Physical activity and fitness are associated with 30% to 50% lower risk of cardiovascular events[67]. In patients with established cardiovascular disease, physical activity reduces angina symptoms, benefits heart failure, decreases claudication, and lowers mortality after myocardial infarction[67]. Even modest daily physical activity bouts (30 minutes of brisk walking on most days) have been shown to reduce NCD risk[68]. Adults who accumulate at least 150 minutes of moderate-intensity physical activity per week have a 20–30% decreased risk of all-cause mortality compared to those who do not reach the WHO's recommendation[69]

ii Nutrition

The past two decades have seen a major shift in dietary habits. Daily consumption of high-energy-dense products, 'fast foods', and sugar-sweetened beverages have all increased substantially[70]. At the same time, the prevalence of overweight and obesity has also increased dramatically[71]. These trends indicate a capacity for rapid and significant behaviour change. Investigating the determinants of these behaviour changes and the means to reverse them should be one of the priorities of our scientific inquiry[42].

Dietary habits have been shown to affect both established and intermediary risk factors[72]. In 2015, the World Health Organization estimated that the consumption of foods high in saturated and industrially produced trans fats, salt, and sugar are the cause of at least 14 million deaths or 40% of all deaths every year from NCDs[12]. For example, over consumption of salt causes up to 30% of all cases of hypertension[73]. A diet which does not include different food types has been associated with cardiovascular risk[74], dyslipidaemia[75], as well as a risk factor for the metabolic syndrome[76].

A high sugar intake is associated with the development of chronic conditions such as dental caries, obesity and diabetes[77]. It is also a contributory factor to the nutrition transition, whereby urbanisation results in the consumption of an increased intake of sugar, fat, saturated fat, and salt in the diet[78]. Globally, consumption of sugar-sweetened beverages (SSBs) has increased alongside the increase in NCD prevalence[79].

Modest consumption of oily fish (1 to 2 servings per week) reduces the risk of CHD death by 36%, with 17% reduction in total mortality in randomized controlled trials of fish oil in higher-risk populations[80]. Reducing trans-fat consumption has resulted in substantial reductions in cardiovascular risk[81]. Consumption of whole grains, legumes, and cereal fibre[82] and fruits and vegetables[83] have all shown to decrease the risk of NCDs. Other dietary habits that may lower the risk for NCDs include modest consumption of nuts[84], Omega-3 fatty acids[72], and replacement of saturated fat or refined carbohydrates with unsaturated fats[85].

iii Tobacco use

Tobacco use is the leading cause of premature mortality globally[49] accounting for one in six of all NCD-related deaths[12]. Tobacco smoking causes about 71% of lung cancer, 42% of chronic respiratory disease and nearly 10% of cardiovascular disease[49]. Smoking increases the risk of coronary heart disease and strokes by 2 to 4 times, developing lung cancer by 23 times and dying from chronic obstructive lung diseases (such as chronic bronchitis and emphysema) by 12 to 13 times compared to non-smokers[86].

In 2015, over 1.1 billion people smoked tobacco[12]. In most countries, including South Africa, smoking prevalence is far higher in males than females[87]. Tobacco use accounts for 7% of all female and 12% of all male deaths globally[88]. Unless the current tobacco use trends are reversed, the annual toll is projected to increase to 8 million deaths per year by 2030, or 10% of all deaths projected to occur each year[89]. Even though the prevalence of tobacco smoking is declining worldwide, it appears to be increasing in the Eastern Mediterranean and African regions[87]. The main obstacles to global smoking cessation programmes appear to come from industry interference[87]. The tobacco industry is fiercely challenging the implementation of pictorial health warnings and plain packaging of cigarette packs in multiple countries, arguing that the packaging regulations impinge upon trademark and intellectual property rights. International trade and investment agreements are also being used by the tobacco industry to challenge tobacco-control measures[87]. Quitting smoking reduces total mortality by approximately one third[90]. Decreases in smoking rates have substantially reduced NCD risk in some populations[91].

iv Alcohol use

Binge drinking is a major global contributing factor to death, disease and injury[92]. In 2012, an estimated 5.9% (3.3 million) of all deaths worldwide and 5.1% of disability-adjusted life years (DALYs) were attributable to alcohol consumption[5]. Worldwide alcohol consumption in 2015 was projected to be 6.3 litres of pure alcohol per person aged 15 or older[93]. In 2010, 38% of the world population aged 15 or older had drunk alcohol in the past 12 months, 16% of these were engaged in heavy episodic drinking[5]. In 2012, 3.3 million deaths, 5.9% of all deaths worldwide, were attributable to alcohol consumption, with a significant proportion of alcohol-attributable deaths from NCDs and injuries[93].

1.2.3 BURDEN OF NCD IN SOUTH AFRICA

As of 1 January 2018, the population of South Africa was estimated to be at 56,007,479. The majority of the population (66%) ranged between 15 and 64 years of age. Total life expectancy (for both genders) at birth is 49.3 years[94]. This is below the average life expectancy at birth of the global population which is about 71 years[95]. Male life expectancy at birth is 50.2 years while female life expectancy at birth is 48.4 years. The vast majority of the adult population (94%) (aged 15 years and above) are able to read and write[94]. The 2011 South African census figures revealed that 76.4% were classified as Black, 9.1% were White, 8.9% made up the Coloured population, Asian made up 2.5% of the population. Lastly, and 0.5% were classified as Other/Unspecified[96]. The major ethnic groups include the Zulu, Xhosa, Basotho (South Sotho), Bapedi (North Sotho), Venda, Tswana, Tsonga, Swazi and Ndebele, all of which predominantly speak South African Bantu[96]. The unemployment rate in South Africa is around 25% percent. The youth (age 15-24) unemployment rate is even higher[97]. Of the total deaths in 2016, Tuberculosis had the highest number (6.5% of all reported deaths), diabetes mellitus was the second highest cause of death (5.5%). Heart disease and cerebrovascular diseases accounted for (5.1%), Human immunodeficiency virus (HIV) accounted for 4.8%, hypertensive disease resulted in 4.4%, influenza and pneumonia resulted in 4.3%. Lastly, Ischaemic heart diseases resulted in 2.8% of deaths[98].

An assumption has been that NCDs exist primarily in high-income countries and that communicable diseases exist primarily in LMICs[99]. Cardiovascular diseases are the leading cause of death in every region of the world, with the exception of sub-Saharan Africa (SSA) where infectious diseases are still the leading cause of death[7]. In SSA it is understandable that governments, donors and research-funding agencies have channelled most resources into infectious diseases: 5.9% of the population between the ages of 15 and 49 are HIV positive[100] and malaria alone kills one million children under the age of five annually[101].

Since the first democratically held elections in 1994, South Africa has been in the midst of a profound health transition characterised by a quadruple burden of communicable, non-communicable, perinatal and maternal disorders, and injury and violence-related deaths[102-104]. South Africans have not derived all the benefits anticipated from progressive health-care policies, such as free primary health care, that were introduced by the first democratically elected government in 1994. This is partly due to a low quality of health care and inequitable access to services[105-107].

The HIV/AIDS and Tuberculosis epidemic still predominates in South Africa both in terms of morbidity and mortality[108]. However, with the rise in urbanisation, industrialisation and economic transition and health services that are not always adequately equipped to deal with the issues, more people are becoming ill and dying from NCDs[92]. According to the World Health Organisation (WHO), NCDs accounted for 29% of all deaths in South Africa in 2008[109]. By 2013, this figure had risen to 40% of all deaths (excluding injury) and around 35% of the burden of disease[108]. More recently, these figures have however been shown to be even higher[109]. Smoking and alcohol use is reported to be more common in men, while women have a higher prevalence of obesity[108].

The cardiovascular disease epidemic in South Africa is driven by changing lifestyles including physical inactivity, increased alcohol consumption and tobacco use, and increased consumption of foods high in saturated fat, salt, and sugar[110]. This has been as a result of increasing urbanisation, modernisation, and westernisation; socioeconomic development; and the embrace of free market policies[110]. The ongoing nutrition transition in South Africa, characterised by a shift from the traditional African diet to processed and fast foods, is at the heart of the cardiovascular disease epidemic[110].

South Africa has several comprehensive policies and programmes that target all the four major NCD risk factors[111]. The purpose of formulating NCD policies is to effect behavioural change and the reduction of NCDs in general[111]. Although there are NCD policies are in place, the prevalence of NCDs in South Africa, with the exception of smoking, has actually increased[111]. Physical inactivity is particularly challenging among women in LMICs and South Africa, in particular[111]. The lack of green spaces for walking in the sprawling urban informal settlements, the poor state of pavements, aggressive driving habits as well as crime and gender-based violence in South Africa are deterrents to physical activity[111]. The sections below will report on the established and lifestyle risk factors in South Africa.

A. Established risk factors in South Africa

i Hypertension

High blood pressure is responsible for a high burden of disease in South Africa (including morbidity and mortality)[112,113]. According to the South African National Health and Nutrition Examination Survey (SANHANES-1), more than one third (38.3%) of individuals had systolic and diastolic blood pressure levels in the pre-hypertensive and hypertensive ranges, 10.2% of individuals were classified as hypertensive[114]. There is no difference between males and females[114].

ii Diabetes

In 2000, diabetes was associated with 4.3% of South African adult mortality, placing it among the top ten leading causes of adult deaths in the country at that stage[115]. In 2009, the prevalence of type 2 diabetes was approximately 9.0% in people aged 30 years and older, representing approximately 2 million cases[116]. In 2013, the incidence was reported at 9.6% and almost 19% had impaired glucose homeostasis (HbA1c > 6.5%)[114].

iii Body mass index (BMI)

According to Okop *et al.*, 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 among adults in South Africa[117]. Further, the prevalence of obesity in women from different race groups has been found to range between 48.9% and 58.5%[118].

Results of SANHANES-1 indicated that overall, overweight and obesity are thought to be on the rise[114]. South African females were more overweight and obese compared to males (24.8% and 39.2% compared to 20.1% and 10.6% respectively). Conversely, the prevalence of being underweight and normal weight was significantly higher in males than females (12.8% and 56.4% compared to 4.2% and 31.7% for males and females, respectively)[114]. Alarmingly, obesity has increased very dramatically amongst females from 27% to 39.2% from 2003 to 2013[114].

The evidence that BMI is associated with SES is also well established, but, unlike what has been observed in high-income countries, in South Africa, as in most LMICs, high SES status has been associated with higher BMI[119,120]. The analysis of Cois and Day (2015) suggested that subjects at the very high end of the income distribution and belonging to the White population group (a strong indicator of high SES) are more at risk of increasing their BMI compared to those in the lower SES bands[121]. The authors also reported that South African subjects with tertiary education, another strong indicator of high SES, also showed higher rates of increased BMI, even though the relationship did not reach statistical significance[121]

B. Lifestyle risk factors in South Africa

i Physical activity

The growing health risks associated with physical inactivity in the South African population have been widely reported[122-125]. Over the past decade, black women have been noted as a high-risk group, having the highest levels of inactivity, overweight and obesity[10,126]. Only 36% of SA men and 24% of women report sufficient levels of daily health-enhancing physical activity[127]. Further, 30% of ischaemic heart disease, 27% of colon cancer, and 20% of diabetes in South Africa have been attributed to physical inactivity[128]. A higher percent of South African men appear to meet the WHO's recommendations of 150 minutes of moderate to vigorous physical activity in week (40% vs 20%)[129]. Men have also been reported to be fitter than women (62.4% vs. 42%)[114].

ii Nutrition

Shifts in dietary intake are occurring, particularly in the black South African, which makes up more than three-quarters of the South African population[114]. A relative fat increase of 59.7% and a relative decrease of 10.9% in carbohydrate consumption has been seen in urban black people in the past 50 years[104]. An important aspect in the nutrition transition is that poorer people tend to buy the least expensive, most energy-dense foods, that are also the most filling. This results in the overconsumption of higher energy-dense foods[130] that typically contain high quantities of fats, added sugars and/or carbohydrates.

Over the past 50 years, fat intake has increased in people living in urban settings from 16.4% to 26.2% of total energy (a relative increase of 59.7%), whereas carbohydrate intake has decreased from 69.3% to 61.7% (a relative decrease of 10.9%). A shift towards a diet similar to that in developed countries has also been apparent in people residing in rural areas[104].

The Who recommendation of 400 g of vegetables and fruit per day, the equivalent of five servings of 80 g each[131], has been shown to have certain preventative qualities against cancers and cardiovascular disease. The South African recommended fruit and vegetable guidelines are: 6 to 8 portions is considered high, a moderate score is 3 to 5 servings a day. A daily consumption of less than 2 servings is classified is low[114]. South Africans are reported to be consuming only 200 g per day[132]. The five a day recommendation is believed to provide sufficient micronutrients, particularly vitamin A, vitamin C, folate, vitamin E, potassium and fibre, in the diet[133]. The South African recommendation is based on these guidelines[132]. The estimated daily intake of vegetables and fruit in South Africans aged 15 and older (235 g/day in males and 226 g/day in females)[134] are well below the 400 g/day recommendations established by the WHO[135]. Lack of fruit and vegetables typically results in micronutrient deficiencies such as vitamins A and C, folate and potassium, as well as a suboptimal intake of dietary fibre[133]. This study used the 5 servings cut off limit as it has been used in previous studies using an HRA in worksite settings.

Between 2005 and 2010, added sugar and sucrose sweetened beverage consumption doubled in both urban and rural areas in South Africa, with a corresponding increase in NCD risk[136]. South Africa has the eighth highest sugar consumption in the world[137]. In 2012-2013, the average amount of sugar consumed per person per day was 23.5 teaspoons, or about 99 g (36.4 kg) per year. This is almost four times the new WHO recommendation of about 25 g per day[138]. Meanwhile, soft drink sales in South Africa have increased by nearly 13% between 2012 and 2017[139].

Vorster *et al.*, reported that total fat intake increased from 21% to 30% of energy in urban African women in South Africa, and from 15.5% to 21% of energy in rural African women from 1996 to 2005[140]. An increased intake of energy from total fat was observed in the urban areas with >10% energy coming from saturated fats[140]. Fast foods are generally known to be high in energy and total fat and most are also high in saturated fats[141]. In a study by Steyn *et al.*, 32% of the total sample reported eating fast foods at least two to three times per month or roughly once per week, while 6.8% consumed fast food two or more times a week[142].

iii Tobacco use

South Africa has been a global leader in the development and implementation of appropriate legislation for tobacco use and control[113]. The Tobacco Products Control Act of 1993 has created one of the most effective policies of this type worldwide[105]. The Act protects children and adolescents by banning advertising and assures the rights of non-smokers to a smoke-free environment. Additionally, the tax on tobacco has been increased every year as part of the policy for reducing use. South Africa is one of the few countries that has added information about smoking on the death notification form, enabling the attributable burden of tobacco over time to be monitored[143]. These actions are thought to have brought about the falling tobacco consumption in South Africa, by encouraging existing smokers to quit and discouraging non-smokers to start smoking[144].

Despite the strong legislation, overall, 21% of the South African population are reported to have smoked tobacco products. Male smoking rates are more than three times that of females[144]. Possible reasons for this are that it is more socially acceptable for males to smoke, or men often have more disposable income to buy tobacco products than women[145]. Of current smokers, 48% had tried to quit and 50% reported that the health warning labels on tobacco packages made them think about quitting, suggesting that health warning labels may be effective in encouraging smoking cessation[146]. This effect may be augmented when combined with plain packaging, as is done in Australia. Those who noticed warning labels on tobacco packages were 1.7 times more likely to attempt to quit smoking than those who did not notice warning labels[146].

Among current smokers, only 29% reported having been advised to quit smoking[144]. This low percentage suggests that health care professionals should be more aggressive in advising their patients to quit using tobacco products[144]. Individuals who received advice to quit smoking from a healthcare provider were 3.8 times more likely to attempt to quit than those who did not receive advice[146]. Women received advice to quit smoking much more often than men[146].

Since the comprehensive tobacco control legislation was promulgated by the South African Government[114], there has been a 25% reduction in smoking rates (from 23% in 1999 to 17% in 2011) amongst school going youth. Public health interventions have led to a decrease in tobacco consumption over the past 20 years, due to changes at the social level, specifically in attitudes towards smoking[147].

iv Alcohol use

Not only does South Africa have one of the highest levels of alcohol consumption in the world[92], there are also high levels of binge drinking (that is, heavy episodic drinking) which leads to intoxication and occurs mostly during weekends, month end, and holidays[114]. Although Sorsdahl *et al.*[148] reported that 75.8% of the 4 271 participants had no alcohol intake in the 12 months preceding their survey, among those who consumed alcohol, 25.4% engaged in heavy episodic drinking (four or more for women and five or more for men) on a daily or weekly basis. Five percent of participants indicated high quantity and frequency of alcohol consumption[148]. Numerous studies have highlighted the hazardous role alcohol consumption has on hypertension and diabetes[149,150].

1.2.4 NCD RISK FACTORS IN THE EMPLOYED SOUTH AFRICAN POPULATION

As a large proportion of the adult population, from a wide range of socioeconomic and cultural backgrounds, are involved in the workplace, it has been identified by numerous health authorities as a strategic environment to impact on health behaviours[151] The workplace affects individual health behaviours through both physical and psycho-social mechanisms[151]. The workplace influences employees' health, safety and risk behaviour, and can act as an accelerator or preventer of chronic diseases[152]. According to the WHO, a healthy workplace is one where employees and managers collaborate to continually improve the health, safety and well-being of all employees, and by so doing, also sustains the productivity of the business[39]. Innovative actions in the workplace are needed to tackle the predicted increase of NCDs over the next two decades in South Africa[153]. While there are multiple workplace wellness programmes, there is no South African guideline on preventing NCDs in the workplace and there may be a need for such a guideline to be informed by local evidence[151].

Numerous studies investigating the health of the workforce in South Africa indicate that a significant number of employees suffer from NCDs[154-158]. In a cross-sectional study describing the health and NCD risk profile of 18 companies, most employees (>50%) were not meeting the recommendation for 30 minutes of moderate to vigorous physical activity on at least five days of the week. They also exhibited additional risk factors such as insufficient fruit and vegetable intake (80%), smoking (61%), being overweight or obese (31%), increased serum cholesterol concentration (19%) and elevated blood pressure (12%)[154]. Many of these conditions may also interfere with worker productivity and carry an economic impact. Interventions addressing NCD risk factors have however been shown to have positive return on investment[155]. Kolbe-Alexander *et al.*,[155] evaluated the modifiable health risk status of over 6500 employees from 68 companies and associated health care utilisation and expenditure. The most prevalent risk factors were insufficient physical activity (68%) and being overweight (67%). Employees who were inactive also had a higher number of NCD risk factors ($chi^2 = 43.55$; $p<0.0001$). Physically active employees had significantly fewer visits to the doctor (2.39 versus 2.85; $p<0.001$) than those who were insufficiently physically active, indicating an associated average cost saving of ZAR100 per year ($p<0.01$). Berry *et al.*, reported a medical claims cost reduction of $1,421 per individual per year by employees who participated in a corporate wellness programme compared to their previous year's claims[159]. The return on investment from the Johnson & Johnson employee health programme between 2002 and 2008 was $2.71 for every dollar spent[160]. These findings show the need for comprehensive worksite intervention programmes that aim to reduce the prevalence of risk factors for NCDs in South African employees. It is estimated that the accumulated losses to South Africa's gross domestic product between 2006 and 2015 from diabetes, stroke and coronary heart disease alone cost the country US$1.88 billion[161].

1.2.5 SOUTH AFRICAN EDUCATORS

In 2016, there were 12 932 565 learners in ordinary public and independent schools in South Africa, who attended 25 574 schools and were served by 418 611 educators[162]. Almost 60% of schools in South Africa are primary schools (14 927) with 6 655 171 learners and 201 673 educators[163]. Of the 418 611 educators, approximately 69.4% are female[163]. It is estimated that 67% of children attending schools were not paying school fees in 2017. Approximately 5% reported paying between R 1 to R 100 in school fees per year, although this could include voluntary contributions. At least 71% of children therefore could be benefiting from the no-fee school policy[164].

Schools can play an important role in motivating learners to pursue healthy behaviours and instilling healthy lifestyles[165], and educators have been identified as primary agents for showing learners how to adopt and maintain healthy behaviours[166]. The view that educators are important role models has been highlighted since the 1980s when it was proposed that health messages are more effective when they are promoted by educators who practice healthy behaviours[167]. Learners are more likely to eat healthier foods if educators are of normal weight, and are regularly seen to eat healthy foods compared with obese educators who snack on unhealthy high-energy foods[168]. Schee and Gard also reported that unhealthy educators are less effective in the classroom[167]. In addition, educators are often expected to be implement intervention programmes and may also serve as health role models for learners[169,170]. The World Health Organisation School Policy Framework[170], therefore highlights the importance of the need for educators to be aware of and be responsible for the messages they give to learners as educators, potential programme implementers and as role models[170]. The PubMed search found no studies comparing the health of educators to other worksite populations in South Africa. Comparisons were therefore made between studies reporting on the health status of South Africa employed population and South African educators.

A. Resilience in South African Educators

Educators in South Africa have been shown to have very stressful working conditions[171] and are at risk for occupational stress, 'burnout', high levels of exhaustion, cynicism and stress-related illnesses[172,173]. It is estimated that between 5% and 20% of all educators are 'burned out' at any given time[172,174]. These behaviours could directly affect their productivity, classroom effectiveness, absenteeism and the cost of their health care. It is estimated that on average, between 20 and 24 days per year of regular instructional time is lost by each educator in South Africa due to poor health[175]. This intense stress may lead to low employee morale and high turnover[171].

The physical and mental health of school employees is integral to promoting and protecting the health of learners and ensuring their academic success[165]. Like their counterparts in other segments of the South African workforce, school educators should be encouraged to look after their health to ensure that they perform at optimum levels[176]. The provision of good quality education in public sector schools in South Africa is intrinsically linked to the health, wellbeing and productivity of educators employed in this sector[177].

B. Health status of South African educators

As a group, South African educators[168,172,177-179] appear to be an at risk population for suffering from NCDs[180]. Zuma *et al.*, reported that 22.1% of the 21 428 educators in their study were hypertensive, 9.0% were diabetic, 4.3% suffered from lung or breathing problems, 3.1% had heart disease and 1.3% had cancer[177]. The NCD prevalence is higher than those reported in 2004[181]. Only 4% of the educators reported that they engaged in irresponsible alcohol consumption, this was more prevalent among males. Current tobacco use (16.4%) was found to be lower among educators compared to the general South African population[177]. The overall prevalence of overweight and inactivity are higher than that found in SANHANES[168]. In another study, Senekal *et al.*, reported that 46% of educators were hypertensive, more than 30% had high waist circumferences, and elevated cholesterol levels[168]. The high hypertensive discrepancy rates between the two studies could have been attributed to the samples recruited. Senekal *et al.*, investigated educators from low socio-economic areas while Zuma recruited educators from both low- and high socio-economic areas. Studies have shown that low socio-economic communities are, on the whole, less healthy than individuals from higher socio-economic communities[114]. Adeniyi *et al.*, also reported a very high prevalence of other cardiovascular disease risk factors in a sample of 489 educators in Cape Town. They reported a mean BMI in the obese range of (31.6 ± 7.0 kg/m^2)[179].

Together, these studies suggest that South African educators represent an 'at-risk' group for NCDs, in part, due to the associated lifestyle behaviours and occupational stress as well as lack of interventions to address them. Table 1-1 below compares the NCD risk factors of the general, employed and educator populations in South Africa.

There is limited research on the impact of health promotion interventions for educators in the school setting, and those that are available more commonly occur in high-income countries. An example of an intervention include one that targeted educators in a district-wide, worksite wellness programme demonstrated not only improvements in fitness and cardiovascular disease risk factors, but had on average 1.25 fewer days of absenteeism, when compared to controls[173]. In another small-scale quasi-experimental study, conducted in 3 schools, in Ontario Canada, educators underwent an Aerobics Personalized Wellness Process for a 10-week period, which incorporated an individualised counselling session, a weekly educational session, five evening sessions with spouses, and a weekly supervised physical activity session, modest changes in energy expenditure were observed. Although no significant changes in muscle strength and body fat were reported, individuals showed significant improvements in their knowledge of the health benefits of fitness[182]. Perhaps of even greater importance were the psychosocial benefits: general well-being, job satisfaction and self-concept all showed significant improvements. Educators also scored higher on ratings of stress management and job-performance by their principals and upon self-scoring[182].

Table 1-1 NCD risk prevalence among the general, employed SA population and SA educators

	General SA population[114]	*SA employed population*[155]	*SA educators*
% overweight and obese[a]	30%	31.5%	53.6% obese[183]; 31% overweight[168]
% hypertensive[b]	10.2% males; 11.8% females	12%	22.1%[177]
% not meeting PA guidelines[c]	67%	>60%	48.7%[181]
Fruit and vegetables servings/day	2.8 ± 1.6	2.7 ± 1.7	No data available
% smokers	20.8%	20%	18%[183]

[a]BMI ≥ 25 Kg/m2; [b]systolic BP≥140mmHg or diastolic BP ≥90mmHg; [c]≥ 150 minutes per week

1.3. SCREENING FOR NCD RISK FACTORS

There is robust evidence to show that population-based targeting of risk factors with effective behaviour change strategies can help in the prevention and control of NCDs[42,184,185]. Wellness days can form the basis of brief interventions by providing customised feedback to individuals[186], and the results may also be used to identify aggregate worker needs[187]. Health screening programmes, including wellness days, have been in the focus of research in recent years as a means to promote health and improve productivity among employees[188]. Many health screening programmes have been shown to offer benefits such as reduced sickness[189,190], reduced medical costs[189,191], improved productivity[192], happier, healthier and more loyal employees[193] and lowered disease prevalence[194,195]. Most of the findings however have been reported from high-income countries. Furthermore, there is a scarcity of literature reporting on health screening programmes targeting educators, and in particular, from LMICs. The World Economic Forum highlights the need for additional research, particularly in LMICs[196].

Identifying individuals at risk and assisting them to improve their lifestyle behaviour is an important strategy to prevent NCDs[197]. Moreover early identification through screening programmes offers important opportunities for preventing NCD morbidity and mortality[153]. Health screening, primarily through wellness days, aims to improve health by detecting risk factors or early identification of disease[198]. Wellness days typically include a health risk assessment (HRA), clinical measures such as random glucose, serum cholesterol, height, body mass and waist circumference[199]. Risk factor screening is often accompanied by lifestyle advice which aims to encourage participants to improve their health behaviour[198].

Wellness days have traditionally been one of the most common worksite health promotion programmes in the United States, implemented in at least 72% of large companies (>750 employees)[200]. Although wellness days are scalable and relatively easy to administer, there has been substantial underutilisation by employees of existing programmes[154]. Barriers include time pressures caused by the need for face-to-face clinical setting attendance[201], lack of motivation[202,203], unfavourable work schedules[203], and individuals already feeling healthy[204]. Several studies have also shown a substantial mismatch between actual and perceived health risk, where individuals tend to overestimate their health status which is partly caused by insufficient knowledge[205,206].

Although wellness days have been widely implemented and some studies have shown lowered disease prevalence[194,195], significant changes in health status or lifestyle behaviours following a wellness day have been mixed. Alageel *et al.*, reported reductions in blood pressure, total cholesterol and smoking. Alcohol consumption, physical activity and dietary behaviours showed improvement while waist to hip ratio and BMI measurements increased in the 119,631 participants over a 20-year period using data from the Health Survey for England[207]. Prior *et al.,* found significant improvements in the percent of individuals who were overweight and obese following a wellness day[208]. However other studies found small non-significant reductions in BMI[209-211]. Increased physical activity levels[186,212-214] and fruit and vegetable intake[215,216] have also been reported in the literature. Cook *et al.,* found no significant changes in stress levels following a wellness day[217], whereas Ozminkowski *et al.,* found that employees who participated in the wellness day were better able to manage their stress[218]. In the review by Soler *et al.,* there was insufficient evidence to show improvements in body composition, physical activity habits and fruit and vegetable intake following a workplace wellness day[186], while other studies[154,196,219] have reported that a wellness day is an effective entry-into-care intervention, as it has the ability to create awareness of risk factors and highlight behaviours which should be improved. In some studies, this increased awareness has been shown to result in improvements in health risk status[220].

Wellness days may also present people with opportunities to set goals and assist them to overcome barriers[219]. According to Pai *et al.*, the improvements in health status following a wellness day may be a consequence of the feedback received, highlighting areas for improvement and suggested next steps[219]. Another possible explanation is that participation in a wellness day is based largely on individuals volunteering to complete the assessments, and therefore may over-represent the proportion of participants who comprise the 'worried well' and who are more interested or concerned about their health status[196]. Improvements in health following wellness day screening have also been attributed to individuals feeling cared for and supported and therefore appreciate communication around their health issues[196]. Lastly, Pai *et al.*, reported that the frequency of wellness day participation has an effect on health outcomes. Individuals who attended more than one wellness day per year had significantly fewer risk factors at follow up than at baseline[219]. McGlynn *et al.*, argued that one reason for the inconsistence changes in behaviours following a HRA is that effective behaviour change takes time as new habits need to be formed and once-off wellness days are not able to offer this. They showed that individuals who participated in a wellness day and received personal counselling about the results showed reduced risks by 30 percent more than those who only completed the wellness day and received written feedback[221].

1.3.1 COMMUNICATION FOR BEHAVIOUR CHANGE

A. Behaviour change theories

The task of health behaviour and health education is both to understand health behaviour and to transform knowledge about behaviour into effective strategies for health enhancement[222]. According to Michie *et al.*, health behaviours are complex, and decisions concerning health behaviours are influenced by both intra- and inter-personal, as well as socio-environmental factors[223]. While it may be assumed that individuals would choose healthy behaviours to benefit them in the long-term, research has shown this not to be the case[224,225]. Decisions are often based on a range of other psychological motivators which include immediate gratification and hyperbolic discounting where individuals underestimate and discount the risk of future negative states (such as poor health, disease and poor finances) in favour of the often more pleasurable short-term rewards[224].

Health communication strategies use different approaches to inform and influence decisions which would improve health[226]. They also recognise the importance of carefully planning theory-based interventions[227]. Theory provides a helpful basis for designing interventions to change behaviour, but offers little guidance on the implementation process[228]. In order to merge the theory and methods of implementation, (i) health problems need to be identified, (ii) related behavioural risk factors need to be highlighted, (iii) the causes of these risk behaviours need be translated into intervention goals, and finally, (iv) change strategies and methods need to be integrated in a comprehensive intervention package[229].

The design of interventions that yield desirable changes can best be achieved when there is an understanding of theories of behaviour change and an ability to use them skilfully in research and practice[222]. Behaviour change communication is used to provide messages and a supportive environment that persuades individuals and communities to make positive health behaviour changes[230]. As stated earlier, wellness days have been used to identify health issues, the feedback and customised communication gives participants advice on how to manage their risk factors and behaviours. A common thread reported in the literature revolves around effective health communication and how can relevant, interesting and informative messages can be created and delivered to the public, which have the greatest chance of being persuasive and lead to action[231].

Health behaviours such as physical activity or healthy eating are complex, and are influenced by both intra- and interpersonal as well as socio-environmental factors[232]. Theoretical approaches to behaviour change may emphasise the perceived outcomes, including the benefits (health belief theory) and outcome expectations (social cognitive theory and theory of planned behaviour) and/or the individual's perceived control over the behaviour (self-efficacy and perceived behavioural control theory of planned behaviour), as well as social influences (ecological model, social cognitive theory, etc.)[233].

Interventions often use several different behaviour change techniques ranging from providing information (for example, about the consequences of behaviour) to promoting the setting of specific goals and providing opportunities for social comparison[234]. Theory-based models are designed to understand the cognitive psychology of a person within the context of that person's social environment as well as other constructs such as motivation and intentions[235]. Two behaviour change theories which have been used in health interventions and reviewed extensively are presented below.

i *theory of planned behaviour*

The Theory of Planned Behaviour (TPB) was developed by Ajzen and Fishbein in 1980[236]. The TPB is a widely applied socio-cognitive model of the attitude–behaviour relationship, assuming that most conscious behaviours is rational and goal directed[237]. The TPB proposes a causal link between attitudes and behaviour mediated by behavioural intentions. This theory assumes that human social behaviour is reasoned, controlled or planned in the sense that it takes into account the likely consequences of the considered behaviour[238]. The underlying model has been applied for the prediction of many types of human behaviours. The TPB has been cited frequently[239] and widely adopted to explain health-related behaviour such as exercise[240], food choice[241], family meal frequency[242] and fruit and vegetable intake[243]. It provides a useful framework to analyse how educators'' healthy behaviour choices are influenced by tailored messages. The central factor of the TPB is the individual's intention to perform a given behaviour[238].

The main assumption of this theory is that intention is the result of three conceptual determinants. The first determinant is the individual's attitude toward the behaviour. This relates to the degree to which an individual has a favourable or unfavourable evaluation or appraisal of the behaviour in question[238]. When new issues arise requiring an evaluative response, people can draw on relevant information (beliefs) stored in memories. Because each of these beliefs carries evaluative implications, attitudes are automatically formed. This factor encompasses the notion of perceived desirability (or lack thereof)[238]. The second determinant is an individual's subjective norms. This relates to the perceived social pressures in individuals feels to perform or not perform a particular behaviour [236]. It relies on an individual's perception of other people's opinions of the proposed behaviour. These perceptions are influenced by normative beliefs and are of less relevance for individuals with a strong internal locus of control than for those with a strong action orientation[244]. The third determinant is based on an individual's perceived ease or difficulty of performing a behavioural[236]. This relates to perceptions of the behaviour's feasibility, which are an essential predictor of the behaviour[238]. Individuals usually elect to adopt behaviours they think they will be able to control and master.

The three factors identified above are the antecedents of intention and therefore will influence future behaviours[245]. The underlying basis of intention and the determinants of behaviour are perceptions, which are developed gradually from beliefs. Attitudes and self-efficacy have been found to be the strongest predictors of intentions[246]. Intention directly influences behaviour and is shaped by attitudes, subjective norms and perceived behavioural control regarding the behaviour. Empirical validations of the TPB have revealed that the model reliably explains 40–50% of the variance in intention and that intention explains between 20 and 40% of the variance in actual behaviour[247,248].

ii Transtheoretical model

A key premise of behaviour change is that prior to making any behavioural changes, there needs to be awareness that behaviour needs to change[249]. The Transtheoretical model (TTM) describes people being in various stages of readiness to change. The likelihood of engaging in a particular behaviour will therefore depend on the readiness stage an individual is currently in[250]. Stages of change are typically measured in six month periods[222]. The first stage of this model, the *pre-contemplation stage*, occurs when an individual has either no awareness of the health behaviour or no intention to change the behaviour[250]. It is also possible that an individual may be aware of the health issue, but may be demoralised from previous failed attempts to change, and therefore will have no interest in making any changes over the next six months[222]. The second or *contemplation stage*, is characterised by individuals becoming aware of the health problem and are seriously considering to make a change in the next few months but have not made a commitemnt to do so[251]. In the third stage, the *preparation stage*, individuals have realised that change is necessary. Individuals are likely to start creating a plan or have taken some small steps towards action[251]. In the fourth or *action* phase, individuals have successfully taken a specific action and have made the behaviour change for less than six months[251]. The final *maintenance phase*, occurs once the behaviour has taken place for at least six months[251]. Rather than bing linear, the stages are cyclical. Most people "recycle" to previous stages several times before successful behavior change is achieved[251]. The TTM argues that people who are in different stages of change, require different interventions and need to be communicated to differently[252]. As it may not always be possible to accurately identify which stage of change a person is in, using approparite health communication messaging may be challenging[252]. Furthermore, movement through these stages is not linear and people may move back and forth through the stages until the new behaviour is established.

iii Integrating the TPB with TTM for behaviour change interventions

The TPB and TTM share many conceptual similarities but the TPB may be a more comprehensive and sophisticated model for explaining why people change their health behaviours. Specifically, the pros and cons from the TTM are comparable to the behavioural beliefs of the TPB[253]. In the TTM, however, the pros and cons are not weighted in an expectancy-value formula, as they are in the TPB, but rather are operationalized only in terms of value[253]. Moreover, the TPB includes a global assessment of attitude that is theorised to capture and summarise all the individual beliefs (i.e. pros and cons) that are held regarding a behaviour. Attitude is arguably the most fundamental construct in social psychology and is a strong determinant of behaviour[237], including physical activity[254](Godin & Kok, 1996).

The TPB also includes an assessment of social influence (i.e. normative beliefs and subjective norm) which is neglected by the TTM[253]. Finally, the TPB includes intention strength (i.e. commitment) as the immediate determinant of behaviour change which is perhaps the best summary measure of motivation and probably an important precursor to all stage changes[253].

Research has shown support for the integration of the TPB with the processes and stages of change in the exercise domain. The evidence suggested that the TPB performs well in mediating the relationship between the processes and stages of change[253,255-257]

Although TPB was the primary theory guiding the design of the tailored letters and SMS advice messages, educators were also asked to identify their readiness to change physical activity patters, eating and smoking habits and stress levels. Educators' stages of change were also considered when selecting the appropriate messages for the tailored letters and SMS advice messages.

1.3.2 CUSTOMISATION OF COMMUNICATION

The customisation of health messages can be viewed on a continuum (Figure 1-1). Messaging has traditionally been grouped into five distinct categories: (i) generic or mass communication, (ii) personalised generic communication, (iii) targeted communication in which separate audience segments (often demographic categories) benefit from a shared message, (iv) tailored communication that produces a message matched to the needs and preferences of individuals, and (v) interpersonal communication[258].

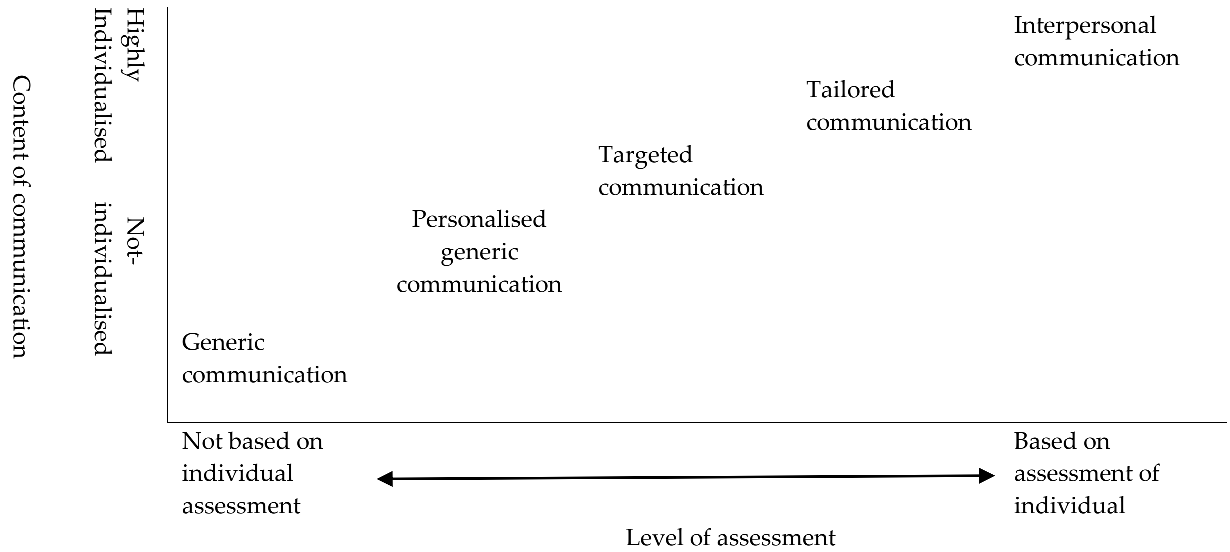

Figure 1-1 Classification of level of five approaches to health personalisation communication by level of assessment and nature of content. (Source: Kreuter et al.[259]).

A. Generic communication

The most generic communication has been defined as communication that is not individualised or based on any kind of individual assessment. Generic or mass communication uses relatively large, undifferentiated, identical messages[258]. Health communication materials commonly consist of a single, generalised body of information in the form of brochures, booklets, or pamphlets designed for the general population or for some demographic subgroup.

The main strength of generic materials is their breadth of coverage of general information which is also their greatest weakness. These materials are typically created for general populations and therefore do not consider specific characteristics of prospective consumers[260]. Generic educational materials however, do not assume that all people have the same informational needs; rather individuals can and will sift through the parts of the material that do not apply to them and find and consume the relevant information[260].

B. Personalised generic communication

Personalised generic communication is very similar to generic communication, except that it uses a characteristic, such as a person's name, to personalise the message[261,262]. Superficially personalised materials are frequently used in mass mailings so that even a low percentage of return might generate a profit[263]. A newsletter from a doctor's office might be described as personalised generic communication[260].

C. Targeted communication

Targeted communication refers to messages that are developed with a certain segment of the population in mind[258]. The practice of message targeting is one that has been widely applied in health education and health communication[258]. The content and presentation of targeted information is guided by an understanding of the unique needs and concerns of the population's members[258]. This is an incremental advance over the generic one-size-fits-all approach. There is some evidence that such materials can encourage an individual to change or improve their lifestyle behaviour[264,265]. As certain health problems disproportionately affect specific population groups, there is a sound public health rationale for using a targeted approach. Its appropriateness as a mass communication strategy is unclear though[265].

Implicit in the use of targeted communication is the assumption that sufficient homogeneity exists among members of a demographically-defined group to justify using one common approach to communicate with all its members[265]. This assumption has however been largely unfounded for some population groups[266]. Although both targeted and personalised communication is based on factors that are unique to individuals (e.g. age, race, name), these factors alone provide little information about the many cognitive and behavioural mediating mechanisms hypothesised to influence individuals' health-related decision-making and actions[265]. Without this information, it is difficult to create truly individualised strategies to address complex lifestyle behaviours[265]. This practice was adapted from the age-old practice in advertising where customers were divided into market segments and sent communications[258].

D. Tailored communication

Tailored messaging, on the other hand, is a process that 'fits' the message to the particular individual. 'Tailoring' means creating a communication which is intended to reach one specific person[263]. It is based on characteristics that are unique to a particular person, is related to the outcome of interest, and has been derived from an individual assessment[263]. This definition highlights the two features that distinguish tailored communication from other commonly used approaches: (i) it is assessment-based meaning that the needs of the particular individual are assessed and understood and (ii) its messages are individually-focused[263]. In general, as the level of assessment increases, so does the degree of individualisation in the communication content[263]. As tailored interventions are more intensive, complex and costly, there is an assumption that they will be more efficacious and show greater changes in health risks. However, an optimal model for tailoring has not as yet been established[266]. Some components of tailoring may actually be less efficacious. There are therefore complex trade-offs between reach, efficacy, and cost-effectiveness[267].

E. Interpersonal communication

Interpersonal communication is the most individualised form of communication and has been used in a variety of health education interventions (e.g. brief counselling interventions)[268]. For example, health care organisations can send individually tailored information to patients who can, at their own '24/7' convenience, read, respond, ask questions, request services, and even transmit their views and advice to virtual communities[268]. Face to face communication has also received attention. Results of the meta-analysis reported by Wanyonyi *et al*.[269] showed an overall positive effect on health behaviour change using a tailored messaging approach with face to face counselling for smoking cessation[270], diet changes[271], weight loss[272], diabetes self-management[273], alcohol intake reduction[274], and mammography screening[275]. Two of the studies however, only achieved borderline positive effects[270,272]. Motivational Interviewing was the most frequently adopted technique in the studies[271,273,274]. These findings are consistent with other studies that have reviewed tailored messages and face to face counselling with regard to smoking cessation and physical activity[276,277].

1.3.3 EVIDENCE FOR THE EFFECTIVENESS OF TAILORED INTERVENTIONS FOR HEALTH BEHAVIOUR CHANGE

A growing area of research has focused on the incorporation of tailored messages as a mode of delivery to allow for individualised behaviour change interventions[278,279]. Because interventions do not apply to all populations and circumstances in the same way, it has been suggested that tailoring the intervention content and offering personal behavioural and action feedback may increase the effectiveness of such programmes in comparison to generic interventions[263]. Specific tailored feedback for individuals based on their perceptions about a given behaviour may be similar to feedback provided in face-to-face interactions and thus hold a higher personal relevance for the participant[280,281]. In addition, compared to face-to-face interventions, tailored interventions are easily accessible when delivered via the Internet and provide a cost-effective means to reach a wide population[278,279].

Conducting assessments and providing individualised tailored feedback is not new, nor is its use unique to health communication[265]. This technique has been commonly employed by successful real estate agents, physicians, educators, brokers, and sales people, all of whom identify a client's needs through observation and inquiry and use that information to customise solutions[263]. In health education, individual counselling for behaviour modification such as improved nutrition, increased physical activity, and smoking cessation is also typically based on this approach[265]. The face-to-face contact, interactivity, and immediacy of feedback that can be provided makes this approach more desirable than a computer-tailored print communication programme[265]. The impact of counselling on the health of populations is however limited by cost and by the relatively limited number of individuals who can be reached by a small number of trained professionals. A skilled counsellor can do everything a tailored message programme can do except be available at all times to simultaneously serve multiple and diverse members of mass populations[263].

A primary reason for the explosion in tailored health communication literature is the potential to achieve both high reach and high efficacy[282]. Traditionally, health communication initiatives managed to achieve only one of these goals[282]. Mass media campaigns for example, reach large segments of the population (i.e. high reach), but traditionally have achieved low efficacy[282]. Interpersonal health communications (e.g. clinic-based smoking cessation programmes and telephone quit lines) on the other hand, have been able to achieve high efficacy but their reach has tended to be low[282]. Recent reviews [283-285] have concluded that such interventions are generally efficacious across a broad range of health behaviours. The rationale for using tailored communication can be summarised as a five-part logic sequence: (i) superfluous information is eliminated, (ii) the information that remains is more personally relevant to the recipient, (iii) people pay more attention to information they perceive to be personally relevant, (iv) information that is attended to is more likely to have an effect compared to information which is not, and (v) when attended to, information that addresses the unique needs of an individual will be useful in helping them become and stay motivated, acquire new skills, and enact and sustain desired lifestyle changes[286].

Kreuter *et al.*, argue that tailored health communication would elicit the following responses when compared with generic communication: (i) greater attention, (ii) greater comprehension, (iii) greater likelihood of discussion of the content with others, (iv) greater change in cognitive behavioural mediating constructs addressed by the content, and (v) greater likelihood of behaviour change[265]. Further, several well-designed randomised studies have reported that tailored health communication is more likely to be read and remembered[287,288], saved[265], discussed with others[288,289], and be perceived by readers as interesting[290], personally relevant[291] and having been written especially for them[265,288] when compared with generic messages.

One theory as to why tailored communication is more effective in persuading individuals to change their health behaviours compared to more generic messages is provided by the likelihood model[292]. This model suggests that individuals engage in two types of processing of messages: central and peripheral route processing. Central route processing is characterised by a careful examination of the arguments contained within a message. Peripheral route processing, on the other hand, is characterised by a reliance on cues that may be persuasive (in the short term) but tend to be unrelated to the core arguments contained within a message. Central route processing results in attitudes which are more likely to remain stable over time and to be related to future behaviours as compared with peripheral route processing. The model suggests that the extent to which individuals are motivated to 'elaborate' with regard to a message and engage in central processing is heavily influenced by personal involvement with a message. Tailored messages have the advantage of being customised to individuals. As this increases the likelihood that the message will be viewed as personally relevant, central processing will take place, and an individual will be persuaded[292]. This theoretical explanation is consistent with reviews of the literature that demonstrate that tailored messages are more likely to be read, understood, recalled, rated highly, and perceived as credible[266], as well as with empirical studies that show greater impact of health education materials that are perceived as a better 'fit' by participants[265].

Interventions that use tailored printed materials as the primary method of communication were often based on behaviour change theories (BCT) that predict behaviour change[222]. The poor description of BCT in many research protocol interventions presents a barrier to replication. A well-specified and described intervention is essential before evaluation of effectiveness is worth undertaking. An under-specified intervention cannot be delivered with fidelity and, if evaluated, could not be replicated effectively[223]. "Behaviour change theories are observable, replicable, and irreducible components of an intervention designed to alter or redirect causal processes that regulate behaviour"[223]. The most widely used BCT across all health behaviours (smoking cessation, physical activity and healthy eating) was the Transtheoretical (stages of change) Model[293-297]. This model focusses on a participant's readiness to change a particular behaviour[250]. The social-cognitive theory's emphasis on social influence and its emphasis on external and internal social reinforcement[298] has also been used widely in behaviour change interventions[293,296,297]. Other theories cited include the theory of planned behaviour where an individual's attitudes, subjective norms as well their perceived control over the behaviour will determine whether behaviour change will occur[299] and the theory of self-efficacy where behaviour change is determined by one's confidence in their ability to take action[289,300].

A number of systematic reviews and meta-analyses have provided evidence to suggest that tailored interventions are moderately more effective than non-tailored interventions[260,263,283,301,302]. In a systematic review of tailored interventions for smoking, there was evidence that print-based tailored self-help materials were more effective at achieving abstinence at 6 months follow-up than no materials and non-tailored materials (RR 1.28; 95% CI=[1.18, 1.37])[301]. In a review of tailored print interventions for physical activity, seven out of 12 studies reported significant positive changes in physical activity between three and 18 months post-intervention[303].

A meta-analysis of six randomised controlled trials pooled data from studies where tailored information delivered face-to-face was compared with either usual care, generic health promotion, or tailored print materials[269]. The meta-analysis showed an overall positive effect on health behaviour (diet/physical activity, diabetes self-management, alcohol abuse, smoking cessation) using face-to-face delivery of tailored information (pooled standardised mean difference= 0.487; 95% CI=[0.02, 0.96], p=0.04). Only two of the studies however included 'specific accounts' of how theory translated to action[270,271]. This is also the case across many other health domains. For example, in the smoking cessation literature (an area of health behaviour change research that is in many other aspects well-developed), Yuan *et al.*, (2012) found a noticeable gap in the literature regarding strategies and effectiveness of tailored face-to-face tobacco cessation interventions[304].

1.3.4 TAILORED PRINTED COMMUNICATION TO COMBAT NCDS

This following sections focus on tailored print communication and SMS messages to combat NCDs as they were the forms of delivery for this intervention. Section 1.4.5 reviews newer mHealth technologies.

A. Smoking cessation

Tailored communication focusing on interventions for smoking cessation have been applied to a variety of populations, including adolescents[305], young adults[306], and older adults[265,307]. A small number of studies focused on very specific target populations, such as parents of children with asthma[308], African American smokers[309], and smokers with low intention to quit[310,311].

The vast majority of tailored messages for smoking cessation used print materials, often in combination with other intervention components such as telephone counselling[312], physician advice[270] or nicotine therapy[313]. A small number of studies have tested interpersonal counselling as the sole tailoring delivery channel. These studies were typically conducted in combination with nicotine replacement therapy[314,315]. Standard, print-based self-help materials increased quit rates compared to no intervention, but the effect was generally small[316]. There is no evidence that tailored letters have an additional benefit when used alongside other interventions such as advice from a healthcare professionals[270] or nicotine replacement therapy[317].

A review of 10 tailored programmes found the majority to be effective in smoking cessation[318]. A review of 60 self-help smoking cessation trials found only significant effects among those that tailored the content to the specific individuals[319]. In a meta-analysis of 57 print tailoring studies[301], smoking cessation and healthy eating interventions, in particular, had significantly larger effects than tailoring interventions for physical activity[301].

Finally, evidence exists that tailored smoking cessation programmes tend to be efficacious. Te Poel *et al.*,[320] Etter[321] and Strecher *et al.*,[322] found web-delivered tailored smoking cessation interventions in combination with nicotine replacement therapy to have positive effects compared with web-delivered generic interventions. Cobb *et al.*,[323] reported that sustained use of a smoking cessation website with tailored content had positive effects on abstinence rates but used no comparison group. Lenert *et al.*,[299] found short-term beneficial effects of a web-based intervention that included individually timed e-mail messages compared with a single-point-in-time web-based intervention.

B. Healthy eating

Tailored interventions focusing on diet-modification overwhelmingly targeted increased fruit and vegetable consumption[324] or fat intake reduction[325]. Selected studies also investigated fibre intake[326], meat consumption[327] or sugar-sweetened beverages[328].

Tailored interventions for improving dietary behaviours have also been diverse. In addition to recruiting from the general adult population[329], studies have targeted specific groups such as African American churchgoers[330] and Latino women[326], callers to the Cancer Information Service[331], patient groups[332], Health Maintenance Organisation clients[333], and young adults[334]. The tailored diet intervention literature also involved adolescents more than any of the other areas of study, and it uniquely acknowledged that eating behaviours do not occur in a vacuum, by also incorporating a focus on families in addition to individuals[335].

As with smoking cessation interventions, evidence exists that tailored dietary change programmes tend to be efficacious. A review of 8 web-based tailored nutrition programmes found nearly every study to be efficacious in changing dietary behaviours (the most consistent effects were on reducing fat intake)[336]. In a review of 26 studies of computer-tailored programmes, 77% showed significant improvements[337].

C. Physical activity

In contrast to smoking and healthy eating interventions where additional components were typically tested alongside the tailored print materials, many physical activity studies have tested print materials on their own[338-341]. Participants have typically been provided with print materials such as newsletters[342], tip sheets[343], or letters[344]. Physical activity interventions almost exclusively focused on the adult population. Only one study targeted adolescents[345]. Besides this one study, samples included either the general adult population[346] or specific populations, such as women[347,348], diabetics[349] or patients from health clinics[350].

Evidence for the efficacy of tailored physical activity programmes is more modest and less consistent than that for smoking cessation or healthy eating programmes. A review of 11 studies found only 27% to have significant improvements in weekly physical activity as a result of tailoring[337]. The meta-analysis by Noar *et al.*, failed to find a significant effect of tailored messages on weekly physical activity habits[301]. A possible reason for the lack of significant effect could be due to the heterogeneity of the interventions. In addition, studies reporting subjective physical activity levels have been shown to be highly susceptible to bias through social desirability[351] and have been shown to correlate poorly with accelerometer-measured objective physical activity[352-354]. Several published studies have however shown significant improvements in physical activity habits due to tailored messages[293,348,355-357].

D. Multiple Behaviours

Studies investigating multiple behaviours have received more attention over the past number of years compared with interventions focussing on single behaviours[260,358,359]. Interventions that target two or more health behaviours have been identified as a strategic priority in some governments as they could potentially increase health benefits and reduce healthcare costs[360].

Multiple behaviour change interventions have focused on print materials, either on their own[361,362] or in combination with telephone counselling[363], physician advice[364], video intervention[365] or multiple additional components[366]. Only a limited number of studies used interpersonal channels[272] for intervention delivery. Similar to other areas in tailoring, the most recent studies have made use of the Internet for the delivery of tailored interventions, testing tailored websites[290,367] or email counselling[368]. Approximately half of the studies focused only on diet and physical activity[358]. The remaining studies tended to focus on diet and or physical activity and smoking[290], depression/quality of life[369], sleep[370], vitamin intake[371] or multiple additional behaviours[372]. As with single behaviour interventions, the Transtheoretical Model[260,361] and Social-Cognitive Theory[260,369] were used most often to inform tailored multiple behaviour interventions. These theoretical perspectives accounted for approximately half of multiple behaviour change studies.

Most reported studies focused on the general adult population. Some of the more specific adult populations included minority populations[365,366,371], at-risk women[272,373], primary care patients[364,369] and cancer survivors[374,375]. The review by Kroeze *et al.*, included tailoring programmes that attempted to change both diet and physical activity[337]. They concluded that while too few studies existed to make firm conclusions at that time, those studies targeting multiple behaviours did not have a reduced chance of significant behavioural effects[337]. Later reviews however appeared to indicate that there is clearly reason for optimism, as many of the studies showed an impact on multiple health behaviours targeted by the intervention[260,358].

Two studies compared multiple and single risk behaviour interventions[376,377]. One study[376] compared an intervention targeting two behaviours (smoking and diet) with an intervention targeting smoking cessation. No statistically significant differences were found between groups for either smoking or dietary behaviours. Another study compared four groups: a physical activity only group, a fruit and vegetable intake only group, a combined physical activity and fruit and vegetable intake group and a non-intervention control group[377]. The diet-only intervention was effective in increasing fruit and vegetable intake. There was also supportive evidence for the physical activity intervention improving physical activity. The findings were however inconclusive (as it was a relatively small study) whether the combined intervention improved either fruit and vegetable intake or physical activity.

The meta analysis by Meader *et al.*, included 69 randomised controlled trials with a total of 73 873 participants[378]. Diet and physical activity were most frequently targeted and interventions consisted mainly of education combined with skills training. All 69 trials examined the simultaneous change of behaviours. Three[284,379,380] compared simultaneous with sequential change. Overall, small improvements in diet (e.g., fruit and vegetable, fat, and calorie intake); physical activity; and smoking were found, but effects diminished over time for fruit and vegetable intake.

Reductions in smoking were associated with improvements in fruit and vegetable intake and physical activity. This is consistent with the finding that interventions that targeted smoking and other risk behaviour sequentially are more effective than those that seek simultaneous change[284]. By contrast, no statistically significant differences were found in the three studies that compared sequential and simultaneous change of diet and physical activity[284,379,380]. Appendix M summarises the studies listed above.

A meta-analysis of randomised controlled studies reported on a range of potential moderators of effectiveness: intervention characteristics (e.g., follow-up time, intervention characteristics [content], sequential or simultaneous targeting of risk behaviours); contextual factors (e.g., setting, geographic location, significant external events occurring at time of intervention); and participant characteristics (e.g., ethnicity, income). Length of follow-up was a statistically significant predictor for meeting recommendations for fruit and vegetable intake. Longer follow-up was associated with reduced effectiveness compared with post-intervention follow-up (<6-month follow-up: slope=1.68, 95% CI=1.31, 2.17, p=0.002); 6 to 12–month follow-up: slope=1.54, 95% CI=1.26, 1.97, p=0.005). Length of follow-up was not associated with any other outcome[378].

The systematic review comparing the efficacy of simultaneous (impacting on multiple health behaviours concurrently) versus sequential (focussing on one health behaviour at a time) multiple health behaviour change interventions[359] found that compared to a usual care/control conditions, both simultaneous and sequential interventions appeared to be efficacious in changing multiple health behaviours. Simultaneous or sequential delivery did not impact retention rates. The precise mechanisms underlying the benefits of sequential versus simultaneous treatment of addictive behaviours are still unclear. Although intervening simultaneously on three or more behaviours may be more time and cost effective[381], caution needs to be applied as it could result in information overload to the participants which could result in premature drop out of the intervention programme.[359,382]. Further, simultaneous interventions may not address any behaviour in sufficient depth resulting in reduced effects[359]. Sequential interventions may negate the above limitations and result in stronger habits[359]. Proponents of sequential interventions argue that successfully changing a behaviour would result in greater self-efficacy to tackle another behaviour[383]. Sequential programmes often require longer intervention time periods resulting in greater costs and reduced adherence[359].

All the systematic reviews were based on studies from high-income counties, specifically North America and Europe. The data may therefore not necessarily apply to interventions in LMICs. Furthermore, the studies were either randomised controlled trials, controlled trials, or before-and-after studies with a control group. There was limited 'process' information regarding intervention implementation reported in the individual studies and, consequently, the systematic reviews. This greatly limits any conclusions about how the tailored elements are delivered in effective interventions.

1.3.5 MOBILE HEALTH (mHEALTH) TO COMBAT NCDs

Mobile health (mHealth) technologies, including the Internet, mobile devices, and smartphone applications (apps), provide opportunities for population wide promotion of healthy behaviours[384,385]. Precise definitions of mHealth vary because they are applied in differing contexts and because of the ongoing development and advancements of information technologies that lead to new applications for mHealth[386]. However, for the purpose of this thesis mHealth, is defined as ''medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices (e.g., heart rate monitors), personal digital assistants (PDAs), and other wireless devices''[2].

A. Review of tailored SMS-text messaging for lifestyle behaviours

Mobile phones have been shown to be an effective strategy that may facilitate and support individuals' health goals[201,387]. In recent years, a number of randomised clinical trials have shown the effectiveness of mobile phone text message-based interventions to promote smoking cessation[388-390], weight loss[391-393], physical activity[339,394], glycaemic control in diabetes[395,396] and blood pressure management[397]. Although strong evidence supports the value of integrating SMS-message interventions into public health practice, additional research is still needed to establish long-term intervention effects, identify recommended intervention frequency, duration or intensity, the effect of prior interventions on the target behaviour, the current context of the individual (time, location, social environment, psychophysiological state, etc.) and explore issues of cost-effectiveness[398]. In addition, there is very little evidence concerning the use of and effectiveness of mobile phone interventions used to address multiple risk factors[399].

Compared to interventions delivered to desktop and laptop computers via the internet, SMS or text-based interventions have the capacity to interact with an individual with much greater frequency and in the context of the behaviour[398]. The use of text messaging in health interventions is, however, a relatively new practice. The first formal evaluation of a health intervention using SMS messaging only, appeared in 2002[400]. The first randomised controlled trial of a health promotion intervention which focused on smoking cessation appeared three years later[401]. Fjeldsoe *et al.*, list four purposes for which text messaging have been used: (i) to enhance health service provision, (ii) to send mass health education messages, (iii) to assist and encourage better disease self-management practices, and (iv) to deliver personalised health promotion interventions[402]. Text messages have the potential to provide information alone (informational), or to provide two-way communication (interactive, adaptive, or just in time message)[387].

Mobile-phone-based SMS-text interventions have been used to address individual-level factors in health by providing timely access to relevant information. They also provide support through context-specific tips and prompts to action[201]. The review by Stephens and Allen[403] highlighted that text-messaging interventions are effective only when supported by other methods or are incorporated into already existing programmes. They found no evidence to suggest that text messages as a standalone intervention are effective[403]. The meta-analysis by Head *at al.*, however, found that there were no significant differences between SMS text-only interventions and interventions that included texting plus other components. They also found smoking cessation and physical activity interventions to be more successful compared to interventions targeting other health behaviours[358]. Tailoring the messages was associated with significantly greater intervention efficacy[358].

Riley *et al.*,[398] reviewed studies of health behaviour interventions delivered via SMS using behaviour change theories. They exposed a paucity of discussion and analysis regarding the health behaviour theories that provided the basis of the interventions. Even among those studies that cited a theoretical basis, very few attempted to evaluate any of the theoretical components hypothesised to be affected by the intervention[398]. Studies in the smoking and weight loss areas tended to draw predominately from the Social Cognitive Theory or its variants (e.g., self-efficacy)[393,404]. As interventions become deliverable on mobile devices, the content of interventions should be adapted for each individual, not only initially but also over time, based on their prior outcome data, prior responses to specific intervention outputs, current environmental and/or social context and a range of other variables that might influence the optimal intervention[405].

B. Review of SMS-text messaging in LMICs

South Africa has seen the emergence of a relatively sophisticated information and communication technology sector during the last two decades of telecommunications. There are currently two national fixed-line operators (Telkom and Neotel), five mobile operators (Vodacom, MTN, Cell C, Telkom Mobile and mobile virtual network operator [MVNO] Virgin Mobile), and hundreds of internet service providers (ISPs) and value-added network service providers[406]. The total South African telecommunications market had grown from ZAR 131billion in 2007 to ZAR 179billion in 2010[407]. Mobile operators claims penetration rates of over 100%. Individual mobile phone ownership stands at 86% of the adult population (15 years or older). There are now few differences, in use of basic voice and SMS services, between mobile phone users in urban and rural areas, or between those at the top of the pyramid and those at the base of the pyramid[406]. Affordability appears to be a barrier to cell phone use. Gillward (2012) reported that 67% of individuals who do not own a mobile phone could afford one, and more than half (53%) of the people who do not own a mobile phone had used a mobile phone in the preceding three months – mostly the phones of other family members. About 24% of people without a mobile phone intend to get one within a year[406]. Income and education are also key determinants of access and use of information and communication technologies. As the technologies and services become more sophisticated and expensive, higher levels of income and education are prerequisites to access and operate them[408].

By mid-2016 South Africa had approximately 21-million Internet users[409]. This growth brings Internet penetration in South Africa to about 40%[410]. Of the 21-million

Internet users, 7-million access the Internet only through their mobile devices. The rest have access at work or use WiFi hotspots[411].

Despite the relatively high Internet usage, South Africa still lags behind the biggest Internet user bases in Africa: Nigeria with 45-million users and 29% penetration, Egypt's 21.6-million users and 26% penetration, Morocco's 15.6-million users and 49% penetration, and Kenya's 10.4-million users and 25% penetration[410]. The main reason for this is price. The rental charge for an Asymmetric digital subscriber line (ADSL) line comes on top of phone line rental at about US$10 a line[410]. Mobile consumers spend an average of US$8 a month in total on their phones. So the rental of lines (before making calls) is beyond the reach of many South Africans[410]. The relatively high penetration in South Africa provides a favourable platform for extensive broadband and Internet usage[412]. The recently expanded capacity of undersea cables connecting South Africa to the world has contributed towards providing improved international connectivity, greater speed and reduced costs[413]. Approximately 40% of the South African population use their mobile phones to access the internet[409]. While individuals in the lower SES need cheap internet access, individuals in the higher SES are looking for faster internet access[409]. Almost one-quarter of smartphone users do not access the internet through their mobile devices which may indicate that they cannot afford the cost of the data[409].

Although access to infrastructure is still largely limited to urban areas, mobile phone penetration is not[410]. In 2015, 90% of people living in LMICs owned a mobile phone and two thirds of the global Internet users were based in these countries[414]. In South Africa, there are 59,474,500 mobile phone users, which represents 117.6 connections per 100 citizens[415]. Perhaps the most interesting aspect of this technology is its omnipresence. Cell phones have become an integral part of our daily lives[358]. Most mobile phone owners (65%) report sleeping with their mobile phones either in or right next to their bed[416]. The huge penetration of mobile phone networks in various LMICs has even been found to exceed the development of basic services such as water, sewerage, roads, sanitation and electricity[22,417,418].

There is a paucity of literature relating to mHealth and NCDs in LMICs. Of the four recent systematic reviews, three specifically focussed on the use of mHealth interventions for the care and management of NCDs in sub-Saharan Africa[419] and in LMICs[420,421]. The other study reported more broadly on the use of mHealth interventions against NCDs in LMICs[417]. All four studies generally reported positive outcomes. However, all the authors also noted that there was insufficient evidence to support the scale-up of mHealth interventions because there were only five studies from sub-Saharan Africa countries[419] and only 16 studies from LMICs[417,420,421]. Mobile health interventions could be particularly effective in LMICs where mobile phones have high penetration rates[422] and a disproportionate burden of NCDs[22]. In fact, mHealth interventions could address individual-level factors in health by facilitating timely patient access to relevant health information and support, making patient-provider communication easier, and providing context-specific support and prompts to action[423]. Simple, low-cost, widely available automated SMS-text messages are designed to remind, encourage, and motivate individuals about healthy lifestyle choices[201]. The systematic review by Muller *et al.*[421] suggested that mHealth interventions can be effective in improving physical activity and diet quality in LMICs. Their review showed that 50% of the mHealth interventions were effective in increasing physical activity, and 70 % of the identified interventions were effective in improving diet quality. This result is consistent with the findings of the other systematic reviews. The study by Haricharan *et al.*, reported that SMS messages were effective in improving hypertension knowledge among deaf South Africans{Haricharan, 2017 #1826}. The small sample size and the fact that the study was conducted in a metropolitan area and used convenience sampling, may limit the generalisability of the study. Bobrow *et al.*, showed that support delivered via SMS text-messages could improve collection of medicines and may have a small impact on blood pressure as compared to usual care in a general outpatient population of adults with high blood pressure{Bobrow, 2016 #1184}

Print and SMS messages have also been combined to develop a range of health behaviour change interventions[387,389,424-427]. Through carefully developed algorithms, print-based tailored letters and SMS communication can be delivered to large groups of people at a relatively low cost making them a scalable, rapid and inexpensive way to communicate health risk status and support behaviour change in LMICs in general and specifically to the employed population[22]. Appendix N given more details of the studies mentioned above.

1.3.6 NEWER METHODS OF TAILORING FOR HEALTH BEHAVIOURS

A review and detailed discussion around newer mHealth technologies is beyond the scope of this study. A brief overview of a number of the newer mHealth methods are however described below.

A. Web 2.0 and social media

Web 2.0 technologies have significantly changed the health communication landscape in recent years[428]. There has been a shift in the online environment, from unidirectional and 'read-only' (whereby information is 'pushed' on passive audiences) to multidirectional communication characterised by participation, collaboration, and openness[268,429]. Websites with more dynamic, interactive, user-focused features, also referred to as second generation or Web 2.0 features, are now commonly used and include social networking, blogs, wikis, podcasts, and mash-ups[430]. Web 2.0 also provides users with the opportunity to directly generate, modify, and share information[431]. A review by Maher *et al,* however, indicated that the use of online social networks in behaviour change trials was only modestly effective[432]. In this context, it has been argued that randomized controlled trials may not the most appropriate research design to truly examine the effectiveness of Web 2.0 features[433]. Vandelanotte *et al.* compared the physical activity behaviour, engagement retention and usability of individuals using a traditional Web 1.0 physical activity website to those using an innovative Web 2.0 physical activity website in a real-world setting[430]. Results showed that those in the Web 2.0 group displayed significantly higher levels of physical activity at three months compared to those in the Web 1.0 group. In addition, BMI significantly decreased, engagement was significantly higher in website visits in the Web 2.0 group compared to the Web 1.0 group at three months[430].

Schools, especially from quintile two and three, have a limited number of computers which are accessed by all educators[434]. These computers are mainly used by educators to access the Internet to search for teaching material, it has been reported that educators, generally do not use these computers for personal use[434]. Although web based interventions are more prevalent than print-based interventions, the current study chose to use print-based materials as they are more accessible and appropriate to this population.

Online social media platforms like Twitter and Facebook could represent promising opportunities for public health promotion[435]. Research is limited, however, on the effectiveness of social media at improving knowledge and awareness of certain health topics and motivating healthy behaviour change[428,435].

B. Smartphone applications

In line with the increased availability and usage of smartphones, applications for health promotion practices and health outcomes have advanced over the past few years. mHealth applications serve two primary purposes: disease management and wellness/fitness[436]. In 2015, 38% of the mHealth applications in the Apple Store and Google Store were grouped under the fitness category[437]. Further, 12,991 apps in the Apple Store and 1420 apps in Google Store targeted multiple cardiovascular risk factors[438]. The major function of health applications is to encourage and support consumers to adopt healthy behaviours[439]. Further, health applications enable self-monitoring, health tracking and creating social connections[440]. Despite the increased number of developed health apps which can be downloaded through app stores, little scientific research has been conducted investigating health promotion practices and health outcomes. There is there is a lack of holistic workplace health promotion applications which have been implemented in the organisational process[441]. Applications in health promotion have multiple benefits. These include being relatively inexpensive, reaching a large number of individuals even in remote places, supporting highly stigmatised groups without exposing them, sharing health information on social media, 24-hour accessibility, providing updated content to the application at any time, implementing visual materials such as graphs and videos, and repeating lectures/trainings as often as wanted[442-444]. Another major advantage is delivering instant feedback and support[445,446]. Instant feedback helps participants monitoring their personal progress and can motivate participants to proceed with health applications[441].

Health applications can also include online assistance. This professional support can be delivered frequently by qualified health professionals using e-mail, forums, audio chats, webcams, or even face-to-face support[447]. There are a number of challenges with these applications. Currently anybody who has the skills is allowed to develop an application, this could lead to quality assurance issues[448]. Another potential risk is data security and privacy[449,450]. Lastly, the user's lack of technical skills or knowledge related to the use of new media is an additional barrier that can prevent persons to try app-based health promotion programs[448].

C. Wearable Health Devices

Wearable Health Devices (WHDs) such as fitness applications, activity trackers and smart watches are an emerging technology that enables continuous monitoring of vital signs, over extended periods of time, during daily life (during work, at home, during sport activities, etc.) or in clinical environments. The sensor technologies installed in smart phones and wearable devices record a variety of metrics automatically and without active user engagement[451]. A major advantage of WHDs is that they generally minimise discomfort and do not interference with normal daily activities[452]. These devices have been primarily used in medical and/or fitness/wellness settings[453]. In 2017, the wearable devices market had a worldwide revenue of around $26 billion[454]. This is expected to reach almost $34 billion in 2019[454].

Many WHDs rely on triaxial accelerometer sensors to detect motion and quantify activity[455]. The data is linked to activity tracker websites or phone-based applications that allow individuals to monitor and store information on their daily total activity (e.g., step counts, number of stairs climbed, minutes spent exercising, heart rate intensities, estimated calories burned and sleep patterns). Some devices also offer the ability to interact with other users via online social networks, which has been shown to have potential benefits for positive health behaviour change[432]. Sensors in WHDs can provide vital signs and other clinically relevant data. Algorithms can be synthesised to predict when interventions may be necessary, and population data can be used to better understand what therapeutic solutions work best in which cohorts of patients[456]. Wearable biosensors and mobile applications are changing the way health care is delivered to millions of people[451]. Activity and heart rate trackers, smart clothing that provides vital-sign monitoring, smart patches, and even smart pills, are being used to help individuals (and often their physicians) with medication compliance, disease management, and pain management[451].

Table 1-2 below lists some of the advantages and disadvantages of the different forms of mHealth interventions.

Table 1-2 Summary of the advantages and disadvantages of mHealth interventions

	Advantages	**Disadvantages**
SMS text messaging	• Universally available on all mobile phone networks[457] • Relatively inexpensive and simple to use[201] • Not reliant on internet or Wi-Fi access[201] • Allow almost instantaneous communication[458] • Offer greater simplicity because texts just arrive to the phone, obviating the need to pull information as is the usual means of interacting with an app[201] • Can be customized and delivered via computer algorithms[438]	• Cost and literacy can be barriers in LMICs[425,458] • Text messages are usually unidirectional, responses are not encouraged[201]
Web 2.0 and social media	• Provides opportunities for individuals to generate, share, receive, and comment on social content with other users through multisensory communication[459,460] • Social media users have the potential to increase the number of interactions and thus are provided with more available, shared, and tailored information[461] • It can provide valuable peer, social, and emotional support for individuals[462] • Public health surveillance[463]	• Limited utility for the less technology-literate user[464] • Require an internet connection and data plan, which results in greater mobile phone running costs[457] • Information exchanged needs to be monitored for quality and reliability[465] • Information overload[461] • Users' confidentiality and privacy need to be maintained[465]
Smartphone applications	• Smartphone technology, including the Global Positioning System (GPS), accelerometer, microphone, speaker, and camera, has average-to excellent	• Limited utility for the less technology-literate user[464] • Require an internet connection and data

	accuracy to objectively measure a range of physical activities[456,466] • The applications remove geographic barriers to participation[467] • The capacity to gather data through mobile phones provides a powerful platform for studying ways to motivate healthy behaviours[467] • The embedded sensors within mobile phones allow for multiple data collection and passive monitoring[467] • Individuals receive real-time feedback on their individual behaviours and results[468]	plan, which results in greater mobile phone running costs[457] • Need to be specifically developed for the operating system type (e.g., Android, Apple) and require regular maintenance and updates[457] • Largely unregulated, with Food and Drug Administration regulation being limited to those apps that transform the smartphone into a medical device[469,470] • Most physical activity apps are not developed on the basis of evidence-based strategies or on established behaviour change theories[471] • Individuals' privacy of information[456]
Wearables	• A single device can monitor a range of health and fitness factors as well as detect certain risk parameters[472] • Objective measure of physical activity key matrices[473] • Allows individuals to quantify their progress[474] • Gamification of activity with competitions, badges, challenges, publication of visible feedback on performance utilising social influence principles, or reinforcements in the form of virtual rewards for achievements[475] • Applications that encourage social networking and sharing workout achievements, may help overcome these barriers due to lack of encouragement, support, or companionship from family and friends[476]	• There appears to be great deal of variability in total daily energy expenditure and moderate to vigorous physical activity between devices[477] • Expensive and can be difficult to use[477] • Limited scientific evidence regarding their reliability and validity[477] • Individuals' privacy of information[456] • Limited battery life means that devices need to be charged often and have limited time to track data[478] • Very few longitudinal, randomised controlled

studies focus on the impact of wearable technology on healthy users' behaviour[472,479,480]

- Sustained user engagement, recent surveys showed that 32% of users stop wearing these devices after six months, and 50% after one year[481]

1.4. SUMMARY AND CONCLUSION

A key concern facing the changing communication landscape centres on the issue of the digital divide. Inequalities in access to and use of technologies have been observed, whereby those of lower SES, minority race/ethnicity, older age, poorer health, and living in geographically isolated locations are less likely to have adequate access to these technologies[482-484]. It was for these reasons that the researchers chose to focus on 'older' tailoring technologies. Although the literature highlighted newer, more sophisticated web- and application-based tailored interventions to combat NCDs, this study focussed on print and SMS communication. The primary reasons for this include the fact that despite technological advances in South Africa outpacing other parts of Africa, there is still a significant variation within the country, with many citizens still using standard phones while others have internet-capable devices[485]. More economically developed areas of South Africa have higher usage rates of 'smart phones', as do younger and male populations[485]. As the aim of this study was to investigate a scalable, cost effective intervention across different socioeconomic bands, using educators who are primarily female and older, it was felt that the use of non-smartphones and print and SMS messages was more appropriate than developing an intervention using smartphones and applications which some educators would not have access to.

1.5. ECOLOGICAL MODEL AND HEALTH BEHAVIOUR CHANGE

1.5.1 INTRODUCTION TO THE ECOLOGICAL MODEL OF BEHAVIOUR CHANGE

Attempting to change behaviour without considering the social and environmental influences has been shown to result in smaller improvements[486]. The Socio-Ecological Model proposes that there is a dynamic inter-relationship between individuals and their environments. People-environment interactions are characterised by cycles of mutual influence. Health is directly influenced by the physical and social settings. At the same time, individuals impact on the healthfulness of their surroundings through their individual and collective actions[487]. The basic premise of the ecological perspective is that simple, behaviour change cannot be effective, no matter how much motivation or how many skills an individual may have, if environments and policies make it difficult or impossible to choose healthy behaviours[487]. Behaviour change is anticipated to be maximised when environments and policies support healthful choices, when social norms and social support for healthful choices are strong and when individuals are motivated and educated to make those choices[488]. In order to facilitate healthy behaviours, convenient, attractive, and economical environments and policies need to be created[222].

As the determinants of health behaviour are multifactorial, ecological models that recognise the importance of environmental and policy interventions have been adopted as guiding frameworks for NCD prevention worldwide[488-490]. The core concept of an ecological model is that behaviour has multiple levels of influences. These typically include intrapersonal (biological and psychological), interpersonal (social and cultural), organisational, community, the physical environment and policy [488]. It is believed that ecological models provide a comprehensive framework for understanding the multiple interacting determinants of health behaviours[488]. As such, ecological models have been used to develop comprehensive intervention approaches that systematically target mechanisms of change at each level of influence. Being able to examine all of these factors independently and in combination can highlight more clearly the role of the multiple influences on health and NCD risk factors[491].

1.5.2 SCHOOL ENVIRONMENT INTERVENTIONS

The physical, social and cultural environment in which educators and learners spend the majority of their day may have a profound influence on their physical, emotional and mental health[492]. Although much has been written about interventions focused on the school environment for addressing the health of learners[493-495], less has been written about similar strategies for addressing school employees' health, particularly in LMICs. The physical and mental health of school employees is integral to promoting and protecting the health of learners and ensuring their academic success[492]. The fact that educators' feelings of well-being are declining is a vital public health concern[177]. Health promotion in schools can help to create an environment that fosters good health[492]. The South African school environment in particular has been shown to be in need of improvement[493]. By ignoring the health of their employees, school districts put a valuable asset of the nation's schools at risk. This asset has the potential to either improve or diminish learners' academic, social, physical and mental health[165].

The health environment has been conceptualised as all factors that can affect an individual's health-related behaviours, are external to the individual, and are shared by members of the individual's community[496]. Environmental interventions are designed to (i) provide access to opportunities for engaging in health-enhancing behaviours, while eliminating or weakening those aspects of the environment that make it easier for individuals to engage in health-compromising behaviour, and to (ii) highlight positive role models, generate social support, and establish rewards and cues to action for engaging in health-enhancing behaviour[497]. The ultimate goal is to shift social norms and the physical environment so that they naturally reinforce health-enhancing behaviours and discourage health-compromising behaviours. Environmental interventions often involve changes in laws, regulations, or organisational policies[488].

Interventions focussing on the school environment can include actions addressing health directly, for example: modifying school policies on smoking[494], improving the nutritional quality foods sold in school tuck shops or canteens[495] or creating an activity-permissive environment and promoting a school culture which encourages educators to be more physically active[495]. Other focus areas include school connectedness by improving social support and engagement[498]. Schools could provide both learners and educators with opportunities to engage in physical activity and eat healthy foods[499].

A. The impact of the school environment on physical activity

Well-designed and well implemented school-based programmes have been shown to improve the physical activity and eating behaviours of learners[500]. The Center for Disease Control and Prevention (CDC), has identified policies and pragmatic strategies most likely to be effective in promoting physical activity and healthy eating among learners[501].

Participation in regular physical activity breaks during the school day is an effective way to promote physical activity[502]. Such strategies could include the use of short physical activity breaks conducted in the classroom[503] and integrating physical activity to assist learning in other curriculum areas (e.g., maths and science)[504]. There are a number of commonly cited barriers to physical activity promotion in the school setting. These are generally categorised as institutional (school policies, facilities and administrative support)[505], educator-related (arising from the educator' beliefs and skills)[506] or learner-related[507]. Barriers often differ by school level (i.e., primary vs. secondary, public vs. private) and level of experience (i.e., specialist versus non-specialist)[508] yet there is consistency in the types of barriers reported across the globe[502].

Poor access to facilities and equipment[509], low emphasis on physical activity and physical education[178,510] and conflicting priorities with other teaching subjects within the school curriculum have been identified as barriers to physical activity promotion in both primary and secondary schools in Australia[508], the U.S.[507] and the United Kingdom[511] and South Africa[178,510]. School facilities, time allocated to physical education and other reported institutional barriers to physical activity are generally controlled by the school principal and other school administrators, which may explain why educators and principals often report different barriers[512].

Educator-related barriers differ by school level, with non-specialist primary school educators often reporting a lack of confidence in their ability to teach physical education[513,514]. Lack of interest, poor attitudes to physical education and inadequate expertise and qualifications have also been described in previous studies with non-specialist primary school educators[513,515].

The built environment may be defined as "all buildings, spaces, and products that are created or modified by people"[516]. Studies investigating the school built environment's impact on learners have been shown to increase physical activity behaviour. Features shown to be positively associated with physical activity in schools include sport facilities[499], sports fields[517] and availability of fixed equipment[518]. The provision of physical education and extracurricular sport also needs to be clearly outlined[519]. Although these facilities are primarily targeted at the learners, there may be are opportunities for educators to use them and benefit from them too. To the authors' knowledge, this has not been studied in educators.

B. The impact of the school environment on food choices

Since learners and educators consume a substantial proportion (between 19 and 50%) of their total daily calories at school, the school food environment has been shown to have a large impact on their eating habits[520]. Food and beverages at school fall into two main categories: school feeding programmes (the National Schools Nutrition Programme) and food and beverages sold outside the feeding programmes, specifically foods sold in tuck shops (cafeterias), and by vendors outside the school[521]. The rise in obesity over the past few decades has been accompanied by an increase in the number of food options available throughout the school day. Tuck shops and vendors at schools mostly sell unhealthy food items such as sweets, chocolates, potato chips (crisps), meat pies, hot dogs, biscuits, cakes and soft drinks[522,523]. Several studies have related the availability of snacks and SSB drinks sold in and around the schools to higher intakes of total calories, total fat and saturated fat, and lower intakes of fruit and vegetables, milk and other key nutrients[522,524,525]. Unhealthy foods sold in schools have been reported to outnumber healthy ones by a ratio of 2:1[526]. A 2015 report[527] assessed the impact of the National Schools Nutrition Programme (NSNP) on fruit and vegetable consumption in primary school learners in the Eastern Cape. Most children consumed less than one portion of fruit or vegetables on the previous day, and none had eaten the recommended five portions per day[527].

One strategy aimed at getting learners and educators to eat healthier foods at school is to change the pricing structure of foods[528]. A study conducted in a high school tuck shop in the United States halved the price of fruit, carrots and salad. This resulted in a four-fold increase in sales of fruit, a two-fold increase in carrots, and a significant increase for salads[529]. Placing fruit, rather than sweets, at eye level on the tuck shop counter has also been shown to increase sales of fruits by as much as 70%[530]. These studies illustrate the potential for policy intervention, especially lowering prices and placing healthier foods in more convenient locations in tuck shops, to redirect food choices towards purchasing healthier products.

C. School food policies

In the United States, a national school wellness policy was implemented in the 2006-2007 school year, with the goal to reduce childhood obesity by promoting a healthy school food environment[531]. A school nutrition policy has the ability to increase the availability of healthy foods in schools and encourage learners to make healthier food choices[532]. These policies need to stipulate the nutritional standards for food consumed during school hours, including food sold at school, and specify requirements for school tuck shops (e.g. unhealthy foods must be replaced with milk, yogurts without added sugar, water, fruit juices without added sugar, sandwiches, fruits, nuts or vegetables). The policy can also give instructions to food vendors near schools about the nutritional standards of food that they may sell to learners[533]. Lastly, the policy may also control the type of advertisements that may be placed on school grounds and on school stationery and ensure that appropriate sponsorship of equipment, events or teams must be obtained that does not encourage learners to consume unhealthy food and beverage items[533-535]. School policies typically focus on the health of learners in the school, however, they have the potential to create a culture of a supportive healthy eating environment which would also impact on educator health[536]. Although a draft legislation has been prepared on the control of marketing of unhealthy foods and beverages to children in South Africa, it has yet to be promulgated. One study addressed the urban, obesogenic environment and the density of visual advertising media in the neighbourhood[537]. In Soweto, a total of 145 advertisements for SSBs were found over a driven or walked distance of 112km. The density of advertisements was 3.6 per squared km in relation to schools (increasing intensity with closer proximity to schools), and 50% of schools had branded advertising on their school property. Most of the 180 vendors in the study sold sugar-sweetened beverages, with half of the schools displaying advertisements of these beverages on school premises[537].

1.6. SUMMARY AND CONCLUSION

This chapter highlighted the fact that NCDs are a global issue affecting high- and low-income countries, the rich and poor as well as the old and young. The prevalence of NCDs in LMICs in general, and South Africa in particular is worrying. Further, educators are an at risk population for developing NCDs. Businesses are increasingly recognising that workers are their most valuable resource[165]. The most progressive organisations are implementing policies and programmes to maintain and enhance the health and productivity of their workers[165]. A review of the literature emphasised that social norms play an important role in decision making about healthy eating and physical activity through their influence on attitudes. Interventions may help to change perceptions and social norms and strengthen other positive influences. A strong healthy school culture and social norms have been shown to result in more motivated and healthy educators[538]. Highly motivated, healthy educators have greater success in terms of learner performance and health[170].

To continue to improve the quality and academic achievement of learners, the quality of life, health, and productivity of school employees also needs to receive attention. Massive challenges call for practical, affordable, sustainable, scalable and best-practice solutions[539]. More research is needed to find interventions which will improve the school health and policy environment and improve the wellbeing of educators.

Chapter 2 **METHODOLOGY**

2.1. BACKGROUND

In order to change behaviour, it is first necessary to understand why people engage (or do not engage) in the behaviour. Ideas, cognitions, emotions, beliefs, processes, or automatic associations generally determine behaviours[540]. Behaviour change methods are defined as techniques or processes that have been shown to change one or more behaviour determinants within members who are part of an at-risk group[540].

Intervention Mapping (IM) originated in response to an attempt to link behaviour change theory to the logistical and practical issues involved in the development of effective interventions[541]. Originators of this approach began to examine programmes developed within their own work and identified general principles and procedures which they used in the development of the behaviour change technique[541]. This led to a systematic approach for the planning and development of health promotion interventions[542]. The IM protocol describes an iterative path from the identification of the problem to problem-solving or mitigation[540]. In each of the six steps of IM there are several tasks, each of which integrates theory and evidence. The completion of tasks within a step creates a product that is the guide for the next step. The completion of all six steps serves as a blueprint for designing, implementing, and evaluating an intervention based on a foundation of theoretical, empirical, and practical information[543]. The six steps in the IM approach are: 1) needs assessment, 2) identification of outcomes and change objectives (matrices), 3) selection of theory-based methods and practical applications to change health related behaviour, 4) designing an intervention programme, 5) creation of an adoption and implementation plan and 6) evaluation plan[543].

The aim of this chapter was to describe the development of a tailored, single print letter feedback and SMS-text communication for a behaviour change intervention for a sample of educators in primary schools in the Gauteng and Western Cape Provinces in SA, using an adapted Intervention Mapping approach[541]. As the efficacy of the IM approach requires substantial time and effort to complete and there is great complexity in the process, it was decided to use a modified IM approach. A similar approach was employed by using components of the IM protocol in the development of a school-based intervention[544].

2.2. DEVELOPMENT OF THE INTERVENTION

2.2.1 STEP 1: NEEDS ASSESSMENT

The needs assessment included a review of the literature and meetings with relevant stakeholders and deciding on the behavioural outcomes the intervention needed to target.

A. Review of the literature

A review of the literature in Chapter One revealed that educators in South Africa are an 'at risk population', in part, due to the associated lifestyle behaviours and occupational stress as well as lack of interventions to address NCDs. In fact, the literature revelaed that educators in South Africa are less healthy than the general population[168,171,172,177].

B. Stakeholder consultations

A second task for the needs assessment was to collect information to enable a deeper understanding of the context or community in which the intervention was to be delivered[543]. The leaders of the Care and Support for Teaching and Learning (CSTL) programme within the South African Department of Basic Education (DBE) were approached to gather such information. Twelve meetings were held between investigators and educational authorities from May 2013 and July 2014 to understand the types of interventions that would be most useful for educators and which had the potential to be scaled up. Attributes of the proposed intervention were identified during these discussions. The intervention needed to be low-cost, scalable and appropriate for educators in all socioeconomic strata, so that it could be implemented nationally could not interrupt educators' teaching time. Lastly, the type of technology most appropriate for this sample and the time of year best suited for the intervention to take place were explored.

C. Behavioural outcomes

Lastly, the needs assessment needed to define the desired outcomes[543]. These would include reductions in health risk, and positive health behaviour changes. The discussions with DBE and review of the literature revealed that educators have five major health areas of concern. These included: 'achieving or maintaining a healthy weight; increasing physical activity; quitting smoking; managing stress; and eating a healthy diet'. Consequently, they informed the behavioural outcomes to be addressed by the intervention. Each of the five behavioural changes had a specific peformance objective. For example, increasing physical activity was aimed at accumulating at least 30 minutes of moderate to vigorous physical activity (MVPA) per day. Eating a healthy diet involved increasing fruit and vegetable consumption to five servings per day. These goals were incorporated into the advice messages each educator received (discussed under Step 4).

2.2.2 STEP 2: MATRICES

The second step in IM involves specifying the desired outcomes of the intervention in detail[540]. The overall desired outcome of this study was to engage educators to help them to improve their health status and change their lifestyle behaviours if they were deemed unhealthy. The Theory of Planned Behaviour[236] was the underlying theory of the intervention. According to this model, the best predictor of a behaviour is behavioural intention, which in turn is determined by attitude toward the behaviour and social normative perceptions regarding it[251]. This theory is explained in more detail in Step Three below. By identifying the specific goals and barriers of the educators in this study, tailored messages were developed to address those factors directly. The selection of the goals and barriers is explained in detail in Step Four.

In addition to identifying the desired outcomes of the study, the primary and secondary outcomes of the study were discussed with the DBE. The primary and secondary outcomes of the study are presented in Table 2-1.

Table 2-1 Primary and secondary outcomes of SA-NEWS

Primary outcomes	1. Describe the development of a tailored, single print letter feedback and SMS-text communication for a behaviour change intervention for a sample of educators in primary schools in the Gauteng and Western Cape Provinces in SA, using an adapted Intervention Mapping approach; 2. Determine the health risk status of a convenient sample of primary school educators in South Africa, from schools with communities with widely varying socioeconomic status (based on quintiles); 3. Determine the efficacy of tailored feedback print communication and SMS-text messages following a health risk assessment, compared to standard of care.
Secondary outcomes	1. Determine the correlates of health risk status in South African primary school educators; 2. Evaluate the feasibility, acceptability and efficacy of the SMS-text messages delivered to educators over the five-month period; 3. Investigate the school environment and how it may impact on healthy behaviours.

2.2.3 STEP 3: THEORY-BASED METHODS AND PRACTICAL STRATEGIES

In the third step of IM, theoretical methods and practical applications needed to be selected[540]. Theoretical approaches to behaviour change may emphasise the perceived outcomes, including the benefits (health belief theory) and outcome expectations (social cognitive theory and theory of planned behaviour) and/or the individual's perceived control over the behaviour (self-efficacy and perceived behavioural control theory of planned behavior), as well as social influences (ecological model, social cognitive theory)[233].

The Theory of Planned Behaviour proposes that there are three constructs that lead to a positive intention: (i) the individual's attitude, (ii) the subjective norm and (iii) the perceived amount of control that the individual has over the behaviour[236]. The perceived control has been defined "as the *belief* that one can determine one's own internal states and behaviour, influence one's environment, and/or bring about desired outcomes"[545]. In combination, attitude toward the behaviour, the subjective norm, and the perception of behavioural control lead to the formation of a behavioural *intention*[546]. An individual's intention is the most important motivator for behaviour change. Intentions are supposed to reflect the relative strength of an individual's motivation to engage in the behaviour. As a general rule, the more favourable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behaviour in question[546]. Intention is viewed as the most proximal predictor of behaviour in the perceived behavioural control and is thought to mediate completely the influence the attitude, subjective norms and perceived behavioural control on the particular behaviour[547].

In addition to measuring attitudes toward the behaviour, it is also important to assess an individual's subjective norms. Subjective norms are beliefs about how people they care about will view the particular behaviour. Perceived behavioural control refers to a person's perceptions of their ability to perform a particular behaviour. The greater the perceived control, the more positive the attitude and the greater the subjective norm, the stronger the intention to perform the required behaviour will be[236].

One behaviour change theory which has been used extensively in behviour change interventions and was therefore the primary theory to guide the intervention is the Transtheoretical Model (TTM)[293-297]. This model describes individuals as being in various stages of readiness to change. The likelihood of engaging in a particular behaviour will therefore depend on the stage of readiness an individual is currently in[250]. Stages of change are typically measured in six month periods[222]. The first stage of this model, the *pre-contemplation stage*, occurs when an individual has either no awareness of the health behaviour[250], or they may be aware of the health issue, but may be demoralised from previous failed attempts to change, and therefore will have no interest in making any changes over the next six months[222]. The second stage, the *contemplation stage*, is characterised by an individual becoming aware of the health problem and is seriously considering making a change in the next six months but he/she has not made a commitment to do so yet[251]. In the third stage, the *preparation stage*, an individual has realised that change is necessary. An individual is likely to start creating a plan or to take some small steps towards action[251]. In the fourth or *action stage*, an individual has successfully taken a specific action which has lasted for less than six months[251]. The final *maintenance phase*, occurs once the behaviour has taken place for at least six months[251]. Rather than being linear, the stages are cyclical. Most people 'recycle' to previous stages several times before successful behaviour change is achieved[251]. The TTM argues that people who are in different stages of change, require different communication styles in order to move them from one stage to the next[252].

During the wellness day, participants were asked how ready they were to change their weight, physical activity, eating and smoking habits. The wellness day feedback to these questions were based on the Transtheoretical[548] and the Social–Cognitive[549] Models. Participants were grouped into three categories: (i) no intention to change the behaviour ('I am happy with my current behaviour'), (ii) awareness that the behaviour needs to change but no intention to change it within the next six months ('I know my behaviour has to improve, but I don't really want to change it right now), and (iii) intention to change the behaviour within the next six months ('I want to change the behaviour, and would appreciate some help'). The wellness day feedback reports were designed on the basis of responses to the above questions, adapted from the I-Change model[320] which deals with a specific risk factor goal, readiness for change, barriers and facilitating factors, and preferences. The tailored letter and SMS-text messages were designed based on each individual's goals and selected barriers as well as their readiness to change their behaviour.

2.2.4 STEP 4: INTERVENTION PROGRAMME

During the discussions with the DBE, several health interventions were explored and proposed. It was agreed that an intervention consisting of a wellness day with immediate feedback, followed by a single tailored letter and an SMS campaign would meet the attributes of an intervention which were that it should be affordable, scalalble and appropriate to promote the health of educators. The DBE, through its health and wellness partners, have implemented wellness days in a number of schools in the different provinces which have been well received by staff and the teacher unions. At the completion of the wellness day, participants received a printout, detailing their health risk status and providing general recommendations (see Appendix G). The proposed intervention would use the wellness days as a platform, but would add 'tailoring' in the form of a single letter focussing on the goals and barriers selected by the educators, followed up by a minimum of eight tailored SMS-text messages over the five-month period. The SMS communication method was suggested, as some educators may not have access to 'smart phones', but would still be able to receive this form of communication. Personal communication with Dr Faith Kumalo of the Care and Support for Teaching and Learning at the Department of Basic Education revealed that most educators owned a mobile phone. However, only approximately 70% owned smart phones. These smartphones were also more prevalent in the higher SES areas. Most of the educators used prepaid airtime as opposed to contracts and frequently owned more than one SIM card. According to Dr Kumalo, the vast majority of educators are exceedingly frugal with their airtime and they meticulously keep track of their expenditure, preferring free services such as "please call me". The length of the SMS-text messages was limited to 160 characters (including spaces). After five months, educators in both the control and intervention schools would then be invited to participate in a follow-up wellness day.

In order to better understand the school health and policy environments, and the extent to which this might influence the success or failure of the intervention, a school health environmental audit was developed and completed by the school principals (Figure 2-2). Finally, educators from the intervention schools were asked to evaluate the acceptibility and feasibility of the SMS-text messages. Evaluation of the efficacy and effectiveness of the SMS-messages is discussed in more detail below.

A. Programme components

i Wellness days

Educators in both the intervention and control schools were offered a health risk assessment at a school wellness day, by appointment, at the commencement of the study and again, after five months (Figure 2-2). Wellness days included a health risk assessment (HRA), clinical measures, anthropometric measures and the completion of the Kessler 10 questionnaire which is an instrument to measure psychological distress. At the completion of the wellness day, individuals were given a composite report about their health status. This report was referred to as a 'Vitality Age' report and is explained in more detail in the evaluation section 2.2.6.4.1 below.

ii Goal and barrier selection

The goals and barrier selection took place once educators in the intervention group had a better understanding of their health risks and Vitality Age (risk age estimate) from the feedback they received at the wellness day. Educators could choose from one of five health goals they hoped to change or manage and to rank their top three barriers (one indicated their top barrier) and the tailored print communication they received reflected these. (Appendix I contains an example of a tailored letter sent to an educator). The SMS text messages followed the same pattern. The first SMS contained advice focussing on their top barrier, the second SMS educators received assisted them overcome their second barrier, this process repeated itself for the duration of the study (illustrated later in Figure 4-1).

Five objective outcomes (goals) were identified as important for educators. These are listed in point 2.2.1.3 above. A set of six possible barriers for each objective outcome were listed per health goal selected. The barriers included (i) lack of knowledge; (ii) not having enough time; (iii) lack of support from family, friends, co-workers, or community members; (iv) lack of resources (e.g. funds, facilities, access to transport); (v) lack of confidence in their ability to achieve the desired goal and (vi) difficulty with prioritising lifestyle changes. These barriers have also been highlighted in the literature[168,171,172].

Text messages provided advice, motivational reminders, and suggestions to change lifestyle behaviours. Educators in the intervention group (n=264) received a minimum of eight SMS-text messages over the five-month period. Each SMS was sent at the beginning of each month for five months. Educators that used the *'Please call me'* functionality received an additional message as soon as the message was received by the server.

iii Development of the advice messages to address the behavioural changes

Once the goals and barriers were identified, sessions with content specialists in the fields of physical activity, nutrition, stress management, smoking cessation and weight management were held in order to develop content and advice messages to overcome the identified barriers. Each content specialist undertook the development of the advice messages in their area of expertise separately. Each barrier was assigned a practical message that educators could implement (Figure 2-1). The advice specified an action which needed to be taken in order to achieve the relevant performance objective. Once input was gathered from each expert, the principal researchers reviewed and refined the messages to ensure they were autonomy supportive, relevant and appropriate. Autonomy supportive communication encourages self-initiation[550]. The theory focuses on autonomous motivation which emphasises that a person's degree of autonomous motivation will positively predict sustained behaviour change and positive health outcomes[550]. A behaviour such as eating healthier foods is autonomous to the extent that people will engage with it with a full sense of choice and volition because of their belief in its personal importance and benefit for them[550] as opposed to them feeling controlled or coerced to change a behaviour.

Once the messages were developed, they were used in the generation of the tailored letters which had no character limit. The advice from the letters were condensed to fit into an SMS format (maximum of 160 characters). A separate formula-encrypted spreadsheet was created for each goal, the letter and SMS advice messages were copied and stored in the spreadsheet. A total of 60 messages (30 messages for the letters and 30 SMS messages) were developed.

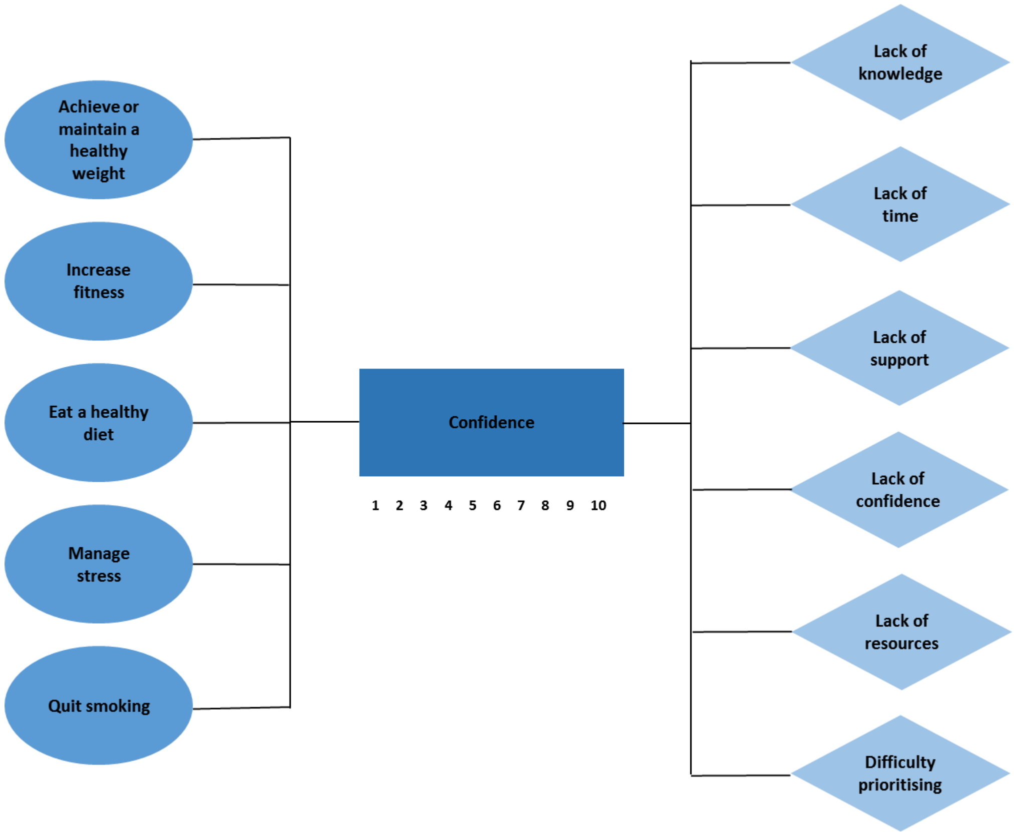

Figure 2-1 Algorithm for the goal setting feedback letter and SMS's

iv Delivery of the tailored letters

In order to create the letters, the relevant advice messages for each barrier were extracted from a formula-encrypted spreadsheet. A mail merge was then performed to create individual letters for each educator in a word processor. After printing, each letter was placed and sealed into separate envelopes with the educator's name written on it. Letters from the same school were placed into a large envelope with a covering letter addressed to the principal and couriered to the relevant schools. These letters were sent to each school one week after the wellness day took place. Appendix J contains a full list of the SMS advice messages.

An example of a message for an educator wanting to improve their fitness but lacking time is given below:

You have indicated that you would like to 'increase your fitness'. However, you have expressed some concern that you do not have time to pursue this goal. Some people who find it difficult to 'fit fitness in', might try to exercise longer at a moderate intensity over a weekend… for example, taking a walk with the family, in a natural environment. We call these individuals 'weekend warriors'. Another strategy is to increase the intensity of the exercise. In other words, exercising a bit harder instead of longer. Short, high-intensity exercise bouts can increase your fitness and help achieve your goals without having to commit to longer hours, and hence time away from other priorities in your life. You can also increase your fitness by playing sports such as squash or tennis, or by doing interval training. Interval training is a combination of high-intensity

v SMS data capture, storage and delivery

A week after the letters were couriered to each educator, they received a SMS asking them to confirm receipt of the letter. Educators were given a '*please call me*' number to dial if they did not receive their letter. A different '*please call me*' number was given if they did receive their letter. During the fifth week of the intervention programme, a first prompt SMS was sent to all educators in the intervention group. The '*please call me*' function is a free, widely used service offered to mobile users in South Africa. It is part of the Unstructured Supplementary Service Data (USSD) solution architecture and is based on Global System for Mobile (GSM) technology, meaning that it is not dependent on Internet connectivity and data traffic. No extra software downloads are needed to use this functionality. The service allows subscribers to send a free SMS message requesting to be called by the recipient.

SMS data were stored using OpenMRS[551] (Version 1.9.8), an open-source client-server medical record software system initially designed as an electronic medical record and health system management platform specifically developed for use in low resource settings[425]. OpenMRS allowed for the creation of individual participants identified with a unique identifier (assigned during the creation of the participant). Participant information was captured electronically. The OpenMRS instance was hosted by a secure server at the University of Cape Town, and accessed via a web-based interface. Access to the server was restricted by IP address for added security.

OpenMRS also allowed for the addition of custom modules in order to extend its capabilities. A custom 'SA-NEWS' module was created to handle all text messaging for the study. This module ran a schedule of SMS messages. A delivery report of each message was received and stored on the OpenMRS server. Failed messages were resent up to three times.

An example of a SMS-text message for an educator wanting to improve fitness but lacking time is shown below.

If time is a challenge, work on increasing the intensity of your sessions. This will help improve your fitness. SA-NEWS team

After each message, educators were prompted to reply to the SMS message they received. The text sent was "We hope things started off well with [**insert short goal**]! Send a 'please call me' to <XXX XXX XXXX> if you're doing well, or to <XXX XXX XXXX> if you need some help. SA-NEWS team". Two separate 'please call me' numbers were created, one for each scenario. Once a response was received from an educator, a follow-up SMS was automatically sent, for which the content was adapted based on the educator's previous response. In the case where no response was received by the researchers, a default SMS was automatically sent to the individual.

Participant responses to the SMS messages were received on Android smartphones equipped with a custom-coded application that extracted the content and phone number from the message, and forwarded this information to the OpenMRS server. The SA-News module within the OpenMRS server then identified which participant sent the message, the last message that was sent to that participant, and then selected the appropriate reply message.

vi Overall delivery plan

Once the initial set of messages was created for each target behaviour, a structured programme plan for the delivery of these messages was developed. This involved developing a schedule for conducting the initial wellness days, sending the letters to the educators and following that up with the SMS messages. The first set of wellness days were booked between February and April 2015. At the completion of the wellness day, all educators received a check in SMS. The purpose of the SMS was to ensure that the system campured to correct mobile phone number. Two weeks after the wellness day, the tailored letters were sent to educators in the intervention school. One week after the letters were couriered to educators, a letter check SMS was sent. Educators were asked to confirm that they received their letters by sending a '*please call me*' to the numbers provided. Two numbers were given, one for confirmation that the letter was received, a different number was to be used if educators did not receive the letter. During weeks five, six and seven one SMS was sent ot each educator in the intervention group. The SMS contained advice relating to the goal and one of the barriers each educator selected. Educators were asked to reply to the message using the '*please call* me' funtionality indicating whether they found the message useful. Educators who failed to send a message back received a default SMS. In week 12 all educators in the control and intervention groups received a check in message reminding them of the upcoming wellness day in a few months time. In week 14, educators in the intervention group received a good-bye SMS thanking them for participating in the study. During week 18, educators in the intervention and control groups receieved an SMS reminding them of the upcoming wellness day. The follow-up wellness days (post-test) were also pre-booked, these took place between August 2015 and October 2015. Table 2-1 outlines the timeline and communication strategy. Details of each component are explained in step six below. Figure 2-2 highlights the overall delivery plan of the SMS messages.

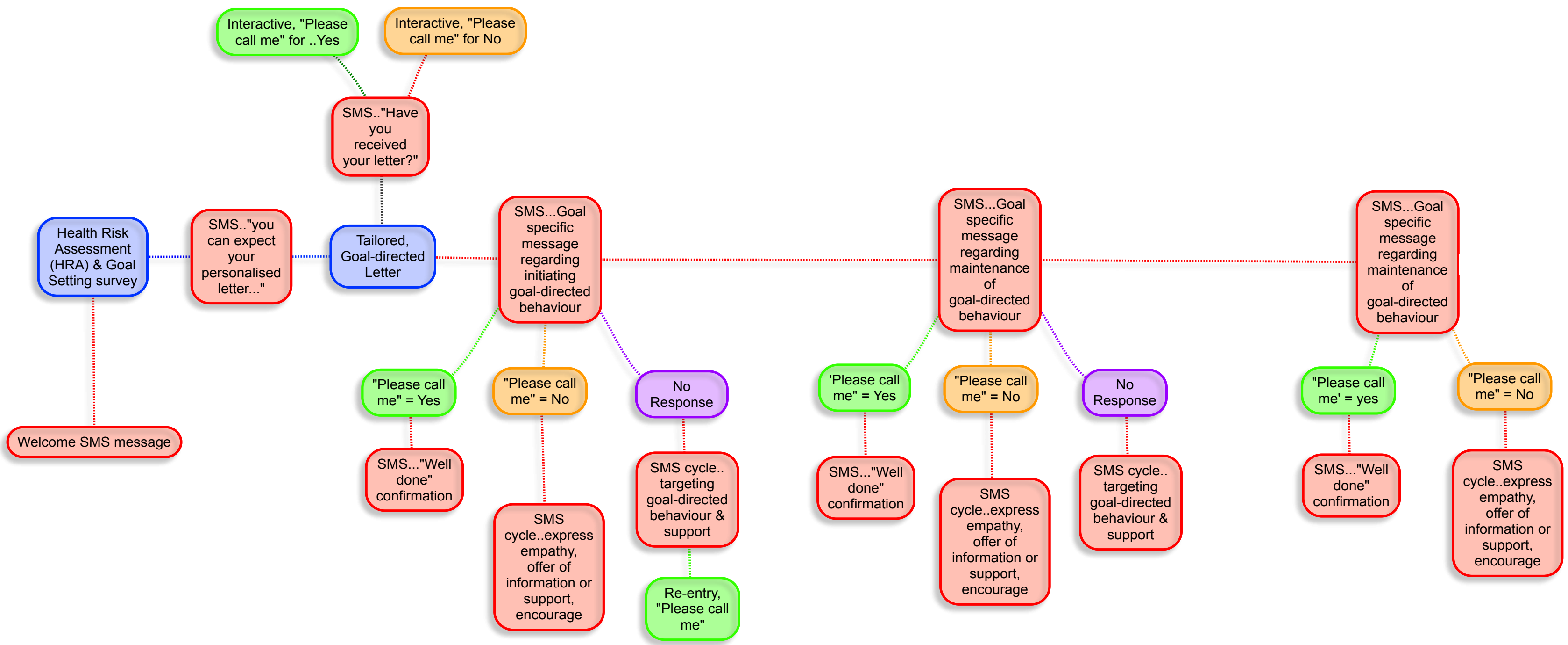

Figure 2-2 Overall delivery plan of the SMS messages

Prior to the commencement of the intervention, 10 educators from a school in the Western Cape were invited to participate in a pilot. The purpose of the pilot was to ensure that the letters were generated correctly, delivered timeously and that the correct SMSs were delivered. With the exception of the timelines being shorter, all participants were exposed to the intervention.

Table 2-2 Timeline and contact schedule for educators participating in the study

Week	Description	Example of communication
0	Wellness day (**control and intervention groups**)	*Vitality Age printout*
0	Welcome SMS (to confirm the correct mobile number - **received by both control and intervention groups**)	*Welcome to the SA-NEWS study! Thanks for participating in the Wellness Day. We hope you found it helpful. SA-NEWS team*
2	Letters (**intervention group**)	*For example, see section six*
3	Letter check SMS (**intervention group**)	*We hope things started off well with your XXX goal! Send a 'please call me' to XXX if you did not receive your letter*
5	Prompt 1 SMS (**intervention group**) with follow-up 2 days later if no reply	*For example, see section six*
6	Prompt 2 SMS (**intervention group**) with follow-up 2 days later if no reply	*For example, see section six*
7	Prompt 3 SMS (**intervention group**) with follow-up 2 days later if no reply	*For example, see section six*
12	Check-in SMS (**control and intervention groups**)	*We hope that we've inspired you to make some healthy lifestyle choices in the last few months. The next wellness day is in a few months time! SA-NEWS team*
14	Goodbye SMS (**intervention only**)	*We've come to the end of the SA-NEWS messages & we hope you have found them helpful. Thanks so much for participating in our study*
18	SMS reminder of upcoming wellness day (**control and intervention groups**)	*Remember that the upcoming wellness day will be held at your school within the next 2 weeks. SA-NEWS team*
20	Wellness day (**control and intervention groups**)	Vitality Age printout

B. Ethical considerations

Permission to conduct the study in schools was obtained from the National Department of Basic Education as well as the Gauteng and Western Cape Provincial Departments of Education. Principals from the schools had the right to refuse on behalf of their school. Educators from schools agreeing to participate were required to sign consent. Ethical approval for the study was obtained from the Faculty of Health Sciences Human Research Ethics Committee at the University of Cape Town (HREC REF: 216/2014).

2.2.5 STEP 5: ADOPTION AND IMPLEMENTATION PLAN

Step five involved identifying potential adopters and implementers. The current proof-of-concept study was designed to assist educators to manage NCDs. If educators' behaviours and risk factors showed an improvement as a result of the study, DBE would have a working model to adopt and implement in the more than 25 000 schools across South Africa. In addition, this model has the potential to be adapted to other 'at risk' population groups.

Initial road shows were conducted with the Western Cape and Gauteng Departments of Education in order to explain the purpose of the study and to request that they send a list of potential schools. It was hoped that the process would take a maximum four weeks, however, the process took seven weeks. Once the school contact and location details were received, school visits and meetings with the principals took place. In all schools, principals requested to speak to the educators before giving consent. Twelve schools from the list given by the Provincial Departments did not particiapte in the study for two main reasons: the number of educators in the school was too small or the principal and educators were not interested in participating. Alternative schools were then approached and recruited.

2.2.6 STEP 6: EVALUATION PLAN

The sixth stage of IM involves specifying an evaluation design[540].

A. Study design

The intervention which was developed in the previous steps was evaluated in a cluster-randomised, controlled trial in public schools from two provinces in South Africa. The current study was designed as a proof-of-concept, pilot study.

i Study setting and population

Originally, the study contained 28 schools (14 intervention and 14 control schools). These schools were randomly selected from a list provided by educational authorities, grouped according to socio-economic status (by quintiles) and geographic location, in two provinces (Gauteng and the Western Cape). Although the intial requirement was for the DBE to supply a list schools with at least 50 educators, they were unable to do so. The researchers therefore had to recruit more schools in order to ensure that there were at least 500 educators in the sample. Schools from each province and quintile were assigned a unique identifier. These identifiers were placed into a 'research randomiser' application on the Internet (https://www.randomizer.org/). Schools from the same quintile and province were then drawn onto intervention and control schools.

Public schools in SA are categorised into quintiles, largely for purposes of the allocation of financial resources. Quintile one is made up of the 'poorest' 20% of schools in each province, while quintile five is made up of the 'least poor' 20%. Quintile rankings are determined according to the poverty of the community around the school as well as certain infrastructural factors[552]. As the list from the Gauteng province was larger and more comprehensive than the one provided by the Western Cape province, 18 schools were recruited from Gauteng province and 10 schools were enlisted from the Western Cape province. School principals received letters of introduction from the provincial educational authorities as well as a synopsis of the study and were invited to participate in the study.

One quintile four school from Gauteng had to withdraw from the study as they experienced a shooting at the school. The principal therefore felt that they needed to deal with the trauma and this study would distract the staff and learners from dealing with the incident. The incident occurred a week after the initial wellness day. Besides the feedback from the wellness day, educaotrs received no further communication from the researchers. The 17 educators from that school were therefore excluded from the study analysis. The final study therefore analysed the remaining 27 public primary schools (14 control and 13 intervention) from Gauteng and Western Cape provinces. Table 3-1 in the next chapter describes the distribution of schools and educators per province and quintile

ii Study outline

All educators were invited to participate in the wellness days. Educators were invited to book a time for their wellness assessment, ensuring that it did not interfere with their teaching time. Once educators had completed all the tests, they received a composite report of their health status (example in Appendix G). All clinical assessments and result explanations were conducted by trained nursing staff.

Pre test
(N=27 schools, 571 educators)

1. Wellness day:
Health Review Questionnaire
Blood pressure, random blood glucose and cholesterol, height and weight (BMI)

2. School environment Assessment (completed by the school principal)

CONTROL GROUP
(n=307):
1. Targeted Feedback
(standard HRA feedback based on educators' results)

INTERVENTION GROUP
(n=264):
1. Targeted Feedback
(standard HRA feedback based on educators' results)

2. Selection of a health goal and three top barriers

3.1 Single printed tailored communication based on selected goal and barriers
3.2 SMS messages over a 5 month period

Post test
(N=27 schools, 348 educators)

1. Wellness day:
Health Review Assessment
Blood pressure, random blood glucose and cholesterol, height and weight (BMI)

2. SMS evaluation
(intervention schools only)

Figure 2-3 Overview of the research protocol

iii Wellness days

The four key objectives for conducting the wellness days were to i) get a baseline health risk status of each educator, this was then compared to their risk status after the intervention, ii) decide on the exact content and mode of delivery for each practical intervention application, iii) ensure each of the goals were addressed with appropriate practical application, and iv) ensure the proposed intervention content was appropriate for the South African educator population.

Clinical measures

Trained, contracted nursing staff conducted the wellness day assessments. Measurements included screening tests for glucose and cholesterol concentrations using finger-prick capillary blood samples (Accutrend® GC analysers, Roche Diagnostics). For logistic reasons, fasting blood samples could not be obtained. The random blood glucose was measured by the nurse placing a drop of the educator's blood on to the glucose strip directly from the finger. Cholesterol concentrations were measured by placing 40 μL of the participant's blood in an appropriate-sized pipette, and applying it directly to the test strip in the application window. Once readings were obtained from both tests, the nurse wrote the values on a piece of paper. Educators entered these values into the Lenovo tablet as part of their results.

Blood pressure was measured using an automated sphygmomanometer (Omron HBP-1300 Professional Automated Blood Pressure Monitor) and appropriately sized cuff. Measurement was taken to the nearest 1 mmHg, with the participant relaxing while sitting in a chair, arm resting on a table at chest height, with the blood pressure cuff placed around the upper part of their arm. They could not speak, move or cross their legs during the measurement. Once the educator was seated and comfortable the measurement was taken.

Anthropometric measures

A stadiometer was used to measure standing height (cm) to the nearest 0.1 cm. A portable calibrated scale measured weight to the nearest 0.1 kg. Participants were required to remove their shoes for both measurements. Body Mass Index (BMI) was subsequently calculated as body mass (kg) divided by height (m) squared (kg/m^2).

Health Risk Assessment (HRA) questionnaire

The HRA questionnaire was administered after the clinical measures were completed on a Lenovo tablet while participants were seated at a table with the tablet placed on an upright stand on the table. The HRA was designed as a series of questions which were divided into different screens and themes on the Lenovo tablet. Once educators completed the questions on one screen, they were prompted to go to the next screen and answer the relevant questions. In addition to the lifestyle risk factors described below, the clinical and anthropometric measures were recorded on a piece of paper and given to each participant. Participants were required to input these measures into the relevant sections in the Lenovo tablet. (Appendix E shows an example of a printed HRA).

The HRA was comprised of demographic, health and lifestyle risk factor questions, as well as those related to stages of change for the various risk behaviours. The demographic variables included age, gender, personal and family medical history. The lifestyle measures included seven components; smoking habits, habitual alcohol consumption, nutrition habits, levels of physical activity, sleeping patterns, stress levels and work productivity.

Smoking habits

Participants were asked whether they had had ever used tobacco products (cigarettes, cigars and/or pipes). If they answered 'Yes', they were asked to indicate quantities of each and how long they had been smoking or how many years it had been since they quit.

Alcohol intake

Participants were asked whether they felt they needed to decrease their alcohol consumption, whether others were criticising their drinking habits, whether they felt guilty about their drinking habits and whether they had a drink first thing in the morning. They were also asked to indicate the daily quantity of alcohol use and on how many occasions in the past two months, they had more than five drinks on one occasion.

Eating habits

The number of fruit and vegetables, weekly quantity and quality (lean vs. fat, with or without skin) of meat, weekly quantity and quality of (oily vs. normal) fish and daily use of oils (butter, margarine, avocado, salad dressings, olive and sunflower oil), dairy products (low fat vs. full cream vs. skim or fat free) consumption, and the number of glasses of water participants drank were investigated. In addition, educators were asked to indicate daily servings of wholegrain products, amount of salt added to food, the number of cakes, pastries, muffins etc., fried foods, processed meat consumption and fast food consumption per week. Habitual dietary habits were based on the study by Kant *et al.*, (2009)[553]. This tool has subsequently been validated by Till (2014)[554] and has been used extensively in over nine countries.

Physical activity levels

This section comprised the number of days, duration and intensity of exercise, type of exercise and daily sedentary time (number of hours spent sitting in meetings and in front of a computer and watching television). Habitual physical activity was based on the 'Global Physical Activity Questionnaire' (GPAQ)[555]. This is a self-administered questionnaire that included questions on habitual levels of light, moderate and vigorous activity. The physical activity domains include work-related activity, transport and leisure time activity, which were then summed to calculate total minutes of physical activity per week. Participants were categorised according to whether they met the American College of Sports Medicine guideline of 150 minutes of physical activity per week.

Sleeping patterns

Educators were asked to quantify the average hours of sleep they have per night and the sleep quality.

Stress levels

The Kessler 10 is a 10-item instrument that yields a global measure of psychological distress[556] based on questions regarding anxiety and depressive symptoms in the preceding four weeks. The test uses a five value Likert response option for each question: 'all of the time; most of the time; some of the time; a little of the time; and none of the time' which is then scored from five through to one. The maximum possible score is 50 indicating severe distress, a minimum score of 10 indicates no distress. The Kessler psychological distress scale questionnaire has been previously validated[557,558]

Work productivity

Questions relating to an individuals' wellbeing affecting their daily activities was explored in this section. Number of hours worked, number of days missed due to ill-health (both physical and mental), and overall perception of health made up this section. Work productivity was based on the Healthy Days Questionnaire, devised and tested by the US Centers for Disease control[559]. These questions were used to measure health-related quality of life. Healthy days are calculated using a series of four questions, focusing on general perceived health, self-rated physical and mental health and the extent to which physical and/or mental health may have limited activity within the past 30 days[559].

Vitality Age

Once educators completed the wellness day, they were given a report with their risk-related age, called 'Vitality Age' (Appendix G shows an example of the printed Vitality Age report). Vitality Age provides a comparison of an individual's chronological age with their health risk-adjusted age. An algorithm that incorporates multiplicative pooled relative risks for all-cause mortality associated with smoking, physical activity, fruit and vegetable intake, BMI, glucose and cholesterol concentrations, was used to calculate Vitality Age.

The calculation of Vitality Age is described by Kolbe-Alexander et al.[154], as the relationship between all-cause mortality and elevated cholesterol, BMI, habitual weekly physical activity, fruit and vegetable intake and smoking status. Development of the Vitality Age algorithm employed two process. Firstly, a pub-med search was conducted for cohort studies published between 1990 and 2000, which investigated the relationship between the specific risk factor and all-cause mortality after adjusting for age, years of education, SES and co-morbidities. A separate search was conducted for each of the following risk factors: smoking, physical activity, fruit and vegetable intake, serum cholesterol concentration and Body Mass Index (BMI). The second step involved the calculation of a pooled relative risk for each risk factor and all-cause mortality. The pooled relative risks were then entered into a mathematical model which developed to calculate risk-related age. The following assumptions were considered when developing the algorithm to calculate risk-related age; the risk of dying from chronic disease at 20 years of age is 0%; the individual relative risks are independent; the model is only valid for those younger than 70 years; the model is not valid for those who already have a pre-existing condition such as hypertension or diabetes, or those who have already had an "event", such as a myocardial infarction[154]. Vitality Age has been used extensively in at least nine countries where wellness days are conducted as part of a wellness programme.

Vitality Age was purpose-built for creating awareness and 'health messaging' and to encourage lifestyle behaviour change[155]. The variables that lead to a higher Vitality Age include: increased BMI, elevated blood cholesterol and glucose concentrations, elevated blood pressure, diabetes and being a current smoker. Meeting physical activity and fruit and vegetable intake guidelines reduces Vitality Age. The wellness day reports were the 'standard-of-care', and provided targeted feedback for both the control and intervention groups.

The difference between chronological age and the Vitality Age was calculated as an indicator of total risk for all-cause mortality[154]. Behaviours and risk factors that were outside the recommended guidelines (Table 2-1 below) were highlighted and standard advice on ways to improve these values were given. Table 2-1 below lists the risk factor cut-off points for NCD risk.

Table 2-2 Risk factor classification and risk factor cut-off points for CND risk

Risk factor classification	**Value**
Lifestyle risk factors	
Physical activity risk	≤150 minutes of reported low intensity physical activity per week[560]
Nutrition risk	≥ 1 sugar sweetened beverage (SSB) and/or ≥ 1 teaspoon of sugar in tea or coffee per day[561]
Stress status	A combined Kessler 10 score of ≥21[556]
Smoking status	An answer of "Yes" to "Do you smoke?"[562]
Anthropometric risk factors	
Body composition risk	A BMI ≥25 kg/m^2 and/or a waist circumference ≥ 102 cm (for females) and ≥ 88 cm (for males)[563]
Blood pressure risk	Above 140/90mmHg[564]
Biochemical risk factors	
Glucose risk	≥ 6.4 mmol/l[562]
Cholesterol risk	≥5.2 mmol/l[562]
Non-modifiable risk factors	
Age risk	males ≥ 45 years, females ≥ 55 years

B. SMS message evaluation

At the completion of the second wellness day, at the end of the intervention, educators in the intervention group were asked to rate their perception of the effectiveness and relevance of the SMS messages on a Likert scale of 1–5 (1 = strongly disagree, 5 = strongly agree). Participants were also asked how the process could be improved and which SMS's they felt were the most helpful. A copy of the evaluation form can be found in Appendix K.

2.3. HEALTHY SCHOOL ENVIRONMENTAL SURVEY

An additional component which was integrated into the South African National Educators Wellness Study was an audit of the school's health environment (Appendix L). Each school principal was given the school environment survey on the day on which the wellness day was administered. Principals from schools in the Western Cape were requested to fax or email the questionnaire back to the principal investigator once completed. The questionnaires from the Gauteng schools were collected at the end of the wellness day by the principal investigator.

The purpose of the questionnaire was to investigate the degree to which the school's health policies, environment and surrounding neighbourhood may have contributed to the health status of educators and/or the success or failure of the intervention. The school environment audit was adapted from three previous questionnaires. The International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)[565], the Physical Activity Neighbourhood Environment Scale (PANES)[566,567] and the HealthKick questionnaire[568]. The healthy school environment survey was based on previous studies conducted on a sample of 100 urban and rural disadvantaged schools from two education districts in the Western Cape, South Africa[569]. The researchers tried to minimise the bias by sitting with the principals while they completed the questionnaire, this also assisted to clarify any questions they had while completing the questionnaire.

Previous studies have highlighted the limitation that some of the findings, such as those on health priorities within the school community, rely only on the perspective of the school principals[569]. The findings do however contribute to the knowledge of key environmental and policy determinants that play a role in the health behaviour of learners, their parents and educators.

2.3.1 SCHOOL ENVIRONMENT AUDIT EVALUATION

A. School demographics and neighbourhood

This section investigated the school's demographics and the surrounding neighbourhood, and contained seven questions. The first three questions focused on the number of classes, learners and educators in the school and a learner to educator ratio was calculated. The socioeconomic status of the learners within the school and community that it served and the area or community surrounding the school gave an indication of residential density. The mode of transport most learners used to get to school made up the sixth question. Lastly, principals were asked to list any written health policies the school had implemented.

B. The physical environment of the school

Neighbourhood attributes of relevance to physical activity were measured with ten questions. Principals were given four options; 'strongly agree'; 'somewhat agree'; 'somewhat disagree; or 'strongly disagree'. For data analysis, responses were combined to create two levels: agree (strongly agree and somewhat agree) and disagree (strongly disagree and somewhat disagree). The agree answers were given a score of 1 while those for disagree were scored zero. Scores could therefore vary between 0 and 10 with higher values indicating greater environmental support for physical activity. The individual environmental attributes indicated which items were most strongly related to physical activity. A neighbourhood environment index was constructed by summing the number of favourable 'activity friendly' environmental attributes. This scoring system was also adapted from PANES[567]. Questions were also categorised into different constructs. These included land use mix, transit access, pedestrian and bicycle infrastructure, recreation facilities, street connectivity, traffic and pedestrian safety and neighbourhood aesthetics.

In addition to the physical neighbourhood surrounding the school, school safety access and safety measures within the school were evaluated. Eight questions related to safety access to the school. Six questions considered security measures schools implemented in order to ensure safety. Principals were given a 'yes' or 'no' option. With the exception of 'busy roads with high vehicle traffic' where the scoring was reversed, 'yes' answers were scored as a 1, an answer of 'no' was given a score of 0. A higher score indicated more safety and security measures in the school. All answers were summed, a composite score for the physical environment of the school was then generated.

C. Physical activity-enabling environment

The third section investigated the degree to which the school offered a physical activity- enabling environment (five items). Principals were asked to rate the condition of the playgrounds and sports fields, and the types of sports facilities the school had, and whether physical education and extra-mural sports were compulsory at the school. Principals were also asked to list the equipment which could facilitate free play before, during and after school. All 'yes' answers were scored as a 1, an answer of 'no' was given a score of 0. A higher score indicated a more physical activity enabling environment. All answers were summed, a composite score for the physical activity enabling environment was then generated. A higher overall score indicated an environment more conducive to physical activity.

D. Healthy eating enabling environment

Lastly, five items were included that explored community environmental attributes promoting healthy eating. The first two questions investigated the quality, availability and selection of fresh fruits and vegetables in shops and stores in the neighbourhood in the school's vicinity. The third question explored the selection of low-fat products available in shops and stores. Principals were asked about the density of fast food restaurants or vendors that sold high fat, or high sugar, low quality foods in the neighbourhood. With the exception of one question where the scores were reversed (fast food restaurants or vendors), all 'yes' answers were scored as a 1, an answer of 'no' was given a score of 0.

The school nutrition policy consisted of five questions; these included whether the school had a subsidised feeding programme, the sale of soft drinks or sweets/potato chips in the tuck shop (canteens) or by vendors, the sale of soft drinks or sweets/potato chips for school functions, the ability of learners to leave school during the day to purchase food or snacks and the types of foods and beverages vendors within or adjacent to the school are permitted to sell. Principals were also asked to list the types of foods sold at the school and by vendors outside the school. All foods deemed unhealthy received a score of -1, healthy foods received a score of 1. Foods not sold at the school received a score of 0. The 'other' category was excluded from the analysis. All answers were summed, a composite score for a healthy eating enabling environment was then generated. A higher overall score indicated an environment more conducive to healthy eating.

2.4. SAMPLE SIZE CALCULATION

In order to determine differences between the intervention and control schools, with respect to the educators' perception of the tailored vs. standard care, the study by Te Poel *et al.*, was used as a reference[320]. Based on the differences between groups, with a statistical power of 0.80, at an alpha level of 0.05, between 36 and 44 educators per group were required. To show differences in physical activity behaviour between the tailored print communication and standard care, the Vitalum study[570] was used as a model. With a regression coefficient of 0.19 and a standard deviation of 1.92 and a statistical power of 0.80, at an alpha level of 0.05, a minimum sample size of 59 educators per group would be required.

We subsequently recalculated the sample size to accommodate the potential effect of clustering within schools. For this, we estimated the sample size required to detect changes in physical activity behaviour, in response to SMS-text messaging interventions. A number of assumptions were made, based on the results of the systematic review by Buchholz *et al.*[571]. Firstly, we assumed an effect size of 0.6 and a population standard deviation of 1.5. We considered schools as the cluster variable, 50% of which were comprised of the intervention group, and the remainder as the control group. In the present study, there were 27 clusters. We also assumed that the within-cluster correlation coefficient was 0.05. Using the formula by Donner *et al*[572], we required a sample size of 154 per group, to show differences in physical activity behaviour in response to the intervention, after accounting for the cluster effect.

2.5. STATISTICAL ANALYSES

Data were captured in an Excel spreadsheet and subsequently exported in a de-identified manner to STATISTICA (Statistica version 13.2 for Windows, ©1984 – 2016, Dell Inc.). Continuous variables are reported as means ± standard deviations, or medians and interquartile ranges (IQR), whereas categorical data are reported as numbers and percentages. All data were cleaned, and checked for normality of distribution. Where data were not normally distributed, non-parametric procedures were applied. All analyses were conducted by the principal investigator after consultation with the supervisors. It is important to note that codes were allocated to each participant in order to ensure that the statistical analysis was done in a manner which blinded the investigator as to which group received the intervention and which received the standard-of-care.

2.5.1 BASELINE MEASUREMENTS

Descriptive statistics were performed for the total sample. Means and standard deviations were presented for the continuous variables: age, glucose, cholesterol, body mass, BMI, waist circumference, diastolic and systolic blood pressure, weekly physical activity, daily SSB and fruit and vegetable consumption, and Kessler score. Percentages were presented for the dichotomous variables: percent the educators who were female, overweight, obese, hypertensive, not meeting physical activity guidelines, and smokers.

Differences in baseline values between the intervention and control groups, were evaluated using independent t-test for continuous variables. When covariates were applied, baseline measurements between groups were compared using analysis of covariance, and where appropriate, covariates such as age were applied. Where the data were not normally distributed, a non-parametric alternative, the Wilcoxon rank sum test (or the Kruskal-Wallis test for more than two categories) were used. Pearson Chi-squared tests for categorical and dichotomous variables were conducted or Fisher's exact test was used for 2 x 2 tables or where the requirements for the Pearson Chi-squared test could not be met.

2.5.2 PRE AND POST INTERVENTION ANALYSIS

Analyses were conducted using both as per-protocol (APP) and intention-to-treat (ITT) methods. The APP approach proposes including only those individual who adhered to the assigned intervention and completed the pre-specified follow-up without any major protocol deviation[573]. The ITT principle states that any subject should be included and analysed as if he or she has completed the study. The ITT population therefore includes all randomised individuals (excluding the school that withdrew because of the shooting) in the study regardless of whether they completed or complied with all aspects of the study. Given that the ITT estimate would include individuals who may not have received the entire experimental treatment, one would expect them to show attenuated values[574]. According to Collet *et al.*, if the reasons for the dropouts in a study are similar to future dropouts, it can be argued that a valid study-based ITT analysis will adequately address effectiveness[575]. An APP analysis may also result in a reduced sample size, which could result in a loss of statistical power[576,577].

Unlike the APP analysis, the difficulty with implementing an ITT analysis is that as soon as an individual drops out of the study, measurements are no longer available. The most popular method for dealing with missing data in intervention studies is the last value carried forward (LVCF). This method uses the last observation obtained for a participant for all subsequent missing observations[578]. This method assumes that the last observation for a given individual is an unbiased estimate of what the missing value would have been had the individual not dropped out of the study. "This method has been criticised as a simple attempt at imputation that underestimates the variability and provides a biased estimate of treatment difference when time-trend exists"[578]. Since individuals who drop out of the study will not have post-intervention responses, the results of using the full analysis set may be biased toward demonstrating equivalence[579]. For this reason, ITT analysis is sometimes preferred over APP as it tends to avoid over-optimistic estimates of efficacy and is therefore more conservative for a superiority study[578].

The ITT and APP populations have shown different roles in superiority (is the intervention effect greater than the standard-of-care) and in equivalence (is the intervention as effective as the existing standard-of-care) or non-inferiority (is the intervention worse than the standard-of-care) trials[578]. In non-inferiority trials, both ITT and APP analysis are recommended as both approaches should support non-inferiority[580]. An APP analysis tends to overestimate intervention effects, however, the LVCF in a pre-post design may underestimate the overall benefit[581]. For superiority trials, the ITT population would be considered the primary analysis set since it tends to avoid the over-optimistic estimates of efficacy that result from a APP analysis[578]. Non-compliers included in the ITT analysis will generally diminish the estimated treatment effect[579]. According to Ebbutt and Frith, APP analyses always have wider confidence intervals than those for the ITT analyses due entirely to the smaller number of subjects included in the APP analyses[582].

Data from the pre- and post- wellness days was transferred from the Lenovo tablets and stored in secure databases. These were extracted, de-identified and exported into Excel spreadsheets. Completers and drop-outs were compared using a two-way ANOVA for normally distributed data.

Pearson's Chi-squared tests were used in non-normally distribute data. Independent T-test for continuous data or a Pearson's Chi-Square test for nominal or binary data. A two-way analysis of variance for repeated measures, covarying for potential confounders, was applied for the pre-post measures and for sub-group analysis (overweight and obese vs. normal weight, hypertensive vs. normotensive, etc.) based on the intention to treat (ITT) population. Educators were included in the as-per-protocol (APP) analysis if they remained in the study and attended both pre- and post-intervention wellness days.

2.5.3 THE SCHOOL ENVIRONMENT ANALYSIS

Inter-item scale reliability was analysed using Cronbach's alpha[583] and ordinal alpha for the overall scale and subscales[584]. Inter-item correlations and item-rest correlations were also used to assess the scales and the individual items. Item-level inter-item correlations provide a measure of how much the average inter-item correlation would improve with the removal of an item. Item-test correlations show the correlation between the individual items and the scale as a whole, and item-rest correlations show the correlation between the item and the scale if it was created without this item (data not shown, see Appendix O).

As the choices of 'games and equipment available in the school' under the physical activity enabling environment component was much larger than the other questions, it was removed from the analysis.

A Generalised Linear Models which estimated the relationship between the school physical environment, the physical activity enabling environment of the school and the schools' healthy eating environment, with educator health risk status, adjusting for individual level variables (age and gender), as well as school quintile.

2.5.4 SMS MESSAGE ANALYSIS

Responses from the SMS evaluation of educators in the intervention schools were analysed according to quintiles, and the extent to which educators felt they achieved their goals, and the goals they selected. As the 'quit smoking' group was very small (n=5), it was excluded from the analysis. A Kruskal-Wallis analysis was conducted to determine whether there were significant differences in responses, according to the quintiles and goal selected. Where significant differences were observed, a Mann-Whitney with a Bonferroni Correction for multiple variables was conducted to ascertain between which groups the significance occurred.

2.6. STRENGTHS AND LIMITATIONS

The intervention was developed using an adapted IM approach and considered different behaviour change theories. In LMICs where resources are scarce, implementing untested mHealth interventions without a theory of behaviour change is likely to result in many projects failing to be scaled up and in significant levels of wasted resources[585]. Employing evidence-based content and theoretical constructs to interventions can lead to improved health outcomes and has shown promise in helping individuals sustain healthy behaviours[543]. Using an intervention mapping approach in the development, implementation and evaluation of a behaviour change intervention provides a vocabulary for programme planning, procedures for planning activities, and technical assistance with identifying theory-based determinants and matching them with appropriate methods for change[543]. Chapter Two showed that that the application of an adapted IM approach is a feasible and helpful method for providing an evidence-based and theoretical structure to a complex health behaviour change intervention. Chapter One revealed that using behaviour change theories to develop interventions results in greater intervention effects[231,586].

2.7. CONCLUSION

The current chapter presents a detailed outline of the SA-NEWS intervention protocol, which has been developed using an adapted IM model. This chapter has shown that applying an adapted IM approach is a feasible and helpful method for providing an evidence based and theoretical structure to a complex health behaviour change intervention.

Table 2-3 summarises the steps and describes the tasks which took place during each step of the IM process.

Table 2-3 Summary of the steps and tasks which took place during each step of the IM process.

Steps	Relevant tasks and outcomes
Step 1: **Needs assessment**	• Review of the literature: o Global burden of NCDs o NCD burden in South Africa o NCD burden among South African employees o NCD burden among South African educators • Stakeholder consultations: o Meetings with CSTL department of DBE • Behavioural outcomes o Five behavioural outcomes were identified
Step 2: **Matrices**	• Eat five fruits and vegetables per day • Engage in at least 30 minutes of physical activity per day • Achieve a BMI between 18.5 kg/m^2 – 25 kg/m^2 • Not smoking • Find stress releasing techniques • Primary and secondary outcomes of the study
Step 3: **Theory-based intervention methods and practical applications**	• Theory of Planned Behaviour • Transtheoretical Model of behaviour change • I-Change Model
Step 4: **Intervention programme**	• Wellness days • Tailoring for lifestyle behaviour change • Development of the advice messages to address the behaviour change • Data capture and storage • Healthy school environment survey • SMS acceptability
Step 5: **Adoption and implementation**	• If there is a significant improvement in the health status and healthy behaviours of educators, there is potential to upscale the programme and implement it into all ±26 000 schools in SA
Step 6: **Evaluation plan**	• 27 schools randomly allocated into a control and intervention group in two provinces in SA

Chapter 3 **BASELINE HEALTH RISK STATUS OF PRIMARY SCHOOL EDUCATORS IN GAUTENG AND WESTERN CAPE PROVINCES, SOUTH AFRICA**

3.1. INTRODUCTION

The review of the literature in Chapter One revealed that South African educators appear to be less healthy than the general South African population[168,172,177,178,180]. Zuma *et al.*, reported that of the 21 428 educators in their study, just under 22% of educators were hypertensive, 9% were diabetic, 4% suffered from lung or breathing problems, 3% had heart disease and around 1% had cancer[177]. The overall prevalence of overweight and inactivity was also reported to be higher than the general South African population[168]. Further, 16% of educators reported smoking and irresponsible alcohol consumption was reported in 4%[177]. The NCD prevalence in educators has also shown to be on the rise since 2004[181].

In addition to the high NCD prevalence, South African educators have been shown to have very stressful working conditions[171] and are at risk for occupational stress and burnout[172,173]. Studies have shown that between 5% and 20% of all educators are 'burned out' at any given time[172,174]. On average, over one month per year of regular instructional time is lost by each educator in South Africa due to poor health[175].

Together, these studies suggest that South African educators represent an 'at-risk' group for NCDs, in part, due to the associated lifestyle behaviours and occupational stress as well as lack of interventions to address them.

The primary aim of this chapter was to document the baseline levels of risk factors amongst educators in the selected 27 schools. Educators' risk factors were compared to the general South African population, to other worksite studies and to other studies reporting on South African educators' health risk factors. Secondary aims were to report on educators' goals and barriers selection, and the relationship between goals and health risk status. Lastly, the clustering of risk factors was explored.

3.2. METHODS

3.2.1 SAMPLE

The sample represents the 571 educators who were recruited at the outset of the study. All educators attended the first set of wellness days in the 27 schools in the two provinces in South Africa. Of a total possible 623 educators from the 27 schools, 571 attended the first set of wellness days (92%). As participation in the wellness days was voluntary, we did not follow up with those who chose not to attend. We have no data on the characteristics of those educators who declined to participate and cannot say whether they differed in important ways from the educators who chose to participate. A possible reason for the high turnout in the study could have been that the researchers met with each school's principal prior to the study to explain the purpose and protocols of the research. School principals could have acted as gatekeepers. The highest number of educators who chose to participate came from schools where the principals themselves were also enrolled. In addition to the principals agreeing to take part, they also met with the educators and explained the purpose and protocols to them. It has been found that if principals support initiatives within their schools, turnout rates are higher than if principals do not support the initiatives[587].

3.2.2 MEASURES

As described in Chapter Two, baseline measures from the wellness day included a HRA, clinical measures, anthropometric measures and a Kessler 10 questionnaire which is an instrument to measure psychological distress. Questions relating to readiness to change weight, physical activity, eating and smoking habits were also investigated. Educators were asked how happy they were with these behaviours. Three options were given: (i) 'I am happy with my current behaviour', (ii) 'I know my behaviour has to improve, but I don't really want to change it right now, and (iii) 'I want to change the behaviour, and would appreciate some help'. These options were used in section 3.2.6 below to investigate the association between health variables and level of behaviour satisfaction.

At the completion of the wellness day, individuals were given a composite report about their health status, called Vitality Age, a risk-related age determined on the basis of multiple risk factors, which is explained in detail in Chapter Two. Once educators were given their health report, they were asked to select one of five health goals they hoped to change or manage and to rank their top three barriers (1 indicated their top barrier). Briefly, the five goals were: (i) achieving or maintaining a healthy weight; (ii) increasing physical activity; (iii) quitting smoking; (iv) managing stress; and (v) eating a healthy diet. The six possible barriers included: (i) lack of knowledge; (ii) not having enough time; (iii) lack of support from family, friends, co-workers, or community members; (iv) lack of resources (e.g. funds, facilities, access to transport); (v) lack of confidence in their ability to achieve the desired goal and (vi) difficulty with prioritising lifestyle changes.

3.2.3 ANALYSIS

A one-way Analysis of variance (ANOVA) was used to compare the baseline health of educators between quintiles. Where significance was found, a Tukey HSD post-hoc analysis was conducted to determine differences between groups. Chi-square analysis was used to determine relationships between goals, health risk status and readiness to change, as well as clustering of risk factors.

3.3. RESULTS

3.3.1 DISTRIBUTION OF SCHOOLS AND EDUCATORS PER PROVINCE AND QUINTILE

A final sample of 571 educators from 10 Western Cape and 17 Gauteng province schools participated in this study. Quintiles two and five schools had six schools each. There were eight quintile three schools and seven quintile four schools (Table 3-1). Table 3-2 describes the distribution of intervention and control schools per educators and quintile. The study comprised 13 interventioin and 14 control schools. Intervention schools had eight schools from Gauteng and five schools from the Western Cape. Control schools consisted of nie intervention and five cotrol schools (Table 3-2).

Table 3-1 Distribution of schools and educators per province and quintile

Quintile	Total number of schools per quintile	Number of schools from each province		Number of educators from each province per quintile	
		Gauteng province	Western Cape province	Gauteng province per quintile (417)	Western Cape province per quintile (154)
Quintile 2	6	4	2	111 (90♀; 21♂)	37 (30♀F; 7♂)
Quintile 3	8	5	3	130 (105♀; 25♂)	34 (24♀; 10♂)
Quintile 4	7	4	3	80 (66♀ ;14♂)	51 (42♀; 9♂)
Quintile 5	6	4	2	96 (81♀; 15♂)	32 (25♀; 7♂)

♀ = female; ♂ = male

Table 3-2 Distribution of intervention and control schools per educators and quintile

Quintile	Total number of schools	Number of schools from each province		Number of educators from each province per quintile	
		Gauteng province	Western Cape province	Gauteng province per quintile (417)	Western Cape province per quintile (154)
Intervention	13	8	5	200 (163♀; 37♂)	81 (63♀F; 18♂)
Control	14	9	5	217 (182♀; 35♂)	73 (58♀; 15♂)

3.3.2 BASELINE HEALTH STATUS OF EDUCATORS

Table 3-3 summarises the health risk status of educators in the four quintiles.

A. Socio-demographic profile of educators

The mean age for the total group was 44.6±10.1 years. Overall, 82% of the sample were women. The majority of educators were between 40 and 49 years followed by the 50+ age group.

B. Clinical measures

Educators in quintile 5 schools had significantly lower (p=0.023) glucose measures compared to educators in quintile 3 schools. Educators in quintile 2, 3 and 5 schools had significantly lower (p=0.000) cholesterol measures compared to educators in quintile 4 schools. Just over one third of educators were hypertensive. A significantly lower percentage (p=0.000) of educators were hypertensive in quintile 3 and 4 schools compared to educators in quintile 2 schools.

C. Anthropometric risk factors

The mean BMI of the total sample was in the obese category (30.8±7.0). Educators in quintile 5 schools had significantly lower (p=0.000) body weights and BMI measures compared to educators in quintile 2 and 3 schools. Educators in quintile 5 schools also had significantly lower (p=0.010) waist circumferences compared to educators in quintile 2 schools. Overall, 27% of educators were overweight and 50% were obese. A significantly lower (p=0.000) percentage of educators were overweight in quintile 3 and 5 schools compared to educators in quintile 2 schools. A significantly higher (p=0.000) percentage of educators were obese in quintile 3 schools compared to educators in quintile 5 schools.

D. Lifestyle risk factors

Overall 82% of educators did not meet the recommended physically activity guidelines of 150 minutes of MVPA per week. Educators in quintile 5 schools were significanly (p=0.005) more active and likely to meet the recommended 150 minutes of MVPA compared to educators in quintile 3 and 4 schools. Only 11% of the educators met the recommended five fruits and vegetables servings per day. Educators in quintile 4 schools ate significantly more (p=0.006) fruit and vegetables compared to educators in quintile 2 and 5 schools. Educators in quintile 5 schools consumed significantly fewer (p=0.002) SSBs compared to educators in the other 3 quintiles. Finally, educators in quintile 2 schools were significantly less (p=0.001) likely to smoke compared to educators in the other 3 quintiles.

3.3.3 GOAL SELECTION

The most popular goal selected by educators was to achieve or maintain a healthy weight (41%). Twenty three percent selected the healthy diet goal. The percentage of educators who wanted to increase their physical activity levels was almost identical to those wanting to manage their stress (17% and 16%, respectively). Of a possible 57 (10%) of educators who reported being smokers, only 3% (19) selected quitting smoking as a goal (Figure 3-1).

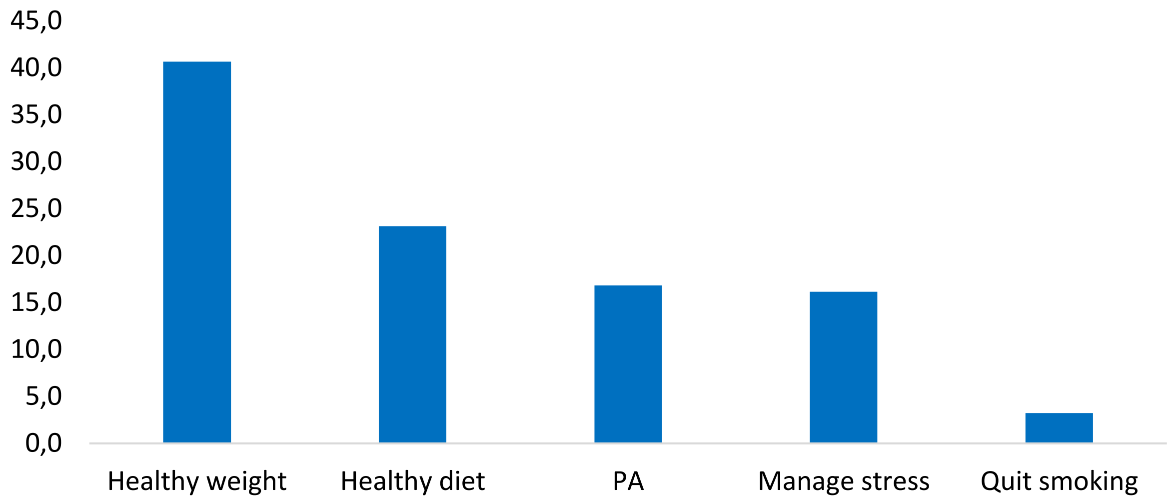

Figure 3-1 Percentage of educators selecting each goal

Table 3-3 Overall health risk status of educators (n=571)

	Overall	Quintile 2 (n=148)	Quintile 3 (n=147)	Quintile 4 (n=148)	Quintile 5 (n=128)	p-value
Non-modifiable risk factors						
Age (years)	44.6±10.1	45.1±8.5	43.6±10.9	45.6±9.1	43.6±11.9	0,239
Clinical measures						
Glucose (mmol/l)	5.6±2.4	5.4±2.1	5.9±3.2*	5.7±2.2	5.1±1.4*	0.023
Cholesterol (mmol/l)	4.5±1.1	4.3±1.1*	4.3±1.0*	4.9±1.1*	4.5±1.2*	0.000
Diastolic BP (mmHg)	81.0±16.2	81.7±17.7	78.5±15.3	83.2±11.5	80.2±18.8	0.068
Systolic BP (mmHg)	129.0±22.8	130.6±24.0	125.8±22.1	132.3±20.0	127.1±24.9	0.057
% hypertensive[a]	35.7%	49.3%*	24.5%*	39.9%	28.1%	0.000
Anthropometric measures						
Body mass (Kg)	80.2±18.1	83.2±17.7*	82.3±16.1*	79.6±18.8	74.8±18.8*	0.000
BMI[b] (Kg/m^2)	30.8±7.0	31.7±6.8*	31.9±6.9*	30.6±6.9	28.5±6.5*	0.000
% educators overweight[c]	27.3%	32.4%*	25.2%*	29.1%	25.0%*	0.000
% educators obese[d]	50.3%	54.1%	57.8%*	49.3%	38.3%*	0.000
Waist Circumference (cm)	94.9±16.5	97.6±14.9*	94.7±16.1	96.2±17.3	91.3±16.2*	0.010
Lifestyle behaviours						
Physical activity (min/week)	73.9±122.2	75.8±143.4	62.3±104.0*	51.4±99.4*	100.1±120.0*	0.005
% educators not meeting physical activity guidelines[e]	81.8%	81.8%	85.0%	88.5%	73.4%	0.008
Fruit and vegetables servings/day	2.5±1.6	2.3±1.5*	2.4±1.6	2.9±1.8*	2.3±1.4*	0.006
SSB[f] per day	1.5±1.9	1.4±1.8*	1.3±1.6*	1.4±1.6*	0.8±1.0*	0.002
% educators who smoke	9.7%	2.0%*	10.2%	14.2%*	14.1%*	0.001
Kessler score	19.8±6.8	20.3±6.7	20.3±6.3	18.3±6.5	20.0±7.2	0.333

Data are presented as mean ± SD; *p<0.05

Quintile 2 = lowest SES schools, Quintile 5 = highest SES schools

aHypertensive =BP ≥140/90mmHg; bBMI = body mass index; [c]BMI ≥ 25 Kg/m^2; [d]BMI ≥ 30 Kg/m^2; [e]% educators not meeting physical activity guidelines ≥ 150 minutes MVPA per week; [f]SSB = sugar sweetened beverages

3.3.4 BARRIERS SELECTED BY EDUCATORS

A. Overall barrier selected

Almost one quarter of educators (23.4%) reported that a lack of time was the major barrier to achieving their goal. The second most cited barrier was a difficulty prioritising lifestyle changes (22.3%). These were followed by a lack of knowledge about what to do and how to do it (18.6%), lack of resources (15.9%) and a lack of confidence in their ability to achieve the goal (12.8%). Only 7% felt that a lack of support from family, friends, co-workers or community members was a barrier to achieving their selected goal (Figure 3-2).

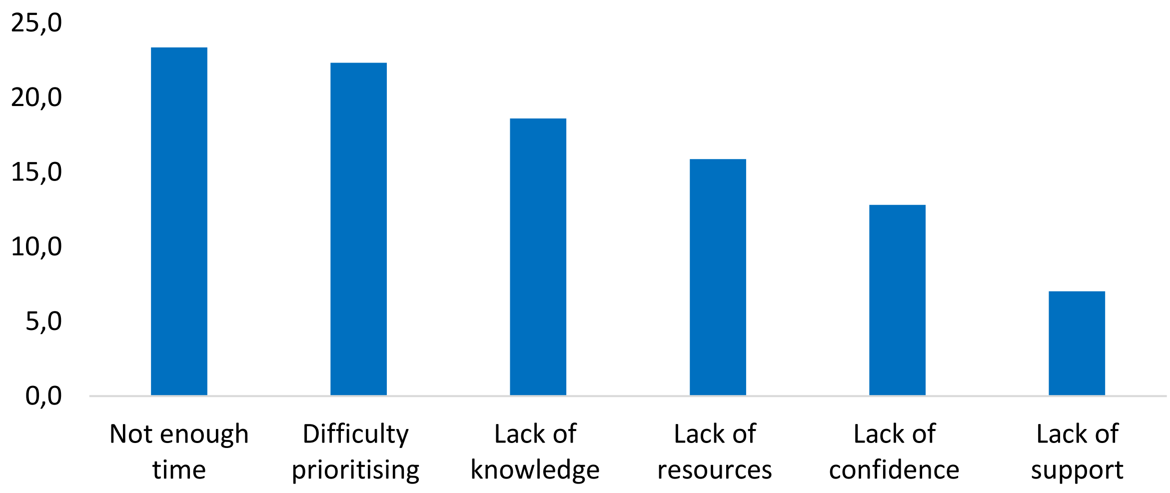

Figure 3-2 Percentage of educators selecting each barrier

3.3.5 RELATIONSHIP BETWEEN GOAL SELECTION AND HEALTH RISK STATUS

There was no clear relationship between goal selection and health risk status or specific lifestyle behaviours. Educators who selected the 'achieve or maintain a healthy weight' goal were not significantly more overweight or obese than educators who selected any other goal ($p=0.584$). Similarly, those who chose to 'manage their stress' as a goal did not have significantly higher Kessler scores than educators who selected a different goal ($p=0.333$). The results were consistent for educators who selected any other goal. This lack of association is probably due to very high prevalence of overweight and obesity and very low levels of health behaviours across all groups.

3.3.6 READINESS TO CHANGE AND HEALTH RISK STATUS

Educators were asked to rate 'how happy they were' with their weight, physical activity levels, eating and smoking habits and whether they wanted help to imrove these behaviours (see section 3.2.2 above). The association between the perceptions and associated risk factors are analysed below.

A. Relationship between BMI category and readiness to change body weight

Perception of weight was significantly associated with BMI category ($p<0.000$). The proportion of educators who wanted help to lose weight was higher, and the proportion of those who were happy with their current weight was lower, was associated with BMI (Figure 3-3).

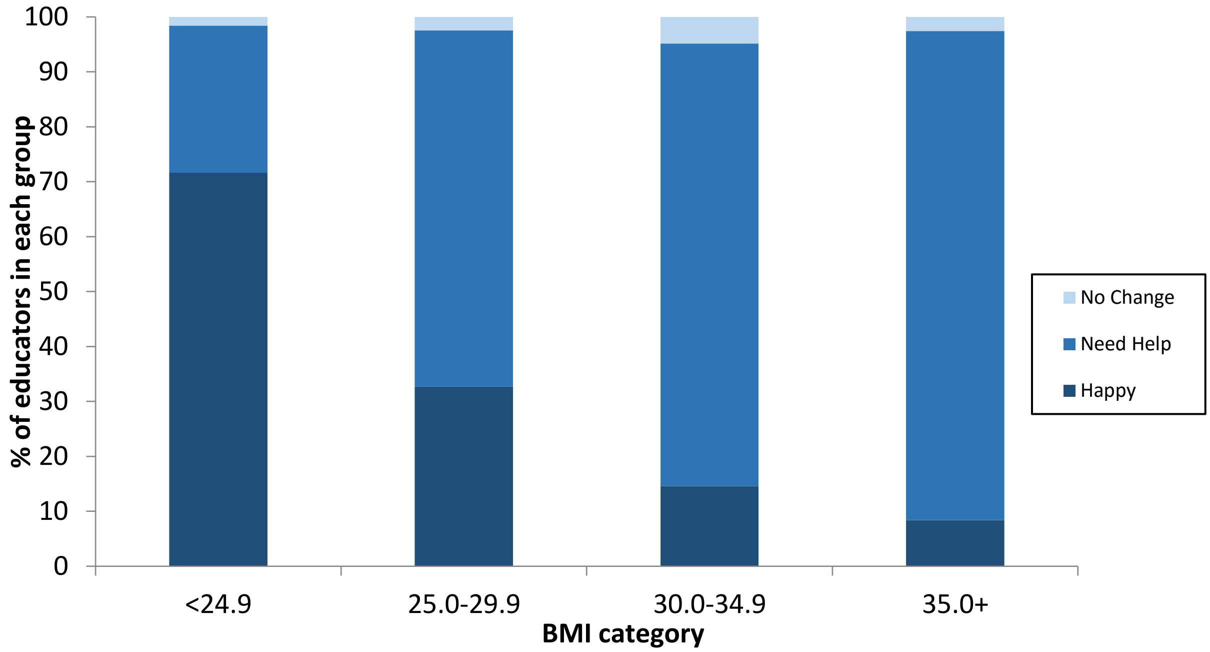

Figure 3-3 Relationship between body weight perception per BMI category

B. Relationship between body weight perception and BP category

Perception of weight was significantly associated with BP category ($p<0.0001$). The proportion of educators who wanted help to manage their weight was higher for those with high BP compared to those whose BP was normal (Figure 3-4).

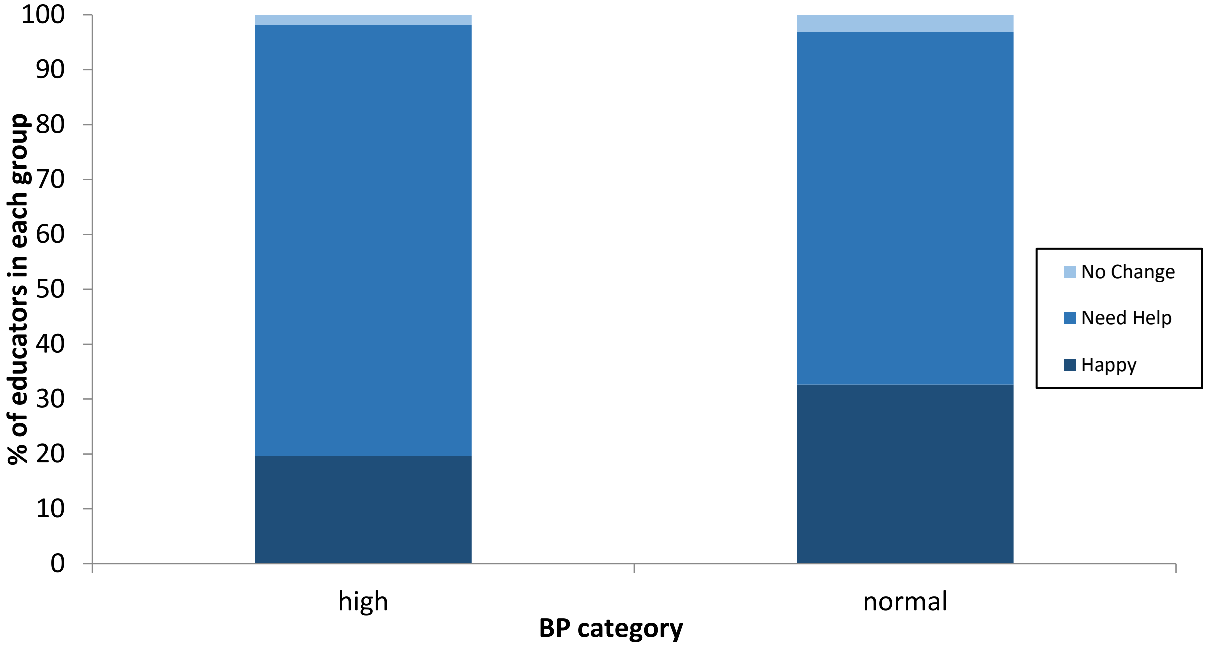

Figure 3-4 Relationship between weight perception and blood pressure category

C. The relationship between physical activity perception and BMI category

Perception of readiness to change physical activity levels was significantly associated with BMI category (p=0.001) and physical activity (minutes per week) (p=0.0001). The proportion of educators who wanted help was higher in persons with a higher BMI (Figure 3-5). Similarly, the proportion of educators who wanted help to become more active was higher, and the proportion in those who did not reach the physical activity recommendation of 150 minutes of MVPA per week (Figure 3-6).

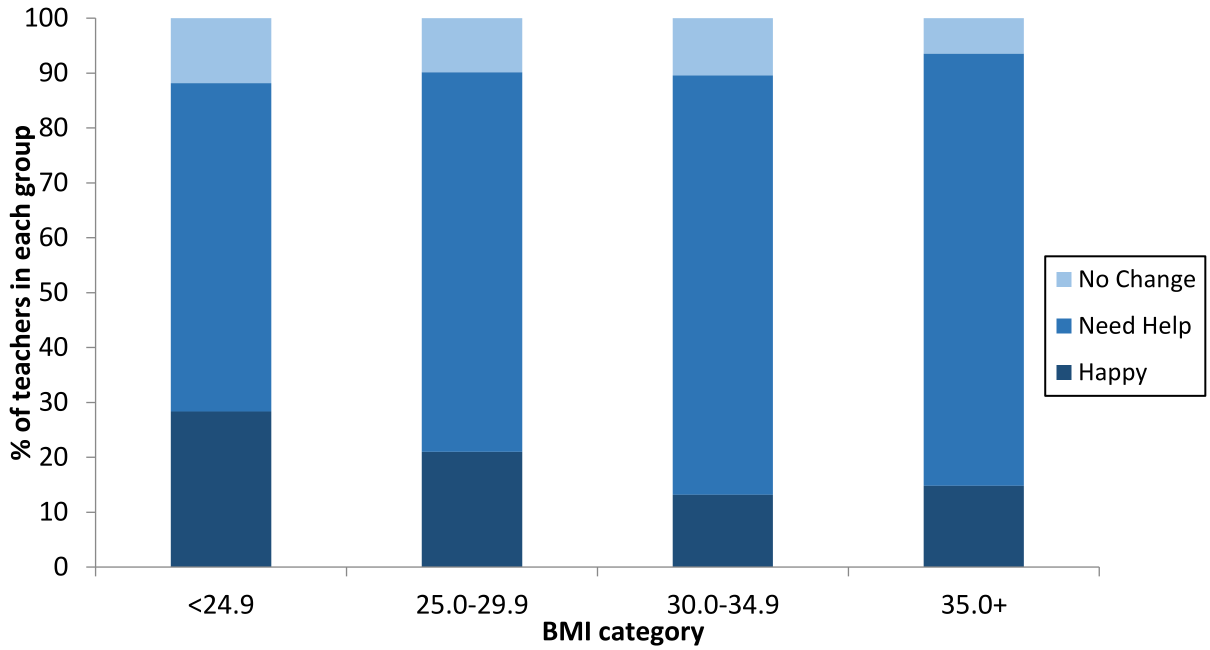

Figure 3-5 Relationship between physical activity perception and BMI category

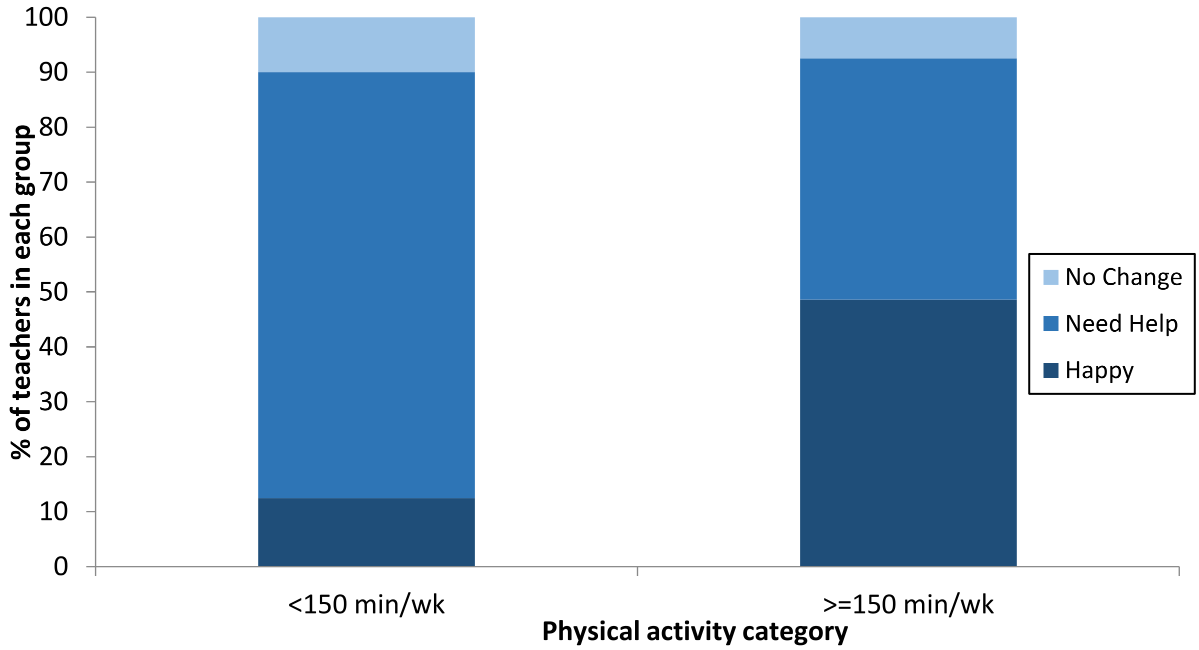

Figure 3-6 Association between physical activity perception and physical activity

D. Relationship between eating habits perception and BMI category

There was a significant association between perceived eating habits and BMI category (p=<0.0001), and also with exercise (minutes per week) (p=0.0001). The proportion of educators who wanted help was higher, and the proportion of those who were happy lower, with increasing BMI category (Figure 3-7). In addition, the proportion of those who wanted help was higher, and the proportion of those who were happy was lower, for those who were insufficiently active (Figure 3-8).

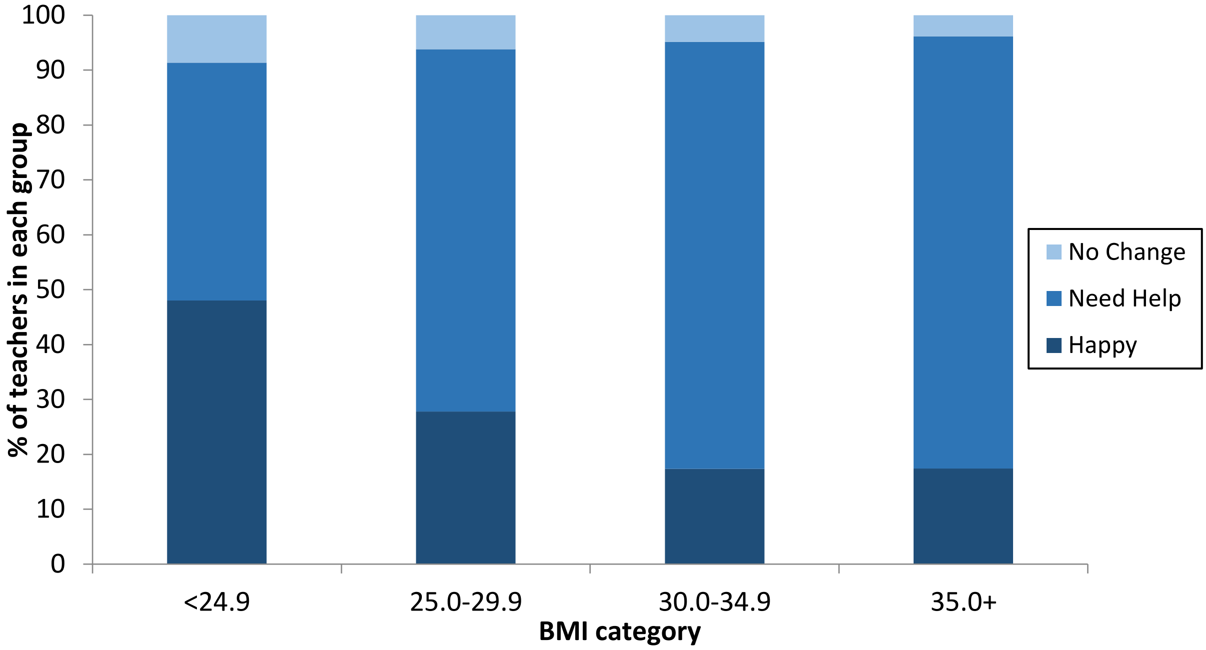

Figure 3-7 Relationship between eating habits perception and BMI category

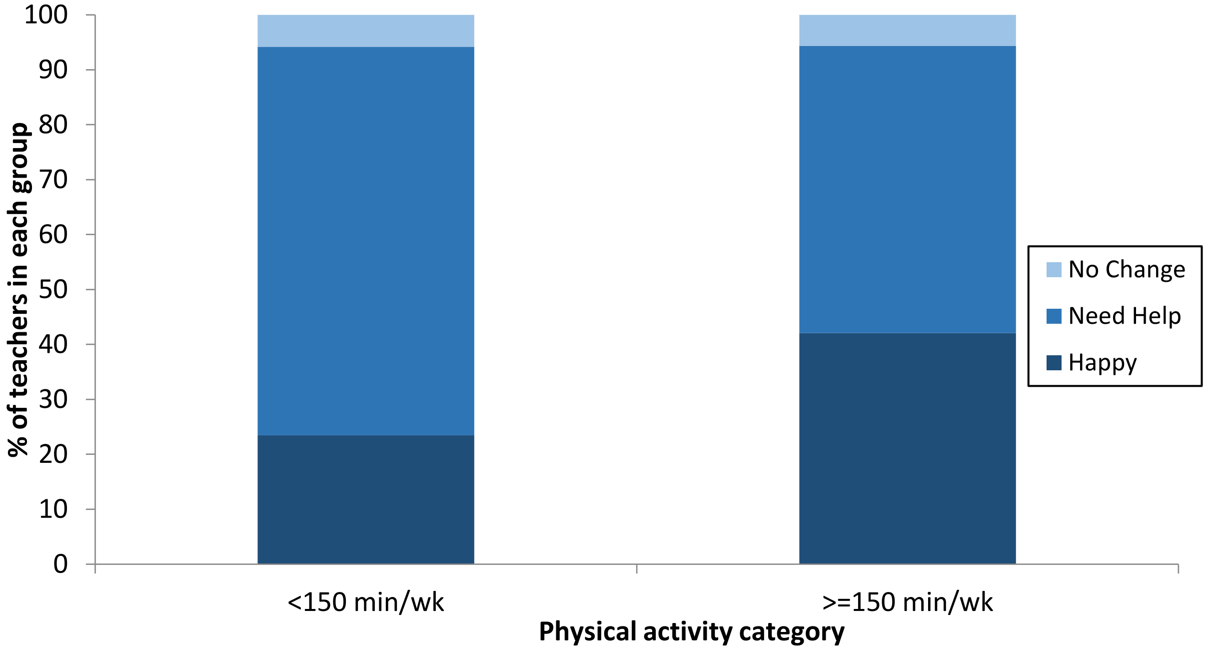

Figure 3-8 Association between eating habits perception and physical actity

E. Relationship between Kessler 10 Score and physical activity

There was a significant association between the Kessler 10 Score and physical activity levels (minutes per week) (p=0.0001). The proportion of educators who needed help to manage their stress was higher, and those who are happy was lower, in the group which did not meet the physical activity target (Figure 3-9).

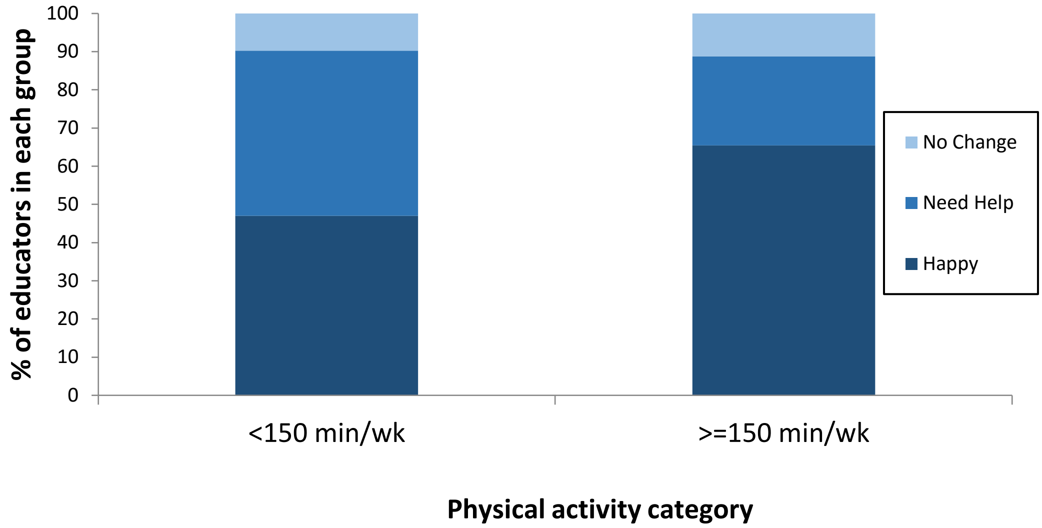

Figure 3-9 Relationship between stress status and physical activity

F. The association between health goals and BMI category

Health goal perception was significantly associated with BMI category (p=0.0001). The proportion of educators wanting to achieve or maintain a healthy weight was higher, and those wanting to increase their fitness was lower, as BMI increased (Figure 3-10).

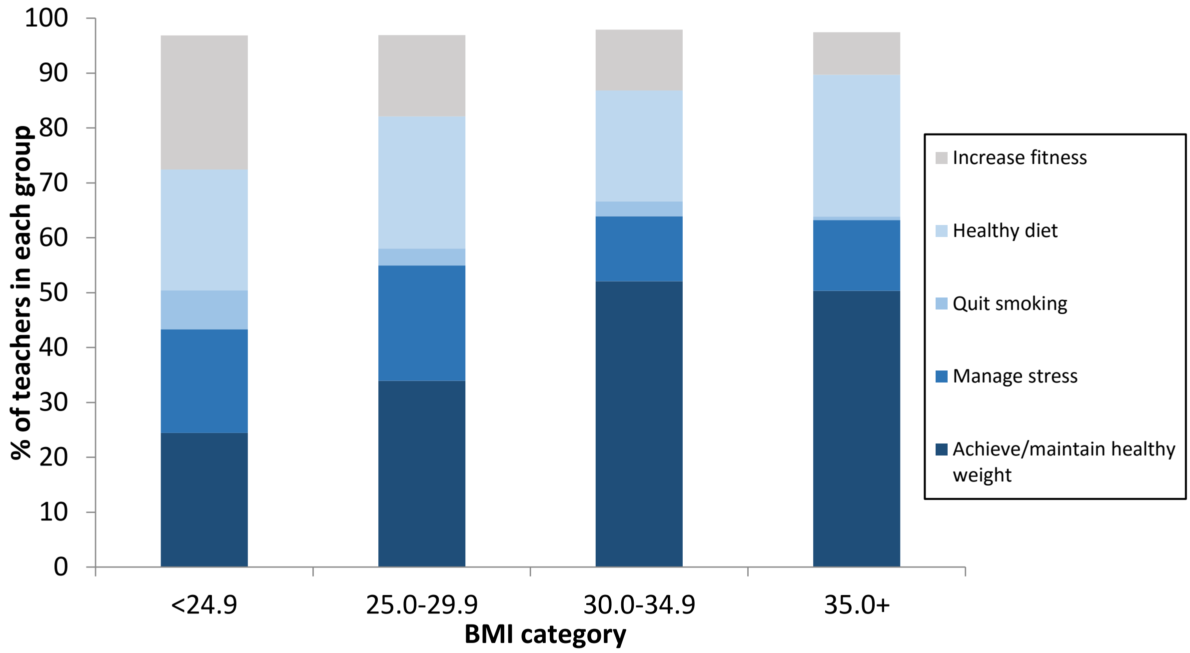

Figure 3-10 The Relationship between health goals and BMI category

3.3.7 CLUSTERING OF NCD RISK FACTORS

A. Overall clustering of NCD risk factors

Overall, educators had an average of 4.2 risk factors. When considering the biochemical and anthropometric risk factors only, educators had an average of 1.8 risk factors out of a possible five. Educators had an average of 2.0 risk factors out of a possible 4 for lifestyle risk factors (Table 3-3).

Table 3-4 Percent and number of educators with various categories of risk factors (n=571)

Number of risk factors	Overall risk factors[1]	Biochemical and anthropometric risk factors[2]	Lifestyle risk factors[3]
1	5.4% (32)	44.6% (262)	29.2% (172)
2	14.2% (84)	29.4% (156)	43.2% (237)
3	18.7% (93)	17.3% (102)	24.7% (145)
4	24.0% (141)	7.3% (43)	2.9% (17)
5	19.7% (116)	1.4% (8)	
6	11.6% (68)		
7	4.8% (28)		
8	1.6% (9)		
Average number of risk factors	**4.5**	**2.1**	**2.2**

[1]Physical activity, nutrition, smoking, stress, body composition, BP diastolic, BP systolic, glucose, cholesterol, age

[2]Body composition, waist circumference, blood pressure, glucose, cholesterol

[3]Physical activity, nutrition, smoking, stress

Risk factor cut off limits: Hypertensive =BP ≥140/90mmHg; Overweight = BMI ≥ 25 Kg/m^2; Obese = BMI ≥ 30 Kg/m^2; Physical activity guidelines ≥ 150 minutes MVPA per week; Nutrition = ≥ 5 fruits and vegetables per day

B. NCD risk factors per school quintile

Table 3-5 highlights the prevalences of lifestyle and clinical risk factors amongst educators, according to school quintile.

Table 3-5 Number of NCD risk factors per quintile

Number of risk factors	Quintile 2 (n=148)	Quintile 3 (n=147)	Quintile 4 (n=148)	Quintile 5 (n=128)
1	0.7% (1)	2.0% (3)	4.7% (7)	3.9% (5)
2	8.1% (12)	8.9% (13)	8.1% (12)	12.5% (16)
3	11.5% (17)	11.6% (17)	10.1% (15)	12.5% (16)
4	27.0% (40)	22.4% (33)	19.6% (29)	30.5% (40)
5	21.7% (32)	26.5% (39)	22.3% (33)	22.7% (29)
6	18.2% (27)	16.3% (24)	22.3% (33)	13.3% (17)
7	10.8% (16)	10.3% (15)	11.5% (17)	2.3% (3)
8	2.0% (3)	2.0% (3)	1.4% (2)	2.3% (2)
Average number of risk factors per quintile	**4.7**	**4.6**	**4.7**	**4.1**

3.4. DISCUSSION

The baseline health risk status of educators who attended the baseline wellness days in the 27 schools is presented in this chapter. Educators' goals and barriers selection, the relationship between goals and health risk status, as well as the clustering of risk factors were also explored.

3.4.1 BASELINE HEALTH STATUS OF EDUCATORS

The first important finding of this study is that the high prevalence of overweight and obesity and the added risk of central adiposity (as measured by waist circumference) is a cause for concern and puts this sample of educators at a higher risk of developing NCDs than the general South African population[114]. Senekal *et al.* reported overweight and obesity rates of 31% and 47%, respectively in 517 educators from low SES areas in the Western Cape[168]. Our study recruited a similar number of educators, however, they were from low, middle and high SES areas as well as from two provinces in South Africa. These differences may have contributed to the differences in the prevalence of overweight and obesity in this study.

Further, educators in this study were found to have similar obesity rates and waist circumference measurements to educators in India, another LMIC[588]. Sixty percent of educators in the Indian study were classified as obese with a BMI above 30kg/m^2, only 16% had a BMI below 25kg/m^2, while 65% had a waist circumference greater than the normal cut-off values[588]. Obesity has been associated with a significant psychosocial burden[589]. A higher BMI has been linked to decreased quality of life and increased depressive symptoms and higher rates of mood disorders[589]. Obese individuals are often stigmatised and discriminated against in a wide range of social situations, including the workplace[589]. Persons with obesity report less satisfaction with their employment than individuals of average body weight[589]. Obesity may pose an economic burden to the workforce through direct healthcare costs as well as indirect costs, such as increased absenteeism from work due to health problems and reduced productivity[590,591]. Overweight and obese employees have been shown to have more days of sick leave compared to normal-weight employees. Obese individuals also tend to have longer duration of individual sick leave[592,593]. Managing obesity is therefore key to reducing the burden of NCDs and improving the health of populations[594].

Just over one third (36%) of the educators in this study had mean systolic and diastolic blood pressure above the respective cut-offs for hypertension[595]. This is very similar to other worksite settings in South Africa. Kolbe-Alexander *et al.*, reported one in three employees from a sample of 2 867 from various worksite settings were diagnosed with blood pressure values above 140/90mmHg[155]. Educators in this study were three times more hypertensive than the South African general population[114]. Shisana *et al.*, reported hypertension rates of 10.2% and 11.8% in the in the male and female general populations respectively[114]. Hypertension rates among educators in South Africa has been varied. Senekal *et al.*,[168] reported a higher percentage of educators who were hypertensive (43.5%) compared to the present study. Zuma *et al.*,[177] found a lower proportion of educators in their study to be hypertensive (22.1%). The prevalence of hypertension in South African educators reported by Zuma *et al.*, is very similar to those found in Indian and Ethiopian educators[588,596]. These discrepancies could be related to the particular populations, the different sample sizes and location of the studies.

A very concerning finding was that more than 50% of educators reported that they did not participate in any moderate-to-vigorous physically activity (MVPA). Physical inactivity is recognised globally as the fourth leading risk factor for mortality and is responsible for approximately 6% of NCD risks such as coronary heart disease, type 2 diabetes, breast cancer and colon cancer[597]. Educators who did report being physically active spent most of their time engaging in low intensity physical activity, such as standing and walking. Educators in this study also reported being less physically active than individuals in other South African worksite studies (73.9 minutes per week compared to 115.7 minutes per week)[154].

In addition to the lack of physical activity, educators in this study also reported consuming fewer fruit and vegetables than the general South African population[114]. Fruit and vegetable consumption was low in both cohorts, with 89% of educators and 81% of the general population consuming less than the recommended five fruits and vegetables per day. The amount consumed was however comparable to other employed individuals in South Africa[154].

In contrast to many studies[171,172,174], the current study found that most educators reported low to moderate stress levels of stress and 'burnout'. Numerous studies have also shown that educators face the greatest amount of pressure at work[598,599]. Educators' responsibilities often goes beyond the classroom, they interact with people whose safety and well-being they are responsible for, apart from their role of educating[600]. Furthermore, women and younger educators appeared to experience less psychological distress than men and older educators. Domingo *et al.*, found high levels of stress among primary school educators in the Western Cape[601]. There were however no differences between men and women. This may have been due to both genders in their cohort being similar in age, and of similar cardiovascular risk, and experiencing the same type of job stress[601]. In contrast to previous findings[171,172,174], educators in the present study appear to cope with their work demands. It is also plausible that the lower levels of stress in educators in this study may be due to the fact that they felt a higher degree of self-efficacy and were less overwhelmed and therefore felt more confident to participate in the study. Different measurement tools used to assess stress and 'burnout' inventories and different working conditions in schools may have also resulted in the conflicting findings between this and previous studies.

3.4.2 GOAL AND BARRIER SELECTION

As over 40% of the educators selected to achieve or maintain a healthy weight as a goal, it appears they were concerned about their weight and felt it is necessary to manage it. This is supported by the readiness to change, as educators with a higher BMI were more likely to indicate that they were unhappy with their weight and needed help. The lack of a significant relationship between educators who selected the healthy weight goal and those who were overweight or obese may be related to the fact that overweight and obesity were so prevalent (>80%). These results are supported, in part, by a previous study of employed South Africans undergoing wellness day screening. In the study by Kolbe-Alexander[155], the majority of persons who were overweight or obese expressed a desire to lose weight.

3.4.3 RELATIONSHIP BETWEEN GOALS AND HEALTH RISK STATUS

No association was found between any goal selected and risk status. Senekal *et al.*, highlighted that awareness of health problems was very low amongst South African educators[168]. One third of hypertensive educators in their study did not know they were hypertensive. Further, 38% of female educators and 32% male educators who were overweight/obese, thought that their weight was normal[168]. This finding does not appear to be unique to South African educators. In a study of 1 954 employees from 18 companies, one fifth of the employees who consumed less than five servings of fruit and vegetables per day, believed that their habitual diet was already healthy and 37% reported that their diet was healthy with only occasional periods of unhealthy eating. Just under one-third of the cohort who did not consume sufficient fruit and vegetables expressed a desire to improve their nutritional habits. On the other hand, 62% who were identified as insufficiently active expressed a desire to increase their weekly levels of habitual physical activity, 11% reported that they were doing sufficient exercise, while 23% indicated that they were not intending to become more active[154]. Increasing awareness and public health education related to NCDs is an important step to reducing their prevalence[168].

In the present study, another possible explanation for the lack of significant association between the goal selected and health risk status, may be due to the fact that the majority of educators had more than one risk factor, and as such, the goal selected may have reflected one of several.

3.4.4 SOCIOECONOMIC STATUS AND HEALTH RISK

Overweight and obesity appeared to be strongly linked to SES in this study. Educators from higher quintile schools were significantly less likely to be overweight and obese compared to those from lower quintile schools. The findings of this study however appear to contradict previous findings amongst the general South African male population where obesity rates among rich men are likely to be higher compared to their poorer counterparts by a CI of 0.27, probably due to the adoption of Western lifestyles and diets[594,602]. Women on the other hand have similar obesity patterns, regardless of socioeconomic status with CI of 0.07[594]. The higher obesity rates in the general population compared to educators in this study, may be related to levels of education. Educators are generally more educated than the general South African population, this becomes even clearer when this population is further stratified by SES.

Educators in quintile 2 schools had a two-fold greater likelihood of being hypertensive compared to educators in quintiles 3 and 5. The impact of SES on hypertension has been mixed in the South African general population[603,604]. Inconsistencies in SES measurements, sample heterogeneity, and varying methods of blood pressure measurement have been sited as possible explanations of these conflicting results[34].

Although educators in quintile 4 schools were the least physically active and had the highest proportion of educators not meeting physical activity guidelines, they reported consuming the highest number of fruit and vegetable portions per day. Schools in quintile 4 and 5 do not belong to the NSNP. Educators and learners in these schools therefore rely more heavily on food they bring from home and on the school tuck shops for food[605]. It is possible therefore that educators in the higher quintiles may eat healthier food as they can select what to bring to school and what to buy. Educators from quintile 5 schools accumulated almost double the weekly physical activity minutes compared to quintile 4 schools. The significantly higher physical activity patters of educators in quintile 5 schools in this study may have also contributed to the lower rates of overweight and obesity in the high SES group.

Lastly, the increasing prevalence of smoking as quintile increases may be related to affordability. Cigarette prices in South Africa, rose nationally from ZAR18.99 ($2.59) in 2008; to ZAR21.99 ($3.00) in 2010, and reached ZAR30.90 ($3.77) in 2012[88]. Individuals from lower SES populations are generally more sensitive to changes in prices and taxes compared to individuals from higher SES populations because of their lower disposable incomes[606]. Increased tobacco taxes therefore accompanied by reduced affordability have been consistently shown to help reduce tobacco consumption among low SES individuals[607].

3.4.5 CLUSTERING OF RISK FACTORS

The present study found that 83% of educators had three or more risk factors for NCDs. School quintiles showed an even higher occurrence of clustering. Quintile 2 schools had the highest percentage of educators with 3 or more risk factors (91%), 89% of educators in quintile 3 had 3 or more risk factors, 87% of educators in quintile 4 had 3 ore more risk factors. Quintile 5 had the lowest number of educators with 3 or more risk factors (84%), individuals in Quintile 5. Further, educators in quintile 5 schools also had the lowest average number of risk factors (4.1 compared to 4.7, 4.6 and 4.7 in quintiles 2, 3 and 4 respectively). Kolbe-Alexander *et al.*, found that individuals with two or more risk factors had significantly more visits to medical practitioners, and subsequently, higher associated healthcare expenditure[155]. Khaw *et al.*, reported that people who are physically inactive, smoke, consume excessive alcohol, and consume less than five servings of fruit and vegetables per day, had a more than four-fold increase in risk of all-cause cardiovascular mortality compared to individuals who do not engage in all four risky behaviours[608]. Conversely, Ford *et al.*, reported that individuals who do not smoke, eat a healthy diet and are physically active have a 65% lower risk for cardiovascular disease mortality compared to individuals who do not engage in these risk-lowering behaviours[609].

Compared to other quintiles, educators from quintile 5 schools had the lowest number of risk factors. Educators in these schools also had the lowest glucose, body mass, BMI and waist circumference values as well as the lowest number of hypertensive, overweight and obese individuals. Educators from quintile 5 schools also accumulated the highest number of weekly physical activity minutes compared to educators from other quintiles. An overview of systematic reviews investigating SES inequalities in NCDs and their risk factors revealed that low SES and/or living in LMICs increased the risk of developing cardiovascular diseases, lung and gastric cancers, type 2 diabetes, and chronic obstructive pulmonary disease (COPD). Furthermore, low SES increased the risk of mortality from lung cancer, COPD, and reduced breast cancer survival in high-income countries[9]. To our knowledge, the impact of SES on NCDs in South African schools has however not been investigated.

3.5. STRENGTHS AND LIMITATIONS

Although the sample size was relatively small, the study attempted to recruit a diverse group of educators and schools from different ethnic, SES and religious backgrounds. Although limited, this diversity could allow for a certain amount of generalisability of results.

This study has several limitations. Firstly, a convenience sample of educators that comprised of individuals presenting for a health risk assessment may have resulted in sampling bias. The results of this study may therefore not be applied to the general population. The sample size, although comparable with others investigating the health of educators in South Africa, might limit the ability to generalise to other populations. Further, although the mean age distribution in this study was similar to thos reported by Zuma *et al.*[177] and Senekal *et al.*,[168]the percent of female educators in this study (82%) was considerably higher than those reported in previous studies (60%[168] and 70%[177]) and is higher than the national proportion of female educators in the coutry (69.4%)[163] making generalisations to the entire educator population almost impossible.

Secondly, as the sample in this study was relatively small and it is well established that intervention samples typically include individuals who are more motivated to improve their health, selection bias may have decreased the generalibility of the findings. There were numerous layers of selection bias which could have taken place in this study. Firstly, not all educators from the schools attended the wellness days. Secondly, not all educators who attend the first wellness days participated in the study. Lastly, not all educators who attended the first wellness days attended the second set of wellness days, this will be explored in more detail in the next chapter. This leaves a very select group of individuals, very unlikely to be representative of the entire educator population.

Clustering analysis between clinical measures (obesity, hypertension, elevated cholesterol and glucose measures) and lifestyle risk factors (lack of physical activity, poor eating habits and stress) was not statistically analysed. We also did not analyse the association between health risk status, lifestyle goals and school SES.

Although the questions relating to lifestyle risk habits (levels of physical activity, eating habits, alcohol intake,smoking habits and stress levels) were based on previously validated questionnaires, the self-reported nature of the HRA could have resulted in bias.

3.6. CONCLUSIONS

The findings of this study demonstrated that this sample of educators are, on the whole, less healthy than the general South African population and other employed individuals in South Africa. The high levels of obesity, hypertension, waist circumference, lack of physical activity and poor nutritional choices place this sample group at elevated risks for NCDs.

In addition to their normal teaching responsibilities, educators are often expected to be role models for healthy behaviours for their learners[610]. The World Health Organisation School Policy Framework[170] therefore highlights the importance of the need for educators to be aware of and responsible for the messages they give to learners. Hartline-Grafton *et al.*, argue that greater attention should be directed towards improving the health of educators, not only for their own health status but also to improve their effectiveness as role models for their learners[611]. Educators who are of normal weight and who are regularly seen to eat healthy foods are more likely to have learners who eat healthier foods and are of normal weight[167].

It is therefore vital to strengthen integrated educator health and wellness programmes, including partnerships with private and public health-care providers[177]. This should also include screening for NCDs as well as referral systems and interventions to address these NCDs[177]. The rationale for exploring clustering of health behaviours was to identify high risk individuals and groups that can be targeted through primary prevention. Wilson *et al.*, demonstrated that the co-occurrence of various lifestyle behaviours on health over a lifetime may significantly increase disease risk to a level greater than either factor alone[612].

Lastly, intervention efforts should focus on educators who have multiple risk factors. Future research should investigate other demographic, personality, cognitive and environmental factors associated with educators who have multiple risk behaviours. Such investigations may further help to guide and refine intervention efforts.

The development of an educator NCD risk profile could help predict the future burden of disease as well as providing key information required for planning effective interventions. Although the present sample may not be representative of other educators in the country, the baseline information on the magnitude of the problem of risk factors provided by this study can help policymakers to set up interventions addressing the NCD epidemic. There is therefore a need to find simple, practical, affordable, scalable and best-practice solutions to assist and motivate educators to overcome the barriers which they face.

Chapter 4 **THE EFFECTS OF TAILORED PRINT COMMUNICATION AND SMS TEXT-MESSAGING ON RISK-FACTOR MODIFICATION IN EDUCATORS -THE SOUTH AFRICAN NATIONAL EDUCATOR WELLNESS STUDY (SA-NEWS)**

4.1. INTRODUCTION

Chapter Three confirmed that South African educators are an 'at risk' population, with a high degree of risk factor clustering and are less healthy than the general South African population[114]. Many of these conditions are preventable and may interfere with worker productivity. Although a limited number of studies have focused specifically on employees in school systems, they have shown that educators experience similar health problems and unhealthy behaviours as the general South African employed population[168,172,178]. Educators have also been shown to have very stressful working conditions[171]. Van Deventer[613] and Sedibe[614] found that educators who are responsible for conveying health messages to learners generally felt unsupported and under resourced to teach health issues. There is also some indication that they are at risk for occupational stress and 'burnout'[172,173]. These behaviours may directly affect their productivity, classroom effectiveness, absenteeism and health care costs[172]. Educators who are unhealthy and stressed cannot be appropriate role models for their learners[167]. The literature also highlighted the paucity of interventions targeting this at-risk population. There is therefore an urgent need for a sustainable intervention, that could be implemented at scale and within the capacity of the DBE.

Tailored interventions have been shown to have high efficacy, effectiveness and acceptability in supporting and changing healthy behaviours in other population groups[260,337]. Following a health risk assessment, tailored messages can be delivered to large groups of people at a relatively low cost making them a scalable, rapid and inexpensive way to communicate health risk status as well as providing advice to improve risk status[22]. This intervention was designed in consultation with the DBE using an adapted Intervention Mapping method.

We hypothesised that the tailored print and SMS-text communication intervention, in addition to the standard-of-care feedback following a wellness day health risk screening, would result in greater changes in health risk behaviour than the standard-of-care. The results of the intervention are reported in this chapter.

4.2. METHODS

The methods for the intervention were discussed in detail in Chapter Two. Between February 2015 and August 2015, 27 schools were recruited. All educators (n=571) participated in a wellness day at the beginning of the study. Three hundred and forty eight educators attended the second wellness day after the five-month intervention. In addition to the immediate, onsite targeted print feedback educators received at the wellness day (see Appendix G for an example), educators in the intervention group also received one tailored letter with advice on how to overcome the three barriers for the goal that they selected, as well as a minimum of eight SMS-text messages, scheduled over a five month period, and sent at one week intervals (Figure 4-1).

4.2.1 Statistical Analysis

Briefly, completers were compared to drop-outs using indepent t-tests and Chi-Square analysis to explore potential bias for interpreting the effectiveness of the intervention. The results of the intervention were evaluated in a blinded manner, using a two-way analysis of variance for repeated measures, both APP and by ITT, using the LVCF.

4.3. RESULTS

4.3.1 4.3.1 COMPARISON BETWEEN PARTICIPANTS WHO COMPLETED PRE-POST ASSESSMENT AND THOSE WHO DROPPED OUT

Table 4-1 summarises the characteristics of educators who dropped out and those who completed the study for the intervention and control groups. Of the 571 educators who attended the first wellness day at baseline, 348 attended the follow up wellness day (n=156 and n=192 in the intervention and control groups, respectively). The retention rate was therefore 61%. The intervention group had a higher dropout rate (41%) compared to the control (38%) group. The two-way ANOVA revealed significant differences ($p<0.05$) between those who completed the study and those who dropped out for gender ($p=0.000$), physical activity levels ($p=0.000$), fruit and vegetable intake ($p=0.000$) and daily consumption of sugar-sweetened beverages (SSBs) ($p=0.000$).

Men in the control group had a significantly greater propensity to drop out than women ($p=0.0001$). The educators who dropped out from both groups were significantly more physically active at the outset ($p=0.000$), and reportedly drank fewer SSBs ($p=0.000$), but their overall fruit and vegetable consumption was also lower ($p=0.000$). Educators in the control group who completed the study had significantly lower BMI values ($p=0.032$) and waist circumferences, compared to those who dropped out ($p=0.082$).

There was a significant interaction effect for cholesterol ($p=0.030$) and BMI ($p=0.032$) in educators in the intervention group who completed the study. Individuals in this group had significantly higher cholesterol concentrations ($p=0.030$) and BMI levels ($p=0.032$) at baseline compared to the other three groups. Educators who completed the study in both intervention and control groups had the highest Kessler scores, which indicates that those who stayed in the study experienced more psychological distress and anxiety than those who dropped out. Results appear to indicate that those who completed the study, irrespective of group, had an overall less favourable health risk status at baseline.

Table 4-1 Comparison of educators who dropped out vs. those who completed the study in the intervention and control groups

	Control (n=307)		Intervention (n=264)		
	Dropped out (n=115)	Completed the study (n=192)	Dropped out (n=108)	Completed the study (n=156)	p-value
Non modifiable risk factors					
Age (years)	45.4 ±10.1	43.7 ± 10.1	44.9 ± 10.3	44.3 ± 9.9	† 0.777 * 0.162 ∞ 0.326
Gender (% female)	80% (92)	83% (160) †*	79% (99)	80% (125) †*	† 0.000 * 0.000
Clinical measures					
Glucose (mmol/l)	5.9 ± 3.2	5.6 ± 1.3	5.9 ± 3.3	5.7 ± 1.4	† 0.128 * 0.144 ∞ 0.420
Cholesterol (mmol/l)	4.5 ± 1.2	4.5 ± 1.0 *†	4.5 ± 1.2	5.0 ± 1.2 *†	† 0.000 * 0.030 ∞ 0.185
Diastolic BP (mmHg)	82.0 ± 17.7	80.8 ± 10.4 †	81.8 ±17.4	85.1 ± 10.7 †	† 0.004 * 0.407 ∞ 0.449
Systolic BP (mmHg)	129.8 ± 24.1	127.7 ± 17.5 †	129.6 ± 23.7	133.4 ± 17.8 †	† 0.008 * 0.613 ∞ 0.536
Anthropometric measures					
Body mass (Kg)	82.1 ± 18.5	76.7 ± 17.6 *	81.3 ± 19.1	83.0 ± 7.0 *	† 0.205 * 0.036 ∞ 0.051
BMI (M/kg^2)[a]	31.4 ± 6.9	29.5 ± 6.8 ∞	31.0 ± 7.0	31.8 ± 7.0 ∞	† 0.107 * 0.334 ∞ 0.032
Waist circumference (cm)	97.2 ± 16.4	92.9 ± 13.8	96.6 ± 16.9	96.5 ± 14.8	† 0.241 * 0.082 ∞ 0.105
Lifestyle behaviours					
Physical activity (min/week)	55.0 ± 75.7	33.6 ± 70.1*	79.6 ± 91.1	31.9 ± 78.5*	† 0.481 * 0.000 ∞ 0.336
Fruit and vegetables / day	2.4 ± 1.6	2.5 ± 1.6*	2.3 ± 1.6	2.4 ± 1.2*	† 0.354 * 0.000 ∞ 0.188
SSB[b] per day	0.9 ± 1.0	1.2 ± 1.3*	1.0 ± 1.0	1.2 ± 1.3*	† 0.226 * 0.000 ∞ 0.490
% educators who smoke	9.6% (11)	8.3% (16) †	10.4% (13)	10.9% (17) †	† 0.004 * 0.061 ∞ 0.067
Kessler	19.5 ± 6.8	20.3 ± 6.8 †	19.6 ± 7.0	21.0 ± 7.0 †	† 0.004 * 0.061 ∞ 0.067

Data are presented as mean ± SD;
† = intervention vs. control groups; * = group that dropped out vs. those that completed; ∞ = interaction between † and *
[a]BMI = body mass index; [b]SSB = sugar sweetened beverages
* P < 0.05 for retention effect; † P < 0.05 for group effect; ∞ P < 0.05 for retention and group effect

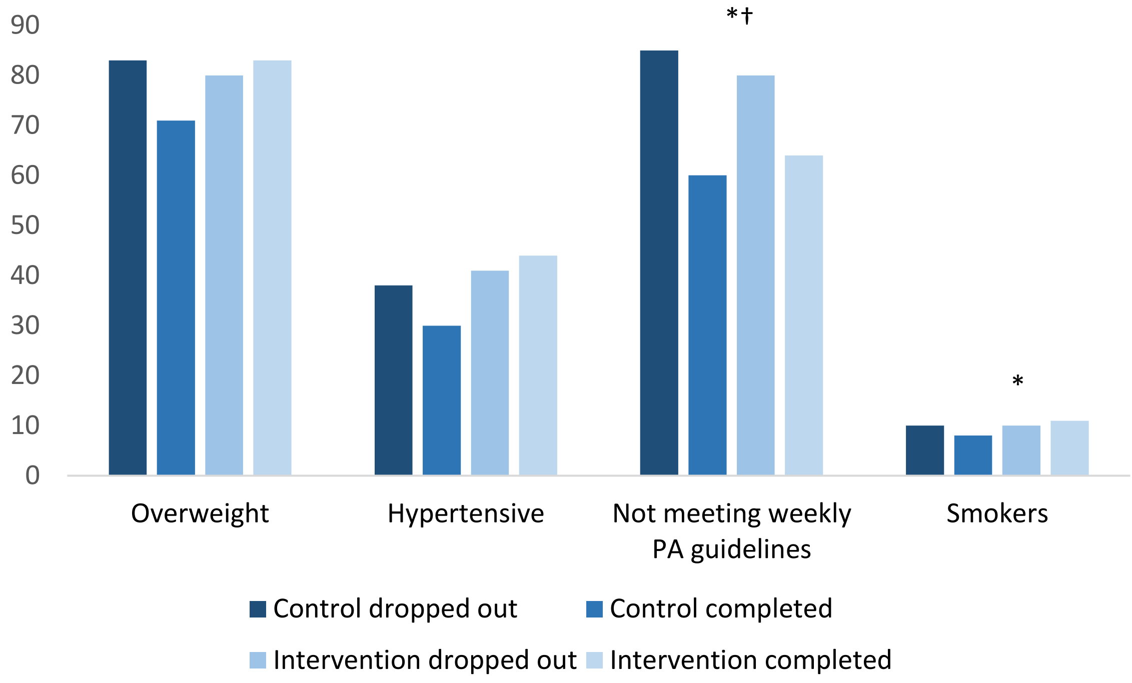

Figure 4-1 Percentage of educators at risk in the control and intervention groups

Overweight = BMI ≥25 M/Kg²; Hypertensive = systolic BP ≥140mmHg or diastolic BP ≥90mmHg; Not meeting weekly PA guidelines = ≥150 minutes per week
* $P < 0.05$ for retention effect; † $P < 0.05$ for group effect

4.3.2 PRE- AND POST-INTERVENTION RESULTS USING THE APP ANALYSIS

Three hundred and forty eight educators (n=192 in the control and n=156 in the intervention groups) were included in the APP analysis.

A. Anthropometric risk factors

At baseline, educators in the intervention group had significantly higher BMI and waist circumferences, as well as systolic and diastolic blood pressures compared to educators in the control group (P=0.001) (Table 4-2). Although both groups showed a decrease in BMI over the study period, the intervention group lost significantly more weight than the control group (1.3% compared to 0.7% decrease) indicating a significant interaction effect (p=0.001). While both groups showed a reduction in the prevalence of overweight and obesity after five months, the intervention group showed a greater relative decrease compared to the control group (8.9% vs. 1.1% respectively). There was also a significant difference in group and time effects for waist circumference and diastolic (p=0.001) and systolic blood pressures (p=<0.032). Although small, both groups showed significant decreases in systolic and diastolic blood pressures following the intervention (p=0.01). Educators in the intervention group exhibited a significantly greater (p=0.002) decrease in systolic blood pressure compared to the control group (7.1% vs. 6.3% decrease) (Table 4-2).

B. Lifestyle risk behaviours

Despite educators in the intervention group having significantly (p=<0.021) lower baseline levels of self-reported physical activity, they showed a much larger improvement compared to educators in the control group (21.3 min/week vs. 12.3 min/week, p=0.000). Educators in the intervention group also showed a significantly greater relative increase (p=0.003) in those meeting physical activity guidelines following the study compared to those in the control group (14.7 vs. 8.3%). Self-reported healthy eating did not change in response to the intervention, and Kessler scores improved in both groups significantly, following the intervention period (P=0.001).

C. Impact of the intervention according to baseline health risk status

We further examined whether the results of the intervention were different in persons who were 'at risk' at baseline, for example, who were overweight or obese, hypertensive, or who were not meeting physical activity guidelines. The analysis was explained in detail in Chapter Two. Educators who were overweight or obese did not show a significantly greater change in BMI in response to the intervention, compared to individuals who were not overweight or obese at baseline (p=0.150). However, weight loss was significantly greater over time for those who were overweight or obese (p=0.017), irrespective of whether they were in the control or intervention group. Educators who were insufficiently active (<150min moderate to vigorous physical activity per week) at baseline did not show a significantly greater change in physical activity patterns following the intervention (p=0.821). Lastly, there was a significant difference in the change in diastolic blood pressure for hypertensive educators (p=0.0226) in both the intervention and control groups. This was however not the case for systolic blood pressure ($p=0.937$).

4.3.3 PRE- AND POST-INTERVENTION RESULTS USING THE ITT ANALYSIS

The ITT analysis included all 571 educators ($n=307$ in the control group and $n=264$ in the intervention group). Although the primary data analysis was conducted using the APP approach, the overall high dropout rate coupled with the fact that the people who dropped out of the study were different to those that remained in the study (Table 4-1), an ITT analysis was required to give a clearer view of the effectiveness of the intervention applied in a 'real world' sense. When the ITT analysis was applied there were only time effects for self-reported physical activity and Kessler scores. All group and time interaction effects were no longer significant ($p>0.05$).

Table 4-2 Pre- and post-intervention results in intervention and control schools

	APP (N=348)				ITT (N=571)			
	Control (n=192)		Intervention (n=156)		Control (n=307)		Intervention (n=264)	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Clinical measures								
Glucose (mmol/l)	5.6 ± 1.3	5.6 ± 1.3	5.7 ± 1.4	5.8 ± 1.2	5.7 ± 2.1	5.7 ± 2.1	5.9 ± 2.5	6.0 ± 2.4
Cholesterol (mmol/l)	4.5 ± 1.0	4.6 ± 1.1	5.0 ± 1.2	4.9 ± 1.2	4.5 ± 1.1	4.5 ±1.1	4.8 ± 1.2	4.8 ± 1.2
BP diastolic (mmHg)	80.8 ± 10.4	79.9 ± 10.3 *†	85.1 ± 10.7	83.5 ± 10.6 *†	80.7 ±14.2	80.3 ± 14.0†	84.3 ± 13.1	83.4 ± 13.0†
BP systolic (mmHg)	129.7 ± 12.5	125.4 ± 16.4*†	133.5 ± 12.8	130.5 ± 17.8*†	127.8 ±20.5	126.4 ± 20.0†	132.6 ± 20.0	130.9 ± 20.0†
% hypertensive[d]	29.7% (57)	23.4% (45)*† ∞	43.6% (68)	36.5% (57)*† ∞	32.8 (101)	29.0 (89)	45.5 (112)	38.3 (101)
Anthropometric measures								
Body mass (Kg)	76.7 ± 17.6	76.7 ± 17.6 †∞	83.0 ± 18.1	82.6 ± 18.0 *†∞	78.4 ± 18.1	78.2 ± 17.9†	82.3 ± 18.5	82.0 ± 18.5†
BMI (M/kg²)[a]	29.6 ± 6.8	29.4 ± 6.7*†∞	31.8 ± 7.0	31.4 ± 7.1*†∞	30.2 ±6.9	30.1 ± 6.8†	31.5 ± 7.1	31.2 ± 7.1†
% overweight[b]	44.3 (85)	43.8 (84) *†	57.0 (89)	51.9 (81)*†	75.3 (232)	76.5 (235)	80.7 (213)	79.5 (210)
% obese[c]	34.9 (67)	34.4 (66) *†	49.4 (77)	44.9 (70) *†	47.9 (147)	47.2 (145)	54.5 (144)	51.5 (136)
Waist circumference (cm)	92.9 ± 13.8	91.2 ± 13.6 *†∞	96.5 ± 14.8	96.6 ± 14.0 *†∞	94.3 ±14.9	93.3 ±14.9†	96.5 ± 15.6	96.5 ± 15.2
Lifestyle behaviours								
Physical activity (min/wk)	33.6 ± 70.1	53.4 ± 89.3*∞	31.9 ± 78.5	67.9 ± 96.4*∞	41.4 ±73.6	53.7 ± 84.9*	45.5 ±84.7	66.8 ± 93.5*
% not meeting PA guidelines[e]	60.4% (116)	52.1% (100)* ∞	64.1% (100)	49.4% (77)* ∞	86.4 (266)	87.0 (267)	90.9 (240)	84.1 (222)
Fruit and vegetables/day	2.5 ± 1.6	2.7 ± 1.7	2.4 ± 1.2	2.3 ± 1.4	2.4 ± 1.6	2.5 ± 1.6	2.4 ±1.5	2.4 ± 1.6
SSB[f] per day	1.2 ± 1.3	1.2 ± 1.3	1.2 ± 1.3	1.0 ± 0.9	1.1 ±1.1	1.1 ± 1.2	1.2 ±1.2	1.0 ± 1.0
% smokers	8.3% (16)	8.3% (16)	10.9% (17)	9.6% (15)	10.1 (31)	11.4 (35)	11.7 (31)	10.9 (29)
Kessler	20.3 ± 6.8	18.4 ± 6.7*	21.0 ± 6.7	18.9 ± 6.1*	19.6 ±6.6	18.4 ± 6.5*†	21.1 ± 7.1	19.9 ± 6.7*†

Data are presented as mean ± SD or percent and (number of individuals);
[a]BMI = body mass index; [b]BMI ≥ 25 M/Kg²; [c]BMI ≥ 30 M/Kg; [d]Systolic BP≥140mmHg or diastolic BP ≥90mmHg; [e]% educators not meeting PA guidelines ≥ 150 minutes per week; [f]SSB = sugar sweetened beverages
* P < 0.001 for time effect; † P < 0.001 for group effect; ∞ P < 0.001 for time and group effect

4.4. DISCUSSION

This study aimed to compare the effectiveness of tailored print and SMS communication to a standard-of-care wellness day. Clinical, anthropometric and lifestyle risk factors were compared between the intervention and control groups, using an APP analysis. The first important finding of this study was that the use of a tailored print letter and SMS campaign resulted in a significantly greater reduction in the proportion of educators who were overweight and obese, as well as those who were hypertensive. The intervention also resulted in a higher prevalence of individuals meeting physical activity guidelines on the basis of self-report. This occurred despite the intervention being 'low-touch' with no face-to-face or telephonic meetings. Text messages can be sent quickly at a low cost (approximately ZAR56 or US$4 for the 2 835 messages sent during this study over the five month period) and can be easily automated. Overall, the results appear to indicate that individuals who were exposed to the tailored letter and SMS campaign, and who presented for follow-up, showed greater health benefits and improved health risk status compared to individuals who were exposed to the standard-of-care wellness day with targeted feedback.

Educators in the intervention group showed a markedly greater increase in self-reported physical activity levels (21.3 minutes/week vs 12.3 minutes per week). These findings are consistent with those reported in the SMS-text based intervention literature[615,616]. Fjeldsoe *et al.*, sent three SMS-text messages per week for 13 weeks to postnatal mothers. They reported a statistically significant increase in MVPA frequency between control and intervention groups[616]. Despite the intervention being shorter (only 13 weeks), participants received more SMS-messages. In a small study in Hong Kong, 52 educators from four schools (three intervention and one control) reported significant increases in the number of steps taken during school time (using pedometers) in the intervention group compared to the control group[615]. Educators received 12 SMS-text messages, leaflets and posters promoting walking[615]. A possible explanation for the large change in physical activity levels could have been the low physical activity levels at baseline, which would have given participants more 'room to improve'. Another possible explanation is that adherence and efficacy for physical activity behaviour was based on self-report. These subjective outcome measures have been shown to be highly susceptible to bias through social desirability[351] where individuals tend to over-report physical activity levels compared to objective measures. Despite this potential for bias however, the significant improvement in self-reported physical activity habits in both groups suggests an increased awareness and may have important health and NCD implications beyond the scope of this study.

Tailored letters sent to individuals have also shown positive results. In a systematic review of randomised trials investigating the efficacy of tailored-print interventions to promote physical activity, interventions appeared to be most effective when underpinned by a behaviour change theory. The Social Cognitive Theory, The Theory of Planned Behaviour or the I-Change Model appeared to be most efficacious. The use of the TTM alone or the use of no theory could be related to lower efficacy[303]. Their review also highlighted the importance of tailoring messages on psychosocial variables such as perceived barriers[303]. While educators in the current study only received one tailored letter, other studies have highlighted that the delivery of more than one tailored-print material appears to be a key determinant of intervention efficacy, with multiple-contact studies showing superior effects compared to single-contact studies[303]. As an 'optimal intensity' may be population and behaviour specific, current research has been were unable to determine the most appropriate number and frequency of letters[280,301,303]. The fact that individuals received a tailored letter based on TTM, the TPB and the I-Change Model with a combination of SMS advice messages may have resulted in great changes in PA than those reported in the literature using only tailored letters. Parekh *et al.*, showed similar findings to the current study that a low-touch tailor printed letter resulted in significant changes in dietary habits (reduced salt intake, increased fish intake and substituting margarine for butter)[617]. Their study however reported that the low-touch printed letters did not result in PA changes and smoking cessation. The authors postulate that it was likely that the minimal intervention provided was insufficient to motivate change in those complex behaviours[617]. The addition of the SMS advice messages could have accounted for the significant changes in PA levels amongst South African educators.

The high percentage of educators in the current study who were overweight or obese in both intervention and control groups was a concern, although consistent with the general South African population[114]. More educators were overweight and obese in the intervention group at baseline and they showed a greater relative percentage decrease at follow-up. Patrick *et al.*, recruited 65 overweight men and women over a 16-week intervention period which included a monthly tailored letter and daily non-tailored SMS-text messages. Individuals in the intervention group showed a significantly greater weight loss (3.2%) compared to the control group[618]. Although not the primary focus of their study, Chow *et al.*, reported significant reductions in BMI values in patients suffering from Coronary Heart Disease (CHD). In that study, the intervention consisted of four semi personalised SMS-text messages per week for six months (a total of 96 messages). The messages provided advice, motivational reminders and support to change lifestyle behaviours. At six months, participants in the intervention group had significantly lower BMI values compared to those in the control group[201]. The relatively short intervention (four to six month) period in this and the aforementioned studies may account for the very modest weight losses seen.

The high prevalence of hypertension in the educators is similar to that seen in the general South African population[114]. The significant reduction in blood pressure in educators who were hypertensive in this study also confirms previous findings conducted in high-income countries[201,619-621]. Significant improvements in blood pressure outcomes as a result of an SMS-text intervention alone or in combination with other communication methods (e.g., telephone coach calls) has been reported[621,622]. As with other SMS-text message interventions focussing on NCDs, improvements were most effective when two-way communication was employed. Messages contained patient-tailored content, and a combination of other evidence-based hypertension management support practices (e.g., health education group sessions) were used.

There were no significant changes in self-reported dietary habits. Fruit and vegetable intake was low to begin with and remained low; SSB consumption was high to begin with and remained high. An aspect not considered in this study was the effect of the school culture and environment on eating habits. Culture and the establishment of social norms within an organisation or community have been shown to affect people's behaviour and thinking which may have a direct bearing on their health[623]. Individuals generally follow social norms in an attempt to be accepted by peers and avoid any punishment, stigma, or humiliation that may come from being an outlier[624]. Social norms have been shown to influence food choices in terms of high or low caloric intake[625]. Individuals are also more likely to feel pressured socially to make healthy food choices rather than unhealthy food choices[626]. Creating a school environment where educators can support and influence each other in making healthy eating choices could have a major impact on their health risk status. This is the focus of Chapter Six of this dissertation.

Clinical measures (glucose and cholesterol) showed non-significant changes in response to the intervention. This is in line with a similar study by Dale *et al.*, who recruited 123 CHD patients from two New Zealand hospitals. Participants in the intervention group received one SMS-text message per day (seven per week) for the first 12 weeks. From weeks 13 to 24, SMS message frequency decreased to five per week. Messages were bi-directional so that participants could text their weekly step counts and ask questions or for feedback. As with the current study, there was no significant difference in cholesterol levels between the intervention and control groups at six months. The lack of change in eating habits (fruit and vegetable and SSB intake) may have contributed to the lack of change in glucose and cholesterol levels among the intervention group in both studies.

The second significant finding of this study was that the standard-of-care wellness day with immediate feedback, repeated after five months, also resulted in significant changes ($p<0.05$) in the proportion of educators who were overweight and obese, hypertensive and those meeting physical activity guidelines. Although the review by Soler *et al.*, concluded that there was insufficient evidence to show improvements in body composition, physical activity habits and fruit and vegetable intake following a wellness day on worksite health promotion[186], results of this study highlight that a wellness day may be an effective entry-into-care intervention in this underserved group. The wellness day assessments with targeted and immediate print feedback has the ability to create awareness of risk factors and highlight behaviours which should be improved. This increased awareness has been shown to impact on health risk behaviour and thereby improve health status[220]. According to Pai *et al.*, the improvements in health status following a wellness day could be a consequence of the feedback, highlighting areas for improvement and suggested next steps[219]. Another possible explanation is that participation in a wellness day is based largely on individuals volunteering to complete the assessments. It is therefore plausible that a bias exists when reporting repeated measures in wellness day data, as this might reflect the proportion of participants who comprise the 'worried sick' and are interested or concerned about their health status[196]. A fourth possible explanation for the improvements is that individuals want to feel that they are cared for and supported and therefore appreciate personalised or tailored communication[219]. Lastly, Pai *et al.*, reported that the frequency of wellness day participation has a positive effect on health outcomes. Individuals who attended more than one wellness day in a year had significantly fewer risk factors at follow up than at baseline[219]. The important differences with the current study are that this study targeted multiple risk factors rather than a single risk factor. Additionally, the follow-up time was shorter than all the studies mentioned above which had intervention times ranging between once every year or once every two years.

Participation rates among eligible participants in worksite health interventions can vary from 8% to 97% with a median of 61%[627]. Participation rates can therefore be very low. As stated in section 3.2.1, participation rates of educators in the first wellness days in this study was 92%. Kolbe-Alexander *et al.*,[154] noted a mean participation percentage of 26% with a range of 4% to 81% in 18 different companies in South Africa. Companies with the highest response rates had significantly higher total risk factors for NCDs. The authors therefore suggest that wellness days in the companies with the highest attendance seemed to be attracting employees at increased risk of NCDs[154]. Educators who completed the study were less healthy than those who dropped out, potentially more worried about their health and perhaps had the most to gain from participation. Kolbe-Alexander *et al.*, further suggest that advertising the importance of wellness days or offering incentives to attendees may increase participation in wellness days[154].

The current study found a 40% drop-out rate. While the interaction effects in this study may have been effective for the 60% cohort that completed the study, when considering those that dropped out, this effect became inconsequential. As high dropout rates are a reality in wellness day interventions, it is imperative to find alternative methods of keeping individuals engaged in programmes. It is also important to get the 'buy-in' from management, and a culture of participation, prioritising attendance at the follow-up wellness days.

4.5. STRENGTHS AND LIMITATIONS

This chapter highlighter a number of strengths. The system for delivering the text-messages was innovative; combining low-cost technology and open-source software. In addition, mobile technologies have the potential to solve one of the most difficult problems facing global health efforts - that of structural barriers to access[585]. Travel, especially to remote areas in LMICs, is expensive, destructive to the environment, time-consuming, exhausting and physically challenging for many health promoters[628]. The challenges of travel and complex intercultural contact, so much a feature of the current global health enterprise, may now be a thing of the past[629]. Mobile technology may hold out the promise of a world where these difficulties could be minimised or eliminated[385]. There is an obvious appeal to be able to remotely interact with and improve the health of people who are scattered around the country and indeed the globe. Further, the continuation of support and communication after diagnosis of disease or identification of risk factors has also shown great promise in assisting individuals to pursue self-management of long-term conditions and healthy behaviours[390,630-632]. A review of the literature in Chapter One revealed that mobile technologies could reduce the need for ongoing face-to-face contact and appointments with health promoters[633].

The major limitation of this study was very low touch and low intensity intervention. Although the literature did highlight that South Africa has a developed mobile infrastructure, there are still challenges with the network infrastructure making and basic provisions such as electricity resulting in poor data coverage, especially in rural communities[634]. Further, the price of a basket of information and communication technologies (ICT) services is higher in Africa than anywhere else in the world[635]. Internet access and usage have, consequently, largely remained the preserve of the wealthy and educated elite[635]. More educated individuals and males were more likely to use their mobile phones for Internet access. Since educators are more educated and may have more income than the population reported Bornman's study[636], it is possible that they use their mobile phones for Internet access to search for information on topics they are teaching[637]. The design of future research could investigate increased intensity and interactivity with educators.

Secondly, although it is believed that the use of an SMS campaign was appropriate for the country setting and the population being investigated, the use of a print letter and SMS messages may be considered 'old technology'. Newer technologies which allow for objective analyses and feedback could replace the self-reported questionnaires should be investigated in the future, there is little doubt that these old technologies will be replaced with newer ones in the very near future.

Further, this study relied on the '*please call me*' functionality which is not as interactive as the newer methods such as WhatsApp. In higher resourced environments where data coverage is better and costs are lower and where internet smartphone coverage is more comprehensive, and is more representative of the country, it would make more sense to use the more advanced technologies. The low response rate to the '*please call me*' during the intervention could have been the result of the clumsiness of the functionality compared to other options. More research is necessary to investigate this further. This study was based on previous studies using the identical technology[425,458,638].

In addition to the small sample size, this study was characterised by high attrition. Although similar attrition rates have been documented in the literature [638], our study protocol did not include additional contact with the participants other than the automated SMS text messages and the '*please call me*' functionality. The primary reason for the limited contact was to try to conduct a real-world trial of an automated system. Future research should focus more on studying attrition, and include different elements that can reduce it. Frequent interaction between the Department of Education and educators could have great potential in improving health outcomes.

The control group received the standard of care wellness day which is an intervention in itself. Studies have shown that wellness days may impact on health behaviours. We did not include a control group which did not receive any input during the duration of the study. This makes a difference between the groups even more difficult to detect, adding to the low statistical power problem. Although the design of the study might have decreased the statistical power, it helps estimate whether the tailored programme is helpful and, if so, how it may work and for whom. The study design was an effectiveness study design with the goal of isolating the effect of the tailoring rather than determining the effect of an intervention compared with a no-treatment control group.

There was no follow up after the intervention. Extended contact following behavioural change interventions is considered best practice for the maintenance of these behaviours[639]. Text messaging may offer an ideal medium to deliver this extended contact. It would also be important to identify the dose-responsiveness of extended contact. This was beyond the score of this study.

4.6. CONCLUSION

Currently there is limited evidence on mHealth interventions particularly in school educators, and very little from LMICs or under-resourced settings. These types of interventions have been shown to be scalable, low-cost, behaviourally appropriate, autonomy-supportive, and may exert an effect on multiple risk factors. The potential for population health benefit, particularly in LMICs is apparent for policy makers and publicly or privately run health and education systems. For schools and other public sector employees, text messaging provides a simple, low-cost means of providing a support programme and perceived continuation of their care beyond the school or work setting. One possible way in which these interventions may work is through greater participant engagement. This would require further examination in future research studies. In this study, we showed that a low-cost and 'low touch' tailored print and SMS text messaging communication is effective for some individuals who completed the five month intervention, and who had an overall poorer health risk status at the outset.

Chapter 5 **FEASIBILITY, ACCEPTABILITY AND EFFICACY OF THE SMS-TEXT MESSAGES**

5.1. INTRODUCTION

A review of the literature in Chapter One revealed that mobile phone text message-based interventions have been effective in promoting smoking cessation[388-390], weight loss[391-393], physical activity[339,394], glycaemic control in diabetes[395,396] and blood pressure management[397]. A number of gaps in the literature were highlighted. These included issues around the optimal number, frequency and duration of SMS messages, the lack of reported and evaluated behaviour change theories underpinning the studies, the current state of individuals in the studies (time, location, social environment, psychophysiological state, etc.) and the cost effectiveness of the SMS interventions. Lastly, there is very little evidence of mobile phone interventions on multiple risk factors particularly in LMICs[399].

Chapter One further showed that SMS-based interventions could be particularly effective in LMICs where mobile phones have high penetration rates[422] and a disproportionate burden of NCDs[22]. Simple, low-cost, widely available automated SMS-text messages could remind, encourage, and motivate individuals to improve their lifestyle behaviours[201]. Through carefully developed algorithms, SMS-text messages can be delivered to large groups of people at a relatively low cost making them a scalable, rapid and inexpensive way to communicate health risk status and support behaviour change in LMICs[22].

This chapter evaluates the feasibility, acceptability and efficacy of the SMS-text messages delivered to educators over the five-month period. The analysis assesses the: (i) feasibility (intervention delivery and text message receipt tracking), (ii) acceptability (educator satisfaction, engagement and recommendations) with the SMS-messages, (iii) the efficacy of the SMS-text messages between quintiles, goals selected and percent of goal achieved and (iv) the costs to deliver the intervention.

5.1.1 METHODS

Chapter Two discussed the methodology behind the SMS evaluation in more detail. Briefly, at the completion of the second wellness day, at the end of the intervention, educators in the intervention group were asked to rate on a Likert scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree) the acceptability of the SMS messages. There were also two open-ended questions which evaluated how the process could be improved and which SMS messages they felt were the most helpful. All 156 educators completed the effectiveness and relevance of the intervention, however, many of the educators chose not to comment on the open-ended questions. Although it was hoped that educators would write their names on the evaluation forms (there was space for this purpose), the majority of educators selected to remain anonymous and did not put their name on the evaluation forms.

5.1.2 STATISTICAL ANALYSIS

A Kruskal-Wallis analysis was conducted to determine whether there were significant differences in responses, according to the four quintiles and the goals selected. Where significant differences were observed, a Mann-Whitney with a Bonferroni Correction for multiple variables was conducted to ascertain between which groups the significance occurred. Analyses were conducted for school quintiles, health goals and the percent of goal educators felt they had successfully achieved. As the 'quit smoking' group was very small (n=5), it was excluded from the analysis.

5.2. RESULTS

5.2.1 FEASIBILITY OF THE SMS-TEXT MESSAGE DELIVERY

Over the five-month period, a total of 2 835 SMS-text messages were sent. Of the 2 835 messages, 2 694 were successfully delivered and 141 messages failed. The delivery outline and content of the SMS messages were described in Chapter Three. Among the 156 intervention participants, only 21 (13%) used the '*please call* me' functionality requesting another SMS advice. Seven educators used the functionality more than once (Table 5-1). This means that the vast majority of participants received a more generic SMS, which was at least tailored on the basis of their selected goal, and the barriers that they experienced.

Table 5-1 Breakdown of SMSs sent over the five-month intervention period

SMS title	Number of SMSs sent	Description
Welcome SMS	526	This SMS was sent after the first wellness day while participants were present in the classroom. It included a welcome message and was designed confirm that the system had the correct mobile number. Educators who did not receive the welcome SMS could update their numbers on the tablet. *"Welcome to the SA-NEWS study! Thanks for participating in the Discovery Vitality Wellness Day. We hope you found it helpful. SA-NEWS team"*
Letter check SMS	222	*We hope things started off well with your <YYY> goal! Send a 'please call me' to <XXX XXXX XXXX> if you did not receive your letter*
Letter follow up SMS	12	This SMS was sent to educators who did not confirm receipt of their letters. *If you still have not received your letter, please send a 'please call me' to <XXX XXXX XXXX>. SA-NEWS team"*
Check in SMS	482	This SMS was sent on week 12 of the intervention. Its purpose was to remind participants of the upcoming wellness day. *We hope that we've inspired you to make healthy lifestyle choices in the last few months. The next wellness day is in a few months time! SA-NEWS team*
Goodbye SMS	240	This SMS was sent on week 14. *We've come to the end of the SA-NEWS messages & we hope you have found them helpful! Thanks so much for participating in our study!*
No Response to SMSs	647	This SMS was sent to participants who did not reply to the Prompt SMSs. *We hope things started off well with <insert goal>! Send a 'please call me' to <XXX XXX XXXX> if you're doing well, or to <XXX XXX XXXX> if you need some help. SA-NEWS team'.*
Prompt SMSs	691	These SMS were sent to individuals in the intervention group. An example of a tip for an educator wanting to improve their fitness but lacking time is given below *If time is a challenge, work on increasing the intensity of your sessions. This will help improve your fitness. SA-NEWS team*
Negative Response SMSs	12	These SMSs were sent to participants who indicated that they needed more help
Positive Response SMSs	3	These SMSs were sent to participants who indicated that they did not need help

<YYY> refers to the specific goals each educator indicated they wanted to improve or manage
<XXX XXX XXXX> refers to the specific mobile number that educators were asked to reply to

5.2.2 EDUCATOR'S SUGGESTED IMPROVEMENTS TO THE SMS CAMPAIGN

Of the 165 educators who participated in the study, only 56 chose to leave suggestions on how to improve the SMS messages in the future. Just over one third (68%) felt that there was no need to improve or change the messages. Feedback was generally positive. One respondent commented "*The SMS system worked perfectly as it was a constant reminder of my intended goal. The language was understandable. Thank you for your care and concern*". One educator however felt that in some situations it was important to still have the option to speak to a person, "*I would appreciate more one-on-one visits. Having the nurses at our school on more occasions would be very helpful*". Almost 10% would have preferred to receive the messages via email, a smart phone application or through other means. A small number requested the messages to be sent in other languages, more frequently and to include specific products to assist with their chosen goal. Although educators could select a specific time of day for the messages to be sent (in the morning, afternoon or at night), one individual specifically requested the messages to only be sent at night (Table 5-2).

Table 5-2 Suggested improvements to the SMS-text messages

Suggestion	Number of responses (n=56)
No changes	38
Messages sent via email, WhatsApp or through face-to-face appointments	5
Other languages besides English	4
SMSs should be sent more frequently	4
Messages with specific reference to nutritional products or specific programmes helpful to smoking cessation	3
Messages only sent at night	1

5.2.3 MOST HELPFUL SMS-MESSAGES

Of the 69 responses, almost one quarter indicated that all SMS messages were helpful (Figure 5-3). The general health messages and healthy eating messages were found to be the most helpful and popular. An educator commented that the most helpful SMS was "*The SMS which stated that improvement is always possible and to keep striving for* *your goals*". The least useful messages, according to educators, were the ones recommending advice for smoking cessation. This may however have been due to the very low number of educators selecting the smoking cessation goal.

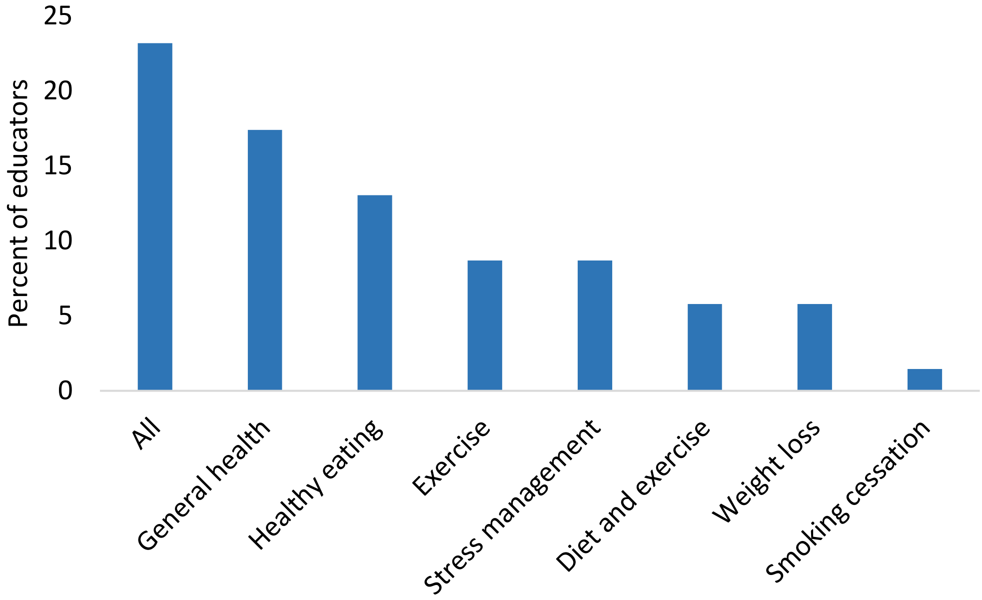

Figure 5-1 Percent of educators selecting the most useful SMS-messages.

5.2.4 UTILITY AND PERCEIVED ACCEPTABILITY OF THE SMS-TEXT MESSAGES

A. Overall utility and perceived acceptability of the SMS-text messages

All educators (n=156) in the intervention group answered the utility and perceived acceptability of the SMS-text messages. The overall acceptability of the SMS-text messages was also very positive. Although the messages were only delivered in English, which was not have been the home language of all educators, the vast majority found the language clear and easy to understand. A high proportion found the messages useful, encouraging and helpful in achieving their selected goals. Eight educators (5%) did not think that the messages were helpful or encouraging. Of these, only 2% (3 educators) felt that the messages did not help them achieve their goal at all. The length and frequency of the messages also appeared to be appropriate. However, 10% (15 educators) did not find the '*please call me*' functionality helpful. Further, only 7% (10 educators) used the '*please call* *me*' functionality after every SMS they received. As the majority of educators did not use the '*please call me*' functionality, it appears that it had less value. Educators also rated it low on the Likert-scale. Many of the educators indicated that they would use an SMS campaign to improve their health in the future and the majority would recommend this type of service to others. The majority of educators (95%) felt that the message length was appropriate. Only one educator would not make use of a similar campaign in the future (Table 5-3).

Table 5-3 Overall utility and perceived acceptability of the SMS-text messages (n=156)

Question	**Score[a]**
The language used was clear and easy to understand	5; 4-5
The messages helped achieve goal	4; 3-5
The messages were useful and encouraging	4; 4-5
The messages were inappropriate and irrelevant	1; 1-2
The frequency was just right	4; 4-5
The length of the messages was perfect	4; 4-5
I read every single SMS that I received	4; 4-5
I found the '*please call me*' back option helpful	4; 3-5
I used the '*please call me*' back option after every SMS I received	3; 2-3
I would make use of an SMS campaign to improve my health in the future	4; 4-5
I would recommend this type of service to other educators, friends and family	5; 4-5

Data is presented as medians and 25%-75% interquartile ranges. Maximum possible score=5
[a]Response options were 'Strongly agree, Agree, Neutral, Disagree, Strongly disagree'

B. Acceptability of the SMS-text messages per quintile

Significant differences (p=0.0391) were found in the proportion of educators achieving their goal between quintiles 2 and 5, 3 and 4, and 4 and 5 schools. Educators from quintile 5 schools reported achieving a significantly higher (p=0.0391) goal percentage compared to other quintiles. Quintile 4 educators were significantly (p=0.0103) more likely to make use of an SMS campaign to improve their health in the future compared to educators in quintile 2 schools. Although not significant (p=0.2572), quintile four educators were the least likely to consider the messages to be helpful in assisting them achieve their goals. Quintile five educators did not find the messages encouraging and helpful, and were more likely to consider the messages to be inappropriate and irrelevant, while quintile two educators found them to be both appropriate and relevant (p=0.9921). Quintile two educators rated the frequency of the messages lowest while quintile five educators rated them highest (p=0.4021).

While quintile four educators found the '*please call me*' option most helpful, quintile five educators found them least helpful (p=0.9704). Despite this, quintile five educators were also most likely to use and recommend a similar type of intervention. Educators from quintile two schools were least likely to recommend this type of intervention in the future (Table 5-4).

C. Acceptability of the SMS-text messages per goal selected

As the 'quit smoking' goal was so small (n=5), it was excluded from the analysis below. Individuals selecting to manage their stress as a goal appeared overall to be most satisfied with the SMS-text messaging while educators selecting to achieve or maintain a healthy weight appeared to be least satisfied with the SMS campaign (Table 5-5). Educators selecting to manage stress as a goal reported the messages to be significantly more ($p<0.05$) useful and encouraging as well as the length of the messages to be better compared to educators who selected to achieve or maintain a healthy weight as a goal.

Table 5-4 Utility and perceived acceptability of SMS-text messages per quintile

	School quintile				
	2 (n=2)	**3 (n=4)**	**4 (n=4)**	**5 (n=3)**	**p-value**
Percent goal achieved	30; 25-30*	25; 25-50*	25; 0-44*	50; 25-50*	0.0391
The language used was clear and easy to understand	5; 4-5 (100)	5; 4-5 (100)	5; 5 (100)	5; 5 (100)	0.0876
The messages helped me achieve my goal	4; 3-4 (70)	4; 4-5 (86)	4; 3-4 (58)	4; 4-5 (79)	0.2572
The messages were useful and encouraging	4; 4-5 (90)	4; 4-5 (90)	5; 4-5 (92)	4; 4-5 (76)	0.1985
The messages were inappropriate and irrelevant	1; 1-2 (13)	1; 1-2 (16)	1; 1-2 (16)	2; 1-4 (27)	0.9921
The frequency was just right	4; 4-4 (80)	4; 4 (90)	4; 4-5 (84)	4; 4-5 (94)	0.4021
The length of the messages was perfect	4; 4-5 (93)	4; 4-5 (94)	4; 4-5 (92)	4; 4-5 (100)	0.1713
I read every single SMS that I received	4; 4-5 (93)	4; 4-5 (86)	4; 4-5 (87)	5; 4-5 (91)	0.5703
I found the '*please call me*' back option helpful	3; 3-4 (43)	4; 3-5 (65)	4; 4-5 (89)	3; 3-4 (45)	0.9704
I used the '*please call me*' back option after every SMS I received	3; 2-3 (7)	3; 2-3 (18)	2.5; 2-4 (29)	2; 2-3 (24)	0.7575
I would make use of an SMS campaign to improve my health in the future	4; 4-5 (93)	4; 4-5 (90)	5; 4-5 (82)	5; 4-5 (97)	0.2119
I would recommend this type of service to other educators, friends and family	5; 4-5 (97)*	5; 4-5 (98)	5; 5 (95)*	5; 5 (100)	0.0103

Data is presented as medians and 25%-75% interquartile ranges. Maximum possible score=5; Values in brackets indicate the percent of educators agreeing or strongly agreeing with a statement;
$p<0.05$
[a]Response options were 'Strongly agree, Agree, Neutral, Disagree, Strongly disagree'

D. Utility and perceived acceptability of the SMS-text messages according to the extent to which goals were achieved

Individuals who reported not meeting their goal at all (0% of goal achieved) found the SMS-text messages least helpful. Individuals who met 50% of their goal found the messages least useful, encouraging, appropriate and relevant while educators who reported 100% goal achievement found the messages most appropriate and relevant. They also appeared the most likely to use a similar intervention in the future. There were no significant differences between the groups for any variable (Table 5-6).

Table 5-5 Utility and perceived acceptability of the SMS-messages per goal selected

	Achieve or maintain a healthy weight (n=63)	**Eat a healthy diet (n=36)**	**Increase my fitness (n=26)**	**Manage my stress (n=26)**	**p-value**
Percent goal achieved	25; 25-50	25; 25-50	25; 25-50	40; 25-50	0.2775
The language used was clear and easy to understand	5; 4-5 (100)	5; 5 (100)	5; 5 (100)	5; 5 (100)	0.1450
The messages helped me achieve my goal	4; 3-5 (64)	4; 4 (85)	4; 4-5 (82)	4.5; 4-5 (79)	0.1100
The messages were useful and encouraging	4; 4-5 (81)*	5; 4-5 (91)	5; 4-5 (91)	5; 5 (100)*	0.0268
The messages were inappropriate and irrelevant	1.5; 1-2 (17)	1; 1-2 (21)	1; 1-2 (21)	1; 1-1.8 (7)	0.5102
The frequency was just right	4; 4-5 (84)	4; 4-5 (94)	4; 4 (85)	5; 4-5 (93)	0.1246
The length of the messages was perfect	4; 4-4.75 (93)*	4; 4-5 (97)	4; 4-5 (94)	5; 4-5 (93)*	0.0538
I read every single SMS that I received	4; 4-5 (83)	4.5; 4-5 (94)	4; 4-5 (94)	5; 4-5 (100)	0.4391
I found the *'please call me'* option helpful	4; 3-5 (56)	4; 3-5 (68)	4; 3.25-5 (74)	4; 3-5 (57)	0.3337
I used the '*please call me*' back option after every SMS I received	3; 2-3 (14)	2.5; 2-3.75 (26)	3; 2-3 (24)	2.5; 2-3 (57)	0.9173
I would make use of an SMS campaign to improve my health in the future	4; 4-5 (87)	4; 4-5 (100)	5; 4-5 (88)	5; 4.3-5 (86)	0.2328
I would recommend this type of service to other educators, friends and family	5; 4-5 (99)	5; 4-5 (97)	5; 4-5 (94)	5; 5 (100)	0.5427

Data is presented as medians and 25%-75% interquartile ranges. Maximum possible score=5. Values in brackets indicate the percent of educators agreeing or strongly agreeing with a statement; p<0.05

[a]Response options were 'Strongly agree, Agree, Neutral, Disagree, Strongly disagree'

Table 5-6 Utility and perceived acceptability of the SMS-text messages per perceived goal achieved

	0% (n=25)	25% (n=76)	50% (n=38)	75% (n=11)	100% (n=6)	p-value
The language used was clear and easy to understand	5; 4-5	5; 4-5	5; 5	5; 5	5; 5	0.5426
The messages helped me achieve my goal	4; 3.3-5	4; 3-4	4; 4-5	5; 4-5	5; 4.3-5	0.5460
The messages were useful and encouraging	4; 4-5	4; 4-5	4; 4-5	5; 4-5	4.5; 4-5	0.8177
The messages were inappropriate and irrelevant	1; 1-2	1; 1-2	2; 1-3	1; 1-2	1.5; 1-2	0.5758
The frequency was just right	4; 4-5	4; 4	5; 4-5	4; 3.5-4.5	4.5; 4-5	0.3945
The length of the messages was perfect	4; 4-5	4; 4-4.75	4; 4-5	4; 4-4.5	4.5; 4-5	0.9296
I read every single SMS that I received	4; 4-5	4; 4-5	5; 4-5	4; 4-5	4.5; 4-5	0.9774
I found the *'please call me'* option helpful	4; 4-5	4; 3-4	4; 3-5	4; 3.5-4.5	4.5; 3.3-5	0.8695
I used the '*please call me*' back option after every SMS I received	4; 3-5	2; 2-3	3; 2-4	3; 2-4	2; 2-3.5	0.9571
I would make use of an SMS campaign to improve my health in the future	3; 2-3	4; 4-5	5; 4-5	4; 4-5	5; 4.3-5	0.2783
I would recommend this type of service to other educators, friends and family	5; 4-5	5; 4-5	5; 5	5; 4-5	5; 5	0.5226

Data is presented as medians and 25%-75% interquartile ranges. Maximum possible score=5; $p<0.05$
[a]Response options were 'Strongly agree, Agree, Neutral, Disagree, Strongly disagree'

E. Cost of the intervention

The initial set up of the intervention included securing server space on the University of Cape Town's secure server, procuring two android tablets and paying the license fee as well as paying experts to develop the advice messages. Including these set-up fees into the entire SMS intervention resulted in an average cost of ZAR 56 or US$ 4 per SMS for the 2 835 messages or ZAR 728 per participant (US$ 52 per participant). Removing the set-up cost resulted in an average cost of ZAR 13.90 or around US$ 1 per SMS or ZAR 180.70 or US$ 12.90 per participant.

5.3. DISCUSSION

In line with the DBE's commitment to evidence-based service delivery in improving the health of educators, this analysis will inform recommendations for future modifications and improvements to a rollout plan. Findings could also inform the broader field of SMS-based interventions targeting multiple health risk behaviour change, particularly given the 'real-world' context of the evaluation and the potentially cost-effective means of intervention delivery.

To our knowledge this is the first SMS-text based study investigating issues of feasibility and acceptability of an SMS-based intervention involving educators in resource-limited settings. Further, there is minimal scientific data on the perceived acceptability and utility of such interventions in LMICs.

5.3.1 FEASIBILITY

Almost 5% (141 out of 2 835) of the SMSs in the study failed to be sent. The low number of '*please call me*' requests for additional advice in this study is similar to other studies[390,640,641] and suggests that educators do not use this functionality strategically. Better promotion of the '*please call me*' functionality may have resulted in increased usage among those who either were not aware of how to access it or did not think it would help. Further research is required to explore how on-demand support can complement these types of interventions.

5.3.2 ACCEPTABILITY

Acceptability of the SMS messages was high regardless of quintile, goal or perceived percent goal achieved. Based on prior studies, there is evidence that consumers utilise SMS-messages on the basis of their convenience, usefulness, the minimal intrusion into their daily lives and ease of use[642,643]. Despite the fact that many educators did not use the '*please call me*' option after each message, giving them the option could have resulted in the high acceptability in the study. Márquez *et al.*, reported that the poor participant retention and engagement in their study could have been the result of the lack of interaction with participants[644].

A possible reasons for the high perceived acceptability and utility of the SMS-message campaign is that SMS messaging is typically a communication medium used between two people in a personal relationship. The perceived personal connection as well as the immediacy of feedback may therefore be higher than other forms of communication[616]. In addition, as the messages were tailored, individuals could have appreciated that the intervention was 'person-centred' and supportive rather than focussing on the entire group of educators. Individuals could therefore have appreciated that someone (the DBE) cared about their health and was willing to support them[645].

Educators in the study felt that the frequency of SMS-messages (one or two per month for five months) was appropriate. Chow *et al.*, sent four SMS messages per week (96 messages) over six months to patients suffering from coronary heart disease[201]. Although the messages were unidirectional (not interactive), over 90% of participants reported usefulness and ease of understanding. Further, 86% also reported that they were happy with the number of messages received. Fjeldsoe *et al.*, and Jones *et al.*, however both reported that a SMS-text message frequency exceeding three per month would be viewed as nagging and annoying[646,647]. The present study did not exceed this frequency.

Although not investigated in this study, deciding on the signature of the message has also been shown to affect the degree of engagement with the messages. Texts from an automated computer, rather than a personal phone, could make the messages appear less personal, and could make the text perceived as 'junk' leading to disengagement. Ending the message with a name individuals can identify with has been shown to increase that personal relevance of the message and may therefore have a major influence on acceptance[648]. The decision to end each SMS messages with a 'SA-NEWS Team' signature was discussed with the DBE prior to developing the messages. It was felt this signature would be more acceptable to educators than a signature directly from the DBE. Future research would need to be conducted to ascertain which signature would result in best engagement and acceptance.

The cost of the SMS campaign in this study was very high. Unfortunately, the researchers could find only one other study which reported on the cost-effectiveness of a tailored SMS campaign to improve cardiovascular risk factors[201]. They sent 96 messages to each participant in the intervention group and reported a cost of approximately US $0.10 per message. The current cost of ZAR 13.90 or around US $1 per SMS makes scaling up unfordable. The costs in this study are considerably higher than the approximate US$0.10 per SMS reported by Chow *et al.* who delivered 96 messages to participants over six months[201]. Although not reported by Chow *et al.*, it is possible that they negotiated cheaper SMS rates as they sent a considerably higher number of SMS messages compared to the current study. While the costs in this study are very high, depending on the telecommunication carrier, it is also possible to negotiate to reduce the unit cost of each SMS as the volume of messages increases. This could reduce the price substantially to less than ZAR 0.20 per SMS[649].

5.4. STRENGTHS AND LIMITATIONS

Mobile phones are ubiquitous, SMS use is a popular form of communication particularly in LMICs where 'smart phones' penetration is still relatively low[650]. SMS-text messaging provides an opportunity for individualised and interactive information delivery that may easily be accessed, independent of time and place[651]. The high fidelity of the text messages highlighted in this chapter is a feature of the intervention which could be scaled up to educators in all schools in South Africa regardless of SES status.

A potential downside to the SMS messages is their transient nature. It is well known that text messages are routinely deleted once they had been read or once a mailbox starts to fill. Furthermore, just the ease of access in many cases appears to reduce the value of the message: "*Once I have read a message, I then throw my phone back in my bag and that's it, it's gone out my head within five minutes*". One educator also suggested that "*sending SMS campaign could be sent after hours while we are at rest so that we concentrate when reading them*". Although not investigated in this study, Chow *et al.*, reported that 54% of the participants in their study saved the messages and 55% shared them with family, friends and/or clinicians[201].

As the '*please call me*' option was poorly used, it is recommended not to include it in the roll out in its current form. Finding a different option of bi-directional communication should be investigated. If the DBE wanted to roll the intervention out to all schools in South Africa, it would need to consider explaining the use and functionality of the '*please call me*' to educators before the roll. This may increase usage. Another option would be to find a different option of bi-directional communication. Although participants had the opportunity to have bi-directional communication, only a small percent used the '*please call me*' messages (13%). An email or website may be an option, however, this would also add to the workload of the staff and possibly be limited due to power outages or loss of internet access. It has also been shown that many educators do not check their email at work as many schools only possess a limited number of computers for educators to use.

This study also did not allow individuals to change their goals for the duration of the study. Allowing individuals to change their goal could increase usage, motivation and relevance of the programme[652]. Although this could increase costs[653], it is important that the individual, not the system, dictate how the SMS interface should behave[654]. Creating a more flexible, dynamic, and customisable system could result in even higher engagement and retention rates which would ensure that fewer individuals drop out[652]. In a study by Fjeldsoe *et al.*, participants were prompted to consider their weight and behavioural goals and reset them if they wished at two intervals (weeks six and 18) during the study. Results showed a 95% retention rate over the six-month period[652]. In addition, significant intervention effects, all favouring the intervention group, were observed for change in weight (-1.35 kg, 95% confidence interval (CI): -2.24, -0.46, P=.003), weekly moderate physical activity sessions (0.56 sessions/week, 95% CI: 0.15, 0.96, P=.008) and accelerometer-assessed MVPA (24.16 minutes/week, 95% CI: 5.07, 43.25, P=.007). Waist circumference, other physical activity outcomes and dietary outcomes, did not differ significantly between groups[652].

Despite considerable ethnic diversity among the study participants, messages were only sent in English. There are 11 official languages and many more indigenous ones in

South Africa[655]. Although English may not be their home language, all educators were able to read, write and understand it. Chapter Five revealed that with the exception of one educator, all were happy to receive the messages in English. While there would be considerable cost designing messages in all official languages, communicating with individuals in their home language has also been shown to increase participation and engagement[291,656].

Additionally, individuals were asked to indicate the time of day that they wanted to receive the SMS-messages, however, there was no option to change the time once the study started. The reasons for this was that the system used did not allow for such modifications. Changing the code within the system to allow for the modification would have resulted in additional costs to the study. Chapter Five showed that allowing individuals to change this option during the course of the year or ensuring that time of delivery is appropriate for the message may also enhance retention and engagement. For example, messages about breakfast should be sent in the morning rather than at lunchtime or evening regardless of an individual's time preference.

It is also possible that greater improvements could have been seen in the intervention group had the SMS messages been sent more frequently, instead of only two SMS messages per week for three weeks. The meta-analysis by Head *et al.* revealed that message frequency moderated intervention effectiveness. For example, compared to interventions that used a fixed frequency (e.g. once per month), interventions that allowed participants to set their own schedule and interventions that used decreasing frequency over the course of the study were most effective[358]. Following a weight loss and increased physical activity six-month intervention, Spark *et al.*, send a minimum of 21 text-messages over a six-month follow up period to breast cancer survivors[631]. Results indicated statistically significantly lower mean weight loss than at baseline, participants significantly increased MVPA and significantly decreased their energy intake from baseline. Each additional text message received per week was associated with an additional 9.5 minutes more physical activity per day (95% CI 3.1-15.8; P=.004]. There was however no significant association between weekly text message dose and change in weigh (1.3 kg [95% CI -0.3 to 2.8]; P=.098) or change in energy intake (279 kJ/day [95% CI -157 to 716]; 67 kcal/day [95% CI -37 to 171]; P=.198)[631].

It was unfortunate that a low percentage of individuals had suggestions on how to improve the SMS messages. Only 56 out of the 156 (36%) educators had suggestions on improvements. These suggestions could have assisted the researchers to refine and suggest improvements to the messages and their delivery.

Behavioural lifestyle interventions have been shown to be effective at promoting initial weight loss[657] and supporting physical activity and dietary behaviour change[39,658]. Maintaining improvements once the intervention has ended is often more difficult to achieve[659,660]. Weight gain and relapses in health behaviours are common following the end of an intervention. Trials indicate an average of 0.3 kg of weight is regained per month post intervention[661,662], and up to 50% of initial weight loss is regained within one year post intervention[663]. The challenge in maintaining weight loss has been largely attributed to the failure in maintaining physical activity and dietary improvements[664]. Extending contact with individuals after an initial intervention has been found to improve weight loss maintenance[631,639,665] and support long-term physical activity and dietary behaviour change[39,666]. A recent review of extended contact interventions delivered via telephone or face-to-face contact reported an overall average weight regain of 3.2 kg less than in the corresponding control groups over approximately 18 months follow-up[639]. Extended contact interventions delivered via face-to-face and telephone can be costly and time consuming[667,668], while web-based delivery has been associated with poor participant retention and engagement[669,670]. Mobile phone text messaging may be an ideal extended contact intervention delivery modality due to its cost-effectiveness and ability to provide highly tailored support to participants in 'real-time'[571,671]. Emerging evidence supports the feasibility, acceptability[672] and efficacy[632,673] of providing text message-delivered extended contact interventions to promote the maintenance of weight loss. Sending health reminder messages to educators during the year could show continued care and support as well as ensuring healthy behaviours are reinforced and maintained.

Lastly, this study only assessed the costs of the text messages delivered in the programme. Given the modest effect sizes, it is not possible to determine whether the intervention represents a good return on investment until formal cost-effectiveness analysis is conducted.

5.5. CONCLUSION

The findings of this study help to address this gap in evidence to show that such an intervention may be effective and have a high level of acceptability, with an overwhelming number of participants perceiving the messages to be of use and the level of contact to be appropriate. Text message are more likely to work under a set of parameters: (i) when there is follow-up, (ii) when the message is personally tailored, (iii) when the frequency, wording and content are highly relevant. The findings of this study suggest the SMS-text based intervention is feasible, efficacious and acceptable.

Chapter 6 SCHOOL HEALTH ENVIRONMENT ANALYSIS

6.1. INTRODUCTION

"Behaviour change is expected to be maximised when environments and policies support healthful choices, when social norms and social support for healthful choices are strong, and when individuals are motivated and educated to make those choices"[488].

Healthy and unhealthy behaviour choices are complex, and are affected by multiple levels of influence, including individual characteristics and higher order factors such as local and national policies, the physical or built environment, numerous behavioural settings and domains, and local cultures[674,675].

In order to change a population's behaviour, multilevel, ecological based models targeting individuals, social environments, physical environments, and policies must be implemented[674]. In public health settings, ecological models refer to people's interactions with their physical and sociocultural surroundings[487]. Ecological models are particularly well suited for studying health behaviours such as physical activity and eating habits, because these behaviours take place in specific settings, such a schools and workplaces. Studying the characteristics of these settings that may facilitate or hinder healthy behaviours, therefore, should be a priority[674].

Individuals, on average, spend about one third of their time at school or work. These settings are therefore seen as important environments for the promotion of healthy behaviours[676]. It has been suggested that environments that do not encourage healthy behaviours as part of daily life, may play a part in the marked shifts in energy imbalance[677]. This has been characterised by the high intake of energy-dense foods and low energy expenditure (low levels of physical activity) which is at least partially responsible for the rapid rise of obesity levels and increased global prevalence of NCDs[677]. This chapter sets out to investigate the school environment and how it may impact on healthy behaviours.

6.2. METHODS

The development of the school health environment audit and scoring was explained in detail in Chapter Two. The school environment audit was adapted from three previous questionnaires. The International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)[565], the Physical Activity Neighbourhood Environment Scale (PANES)[566,567] and the HealthKick questionnaire[568]. The healthy school environment survey was based on previous studies conducted on a sample of 100 urban and rural disadvantaged schools from two education districts in the Western Cape, South Africa[569]. A copy of the questionnaire can be found in Appendix L

Each school principal was asked to complete the school health environment survey on the day on which the wellness day was conducted at their school at the beginning of the study. The purpose of the survey was to explore relationships between the school health envionrment (school's health policies, built environment and surrounding neighbourhood) and health risk status of educators within a school.

The characteristics or attributes of the school health environment as they relate to the school demographics and surrounding neighbourhood, the physical environment of the school and the degree to which the school promotes physical activity and healthy eating habits are presented in this chapter. The relationships between the baseline health risk status of the educators and the components of the school health environment were also explored.

6.2.1 SCHOOL DEMOGRAPHICS AND THE NEIGHBOURHOOD

This section investigated the school's demographics and the surrounding neighbourhood, and contained seven questions. The questions focused on the number of classes, learners and educators in the school, the socioeconomic status of the learners within the school, and community that it served, and the area or community surrounding the school. The mode of transport most learners used to get to school and any written health policies the school had implemented were also investigated.

6.2.2 THE PHYSICAL ENVIRONMENT OF THE SCHOOL

Neighbourhood attributes of relevance to physical activity were measured with ten questions. A neighbourhood environment index was constructed by summing the number of favourable 'activity friendly' environmental attributes. This scoring system was adapted from PANES[567]. Questions were categorised into different constructs. These included land use mix, transit access, pedestrian and bicycle infrastructure, recreation facilities, street connectivity, traffic and pedestrian safety and neighbourhood aesthetics.

In addition to the physical neighbourhood surrounding the school, school safety access and safety measures within the school were evaluated. Eight questions related to safety access to the school. Six questions considered security measures schools implemented in order to ensure safety.

6.2.3 PHYSICAL ACTIVITY-ENABLING ENVIRONMENT

The third section investigated the degree to which the school offered a physical activity- enabling environment and consisted of five items. Principals were asked to rate the condition of the playgrounds and sports fields, and the types of sports facilities the school had, and whether physical education and extra-mural sports were compulsory at the school. Principals were also asked to list the equipment which could facilitate free play before, during and after school. All answers were summed, a composite score for the physical activity enabling environment was then generated.

6.2.4 HEALTHY EATING ENABLING ENVIRONMENT

Lastly, five items were included that explored community environmental attributes promoting healthy eating. The first two questions investigated the quality, availability and selection of fresh fruits and vegetables in shops and stores in the school's vicinity. The third question explored the selection of low-fat products available in shops and stores. Principals were asked about the density of fast food restaurants or vendors that sold high fat, or high sugar, low quality foods in the neighbourhood.

The school nutrition policy consisted of five questions; these included whether the school had a subsidised feeding programme, the sale of soft drinks or sweets/potato chips in the tuck shop (canteens) or by vendors, the sale of soft drinks or sweets/potato chips for school functions, the ability of learners to leave school during the day to purchase food or snacks and the types of foods and beverages vendors within or adjacent to the school are permitted to sell. Principals were also asked to list the types of foods sold at the school and by vendors outside the school. All answers were summed, a composite score for a healthy eating enabling environment was then generated.

Inter-item reliability of the school health audit instrument was determined using Cronbach's alpha and ordinal alpha for the overall scale and subscales. Inter-item correlations and item-total correlations were used to assess the scales and the individual items. Item-level inter-item correlations provided a measure of how much the average inter-item correlation would improve with the removal of an item. Results from these analyses are presented in Appendix O.

A Chi square and multiple regression analysis were conducted to explore the associations between the school health environment, age and gender and educator's BMI, systolic and diastolic blood pressures, exercise (minutes per week) habits and SSB and fruit and vegetable intake.

6.3. RESULTS

Four distinct dimensions of the school built environment were analysed. These included school demographics and the neighbourhood surrounding the school, the physical environment of the school, the degree to which the school promoted a physical activity enabling environment and lastly, the degree to which the school promoted healthy eating habits.

6.3.1 OVERALL SCHOOL ENVIRONMENT ANALYSIS

Table 6-1 presents the overall summary of results for the school environment survey.

A. School demographics and neighbourhood environment

Schools had an average of 21 classes, 24 educators and an average of 40 learners per class. Most learners either walked or used bicycles as the primary means of transport to and from school. Schools, on average, were described as mixed low, moderate or high socioeconomic status in relation to the region surrounding the school. Most school principals described the area or community surrounding the school as mixed land use which is a combination of both residential and commercial land use.

B. The physical environment of the school

A relatively high environmental support for physical activity was reported. Out of a possible score of 10 environmental attributes, on average schools reported a 7.9 score for a favourable 'activity friendly' school environment. The majority of schools (96%) reported bus, taxi or train stops within a 10 to 15 minute walk from the school.

School safety was rated a little lower than the environmental support for physical activity. Of a possible score of 8, schools indicated an average score of 4.9 for safety access and an average score of 4 out of a possible 6 for safety measures. Most schools (85%) had controlled access to the school and 81% had barbed or razor wire around the perimeter. Seventy four percent had a security guard at the entrance to the school. Most of the school buildings (89%) were neat and received regular maintenance. They had painted murals, plant beds, shade trees, benches for sitting, which were all in good condition. Schools reported having implemented an average of 2.4 health and wellness policies out of a possible seven options. The majority of schools (67%) had implemented an anti-bullying policy in the school (Table 6-1).

C. Physical activity enabling environment

The condition of most playgrounds, sports fields and sport facilities was very good. Most playgrounds (91%) were generally free of glass and other dangerous objects and free of litter. Most schools (89%) had equipment on the playgrounds (jungle gyms, slides and/or see-saws, swings and markings on the playgrounds). Only 19% of schools had no sports fields or facilities. Schools that had sports fields and sports facilities also had a good selection of equipment to allow learners to participate in sport and play games.

All schools in the study had compulsory weekly physical education lessons. Four principals indicated that their school employed specialist physical education educators as opposed to generalist educators. Almost half of the schools (48%) in this study did not offer compulsory after school extramural sports (Table 6-1).

D. Healthy eating enabling environment

Just over half the schools (56%) had a nutrition policy. Most (81%) provided learners with free meals which were part of DBE's National School Nutrition Programme (NSNP). Only one school had a policy related to the sale of soft drinks or sweets/chips in the tuck shop or by vendors. The majority of foods sold in tuck shops and by formal and informal vendors outside the schools were unhealthy (Table 6-1). The most frequently sold items were sports drinks, SSBs, French fries, sausage rolls and pies, fruit juice and hamburgers. Eight schools had branding from an international sugar-sweetened beverage company on the school sign / banner. One school had a popular fast food chain logo on their school sign and another had a popular grocery chain outlet on their school sign. Two school signs were sponsored by a banking institution. A higher score for foods sold in tuck shops and by formal or informal vendors indicated more unhealthy food sales.

E. Top health problems experienced by educators and learners

Principals identified the top three health problems experienced by educators and learners. The top three health priorities for educators were a lack of a heathy diet (74%), lack of physical activity (70%) and being overweight (70%). Learners' top three health problems were reported to be unhealthy diets (89%), lack of physical activity (78%) and being underweight (48%).

6.3.2 SCHOOL ENVIRONMENT ANALYSIS PER QUINTILE

Table 6-2 summarises the school environment audit by quintiles. At the DBE's recommendation, quintile one schools were excluded from the study. There are two primary reasons for the exclusion of quintile one schools from the study. Firstly, the DBE has identified them as the most challenging schools. They therefore felt that it would be too difficult to try and recruit them. Secondly, quintile one schools are mostly rural, and very difficult to identify in the Cape Town and Johannesburg Metropole. Quintile one schools in these urban areas would have therefore been outliers for these settings.

Table 6-1 Overall summary of the school environment assessment

Component	Results
School Demographics and neighbourhood	
Average number of classes	20; 16.5-28.5
Average number of learners	717; 589-1088
Average number of educators	23; 19-31
Learner/educator ratio	34; 31-37
SES[1] of the learners within the school and community	59% Low to moderate; 26% mixed low, moderate or high; 15% upper middle income
How do most learners travel to your school?	15% car or private vehicle ; 44% public transport[2]; 41% walk or cycle
Which best described the area or community surrounding your school	19% informal settlements; 22% mixed land use[3]; 59% residential urban or suburban
The built and policy environment of the school (35)*	**24; 18-26.5**
Physical neighbourhood (10)	9; 6-10
School safety access (8)	5; 3.5-7
Safety measures (6)	4; 3-4.5
Condition of school buildings (4)	3; 3
School policies (7)	3; 1.5-4
Physical activity enabling environment (23)*	**20; 17.5-21**
Condition of the playground (2)	2; 2
Condition of the sports fields (2)	2; 1-2
Sport facilities (3)	2; 1-3
Availability of equipment for games (15)	13.4±2.7; 15; 6-15
Are extramural sports compulsory? (1)	1; 0-1
Healthy eating enabling environment (39)*	**13; 9-16**
Food environment (4)	2; 1.5-3
Nutrition policy (5)	1; 0-1
Healthy food sales (15)	9; 5-11
Formal or informal vendor (15)	3; 0-4

Data are presented Results are as medians and 25%-75% interquartile ranges.
*Numbers in brackets indicate the maximum score per component. [1]SES = socioeconomic status; [2]taxi, bus or train; [3]Residential and business or commercial use

A. School demographics and neighbourhood environment

Quintile two schools had significantly more classes than quintile three schools (p=0.044) and consequently had nearly double the number of learners than quintile three and quintile five schools (p=0.044). Quintile two schools also had the highest learner to educator ratio (38.7:1) while quintile five schools had the lowest learner to educator ratio (27.9:1). Most (83%) quintile two principals described the school as the lowest socioeconomic status in relation to the region, while all quintile five principals described their schools as upper middle income groups in relation to the region. The primary mode of transport to and from school for most learners from quintile five schools was by motorised transport (67%) while most learners from quintile two, three and four (50%, 50% and 57% respectively) walked or cycled to school.

B. Physical environment of the school

Quintile two schools had a significantly lower (p=0.024) overall score compared to quintile five schools. Quintile two schools had significantly fewer health and wellness policies than quintile five schools (p=0.070). Quintile two schools also had the lowest overall score for the physical environment while quintile five schools had the highest overall scores indicating greater environmental support for physical activity. The high number of safety measures taken by all schools appears to indicate that they were concerned about their safety irrespective of quintile.

C. Physical activity enabling environment

Quintile five schools had a significantly higher average number of designated playgrounds (4.8) compared to quintile two schools (1.7). Quintile two schools also had significantly less equipment available for games and play compared to quintile five schools (p=0.007). Principals in the quintile two schools reported that extramural sports were not compulsory while those at quintile five schools reported that extramural sports were compulsory (p=0.006). Quintile three schools had the highest scores for a physical activity enabling environment while quintile two schools had the lowest physical activity enabling environment.

D. Healthy eating enabling environment

The food environment component of the survey consisted of questions related to the quality, selection and sale of fresh fruits and vegetables and low fat products at the school. The availability of fast-food restaurants in the neighbourhood surrounding the school also formed part of this component. Quintile five schools had a significantly healthier food environment compared to quintile two schools (p=0.000). Quintile five schools also sold significantly healthier foods compared to quintile two schools (p=0.020).

6.3.3 OVERALL SCHOOL ENVIRONMENT ANALYSIS BY PROVINCE

Table 6-3 summarises the findings between Gauteng and Western Cape provinces for school demographics and neighbourhood environment, the physical environment of the school, the physical activity and healthy eating enabling environments.

A. School demographics and neighbourhood environment

Gauteng schools had significantly more learners than Western Cape schools (p=0.012). Although not significant, Gauteng schools also had more classes and educators compared to Western Cape schools (p=0.044). In general, learners from Gauteng had a significantly higher SES compared to those from the Western Cape (p=0.027).

B. The physical environment of the school

The community surrounding the schools appeared to be significantly different (p=0.060) between the Gauteng and Western Cape. Gauteng schools had a significantly higher physical neighbourhood score compared to Western Cape schools (p=0.051), as well as a higher overall score indicating greater environmental support for physical activity.

C. Physical activity enabling environment

There were no significant differences in the physical activity enabling environment between the schools from Gauteng and the Western Cape provinces.

D. Healthy eating enabling environment

Schools from Gauteng province had a significantly healthier eating enabling environment compared to schools from the Western Cape ($p=0.000$). Gauteng schools also sold a significantly higher number of healthier foods compared to schools from the Western Cape ($p=0.047$).

Table 6-2 Summary of the school demographics and neighbourhood per quintile

	Quintile 2 (n=6)	Quintile 3 (n=8)	Quintile 4 (n=7)	Quintile 5 (n=6)	p-value
School Demographics and neighbourhood					
Average number of classes	29; 25-29†	16; 14-19†	21; 18-25	19; 16-21	0.044
Average number of learners	1357; 1151-1447	614; 524-741	816; 693-980	630; 582-675	0.021
Average number of educators	36; 31-38	18; 15-21	23; 21-27	22; 20-25	0.071
Learner/educator ratio	38; 37-39†	34; 33-35	34; 32-37	29; 24-31†	0.002
SES[1] of the learners within the school and community	83% Low to moderate; 17% mixed low, moderate or high	75% Low to moderate; 25% mixed low, moderate or high	43% Low to moderate; 57% mixed low, moderate or high	33% Low to moderate; 67% upper middle income	0.0362
How do most learners travel to your school?	50% walk or ride bicycles; 50% public transport[2]	50% walk or ride bicycles; 50% public transport[2]	57% walk or ride bicycles; 43% public transport[2]	33% public transport[2]; 67% car or private vehicle	0.2681
Which best described the area or community surrounding your school	66% informal settlements; 17% mixed land use[3]; 17% residential urban or suburban	13% informal settlements; 87% residential urban or suburban	43% mixed land use[3]; 57% residential urban or suburban	33% mixed land use[3]; 67% residential urban or suburban	0.029

[1]SES = socioeconomic status; [2]taxi, bus or train; [3]Residential and business or commercial use

Table 6-3 Summary of the school physical environment, physical activity enabling and healthy eating enabling environments

	Quintile 2 (n=6)	Quintile 3 (n=8)	Quintile 4 (n=7)	Quintile 5 (n=6)	p-value
The physical environment of the school (35)*					
OVERALL SCORE	**17; 12.5-24**	**24; 17-25**	**21; 20-27**	**29; 24-31**	0.024
Physical neighbourhood (10)	5.5; 3-8	8; 6-10	9; 8-10	9.5; 7-11	0.186
School safety access (8)	4; 2-7	4.5; 4-5	6; 4-7	7.5; 6-8	0.152
Safety measures (6)	3; 2-5	3.5; 2-5	4; 3-5	4.5; 4-6	0.204
Condition of school buildings (4)	3; 3	3; 3-4	3; 2-4	3; 3	0.748
School policies (7)	1; 0-2†	4; 1-5	3; 5	4; 3-4†	0.070
Physical activity enabling environment (23)*					
OVERALL SCORE	**20.9; 17-21**	**21.5; 20-22**	**18; 17-20**	**18; 16-20**	0.075
Condition of the playground (2)	2; 1-2†	2; 2	2; 2	2; 1-2†	0.334
Condition of the sports fields (2)	1.5; 0-2	2; 1-2	2; 2	2; 2	0.534
Sport facilities (3)	1; 0-3	2.5; 2-3	1; 1-2	3.5;2-4	0.159
Availability of equipment for games (15)	12; 15†	15; 15	13; 10-15	12; 7-14†	0.007
Are extramural sports compulsory? (1)	0.0†	1; 0-1	0; 0-1	1; 1†	0.006
Healthy eating enabling environment (39)*					
OVERALL SCORE	**15.5; 13-17**	**14.5; 13-15**	**13; 11-18**	**7; 4-9**	0.000
Food environment (4)	1; 1-2†	2; 2	3; 2-3	3; 3†	0.026
Nutrition policy (5)	1; 0-1	0.5; 0-1	1; 0-1	0.5; 0-1	0.952
Healthy food sales (15)	11; 11†	11; 8-11	7; 5-10	4; 2-5†	0.020
Formal or informal vendor (15)	3.5; 2-4	1.5; 0-4	3; 1-4	3; 1-4	0.254

Data is presented as medians and 25%-75% interquartile ranges; $p<0.05$
*Numbers in brackets indicate the maximum score per component.

Table 6-4 Summary of the school environment assessment per province

	Gauteng (n=17)	Western Province (n=10)	p-value
School Demographics and neighbourhood			
Average number of classes	21; 19-29	17; 16-20	0.096
Average number of learners	816; 660-1200†	602; 573-768†	0.012
Average number of educators	25; 21-36†	19.5; 17-21†	0.044
Learner/educator ratio	35; 31-37	33.5; 32-37	0.880
SES[1] of the learners within the school and community	41% Low to moderate; 35% mixed low, moderate or high; 24% upper middle income†	90% Low to moderate; 10% mixed low, moderate or high†	0.027
How do most learners travel to your school?	24% car or private vehicle; 52% public transport[2]; 24% walk or cycle	70% walk or ride bicycles; 30% public transport[2]	0.764
Which best described the area or community surrounding your school	11% informal settlements; 24% mixed land use[3]; 65% residential urban or suburban) †	30% informal settlements; 20% mixed land use[3]; 50% residential urban or suburban†	0.060
The physical environment of the school (35)*			
OVERALL SCORE	48; 42-50†	22; 17-26†	0.000
Physical neighbourhood (10)	9; 7-10†	6.5; 5-8†	0.051
School safety access (8)	6; 4-7	5; 2-11	0.820
Safety measures (6)	4; 3-5	4; 3-4	0.675
Condition of school buildings (4)	3; 3	3; 2-4	0.269
School policies (7)	2; 1-4	3; 3	0.701
Physical activity enabling environment (23)*			
OVERALL SCORE	20; 17-21	22; 17-26	0.084
Condition of the playground (2)	2; 2	2; 2	0.881
Condition of the sports fields (2)	2; 2	2; 1-2	0.453
Sport facilities (3)	3; 1-3	2; 0-3	0.179
Availability of equipment for games (15)	14; 13-15	15; 14-15	0.281
Are extramural sports compulsory? (1)	1; 0-1	0.5; 0-1	0.885
Healthy eating enabling environment (39)*			
OVERALL SCORE	2.5; 2-3†	13; 8-15†	0.000
Food environment (4)	3; 2-3†	2; 1-2†	0.040
Nutrition policy (5)	1; 0-1	0; 0-1	0.401
Healthy food sales (15)	11; 5-11†	7; 5-11†	0.047
Formal or informal vendor (15)	2; 0-3	4; 0-4	0.423

Data is presented as medians and 25%-75% interquartile ranges; $p<0.05$
*Numbers in brackets indicate the maximum score per component; [1]SES = socioeconomic status; [2]taxi, bus or train; [3]Residential and business or commercial use

6.4. RELATIONSHIP BETWEEN THE SCHOOL HEALTH ENVIRONMENT AND HEALTH RISK STATUS OF EDUCATORS

Table 6.5 represents the results of the Generalised Linear Models which estimated the relationship between the school physical environment, the physical activity enabling environment of the school and the schools' healthy eating environment, with educator health risk status, adjusting for individual level variables (age and gender), as well as school quintile.

Both school physical activity and healthy eating environments, as well as age and gender are significant parameters in the overall models predicting educator BMI and random glucose ($p<0.01$). The school physical environment, age and gender were significant in the model predicting total cholesterol. All school environment parameters, as well as age, were significant in the model predicting diastolic blood pressure ($p<0.01$). The school physical environment and healthy eating environment and age were significant in the model predicting systolic blood pressure ($p<0.01$). The school physical environment and gender were significant in the model predicting physical activity ($p<0.05$). All school environment parameters, were significant in the model predicting educator stress ($p<0.05$). Lastly, all school environment parameters, with the exception of the school physical environment, as well as age, were significant in the model predicting waist circumference ($p<0.05$).

Table 6-5 Results of Generalised Linear Models predicting the relationship between the school physical environment, physical activity environment and healthy eating environment, adjusting for age and gender and school quintile on health risk factors.

	df	BMI[1] (kg/m²)		Waist Circumference (cm)		Systolic Blood Pressure (mmHg)		Diastolic Blood Pressure (mmHg)	
		Wald Chi-Square	Sig	Wald Chi-Square	Sig	Wald Chi-Square	Sig	Wald Chi-Square	Sig
Intercept	1	70.480	0.000*	130.205	0.000	92.410	0.000	57.969	0.000
School Physical Environment	5	2.566	0.766	6.214	0.286	14.286	0.014*	11.533	0.042*
Physical Activity Environment	8	19.179	0.014*	16.007	0.042*	10.017	0.264	24.207	0.002*
Healthy Eating Environment	10	33.421	0.000*	20.738	0.023*	24.578	0.006*	54.126	0.000*
Age	47	73.918	0.007*	97.386	0.000*	110.453	0.000*	68.266	0.023*
Gender	1	25.733	0.000*	0.591	0.442	2.237	0.135	3.698	0.054
Quintile	1	3.198	0.074	3.459	0.063	0.090	0.764	0.163	0.687

	df	Glucose (mmol/l)		Total Cholesterol (mmol/l)		Exercise MVPA (mins/wk)		Kessler Score	
		Wald Chi-Square	Sig	Wald Chi-Square	Sig	Wald Chi-Square	Sig	Wald Chi-Square	Sig
Intercept	1	70.480	0.000	42.094	0.000	5.002	0.025	14.959	0.000
School Physical Environment	5	2.566	0.766	21.596	0.001*	6.130	0.294	31.509	0.000*
Physical Activity Environment	8	19.179	0.014*	6.417	0.601	16.027	0.042*	16.615	0.034*
Healthy Eating Environment	10	33.421	0.000*	8.824	0.549	14.049	0.171	23.471	0.009*
Age	47	73.918	0.007*	97.742	0.000*	50.221	0.347	51.608	0.298
Gender	1	25.733	0.000*	5.497	0.019*	41.323	0.000*	3.091	0.079
Quintile	1	3.198	0.074	0.848	0.357	0.634	0.426	0.443	0.506

1BMI=body mass index
*p<0.05

6.5. DISCUSSION

The aim of the school audit was to provide a baseline assessment of the school health environment in schools from different socioeconomic statuses and provinces. The audit related to school demographics and the neighbourhood surrounding the school, the school's physical environment and the degree to which the schools have a physical activity and healthy eating enabling environment. It has been suggested that environments where the healthier choices are the easier choices may result in healthier behaviours[678]. Findings from this investigation may be used to inform school principals and educational authorities of the areas in their school that could be improved or that may be associated with the health risk status of the educators in schools.

The overall learner to educator ratio in this study (34:1) was slightly higher than the national reported ratio of 31:1[162]. The maximum learner-educator ratio for South African primary schools has been set at 40:1[679]. The national average ratio (31:1)[162] as well as all schools in this study (34:1) were well below these requirements. Compared to the national educator to learner ratio (31:1) [162], both provinces in this study had higher ratios (33:1 and 35:1 in Gauteng and the Western Cape respectively)[162]. Only quintile five schools had a lower learner to educator ratio (28:1). In addition to the physical environment of the school, over-crowded classrooms have been shown to have a direct impact on poor health[680,681], poor learner performance[682,683] and added stress on educators[679]. Many schools are overcrowded because of budgetary constraints and economic resources[684]. Educators experience higher stress levels in overcrowded classrooms[685].

While most learners from quintile five schools used private or public transport to get to school, the majority of learners from the other quintiles walked or cycled to school. This allowed children in poorer communities to engage in physical activity on their way to and from school. These findings are consistent with those of Uys *et al.*,[686] who also reported that most learners from higher socioeconomic communities used motorised transport to get to school, while the majority of learners in the lower socioeconomic communities travelled to school using active transport.

As higher quintile schools have been shown to offer a better education and therefore more opportunities for tertiary education[687] study or better jobs[688] once learners leave school, many parents will make sacrifices in order to send their children to schools from a higher quintile where the school fees are higher[689]. Over one third of learners in the 'Birth to twenty cohort study' from Soweto, travelled more than 6 kilometres to get to school[689]. Only 18% attend their nearest school while over 60% leave the suburb where they live to attend a 'better' school in a higher quintile[689]. In 2007, 49% of learners went to the schools in the same wealth quintile as the area in which they resided, 21% went to a poorer and 30% to a richer school quintile. In 2013, the share of learners that went to the same quintile was even less at 43%, and about 40% went to a higher quintile school[690].

Although quintile two schools had the lowest overall score for the physical environment, fewest designated playgrounds for play, and grounds which were less well-kept offering less opportunities for physical activity, these schools also had the most open spaces around the school. Play may therefore have taken place in a more unstructured environment. Low-income neighbourhoods generally have fewer parks, sports fields, fitness clubs, and trails than more affluent neighbourhoods[691]. This suggests that individuals residing in low-income neighbourhoods may face more environmental barriers to physical activity[691]. The shared use of school recreational facilities can provide safe and affordable places for communities[692]. Several studies in the United States have found that opening school grounds in low income communities to the community results in increased physical activity in those communities[693,694]. Many higher quintile school playgrounds consist primarily of open expanses of turf and asphalt, features which offer valuable opportunities for physical activity.

All schools in the study had compulsory weekly physical education lessons. This has been reported in a previous study which recruited 100 schools from two primary schools in disadvantaged settings in two education districts of the Western Cape Province[569]. It is not clear as to whether these lessons are being implemented as intended. Insufficient equipment, limited time for physical education in the curriculum and low levels of educator expertise and confidence have all been reported as reasons for the inadequate implementation of physical education in South African schools[507]. Four principals indicated that their school employed specialist physical education educators as opposed to generalist educators. Unlike a specialist educator, a generalist has not undergone intensive physical education training[695]. As a result of their limited training and exposure to this unique learning environment, they will in all likelihood lack self-assurance and an embodied understanding of physical education[695]. Not surprisingly, the four schools that employed specialist physical education educators were all quintile five schools which generally are better funded and therefore resourced[696]. Almost half of the schools (48%) in this study did not offer compulsory after school extramural sports. The HealthKick study reported that all schools in their study offered extramural sports, however, a lack of available facilities or the facilities not being in good condition could also contribute to less than ideal extra mural sports[569].

The ability to make healthy choices however presumes an environment where healthy choices are readily available; where people can breathe smoke-free air, buy fresh produce, and walk safely through neighbourhood streets to and from school[697]. For many South Africans however, this vision reflects an impossible reality. Much of the landscape was designed for cars, making it not only challenging but also frequently dangerous to walk or ride a bicycle[698]. At school, learners and educators are tempted by an array of unhealthy foods and beverages, and many schools do not implement physical education in the curriculum[569]. Since the physical, social and cultural environment in which educators spend a high proportion of every weekday may have a profound influence on their emotional and mental health[492], it is vital that schools create environments and policies that support healthy lifestyle behaviours. Very few schools in this study had implemented clear policies guiding healthy eating and a physical activity enabling environment. A possible reason for this could be that the DBE does not require them. In the global strategy on the prevention of NCDs, the WHO[699], urges governments to draft policies that encourage schools to promote healthy eating and increased physical activity. Intervening in schools at the policy level has been successful in many studies[700]. In this regard South African schools appear to lag other countries.

There is a paucity of data providing evidence of the relationship between school cultures of health, which include programmes and environmental initiatives supporting healthy behaviors, and educator health. The limited research available, has shown that worksites with more health promotion facilities have employees with lower NCD risk factors, have more physically active employees who also consume more servings of fruits and vegetables per day than environments with fewer such facilities[701,702]. The relationship between facilities and behaviour improved if the facility specifically promoted the healthy behaviour. For example, physical activity increased if the company subsidised gym membership or if they were able to participate in physical activity during working hours[702]. Furthermore, employees were 4.1 (95% CI, 2.01; 8.40) times more liley to participate in physical activity during their leisure time if the worksite had at least three policies or programmes promoting physical activity[702]. Similarly, Kolbe-Alexander *et al.*, showed that for every South African employee in their study consuming five or more servings of fruits and vegetables per day, 4.5 employees did not, and the nutrition-related facility scores were higher for those meeting the recommendation. Total facility scores showed a very small, but significant relationship with fruit and vegetable intake, with the odds of meeting guidelines only 1.01 ($P = 0.007$) for every additional facility. The odds increased to 1.18 for every additional nutrition-related facility added to the worksite ($P = 0.005$) when only considering nutrition-related facilities[701]. School principals that would like to encourage a particular behaviour should consider developing facilities that specifically address those behaviours and not general health facilities[701].

Chapter Three showed that over 80% of the educators in the study did not meet the recommended physical activity guidelines. This chapter highlighted that educators' baseline physical activity was significanly associated with the school physical environment and the physical activity enabling environment. Changing school environments to ensure they are physical activity permissive environment could increase physical activity levels. Increasing opportunities for educators to be more physically active at school has been shown to have positive influences on Flemish educators' physical, mental, and work-related health[703].

The school food environment has been shown to be one of the most important components in effective school-based interventions to promote healthy eating among educators and learners[605]. This study found a significant association between SSB consumption and a healthy eating environment. A more enabling healthy eating environment resulted in significantly lower SSB consumption. Laska *et al.*, also found a strong association between healthy eating environments and reduced SSB intake in a low-income communities and schools in Minneapolis/St. Paul[704]. A healthy eating environment also resulted in significantly lower systolic (but not diastolic) blood pressure.

School environment interventions should include modifying school policies around food sales[492], smoking[494], encouraging staff members to walk more[495] or encouraging social support[498]. Various sudies[705,706] have suggested that increasing social supports available to educators may be a useful strategy for preventing burnout. Empirical evidence concerning the impact of social support on burnout among educators is however very limited. A study of educators, nurses, therapists and lawyers indicated that those who were classified as burned out spent less time with their fellow workers than those who were not burned out[707]. A survey of a random sample of school educators in New Hampshire found that higher levels of social support from colleagues was associated with lower levels of 'burnout'[708]. Russell *et al.*, reported that three aspects were predictive of 'burnout'. These included social support received by educators, support from principals and reassurance of worth[709].

Higher quintile schools in this study had overall healthier food environments. This was evident in Chapter Three where educators from quintile five schools consumed significantly less SSBs compared to educators from other quintile schools. In addition, quintile four educators consumed significantly more fruits and vegetables compared to educators from other quintile schools. Foods sold in tuck shops and by vendors in the lower quintiles were mostly unhealthy options. These foods are typically processed, ready-to-eat, energy-dense, low in dietary fibre, high in saturated fat and with added sugar and sodium which is in line with previous studies[522,605,710,711]. Learners and educators in lower quintile schools bought more unhealthy foods compared to higher quintile schools. This has also been reported in previous studies of tuck shops in South Africa[522,605,711]. A possible reason for the unhealthier foods being sold in lower quintile schools could be that healthier food choices are, in general, more expensive than unhealthy foods. It has been argued that a healthy diet is unaffordable for the large majority of South African households[712]. There are several barriers for selling healthier foods. Tuck shop managers in quintile five schools in Pietermaritzburg, Kwa-Zulu Natal did not want to stock fruit because it did not sell well and eventually decayed[711]. Other barriers included learner's preference for unhealthy foods[713,714], a fear of losing income through selling healthier items which learners would not buy[569] and the higher cost of healthier foods[712,714]. Tuck shops particularly in lower quintile schools may also lack appropriate storage space and facilities to sell significant amounts of perishable foods, such as milk and fruit[715]. Schools in Minneapolis that implemented price discounting of healthy foods by 25% and 50% increased sales by 39% and 93%, respectively[716]. Cullen *et al.*, reported the effects of a policy to remove chips, sweets, SSBs and desserts from snack bars[717]. According to self-reported food frequency questionnaires, less SSBs and more milk were consumed at school while consumption of chips and sweets declined[717]. Policies around smoking have shown that social unacceptability and pricing could reduce involuntary exposure to toxic second-hand tobacco smoke, reduced tobacco consumption, and promoted quitting[718].

Studies have shown that one of the reasons learners generally buy unhealthy foods is that schools do not have policies in place regarding the types of food items for sale on the premises of the school, or that existing policies may not be properly implemented[719]. School policies should be in place to encourage a healthy preference food environment through repeated and sustained exposure to healthy foods[720]. In this study, 56% of schools had a school nutrition policy which was based mostly on clean and healthy foods. The Integrated School Health Policy (ISHP) is a joint initiative between the National Departments of Health and Basic Education designed to assist schools in achieving healthy school food environments in South Africa[721]. The policy provides a platform for the regulation of nutritional standards of foods sold in schools. Real progress in promoting healthy eating behaviours can only be attained if effective policies on the sale of foods are implemented and a healthy school environment is promoted.

Sixty seven percent of schools were part of the NSNP. Only 10 schools had vegetable gardens which were primarily used to grow food for the learners and to supplement the NSNP scheme. School gardens could increase access to fresh vegetables and fruit[605] as well as being used as an effective platform for learning about gardening and healthy eating[605]. A previous study also reported positive attitudes of educators and learners to food gardens[722]. Although this study found no significant associations between baseline fruit and vegetable consumption of the educators and healthy eating school environments, ensuring access to fruit and vegetables has the potential to increase educators' fruit and vegetable consumption.

The health problems experienced by learners in this study (as reported by the school principals) were identical to those reported in the HealthKick study[569]. The HealthKick study evaluated the school health, nutrition and physical activity environments of 100 urban and rural disadvantaged schools in two education districts in the Western Cape. As with the current study, unhealthy diets, lack of physical activity and underweight were the top three health problems among learners. While the top three health issues for educators in the HealthKick study were a lack of physical activity, chronic health conditions and being overweight[569], educators in the current study reported a lack of a heathy diet, lack of physical activity and being overweight as the top three health problems. The different health problems among the educators in two studies may be due to the different SESs and locations of the schools. The HealthKick study recruited rural and urban schools from low quintiles while the present study comprised low and high quintile schools which were located in urban areas only.

Thirteen schools appeared to have received funding from companies (beverage, fast food chains, a grocery chain outlet and banks) on their school sign. Companies often use school billboards to promote their products[723]. Thirty percent of schools had their name displayed on a branded cool drink billboard. De Villiers *et al.*,[569] reported double that number in schools in the Western Cape. Vendors selling sugar sweetened beverages in Soweto, South Africa had advertisements for sugar sweetened beverages located in close proximity to the schools[537]. These billboards often imply that the school supports and promotes the use of these particular products. This obviously is not a health promotion message that schools should encourage[569]. Regulating the advertising of food products in and around schools has been shown to influence consumer buying choices[724].

When analysing the school environments, it is important to understand the context in which the intervention took place. The majority of schools included in the present study experienced issues such as poverty, crime (gangsterism), bullying, family issues, malnutrition and diseases associated with infections such as HIV and tuberculosis. These issues are still rife in the communities[569]. As mentioned previously, one school had to withdraw from the study as they experienced a shooting at the school. The principal therefore felt that they needed to deal with the trauma and this study would distract the staff and learners from dealing with the incident. Schools battle with these challenges on a daily basis making it difficult for staff to undertake health promoting activities that are not directly associated with normal day-to-day activities. According to de Villiers *et al.*, educators' issues around NCDs are often perceived as a 'disease in the distant future' which may not necessarily directly impact their current everyday lives[569]. Using interventions from programmes implemented in high-income countries may therefore not be appropriate for LMICs as resource and every day challenges are very different[569].

6.6. STRENGTHS AND LIMITATIONS

The WHO[699] and the American Centre for Disease Control (CDC)[725] have provided important guidelines to promote health through the school system. One of the core elements of the guidelines proposed by the WHO is to conduct a school situational analysis prior to an intervention. The analysis provides a baseline of factors relating to the school environment and school policy which are likely to impact on the health of the educators, learners, parents, and the surrounding community. A situation analysis would help schools, principals and educators better understand the needs, resources and conditions that are important to planning and implementing interventions"[699].

As mentioned previously, it is impossible to draw generalisations from a sample of 27 schools to the over 25 500 schools in South Africa. A further compounding issue is the fact that principals were required to complete the questionnaire which may have resulted in bias.

Three limitations were identified in the school environment analysis. Firstly, the school built environment was assessed via a questionnaire. Measures of the school built environment via questionnaires have shown moderate or low agreement compared to objective measures through street and virtual audits (using Google Maps or the like)[726,727].

Secondly, although studies have reported on the significant impact the community around the school exerts on physical activity and healthy eating habits[567,686], this study only investigated policies and facilities within the school. Assessing community factors was beyond the scope of this thesis. Lastly, Chapter Six showed that there were significant differences in the school environment between the different quintiles. Hall and Giese identified numerous pitfalls in the South African school quintile ranking system[728]. In some instances schools in the same SES area are ranked differently. Further, quintile rankings within and across provinces can mask large disparities between schools that are ranked equally. For example, 35% of learners in the Eastern Cape (the poorest province) should be accommodated in quintile one schools, as opposed to 6.5% of learners in the relatively wealthy Western Cape province[728]. If the quintile ranking system is inconsistent, meaningful comparisons between schools and provinces becomes very difficult, if not impossible[728].

6.7. CONCLUSION

Conducting a school environment audit has the potential to highlight areas which a school could improve the health and wellness of not just the learners but the educators and support staff. This study has highlighted that generally, school environments, particularly in the lower quintiles, are not conducive to healthy eating, sufficient physical activity or the promotion of health. Understanding the realities of each school and getting the principal and each educator's buy-in will help to create a maximum impact. The findings from this chapter can help contribute to the knowledge of key environmental and policy determinants that play a role in the health behaviour of learners and educators. This knowledge is essential to create an intervention programme in the school setting when trying to optimise the physical environment and develop relevant school policies.

Chapter 7 **SUMMARY AND CONCLUSIONS**

7.1. SUMMARY

This thesis provides new evidence to support the use of a tailored letter and SMS-text message campaign designed to provide advice and support to an 'at risk' population in South Africa. Educators who received the tailored letter and SMS-text messages showed greater health benefits and improved health risk status compared to those who received the standard-of-care. The intervention resulted in a significantly greater reduction in the proportion of educators who were overweight and obese as well as those who were hypertensive. Educators in the intervention group also showed an almost two-fold greater increase in those meeting physical activity guidelines compared to those in the control group (112.8% vs 58.9%). Although there were greater relative changes in the intervention group, the standard-of-care group also showed significant health benefits and improved health risk status outcomes, supporting the notion that wellness days are an effective 'entry into care' intervention. This study also confirms findings reported in Chapter One that educators in South Africa are less healthy than the general employed population. Overweight and obseity rates were found to be 27% and 50% respectively. Overall, 82% of educators did not meet the recommended PA guidelines and only 11% met the recommended five fruit and vegetable servings per day. Further, the study provides original evidence for the efficacy and acceptability of the use of SMS messages. Lastly, this study supports findings reported in Chapter Six that the school environment is generally unhealthy and that there attributes of the school health environment that are associated with the health risk status of the educators within the schools.

This study was designed in conjunction with the South African National Department of Basic Education and in response to the Action Plan to 2014: Towards the realisation of schooling 2025[729]. The Action Plan has 27 goals. The four relevant goals to support educators (and by implication learners) as part of the realisation of schooling 2025 were identified as: (i) Goal 17: Strive for a teacher workforce that is healthy and enjoys a sense of job satisfaction, (ii) Goal 25: Use the school as a location to promote access amongst children to the full range of public health and poverty reduction interventions, (iii) Goal 26: Increase the number of schools which effectively implement the inclusive education policy and have access to centres which offer specialist services, and (iv) Goal 27:

Improve the frequency and quality of the monitoring and support services provided by district offices to schools, partly through better use of e-Education.

Initial discussions with the DBE highlighted that the objectives of this study needed to conform with the goals and objectives of the DBE. The DBE's mandate for this study was to investigate an intervention (rather than just a formative study) which needed to be low-cost, scalable and appropriate for educators in all socioeconomic strata, and thereby, suitable for implementation nationally.

7.2. GENERALIBILITY OF THE STUDY

Although there were certain characteristics of the schools and educators in the study which have been reported in other studies investigating the health status of educators, the school environment and the acceptability of SMS messages, the small sample size of educators (571 out of a total 418 611) and schools (27 out of 25 574) makes the generalisability of findings impossible. Although the findings of this study showed that wellness days can be an effective 'entry into care' intervention and that including a low-touch, low-intensity tailored SMS campaign had the potential to further improve the health risk outcomes of the educators in this study, a study with a larger number of schools and educators would need to be conducted to ascertain whether these findings could be applied to the broader population and therefore rolled out effectively to the rest of the educators in South Africa.

7.3. STRENGTHS OF THE STUDY

This study has a number of strengths. Firstly, this study was the culmination of many months of planning between the Department of Basic Education, the University of Cape Town and a private healthcare insurer in South Africa. The Public-Private Partnerships allowed all three parties to invest different and unique expertise into the research project. The strong partnership that developed resulted in a coordinated approach to the intervention, a clear understanding of the challenges facing this particular group, what was required from each party to ensure the intervention was successfully implemented and the details for the dissemination of results. To our knowledge, this is the first study to implement and evaluate an intervention focused on educators' health in

South Africa. If the model could be replicated and the DBE could implement wellness days and deliver SMS messages cost-effectively, it would most likely result in a reduced risk profile in more educators in South Africa. This would potentially impact on the health of learners, thereby impacting on a larger South African population.

Secondly, mobile technologies have the potential to solve one of the most difficult problems facing global health efforts - that of structural barriers to access[585]. Travel, especially to remote areas in LMICs, is expensive, destructive to the environment, time-consuming, exhausting and physically challenging for many health promoters[628]. The challenges of travel and complex intercultural contact, so much a feature of the current global health enterprise, may now be a thing of the past[629]. Mobile technology may hold out the promise of a world where these difficulties could be minimised or eliminated[385]. There is an obvious appeal to be able to remotely interact with and improve the health of people who are scattered around the country and indeed the globe. Further, the continuation of support and communication after diagnosis of disease or identification of risk factors has also shown great promise in assisting individuals to pursue self-management of long-term conditions and healthy behaviours[390,630-632]. A review of the literature in Chapter One showed that mobile technologies could reduce the need for ongoing face-to-face contact and appointments with health promoters[633].

Thirdly, mobile phones are ubiquitous, SMS use is a popular form of communication particularly in LMICs where 'smart phones' penetration is still relatively low and the cost of data is disproportionately high[650]. SMS-text messaging provides an opportunity for individualised and somewhat interactive information delivery that may easily be accessed, independent of time and place[651]. The high fidelity of the text messages highlighted in Chapter Five is a feature of the intervention which could be scaled up to educators in all schools in South Africa regardless of SES status.

The intervention was developed using an adapted IM approach and considered different behaviour change theories. In LMICs where resources are scarce, implementing untested mHealth interventions without a theory of behaviour change is likely to result in many projects failing to be scaled up and in significant levels of wasted resources[585]. Employing evidence-based content and theoretical constructs to interventions can lead to improved health outcomes and has shown promise in helping individuals sustain healthy behaviours[543]. Using an intervention mapping approach in the development, implementation and evaluation of a behaviour change intervention provides a vocabulary for programme planning, procedures for planning activities, and technical assistance with identifying theory-based determinants and matching them with appropriate methods for change[543]. Chapter Two showed that that the application of an adapted IM approach is a feasible and helpful method for providing an evidence-based and theoretical structure to a complex health behaviour change intervention. Chapter One revealed that using behaviour change theories to develop interventions results in greater intervention effects[231,586].

7.4. LIMITATIONS OF THE STUDY

A number of limitations were highlighted throughout the study. Firstly, the current study did not include a control group. The standard of care wellness day plus targeted feedback was received by all groups. It is important to note that the wellness days are also considered an intervention. The results of this study, supported by others, clearly demonstrate this.

Secondly, although appropriate for the country setting and the population being investigated, the use of a print letter and SMS messages may be considered 'old technology'. Although discussions with the DBE highlighted that this was the most appropriate method of delivery, newer technologies where objective analyses and feedback could replace the self-reported questionnaires should be investigated in the future. SMS systems are good at sending one-way messages from a source to an individual, but are ill designed to allow interaction, including between individuals who may be in the same geographic area and could potentially provide face-to-face support to each other.

Thirdly, it was highlighted that the single print letter and 13 SMSs is a low-touch, low-intensity. The ideal number and frequency of tailored messages reported in the research is inconsistent. The current study highlighted that although there were significant improvements in a select number of lifestyle risk factors, increasing the number and frequency of the messages may have resulted in more significant changes, particularly in the biochemical and anthropometric risk factors. Future research could investigate the ideal frequency and intensity of tailored SMS messages.

Fourthly, Chapter Three highlighted the fact that it was very difficult, if not impossible to make assumptions and generalisations from the select sample in this study Future studies should include quintile one schools, recruit a representative sample of schools from all none provinces and ensure more educators participate. It would also be important to investigate ways of ensuring educators do not drop out. Chapter Four highlighted that the drop-out rate of educators in this study, while similar to other studies, was high. Should the DBE decide to roll out a similar programme to all educators, it would be crucial to find innovative ways of keeping them 'in the intervention' and interested in their health.

Fifthly, intervening on multiple behaviours simultaneously has the potential to maximise the impact on an individual's health and may also be more cost-effective than addressing one behaviour at a time[201]. It is currently unknown whether changing behaviours sequentially is more effective than simultaneously since few studies have compared the two approaches[644]. Although the broader intervention addressed multiple behaviours, educators were asked to select only one goal (behaviour) for improvement, not multiple behaviours. Future research should investigate multiple behaviours change.

7.5. RECOMMENDATIONS AND WAY FORWARD

A popular strategy to try keep individuals engaged in situations where there may be a high dropout rate is to empower them to take responsibility for their health[730]. Ensuring employees have sufficient knowledge of their lifestyle habits and chronic conditions has been shown to assist them in managing their health[731]. Individuals need to make a shift from being healthcare recipients, to taking greater responsibility in managing their conditions[730]. Self-management education programmes (also called 'the expert patient') should be specifically designed to complement traditional health education in supporting individuals to build their confidence and self-esteem, and identify and solve problems with the support of professionals[732]. In addition, they should assist individuals to become key decision makers in their wellbeing. This should work in partnership with their health care providers in order to have greater control over their lives in reducing the severity of symptoms and improve confidence, resourcefulness and self-efficacy[733]. These programmes have been shown to be particularly effective in LMICs[734-737], however, it was out the scope of this study.

Results of the current study lend support to the importance of wellness days for educators in schools. The DBE, through its health and wellness partners, could roll out wellness days to all schools. Further, using its existing communication infrastructure, the DBE could include ongoing SMS communication to educators. This communication could provide a simple, low-cost means of providing a support programme and perceived continuation of care as well as minimising educator's dropping out of the programme. Spark *et al.*, showed that a supportive text-message programme following a physical activity and weight loss programme maintained these behaviours for a year post-intervention[631]. Messages could be personalised by including each educator's name and having the DBE's signature at the end of the message. General health and wellness advice could be based on themes from the Department of Health's Awareness Calendar (http://www.health.gov.za/index.php/component/phocadownload/category/322). SMS-text messages with advice on managing specific NCD risk factors could further support and assist educators to grow professionally and live healthier, more productive lives.

South Africa has a positive environment for mHealth implementation that includes a high prevalence of mobile phones, a well-developed information and communication technology industry, examples of successful use of mHealth for behaviour change and a government supportive of mHealth development[738]. Nevertheless there appear to be weaknesses in the functioning in the public sector education system that could jeopardize the successful implementation and value of mHealth programmes. Challenges to scaling up exist in all the educational system. Against the background of a struggling educational system with uncertain implementation capacity and the lack of an evidence base on cost-effectiveness of large scale mHealth solutions, it would be wise to not opt at this stage for a full-scale use of a mHealth system. Rather, a recommendation that South Africa adopt a developmental approach to the implementation of mHealth. In selected areas where organisational capacity for implementation exists, the Department of Basic Education could follow a staggered approach that involves encouraging the initial implementation of smaller, phased and heavily evaluated ‘pilot’ projects. Implementation should pay particular attention to the technological issues of educator acceptability, as well as ensuring security and privacy of individuals’ information. This will allow for growing the capacity for implementation and the evidence base on mHealth in mainstream educational settings - evidence that can in turn inform future developments in policy and practice.

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APPENDICES

APPENDIX A: ETHICS APPROVAL

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences

Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492 • **Facsimile** [021] 406 6411
Email: Sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

30 September 2014

HREC/REF: 216/2014

Prof E Lambert
MRC/UCT Research Unit for Exercise Science and Sports Medicine
Human Biology
Sports Science Institute
3 rd Floor
Newlands

Dear Prof Lambert

Project Title: CARE AND SUPPORT OF TEACHING AND LEARNING: SOUTH AFRICAN NATIONAL EDUCATORS WELLNESS STUDY (SA-NEWS) & VITALITY HEALTHY SCHOOLS CHALLENGE (PHD L Josephs)

Thank you for your response letter dated 17 September 2014, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above mentioned study.

Approval is granted for one year until the 30 September 2015.

Please submit a progress form, using the standardised Annual Report Form, if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

We acknowledge that the following student:-Lester Josephs is also involved in this project.

Please note that the on-going ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Hrec/ref/216/2014

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Hrec/ref:210/2014

APPENDIX B: BDE LETTER TO PROVINCES

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Private Bag X895, Pretoria, 0001, Sol Plaatje House, 222 Struben Street, Pretoria, 0002, South Africa
Tel.: (012) 357 3000, Fax: (012) 323 0601, www.education.gov.za

Ref no: s – 1265/14 – 25/07/2014
Enquiries: Dr F Kumalo
Tel: 012 357 3431
Email: Kumalo.F@dbe.gov.za

Mr B Ngobeni
Superintendent-General: Education
Johannesburg
Private bag X7710
JOHANNESBURG
2000

By fax: 086 619 8717

Dear Mr Ngobeni

PROOF OF CONCEPT RESEARCH STUDY ON EDUCATOR WELLNESS IN GAUTENG AND WESTERN CAPE PROVINCES

The Department of Basic Education and Discovery Vitality initiated collaboration in 2012. There is an urgent need to address the modifiable lifestyle risks of South Africa's educators, through school-based health promotion and scaleable interventions. This is in line with the Department of Basic Education's mandate of placing the health and well-being of educators and learners at the centre of achieving quality basic education.

It is proposed that a 'proof-of-concept' study is conducted to test a potentially scaleable intervention involving the health risk assessment of school staff and effective, tailored feedback and scheduled and tailored SMS-text messaging. The baseline survey will provide an ecological study of the school health environment, including the built environment, policy, culture and infrastructure. Further to this, specific process measures around uptake and engagement with the booster, SMS-texts will be monitored. The proposal was jointly developed by DBE, Discovery Vitality and the University of Cape Town and is attached for your information.

The study will help inform the Department's programmes in meeting its commitment to scale up and strengthen the care and support programmes for educators in schools. As a proof-of-concept study, the sample is intentionally not nationally-representative. Gauteng and Western Cape Provinces have been chosen for convenience as the research team is based in these two provinces. However, the study is adequately statistically powered to evaluate baseline correlates of health risk status in educators, as well as the effectiveness of the intervention in changing health risk intentions and behaviours of educators. Schools selected will cover the broad socio-economic spectrum. The researchers have been informed that the research should in no way interfere with teaching and learning time.

I urge you to support this study as it is in line with the sector plans to enable the attainment of quality basic education. Please feel free to contact the above-named official for more information.

Yours sincerely

MR SG PADAYACHEE
ACTING DIRECTOR-GENERAL
DATE: 21/07/2014

APPENDIX C: SCHOOL CONSENT FORM

To:

From: Lester Joseph

Project coordinator

011 529 4591 (tel); 083 377 7771 (cell); 011 539 0001 (fax)

PERMISSION TO INCLUDE TEACHERS FROM YOUR SCHOOL

RE: South African National Educators Wellness Study (SA-NEWS)

Dear Principal,

Obesity, lack of physical activity and other unhealthy lifestyle choices are putting the South African population at greater risk of developing chronic diseases of lifestyle. Your school is one of the schools randomly chosen to represent the provinces of Gauteng or the Western Cape for this study. The MRC/UCT Research Unit for Exercise Science and Sports Medicine (ESSM) in collaboration with the Department of Basic Education (DBE) is undertaking a project concerned with the health and welfare of South African educators: the "**South African National Educators Wellness Study (SA-NEWS)**" which will be conducted in two provinces in South Africa. The results of this study will help support the development of policies and programmes aimed at supporting educators in making lifestyle change which will help to reduce the burden of these chronic diseases of lifestyle, as well as inform provincial/local and national government agencies in South Africa about the health status of South African educators.

What is involved for schools?

As the school principal, you will be asked to complete a short questionnaire called the "**School Environment Assessment**". This questionnaire will help us to understand the school physical environment, policies and facilities that can contribute to healthy lifestyle choices, or may act as a barrier.

A **wellness day** will be conducted at the school, and all staff members will be invited to participate. A wellness day consists of educators making individually scheduled appointments to complete a health risk assessment questionnaire (Vitality Health Review (VHR)) and have certain clinical measures taken. The VHR includes questions on age, gender, medical and family history, and certain self-reported lifestyle behaviours, concerning diet and physical activity, smoking and alcohol intake. There are also questions concerning the number of days in the preceding month that they may have experienced ill health, as well as readiness and intention to change or improve these behaviours. In addition to the health risk assessment, trained staff will perform some clinical measurements, including: screening tests for glucose, and cholesterol concentrations, using finger-prick capillary blood samples. Blood pressure will also be measured as well as standing height and body weight.

Finally, staff members will be asked to select a lifestyle goal, and also to complete a brief questionnaire concerning their lifestyle goal, readiness to change, confidence to change, self-efficacy to change, and barriers to change.

Wellness days will be repeated between 5-6 months after the initial visit, again, by invitation, to determine if communicating risk to educators results in any change in health risk status. All wellness days will be coordinated to disrupt teaching and learning as little as possible, and in consultation with the principals.

Communicating health risk status:

Each staff member will receive a complete report onsite- providing standardised feedback concerning their health status.

Two forms of communication will be compared, using random allocation of schools, and should one result in a more favourable outcome in terms of change in health risk status, this will form part of the recommendations to the Department of Basic Education going forward.

Group 1 (Standard feedback): Educators will receive on-site, standardised feedback which compares their results to healthy normative standards, and trained staff will explain these results to them at the end of their Wellness day appointment.

Group 2 (Standard feedback, print & SMS-text): Educators will receive similar on-site communication, and will also receive a personalised letter (print communication delivered to the school within 2 weeks of wellness day visit) based on their response to some simple questions concerning lifestyle goals, readiness to change, confidence to change, self-efficacy to change, and barriers to change.

In addition, educators will be invited to receive SMS-text messages, based on their lifestyle goals, and responses to the 'change' questionnaires. They will receive a "welcome" message (to test that the SMS system is working) and then one SMS per month, that is tailored to their goal.

What are the benefits for your school?

Your school will receive two reports: 1. a school health report, based on the information from the School Environmental Assessment and 2. a composite educator wellness report with the de-identified results of the educators' health status based on the Vitality Health Review questions.

If you have any questions about the project, please contact Lester Joseph. We look forward to receiving your response.

Risks and benefits for educators

The Department of Basic Education and Faculty of Health Sciences Human Research Ethics Committee at the University of Cape Town have approved this study. Besides a little discomfort and a minimal risk of infection measures for cholesterol and glucose concentrations, from the finger prick, there are no substantial risks to educators and staff members who choose to take part in this study. All efforts will be taken to minimise these risks with the use of sterile techniques, and qualified, trained staff will be employed to conduct these measures.

The results from the School Environment Assessments and the wellness days will remain strictly confidential. Schools and participants will not be identified by name in any reports or publications. This means that individual schools' and participants' names cannot be linked in any way with the results of the study. All educators will be asked to sign an informed consent form prior to participating in the study.

There is a direct benefit of involvement for both groups, to increase health risk awareness and to receive feedback and educational and motivational materials to assist with making lifestyle changes.

All participants will have the opportunity to be re-tested after 5-6 months, to evaluate any changes in health risk status, which may be a result of having made changes in lifestyle.

Participants will be assured that their participation in the research is voluntary, that they may withdraw at any time and that their withdrawal will not have a negative impact on their employment, and that they will continue to receive all usual care health insurance benefits and programmes. The participants will be assured that their employer will not have access to any of the information collected for the research study, and that all information is confidential.

Should any medical problem arise as a direct result of educators' participation in this study, the research team conducting the wellness days will provide onsite care, and the University of Cape Town holds public liability insurance cover, if such an event were to occur.

Please indicate that you agree to the above request by signing the declaration below.

Thanking you,

Prof Estelle Lambert
(Principal investigator)
UCT/MRC Research Unit for Exercise Science and Sports Medicine
Department of Human Biology, Faculty of Health Sciences, University of Cape Town
021 650 4571

Mr. Lester Joseph
(PhD Candidate)
Discovery Vitality
Johannesburg, South Africa
083 377 7771

Dr. Catherine Draper
(Co-investigator)
UCT/MRC Research Unit for Exercise Science and Sports Medicine
Department of Human Biology, Faculty of Health Sciences, University of Cape Town
021-650-4561

Prof Marc Blockman
Chairperson of UCT Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building,
Observatory 7925;
Telephone [021] 406 6338.
Facsimile [021] 406 6411

Please complete the form below to provide consent for this study to be conducted in your school

School Consent Form

		From:	
Fax:		Pages:	1
Re:	**South African National Educators Wellness Study (SA-NEWS)**	Date:	

I have reviewed the **South African National Educators Wellness Study (SA-NEWS)** research application / package. I have read and understood the purpose of the study; I have had a chance to ask questions relating to the study.

Our decision is therefore as follows:

☐ **YES,** we would like to participate in the study. (Note: project staff will contact the following person in the next few days)

Please assign a school contact person: ______________________________________

Preferred method of communication (i.e., phone, email, etc.): ____________________

☐ **NO,** we are not interested in participating in the study at this time. We decline to participate in the project for the following reason(s): *(We would appreciate learning all reasons for declining to participate).*

____

____

____

Sincerely,

Name: ________________________________

Signature: ________________________________

Email: ________________________________

Phone: ____________________________________

APPENDIX D: EDUCATOR CONSENT FORM

<u>Educator Informed Consent</u>

RE: **South African National Educators Wellness Study (SA-NEWS)**

Dear educator,

Obesity, lack of physical activity and other unhealthy lifestyle choices are putting the South African population at greater risk of developing chronic diseases of lifestyle. Your school is one of the schools randomly chosen to represent the provinces of Gauteng or the Western Cape for this study. The MRC/UCT Research Unit for Exercise Science and Sports Medicine (ESSM) in collaboration with the Department of Basic Education (DBE) is undertaking a project concerned with the health and welfare of South African educators: the "**South African National Educators Wellness Study (SA-NEWS)**" which will be conducted in two provinces in South Africa.

The results of this study will help support the development of policies and programmes aimed at supporting educators in making lifestyle change which will help to reduce the burden of these chronic diseases of lifestyle, as well as inform provincial/local and national government agencies in South Africa about the health status of South African educators.

A **wellness day** will be conducted at your school for all staff members. You will be invited to make an individual appointment with the project coordinator on your school's Wellness day. At this appointment, you will be asked to complete a health risk assessment questionnaire (Vitality Health Review (VHR)) and have certain clinical measures taken. The health risk assessment includes questions on age, gender, your medical and family history, and questions concerning your diet and physical activity, smoking and alcohol intake habits. There are also questions concerning the number of days in the preceding month that you may have experienced ill health, and your readiness or intention to change any of your lifestyle habits. In addition to the questionnaire, trained staff will perform some clinical measurements, including: screening tests for glucose, and cholesterol concentrations, using finger-prick blood samples. Blood pressure will be measured as well as standing height and body weight.

In addition to these measures, you will also be asked to select a lifestyle goal, and also to complete a brief questionnaire concerning this lifestyle goal, your readiness to change, your confidence to change, and any barriers that you identify to making a lifestyle change.

Wellness days will be repeated 5-6 months later, to monitor any changes in health status or health habits. All wellness days will be coordinated to disrupt teaching and learning as little as possible, and in consultation with the principals.

Communicating health risk status:

All participants will receive a complete report onsite and feedback concerning their health status. Two forms of communication will be compared, using random allocation of schools, and should one result in a more favourable outcome in terms of change in health risk status, this will form part of the recommendations to the Department of Basic Education going forward. One form of communication involves receiving print and SMS-text messages.

The South African National Educators Wellness Study (SA-NEWS) is approved by both the Provincial Department of Education and your school. The survey is being done on behalf of MRC/UCT Research Unit for Exercise Science and Sports Medicine (ESSM).

Please read the details below and decide if you will agree to participate in the study.

Details about the South African National Educators Wellness Study (SA-NEWS)

- The wellness day will take 30 to 40 minutes. You will need to book a slot prior to the day.
- You can refuse to take part in the survey at any time, with no penalty.

Risks and benefits

The Department of Basic Education and Faculty of Health Sciences Human Research Ethics Committee at the University of Cape Town have approved this study. Besides a little discomfort and a minimal risk of infection measures for cholesterol and glucose concentrations, from the finger prick, there are no substantial risks to those of you who choose to take part in this study. All efforts will be taken to minimise these risks with the use of sterile techniques, and qualified, trained staff will be employed to conduct these measures.

The wellness day and its results are private. This means that your name cannot be linked in any way with the results of the study. Your answers are completely private and will not be given to the school, or anyone else.

The results of the study will only be reported in group form. The school will receive a comprehensive and easy-to-read School Health Profile with Executive Summary that includes your school's educators' health status.

The data we gather from the study will be stored at the University of Cape Town. Only research staff will have access to the written surveys.

There is a direct benefit of involvement for both groups, in that you will receive feedback that may provide motivation, guidance and direction as to important lifestyle changes that may help you to improve your health risk status. All participants will be asked to undergo re-testing after 5-6 months (same procedures as pre-test), to evaluate any changes in health risk status, which may be a result of having made changes in lifestyle.

Your participation in the research is entirely voluntary, and you may withdraw at any time without prejudice. Should any medical problem arise as a direct result of your participation in this study, the research team conducting the wellness days will provide onsite care, and the University of Cape Town holds public liability insurance cover, if such an event were to occur.

Permission

You are the only one who will decide whether to be part of the South African National Educators Wellness Study (SA-NEWS), or not. Besides a little discomfort from the finger prick, there are no known risks to take part in this study. The Department of Basic Education and Office of Research Ethics at the University of Cape Town have approved this study.

If you have any concerns about the survey, feel free to contact Lester Joseph at (083) 377 7771.

Please indicate that you agree to the above request by signing the declaration below.

Thanking you,

Prof Estelle Lambert
(Principal investigator)
UCT/MRC Research Unit for Exercise
Science and Sports Medicine
Department of Human Biology, Faculty of
Health Sciences, University of Cape Town
021 650 4571

Mr. Lester Joseph
(PhD Candidate)
Discovery Vitality
Johannesburg, South Africa
083 377 7771

Dr. Catherine Draper
(Co-investigator)
UCT/MRC Research Unit for Exercise Science and Sports Medicine
Department of Human Biology, Faculty of Health Sciences, University of Cape Town 021 650 4561

Prof Marc Blockman
Chairperson of UCT Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building,
Observatory 7925;
Telephone 021 406 6338.
Facsimile 021 406 6411

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Discovery Vitality

Educator Consent

To:		From:	
Fax:		Pages:	1
Re:	South African National Educators Wellness Study (SA-NEWS) Participation Decision	Date:	

I have reviewed the **South African National Educators Wellness Study (SA-NEWS)** research application/ package. I have read and understood the purpose of the study; I have had a chance to ask questions relating to the study. My decision is therefore as follows:

☐ **YES,** we would like to participate in the survey.

☐ **NO,** I am not interested in participating in the HSS at this time. I decline to participate in the project for the following reason(s): *(We would appreciate learning all reasons for declining to participate).*

____

____

Sincerely,

Name: ______________________ Date: ______________

Signature: ______________________ Phone: ______________

Email: ______________________ School: ______________

APPENDIX E: HRA QUESTIONNAIRE

Vitality Health Review

Discovery Vitality

Contact us
Tel: 0860 99 88 77, PO Box 784262, Sandton, 2146, www.discovery.co.za

Proof 3 • WT110205 • 08.02.13 • Seshnee

Thank you for completing your Vitality Health Review. The Vitality Health Review will give you feedback on your lifestyle habits and health risks. Please answer all the questions in the Vitality Health Review to allow us to give you an accurate assessment of your health risks and general wellness.

How to complete this form

1. Fill in the answers to all the questions to get the feedback and earn Vitality points. Please note that you will not earn any points if the form is not completed in full.
2. Fax the completed form to **011 539 7347.**

About yourself (main member)

First name

Surname

Discovery Health membership number

Discovery Vitality number

Identity number

About your spouse (complete this section only if your spouse is completing the Vitality Health Review)

First name

Surname

ID number

The Vitality Health Review questions

1. Your medical history

Have you ever been diagnosed with any of the following medical conditions by a doctor or have you been prescribed medicine for any of them?
Select all conditions that apply

Allergies	Yes ☐	No ☐
Arthritis	Yes ☐	No ☐
Asthma	Yes ☐	No ☐
Back pain	Yes ☐	No ☐
Cancer	Yes ☐	No ☐
COPD	Yes ☐	No ☐
Chronic lung disease	Yes ☐	No ☐
Chronic pain	Yes ☐	No ☐
Depression	Yes ☐	No ☐
Diabetes	Yes ☐	No ☐
If yes, what type of diabetes do you have?	Type 1 ☐	Type 2 ☐
Are you currently taking medicine to manage your diabetes?	Yes ☐	No ☐
Heartburn or acid reflux	Yes ☐	No ☐
If **yes**, are you currently on treatment for heart burn?	Yes ☐	No ☐
Heart disease	Yes ☐	No ☐
If yes, are you currently on treatment for heart disease?	Yes ☐	No ☐
Do you have any other medical conditions?	Yes ☐	No ☐

High blood pressure	Yes ☐	No ☐
If yes, are you currently taking medicine to control your blood pressure?	Yes ☐	No ☐
High cholesterol	Yes ☐	No ☐
If **yes**, are you currently taking medicine to manage your cholesterol?	Yes ☐	No ☐
Menopause	Yes ☐	No ☐
Migraine headaches	Yes ☐	No ☐
If yes, are you currently on treatment for migraine headaches?	Yes ☐	No ☐
Osteoporosis	Yes ☐	No ☐
If yes, are you currently on treatment for Osteoporosis?	Yes ☐	No ☐
Sleep disorder	Yes ☐	No ☐
If yes, are you currently on treatment for a sleep disorder?	Yes ☐	No ☐
Stroke	Yes ☐	No ☐
If yes, are you currently on treatment for a stroke?	Yes ☐	No ☐
Thyroid disease	Yes ☐	No ☐
If yes, are you currently on treatment for thyroid disease?	Yes ☐	No ☐

If yes, please provide more details about the condition(s)

Are you currently pregnant? Yes ☐ No ☐

2. Your family's medical history

Has anyone in your family (biological mother or father, brother or sister) been diagnosed with any of the following medical conditions? Please tick all the conditions that apply.

Heart disease	Yes ☐	No ☐
Stroke	Yes ☐	No ☐
High blood pressure	Yes ☐	No ☐
High cholesterol	Yes ☐	No ☐
Diabetes	Yes ☐	No ☐
Cancer	Yes ☐	No ☐
COPD	Yes ☐	No ☐
Asthma	Yes ☐	No ☐
Chronic lung disease	Yes ☐	No ☐
Osteoporosis	Yes ☐	No ☐

3. Your key measurements

How tall are you? ☐ . ☐☐ metres

How much do you weigh? ☐☐☐ kilograms

What is your waist circumference? ☐☐☐ centimetres Don't know ☐

Please choose the option that best describes how you feel about your current weight

☐ You are happy with your weight

☐ You are not happy with your weight but have no intention of losing weight any time soon

☐ You would like to change your weight

What is your most recent blood pressure readings? Systolic/Diastolic ☐☐☐ / ☐☐☐ ☐ Don't know

Do you know if it is ☐ High ☐ Normal ☐ Low ☐ Don't know

What is your total cholesterol level? ☐☐☐ mmol/l ☐ Don't know

Do you know if your total cholesterol level is ☐ High ☐ Normal ☐ Low ☐ Don't know

What is your high-density lipoprotein (HDL) level? ☐☐☐ mmol/l ☐ Don't know

What is your low-density lipoprotein (LDL) level? ☐☐☐ mmol/l ☐ Don't know

What is your triglyceride level? ☐☐☐ mmol/l ☐ Don't know

What is your random glucose level? ☐☐☐ mmol/l ☐ Don't know

Do you know if it is ☐ High ☐ Normal ☐ Low ☐ Don't know

What is your HbA1c level? ☐☐☐ % ☐ Don't know

Do you know if your HbA1c level is ☐ High ☐ Normal ☐ Low ☐ Don't know

4. Your smoking status

Do you use tobacco products like cigarettes, cigars or pipes?

☐ No, never used tobacco products

☐ No, but used to smoke tobacco products

☐ Yes, smoke or use tobacco products

If you are a smoker, how many cigarettes, tobacco products, cigars or pipes do you smoke on average per day? **Number** ☐☐☐

How long have you been a smoker or tobacco user? **Years** ☐☐ **Months** ☐☐

Please choose the option that best describes your smoking habits

☐ I have no intention of stopping smoking

☐ I would like to stop smoking but not now

☐ I want to give up smoking and need help to stop smoking

If you used to smoke, how many cigarettes, tobacco products, cigars or pipes did you smoke on average per day? **Number** ☐☐☐

If you used to smoke, how many years has it been since you stopped? **Years** ☐☐ **Months** ☐☐

5. Your alcohol intake

Have you ever felt you should cut down on your drinking? Yes ☐ No ☐

Have people annoyed you by criticizing your drinking? Yes ☐ No ☐

Have you ever felt guilty about your drinking? Yes ☐ No ☐

Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover (eye-opener)? Yes ☐ No ☐

On average, how many alcoholic drinks do you have a day? Number of drinks ☐☐☐

One drink is equivalent to:

One beer can (340 ml)
One small glass of wine (120 ml)
One metric tot of spirits (25 ml)
One small glass of sherry (50 ml)
One small glass of liqueur (30 ml)

How many times in the past two months have you had 5 or more drinks on one occasion?

☐ Never
☐ 1 time
☐ 2 - 4 times
☐ 5 or more times

6. Your eating habits

How many servings of vegetables and fruit do you eat on average in a day? Number ☐☐

Which of the below best describes your eating habits?

You eat poultry such as chicken or turkey Yes ☐ No ☐

When you eat poultry you generally have it:

☐ Without the skin
☐ With skin

You eat red meat

☐ Never
☐ Less than twice a week
☐ More than or equal to twice a week

When you eat red meat you generally have

☐ Lean meat
☐ With fat

You eat oily fish like salmon, tuna, pilchards or herring

☐ Never
☐ Less than twice a week
☐ More than or equal to twice a week

How many times a week do you eat other fish like hake, kingklip or Kabeljou?

☐ Never
☐ Less than twice a week
☐ More than or equal to twice a week

You like to add the following to your food:

☐ Soft margarine
☐ Hard brick margarine
☐ Butter or fat
☐ Avocado pear
☐ Nuts and/or seeds
☐ Salad dressings or mayonnaise
☐ Olive oil and/or canola oil
☐ Sunflower oil and/or grape seed oil
☐ None

When you have dairy products such as milk, yoghurt and cheese, you generally choose:

☐ Low fat or 2% fat
☐ Full cream
☐ Skimmed or fat free
☐ You don't have dairy products

How many glasses of water do you drink a day?

Number ☐☐

You eat wholegrain products (such as wholegrain bread, cereal, oats, barley, millet, whole corn (mealies), wholegrain crackers, brown rice or wholewheat pasta)

☐ Less than three servings a day
☐ Three or more servings a day

6. Your eating habits *(continued)*

How salty do you like your food?

- ☐ Very salty
- ☐ Lightly salted
- ☐ Not salted

How often do you eat any of the following:

(Cakes, cookies, pastries, doughnuts, muffins, chocolate, regular ice cream, sweets or fruit gums?)

- ☐ Often
- ☐ Sometimes
- ☐ Never

(Fried foods like chips, fried chicken, donuts or fritters)

- ☐ Occasionally or never
- ☐ Weekly
- ☐ Daily

(Processed meats like polony, viennas and other deli meats)

- ☐ Occasionally or never
- ☐ Weekly
- ☐ Daily

You eat fast foods:

- ☐ Occasionally or never
- ☐ Weekly
- ☐ Daily

Which statement best describes how you feel about your diet?

- ☐ I am happy with my diet.
- ☐ I know my diet needs improvement but I don't really want to change it now
- ☐ I want to change my diet, and would appreciate some help

7. Your physical activity levels

The following questions assess how much exercise you do in a week.

On average how many days a week do you exercise? ☐☐ days

On the days you exercise, on average:

- How many minutes do you exercise for? ☐☐☐ minutes
- How intense are your exercise sessions? ☐ Low ☐ Moderate ☐ High

Note: The talk test is an easy indicator of the intensity at which you are exercising.

- **Low intensity** – if you can sing several phrases of a song without breathing hard.
- **Moderate intensity** – if you can have a conversation and breathe comfortably.
- **High intensity** – if you have to take a breath between every word you say.

How often do you do strength exercises like push-ups, pull-ups, sit-ups, lifting free weights or using weight machines?

☐ Rarely or never ☐ Once or twice a week

☐ Three to five times a week ☐ Six to seven times a week

How often do you do flexibility exercise like stretching, yoga or Tai Chi?

☐ Rarely or never ☐ Once or twice a week

☐ Three to five times a week ☐ Six to seven times a week

On an average day, how many hours a day do you spend doing the following activities?

Sitting in meetings	☐☐	hours a day	minutes	☐☐
Sitting in front of your computer	☐☐	hours a day	minutes	☐☐
Watching television	☐☐	hours a day	minutes	☐☐

Which statement best describes your exercise habits?

- ☐ I am happy with the amount of exercise I am doing
- ☐ I know my fitness level has to improve, but I don't really want to exercise more right now
- ☐ I want to exercise more and increase my level of fitness, and would appreciate some help

8. Your sleeping patterns

During the last 4 weeks did you have difficulty falling asleep, staying asleep, or did you feel poorly rested in the morning?

- ☐ Never
- ☐ Sometimes
- ☐ Usually
- ☐ Always

On average how many hours of sleep do you get each day? ☐☐ Hours

9. Your stress levels

During the last 30 days, about how often did you:

Feel tired out for no good reason?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel nervous?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel so nervous that nothing could calm you down?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel hopeless?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel restless or fidgety?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel so restless you could not sit still?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel depressed?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel that everything was an effort?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Feel so sad that nothing could cheer you up?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

9. Your stress levels *(continued)*

Feel worthless?

- ☐ All the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Not often
- ☐ Never

Which statement best describes your perception of your stress?

- ☐ I feel that I am coping fine with my current level of stress.
- ☐ I feel stressed, but don't feel the need to do anything about my stress levels.
- ☐ I want to manage my stress better and would appreciate some help.

10. Your productivity

Please answer the following questions about how your wellbeing affects your daily activities.

About how many hours altogether did you work in the past 7 days? (If more than 97, enter 97) ☐☐

How many hours does your employer expect you to work in a typical 7-day week?

(If it varies, estimate the average. If more than 97, entre 97) ☐☐

In the last 28 days, how many days did you:

Miss a work day because of problems with your physical or mental health? Please include only the days you missed for health reasons.

Days ☐☐

Miss part of a work day because of problems with your physical or mental health? ☐☐ days

Come in early, go home late, or work on your day off? ☐☐ Days

Miss an entire work day for any other reason, including vacation? Days ☐☐

Experience problems with your physical or mental health that affected your ability to do your work? Days ☐☐

How would you describe your overall health over the last year?

☐ Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor

On a scale of 0 to 10 where 0 is the worst job performance anyone could have at you job and 10 is the performance of a top worker, how would you rate:

☐☐☐☐☐☐☐☐☐☐

0 10

The usual performance of most workers in a job similar to yours

☐☐☐☐☐☐☐☐☐☐

0 10

The usual job performance over the past year or two?

☐☐☐☐☐☐☐☐☐☐

0 10

Your overall job performance on the days you worked during the past four weeks (28 days)?

☐☐☐☐☐☐☐☐☐☐

0 10

11. Declaration

I confirm that the answers to the question are true and correct.

Signature ☐

APPENDIX F: AN EXAMPLE OF A WELLNESS DAY REPORT BACK TO A SCHOOL

wellness

Discovery Health

Wellness Day Report

Introduction

Discovery Health Corporate Wellness gives your company the tools and research to help you make your employees healthier and in this way, help reduce costs related to healthcare, productivity and absenteeism. International research shows that chronic diseases have a severe impact on health, morbidity and mortality rates worldwide and will be responsible for significant income losses in industries and national economies.

The workplace environment provides the ideal opportunity to help influence the health behaviour of large populations and to extend healthy behaviours and improvements to the broader community. A targeted wellness programme at the workplace may not only help improve companies' financial performance, but also the health and sustainability of our communities in the long-term.

Discovery Health's combination of health and wellness expertise, data and analysis capabilities, risk management and comprehensive range of health products enable us to offer companies an inclusive Corporate Wellness strategy.

An employer investing in the health and wellbeing of its employees helps to:

- improve the health and wellbeing of your employees
- improve quality of life,
- reduce the use of healthcare,
- control disability or,
- enhance productivity.

When companies participate in wellness programmes, it affects certain areas in a positive way. Financial outcomes, cost savings, return on investment (ROI) and net present value (NPV) can be identified in the following company savings:

- Medical costs-Employee absenteeism
- Employee absenteeism
- Short term disability (STD)
- Employee presenteeism

Health outcomes of worksite wellness programmes can be measured in: adherence to evidence based medicine, behavior change, risk reduction, health improvement, quality of life (humanistic) and productivity outcomes.

Mounting scientific evidence links employees' wellness status to their company's productivity and profits. It is also estimated that about half of corporate healthcare expenses are as a result of lifestyle risk factors. So it makes sense for your company to encourage employees to be healthy. The workplace provides a unique setting to promote a holistic and supportive approach to health.

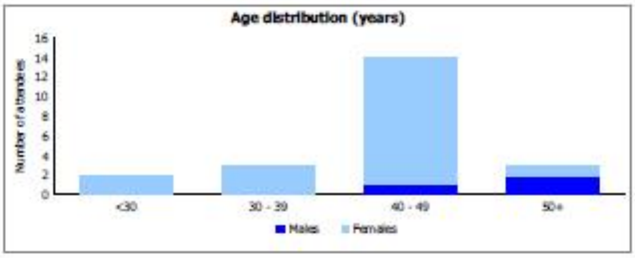
The Wellness Day Report gives you information on your company's health and wellness measurements. Using the information collected during your Wellness Day, we assessed the health of your employees based on four lifestyle risks and six clinical risks. Lifestyle risk factors lead to clinical risk factors which strongly influence the likelihood of developing chronic diseases. This is important because approximately 60% of deaths in the world today can be attributed to chronic diseases. Only the statistics for those employees who attended the Wellness Day have been included in this analysis.

Information in this report is based on the Wellness Day held at Eldorado Park on 19 May 2015.

Participation demographics

22 of your employees attended the Wellness Day with their average age being 43. Of these employees, none have medical cover with Discovery Health.

The breakdown by age and gender of these attendees is shown below:



Lifestyle risks of your employees

The table below summarises each of the four lifestyle risk factors assessed during your Wellness Day, as well as the percentage of your workforce that is at risk in each of these four categories. A risk indicator 'traffic light' (red, orange or green) provides a sense of the severity of each risk for your employees. The average for Wellness Days held for Discovery Health employer groups is also displayed.

Lifestyle risk	Risk indicator	% at risk	Wellness Day average in last 12 months	Definition
Smoking status	●	32%	17%	Attendees that smoke
Alcohol consumption	●	9%	6%	Attendees that consume 3+ drinks per day
Nutritional intake	●	82%	75%	Attendees that have <5 vegetable and fruit servings per day
Physical activity	●	77%	53%	Attendees that exercise for <150 minutes per week

A 'lifestyle score' for your organisation is calculated by combining the above four lifestyle risks, and provides a summary of the lifestyle risks for your employees:

Lifestyle score	Risk indicator	Wellness Day average in last 12 months	Definition
2.0	●	1.5	Average number of lifestyle risk factors per employee

Clinical risks of your employees

The table on the following page provides a summary of your employees' results for the six clinical risk factors assessed. The average for Wellness Days held for Discovery Health employer groups is also displayed.

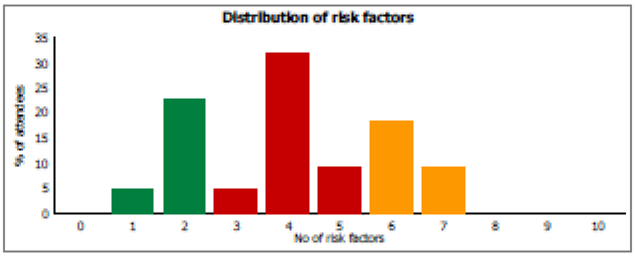
Clinical risk	Risk indicator	% at risk	Wellness Day average in last 12 months	Definition
Body mass index	●	77%	58%	Attendees with a non-normal BMI
Waist circumference	●	50%	28%	Attendees with a non-normal waist circumference
Blood pressure	●	40%	23%	Hypertensive attendees
Cholesterol	●	55%	28%	Attendees with a level >= 5.0 mmol/l
Glucose	●	0%	4%	Attendees with a level >= 7.8 mmol/l
Chronic diseases	●	50%	21%	Attendees with at least one chronic disease

A 'clinical score' summarising these six risks is calculated:

Clinical score	Risk indicator	Wellness Day average in last 12 months	Definition
2.7	●	1.6	Average number of clinical risk factors per employee

Overall risks of your employees

These four lifestyle risks and six clinical risks have been combined to provide a distribution of the number of risk factors across your employee base.



36% of your employees have three or four risk factors, while 36% have at least five risk factors.

The average number of risk factors per employee (lifestyle and clinical risk factors combined) gives an overall risk score:

Overall score	Risk indicator	Wellness Day average in last 12 months	Definition
4.7	●	3.1	Average number of combined risk factors per employee

Vitality Age of your employees

Vitality Age is an estimation of how much an individual's body has 'aged'. The higher the Vitality Age, the greater the chance of medical complications arising. Ideally, an individual's Vitality Age should be equal to or below the individual's real age. 89% of your employees have a Vitality Age that is higher than their real age.

The average difference between your employees' Vitality Age relative to their actual age is given. The average for Wellness Days held for Discovery Health employer groups is also displayed.

Vitality Age %	Risk indicator	Wellness Day average in last 12 months	Definition
15%	●	14%	Percentage difference in Vitality age relative to real age

Health perceptions of your employees

We have reviewed your employees' health perceptions to give an indication of their level of health awareness relative to their actual health status. Awareness is the first step towards making healthy lifestyle choices. 45% of your employees perceive their health to be poor or fair.

Table of Contents

Discovery Health

Section 1: Lifestyle risks of your employees

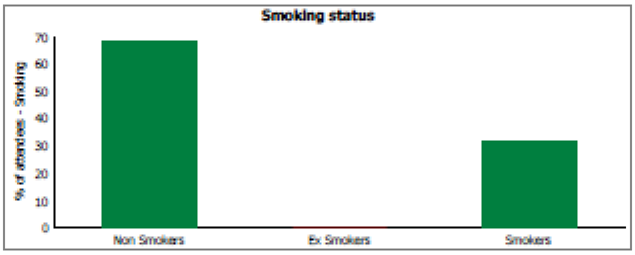
Discovery Health

Smoking, excessive alcohol intake, unhealthy nutrition and physical inactivity are key modifiable risk factors of your organisation's workforce. Empowering employees to make healthy choices will not only have a beneficial impact on productivity and work performance, but will also help to prevent chronic diseases.

1.1 Smoking status

Smoking contributes to the risk of developing several chronic diseases, especially heart and lung diseases and cancers. These diseases are likely to have a negative impact on your employees' wellbeing and their working capability. Stopping smoking will add years to an employee's life.

The following graph provides a breakdown of your employees' smoking statuses:



32% of your employees currently smoke.

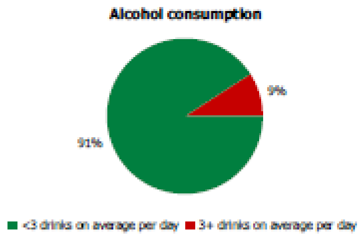
Your employees on Vitality, Discovery's wellness programme, have access to smoking cessation programmes (Smokenders or Allen Carr's Easyway). Also, employees on Vitality who haven't smoked for more than two and a half months can earn 5 000 Vitality points by signing a non-smoker's declaration.

Employers can create awareness around the negative effects of smoking through education campaigns and clear smoking policies at the office.

1.2 Alcohol consumption

Alcohol is a depressant and its regular consumption can cause chronic liver disease, high blood pressure, and other diseases. Information about alcohol consumption and a supportive work environment can contribute to a healthier workforce.

The average number of alcoholic drinks per day for your employees is broken down into two categories: excessive and acceptable. In general, one should not consume more than two alcoholic drinks per day.

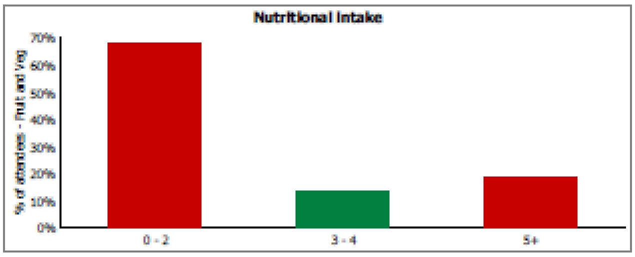


9% of your employees drink more than the recommended daily intake - they consume at least three drinks per day.

1.3 Nutritional intake

Conditions at the modern workplace often lead to poor eating habits, which in turn can lead to nutrition related chronic diseases such as heart disease, stroke, diabetes and certain cancers. Employees should have at least five servings of vegetables and fruit a day. A healthy diet also includes six to eight glasses of clean, safe water per day.

The average number of servings of vegetables and fruit your employees have per day is shown below:



82% of your employees are not meeting the recommended daily intake of five servings of vegetables and fruit.

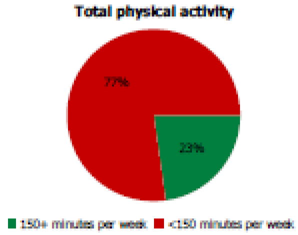
Discovery Vitality makes eating healthily easy with the new HealthyFood™ benefit. By activating this benefit, your employees will save up to 25% on HealthyFood™ purchased at Pick n Pay.

Employees who are looking for an in-depth analysis of their specific nutritional needs can go for a Vitality Nutrition Assessment at a registered dietician who is part of the Vitality Wellness Network. Employees can also access Vitality's online Nutrition Centre, which will provide further information on how to eat more healthily.

1.4 Physical activity

Thousands of South Africans have desk-bound office jobs which means that for eight or more hours a day they are inactive. This is exasperated by long commutes to work. Combating inactivity has many benefits and will help to prevent and manage chronic diseases, regulate body weight, reduce stress levels and increase concentration and efficiency. Generally, the benefits of physical activity increase with higher frequency, duration and intensity of exercise.

According to the World Health Organization, an adequate level of exercise is deemed to be at least 150 minutes per week. The following graph shows the percentage of your employees who either meet, or fail to meet this level of exercise:



77% of your workforce exercise for less than 150 minutes per week.

All Vitality family members have access to the Vitality gym benefit with Virgin Active and Planet Fitness. Vitality also offers savings at its wide range of health partners including Run/Walk For Life, Curves, and sa-active.com.

Regular exercise will have a positive impact on your workforce. You can promote the use of stairs instead of taking lifts as well as walking or exercising during breaks.

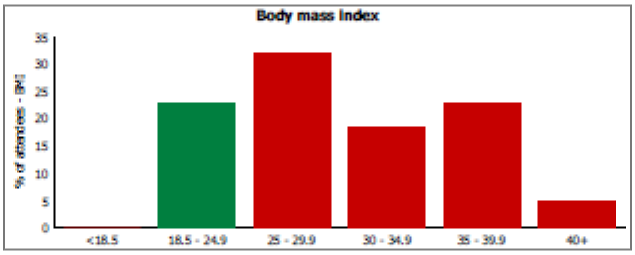
Section 2: Clinical risks of your employees

The lifestyles of your employees affect their clinical risk factors, which often contribute directly towards the development of chronic diseases. Employees should monitor their clinical risk factors by undergoing regular screening tests to assist in the early detection and treatment of chronic diseases.

2.1 Body mass index

Body mass index is a measure of height relative to weight (kg per m^2) and provides a more refined measure of obesity than weight alone. Being over- or underweight impacts on one's overall susceptibility to conditions such as heart disease, high blood pressure, diabetes and cancer. It has also been found that being overweight impacts on productivity. Body mass index results must be interpreted with caution as individuals who are very muscular may have a high body mass index but not necessarily be overweight. For this reason, more than one obesity measure (body mass index and waist circumference) is important.

A body mass index of less than 18.5 is considered to be underweight while one greater than 24.9 is considered overweight. The distribution of body mass index for your employees is:

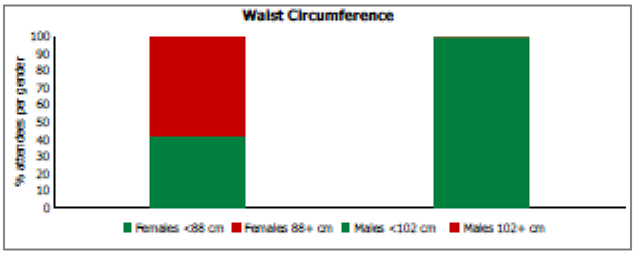


77% of your employees have a body mass index that falls outside the acceptable range.

2.2 Waist circumference

Waist circumference provides an indication of fat distribution and is a key indicator for the development of chronic conditions. As mentioned above, these results should be reviewed in conjunction with the body mass index.

Waist circumferences should be less than 88cm for women and less than 102cm for men.

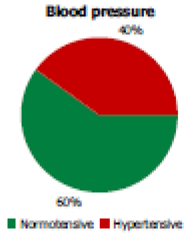


58% of your female employees and none of your male employees have waist circumference values outside the acceptable range.

2.3 Blood pressure

Blood pressure is a measure of the force of the blood on the artery walls as the heart pumps blood through the body. Chronic high blood pressure can increase the risk of having a heart attack or stroke.

Blood pressure is recorded as two measurements, systolic and diastolic pressure, which are expressed in millimetres of mercury (mmHg). Normal blood pressure (normotension) is considered to be lower than 140 mmHg and 90 mmHg for systolic and diastolic blood pressure respectively. High blood pressure (hypertension) is classified as having either a systolic reading of equal to or above 140 mmHg or a diastolic reading of equal to or above 90 mmHg.

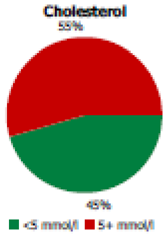


40% of your employees have hypertensive blood pressure readings (high blood pressure).

2.4 Cholesterol

A cholesterol test is a simple blood test that measures the amount of cholesterol (a fat-like material) in the blood. Excess cholesterol in the body builds up along the walls of the arteries and hinders or blocks the flow of blood. This can result in heart disease as less oxygen-rich blood is being transported through one's body.

A cholesterol level of less than 5mmol/l is considered to be normal. The segmentation of your employees into normal and high cholesterol levels is shown in the graph below:



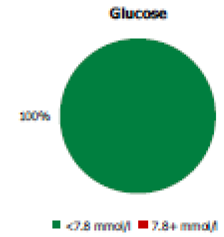
55% of your employees have high cholesterol (at least 5mmol/l).

Employees can prevent or manage high cholesterol by eating a balanced diet, maintaining a healthy weight, stopping smoking and exercising regularly. Medication may also need to be prescribed for certain individuals.

2.5 Glucose

A glucose test determines the amount of glucose (sugar) in the blood and can be used to determine whether an individual is at risk of developing diabetes (type 1 or 2). In the long term, unidentified diabetes can lead to health problems such as heart disease, stroke, kidney damage and poor circulation.

A glucose level of less than 7.8 mmol/l is considered acceptable. The breakdown of your employees into those with normal and high glucose levels is provided:



None of your employees have glucose values of concern (at least 7.8mmol/l).

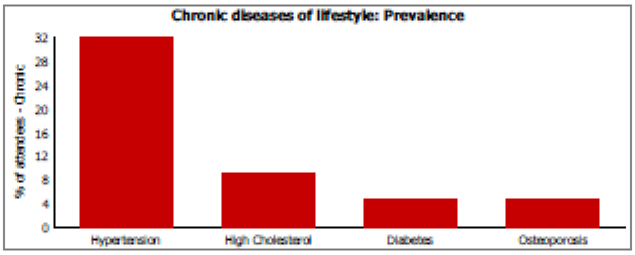
Glucose levels and diabetes can be managed through good nutrition, maintaining a healthy weight, physical activity and medication.This test measures glucose levels, which are an indication of the risk of diabetes, but it cannot diagnose diabetes. Employees with a high glucose level should consult with a doctor regarding further testing.

2.6 Chronic diseases of lifestyle

The development of lifestyle-related chronic diseases is often strongly influenced by presence or absence of the other five clinical risk factors. A pre-existing chronic disease of lifestyle may also contribute toward the risk of developing additional lifestyle-related chronic diseases. Therefore, a pre-existing chronic disease is in itself considered a risk factor. Many chronic conditions of lifestyle go unnoticed for years before detection. This is why it is so important for employers to promote screening and early detection.

Chronic conditions have an effect on companies through mortality (number of deaths), medical costs, absenteeism and presenteeism (on-the-job productivity impairment). Data collected through the Stanford Presenteeism Scale showed that, for employees with a chronic condition, absenteeism results in an additional 2 to 9 days lost per year per employee. It also shows that on-the-job productivity is impaired by 18% to 36% because of presenteeism. The costs associated with presenteeism greatly exceed the costs of absenteeism and medical treatment combined.

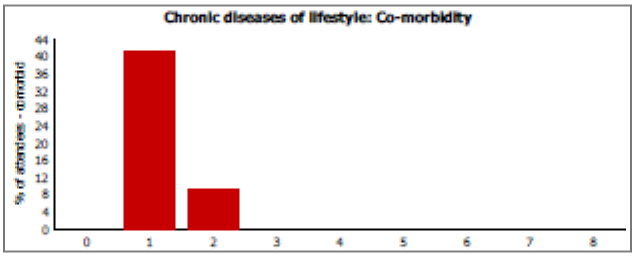
The chronic conditions prevalent in your company, as reported by your employees, are shown in descending order:



The most prolific chronic diseases in your company are Hypertension (32% of employees), High Cholesterol (9% of employees) and Diabetes (5% of employees).

A medical condition that exists simultaneously but independently of another condition is termed a 'co-morbid' condition. Chronic co-morbidities are important as they tend to have a compounding negative effect on an individual's health.

The distribution of the number of chronic conditions or co-morbidities that each of your employees have, is provided:

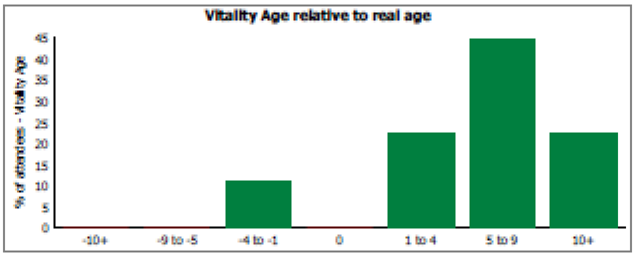


50% of your employees have at least one chronic condition.

Section 3: Vitality Age of your employees

Discovery Vitality and the Sports Science Institute of South Africa have developed the Vitality Age tool to measure risk related age. The Vitality Age tool provides an estimate of a person's age based on the presence or absence of certain risk factors. Younger employees who increase their health risks can 'age' their bodies prematurely. Older employees who eat correctly, manage their stress and have a healthier lifestyle, will have a younger Vitality Age than their real age.

The table below shows the distribution of your employees' Vitality Ages. The ideal Vitality Age of your employees should be equal to or slightly less than their real age.



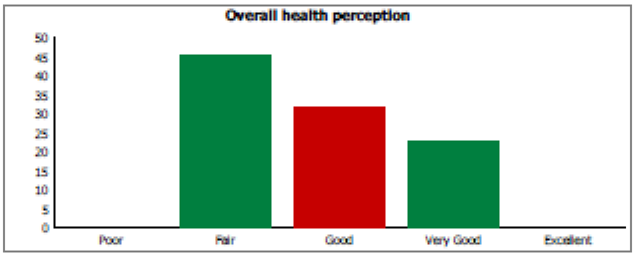
89% of your employees have a Vitality Age greater than their actual age.

Employees who are Vitality members can assess their Vitality Age online at www.discovery.co.za

Section 4: Health perceptions of your employees

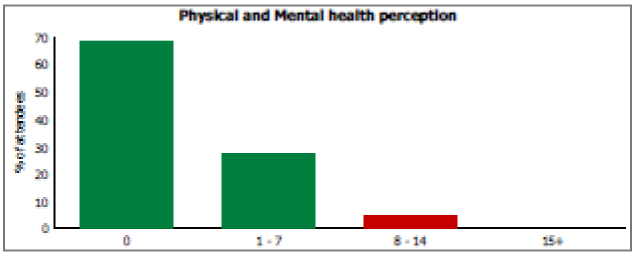
How your employees perceive their level of health is important. If people think they are healthy when they are actually at risk, then they are unlikely to make the necessary lifestyle changes. Wellness Days and screening tests help to give your employees a realistic view of their health status, which will motivate them to change their lifestyles if necessary.

We asked your employees how they would describe their health. The results are shown below:



45% of your employees perceive their health to be poor or fair.

We also asked your employees how many days a month they were negatively affected by poor physical and mental health. Their responses are shown in the graph below:



None of your employees feel that they are physically and/or mentally unhealthy for 15 days or more per month

Conclusion

By providing a comprehensive overview of the health of your employees, we hope to have provided you with valuable information about their current health status and potential health risks. Absenteeism and presenteeism are costly and can be reduced by focusing on employee wellbeing. The health status of your employees has a direct effect on their quality of life and ability to add value to your company.

Empowering your employees to make healthy lifestyle choices will go a long way towards preventing certain chronic diseases. Clinical screening tests should be done regularly so that chronic diseases can be detected and treated early. These screening tests will also make employees more aware of their health status and should motivate them to make healthy lifestyle choices.

Employees who did not attend the Wellness Day

Discovery Health members who were unable to attend the Wellness Day can do their preventive screening tests at a Vitality Wellness Network pharmacy at a time convenient for them. The cost of these tests is covered on all Discovery Health Plans if the employee has them done at a Vitality Wellness Network pharmacy. The list of Vitality Wellness Network pharmacies is available on www.discovery.co.za

Healthy lifestyles through Vitality

Vitality is an excellent tool that encourages healthy lifestyles. Vitality provides immediate access to health and fitness facilities and creates incentives to use them.

Further corporate wellness initiatives

As part of Discovery Health's Corporate Wellness Offering, we also provide a Voluntary Counselling and Testing event to each qualifying employer once every calander year to encourage employees to know their HIV status.

Voluntary Counselling and Testing is an event where employees are taken through the necessary steps needed to establish their HIV status.

Should you be interested in offering Vitality or hosting a Voluntary Counseling and Testing event to your employees, your Corporate Health Manager can provide you with more information.

Information in the report is based on the following Wellness Days

Employer	Level 2	Assessment Date	Attendees
Ew Hobbs Primary School	Eldorado Park	19 May 2015	22

Discovery Health
155 West Street
Sandton

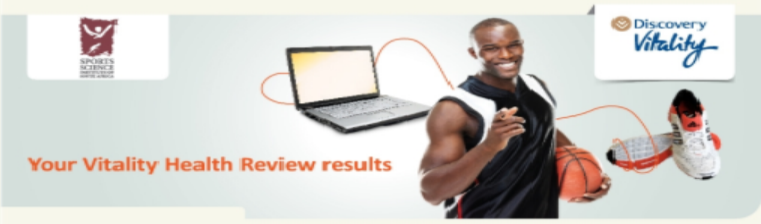
0860 99 88 77 or
083 123 88 77

www.discovery.co.za

Discovery Health

Discovery Health (Pty) Ltd, registration number 1997/013480/07, an authorised financial service provider.

APPENDIX G: AN EXAMPLE OF A WELLNESS DAY REPORT BACK TO A SCHOOL



Dear Avi

Thank you for finding out your Vitality Age. To become as healthy as you can be, you need to know how healthy you are. Your Vitality Age is an understanding of how healthy you are relative to your actual age.

Here is a brief summary of your health indicators and lifestyle habits.

Vitality Age

Your Vitality Age is calculated using your Body Mass Index (height and weight), smoking status, physical activity levels, daily fruit and vegetable intake and cholesterol levels. This value is an estimate of your risk for developing lifestyle-related conditions for your age.

Your Vitality Age is **49**.

You are older than your last birthday suggests. To find out which lifestyle habits are making you older than you are, have a look at the table below.

Health indicators and lifestyle habits

	Your results	What the Guidelines are
Height	1.73 Meters	
Weight	73.9 Kilograms	Between 55.37 and 74.82 Kilograms
BMI (Body Mass Index)	24.7	Between 18.5 and 25
Waist circumference	88 Centimeters	Less than 102 Centimeters
Total cholesterol	5.03 mmol/l	Less than 5 mmol/l
Random glucose	5.7 mmol/l	Less than 7.8 mmol/l
Blood pressure (non diabetic)	119/77 mmHg	Less than 140/90 mmHg
Smoking Habits	Non smoker	Non smoker
Drinking alcohol	0 drinks per day	Less than or equal to 2 drinks per day
Eating fruit and vegetables	4 servings per day	At least 5 servings per day
Eating wholegrains	3 servings per day	At least 3 servings per day
Eating lean meat	Frequently	Choose lean meat such as skinless chicken and fish
Eating and drinking low fat dairy	Always	Choose low fat or fat free dairy products
Adding fat after cooking	Occasionally	Avoid adding spreads and oils after cooking
Adding salt before tasting	Pinch	Less than half a teaspoon a day
Eating salty foods	Occasionally	Avoid salty foods
Eating fatty foods	1 serving per day	Less than or equal to 1 serving per day
Drinking sugary drinks	0 servings per day	Less than or equal to 1 serving per day
Added Sugar	1 cup of tea/coffee containing sugar per day	Less than or equal to 3 cups of tea/coffee containing sugar per day
Exercise - Cardiovascular	300 minutes per week	At least 150 minutes of moderate to vigorous activity each week
Exercise - Strength	3 to 5 times per week	At least 2 times per week
Exercise - Flexibility	1 or 2 times per week	At least 2 times per week
Inactive Behaviour	8 hours per day	Less than 10 hours per day
Stress Score	10	Less than 20
Healthy Days	28 days per month	At least 16 days per month

General Comments

Lifestyle habit or indicator	Comment
Your Family Medical History	Although you have a family history of Heart Disease, Hypertension, Cholesterol, which puts you at greater risk of developing this condition yourself, there are ways in which you can help to prevent or delay the onset. You can focus on healthy lifestyle behaviours like keeping active and following a healthy diet. It is also important that you visit your doctor for regular check-ups.
BMI (Body Mass Index)	Your BMI is a measure of your height in relation to your weight. It is great that your BMI is in the healthy range between 18.5 and 25. By maintaining your BMI in the healthy range you'll not only feel better, but will also reduce your risk of heart disease, high blood pressure, diabetes and even certain cancers. To maintain a healthy weight pay attention to what you eat and get more active. Complete a Vitality Fitness Assessment, visit a registered dietician or complete a Vitality Health Check to track your BMI and earn Vitality points for doing so. Please remember that BMI may not be an accurate measure for pregnant women or for people with larger muscle density, for example bodybuilders.
Total Cholesterol	Your cholesterol level is higher than the upper limit of the normal range. If cholesterol is left uncontrolled, it may lead to blocked arteries, causing heart attack or stroke. You should try to eat at least five servings of vegetables and fruits daily, cut down saturated fats found in fried foods, keep active and take care of excessive stress. If these lifestyle changes don't help to lower your cholesterol, please visit your doctor to look at other ways you can try to lower it. You can earn Vitality points for having your cholesterol checked and for keeping it at a healthy level.
Random Glucose	Your random glucose level is within the normal range, which is great. To keep your blood glucose level within the normal range, try to reach and maintain your ideal body weight, do at least 150 minutes (5 sessions of 30 minutes) of physical activity every week (with your doctor's permission) and follow a healthy diet. You can earn Vitality points for having your glucose checked and for keeping it at a healthy level.
Smoking Habits	Congratulations on never having smoked! As a non-smoker you have a reduced risk of developing diseases such as coronary artery disease, chronic lung disease and cancer. Keep it up.
Drinking Alcohol	Your alcohol consumption is within a healthy range (maximum of two drinks per day), which is great news, as too much alcohol can place you at risk for a number of diseases. Remember that one drink is equal to: 1 can of beer (340ml), 1 small glass of wine (120ml) or 1 metric tot of spirits (25ml).
Eating fruit and vegetables	You should try to increase your vegetable and fruit intake to 5 or more servings a day. Eating enough vegetables and fruit gives your body valuable vitamins, minerals and fibre. Vegetables and fruits are low in fat, making them the perfect healthy snack choices. Sneak in another serving or two by adding vegetables to your pasta and rice recipes and eating fruit as a snack between meals or as a dessert.
Eating wholegrain	Well done! You have reported that you include three servings of wholegrain products in your daily diet. Research has shown that eating three or more servings of wholegrain products every day can reduce your risk of several chronic diseases and may even help you keep a healthy weight.
Eating lean meat	You have reported that you frequently eat lean meats. This is good news because the saturated fat, cholesterol and calories that higher fat meats contain can increase your risk for coronary heart disease, obesity, diabetes, high blood pressure and cancers. Continue to give preference to fish, skinless chicken and turkey and fat trimmed, leaner cuts of meat.
Eating and drinking low-fat dairy	You have reported that you always eat or drink low fat or fat free dairy products. Well done, keep this up. The fat in milk is primarily saturated (hard) animal fat which is associated with an increased risk for high blood pressure, diabetes, coronary heart disease and cancer. Keep choosing low fat or fat free dairy to reduce your intake of saturated fat.
Adding fat after cooking	You have reported that you occasionally add butter, margarine, cream and/or gravy to your food after cooking. You should try to avoid this because these fats have a high calorie content which can lead to weight gain. They can also increase your risk for high cholesterol, coronary heart disease, stroke, diabetes and cancers.
Adding Salt Before Tasting	You have reported that you only add a pinch of salt while preparing your food or at the table without tasting it first. This is good news as it means that you are keeping your added salt intake to a minimum by only using a small amount. Salt increases your risk for raised blood pressure and may be associated with insulin sensitivity. Aim to always taste your food before adding salt to see if it needs it.
Eating salty foods	You have reported that you occasionally eat salty foods such as salty snacks, canned foods, packet soups, soya sauce, stock cubes etc. You should try to avoid these foods as research has found that blood pressure increases with sodium (salt) intake. Reducing sodium intake can prevent high blood pressure developing in people who have normal blood pressure readings; can help to lower blood pressure in those who have high blood pressure already; and is also associated with a reduced risk for cardiovascular disease.
Eating fatty foods	You have reported that you consume one serving per day of biscuits, cakes, pastries, high fat crackers, donuts, processed meats, brick margarines, deep fried foods and potato chips. These products are usually high in trans fatty acids which increase the risk of developing high cholesterol, coronary heart disease, stroke and cancers, so you should try to avoid them completely.

Added Sugar	You have reported that you are consuming less than 3 cups of sugar sweetened tea or coffee per day. While including 1-2 tsp of added sugar into your daily diet is acceptable provided that you are monitoring your total energy intake and intake of sugar from other sources, it is important to be aware that doing this on a daily basis does add up, increasing your total sugar intake as well as contributing excess 'empty' calories to your daily intake. High intakes of sugar are associated with an increased risk for weight gain and chronic diseases and it is therefore important to monitor the amount of sugar that you add to your tea and coffee. If you are drinking less than 1 cup per day, well done! Continue to avoid drinking sugar sweetened tea and coffee during the day. If you are using artificial sweeteners instead of sugar it is important to also monitor your intake of these. If you are drinking 1 or more cups per day, try to reduce your added sugar intake by using less sugar in tea and coffee or choosing more natural sweeteners which are lower in kilojoules such as xylitol. Alternatively try switching to herbal and rooibos teas which are not only free of caffeine, but already have a flavour and therefore do not need any sugar added to them.
Exercise - Cardiovascular	It's great that you are exercising for more than 150 minutes per week, keep it up! The more physical activity you do each day, the greater the health benefits. You'll never regret making the time to invest in your health.
Exercise - Strength	International guidelines suggest doing resistance exercise on at least two non-consecutive days a week. Well done! Muscular strength improves your ability to perform daily activities, while reducing your risk of developing chronic conditions such as osteoporosis, lower back pain, hypertension or diabetes. Keep it up!
Exercise - Flexibility	Inflexible muscles and joints are more prone to injury and reduced muscle strength can often have a negative impact on your ability to carry out daily activities. International guidelines suggest including stretching on at least two, but preferably on most days of the week, so try to increase the amount of stretching you do. Do very slow, controlled stretches without bouncing or pushing yourself beyond your limit
Inactive Behaviour	Well done! You have said that you sit for fewer than 10 hours a day. Research suggests that sitting for more than 10 hours a day has a negative effect on our health. Keep up your active lifestyle!
Sleep Quality	You have indicated that you usually have difficulty falling asleep. Not getting enough good quality sleep can result in tiredness, reduced productivity and concentration, irritability and decreased immunity. Factors which affect our ability to sleep include, worry or stress, smoking and drinking caffeine, disorganized routine, late night television watching, uncomfortable sleeping environment or physical pain, so address any of these factors if they apply to you to improve your sleeping patterns.

APPENDIX H: GOALS AND BARRIERS QUESTIONNAIRE

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Discovery Vitality

Lifestyle Goals Questionnaire

First name

Surname

Cell phone number

Date of birth D D M M Y Y Y Y

You are being invited to complete this questionnaire, as part of your school's Wellness Day, so that we can learn more about you, your lifestyle goals, and the challenges that you may have to making healthy lifestyle choices. This will help us to provide advice that is more relevant to you.

Is this the first time you have had a health risk assessment?
☐ Yes ☐ No

Goals
If there was ONE thing you would change about your lifestyle or health, what would it be?
(Only choose ONE)

☐ Achieve or maintain a healthy weight
☐ Manage my stress
☐ Quit smoking
☐ Eat a healthy diet
☐ Increase my fitness

On a scale of 1-10, how confident are you in your ability to make these changes?
(Circle the number you choose)
1______2_______3_______4_______5_______6_______7_______8_______9_______10

Have you previously tried to make these changes?
☐ Yes ☐ No

Hurdles
In order of priority, which of the following factors makes it more difficulty to achieve this particular goal?
(Choose 3 and place numbers in the spaces provided)

_____ Lack of knowledge about what to do and how to do it
_____ Not enough time
_____ Lack of support from family, friends, co-workers, or community members
_____ Lack of resources (e.g. funds, facilities, access to transport)
_____ Lack of confidence in my ability to achieve the goal
_____ Difficulty with prioritising lifestyle change

APPENDIX I: AN EXAMPLE OF A TAILORED LETTER SENT TO AN EDUCATOR

South African National Educators Wellness Study (SA-NEWS)

Dear [*first name*],

Thank you for participating in the South African National Educator Wellness Study (SA-NEWS), made possible through the Department of Basic Education, in partnership with Discovery Vitality. We hope you enjoyed your experience of health risk screening at the [*School name*] Wellness Day on [*date of wellness day*].

You received your health risk status after completing the screening at the Wellness Day, and you were also asked to select your top lifestyle goals. You identified **'Eating a healthy diet'** as your most important lifestyle goal. We hope that by communicating with you about your lifestyle goal, and providing suggestions for strategies that have been successful for other people who may have similar challenges to you.

You highlighted that **'a lack of resources'** makes it more difficult to reach your goal. Some people in your situation have found the following information helpful:

There is often the perception that healthy food is more expensive. This may be true in some cases, but think of your health as a worthwhile investment. Also consider what unhealthy foods you may be spending your money on, and all of the little things (like a packet of chips, a chocolate or cooldrinks) add up. Once you start cutting down on these, you will be saving money, and can spend this money on making healthier choices. There are also economical ways to eat more healthily, such as cooking in bulk and freezing healthy meals, or buying fresh fruit and vegetables in bulk and sharing the cost with family members, neighbours or friends. Have a look at the Cooking from the Heart Cookbook on ichange4health.co.za for some healthy and economical recipes.

You mentioned that **'A lack of confidence'** makes it hard to achieve your goal. Hopefully this advice will help you make the changes you need to make:

A good first step towards overcoming your lack of confidence is to identify some short-term goals. Then try to keep a food diary, and write down what are eating (and when) every day. A good idea is to write down the types of food you eat when you're happy, sad, stressed or depressed. This food diary will enable you to track your progress with achieving these short-term goals, and will encourage you when you see that you are making progress. When you achieve each short-term goal, give yourself a healthy reward! Do not become discouraged if you are not good ALL the time, it is normal to fail sometimes, remember you can correct and get back on track – the past does not equal the future. Just because you failed in the past does not mean you will fail every time and all

You also felt that **'a difficulty with prioritising'** could get in the way of reaching your goal. Here's a tip that could help you get over this hurdle:

Making changes to your diet may seem like an overwhelming task. Start off by identifying the weaknesses in your diet, and setting yourself some small and achievable goals. For some, their weakness may be snacking late at night, comfort eating when they are stressed, or grabbing that packet of chips or a chocolate when they are running low on energy. If you have many weaknesses in your diet, it may be too daunting to fix everything right from the start. Rather think about which of these you could start with and see some progress in the short term. This will be much more manageable. Remember, small consistent changes are much more sustainable than trying to change everything at once.

We hope that you have found these suggestions helpful to get you started on your way to your goal. We wish you the best of luck in your journey to health and in your efforts to '***Eating a healthy diet***'.

Please feel free to contact Mr. Lester Joseph at avij@discovery.co.za or on 083 377 7771 if you need any assistance or advice.

Yours sincerely

The SA-NEWS Team

APPENDIX J: SMS ADVICE MESSAGES USED IN THE STUDY BY GOAL AND BARRIER

Goal: Achieve or maintain a healthy weight					
Hurdle	***Tips***	***Prompt SMS's***	***SMS if 'yes'***	***SMS if 'no'***	***No response SMS***
Lack of knowledge about what to do and how to do it	Losing weight or maintaining a healthy weight involves healthy eating AND physical activity. In order to maintain your ideal weight, your energy intake (what you eat / put into your body) needs to match your energy output (what you burn off / physical activity). Physical activity not only increases your energy expenditure, it also increases the use of body fat as an energy source, and it also increases fitness levels.	*Prompt message #1* We hope things started off well with your weight goal! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need some help. SA-NEWS team (155 characters) *Prompt message #2* How are things going with your weight goal? Send a 'please call me'	Keep up the good work! Some helpful tips: Aim for 5 fruit&veg/day. Drink water instead of juice or cooldrinks. Go easy on the salt. SA-NEWS team (144 characters)	Well done on asking for help! Try work on 1 of these: Up your fruit&veg/drink water instead of juice or cooldrinks/go easy on the salt/. SA-NEWS team (152 characters)	Need some help to get you going? Helpful tips: Aim for 5 fruit&veg/day. Drink water instead of juice/cooldrinks. Go easy on the salt. SA-NEWS team (146 characters)

	What this means is that your daily metabolism levels increase and this helps to keep the weight off. Being physically active results in more muscle tissue and less fat tissue in the body. This will result in a better balance of hormones and other blood profiles that leads to a healthier you, and can help to lower your risk of developing other chronic conditions (such as type 2 diabetes, heart disease and obesity). Physical activity also makes you feel healthier and improves your mood, and it's easier to make	to 1234 if things are going well, or to 5678 if you're struggling. SA-NEWS team (146 characters) *Prompt message #3* We hope you've made some progress with your weight goal! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need support. SA-NEWS team (154 characters)			

	healthier choices when you are in a good mood!				
Not enough time	A minimum of 30 minutes of moderate-intensity physical activity (this means you are able to talk with a little effort while being physically active) on most days of the week is all you need to keep healthy. This can even be accumulated in short periods of 10 minutes throughout the day. If time for physical activity is a concern for you, do small bits of activity throughout the day, such as taking a short walk during your lunch break or in the evening after work, or		Glad to hear you're making progress! Add 10min bouts of activity into your day. Walk more often & walk a bit faster. Every bit counts! SA-NEWS team (147 characters)	It's good to ask for help! Inject 10min bouts of activity into your day. Walk more often & walk a bit faster. Every bit counts! SA-NEWS team (140 characters)	We hope you're happy with your progress! Inject 10min bouts of activity into your day. Walk more often & walk a bit faster. Every bit counts! SA-NEWS team (154 characters)

	joining the kids for play during break time. Every little bit is better than doing nothing, and all adds up at the end of the day. You can also try to incorporate physical activity into your transport journey to and from school, or to other places. Parking further away from the entrance, getting off a stop earlier before your destination increases the time spent walking. If you travel by car, consider taking public transport once a week, then increase to two and more days as time progresses. Try and walk as briskly as you can.				

Lack of support from family, friends, co-workers, or community members	While you might be inspired about your new lifestyle changes, often our friends and family aren't as inspired, and also possibly jealous and uncomfortable with your changes. It's important to share your concerns about your weight with them, and the goals you have to reduce or maintain a healthy weight. See if you can find just one person in your life that supports your efforts and will encourage you to keep going, even when no one else is. Share your goals with them, help them understand how important these goals		Great to hear you're doing well! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (155 characters)	We are here to help you! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (147 characters)	Struggling to start with those changes? Don't let those around you discourage you from achieving your goal. Find 1 person to cheer you on. SA-NEWS team (151 characters)

	are for you, and ask them to keep you accountable for achieving these goals. You may wish to ask them to join you in making certain changes, e.g. walking before school or during break time, or helping to make sure that there are healthy options for birthday or other work- or family-related celebrations.				
Lack of resources (e.g. funds, facilities, access to transport)	There is often the perception that healthy food is more expensive than unhealthy food. This may be true in some cases, but think of your health as a worthwhile investment! Also consider what		Good job on doing well so far! Try keeping track of what you spend on unhealthy food. Where could you be saving? Spend this on healthy food instead. SA-NEWS team (160 characters)	Asking for help is vital for change. Keep track of what you spend on unhealthy food. What could you be saving? Spend this on healthy food instead! SA-NEWS team (159 characters)	We hope everything is going well with your weight! Keep track of what you spend on unhealthy food. Spend this on healthy food instead! SA-NEWS team (148 characters)

	unhealthy foods you may be spending your money on, and all of the little things (like a packet of chips, a chocolate or cooldrink) add up. Once you start cutting down on these, you will be saving money, and can spend this money on making better choices for your diet. Walking is the best activity to start with when you want to increase your activity levels. It is low-cost, does not require a special skill or special facility (besides when it is raining). Importantly, walking is the activity				

	you would be most used to as it something you do every day. You can decide the route, pace and distance. You can walk alone or with your dog, with your kids, a friend or colleague or in a group. On rainy days, you can ever go walking at a shopping centre!				
Lack of confidence in my ability to achieve the goal	Right now you are not sure if you have what it takes to make the necessary changes to your physical activity and eating habits. A good first step towards overcoming your lack of confidence is to identify some short-term goals. Then try to keep a food and physical		We're happy you're doing well! Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (152 characters)	It's ok to say you need support! Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (154 characters)	Need some support to keep you going? Every step in the right direction is a victory. Celebrate the small wins along the way. SA-NEWS team (137 characters)

	activity or exercise diary, and write down what you are eating (and when) every day, and what activity you have been able to do every day (even if it's only 5 minutes). This diary will enable you to track your progress with achieving these short-term goals, and will encourage you when you see that you are making progress. When you achieve each short-term goal, give yourself a healthy reward! Do not become discouraged if you are not good ALL the time, it is normal to fail sometimes,				

	remember you can correct and get back on track right now – the past does not equal the future. Just because you failed in the past does not mean you will fail every time and all the time.				
Difficulty with prioritising lifestyle change	The thought of trying to lose or maintain a healthy weight may seem like a very daunting task. Start off by identifying a few key things that you need to change about your diet or your physical activity levels. Then work on setting some goals to work towards. A useful tool is to use the **SMART** acronym to		Well done on your progress so far! Try focus on a few key things to change & set some SMART goals. These are easier to prioritise & achieve. SA-NEWS team (149 characters)	We're so glad you asked for help. Focus on a few key things to change & set some SMART goals. These are easier to prioritise & achieve. SA-NEWS team (148 characters)	Battling to achieve your goal? Focus on a few key things to change & set SMART goals. These are easier to prioritise & achieve. SA-NEWS team (140 characters)

	set your goals. They should be **S**pecific (well defined, focused and clear); **M**easurable (put concrete numbers in your goals to know if you're on track); **A**chievable (within your reach); **R**ealistic (you should be willing and able to work towards it) and **T**imely (give yourself enough time to achieve the goal. You can even divide the goal into short-term (3 to 4 weeks, medium-term (1 to 6 months) and long-term (6 months to 1 year) goals). Using this to set your goals makes you much more likely to prioritise				

	and achieve them. It is also very important to develop a plan for how you want to achieve these goals. Write your goals down and share them and your plans to achieve them with someone you can trust, and who will support your efforts.				

Goal: Manage my stress					
Hurdle	***Tips***	***Prompt SMS's***	***SMS if 'yes'***	***SMS if 'no'***	***No response SMS***
Lack of knowledge about what to do and how to do it	Stress management requires self-knowledge and self-awareness more than any other kind of knowledge. Pay more attention to the situations, people and thoughts that may act as triggers and leave you feeling upset or frustrated. The most useful tip to remember in these situations is that feelings	*Prompt message #1* We hope things started off well with managing your stress! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need some help. SA-NEWS team	Well done on your progress so far! Focus on getting to know yourself & get to know what, how, where, when & why stress becomes too much for you. SA-NEWS team (157 characters)	Well done on asking for help! Focus on getting to know yourself & get to know what, how, where, when & why stress becomes too much for you. SA-NEWS team (152 characters)	Need some help to get you going? Focus on getting to know yourself & get to know what, how, where, when & why stress becomes too much for you. SA-NEWS team (155 characters)

<table>
<tr><td></td><td>are just feelings, and thoughts are just thoughts – you have the power to control them. They don't necessarily represent the truth, and they can pass quickly if you let them. It is also very important to attend to all of your physical health needs first when managing your stress. All of the following health behaviours affect stress levels and deserve your attention: healthy eating, rest and sleep (quantity and quality), reducing alcohol intake (and other substances), and increasing physical activity.</td><td rowspan="2">(159 characters)

Prompt message #2
How are things going with managing your stress? Send a ‘please call me’ to 1234 if things are going well, or to 5678 if you’re struggling. SA-NEWS team

(151 characters)

Prompt message #3
We hope you’ve made some progress with managing your stress! Send a ‘please call me’ to 1234 if you’re doing well, or to 5678 if you</td><td></td><td></td><td></td></tr>
<tr><td>Not enough time</td><td>Believing in our ability to change often motivates us to find extra pockets of time to devote to positive change because we realise it will pay off. If you are feeling</td><td>Great to hear you’re doing well! Try spending more time on daily activities that energise you & less</td><td>It’s good to ask for help! Try spending more time on daily activities that energise you & less time</td><td>Struggling to start with those changes? Spend more time on daily activities that energise you & less</td></tr>
</table>

	pressured for time, start by creating a 'balance sheet' of all of your everyday activities, listing the activities that energise you on one side and those that drain your energy on the other. Think about how you can spend more time on the things that energise you, and less time worrying about the ones that drain your energy. Over the long term, generating more energy will help you manage the draining and difficult aspects of life quicker and more efficiently, thus saving you time. When you are feeling stressed, try to quieten your mind and take a long, slow breath out. Think of a calming thing to say or think (such as - a thought is just a thought, a feeling is just a	need support. SA-NEWS team (159 characters)	time worrying about those that drain you. SA-NEWS team (155 characters)	worrying about those that drain you. SA-NEWS team (149 characters)	time worrying about those that drain you. SA-NEWS team (155 characters)

	feeling). It only takes 2-3 minutes to do this, and will teach you to identify and respond to stressful situations and reactions earlier and more effectively.				
Lack of support from family, friends, co-workers, or community members	It can be difficult to manage your stress if you feel like those close to you are not supporting you. See if you can identify other people in your life who make a positive impact on you but perhaps don't come to mind at first (maybe not necessarily family or very close friends). Consider the strengths and abilities they might have seen in you that would help you now. If you have felt any amount of support or encouragement from them before, perhaps they would be supportive again. Share		Keep up the good work! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (145 characters)	We are here to help you! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (147 characters)	We hope you're happy with your progress! Don't let those around you discourage you from achieving your goal. Find 1 person who will cheer you on. SA-NEWS team (158 characters)

	your concerns about your stress levels with them, and the goals you have to manage these. Ask them to keep you accountable for achieving these goals.				
Lack of resources (e.g. funds, facilities, access to transport)	Luckily, stress management actually requires very few physical resources. Your most important and effective resource in dealing with your stress is YOU. Know what sources of stress you can control and accept the sources you cannot control. You will use far less energy and other personal resources by managing stress this way. If a lack of resources is a source of stress for you, consider approaching someone for advice on how you can manage this stress more effectively. If your stress is financial, you		Glad to hear you're making progress! Remember, YOU are your best resource for dealing with your stress. Focus on sources of stress you can control. SA-NEWS team (160 characters)	Asking for help is vital for change. Remember, YOU are your best resource for dealing with your stress. Focus on sources of stress you can control. SA-NEWS team (160 characters)	We hope things are going well! Remember, YOU are your best resource for dealing with your stress. Focus on sources of stress you can control. SA-NEWS team (155 characters)

	could speak to a debt counsellor or a financial advisor.				
Lack of confidence in my ability to achieve the goal	A lack of confidence in your ability to achieve certain goals may be due to your forgetting about the goals you have already achieved, possibly in other areas of your life. Think of a time you successfully made a change in your life. No matter how large or small, it was a success. What did you do then that helped create the change and maintain it? It could also help you to break up your goal to manage your stress into smaller short-term goals, as this may give you more opportunity to celebrate your successes as you go through the change process.		Good job on doing well so far! Think about things in your life that you have been able to change before. Believe that you can do it again! SA-NEWS team (151 characters)	It's ok to say you need support! Think about things in your life that you have been able to change before. Believe that you can do it again! SA-NEWS team (153 characters)	Battling to achieve your goal? Think about things in your life that you have changed before. Believe that you can do it again! SA-NEWS team (139 characters)
Difficulty with prioritising	Make the changes you are embarking on to manage your		We're happy you're doing well!	We're so glad you asked for help. If	Need some support to keep you going? If

lifestyle change	stress a non-negotiable priority. This makes them easier to adhere to as it leaves less room in our minds for debate and indecision. As time progresses, the changes will become part of our habits and routine and we will notice them less and less. Challenge any possible false impressions you may have about making changes for yourself, and prioritising your own well-being. Some people believe that they will not be able to continue being there for others if they are spending time on themselves. But unless you take care of yourself, you won't be able to be there for others.		Your mental well-being is a worthy investment! If change is important to you, then make it non-negotiable. SA-NEWS team (150 characters)	change is important to you, then make it non-negotiable. Your mental well-being is a worthy investment! SA-NEWS team (153 characters)	change is important to you, then make it non-negotiable. Your mental well-being is a worthy investment! SA-NEWS team (156 characters)

Goal: Quit smoking					
Hurdle	***Tips***	***Prompt SMS's***	***SMS if 'yes'***	***SMS if 'no'***	***No response SMS***

Lack of knowledge about what to do and how to do it	Different methods of quitting smoking work for different people. Some stop suddenly from one day to the next, others find a more gradual approach easier. Changing your smoking habits is the first step in gradually giving up. Start by changing the way you smoke (e.g. avoid smoking at your regular times) or changing the situations in which you normally smoke (e.g. try to smoke in an uncomfortable or inconvenient place). Consider using nicotine replacement therapy to help you cope with the nicotine cravings people usually experience while quitting smoking. Various options (sprays, chewing gum, and patches) are available at pharmacies without a prescription. Go to the following site for a comprehensive step-by-step guide on how to quit smoking developed by the Chronic Diseases Initiative for Africa, based at UCT: ichange4health.co.za	*Prompt message #1* We hope things started off well with quitting smoking! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need some help. SA-NEWS team (155 characters) *Prompt message #2* How are things going with quitting smoking? Send a 'please call me' to 1234 if things are going well, or to 5678 if you're	Well done on your progress so far! Nicotine replacement therapy doubles your chances of successfully quitting by reducing withdrawal symptoms. SA-NEWS team (155 characters)	Well done on asking for help! Nicotine replacement therapy doubles your chances of successfully quitting by reducing withdrawal symptoms. SA-NEWS team (150 characters)	Need some help to get you going? Nicotine replacement therapy doubles your chances of successfully quitting by reducing withdrawal symptoms. SA-NEWS team (153 characters)

Not enough time	There is never a perfect time to stop smoking, but it is best to be well prepared before you start quitting or reducing your smoking. Learn more about your smoking habits by keeping a smoking diary in which you record the times and places you smoke; the people you smoke with and how you were feeling when you smoked. Recognising the situations that make you want to smoke is the first step in being able to break those habits. You can then plan to avoid those situations. For example, while you are trying to quit it may be best to avoid social occasions where others are smoking or it might be helpful to plan how you can deal with stress in alternative ways, such as going for a walk, breathing deeply or praying.	struggling. SA-NEWS team (147 characters) *Prompt message #3* We hope you've made some progress with [quitting smoking]! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need support. SA-NEWS team (155 characters)	Great to hear you're doing well! Learn about your smoking habits by keeping a smoking diary & avoid situations that make you want to smoke. SA-NEWS team (152 characters)	It's good to ask for help! Learn about your smoking habits by keeping a smoking diary & avoid situations that make you want to smoke. SA-NEWS team (146 characters)	We hope things are going well! Learn about your smoking habits by keeping a smoking diary & avoid situations that make you want to smoke. SA-NEWS team (151 characters)
Lack of support from family, friends, co-workers, or	Asking for support from someone who cares for you is important. Try to think of a colleague, friend or family member who you can talk to honestly,		Keep up the good work! Don't let those around you discourage	Asking for help is vital for change. Don't let those around you	We hope you're happy with your progress! Don't let those around

communit y members	and who can help you resist the urge to smoke. Most ex-smokers would be willing to offer some support, even if they do not know you that well. Support from someone who has had the experience of quitting themselves can be very helpful. Even a child can help you by reminding you why you want to quit. If you cannot think of anyone, talking to someone on a free online quit smoking support programme, like www.ekickbutt.org.za, is also an option. Or you can phone the Cancer Association Quitline (9am to 4pm) on 0800226622 (free call) or The National Council against Smoking on 011 720 3145 (9am-4pm) and speak to a trained quit smoking counsellor.		you from achieving your goal of quitting. Find an ex-smoker who can cheer you on. SA-NEWS team (155 characters)	discourage you from achieving your goal. Find an ex-smoker who can cheer you on. SA-NEWS team (157 characters)	you discourage you from achieving your goal. Find an ex-smoker who can cheer u on. SA-NEWS team (159 characters)
Lack of resources (e.g. funds, facilities, access to transport)	There is some free help for you out there. The Cancer Association offers free access to trained Quit Smoking counsellors on their free Quitline (0800 22 66 22). You can also join their free, online quit smoking		Glad to hear you're making progress! Think about the money you are saving by quitting / smoking less!	We are here to help you! Think about the money you are saving by quitting / smoking less! Have you	Struggling to start with those changes? Think about the money you are saving by quitting / smoking less!

	support programme, www.ekickbutt.org.za or access a free step-by-step guide on how to quit smoking, which is available at: ichange4health.co.za Using Nicotine Replacement Therapy will increase your chances of quitting successfully. Whilst these products may cost you money, you will only use them for a short time period and quitting smoking will save you a lot of money over the long term. Work out how much money you spend on cigarettes in a day, a month, a year and 5 years. Think about what you would rather use this money for. This may motivate you to quit! If you stop smoking you will also pay less in life insurance premiums and medical aid.		Access the free help available for quitters. SA-NEWS team (159 characters)	accessed the free help available for quitters. SA-NEWS team (158 characters)	Access free help available for quitters. SA-NEWS team (158 characters)
Lack of confidence in my ability to achieve the goal	Think of past difficulties or challenges in your life and how you have managed to overcome them or cope with them. Think about what you learnt from these experiences and the personal		Good job on doing well so far! Think of yourself as a non-smoker as soon as you have quit & give yourself a	It's ok to say you need support! Think of yourself as a non-smoker as soon as you have quit & give	Battling to achieve your goal? Think of yourself as a non-smoker as soon as you have quit & give yourself a

	qualities you have that helped you get through them. This will help you recognise your strengths and how you can use them to quit smoking. Talk to someone you know who has succeeded in quitting and ask them for their support and advice. If you have managed to quit smoking before, think about what triggered you to resume smoking and how you could deal differently with that situation this time. Speak to a pharmacist about nicotine replacement therapy (NRT). NRT makes quitting easier because it helps reduce the physical cravings people usually experience when they stop smoking.		small, healthy reward each day. SA-NEWS team (152 characters)	yourself a small, healthy reward each day. SA-NEWS team (154 characters)	healthy reward each day. SA-NEWS team (145 characters)
Difficulty with prioritising lifestyle change	Being clear about your reasons for quitting helps you make a firm decision to quit. Write down all your reasons for wanting to quit. These may be health reasons (smoking causes over 29 different diseases), but may also include other reasons (such as financial ones). Common reasons		We're happy you're doing well! Take 1 day at a time & don't think about tomorrow. Think only of changing your smoking behaviour	We're so glad you asked for help. Take 1 day at a time & don't think about tomorrow. Think only of changing your smoking behaviour	Need some support to keep you going? Take 1 day at a time & don't think about tomorrow. Think only of changing your smoking behaviour

	given by smokers include: the costs of smoking, the worry about dying young and the effects this would have on their families, the stress of being addicted to nicotine and always needing a cigarette and the fact that smoking gives you wrinkles, bad breath and stains your teeth. It may also be helpful to write down what you will miss about smoking. Understanding these things will help you think about how to cope with losing them when you quit and how you can substitute them. Once you have made a firm decision to quit, commit yourself to a date that you will start quitting. Although some people prefer quitting suddenly from one day to the next, many others choose to quit more gradually. Choose what works best for you.		today. SA-NEWS team (147 characters)	today. SA-NEWS team (150 characters)	today. SA-NEWS team (153 characters)

Goal: Eat a healthy diet					
Hurdle	***Tips***	***Prompt SMS's***	***SMS if 'yes'***	***SMS if 'no'***	***No response SMS***
Lack of knowled ge about	The South African food-based dietary	*Prompt message #1*	Well done on your progress so	Well done on asking for help! Try	Need some help to get you going?

what to do and how to do it	guidelines highlight some key things to bear in mind when aiming to eat a healthy diet. These include eating a variety of foods at every meal and on different days, eating five fruits and vegetables a day, eating MORE foods that are high in fibre (e.g. whole-wheat bread and pasta, brown rice, high-fibre cereals and oats), eating LESS foods and drinks that are high in sugar and/or fat (e.g. sweets, chocolates, fruit juice, cooldrinks, sugar in tea/coffee, chips, cakes and biscuits), and using salt sparingly. It is also very important to be aware of your portion sizes. Since our bodies can get used to large portions, see how you can gradually decrease the size of your portions. One way to do	We hope things started off well with your diet! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need some help. SA-NEWS team (148 characters) *Prompt message #2* How are things going with your diet? Send a 'please call me' to 1234 if things are going well, or to 5678 if you're struggling. SA-	far! Some helpful tips: Aim for 5 fruit&veg/day. Drink water instead of juice or cooldrinks. Go easy on the salt. SA-NEWS team (156 characters)	work on 1 of these: Up your fruit&veg/drink water instead of juice or cooldrinks/go easy on the salt/. SA-NEWS team (149 characters)	Helpful tips: Aim for 5 fruit&veg/day. Drink water instead of juice/cooldrinks. Go easy on the salt. SA-NEWS team (146 characters)

	this is to use smaller plates, which will look fuller and therefore help you take less food.	NEWS team (140 characters)			
Not enough time	You may feel that eating a healthy diet takes more time to prepare and eat. Sometimes grabbing an unhealthy snack or meal may seem quicker, but eating an apple takes no longer than eating a chocolate! You can also plan ahead better when it comes to healthy eating so that you save time in the long run. Ways to do this include cooking healthy meals in bulk and freezing them for you and/or your family, or adding healthy snacks and lunch options (e.g. fruit, raw nuts, whole-wheat bread and healthy sandwich fillings) to your weekly grocery	*Prompt message #3* We hope you've made some progress with your diet! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need support. SA-NEWS team (148 characters)	Great to hear you're doing well! Thinking & planning ahead help you to eat better – saving you time & improving your health in the long-term. SA-NEWS team (154 characters)	It's good to ask for help! Thinking & planning ahead help you to eat better – saving you time & improving your health in the long-term. SA-NEWS team (148 characters)	We hope you're happy with your progress! Thinking & planning ahead help you eat better – saving you time & improving your health long-term. SA-NEWS team (152 characters)

	list and stock up on these at work.				
Lack of support from family, friends, co-workers, or community members	It can be difficult to make changes to your diet when those around you aren't behind you, but don't allow them to get between you and a healthier diet. It's important to share your concerns about your diet with them, and the goals you have to improve your diet. See if you can find just one person in your life that supports your efforts and will encourage you to keep going, even when no one else is. Share your goals with them, help them understand how important it is for you to eat healthily, and ask them to keep you accountable for achieving these goals.		Glad to hear you're making progress! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (159 characters)	We are here to help you! Don't let those around you discourage you from achieving your goal. Find that 1 person who will cheer you on. SA-NEWS team (147 characters)	We hope things are going well with your diet! Don't let those around you discourage you from achieving your goal. Find 1 person to cheer you on. SA-NEWS team (158 characters)
Lack of resources (e.g. funds, facilities, access to transport)	There is often the perception that healthy food is more expensive. This may be true in some cases, but think of your health as a		Keep up the good work! Keep track of what you spend on unhealthy food. What could you	Asking for help is vital for change. Keep track of what you spend on unhealthy food. What	Struggling to start with those changes? Keep track of what you spend on unhealthy

	worthwhile investment. Also consider what unhealthy foods you may be spending your money on, and all of the little things (like a packet of chips, a chocolate or cooldrinks) add up. Once you start cutting down on these, you will be saving money, and can spend this money on making healthier choices. There are also economical ways to eat more healthily, such as cooking in bulk and freezing healthy meals, or buying fresh fruit and vegetables in bulk and sharing the cost with family members, neighbours or friends. Have a look at the *Cooking from the Heart Cookbook* on ichange4health.co.za for some healthy and economical recipes.		be saving? Spend this on healthy food instead! SA-NEWS team (145 characters)	could you be saving? Spend this on healthy food instead! SA-NEWS team (159 characters)	food. Spend this on healthy food instead! SA-NEWS team (136 characters)
Lack of confidence in my	A good first step towards overcoming your		Good job on doing well so far!	It's ok to say you need support!	Need some support to keep you

ability to achieve the goal	lack of confidence is to identify some short-term goals. Then try to keep a food diary, and write down what are eating (and when) every day. A good idea is to write down the types of food you eat when you're happy, sad, stressed or depressed. This food diary will enable you to track your progress with achieving these short-term goals, and will encourage you when you see that you are making progress. When you achieve each short-term goal, give yourself a healthy reward! Do not become discouraged if you are not good ALL the time, it is normal to fail sometimes, remember you can correct and get back on track – the past does not equal the future. Just because you failed in the past does not mean		Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (152 characters)	Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (154 characters)	going? Every step in the right direction is a victory. Celebrate the small wins along the way. SA-NEWS team (137 characters)

	you will fail every time and all the time.				
Difficulty with prioritising lifestyle change	Making changes to your diet may seem like an overwhelming task. Start off by identifying the weaknesses in your diet, and setting yourself some small and achievable goals. For some, their weakness may be snacking late at night, comfort eating when they are stressed, or grabbing that packet of chips or a chocolate when they are running low on energy. If you have many weaknesses in your diet, it may be too daunting to fix everything right from the start. Rather think about which of these you could start with and see some progress in the short term. This will be much more manageable. Remember, small consistent changes are much more sustainable than		We're happy you're doing well! Focus on 1 or 2 things in your diet that you need to work on. Make sure you goals are bite-sized & not too daunting. SA-NEWS team (160 characters)	We're so glad you asked for help. Focus on 1 thing in your diet that you need to work on. Have bite-sized goals that aren't too daunting. SA-NEWS team (150 characters)	Battling to achieve your goal? Focus on 1 part of your diet that you need to work on. Have bite-sized goals that aren't too daunting. SA-NEWS team (146 characters)

	trying to change everything at once.				

Goal: Improve my fitness					
Hurdle	***Tips***	***Prompt SMS's***	***SMS if 'yes'***	***SMS if 'no'***	***No response SMS***
Lack of knowledge about what to do and how to do it	The F.I.T.T. Principle is one of the foundations of exercise that can help you plan your fitness routine and achieve your goals. The acronym stands for *Frequency* (how often you exercise), *Intensity* (how hard you exercise), *Time* (how long you exercise for) and *Type* (the type of activities you do). In order for the body to adapt it needs just the right balance of frequency, intensity and time. This ensures that your body recovers, and that your training is hard enough to overload the body but not too hard resulting in overtraining, injury or burnout. If you are planning to increase your fitness, it is best to plan on increasing duration and/or frequency first before intensity. It is also important to increase any of the 3 F.I.T. components in small amounts, regardless of the type of activities you do (aerobic or strength/resistance training).	*Prompt message #1* We hope things started off well with your fitness! Send a 'please call me' to 1234 if you're doing well, or to 5678 if you need some help. SA-NEWS team (151 characters)	Well done on your progress so far! Remember the FITT principle when working towards your goal. Make small increases to frequency, intensity & time. SA-NEWS team (160 characters)	Well done on asking for help! Remember the FITT principle when working towards your goal. Make small increases to frequency, intensity & time. SA-NEWS team (155 characters)	Need some help to get you going? Remember the FITT principle when working towards your goal. Make small increases to frequency, intensity & time. SA-NEWS team (158 characters)

Not enough time	If increasing the amount of time and the number of days spent in physical activity is a challenge, try increasing the intensity (level of difficulty) of your exercise session. Short, high-intensity exercise bouts can increase your fitness and help achieve your goals without having to commit longer hours, and hence time away from other priorities in your life. You can also increase your fitness by playing sports such as squash or tennis, or by doing interval training. Interval training is a combination of high-intensity exercise workouts with rest periods and/or low-intensity workouts in between. Cross training is another way to boost your fitness, and this involves doing different types of exercises/ sports other than your main type of exercise/sport.	*Prompt message #2* How are things going with [your fitness]? Send a 'please call me' to 1234 if things are going well, or to 5678 if you're struggling. SA-NEWS team (143 characters)	Great to hear you're doing well! If time is a challenge, work on increasing the intensity of your sessions. This will help improve your fitness. SA-NEWS team (157 characters)	It's good to ask for help! If time is a challenge, work on increasing the intensity of your sessions. This will help improve your fitness. SA-NEWS team (151 characters)	We hope things are going well! If time is a challenge, work on increasing the intensity of your sessions. This will help improve your fitness. SA-NEWS team (156 characters)
Lack of support from family, friends, co-workers, or community members	Being active and fit is not only about building muscle, achieving a better time in a race, or being competitive. It is also about achieving optimal health through living an active lifestyle and enjoying it. If you lack the support from those around you, talk to them about why you've chosen this way of life, and the benefits of living an active lifestyle. Invite them to exercise with you, or initiate activities at school involving physical activity or sport, such as a	*Prompt message #3* We hope you've made some progress with your fitness! Send a 'please call me' to 1234 if	Keep up the good work! Consider joining a sport/exercise group to meet others who enjoy the same activities & can support you with your goal.	We are here to help you! Consider joining a sport/exercise group to meet others who enjoy the same activities & can support you with your goal.	We hope you're happy with your progress! Why not join a sport/exercise group to meet others who enjoy the same activities & can support you? SA-

	staff mixed-gender soccer team. You could even play against learners at school at fun sports events. With your family and friends, plan social activities involving exercise, such as a hike, indoor cricket/netball or 5-a-side football. By joining a group, you can also develop new friendships with physically active people, such as at the gym, a running/cycling group, exercise dance group, or sports team. Here you will not only meet people who enjoy the same activities as you do, but can also encourage and help you achieve your fitness goals.	you're doing well, or to 5678 if you need support. SA-NEWS team (151 characters)	SA-NEWS team (154 characters)	SA-NEWS team (156 characters)	NEWS team (154 characters)
Lack of resources (e.g. funds, facilities, access to transport)	There are many ways to achieve your fitness goals without spending money and needing other facilities such as the gym. Calisthenics is an excellent way to get fit without the need for equipment or a facility. By using household or office furniture, or simply your body weight, you can replicate any endurance or strength-based exercise at home or at school, instead of going to the gym. Calisthenic exercises include sit-ups, crunches, star jumps, lunges, squats, calf raises, push-ups and dips. To find out more about calisthenic exercise and to view a number of exercises, visit http://www.calisthenicexercise.com/.		Glad to hear you're making progress! Try these exercises that won't cost u a cent: sit-ups, crunches, star jumps, lunges, squats, push-ups & dips. SA-NEWS team (159 characters)	Asking for help is vital for change. Try these exercises that won't cost you a cent: sit-ups, crunches, star jumps, lunges, squats & push-ups. SA-NEWS team (156 characters)	Battling to achieve your goal? Try these exercises that won't cost u a cent: sit-ups, crunches, star jumps, lunges, squats, push-ups & dips. SA-NEWS team (153 characters)

Lack of confidence in my ability to achieve the goal	If you are living a physically active lifestyle already, you shouldn't find it too hard to increase your levels of fitness. If you lack the confidence, remember that achieving fitness can be done in stages, one step at a time. In addition to increasing incidental physical activity (activities done as part of carrying out normal daily chores), try to gradually increase either the time spent in structured and planned exercise, the number of days, or the intensity (level of effort) of your exercise session. Keeping an exercise diary and identifying short- term goals, such as aiming to go out for a 30 minute run four times a week over the next month, is also an excellent way to overcome lack of confidence and achieve your fitness goal. The diary will enable you to track your progress with achieving these goals, and will encourage you when you see that you are making progress. When you achieve each short-term goal, give yourself a healthy reward! Do not become discouraged if you miss a day or two of exercise, remember you can correct and get back on track.		Good job on doing well so far! Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (160 characters)	It's ok to say you need support! Every step in the right direction is a victory. Celebrate the small wins on your way to achieving your goal. SA-NEWS team (154 characters)	Struggling to start with those changes? Every step forward is a victory. Celebrate the small wins on your way to achieving your fitness goal. SA-NEWS team (154 characters)
Difficulty with prioritising	Increasing your levels of fitness means dedicating more time and effort to exercise. Focus on those activities that you enjoy,		We're happy you're doing well!	We're so glad you asked for help. Focus on	Need some support to keep u going?

lifestyle change	because these will be easier to prioritise and sustain over the long-term. For example, if you enjoy dancing, why not try a type of dancing you have not done before? Being active with a co-worker, friend or family member can also help you to commit to your goal, and make exercising more enjoyable. You may even want to sign a contract with them, committing you both to the goals you have set for yourselves.		Focus on activities you enjoy to improve your fitness & find someone else who can help you commit to your goal. SA-NEWS team (155 characters)	activities you enjoy to improve your fitness & find someone else who can help you commit to your goal. SA-NEWS team (158 characters)	Focus on activities you enjoy to improve your fitness & find someone else who can help you commit to your goal. SA-NEWS team (159 characters)

APPENDIX A: SMS EVALUATION FORM

Name: ______________________________ School: _____________________________________

SMS feedback survey

1. My main goal was to (indicate how many options they can select)

Increase my fitness	Achieve or maintain a healthy weight	Manage my stress	Eat a healthy diet	Quit smoking

2. I believe I achieved:

0% (I did not achieve my goal at all)	25% of my goal	50 % of my goal	75% of my goal	100% of my goal

Please indicate how much you agree with the following statements by placing an X in the appropriate box:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
3. The language used in the sms messages was clear and easy to understand.					
4. The text messages helped me to achieve my goal.					
5. The text messages were useful and encouraging.					
6. The text messages were inappropriate and irrelevant.					
7. The frequency of the messages was just right					
8. The length of the messages was perfect					
9. I read every single SMS that I received					

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
10. I found the call me back option helpful					
11. I used the 'please call me' back option after every SMS I received					
12. I would make use of an SMS campaign to improve my health in the future					
13. I would recommend this type of service to other teachers, friends and family					

14. Please let us know how we could improve the SMS campaign (in terms of the content, delivery, language etc.)

____
____
____
____

15. Which of the SMS messages were the most helpful?

____
____
____
____
____
____
____
____
____

APPENDIX B: SCHOOL ENVIRONMENT ASSESSMENT QUESTIONNAIRE

School Environmental Assessment
Adapted for SA National Educators Wellness Study

Rationale and resources:

The rationale for the School Environment Assessment is to assess the physical, social and policy environment in terms of healthy eating and physical activity in your school.

The instrument is a compilation of instruments from the Physical Activity Neighborhood Environment Survey (PANES), School Health Environment Survey (SHAPES) project, Situational and Observational Analysis from the Health Kick World Diabetes Foundation Project in South Africa, the Alliance for a Healthier Generation Healthy School Inventory, and Centres for Disease Control School Health Index, and the School Healthy Policies and Practices Survey.

School Code ____________
Name of interviewer ___________________ Date___________(dd/mm/yyyy)
Position at school of person being interviewed: _______________________
Date of Consent signed: ___________(dd/mm/yyyy)

Section A: School Demographics and Neighbourhood Environment

We would like to learn more about your school and the learners and community that your school serves. All answers will remain confidential, and your school will never be mentioned by name or area in any communication or publications emanating from this project.

1. **Number of classes:** _______
2. **Number of learners in your school:** ________
3. **Number of educators:** ________
4. **The socioeconomic status of the learners within the school and the community that it serves may best be described as:**
   ____ a) lowest socioeconomic status in relation to the region
   ____ b) low to moderate socioeconomic status in relation to the region
   ____ c) mixed low, moderate or high socioeconomic status in relation to the region
   ____ d) upper middle income groups in relation to the region
   ____ e) do not know
5. **How do most learners travel to your school?**
   _____a) car or private vehicle
   _____ b) walk
   _____ c) ride bicycles
   _____ d) public transport (taxi, bus or train)
   _____ e) other _____________________________
6. **Which best described the area or community surrounding your school?**
   _____a) mostly residential urban or suburban
   _____b) mixed land use, (residential and business or commercial)
   _____ c) mostly commercial or business or industrial
   _____ d) informal settlements urban
   _____ e) deep rural
   _____ f) other _________________________________

7. **Please answer the following questions as they best describe the physical environment of the neighbourhood surrounding the school:**

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Not applicable
a. There are many shops, markets or other places to buy things within easy walking distance of the school.	☐	☐	☐	☐	☐
b. There are transport stops (bus, taxi or train) within a 10-15 minute walk from the school.	☐	☐	☐	☐	☐

c. There are pavements on most of the streets in the neighborhood surrounding the school.	☐	☐	☐	☐	☐
d. There are facilities to bicycle or walk near school, such as separate paths or shared use paths	☐	☐	☐	☐	☐
e. In the neighborhood, there are several free/low cost facilities, like recreation centres, parks, & playgrounds.	☐	☐	☐	☐	☐
f. The crime rate in the neighborhood near the school makes it unsafe to go walking at night.	☐	☐	☐	☐	☐
g. There is so much traffic on the street that it makes it difficult or unpleasant to walk or cycle in this neighborhood.	☐	☐	☐	☐	☐
h. There are many persons being active in this neighborhood, including walking, cycling, jogging or playing sports.	☐	☐	☐	☐	☐
i. There are many interesting places to go and things to look at while walking in this neighborhood.	☐	☐	☐	☐	☐
j. There are many four-way intersections in this neighborhood.	☐	☐	☐	☐	☐
k. The crime rate in this neighborhood makes it unsafe to go walking even during the day.	☐	☐	☐	☐	☐
l. The neighborhood near the school is relatively free from litter, rubbish and graffiti.	☐	☐	☐	☐	☐

8. Please answer the following questions as they best describe the food environment of the neighbourhood surrounding the school:

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Not applicable
a. There is a large selection of fresh fruits and vegetables available in shops & stores in this neighborhood.	☐	☐	☐	☐	☐
b. The fresh fruits and vegetables in shops & stores in this neighborhood are of high quality.	☐	☐	☐	☐	☐
c. There is a large selection of low-fat products available in shops & stores in this neighborhood.	☐	☐	☐	☐	☐
d. There are many fast food restaurants or vendors that sell high fat, or high sugar, low quality foods in this neighborhood.	☐	☐	☐	☐	☐

9. Is access to the school associated with the following?

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Not applicable
a. Busy roads with high vehicle traffic	☐	☐	☐	☐	☐
b. Traffic calming zebra crossings and/or speed humps	☐	☐	☐	☐	☐
c. Sidewalks and/or pavement for walking on one or both sides of the road.	☐	☐	☐	☐	☐
d. Signage denoting school zone or pedestrian crossing.	☐	☐	☐	☐	☐
e. Designated cycle paths	☐	☐	☐	☐	☐
f. Separate entrance for pedestrians and cyclists vs motorists	☐	☐	☐	☐	☐
g. Supervision of younger learners prior to school and at the end of the school day entering and leaving the premises	☐	☐	☐	☐	☐
h. Designated bus stop or public transport stop outside of school used by learners	☐	☐	☐	☐	☐

10. Safety

What measures do you have in place to ensure physical safety at your school?

	Yes	No
Electric fencing		
Barbed / razor wire		
Controlled access to the school		
Remote controlled gates		
Security guards onsite		
Panic buttons in classrooms		

11. Does your school have a School Safety Committee (A school safety committee is a team that develops and monitors the school's health and safety environment, programmes and policies. They identify ways to strengthen these to improve the health of leaners and staff and develop and implement action plans to do so)?

Yes	
No	

12. If yes, who forms part of the committee (tick all that apply)?

Educators	
Parents	
Coaches	
Learners	
Other (specify)	

Section B. School health, physical activity and nutrition environment

School policies and services

13. Does the school have written policies regarding any of the following? (tick all that apply)

Physical education classes	
Extra mural sports participation	
Healthy nutrition (including tuckshop)	
Smoking	
Drugs and alcohol	
Sun protection	
Bullying	
Other (specify	

14. Does your school have a person responsible for implementing wellness initiatives?

Yes	
No	

15. Does your school have a wellness committee (A wellness committee is a team that assesses the school's health environment, programmes and policies. They identify ways to strengthen these to improve the health of students and staff and develop and implement action plans to do so)?

Yes	
No	

16. If yes, who forms part of the committee (tick all that apply)?

Educators	
Parents	
Coaches	
Learners	
Other (specify)	

17. Tick any of the services below if they are offered at your school, free of charge for learners:

Hearing tests	
Eye tests	
Weight and height assessments	
Vaccinations	
HPV vaccine	
Deworming	
Other (specify)	

18. Do your learners have access to counselling facilities at the school?

Yes	
No	

19. Which of the following healthcare interventions do you have at the school?

Intervention	**Yes**	**No**
Sick bay on site		
First aid kit on site		
First aid training for educators		
First aid training for learners		

20. Which of the following describes the condition of the school/buildings/surrounds?

	No, not at all	**A little or somewhat**	**Yes, very much**
a. Clean, with very little litter present	☐	☐	☐
b. Neat, well-looked after, and regular maintenance	☐	☐	☐
c. Disrepair and evidence of vandalism, broken windows, graffiti, and similar			
d. Painted murals, planted beds, shade trees, benches for sitting or similar	☐	☐	☐
e. The name board of the school sponsored by a food / beverage company?	☐	☐	☐
f. Name of the sponsor on the board			

21. **Please indicate whether the following amenities/facilities are available at the school:**

	No, not available	Yes, available
Electricity	☐	☐
Running water and taps for drinking for learners	☐	☐
An indoor hall for activity and physical education in bad weather?		
Teachers/supervisors seen supervising learners during break times	☐	☐
Posters or messages visible concerning healthy eating, physical activity	☐	☐

22. **Please indicate the number of playgrounds/designated play areas for learners.**

Number of playgrounds/designated play areas: ________

23. **Describe the condition of these playgrounds:**

	No	Yes
a. Mostly grass	☐	☐
b. Mostly sand with stones	☐	☐
c. Cement or tarred surfaces		
d. Generally free of glass and other dangerous objects,	☐	☐
e. Some/ a lot of glass and other dangerous objects	☐	☐
f. Generally, Grounds clear of litter	☐	☐

24. Please indicate whether the equipment listed is available for use by learners (and the number if available) as well as, the state of the equipment.

	No/ Non-functional	Yes- number/ Mostly or fully functional
a. Jungle gyms and/or climbing frames	☐	_____
b. if yes, what is the condition?	☐	☐
c. Slides and/or see-saws	☐	_____
d. if yes, what is the condition?	☐	☐
e. Swings / hanging tyres	☐	_____
f. if yes, what is the condition?		
g. Playground drawings (hopscotch, four-square, snakes and ladders, fantasy-type markings, or similar)	☐	☐

25. Please indicate the number of sports fields available for learners.

Number of sports fields: ________

26. Describe the condition of these sports fields:

	No	Yes
a. Mostly grass	☐	☐
b. Mostly sand with stones	☐	☐
d. Generally free of glass and other dangerous objects,	☐	☐
e. Some/ a lot of glass and other dangerous objects	☐	☐
f. Generally, Grounds clear of litter	☐	☐

27. Please indicate whether the equipment listed is available for use by learners (and the number if available) as well as, the state of the equipment.

	No/ Non-functional	Yes- number/ Mostly or fully functional
a. Nets or goal posts	☐	_____
b. if yes, what is the condition?	☐	☐
c. Painted lines or courts	☐	_____
d. if yes, what is the condition?	☐	☐
e. Swimming pool	☐	_____
f. if yes, what is the condition?	☐	☐
g. Netball/basketball/volleyball/tennis courts	☐	_____
h. if yes, what is the condition?	☐	☐

28. Please indicate the availability of the equipment listed below in this school:

	None	A few	Many
a. Skipping ropes	☐	☐	☐
b. Hoola hoops	☐	☐	☐
c. Indigenous games	☐	☐	☐
d. Soccer balls/soccer goal	☐	☐	☐
e. Netballs/Nets/Posts	☐	☐	☐
f. Basketballs/Nets/Posts	☐	☐	☐
g. Cricket bats/pads/wickets	☐	☐	☐
h. Hockey sticks/balls/pads/goals	☐	☐	☐

i.	**Rugby balls/goal**	☐	☐	☐
j.	**Tennis racquets/nets/balls**	☐	☐	☐
k.	**Weight training equipment**	☐	☐	☐
l.	**Gymnastics equipment**	☐	☐	☐
m.	**Whistles/Beacons/Bibs**	☐	☐	☐
n.	**Athletics equipment**	☐	☐	☐
o.	**Other: ....**	☐	☐	☐
p.	**Other: ....**	☐	☐	☐

Physical activity

Physical education

Physical education refers to scheduled instruction-based physical education classes

29. Do you offer physical education classes in line with the CAPS documents?

Yes	
No	

30. If you do offer physical education classes, who teaches them?

Generalist/class educator	
Specialist physical education educator	
Not applicable	

School sport

31. Which sports are offered at your school (tick all that apply)?

Aquatics	
Athletics	
Basketball	
Chess	
Cricket	
Football	
Gymnastics	
Hockey	
Netball	
Rugby	
Softball	
Table Tennis	

Tennis	
Volleyball	
Other (please specify)	

32. Is it compulsory for all learners to take part in school sport other than physical education classes if you have them?

Yes	
No	

33. Are sports coaches:

Full time	
Part time	
Combination	

34. Are sports coaches trained in coaching techniques?

Yes, all	
Yes, some	
No	

35. Are your educators encouraged to make use of school sporting facilities themselves?

Yes	
No	

Section C. School feeding programme /nutrition policies/vendors:

36. Do you have a wellness programme for employees?

Yes	
No	

37. Does the school provide free meals for learners?

Yes	
No	

38. If yes, by whom?

NSNP	
Other (specify)	

39. If you have a Government Nutrition Programme, which of the following menu items do you offer **every day** (tick all that apply)?

Breakfast	Cereal eg. Instant porridge, Morvite, Oats	
Lunch	Protein eg. Pilchards, eggs, milk, liver, soya mince, beans, peas, peanut butter	
	Starch eg. Potatoes, samp, rice, pap, pasta, bread	
	Vegetable/fruit eg. Carrots, cabbage, butternut, green beans, pumpkin, spinach, apples, oranges, apricots, peaches, guavas, pears, plums	

40. Please provide the answer that best apply to the nutrition policy at the school:

	No	Yes
a. **Does the school offer a subsidized feeding scheme?**	☐	☐
b. Does the school have a policy concerning sale of soft drinks or sweets/chips in the tuck shop or by vendors?	☐	☐
c. Does the school have a policy concerning the sale of soft drinks or sweets/chips for school functions?	☐	☐
d. Are learners able to leave school during the day to purchase food or snacks?	☐	☐
e. Does the school have a policy concerning the types of foods and beverages offered by vendors either within or adjacent to the school?	☐	☐

41. Is there a tuck shop/snack shop/canteen at the school? If so, please indicate the items that are sold in the shop from the list provided:

	No	Yes
Is there a tuck shop/snack shop at the school? If yes, which of the following items are available?	☐	☐
a. **Sweets**	☐	☐
b. **Chocolates**	☐	☐
c. **Chips (crisps)**	☐	☐
d. **Fizzy cool drinks or other cool drinks**	☐	☐
e. **Sports drinks, such as Energade™**	☐	☐
f. **100% Fruit juice**	☐	☐
g. **Fresh fruits or salads**	☐	☐
h. **Cooked meals (w/ protein, vegetables, starch)**	☐	☐
i. **White bread sandwiches**	☐	☐
j. **Brown bread sandwiches**	☐	☐
k. **Hamburgers / hotdogs**	☐	☐
l. **Koeksisters / doughnuts**	☐	☐
m. **Slap chips / chip roll**	☐	☐
n. **Sausage rolls / pies**	☐	☐
o. **Ice suckers – bunny licks / ice cream**	☐	☐
p. **Other: ___________________________**	☐	☐
q. **Other: ___________________________**	☐	☐

42. Is there a vegetable garden at the school? If so, please indicate the purpose of the garden and the food produced:

		No	Yes
Is there a vegetable garden at the school?		☐	☐
a.	**To grow food for the learners / feeding scheme**	☐	☐
b.	**To grow food to give to community members**	☐	☐
c.	**To grow food to sell to the learners / community members**	☐	☐
d.	**To teach the learners responsibility**	☐	☐
e.	**As a recreational activity for the learners**	☐	☐
f.	**To support the curriculum**	☐	☐
g.	**To teach learners how to grow vegetable gardens at home**	☐	☐
h.	**Other: ______________________________________**	☐	☐

43. Are there formal or informal vendors at or adjacent to the school? If so, please indicate the items that are sold by these vendors from the list provided:

		No	Yes
a. Are there formal or informal vendors at or adjacent to the school?		☐	☐
a.	**Sweets**	☐	☐
b.	**Chocolates**	☐	☐
c.	**Chips (crisps)**	☐	☐
d.	**Fizzy cool drinks or other cool drinks**	☐	☐
e.	**Sports drinks, such as Energade™**	☐	☐
f.	**100% Fruit juice**	☐	☐
g.	**Fresh fruits or salads**	☐	☐
h.	**Cooked meals (w/ protein, vegetables, starch)**	☐	☐
i.	**White bread sandwiches**	☐	☐
j.	**Brown bread sandwiches**	☐	☐
k.	**Hamburgers / hotdogs**	☐	☐
l.	**Koeksisters / doughnuts**	☐	☐
m.	**Slap chips / chip roll**	☐	☐
n.	**Sausage rolls / pies**	☐	☐
o.	**Ice suckers – bunny licks / ice cream**	☐	☐
p.	**Other: __________________________**	☐	☐
q.	**Other: __________________________**	☐	☐

Section D. Health challenges for learners and teachers

44. We are interested in the following health problems. Please select and prioritise the top three health problems experienced by your learners and educators in the last 6-12 months.

	Learners	Educators
a. Tobacco use among	☐	☐
b. Substance abuse among	☐	☐
c..Lack of physical activity among	☐	☐
d. Unhealthy diet among	☐	☐
e. Overweight among	☐	☐
f. Underweight among	☐	☐
g. Chronic diseases of lifestyle, e.g. diabetes, heart disease, high blood pressure	☐	☐
h. Health problems related to issues of sexuality, e.g. HIV/AIDS, teenage pregnancy	☐	☐

45. What are the top three barriers to health-promotion programmes in schools? Place a 1, 2 or 3 next to the applicable barrier.

		Priority
a.	**Too little time within the timetable**	
b.	**Too many competing priorities**	
c.	**Lack of capacity / training and availability of human resources**	
d.	**Lack of financial resources**	
e.	**Inadequate facilities**	
f.	**Lack of interest / willingness from outside organisations**	
g.	**Lack of interest from learners**	
h.	**Lack of interest / support from teachers**	
i.	**Lack of interest / support from parents**	
j.	**Unsafe for learners to stay after school to participate**	

APPENDIX M: A review of studies using tailored messaging to combat NCDs

Reference	Methods (Sample size; duration; research design; measurement frequency; country; Behaviour change theory)	Description of intervention	Outcome measures	Results	Notes (limitations etc.)
SMOKING STUDIES					
Bock *et al.*[315]	N=543 adult smokers. Follow-up assessments were conducted at 1, 3 and 6 months.	INT: tailored intervention employing motivational interviewing and telephone follow-up. CON: usual care	The efficacy of a smoking cessation intervention on abstinence rates and motivation to quit smoking	Abstinence (7-day point prevalence) rates were significantly greater among INT group compared with CON. The largest difference occurred at 1 month: 16.8% of CON and 27.3% of INT were abstinent, with differences decreasing over time.	
Brandon *et al.*[316]	N=1 874 smokers; 24 months; RCT; USA	INT 1: Standard repeated mailings (8 cessation booklets mailed over a 12-month period) INT 2: Intensive repeated mailings (monthly mailings of 10 booklets and additional material designed to enhance social support over 18 months) CON: traditional Self-Help (existing self-help	The efficacy of a self-help intervention with increased duration and intensity	INT 2 produced the highest abstinence rate (30.0%), followed by INT 1 group (24.4%), and CON group (18.9%). The difference in 24-month abstinence rates between INT 2 and CON groups was 11.0%	Self-reported abstinence rates

		booklet for quitting smoking)			
Elfeddali *et al.*[311]	N=121 adult daily smokers, enrolled in a smoking cessation course; A longitudinal quasi-experimental study; follow-ups at 1 and 3 months after the quit attempt was conducted	Respondents received internet-based questionnaires 2 weeks before quitting (baseline) and 1 and 3 months after the quit attempt.	The role of self-efficacy, recovery self-efficacy, and preparatory planning with regard to short-term smoking relapse. Whether the importance of these variables differed for smokers quitting individually and without help (self-quitters) and smokers quitting with the help of a smoking cessation course (group quitters).	Less preparatory planning significantly predicted relapse at 1 month after the quit attempt among group quitters, but not among self-quitters. Among group quitters, the results indicated a borderline significant curved relation between recovery self-efficacy and relapse after 1 month.	More research is needed on the role of preparatory planning and recovery self-efficacy. Moreover, we recommend incorporating self-efficacy increasing techniques in relapse-prevention interventions.
Etter[321]	N=4 237; 2.5 months; RCT; France; TTM	INT 1: original online, interactive smoking cessation programme based on psychological and addiction theory INT 2: modified programme (shorter and contained more information on nicotine replacement therapy and nicotine dependence, and less information on health risks and coping strategies). Both programs consisted of tailored, personalised counselling letters based on participants'	To compare the efficacy of two Internet-based, computer-tailored smoking cessation programmes. The outcome was self-reported smoking abstinence (no puff of tobacco in the previous 7 days), assessed 2.5 months after entry in the program	Statistically significant differences in quit rates in smokers in the contemplation stage favouring the original program, no between-group differences in quit rates were observed in smokers in the Precontemplation and Preparation stages of change.	Self-reported questionnaire

		characteristics, followed by monthly email reminders. Participants in both programs obtained, on average, 1.2 feedback counselling letters over 2.5 months			
Graham *et al.*[739]	N=5 290 smokers; Age: 18+ years; 3 month; RCT; USA	INT 1: interactive, evidence-based smoking cessation website alone INT 2: interactive website in conjunction with a social network intervention designed to integrate participants into the online community INT 3: interactive website in conjunction with a social network intervention designed to integrate participants into the online community plus free nicotine replacement therapy INT 4: the combination of all treatments (web + social network + nicotine replacement therapy).	To evaluate the impact of a social network intervention and free nicotine replacement therapy on adherence to evidence-based components of smoking cessation treatment in the context of a Web-based intervention	INT 4 outperformed all others on Web site utilization metrics, use of practical counselling tools, intra-treatment social support, and nicotine replacement therapy. It was the only intervention to promote the sending of private messages and the viewing of community pages over website alone. INT 2 and INT 4 outperformed INT 1 on most metrics of online community engagement. INT 3 and INT 4 showed higher medication use compared to INT 1	

Hoffman *et al.*[309]	N=74 African–American smokers. Mean age=51.7 years. TTM; 6 months	Individuals were divided into sections based on the four TTM constructs: (1) Stages of Change, (2) Pros and Cons of smoking; (3) Temptations; and (4) Processes of Change	Participation and retention rates; acceptability of both the computer expert system and the audiotapes; the fit of the TTM for the target population; and the 6-month shift in stages of change.	Data supports the feasibility, acceptability and potential efficacy of stage-tailored computer interactive feedback plus stress reduction intervention delivered at the point of service to low-income African–Americans	The Computer expert System and the audiotape were rated as highly interesting, relevant, and new, and most participants tried them
Lenert *et al.*[299]	N=485; Mean age 38,9 years; 1 month	INT: education website plus individually timed educational messages CON: education-only Web site	To determine whether an automated e-mail messaging system that sent individually timed educational messages (ITEMs) increased the effectiveness of an Internet smoking cessation intervention	No significant differences in factors associated with 30-day quit rates. INT appeared to increase the rate at which individuals set quit dates. The 30-day quit rates were higher in INT group.	
Meyer *et al.*[270]	N=1 499 daily smokers between 18-70 years; Quasi-randomized controlled trial; 24 months; TTM; Germany.	INT 1: up to 3 tailored personal letters INT 2: Brief advice intervention CON: no intervention. Brief advice was delivered during routine consultation by the practitioner after an onsite training session.	Self-reported point prevalence and prolonged abstinence at 6-, 12-, 18- and 24-month follow-ups. The efficacy of (i) computer-generated tailored letters and (ii) practitioner-delivered brief advice for smoking cessation against an assessment-only condition; and to compare both interventions directly	Among participants completing the last follow-up, 6-month prolonged abstinence was 18.3% in INT 1 group, 14.8% in INT 2 and 10.5% in CON group. Statistically significant effects of both INT groups compared to CON.	

Norman *et al.*[305]	N=1 402; grades 9-11 from 14 secondary schools in Toronto, Canada; 3 and 6 month follow up; A two-group repeated measures randomised control trial over 6 months; RCT; theoretical construct that includes measures of self-efficacy, attitudes toward smoking, readiness to change	INT: tailored Web-assisted tobacco intervention (Smoking Zine integrated into a program that included a paper-based journal, a small group form of motivational interviewing, and tailored e-mails) CON: interactive control condition task conducted during a single classroom session with e-mail follow-up. Web site called the	Resistance to smoking, behavioural intentions to smoke, and cigarette use were assessed	INT significantly reduced the likelihood of having high intentions to smoke and increased their likelihood of high resistance to continued cigarette use at 6 months. Also significantly reduced the likelihood of heavy cigarette use adoption by non-smokers during the study period.	The Smoking Zine intervention provided cessation motivation for smokers most resistant to quitting at baseline and prevented non-smoking adolescents from becoming heavy smokers. By providing an accessible and attractive method of engaging young people in smoking prevention and cessation, this interactive and integrated program provides a novel vehicle for school- and population-level health promotion
Strecher *et al.*[312]	N=3 971; 12 weeks; United Kingdom and Republic of Ireland	INT: web-based tailored behavioural smoking cessation materials CON: web-based non-tailored smoking material.	The efficacy of internet based tailored behavioural smoking cessation materials among nicotine patch users. Twenty-eight-day continuous abstinence rates were assessed by internet-based survey at 6-week follow-up and 10-week continuous rates at 12-week follow-up	INT reported clinically and statistically significantly higher continuous abstinence rates than CON. Continuous abstinence rates at 6 weeks were 29.0% in INT vs. 23.9% in CON; at 12 weeks continuous abstinence rates were 22.8% vs 18.1%, respectively. Satisfaction with the program was significantly higher in the INT group	Self-reported quitting rates

Strecher *et al.*[322]	N= 1 978 smokers; 12 months; brief cognitive–behavioural cessation counselling	INT 1: single, tailored smoking cessation guide INT 2: series of 4 printed materials tailored only to baseline data INT 3: 4 printed materials tailored to baseline as well as retailored using 5-month interim progress data. CON: a single, untailored smoking cessation guide	The primary outcome measure was 7-day point prevalence abstinence rates assessed using a computer-assisted telephone interview at 12-month follow-up. To assess the efficacy of adding different types of behavioural smoking cessation materials to brief telephone-based cessation counselling	No differences were found among the four experimental conditions. Participants in the INT 2 and INT 3 groups had significantly higher abstinence rates than participants in the CON and INT 1 groups	
Te Poel *et al.*[320]	N=458 Dutch adults; mean age=46,1 years; 6 month follow up	INT: computer tailored email CON: generic non-tailored emails	The efficacy, understandability, credibility and personal relevance of an e-mail-delivered computer-tailored smoking cessation intervention over 6 months	Significantly more participants in INT reported not having smoked in the last 24 hours (21.5%) and 7 days (20.4%) in contrast with participants in CON (9.8 and 7.8%, respectively). Participants in INT group appreciated the computer-tailored e-mail significantly more in terms of understandability, credibility and personal relevance.	Most participants were motivated to quit smoking

Wakefiled *et al.*[308]	N=264. Parents recruited from South Australian paediatric hospital outpatient waiting rooms; 6 months; RCT	INT: written and verbal feedback about their 1 – 11 year old child's urinary cotinine-to-creatinine levels and information booklets explaining the risks of exposure to environmental tobacco smoke for children with asthma and ways to restrict smoking in the home and an additional booklet on quitting smoking. 2 telephone calls with existing asthma, higher rates of hospital utility encouraging a ban on smoking at home. CON: usual care	Would parents impose bans on smoking in the home or otherwise change their smoking habits.	49.2% of INT group reported having banned smoking in the home compared with 41.9% of CON, the differential effect was not significant.	The intervention did not change parents' propensity to create or maintain bans on smoking in their home or otherwise change smoking habits to reduce their children's exposure to environmental tobacco smoke
HEALTHY EATING STUDIES					
De Bourdeaudhuij *et al.*[335]	N=140; RCT; 4 weeks; Belgium;	INT: mailed nutrition education letters to their home addresses, tailored to personal fat intake levels, motivation to reduce fat intake, awareness of personal fat intake, and attitudes and self-efficacy expectations related to fat reduction. Feedback was manually tailored	To investigate the impact of tailored versus standardized nutrition education on fat intake and on psychosocial determinants of fat intake in families, using a randomized dietary feedback study. To study the differential effect of the tailored nutrition education on	INT was more effective than CON in reducing total and saturated fat intake when all the family members were included. Only mothers benefit from the tailored intervention	Tailored feedback resulted in stronger awareness of personal fat intake and awareness of fat intake of family members. Tailored advice has the potential to communicate the personal need to change

		CON: general nutrition education letters.	different family members		
De Bourdeaudhuij *et al.*[325]	N=337; Quasi-experimental design; Belgium	INT 1: computer-tailored communication INT 2: generic communication CON: no communication	To examine the effectiveness and applicability of an interactive computer-tailored fat reduction intervention	INT 1 was more effective in decreasing employees' fat intake compared with INT 2 or CON.	
Elder *et al.*[326]	N=357; Spain	INT 1: Lay health advisor + tailored print materials INT 2: tailored print materials only CON: regular print material	Primary outcomes: calories from fat and daily grams of fibre. Secondary outcomes: total energy intake, total and saturated fat intake, and total carbohydrates	INT 1 achieved significantly lower levels of energy intake, total fat and saturated fat, and total carbohydrates compared to INT 2 and CON.	The relative superiority of the INT 1 condition may derive from the personal touch in the face-to-face interactions or from the women's use of print materials under the lay heath advisor's guidance
Haerens *et al.*[328]	N= 2991 7th and 8th graders (average age: 13 years); Clustered RCT; Belgium	INT 1: combining environmental changes with computer-tailored feedback with parental support INT 2: combining environmental changes with computer-tailored feedback without parental support Cont: Standard care	To evaluate the effects of a middle school healthy eating promotion intervention, combining environmental changes and computer-tailored feedback, with and without an explicit parent involvement component	In girls, fat intake and percent energy from fat decreased significantly more in INT 1 compared to the INT 2. In boys, no significant decreases in fat intake or percentage of energy from fat as a result of the intervention. No intervention effects in boys or in girls for fruit, soft drink and water consumption.	Combining physical and social environmental changes with computer-tailored feedback in girls and their parents can induce lower fat intake in middle school girls

Heimendinger *et al.*[331]	N=3 402; 12 months; RCT; UK	INT 1: single untailored communication (1 untailored set of materials) INT 2: single tailored communication (1 tailored booklet) INT 3: multiple tailored communication (4 tailored materials) INT 4: multiple retailored communication (4 tailored materials with retailoring based on new information obtained at 5 month follow up CON: standard-of-care	Increase fruit and vegetable consumption among callers to the National Cancer Institute's Cancer Information Service using tailored print materials	At 12 months follow-up, there was a significant linear trend across groups of 0.21 servings. Significant mean serving differences between INT 1 vs. INT 3 and INT 1 vs. INT 4. Multiple tailoring print materials were more effective at increasing fruit and vegetable consumption than were non-tailored messages. Retailoring did not produce a significant difference when compared with longitudinal baseline tailoring.	A higher proportion of recipients of tailored materials reported reading all of the materials and believing that they were written especially for them. No differences by experimental condition were found for the perceived usefulness or motivational impact of the print materials.
Irvine *et al.*[327]	N=517; Average age 43 years; RCT; Colorado and Illinois, USA; TTM	INT: tailored content CON: wait listed-no communication until end of trial	To evaluate whether tailored communication would decrease dietary fat consumption and increase consumption of fruits and vegetables	Significant intervention effects for self-reported consumption of fat and of fruits and vegetables, for stage of change to adopt a low-fat diet, for intention and self-efficacy to reduce dietary fat, and for attitude toward the importance of diet.	The results were obtained utilizing a fully-automated computerised intervention at worksites; no personal contact was required

Park *et al.*[324]	N=160 adult community workers, 18-24 years, RCT; TTM; USA	INT: Stage-tailored Internet program, *Fruit & Vegetable Express Bites* CON: non tailored messages in a comparable format	Evaluate a theory-based, Internet-delivered nutrition education module	Non-significant improvements in self-efficacy, decisional balance and selected processes, with only marginal advantages for the INT group. Non-significant changes in fruit and vegetable consumption. Self-report measures of knowledge, confidence, and motivation improved in INT group (not measured for controls).	Favourable ratings of treatment program acceptability and personal relevance were reported.
Peng[334]	N=40; average age: 20 years; RCT; Self-efficacy	INT: play the RIGHTWAY CAFÉ computer game CON: no intervention	Knowledge of the food pyramid	INT group had a significantly greater score on food pyramid knowledge and self-efficacy than the CON group	
PHYSICAL ACTIVITY STUDIES					
Albright *et al.* (2009)[343]	N=20; 14 weeks; 8 weeks; Social cognitive theory and TTM; Hawaii, USA	Only 1 group which received telephone counselling, pedometers, referral to community PA resources, social support, email advice on physical activity pedometer goals, and newsletters	Minutes per week of moderate and vigorous leisure-time physical activity measured by the Godin physical activity instrument	Significant increase in minutes of moderate and vigorous leisure-time physical activity	Not a randomised trial

Blissmer *et al.*[346]	N=196; mean age 43; 16 weeks; TTM	INT 1: tailored messages based on stages of change INT 2: Stage mismatched tailored communication INT 3: standard-of-care (action oriented) CON: no communication	The comparative efficacy of 4 interventions to increase the physical activity behaviour of college personnel	Stage-matched and standard care interventions resulted in greater levels of both total and lifestyle physical activity compared with the mismatched and CON interventions	
Haerens *et al.*[345]	7 and 8 graders from 15 schools	INT 1: tailored messages with parental support group INT 2: tailored messages only CON: no communication	The effects of a 2-year middle school physical activity and healthy food intervention, including an environmental and computer-tailored component on BMI in boys and girls	Girls: BMI increased significantly less in INT 1 group compared with the CON group or the INT 2 group. Boys: no significant positive intervention effects were found	
Hageman *et al.*[340]	N=31 women; Mean age: 56 years; Baseline, month 1 and month 2; RCT; USA	INT: 3 internet tailored letters CON: 3 internet generic letters	Feasibility and effectiveness of using the Internet to deliver behaviour change interventions for promoting physical activity in women ages 50-69 years	Improvement in measures of flexibility and perceived barriers to exercise for both groups. CON group showed improvement in percent body fat while VO_2max declined. Women indicated the newsletters were helpful in influencing behaviour change. Self-reported physical activity did not increase although selected biomarkers did improve. Whether	Self-reported physical activity questionnaire

				tailored or standard messaging was more effective was inconclusive.	
Hurling *et al.*[339]	N=77; Average age 40 years; 9 weeks; RCT; United Kingdom	INT: access to an Internet and mobile phone–based physical activity programme - tailored solutions for perceived barriers, a schedule to plan weekly exercise sessions with mobile phone and email reminders, a message board to share their experiences with others, and feedback on their level of physical activity. CON: no support	Change in moderate physical activity recorded by the longer version of the International Physical Activity Questionnaire (IPAQ) and the wrist-worn accelerometer.	INT significantly greater increase over baseline vs CON group for perceived control and intention / expectation to exercise. Accelerometer data and leisure time self-report data found a higher level of moderate physical activity in the INT group	
King *et al.*[349]	N=301 type 2 diabetics; 8 weeks; RCT, TTM	INT: Computer-assisted, tailored self-management intervention CON: health risk appraisal with feedback	To evaluate the effectiveness of a multifaceted PA intervention for people with type 2 diabetes that emphasised participant choice in activity selection	INT significantly improved all physical activity and moderate physical activity levels relative to CON	
Shirazi *et al.*[348]	N=116; 45-60 year old; 12 week; RCT; TTM; Iran	INT: Education materials aimed to increase participants' knowledge of osteoporosis, risk factors and effects and preventive behaviours	PA level, muscle strength and balance	INT group: significant improvements in physical activity, lower body muscle strength, static and dynamic balance.	These results support the applicability of the TTM for a PA intervention and indicate that this training program is very effective in

		with a focus on the benefits of exercise and muscle strength training plus exercise instruction tailored to participants' stage of change. CON: Education materials only		No significant changes in CON group. INT: positive, significant progression in psychological stages of change. CON: no significant progression in stages occurred	improving balance and lower body strength in older women
Slootmaker *et al.*[341]	N=102; 23-39 year old; Baseline, 3 months, 8 month follow up; RCT; Netherlands	INT: received the physical activity monitor and tailored Web-based PA advice (PAM COACH); CON: a single written information brochure with brief general PA recommendations.	Changes in physical activity (recall of minutes per week spent on PA, as measured by the Activity Questionnaire for Adolescents and Adults), determinants of PA, aerobic fitness, and body composition.	No significant change in physical activity levels	Activity Questionnaire for Adolescents and Adults (AQuAA) was used to assess the amount of minutes per week spent on light-intensity (2-4 metabolic equivalents, METs), moderate-intensity (4-6.5 METs), and vigorous-intensity (> 6.5 METs) PA, as well as time spent sedentary (< 2 METs), such as watching TV and using the computer.
Smeets *et al.*[344]	N=487; Mean age: 44 years; 3 months; Netherlands; I-Change Model	INT: tailored intervention CON: no information	Whether computer tailored feedback on physical activity is effective and whether there are differences between respondents with low and high motivation to change	At post-test, the motivated respondents in CON group were more likely not to meet recommendation for PA than to meet it, and motivated respondents in the experimental group were more likely to engage in transport-related activities and	The results showed that the effects of the tailored feedback were restricted to respondents who had a positive motivation to change at baseline.

				showed more improvement over time for the total activity score than respondents in the CON group. Both groups improved their behaviour over time. No group differences in PA were found for the unmotivated respondents.	
Wanner *et al.*[338]	N=1 531; Mean age: 44 years; 6 weeks, 6 months, 13 months; Germany	INT: access to Active-online an individually tailored physical activity website CON: non tailored website	How effective is Active-online, compared to a non-tailored website, in increasing self-reported and objectively measured physical activity levels in the general population when delivered in a real-life setting? Do respondents who are recruited for the randomised study differ from spontaneous users of Active-online, and how does effectiveness differ between these groups? What is the impact of frequency and duration of use of Active-online on changes in physical activity behaviour	Both groups showed significant increase in self-reported mean minutes spent in MVPA. No significant differences between groups. No increases in physical activity over time in any group for objectively measured physical activity	Self-reported PA levels as well as accelerometers

MULTIPLE BEHAVIOUR STUDIES					
Bickmore *et al.*[377]	N=113; 2 months; RCT; theory of the structure of dialog	Interactive web-based communication with a health counselor INT 1: PA INT 2: diet INT 3: PA and diet CON: standard-of-care (pedometers)	PA was assessed using International Physical Activity Questionnaire (IPAQ). Steps walked. Servings of fruit and vegetables were assessed using the NIH/NCI Fruit and Vegetable Scan. Body weight	INT 1 participants increased walking compared to CON. INT 2 and INT 3 decreased walking. INT 2 consumed significantly more F&V servings compared to CON. INT 3 consumed more compared to those in the CON.	
Bosworth *et al.*[372]	N=636 hypertensive adults, average age=61 years; RCT; TTM; 24 months	INT: tailored behavioural intervention bi-monthly by a nurse-administered behavioural intervention; CON: standard-of-care	Medication adherence and improve hypertension-related health behaviours	Self-reported medication adherence increased by 9% in the INT group vs. 1% in the CON group at 6 months	
Campbell *et al.*[365]	N=587; 6 months; RCT; social cognitive theory, TTM, health belief model, and social support model; USA	INT: tailored print and video, consisting of 4 individually tailored newsletters and targeted videotapes CON: lay health advisor	Increasing fruit and vegetable consumption, lowering dietary fat, and achieving MVPA activity on most days of the week. The main screening message was for participants to obtain FOBT annually starting at age 50, or earlier if an individual had risk factors.	Tailored print and video significantly improved fruit and vegetable consumption and recreational physical activity. Among those 50 and older, a 15% increase in faecal occult blood testing screening. CON showed no effectiveness, possibly because of suboptimal reach and diffusion	

Demark-Wahnefried *et al.*[375]	N=543 new diagnosed cancer patients; Average age: 57 years; 12 months; RCT; USA	INT: 10-month tailored mailed print materials promoting fruit and vegetable consumption, reducing total/saturated fat intake, and/or increasing exercise CON: a 10-month program of non-tailored mailed materials on diet and exercise available in the public domain.	Increasing fruit and vegetable consumption, reducing total/saturated fat intake, and/or increasing exercise	Both groups significantly improved lifestyle behaviours, significantly greater gains occurred in INT vs CON group	
Eakin *et al.*[366]	N=200; 6 weeks and 6 months; Socio-ecological model; USA	INT: 2 face-to-face, self-management support and community linkage sessions with a health educator, 3 follow-up phone calls, and 3 tailored newsletters CON: usual care conditions	Primary outcomes: Changes in dietary behaviour and PA. Secondary outcomes: changes in multilevel support for healthy living	Significant intervention effects were observed for dietary behaviour and multilevel support for healthy lifestyles but not for PA	
Emmons *et al.*[371]	N=1 954; RCT; 8 months; USA	INT: An initial in-person counselling session with a health adviser using motivational interviewing; 4 follow-up telephone counselling sessions with the health adviser; 6 sets of tailored materials written for low-literacy audiences that targeted social contextual factors and	Fruit and vegetable consumption, red meat consumption, multivitamin intake, and physical activity	Significant increases in fruit and vegetable consumption and multivitamin intake and reductions in red meat consumption in INT compared to CON. No change was found in PA levels	

		links to relevant local activities. CON: Standard-of-care			
Ezendam *et al.*[740]	N=883; 12-13 years; RCT; 4 and 24 months; Theory of Planned Behaviour, Precaution Adoption Process Model, implementation intentions; Netherlands	INT: computer tailored modules (8) addressed issues of weight management CON: regular curriculum and energy balance–related behaviours.	Self-reported diet, PA, sedentary behaviour, pedometer counts, BMI, waist circumference	Intervention was associated with lower odds of drinking more than 400mL of SSB per day and with lower snack intake and higher vegetable intake but also with a lower step count at 4-month follow-up. FATaintPHAT also had a positive effect on fruit consumption at 4-month follow-up and on step count at 2-year follow-up. No effects were found for sedentary behaviour. CON: No effect on BMI and waist circumference	
Glasgow *et al.*[369]	N=335 Type 2 diabetics; average age=62 years; social cognitive theory-based tailored self-management; 2 months; RCT; Denver, Colorado, USA	INT: tailored self-management including assessment of current health behaviour, feedback, identification of benefits and barriers to change, and tailored goal-setting and action-planning. Tailored follow-up letters reinforcing	Changes in dietary behaviours (fat and fruit/vegetable intake), haemoglobin HbA1c, lipids, weight, quality of life and depression	INT group significantly reduced dietary fat intake and weight compared to CON group. Consistent directional trends favouring intervention, but not significant among patients having elevated levels of	

		the patient's selected goals CON: standard-of-care		HbA1c and lipids or depression	
King *et al.*[380]	N=200; Age: over 44 years; 4 and 12 months	Telephone intervention INT 1: sequential PA first then diet INT 2: sequential diet first then PA INT 3: simultaneous CON: Attention-Control	Sequential vs. simultaneous diet plus PA interventions affected behaviour changes	At 4 months, only INT 1 improved PA, and only INT 3 and INT 2 improved dietary variables. At 12 months, mean levels of all behaviours in INT 3 met recommendations, though not in the INT 1 and INT 2 arms.	
Leslie *et al.*[376]	N=83 smokers wanting to quit; Mean age = 50 years; RCT; 24 weeks; Glasgow	INT: An initial 5-week programme of nutritional advice with a different aspect of nutrition covered at each add-on group session. This was followed by 5 additional follow up group sessions for review and reinforcement of advice, and self-monitoring CON: 7 weeks of group support sessions.	To determine the effect of a structured programme of dietary advice on weight change and food choice, in adults attempting smoking cessation	No significant difference in actual and percent weight gain between groups. In comparison to baseline improved consumption of fruit and vegetables and breakfast cereal were reported in the INT group. A higher percentage of CON participants continued smoking	The intervention was not successful at minimising weight gain in comparison to CON but was successful in facilitating some sustained improvements in the dietary habits of INT participants. Improved quit rates in the INT group suggest that continued contact with advisors may have reduced anxieties regarding weight gain and encouraged cessation despite weight gain.

Martin *et al.*[272]	N=144 Overweight/obese women ; Average age=42 years; 6 months; RCT; USA	INT: tailored weight management intervention by physician CON: standard-of-care	Body weight change	INT group lost more weight than the CON group	
Morey *et al.*[374]	N=641 overweight cancer survivors; 12 months; RCT; Canada, UK, USA	INT: Home-based tailored program of telephone counselling and mailed materials promoting exercise, improved diet quality, and modest weight loss CON: wait-listed for 12 months.	To determine whether a telephone counselling and mailed print material– based diet and exercise intervention is effective in reorienting functional decline in older, overweight cancer survivors	Mean function score declined less rapidly in INT compared with the CON group. PA, dietary behaviours, and overall quality of life increased significantly in INT group compared with CON group. Weight loss also was greater in INT group compared to CON group.	
Oenema *et al.*[290]	N=2 159; mean age: 44 years; 1 month, RCT; Dutch	INT: website with tailored information modules on saturated fat intake, PA, and smoking cessation. CON: wait listed, after 1 month, were given access to the website	Saturated fat intake, compliance with the PA guideline and smoking status based on self-reported behaviour	INT group had significantly lower self-reported saturated fat intake and a higher likelihood of meeting PA guidelines in those who were insufficiently active at baseline. No significant intervention effects were found for self-reported smoking status	Short intervention period
Prochaska *et al.*[361]	N= 3 407; RCT; 0, 6, 12 months; TTM	INT: mailed three computer reports at 0, 6, and 12 months CON: no intervention for each at-risk	Percentages of at-risk patients at baseline who progressed to the action or maintenance stages at 24-month follow-up	Significant treatment effects were found for each of the four behaviours, with 25.4% of intervention patients	

		behaviour. The 3-5 - page reports per behaviour were divided into five sections: 1) stage of change and readiness to change behaviour. 2) pros and cons of changing were discussed with feedback, when necessary, about under-evaluating the pros of changing and/or over-evaluating the cons. 3) feedback was given on the participants' use of up to 6 change processes relevant to their stage of change. Participants were compared normatively on each process to peers in their same stage who were successful self-changers. 4) feedback on how to enhance self-efficacy in the most tempting situations. 5) strategies for taking small steps to progress to the next stage. CON: standard-of-care	for each of the risk behaviours. Reduce smoking, improve diet, decrease sun exposure, and prevent relapse from regular mammography	in action or maintenance for smoking, 28.8% for diet, and 23.4% for sun exposure. INT group had less relapse from regular mammography than the control group.	

Resnicow *et al.*[363]	N=906; average age: 46,3 years; 12 months; RCT; USA	INT 1: Culturally targeted self-help nutrition and PA materials INT 2: Same intervention as INT 1 plus 4 telephone counselling calls based on motivational interviewing CON: standard educational materials	The effectiveness of a culturally tailored self-help dietary (focusing on F & V intake) and PA intervention compared to standard health education materials, and (2) to test the effectiveness of using Motivational Interviewing, delivered by telephone, to modify PA and dietary habits	Significant changes in both F&V intake and PA. Changes were somewhat larger for F & V. For F & V, but not PA, there was a clear additive effect for the Motivational Interviewing intervention	
Schulz *et al.*[284]	N=8 429; Age: 18 – 65 years; 12 and 24 months; RCT; Netherlands	Tailored motivational feedback to change unhealthy behaviours. Content was based in I-Change Model INT 1: sequential letters (1 at a time INT 2: simultaneous (all at same time) CON: no intervention	To test the effects of a sequential and simultaneous web-based tailored intervention on multiple lifestyle behaviours	INT 1 had the most significant effects compared to CON after 12 months. INT 2 had the most as most effective change after 24 months. INT 1 was most effective in smoking abstinence and decreased alcohol consumption. INT 1 and INT 2 were associated with small self-reported behavioural changes	Self-reported
Tate *et al.*[368]	N=192; average age 49; BMI>30; 3 and 6 months; RCT	INT 1: computer-automated feedback with access to an electronic diary and message board, and automated, tailored messages	Change in body weight, self-reported physical activity, self-reported dietary intake	INT 1 and INT 2 showed significantly greater weight losses compared with CON group, no significant difference between 2 INT groups at 3	Providing automated computer-tailored feedback in an Internet weight loss program was as effective as human e-mail counselling at 3 months

		INT 2: e-mail counselling with access to an electronic diary and message board and weekly e-mail feedback from a counsellor CON: no counselling. All participants received 1 weight loss group session, coupons for meal replacements, and access to an interactive website		months. At 6 months, weight losses were significantly greater in INT 2 group than in INT 1 group or CON groups	
Vandelanotte *et al.*[362]	N=392; 24 months; RCT	INT 1: Simultaneous group received both interventions INT 2: sequential group first received physical activity intervention, 3 months later they received the fat intake intervention INT 3: sequential intervention first receiving fat intake and then physical activity intervention	To examine long-term efficacy of interactive computer-tailored physical activity and fat intake interventions, and evaluate their efficacy in a simultaneous or sequential implementation over 2 years	Strong time effects for total physical activity and fat intake, indicating that intervention effects remained over 2 years. Overall the interventions were more effective for participants not meeting the public health recommendations at baseline. The sequential intervention mode was overall slightly more effective than the simultaneous mode in maintaining intervention effects.	

Vandelanotte *et al.*[379]	N=567; ages between 20 and 60 years; 6 months; RCT; Belgium	Computer-tailored interventions: INT 1: PA and fat intake simultaneously INT 2: PA at baseline and fat intake at 3 months INT 3: fat intake at baseline and PA at 3 months	To evaluate whether there are differences in successfully changing multiple behaviours in computer-tailored sequential and simultaneous interventions for PA promotion (>60 min increase) and fat intake reduction (5% reduction)	No significant differences in PA and fat intake between groups	Participants that successfully changed fat intake were more likely to be overweight/obese; participants that successfully changed both behaviours were more likely to be overweight/obese and have lower education. Being overweight might be an extra motivator to change health behaviours

Appendix N: Review of SMS-text message studies to combat NCDs

Reference	Methods (Sample size; duration; research design; measurement frequency; country; Behaviour change theory)	Description of intervention	Outcome measures	Results	Notes (limitations etc)
Bombem *et al.*[741]	N=236; 6 months; Brazil	INT: Healthy Weight Programme including dietary and PA education through tailored monthly email messages, as well as goal setting, and self-monitoring of weight. CON: Wait-list control	Diet (food and beverage intake including fruit, vegetables, grains, dairy, meat, legumes, fat and sodium intake)	Diet: Significant decrease in overall diet quality score in both groups. Significantly more decrease in diet quality score in CON compared to INT group. Significant increase	

		Healthy weight programme at the end of 6-months intervention		in grains, but decrease in vegetable consumption, meat, eggs, sodium intake, and overall diet quality.	
Brendryen *et al.*[404]	2 weeks, 1 month, 11 month; self-regulation theory, social cognitive theory, cognitive– behaviour therapy, motivational interviewing and relapse prevention	4 media channels (SMS, IVR, e-mail, and web). The program consists of 3 phases, a precessation preparation phase, a 1-month active quit phase, and an 11-month follow-up phase. In the two first phases the client communicates with the program through the internet and by means of mobile phone with multiple daily contact points between client and program. In the follow up phase, number of contact points is reduced to a few per week, and all communication is by SMS & IVR.	Describe the Happy Ending protocol using an IM approach	The efficacy of Happy Ending has been demonstrated in two previous randomised controlled trials. In these trials, Happy Ending was compared to printed self-help booklet and showed a clinically and statistically improved abstinence rate at 12 months post cessation	Used an IM approach
Chen *et al.*	N=253; 40+ pre diabetic patients in rural China; 6 months; China	Computer tailored web-based intervention for diabetes prevention. Delivered each time a patient presents at medical clinic to see general practitioner. Included education, diabetes risk scoring and	<u>Behavioural outcomes:</u> PA Diet <u>Other relevant outcomes:</u> Body weight, BMI	PA: Significant change in number of participants who increased leisure time exercise Diet: Significant increase in number participants who reduced caloric intake; Significant increase	No CON group

		tailored feedback on changes on lifestyle behaviours (diet and PA) and barriers. Prompts general practitioner.		in number of participants who increased fruit-and vegetable intake BMI: Significant reduction	
Chow *et al.*[201]	N=710; mean age=58 years with proven coronary heart disease; 6 months; single-blind, randomized clinical trial; Sydney, Australia	INT: 4 text messages/week for 6 months in addition to usual care. CON: usual care.	To examine the effect of a lifestyle-focused semi-personalized support program delivered by mobile phone text message on cardiovascular risk factors. Low-density lipoprotein cholesterol (LDL-C) level at 6 months. Systolic blood pressure, BMI, PA and smoking status	Levels of LDL-C were significantly lower in INT group, with concurrent reductions in systolic BP and BMI. Significant increases in PA, and a significant reduction in smoking.	Good efficacy and acceptability of SMS messages. The use of a lifestyle-focused text messaging service compared with usual care resulted in a modest improvement in LDL-C level and greater improvement in other cardiovascular disease risk factors.
Franklin *et al.*[395]	N=92 type 1 diabetics; Age: 8-18 years; 12 months; RCT; Scotland	Daily text-messages from the Sweet Talk software system, containing personalized goal-specific prompts and messages tailored to patients' age, sex and insulin regimen INT 1: conventional therapy and Sweet Talk INT 2: intensive insulin therapy and Sweet Talk CON: conventional insulin therapy	Whether Sweet Talk (a text-messaging support system designed to enhance self-efficacy, facilitate uptake of intensive insulin therapy and improve glycaemic control) will improve glycaemic control in paediatric patients with Type 1 diabetes	HbA1c did not change in CON patients, but improved in INT 2 patients. 82% of patients felt that Sweet Talk had improved their diabetes self-management and 90% wanted to continue receiving messages.	Sweet Talk was associated with improved self-efficacy and adherence

Free *et al.*[388]	N=5 800 smokers; 6 months; single-blind, randomised, trial; United Kingdom	INT: motivational messages and behavioural-change support CON: SMS messages unrelated to quitting	The effect of an automated smoking cessation programme delivered via SMS on continuous abstinence (biochemically verified) at 6 months	Biochemically verified continuous abstinence at 6 months was significantly increased in INT group	
Ganesan *et al.*[742]	N= 36 652; 36.0 year old adult employees; 2.5 months; India, China, Philippines	100-day Stepathlon programme: Participants received pedometer and entered daily step count into Stepathlon website or app. Website to facilitate motivation and engagement via self-monitoring, social networking, quizzes, expert chats and competition between employees. Encouraging emails daily and when milestones were reached.	PA (daily step count, weekly exercise days, daily sitting time Other; Body weight	PA (daily step count): Significant increase of 3519 steps. PA (weekly exercise days): Significant increase of 0.89 days/week PA (daily sitting time): Significant decrease of 0.74 h/day Body weight: Significant reduction of 1.45 kg	No CON group
Haapala *et al.*[393]	N=125 healthy, overweight; age: 25-40 year old; RCT; 0,3,6,9, 12 months	INT: SMS weight-loss programme (a staggered reduction of food intake and daily weight reporting with immediate tailored feedback) CON: no intervention	Changes in body weight and waist circumference.	By 12 months INT lost significantly more weight than CON and had a greater reduction in waist circumference.	Early weight loss, self-efficacy, contact frequency, attitudes towards the medium, changes in work and family life and changes made in dietary habits were the strongest predictors of weight loss
Hanauer *et al.*[396]	N=40 diabetics; Age: 12-25 years; RCT; 3 months; Boston, USA	INT: SMS reminders to check blood glucose levels	Blood glucose monitoring	INT received more reminders and responded with blood glucose results	Pilot feasibility study.

		CON: e-mail reminders to check blood glucose levels		significantly more often. By month 3, usage waned.	Maintaining interest levels for prolonged intervals remains a challenge.
Haug *et al.*[390]	N=174 smokers; 3 months; TTM; Germany	INT 1: 1 weekly individualised SMS feedback INT 2: 3 weekly individualised SMS feedbacks CON: no intervention	The feasibility and acceptability of SMS messages for continuous individual support of smoking cessation	No significant differences between groups for smoking cessation. No difference in acceptability between INT 1 and INT 2	High participation and retention rates suggest that SMS-based smoking cessation interventions are attractive for young adults. Support intensity did not affect the acceptance of the program.
Hurling *et al.*[339]	N=77 healthy adults; mean age: 40.4 years; 12 weeks; randomized, stratified controlled trial; UK	INT: Internet and SMS–based physical activity program (tailored solutions for perceived barriers, a schedule to plan weekly exercise sessions with mobile phone and email reminders, a message board to share their experiences with others, and feedback on their level of physical activity) CON: no support	Evaluate the impact of a physical activity program based on the Internet and mobile phone technology	INT reported significantly greater perceived control and intention/expectation to exercise. Intent-to-treat analyses of both the accelerometer and leisure time self-report data found higher level of moderate PA INT group	INT and CON received wrist-worn accelerometer
Lana *et al*[743]	N=737; Age: 12-16 year old students; 9 months; Mexico and Spain	INT 1: Website targeting cancer risk behaviours (advantages of healthy/disadvantages of risky behaviours. Expert advice, videos, forums, documents, web links, educational games	Evaluate the impact of a web-based intervention supplemented with text messages to improve cancer prevention behaviours among adolescents	Diet: Significant within-group increase in percentage of students consuming enough fruits in all groups; no significant difference within-group changes for other diet behaviours.	

		INT 2: Additional weekly text messages encouraging health behaviour CON: No intervention		PA: No significant within-groups change in percentage of students doing less than 360 min/week PA BMI: Significant within-group changes in percentage of overweight/obese students in INT 2	
Márquez *et al.*[644]	N=67 uncontrolled hypertensive patients; 1, 3, 6 months; RCT; Spain	INT: SMS messages and reminders sent to their mobile phones 2 days per week. CON: received their physician's usual interventions	Effect of an intervention to provide information with mobile phone text messages to patients with hypertension on compliance with therapy for hypertension	No significant changes in BP readings or compliance between groups. SMS messages with alerts and reminders did not improve compliance with therapy in patients with hypertension	
Müller *et al.*[421]	N=39; 55-70 year old; 3 months, 6 month follow up; Malaysia	CON: Printed exercise booklet with 12 age appropriate exercises. INT: Additional 60 encouraging text messages	PA (weekly exercise frequency, daily time spend sitting) BMI	PA (exercise frequency): Significantly more often exercise in INT compared to CON at 3 months; Non-significant difference at 6 months PA (PA related energy expenditure): No significant between-within group changes PA (daily time spent sitting): No significant between-within group changes BMI: No significant between-group changes	

Neville *et al.*[400]	N=30 people with Asthma; Age: 10-46 years; Scotland	INT: daily SMS reminders to use an inhaler, health education tips, and safety messages.	Asthma medication adherence	Participants thought the tone and style of the text messages and the medium were credible. Participants seemed to develop a rapport with their virtual friend with asthma and frequently sent text messages back to 'Max'. Compliance with using an inhaler may have favourably changed in response to the service	
Nurgul *et al.*[744]	N=30; 18-55 year old female university employees; 3 months; Turkey	Web-based health intervention: Modules delivered every 3 weeks. 1 module on nutrition, 1 on diet and 1 on smoking and stress. Modules consist of an audiovisual lecture.	PA Diet	PA: Significant increase Diet: Significant increase from	No CON group
Patrick *et al.*[618]	N=65 overweight individuals; Age: 25-55 years; 16 weeks; RCT	INT: personalised and interactive SMS and MMS messages sent 2-5 times daily, printed materials, and brief monthly phone calls from a health counsellor CON: receipt of monthly printed materials about weight control	Weight loss	INT group lost more weight than CON group	92% of INT participants stated that they would recommend the intervention for weight control to friends and family
Pfammatter *et al.*[745]	N=1 243; 32.2 years (±10.2 years); 6 months; India	INT: 56 motivational text messages addressing awareness of diabetes and diabetes	PA (current exercise) Diet (fruit, vegetable, fat intake)	PA: No significant between-group change in exercise participation Diet (daily intake of fruit	

		risk behaviours CON: No intervention		and vegetables): Significant between-group increase favouring the INT. Diet (fat intake): Significant between-group decrease favouring the INT	
Ramachandran *et al.*[746]	N=517; Age: 35-55 year old men with impaired glucose tolerance; India	INT 1:Face-to-face education and motivation about healthy lifestyle plus written information about diet and PA INT 2: Additional 2-4 weekly text messages; messages based on the Transtheoretical Model and contained information about diet and PA, benefits of healthy diet and PA, strategies for relapse prevention and motivation to maintain healthy diet and PA	To evaluate the effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification	Diet: Significant difference in mean changefavouring INT 2; Sig. more participants in INT 1 adhered to dietary recommendations at follow-up; higher percentage of participants in INT 2 improved portion size, oil intake, carbohydrate consumption vs INT 1. PA: Non-significant difference in mean change in PA score; adherence to PA recommendations did not significantly differ at follow-up	
Rodgers *et al.*[401]	N=1 705 smokers; Age: 15+ years; 6 months; New Zealand	INT: received regular, personalised text messages providing smoking cessation advice, support, and distraction CON: no intervention	To determine the effectiveness of a mobile phone text messaging smoking cessation programme	More participants had quit at six weeks in INT compared to the CON group. Reported quit rates remained high at six months, but there was some uncertainty about between group differences because of incomplete follow up.	

Rotheram-Borus *et al.*[747].	N=22; 3 months and 3 moth follow-up. Age: 21-74 years diabetic township female residents; South Africa	3-component PA and diet programme: Weekly educational group sessions addressing healthy lifestyle; daily text messages asking about adherence to healthy behaviours; peer support for lifestyle changes via text messages or call	To test the feasibility and acceptability of a mobile phone–based peer support intervention among women in resource-poor settings to self-manage their diabetes. Secondary goals were to evaluate the intervention's effectiveness to motivate diabetes-related health choices	PA: No significant change in daily step counts from baseline to 3 months and from baseline to 6 months. BMI: No significant changes	No control group
Rubinstein et al.[748]	N=553; 30-60 year old adults with pre-hypertension; 12 months; Peru, Argentina, Guatemala	CON: Leaflet with information on adoption of healthy lifestyle INT: Additional monthly calls to motivate participants to adhere to healthy behaviours (diet and PA) plus max. 5 text messages per month	PA (weekly MET-minutes) Diet (daily intake of sodium, fat and sugar, fruits and vegetables) Other: BMI, Body weight, waist circumference	PA: Mean difference in change between groups −80.4 (95 % CI:−386; 225.5, p = .61) Diet (daily sodium intake): Mean difference in change between groups − 0.07 (95 % CI:−0.25;0.12 p = .49). Diet (daily fat and sugar intake): Mean difference in change between groups − 0.75 (95 % CI:−1.30;−0.20, p = .008) Diet (daily intake of fruits and vegetables): Mean difference in change between groups 0.25 (95 % CI:−0.01; 51, p = .05) BMI: Mean difference in change between groups − 0.30 (95 % CI: −0.59; 0.06, p = .02)	

				Body weight: Mean difference in change between groups −0.66 (95 % CI: −1.24; −0.07, p = .04) Waist circumference: Mean difference in change between groups −0.64 (95 % CI: −1.62; 0.35, p = .21)	
Shahid *et al.*[749]	N=440; 18-70 year old type 2 diabetes patients; 4 months; Pakistan	CON: Usual care plus leaflet on diet and a healthy lifestyle INT: Additional regular (every 15 days) mobile phone calls to provide feedback on self-monitored blood glucose levels over the past readings of 15 days.	Diet PA BMI	Diet: Significant increase in proportion of participants following dietary plan from baseline to 4 months in INT. Non-significant change in CON PA: Significant increase in proportion of physically active participants from baseline to 4 months in INT. Non-significant change in CON BMI: Sig. reduction in INT and CON favouring CON	
Shetty *et al.*[750]	N=144; Age: 50.3 year type 2 diabetic patients; 12 months; India	INT & CON: During initial and follow-up visits education programme with individual advice on nutrition and PA INT: Additional 2–4 weekly text messages; reminders/instructions to follow regimen of healthy diet and PA; messages on healthy habits	Diet PA BMI	Diet: No significant changes in percentage of participants adhering to diet regiment PA: No significant changes in percentage of participants complying with PA advice BMI: No significant changes	

Sriramatr *et al.*[751]	N=110; 18-24 year old students; 6 months; Thailand	INT: Website and weekly emails incl. PA education, tailored advice, goal setting and self-monitoring via pedometer. CON: Pedometer without website and emails.	PA (daily step count, weekly leisure-time PA)	PA daily step counts: Mean difference in change from baseline to 3 months between groups was 3766 steps favouring INT. PA leisure time activity score: Mean difference in change from baseline to 3 months between groups was 15.13 points favouring INT. Mean difference in change from baseline to 6 months between groups was 14.87 points favouring IG	
Tamban *et al.*[752]	N=104; 19-50 year old diabetes patients; 6 months; Philippines	INT & CON: Lecture from diabetes educator and usual appointments with diabetes educator and endocrinologist. INT: Additional text messages 3 times weekly for 6 months on healthy diet, exercise and consequences of negative health behaviours.	PA Diet BMI, Body weight	PA: Significant between-group increase in minutes of exercise at 6 months favouring the INT; no significant between-group changes in mean number of days meeting PA recommendations Diet: Significant between-group improvements in adherence to 3 meals per day recommendation favouring INT; no significant between-group changes in mean number of days meeting diet recommendations. BMI: No significant between-within group changes	

				Body weight: No significant between-within group changes	
Zolfaghari *et al.*[753]	N=77; 18-65 year old diabetes patients; 3 month exposure; Iran	INT 1: Phone counselling about diabetes management including health behaviour twice weekly for 1st month and weekly for months 2 and 3. INT 2: 6 weekly text messages on diabetes management including behavioural health.	Behavioural outcomes Adherence to diet and PA recommendations as a score Measurements Questionnaire	Diet Adherence: Significant within-group increase in INT 1 and INT 2 but no significant between-group changes. PA Adherence: Significant within-group increase in INT 1 and INT 2 but no significant between-group changes	No CON group

APPENDIX O: School Environment Assessment Cronbach Alpha Tables

The physical environment of the school

Cronbach alpha: 0.758 Standardized alpha: 0.756

	Mean if deleted	Var. if deleted	StDv. If deleted	Itm-Totl Correl.	Alpha if deleted
Physical neighbourhood	12,47173	1,809938	1,345339	0,801129	0,638313
School safety access	14,51190	3,208758	1,791301	0,727358	0,596083
Safety measures	16,27678	3,935188	1,983731	0,952603	0,583273
Condition of school buildings	17,30208	6,180013	2,485963	0,114381	0,848986

Physical activity enabling environment*

Cronbach alpha: 0.717 Standardized alpha: 0.740

	Mean if deleted	Var. if deleted	StDv. If deleted	Itm-Totl Correl.	Alpha if deleted
Playground conditions	4,053571	1,205038	1,097742	-0,032118	0,826503
Sports fields condition	4,343750	0,885742	0,941139	0,701746	0,627358
Sport facilities	3,827381	0,343360	0,585970	0,715971	0,642213
Compulsory extramural sports	5,342262	0,557779	0,746846	0,979464	0,340002

***Games equipment component was removed from the analysis as the values were too different from the other variables**.

Healthy eating enabling environment

Cronbach alpha: 0.713 Standardized alpha: 0.902

	Mean if deleted	Var. if deleted	StDv. If deleted	Itm-Totl Correl.	Alpha if deleted
Food environment	-9,21131	9,66967	3,109609	0,838540	0,601689
Nutrition policy	-7,70685	12,21566	3,495090	0,757917	0,746700
Healthy food sales	0,78423	2,14662	1,465135	0,943832	0,653862
Formal or informal vendor	-4,93304	8,67318	2,945025	0,724126	0,569957