HealthKick: Evaluating the impact of a school-based intervention on the dietary adequacy of learners from low-income settings in the Western Cape Province, South Africa

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DECLARATION

MPH (Epi) Mini-Dissertation

I _____ Student No._____ declare that the work that I have submitted is my own and where the work of others has been used (whether quoted verbatim, paraphrased or referred to) it has been attributed and acknowledged.

Signature: _____

Date: _____

Executive Summary

South Africa is currently experiencing a health transition which appears to be largely affecting poor communities. Traditional diets have been replaced with western foods high in carbohydrates and fats. This has resulted in a population of overweight or obese adults living in the same homes with children who are either over- or under-nourished.

HealthKick is a primary school-based nutrition and physical activity intervention programme aimed at promoting the adoption of healthy lifestyle behaviour to reduce diabetes risk factors in disadvantaged communities in South Africa. HealthKick aims to promote and increase learners', teachers' and parents' consumption of healthy food and their participation in health enhancing physical activity. The intervention consists of a curriculum component and environmental changes, and is currently taking place in 16 (8 urban and 8 rural) primary schools in low-income settings close to the city of Cape Town.

This dissertation sub-study forms part of the evaluation of the greater HealthKick project. The primary objective of the study was to compare the dietary adequacy of learners at intervention and control schools after 18 months of intervention. The subsidiary objective was to identify the determinants of dietary adequacy.

The protocol (Part A) describes the sampling design and methods that were used during the intervention. The literature review (Part B) assesses the effectiveness of other school-based interventions; the relationship between dietary diversity and nutritional status; methods used to assess and quantify dietary adequacy; the use of a dietary

diversity score as a tool for measuring nutritional adequacy; and the determinants of nutritional adequacy.

The article (Part C) presents the data analysis and results of the baseline survey compared to the follow-up survey.

The appendices (Part D) consist of the Research Ethics Committee approval letter, a consent form and questionnaires used in the study, as well as the author guidelines for BMC Public Health Journal.

The results showed that the dietary adequacy of learners improved at both the intervention and control schools. However, the improvement was greater at the intervention schools (11.7% vs. 9.7%). Logistic regression analysis identified factors influencing dietary adequacy of learners. Predictive factors included the number of meals consumed (odds ratio (OR)=2.3; p=0.001), whether the learner had received a meal from the school feeding programme (OR=3.97; p=0.001), whether the learner lived in an urban district (OR=1.52; p=0.045) and whether their gender was male (OR=0.53; p=0.007).

The study concluded that while learners displayed positive behaviour changes as a result of the intervention, dietary diversity was largely reliant on socio-economic determinants.

Acknowledgements

HealthKick is a collaborative project between (1) The Centre for the Study of Social and Environmental Determinants of Nutrition, Human Sciences Research Council (HSRC), (2) The Chronic Diseases of Lifestyle Unit (CDL), Medical Research Council (MRC) and (3) The UCT/MRC Research Unit for Exercise Science and Sports Medicine, Department of Human Biology, Faculty of Health Sciences, University of Cape Town. The project is funded by The World Diabetes Foundation.

I was involved in the planning, fieldwork and data analysis of the HealthKick project.

I would like to thank my supervisors for their support. Dr Nelia Steyn is one of the principal investigators of the HealthKick project from which the data for this dissertation were used. She helped to formulate the objectives of the study and guided the protocol, literature review and article development. Dr Anniza de Villiers is the HealthKick project manager and was my co-supervisor. She reviewed the protocol, literature review and article, and provided insight into the intricacies of dealing with a school-based project. Prof Rodney Ehrlich was a co-supervisor and helped to refine the objectives of the study. He played a pivotal role in the structure and format of the dissertation as well as providing guidance and recommendations for the content of the protocol, literature review and article.

I would also like to thank the entire HealthKick team (Prof EV Lambert, Dr CE Draper, L Dalais, J Fourie, J Hill and E April) for their input and support during the process.

Part A: Protocol

1. Introduction

1.1 Problem Statement

South Africa's disease burden has resulted in over- and under-nutrition co-existing in the same home. Energy, vitamin and mineral deficiencies are widely prevalent in disadvantaged communities.

The South African Food Based Dietary Guidelines advocates consuming a variety of food given that diets which lack variety are associated with dietary inadequacy and micronutrient deficiencies. Dietary adequacy may be quantified using a Dietary Diversity Score (DDS).

'HealthKick' is a three year primary school-based intervention programme funded by the World Diabetes Foundation. This programme is designed to promote the adoption of healthy lifestyle behaviour by learners, their parents and teachers, with the aim of reducing diabetes risk factors in disadvantaged communities in South Africa. By reducing diabetes risk factors, the programme will also reduce the risk factors for other non-communicable diseases.

One of the HealthKick Programme's objectives is to evaluate the efficacy of the intervention in terms of the uptake and adoption of healthy lifestyle behaviours. Measuring the difference in dietary variety (adequacy) between baseline assessment (2009) and follow-up (2010) will provide evidence to demonstrate the programme's efficacy or lack thereof.

This dissertation plans to use data collected from learners at baseline (2009) and follow-up (2010) to measure the effect of the first 18 months of intervention on the dietary

adequacy of learners from low-income settings in the Western Cape Province, South Africa.

1.2 Background to the Study

South Africa has a quadruple burden of disease which consists of poverty-related infectious disease, lifestyle-related communicable diseases (NCDs), the HIV/AIDS epidemic and violence related trauma (Bradshaw et al., 2003). The rapid increase in NCDs has been attributed to the present health transition. Lifestyle changes related to urbanization, socio-economic, cultural and environmental factors as well as dietary changes have been identified as the main predisposing factors. Poor urban residents are the ones most affected by this transition (Mayosi et al., 2009).

Rural/urban studies in South Africa have found that due to urbanisation, traditional diets have been replaced with western diets which are typically high in carbohydrates and fats and low in fibre (Bourne et al., 2002). Globally, childhood malnutrition has remained prevalent, while high levels of obesity have emerged due to these dietary changes (Doak et al., 2005). This has resulted in the paradoxical coexistence of obese adults and malnourished children living in the same household, particularly in middle-income countries experiencing a health transition (Prentice, 2006).

In South Africa, the adult population is predominantly overweight or obese rather than underweight (Bourne et al., 2002), while underweight and overweight/obesity coexist in primary schools learners (Armstrong et al., 2006). The National Food Consumption Survey (Labadarios et al., 2005) reported that nearly one in five South African children between the ages of one and nine years were stunted, and one in ten was underweight for age. In contrast, the survey also reported that 17.1% of the sample were either

overweight or obese (Steyn et al., 2005).

The South African Food-Based Dietary Guidelines (FBDGs) were developed in an attempt to resolve diet-related health problems associated with under- and over-nutrition (Vorster et al., 2001). They consist of ten short messages of which 'Enjoy a variety of foods' is the first. The guideline aims to encourage people to improve their diet where necessary in order to increase the variety of foods being consumed. Increasing dietary diversity is one of four main internationally advocated strategies aimed at improving the micronutrient deficiency in malnourished persons (Maunder et al., 2001).

Furthermore, increased dietary diversity has been associated with improved nutritional status in children. This suggests that a diverse diet may improve the overall quality of the diet and increase the probability of achieving daily energy and nutrient requirements (Arimond & Ruel, 2004).

Counting food groups in a Dietary Diversity Score (DDS) has been shown to successfully predict nutritional adequacy (Hatloy et al., 1998). A DDS is defined as the number of food groups consumed during a period of 24 hours. The food groups are classified according to recommendations by the Food and Agriculture Organisation of the United States (Hatloy et al., 1998; Kennedy & Nantel, 2006) : (1) cereals, roots, tubers; (2) vitamin A-rich fruit and vegetables; (3) other fruits; (4) other vegetables; (5) legumes, pulses, nuts; (6) oils and fats; (7) meat, poultry, fish; (8) dairy; (9) eggs. According to Steyn et al. (2006), children with a DDS of less than four should be regarded as being at risk of being food insecure and micronutrient deficient. In addition, anthropometric Z-scores were positively correlated with DDS. This suggests that children with a DDS of less than four are consuming a diet that is nutritionally

inadequate and will not be able to meet their daily energy and nutrient requirements. Dietary adequacy can therefore be defined as having a DDS of four or more.

'HealthKick' is a primary school-based nutrition and physical activity intervention programme funded by the World Diabetes Foundation (WDF, 2010) and currently in its third year of intervention. The aim of HealthKick is to promote and increase learners', teachers' and parents' consumption of healthy food and their participation in health enhancing physical activity. The programme is currently taking place in 16 (8 urban and 8 rural) primary schools in low-income settings close to the city of Cape Town (Draper et al., 2010).

The HealthKick project is divided into three phases. The first phase was made up of intervention mapping and a formative assessment. Intervention mapping was used to develop the programme by prioritizing environmental and behavioural outcomes as regards nutrition and physical activity. The formative assessment consisted of (1) a situational analysis of the physical and policy environment in 100 randomly selected schools in the Western Cape; (2) health risk assessments of teachers in 83 of the 100 schools; (3) health risk assessments of parents at 4 of the 50 urban schools; (4) small-group parent interviews at 22 of the 100 schools; (5) an assessment of the nutrition and physical activity knowledge, attitudes and behaviour of grade 4 learners at 4 of the 50 urban schools; and (6) an assessment of 887 grade 4 learners at the 16 schools on nutrition and physical activity knowledge, attitudes and behaviour (KAB), dietary intake, anthropometric measurements and fitness levels. The intervention mapping and formative assessment were used to develop eight HealthKick goals. These goals are (1) eat a variety of foods every day, (2) eat more different kinds of fruit and vegetables

every day, (3) eat less fat and oily food, (4) eat less sugar and sweet foods, such as cakes, doughnuts, sweets, etc, (5) eat a regular healthy breakfast daily (6) bring healthy lunchboxes to school as a daily routine, (7) be more physically active during school time, and (8) be more physically active after school (Draper et al., 2010).

The second phase consisted of developing a three year intervention and data collection tools/instruments. A process of action planning was used to guide the intervention schools in identifying and prioritizing realistic goals related to nutrition and physical activity. A toolkit consisting of a resource guide, resource box and physical activity resource bin was developed and distributed to the intervention schools to assist them in implementing the strategies they had identified in the action planning process (Draper et al., 2010). In addition, an Educator's Manual was developed consisting of all materials created and used during the intervention.

The programme is currently in its third phase which involves an evaluation of the intervention. The evaluation aims to assess the efficacy and impact of the intervention on dietary intake and physical activity behaviour of learners, their parents and teachers.

1.3 Justification

A key component of the HealthKick evaluation involves assessing the efficacy and impact of the intervention on dietary intake. In other words, the evaluation needs to quantify any change in the dietary intake of learners that can be attributed to the intervention. Since a DDS can predict nutritional adequacy, comparing the score at baseline (2009) to the score 18 months after the intervention (2010) will provide evidence on the programme's efficacy.

As part of the evaluation of the greater HealthKick project, this dissertation aims to measure the efficacy and impact of 18 months of intervention on the dietary adequacy of learners.

1.4 Objectives

Primary objective

To compare the dietary adequacy of learners at intervention and control schools after 18 months of intervention

Subsidiary objective

To identify the determinants of dietary adequacy

2. Methods[1]

2.1 Study Design

The study design was that of a quasi-experimental trial. Since the study aimed to measure the effect of the HealthKick intervention programme on the dietary adequacy of learners, control and intervention schools were required.

2.2 Population and Sampling

The target population comprised learners from primary schools in low-income settings in a rural and an urban district in the Western Cape Province. The Metropole North Education district represented the urban district, and the Breede River /Overberg Education district (now split into the Overberg and Cape Winelands districts)

[1] This section is written in the past tense since this sub-study forms part of an ongoing bigger project. The author will be analyzing data that has already been collected.

represented the rural district. Primary schools in low income settings were defined as schools from quintiles one to three. 'Quintile' is a ranking structure used by the Western Cape Education Department (WCED), with schools in quintile one representing the poorest and those in quintile five the wealthiest.

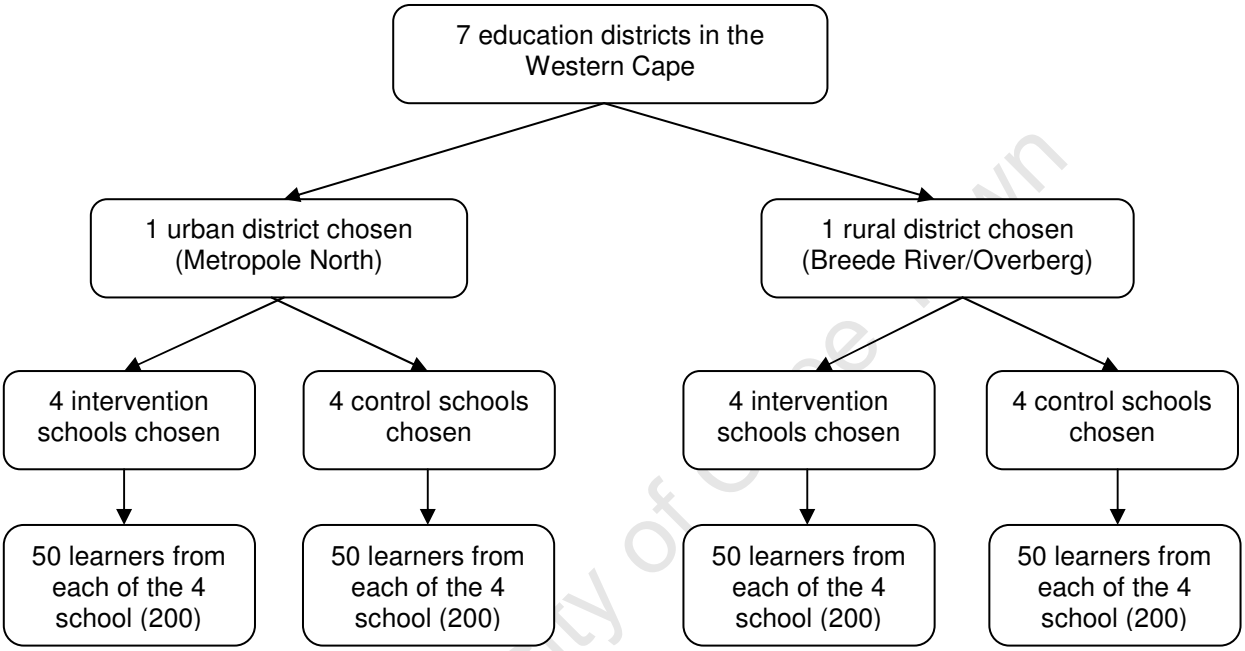

Figure 1: Diagrammatic representation of sampling strategy

A multi-level stratified sampling design was used **(Figure 1)**. The Western Cape Province was stratified into education districts. Two of the seven education districts were purposively selected; a rural and an urban district. Eight schools were purposively selected from each district. Managers in each WCED education district selected schools based on the cooperativeness of the school principal. Schools were paired within each district and randomly allocated to be intervention or control schools by pulling names from a hat. Schools were matched on geographical location, quintile allocation and

number of learners enrolled. Following the model of the Pathways study on American Indian school children (Stevens et al., 2003); grade 4 learners were selected for baseline assessment. Eighteen months later, the same group of learners was selected for follow-up. At follow-up the learners were in grade 5. Learners sampled in 2009 were not automatically be sampled in 2010.

2.3 Sample Size

The study sample consisted of approximately 800 learners. All grade 4 learners from small schools with only one class were included. In schools with more than one class, the first 50-60 learners to return their completed consent forms were selected. The sample chosen is large enough to measure the effect of the intervention.

2.4 Measurement

2.4.1 Instruments

A group administered questionnaire, which can be found in Section D (Appendix 3), was used to assess learner's nutrition knowledge, attitudes and behaviour (KAB). The KAB questionnaire was developed by the research team involved in the HealthKick project, and was informed by questionnaires from Pathways (Stevens et al., 2003) as well as a recent study done in the Western Cape (Steyn et al., 2009; Mchiza, 2009)**.**

A 24-hr recall capture sheet, which can be found in Section D (Appendix 4), was used to collect detailed information on all food and beverages consumed by learners the day before testing. No information was collected on portion sizes or quantities of food consumed. The interviewer prompted learners to provide detailed descriptions of what they had eaten.

The height and weight of each learner was measured by a trained field worker.

Learners were weighed (in kg to the nearest 0.01 kg) without shoes and jerseys using a digital scale. Height was measured (in cm to the nearest 0.1 cm) using a stadiometer which was placed on an even surface. Learners stood on its base without shoes, with heels together, looking straight ahead.

Table 1: **Definition of variables**

Variable	Scale of measurement	Definition
DEPENDENT		
Dietary Adequacy	Categorical - Binary	Identifies whether the learners diet was adequate (DDS≥4) or not adequate (DDS<4)
INDEPENDENT		
Year of data collection	Categorical - Binary	Identifies whether the data were collected at baseline (2009) or follow-up (2010)
School study status	Categorical - Binary	Identifies whether the school the learner attends is intervention or control
Nutrition knowledge score	Numerical - Continuous	A score identifying the learner's nutrition knowledge
Self-efficacy score	Numerical - Continuous	A score identifying the learner's beliefs versus barriers to healthy nutrition
Housing density	Numerical - Continuous	The number of persons per unit area (room) living in the same home as the learner
Meal score (MS)	Numerical - Discrete	Identifies the number of meals consumed during a 24-hr period out of a total of six
Height-for-age	Numerical - Continuous	The relationship of height and age compared with the 50th percentile
BMI-for age	Numerical - Continuous	The relationship of body mass index and age compared with the 50th percentile
Gender	Categorical - Binary	The learner's gender
Geographical area	Categorical - Binary	Identified whether the school the learner attended was situated in an urban or rural area
Breakfast	Categorical - Binary	Identifies whether the learner had eaten breakfast
Tuck shop utilized	Categorical - Binary	Identified whether the learner purchased food from the school tuck shop during first or second break
School feeding programme	Categorical - Binary	Identified whether the learner consumed food provided by the National School Nutrition Programme

2.4.2 Variables

Table 1 lists the types of variables that were used, their scale of measurement as well as their definitions.

2.4.3 Validity and reliability of instruments

Filed workers were trained by qualified dietitians to collect data using the 24-hr recall capture sheets. All field workers were trained to use the same probes when asking questions to standardise the range of responses.

The investigators attempted to increase the validity of the KAB questionnaire by translating the English questionnaires into local first languages, Afrikaans and Xhosa. The questionnaires were administered by trained field workers in the children's home language. In addition, extra fieldworkers monitored the learners and assisted them when further clarification was needed to answer a question.

2.4.4 Pilot study

A pilot study was carried out in four schools that were not included in the sample. All grade 4 learners were assessed. Lessons learned during the pilot study were used to improve the method of data collection as well as the quality of the information collected.

3. Data Management and Analysis

3.1 Data Management

A single data-capturer was responsible for coding the questionnaires and capturing all the data in an Excel spreadsheet. A second person compared the original data sheets to the captured spreadsheet and corrected any incorrect entries.

3.2 Data Analysis (dissertation component)[2]

For the dissertation, Stata/SE statistical software package version 11.0 will be used for statistical analysis. The Excel spreadsheets will be imported into Stata/SE and the data will be cleaned. The characteristics of the sample will be described using means and standard deviations for normally distributed data, and medians and inter-quartile ranges for data that are non-normally distributed. Binary variables will be described using percentages. For the primary objective, t-tests and chi-square tests will be used to establish associations between the learner characteristics and dietary adequacy (Table 2) and control and intervention schools (Table 3).

Table 2: **Dummy table of characteristics of learners by dietary adequacy (as defined by a DDS)**

	Adequate Diet		Inadequate Diet		Total	
	%	***Median (IQR)***	***%***	***Median (IQR)***	***Median (IQR)***	***P***
Knowledge score						
Self-efficacy score						
Housing density						
Meal score						
BMI-for-age						
Underweight (z-score =≤ -2SD)						
Overweight (z-score ≥1 - <2SD)						
Obese (z-score ≥ 2SD)						
		%		***%***	***%***	
Gender is male						
School in urban area						
Breakfast eaten						
Tuck shop utilized						
Feeding programme at schools						

[2] This section is written in the future tense since the author will be responsible for data analysis

For the subsidiary objective, multivariate analysis in the form of logistic regression will be used to examine the relationship between the dependant and independent variables. Logistic regression is suitable since the dependent variable is categorical (Dietary Adequacy: 1 if DDS≥ 4; 0 if DDS< 4) and many variables can be tested simultaneously for their impact on the dependent variable.

Table 3: **Dummy table of characteristics of learners at intervention and control schools**

	Intervention		Control		Total	
	%	***Median (IQR)***	***%***	***Median (IQR)***	***Median (IQR)***	***P****
Knowledge score						
Self-efficacy score						
Housing density						
Meal score						
BMI-for-age						
Underweight (z-score =≤ -2SD)						
Overweight (z-score ≥1 - <2SD)						
Obese (z-score ≥ 2SD)						
		%		***%***	***%***	
Gender is male						
School in urban area						
Breakfast eaten						
Food shop utilized						
Feeding programme at schools						
Diet is adequate (DDS≥4)						

4. Ethical Considerations

The study proposal for the HealthKick project was submitted and approved by the Research Ethics Committee in the Faculty of Health Sciences, University of Cape Town (REF: 486/2005). A copy can be found in Section D (Appendix 1). Approval for the research was obtained from the Western Cape Education Department. Parents gave

written informed consent for their children to participate. A copy of the consent form can be found in Section D (Appendix 2). All information was confidential and subjects were not identified by name.

HealthKick is a collaborative project between (1) The Centre for the Study of Social and Environmental Determinants of Nutrition, Human Sciences Research Council (HSRC), (2) The Chronic Diseases of Lifestyle Unit (CDL), Medical Research Council (MRC) and (3) The UCT/MRC Research Unit for Exercise Science and Sports Medicine, Department of Human Biology, Faculty of Health Sciences, University of Cape Town. The project is funded by The World Diabetes Foundation. Other stakeholders include the Department of Education, Department of Health: Nutrition Directorate, and the parents, learners and staff of the various schools involved.

All stakeholders were engaged in the planning process. On completion of the study, the results will be shared with all stakeholders. The investigators will seek an appropriate peer reviewed journal in which to publish.

5. Dissertation Structure

This dissertation will consist of four parts:

A) Protocol

B) Literature review

C) Manuscript

D) Appendices

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7. Acronyms and abbreviations

BMI	body mass index
CDL	chronic disease of lifestyle
DDS	dietary diversity score
FBDG	food-based dietary guidelines
HSRC	Human Sciences Research Council
IQR	inter-quartile range
KAB	knowledge, attitudes and behaviour
MRC	Medical Research Council
MS	meal score
NCD	non-communicable disease
P	p-value
SD	standard deviations
UCT	University of Cape Town
WCED	Western Cape Department of Education
WDF	World Diabetes Foundation

Part B: Structured Literature Review

1. Introduction and Objectives

The primary objective of this study was to compare the dietary adequacy of primary school learners before an intervention (baseline study) to 18 months after it was started (follow-up study). The subsidiary objective was to determine the key determinants affecting dietary adequacy using multivariate analysis. To inform this research, the objective of this literature review was to assess existing literature with regards to the following elements:

1. The effectiveness of school-based interventions;
2. The relationship between dietary diversity and nutritional status;
3. The methods used to assess and quantify dietary adequacy;
4. The use of a dietary diversity score (DDS) as a tool for measuring nutritional adequacy;
5. The determinants of nutritional adequacy.

1.1 Search Strategy

The following search strategy was used to inform the literature review:

To find literature to assess the effectiveness of school-based interventions, various combinations of the following key words or terms were used: intervention, school, school-based, nutrition, health, diet, best practice, children and learners.

To find literature needed for elements two to four of the literature review, a combination of the following key terms were used: dietary adequacy, nutrient adequacy, dietary variety and dietary diversity score.

For the fifth element, various combinations of the following words or terms were used: nutritional status, school children, health, dietary adequacy, nutrient adequacy, poor,

low income, disadvantaged and underprivileged.

The following databases were searched: Pubmed, Medline, EMBASE, Academic Search Complete, Google Scholar and Google.

1.2 Quality and Relevance Criteria

Due to the limited literature available, all relevant literature was included. No exclusion criteria based on quality was used. Literature on dietary diversity scores published prior to 1998 were excluded.

2. Summary of Relevant Literature

2.1 School-Based Interventions

Schools are commonly used as settings for health promotion activities. Children represent a large percentage of the population and it is believed that influencing health-related knowledge, attitudes and behaviour during childhood will result in healthier behaviour during adulthood. In addition, using schools as settings allows access to a large number of children in an environment where education and learning already take place (Green &Tones, 2010).

In 2009 a systematic review was undertaken (WHO, 2009a) to evaluate existing evidence on the efficacy of nutrition and physical activity interventions taking place in school settings. The review focussed on interventions aimed at preventing NCDs in disadvantaged communities in low- and middle-income countries.

The most successful interventions included a diet and physical activity curriculum

component taught by trained educators; a supportive school environment; a physical activity programme; a parental or family component; and healthy food options being available on the school premises (WHO, 2009a). Nearly all the interventions evaluated showed positive psychosocial and behavioural outcomes. Positive psychosocial changes included improvement in nutrition knowledge, food choice intentions and self-efficacy. Behaviour changes included decreased energy and fat intake, and an increase in fruit and vegetable consumption (WHO, 2009b).

The length of interventions with best practice outcomes ranged from as little as five weeks to as long as six years. Four intervention programmes stand out since they showed effectiveness in two of the three outcomes that was measured. Outcome measures included changes in nutritional knowledge, attitudes, behaviour or self efficacy; changes in clinical outcomes such as body weight; and process or policy changes (Steyn et al., 2009).

These interventions were (1) Pathways: a three-year intervention aimed at preventing obesity and decreasing energy and fat intake (Stevens et al., 2003); (2) High-5: a one-year intervention aimed at increasing fruit and vegetable consumption (Reynolds et al., 2000); (3) Know your Body: a six-year study aimed at promoting healthy lifestyle habits to reduce the risk of developing cardiovascular diseases in adulthood (Manios & Kafatos, 1999); and (4) Healthy Start: a two-year intervention aimed at decreasing total and saturated fat intake (Williams et al., 2002).

In South Africa we have a number of ongoing NGO-partnered or private sector school-based interventions that promote healthy eating and increased physical activity. The Heart and Stroke Foundation's Tuck shop Programme (Heart and Stroke Foundation

South Africa, 2011) and Discovery's Vitality Schools Programme (Discovery, 2011) are two examples. Preliminary evaluations of these interventions have found that they increase nutrition knowledge and improve self-efficacy of learners (Sport Science Institute of South Africa, 2010).

This dissertation used learner data from the HealthKick school intervention programme. The development of the HealthKick intervention (Steyn et al., 2009) was based on lessons learnt from the systematic review (WHO, 2009a; WHO, 2009b).

2.2 Dietary Diversity

The term 'dietary diversity' is widely used when referring to the number of food groups or the number of different foods consumed over a specified period of time (Ruel, 2003; Arimond & Ruel, 2004). The terms 'dietary variety' or 'food variety' are used synonymously.

The concept of eating a variety of foods from different food groups as well as within food groups is reflected in the dietary guidelines of both developed (FAO, 2011) and developing (FAO, 2008) countries. Furthermore, the first recommendation of the South African Food-Based Dietary Guidelines (FBDG's) encourages people to 'Enjoy a variety of foods' (Maunder et al., 2001).

The value of consuming a diet consisting of food from different food groups and within food groups is well recognised, since diets that lack variety have been associated with inadequate micronutrient intakes (Maunder et al., 2001). Lack of dietary diversity is a particularly important issue in developing countries where poverty exists in rural and urban areas.

Underprivileged populations living in developing countries often consume diets that are based on a starchy staple food, with very little animal protein, fruit and vegetables (Ruel, 2003). These diets tend to be low in micronutrients and may lack essential amino acids if their starch and legume intakes are not balanced (MacIntyre et al., 2002).

A number of studies from South Africa (Bourne et al., 1993; Bourne et al., 1994; MacIntyre et al., 2002) indicate that both rural and urban residents have moved away from a traditional high-carbohydrate, low-fat diet to a Western diet. A study carried out in the North West province of South Africa (MacIntyre et al., 2002) found that although adults consumed a diet containing adequate protein, the percentage of energy traditionally obtained from carbohydrates was being replaced with fat. In addition their diets were low in fruit, vegetables and dairy products resulting in a diet that lacked variety.

2.3 Dietary Adequacy

The terms 'dietary adequacy' and 'nutrient adequacy' are synonymous with diets that meet the body's essential energy, protein and micronutrient requirements (Ruel, 2002; Arimond & Ruel, 2002; Ruel, 2003). However, changes in dietary patterns in developed countries as well as countries experiencing a nutrition transition as a result of urbanisation and globalisation, has led to a re-evaluation of the definition of dietary adequacy. Dietary adequacy now includes concepts of nutrient deficiency and over nutrition (WHO, 1996). Subsequent guidelines recommend limiting the quantity of fat, saturated fat, trans fats, salt (sodium) and refined sugars in the diet and increasing fibre intake (WHO, 2003). Simultaneously diets should incorporate servings of fruit, vegetables and whole grain foods (Ruel, 2002).

In developed countries, the quality of diets is often evaluated using more than one method. Dietary adequacy, together with dietary diversity, moderation and proportionality may be assessed. Since developing countries are more concerned with nutrient deficiencies, dietary adequacy is frequently used as an indicator of dietary quality (Ruel, 2002; Torheim et al., 2004).

Dietary adequacy can be quantified by examining the ratio of the mean intake to the recommended intake of energy and nutrients based on the recommended daily intakes (RDA's) (Torheim et al., 2004). However, no standard list of nutrients has been defined in the context of dietary assessment (Ruel, 2002).

Traditional methods of collecting and analysing data on food consumption and nutrient intake are time consuming and expensive (FAO, 2008). With this in mind, a dietary diversity score (DDS) was proposed as an inexpensive, quick and easy method of evaluating dietary adequacy (Kennedy et al., 2009a).

In addition to a DDS being cost effective and fast, it incorporates dietary guidelines reflecting the need for variety in the diet. The rationale underpinning the use of a DDS is based on the premise that people who eat a variety of foods are more likely to meet their essential nutrient requirements than those who do not. Thus, the greater the DDS, the greater the probability of dietary adequacy being achieved (Arimond & Ruel, 2004).

2.4 Dietary Diversity Score (DDS)

There are two basic methods of measuring dietary diversity. Firstly, a score can be calculated based on the number of foods being consumed during a reference period. A second method clusters similar foods into groups before calculating a score based on

the number of food groups consumed during the reference period (Kant, 1996). A DDS based on the number of food groups consumed is considered to be a stronger determinant of dietary adequacy than calculating the number of single foods being consumed (Ruel, 2002).

The reference period commonly used is between one and three days (Ruel, 2002). However, periods as long as 15 days have been used (Drewnowski et al., 1997). In developing countries the most common method used to measure dietary diversity is to count the number of food groups consumed. The number of servings consumed from a group is generally not taken into consideration (Arimond & Ruel, 2004).

Table 1 provides a summary of the characteristics of studies that have used a DDS. Researchers have used various grouping strategies to cluster foods together. The studies evaluated used between 5 and 23 food groups. Several studies have investigated the association between dietary diversity and nutrient/dietary adequacy, micronutrient adequacy and household food security (Onyango, 2003). Associations were found between a DDS and nutritional status (Hatloy et al., 2000; Claasen et al., 2004; Savy et al., 2005), dietary/nutrient adequacy (Hatloy et al., 1998; Ogle et al., 2001; Mirmiran et al., 2004; Azadbakht et al., 2005; Torheim et al., 2004; Steyn et al., 2006; Daniels et al., 2009), micronutrient adequacy (Kennedy et al., 2007; Kennedy et al., 2009b) and height-for-age Z-scores (Arimond & Ruel, 2002; Arimond & Ruel, 2004). Populations studied ranged from infants under 2 years (Arimond & Ruel, 2002; Arimond & Ruel, 2004; Daniels et al., 2009) to adults (Ogle et al., 2001; Torheim et al., 2004; Kennedy et al., 2009b).

Currently, no consensus exists on the optimal number of food groups to include in a

DDS. The Food and Agriculture Organisation of the United Nations has proposed the use of a DDS based on 14 food groups consisting of, (1) cereals, (2) vitamin A-rich vegetables and tubers, (3) white tubers, (4) dark green leafy vegetables, (5) other vegetables, (6) vitamin A-rich fruit, (7) other fruit (8) organ meat, (9) flesh meat, (10) eggs, (11) fish, (12) legumes, nuts and seeds (13) milk and milk products, (14) oils and fats (FAO, 2008).

Similarly, Kennedy & Nantel (2006) have validated the use of a DDS based on 9 food groups in non-breastfeeding children 2-6 years using dietary intake data based on quantitative individual measurements of 24 hours of food intake. The 9 food groups were made up of (1) cereals, roots and tubers, (2) vitamin A-rich fruit and vegetables, (3) other fruit, (4) other vegetables, (5) legumes, pulses and nuts, (6) oils and fats, (7) meat, poultry and fish, (8) dairy, and (9) eggs. Each individual's probability of nutrient adequacy was calculated as well as their DDS based on the above 9 food groups. Correlation tests were used to assess the strength of association between DDS and the probability of nutrient adequacy (Kennedy & Nantel, 2006).

Furthermore, the use of a DDS based on 9 food groups was used in the analysis of the National Food Consumption Survey (NFCS) of children aged 1-9 years in South Africa (Steyn et al., 2006). Steyn *et al* found that the Nutrient Adequacy Ratio (NAR) increased as DDS increased (**Figure 1**). In addition, the mean anthropometric Z-scores for height-for-age, weight-for-age, and weight-for-height also increased as DDS increased (**Figure 2**). The study concluded that an adequate diet consisted of four or more food groups (DDS≥4) while an inadequate diet was associated with fewer than four groups (DDS<4).

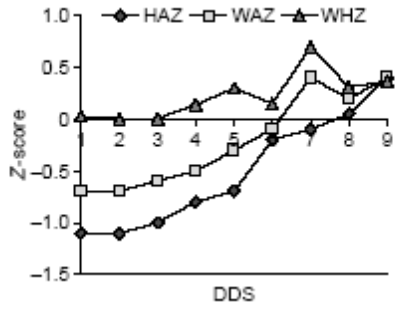

Figure 1: *Mean anthropometric Z-scores (WAZ-Weight-for-age; HAZ-height-for-age; WHZ-Weight-for-height) at different levels of Dietary Diversity Score (DDS) in South African preschool children* **(Steyn et al., 2006)**

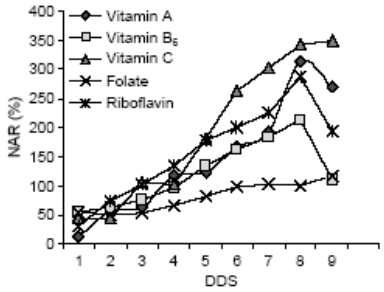

Figure 2: *Mean nutrient adequacy ratio (NAR, expressed as %) of vitamins at different levels of dietary diversity score (DDS)* **(Steyn et al., 2006)**

The scoring system used in the current study is based on the 9 group dietary diversity score validated by Kennedy and Nantel.

2.5 Determinants of Nutritional Adequacy

A number of studies have shown that poor nutrition is often experienced by individuals living in low income households (Paulik et al., 2010; Williams et al., 2011). Their diets are typically high in fat and low in fruit and vegetable intake, thus providing a diet low in micronutrient density (De Irala-Estevez et al., 2000).

In South Africa, particularly in rural areas, food insecurity (lack of access to adequate, safe and nutritious food) is a major area of concern (Bonti-Ankomah, 2001). Findings from the South African National Food Consumption Survey (Labadarios et al., 2005; Labadarios et al., 2008) show that 52% of South African households are food insecure (experience hunger) and live below the poverty line (living on less than R100 a month).

A recent South African study (Temple et al., 2011) found that the cost of healthy food items is far greater than the unhealthier options available. In addition, the same healthy items are considerably more expensive in areas where the poor reside (Temple et al.,

2009), thus making a healthy diet unaffordable to the majority of South Africans.

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Table1: **Characteristics of studies investigating the use of a Dietary Diversity Score**

No of groups	Food groups	Method and reference period	Study population	Country	Author	Findings
5	Bread/ grains, meat, vegetables, fruits, dairy	No. of food groups consumed during 1 week	Adults 60 + years	Botswana	Clausen et al., 2004	DDS associated with nutritional status
	5 main food groups (bread/ grains, meat, vegetables, fruits, dairy) with 23 sub-categories.	Weighted total consumed over 2 days	10 -18 years	Iran	Mirmiran et al., 2004	DDS associated with dietary adequacy
			18 + years		Azadbakht et al., 2005	
6	Starch staples, legumes/nuts, dairy, other animal source food, vitamin-A rich fruit & vegetables, other fruit & vegetables	No. of food groups consumed during 24hrs (at least 10g per group)	Women of reproductive age	Mali	Kennedy et al., 2009b	DDS associated with micronutrient adequacy
7	Grains/roots/tuber, milk, vitamin-A rich fruit/vegetables, other fruit/vegetables, meat/poultry/fish/cheese/eggs/yoghurt, legumes, fats/oils	No. of food groups consumed during 24hrs	Children 12-36 months	Ethiopia	Arimond & Ruel, 2002	DDS associated with height-for-age (HAZ) Z-score
	Starch staples, legumes, dairy, meat/poultry/fish/eggs, vitamin-A rich fruit & vegetables, other fruit & vegetables , foods made with oil/fat/butter	No. of food groups eaten on 3 or more days during the previous week	Children less than 2 years old	Benin, Cambodia, Colombia, Ethiopia, Haiti, Malawi, Nepal, Peru, Rwanda, Zimbabwe	Arimond & Ruel, 2004	DDS associated with height-for-age (HAZ) Z-score (except in Benin)
	Grains/roots/tubers, legumes/nuts, dairy, meat/fish/poultry/organs, eggs, vitamin A-rich fruit/vegetables, other fruit/vegetables	No. of food groups consumed	Children 6-23 months	Ghana, Madagascar, Malawi, India, Philippines, Bangladesh, Peru, Honduras, Brazil	FANTA, 2006	DDS associated with dietary quality (micronutrient density of foods and liquids other than breast milk)

	Yellow/orange fruit and vegetables, green leafy vegetables, meat, chicken, fish, eggs, pulses	Non-grain DDS = sum of days in a week the household consumed at least 1 item from each group	Household Intake	Bangladesh	Thorne-Lyman et al., 2010	DDS associated with food security and socio-economic status
8	Staples, vegetables, milk, meat, fish, eggs, fruit, green leaves	No. of food groups consumed over 2 - 3 days	Children less than 5 years old	Mali	Hatloy et al., 1998	DDS associated with nutrient adequacy
	Grains/roots/tubers, legumes/nuts, dairy, meat/fish/poultry/organs, eggs, vitamin A-rich fruit/vegetables, other fruit/vegetables, fats/oils	No. of food groups consumed	Children 6-23 months	Ghana, Madagascar, Malawi, India, Philippines, Bangladesh, Peru, Honduras, Brazil	FANTA, 2006	DDS associated with dietary quality (micronutrient density of foods and liquids other than breast milk)
	Breast milk, formula milk, dairy products, vegetable protein, non-milk animal protein, snacks and sweetened beverages, fruit and vegetables, complex carbohydrates	Percentage of maximum food diversity that occurred in one week	Children 6-24 months	South Africa	Mpontshane et al., 2008	Low dietary diversity associated with HIV infection
	Grains/roots/tubers, legumes and nuts, dairy products, meat/fish/poultry, eggs, vitamin A-rich fruit and vegetables, other fruit and vegetables, fats and oils	No. of food groups consumed during a 24 hour period	Children 6-18 months	Madagascar	Moursi et al., 2008	DDS associated with dietary quality (micronutrient density of foods and liquids)
9	Cereals/ roots/tubers, β-carotene rich fruit & vegetables, other fruit, other vegetables, legume/ pulses/nuts, meat/poultry/ fish, fats/oils, dairy, eggs	No. of food groups consumed during a 24 hour period	Children 1-9 years	South Africa	Steyn et al., 2006	DDS associated with dietary adequacy
			Children aged 24 months	Philippines	Daniels et al., 2009	
			16 years and older	South Africa	Labadarios et al., 2011	South Africans consume a diet low in dietary variety

			Children aged 10-12 years		Abrahams et al., 2011	Low DDS associated with children who do not carry a lunchbox to school
	Starch staples, legumes/nuts, dairy, organ meat, eggs, flesh food, vitamin-A rich dark leafy vegetables, other vitamin-A rich fruit & vegetables, other fruit & vegetables	No. of food groups consumed during 24 hours (at least 10g per group)	Women of reproductive age	Mali	Kennedy et al., 2009b	DDS associated with a range of micronutrient intakes
	Rice, lentils, green leafy vegetables, yellow/orange fruits, eggs, fish, chicken, meat other than chicken, milk other than breast milk	Sum of the number of days that each of the 9 food groups was consumed	Children 6-59 months	Bangladesh	Rah et al., 2010	Low DDS associated with stunting
10	Staples, vegetables, oil/sugar, fruit, nuts/pulses, meat, milk, fish, leaves/gathered food, eggs	Number of food groups consumed during the previous 24 hours period	Children 6-59 months	Mali	Hatloy et al., 2000	DDS associated with nutritional status
	Cereals/tubers, meat/poultry/ fish, dairy, eggs, pulses/nuts, vitamin-A rich fruit & vegetables, other fruit, other vegetables, oils/fats, other	Number of food groups consumed during a 24 hour period	Children 2-6 years	Philippines	Kennedy et al., 2007	DDS is a significant predictor of adequate micronutrient intake
11	Cereals, green leafy vegetables, other vegetables, pulses/nuts, roots/tubers, fats, fruits, legumes, milk/eggs, meat, sugar	3 day modified weighed intake	Children 24-48 months	Niger	Tarini et al., 1999	DDS correlated with height and weight indices
	Cereals, legumes, oil/sugar, fruit, vegetables, meat, milk, fish, eggs, green leaves, other	No. of food groups consumed during a 7 day period	Adults 15-45 years	Mali	Torheim et al., 2004	DDS associated with dietary adequacy
12	Cereals, starchy roots, green leafy vegetables, other vegetables,	No. of food groups consumed during one	Adult women	Vietnam	Ogle et al., 2001	DDS associated with nutrient adequacy

	fish/seafood, meat, eggs, nuts/legumes, fruit/juice, oils/fats, sauces, beverages/biscuits/sweets	week				
	Cereal/cereal products, meat/poultry/offal, eggs, roots/tubers, vegetables, fruit, pulses/legumes/nuts, dairy, oils/fats, sugar/honey, fish seafood, miscellaneous (spices, sweets)	No. of food groups consumed by the household during the previous 24 hours (1d-DDS) and previous week (7d-DDS)	Children aged 6-59 months	Somalia	Kennedy et al., 2009a	DDS an indicator of household food security
13	Starch staples, legumes/nuts, dairy, organ meat, eggs, small fish with bones, other flesh food, Vitamin-A rich dark leafy vegetables, other vitamin-A rich deep yellow/orange/ red vegetables, vitamin-A rich fruit, vitamin-C rich vegetables, Vitamin-C rich fruit, other fruit & vegetables	No. of food groups consumed during 24 hours (at least 10g per group)	Women of reproductive age	Mali	Kennedy et al., 2009b	DDS associated with a range of micronutrient intakes
14	Cereals, roots/tubers, pulses/ nuts, green leafy vegetables, other vegetables, fruit, sugar, meat/poultry/insects, eggs, fish/seafood, milk/ dairy products, fats/oils, condiments, drinks/ miscellaneous	Number of food groups consumed during the previous 24 hours	Children less than 5 years	Burkina Faso	Savy et al., 2005	DDS associated with nutritional status
21	Grains/grain products, other starchy staples, cooked dry beans & peas, soy beans and soy products, nuts/seeds, milk/yoghurt, cheese, organ meat, eggs, small fish with bones, large fish & seafood, beef/pork/veal/lamb/goat/game, chicken/duck/turkey/pigeon/guinea hen/birds, insects/grubs/snakes/rodent/small	No. of food groups consumed during 24 hours (at least 10g per group)	Women of reproductive age	Mali	Kennedy et al, 2009b	DDS associated with a range micronutrient intakes

	animals, vitamin-A rich dark leafy vegetables, other vitamin-A rich deep yellow/orange/ red vegetables, vitamin-A rich fruit, vitamin-C rich vegetables, vitamin-C rich fruit, other vegetables, other fruit					

Part C: Article

HealthKick: Evaluating the impact of a school-based intervention on the dietary adequacy of learners from low-income settings in the Western Cape Province, South Africa[3]

Article Abstract[4]

Background

HealthKick is a primary school-based nutrition and physical activity intervention programme which is taking place in disadvantaged primary schools in the Western Cape Province, South Africa. This paper reports on the impact of the intervention on the dietary adequacy of learners after intervening for 18 months.

Methods

The study design consisted of a quasi-experimental trial. Sixteen schools were selected and randomly allocated into intervention and control groups. At baseline (2009) 613 grade 4 learners were selected, and at follow-up (2010) 784 grade 5 learners were sampled. Learners sampled in 2009 were not automatically sampled in 2010. Measurement tools included a questionnaire assessing the learner's nutrition knowledge, attitudes and behaviour, an un-quantified 24-hr recall (portion sizes were excluded) and anthropometric measurements (height and weight). The data were used to generate a dietary diversity score (DDS), and meal score (MS). Dietary adequacy was defined as having a DDS≥4, while a DDS<4 corresponded to an inadequate diet in terms of dietary variety. Multiple correspondence analysis was used to develop a score

[3] BMC Public Health Journal recommends that Times New Roman 12, be used. For easier readability, Arial 12 font has been used with double line spacing.

[4] BMC Public Health Journal recommends an abstract of no more than 350 words. A slightly longer abstract has been included for the purpose of this dissertation.

for nutrition knowledge and self-efficacy. The determinants of dietary adequacy were identified using multiple logistic regression analysis.

Results

At baseline, the intervention schools had a higher median knowledge score (2.27 vs. 1.83), and fewer learners that consumed food from the school feeding programme (31.7% vs. 44.7%), than the control schools. Follow-up at the intervention schools showed a decrease in the median scores for knowledge (2.27 to 2.04), self-efficacy (2.68 to 2.44), and obesity z-scores (2.75 to 2.21), and an increase in the percentage of learners eating food shop purchases (44.3% to 52.9%) and having an adequate diet (77.1% to 88.8%). Follow-up at the control schools found an increase in the percentage of learners eating food shop purchases (48.7% to 64.9%) and having an adequate diet (77.2% to 86.9%), and a decrease in the percentage of learners consuming food from the NSNP (44.7% to 31.0%). Multivariate analysis found that the predictors of dietary adequacy were meal score, the school feeding programme, urban area and male gender.

Conclusions

Although positive behaviour changes as a result of the intervention can be seen, the percentage of learners having an adequate diet increased in both the intervention and control schools. In these schools, dietary adequacy appears to be largely reliant on socio-economic determinants. Successful interventions in low income settings need to take into account the fact that schools have many serious immediate priorities and health education for future good health may not be regarded as an urgent one.

Introduction[5]

South Africa is a country in the midst of a nutrition transition (Popkin, 1994). Due to the rapid increase in industrialization, urbanization and economic development (WHO, 2003), many South Africans have replaced their traditional low-fat, high carbohydrate, high fibre diets with diets that are high in energy and fat (especially saturated fat) and low in fibre (Bourne et al., 2002). Accompanying this shift toward a 'western' diet is a decrease in physical activity levels (Popkin, 1994). These changes have resulted in obesity levels increasing, while underweight and stunting still prevail (Bourne et al., 1994; Steyn et al., 1998).

While many South African adults are overweight or obese (Department of Health, 2007), underweight and overweight/obesity coexist in primary schools learners (Armstrong et al., 2006). The National Food Consumption Survey (NFCS) (Labadarios et al., 2005) reported that nearly one in five South African children between the age of one and nine years were stunted, and one in ten were underweight for age. In contrast, the survey also reported that 17.1% of the sample was either overweight or obese (Steyn et al., 2005).

The advice to eat a variety of foods is the first of eleven South African food-based dietary guidelines (Vorster et al., 2001). Consuming a diverse diet is associated with better dietary quality as well as increasing the probability of achieving the daily energy and nutrient requirements (Arimond & Ruel, 2004). Using a dietary diversity score

[5] BMC Public Health Journal recommends that the term Background be used. The term Introduction has been used for the purpose of this dissertation.

(DDS) based on the summation of food groups consumed during a reference period has been shown to successfully predict nutritional adequacy (Hatloy et al., 1998).

A nine group DDS was determined and validated against anthropometric measurements and the mean adequacy ratio (MAR) by Steyn et al. (2006), using data from the NFCS. Results from this study indicate that the consumption of fewer than four food groups is associated with food insecurity and micronutrient deficiency. In addition, dietary diversity was found to be strongly associated with indicators of child growth such as height-for-age and weight-for-age Z-scores.

A recent study (Labadarios et al., 2011) describes the South African diet as being low in dietary variety. This study found that almost 40% of South Africans 16 years or older consumed fewer than four of the nine food groups daily. The most commonly consumed food groups were cereal, chicken or fish and a vegetable that was a poor source of vitamin A. The most neglected groups were eggs, legumes and vitamin A-rich fruit and vegetables.

Due to the prevalence of undernutrition, overnutrition and nutrient deficiencies in South African children, interventions involving children are essential (Labadarios et al., 2005). In addition, no data are currently available that assess the dietary intake and nutritional status of primary school learners in South Africa. 'HealthKick' is a primary school-based nutrition and physical activity intervention programme (World Diabetes Foundation, 2010). The programme was designed to promote the adoption of healthy lifestyle behaviour by learners, their parents and teachers, with the aim of reducing diabetes risk factors in disadvantaged communities in the Western Cape Province, South Africa (Draper et al., 2010).

This paper reports on the dietary adequacy of learners at intervention and control schools before the HealthKick intervention (baseline study) and again 18 months after it was started (follow-up study). Furthermore, multivariate analysis will be used to determine the key variables affecting the dietary adequacy of primary school learners from low income settings in the Western Cape, before and after the intervention.

Methods

Study Sample

The study design consisted of a quasi-experimental trial, which involved control and intervention groups. A rural and an urban education district in the Western Cape province of South Africa were purposively selected from a total of seven districts. Eight of the poorest schools in each district were purposively selected. Each urban school was paired with a rural one and randomly categorized as intervention and control by pulling names from a hat. Schools were matched on geographical location, quintile allocation (a measure of socio-economic status) and number of learners enrolled. A pilot study consisting of 717 grade 4 learners was carried out in 2008. The pilot study formed part of the formative assessment (Abrahams et al., 2011).

In 2009, a sample of grade 4 learners was selected from the participating schools for baseline assessment. In 2010, 18 months after the intervention, a sample of grade 5 learners was selected in the same manner. In schools with only one class per grade, all learners were included. In schools with more than one class per grade, data were collected from the first 50-60 learners to return their completed consent forms. Learners

sampled in 2009 were not automatically sampled in 2010. This was based on the principle that this was a school grade four to six intervention and not aimed at specific individuals. All learners were given consent forms for parents and learners to complete. Data collection occurred during March and April of 2009 and during September and October of 2010. The study sample comprised 613 girls and boys between ages 9 to 12 years in 2009 and 784 learners aged 10 to 13 years in 2010.

Intervention

The HealthKick intervention was made up of a curriculum component and environmental changes as advocated by the World Health Organization (WHO) in their global strategy on diet and physical activity in the prevention of non-communicable diseases (WHO, 2009). The school-based interventions that were most successful consisted of a combination of family involvement, trained educators teaching a curriculum component, a supportive school environment and healthy foods available at school (Steyn et al., 2009).

In February 2010 all grade four to six educators teaching Life Orientation (a learning area which involves the study of the self in relation to others and to society) (Department of Education, 2003) were given a copy of the "HealthKick Curriculum" (Draper et al., 2010). This document was used to place the HealthKick goals into the existing school curriculum. These goals were (1) eat a variety of foods every day, (2) eat more different kinds of fruit and vegetables every day, (3) eat less fat and oily food, (4) eat less sugar and sweet foods, such as cakes, doughnuts, sweets, etc, (5) eat a regular healthy breakfast daily (6) bring healthy lunchboxes to school as a daily routine, (7) be more physically active during school time, and (8) be more physically active after

school (Draper et al., 2010).

The HealthKick Curriculum consisted of activity ideas and assessment possibilities that were grade specific and outcomes-based. In July 2010 all Life Orientation educators from intervention schools were invited to a workshop to discuss the content and use of the curriculum document. These educators were tasked with educating their learners about nutrition using the HealthKick Curriculum document.

The second part of the intervention consisted of creating a healthy school environment. Areas earmarked for change included food shops, lunchboxes, food served at special events, and creating a school vegetable garden. The intervention schools were provided with a series of booklets that provided a step-by-step guide to making the changes. Each school had to choose one or more areas in which to make changes. This method, known as action planning, formed part of an empowerment process whereby teachers were shown how to make changes according to the priorities identified by the school staff themselves. It was based on the method followed by Action Schools! BC (2010) and Centres for Disease Control and Prevention (2010). The action planning process was started in 2009, and schools were required to implement the changes they had decided on during 2010.

Knowledge, Attitudes and Behaviour

Learners completed a classroom-administered questionnaire assessing their nutrition knowledge, attitudes and behaviour (KAB). The questionnaire was developed by the research team, and was informed by questionnaires from the Pathways intervention study on American Indian school children (Stevens et al., 2003) as well as a recent study done in the Western Cape (Steyn et al., 2009; Mchiza, 2009). The English

questionnaires were translated into local first languages, Afrikaans and Xhosa. Each learner completed a questionnaire which was administered by trained fieldworkers in the learner's home language.

Dietary Intake

Dietary intake was determined by means of an un-quantified (portion sizes were excluded) 24-hour recall. Trained fieldworkers recorded what learners had eaten the previous day. Food consumed was recorded at (1) breakfast at home; (2) snack before school; (3) snack at first break: lunchbox; (4) snack at first break: vendor/ food shop; (5) meal from the National School Nutrition Programme (NSNP); (6) snack at second break: lunchbox; (7) snack at second break: vendor/ food shop; (8) snack on the way home, after school; (9) meal at lunch time (home, after care, friend); (10) snack during early afternoon; (11) snack during late afternoon; (12) meal at supper time at home/friend; and (13) snack after supper.

For the purpose of this study, 'lunchbox' referred to any food item brought from home and consumed during first and/or second break at school; 'food shop' referred to a small, food-selling retailer operating on school premises, also known as a tuck shop in South Africa; 'NSNP' referred to a government-funded nutrition programme that provides food to learners at lunch time.

Anthropometry

Height and weight of each learner were measured by trained fieldworkers. Learners were weighed (in kg to the nearest 0.01 kg) without shoes and jerseys using a digital scale. Height was measured (in cm to the nearest 0.1 cm) using a stadiometer which

was placed on an even surface. Learners stood on its base without shoes, with heels together, looking straight ahead. The same measurement protocol was used for all learners. The anthropometric measurements were used to generate Z-scores (a measure of the distance in standard deviations of a sample from the mean) using SAS 9.1 (SAS Institute Inc., Cary, NC, USA).

Ethical Approval

The study proposal was submitted and approved by the Research Ethics Committee in the Faculty of Health Sciences, University of Cape Town (REF: 486/2005) (attached in the Appendix). Approval for the research was obtained from the Western Cape Education Department. Parents gave written informed consent for their children to participate. All information was confidential and subjects were not identified by name.

Data Analysis

Data analysis was carried out using the STATA/SE statistical software package version 11.0 (StataCorp, College Station, TX, USA). The 2009 (baseline study) and 2010 (follow-up study) datasets were analysed separately.

Data from the 24-hr recall were used to generate a Dietary Diversity Score (DDS) and a Meal Score (MS). The DDS was defined as the number of food groups consumed during a 24-hr period (Hatloy et al., 1998; Kennedy & Nantel, 2006) with 9 reflecting the greatest variety. The food groups were classified according to recommendations by the Food and Agriculture Organisation of the United States (FAO) (Hatloy et al.,1998): (1) cereals, roots, tubers; (2) vitamin A-rich fruit and vegetables; (3) other fruits; (4) other

vegetables; (5) legumes, pulses, nuts; (6) oils and fats; (7) meat, poultry, fish; (8) dairy; and (9) eggs. DDS were used to generate a binary variable identifying dietary adequacy (Steyn et al., 2006), where a DDS≥4 identified learners that were consuming an adequate diet while learners with a DDS<4 were consuming an inadequate diet.

The MS identifies the number of meals eaten during a 24-hr period, with 6 meals reflecting the highest score. Breakfast referred to food consumed before school, while the second meal, morning snack, referred to food eaten at first break. Lunch included food eaten at second break, on the way home from school or on arrival at home. Afternoon snack referred to food eaten in the afternoon. The fifth meal was supper/dinner and evening snack referred to food eaten after supper.

A variable called housing density was generated (number of people / number of rooms in home) and used as a proxy for socio-economic status.

Multiple correspondence analyses were used to develop a score measuring learners' nutrition knowledge and self-efficacy. The Burt matrix approach (Greenacre, 1988) was used and the percentage of variability in the first two dimensions of each score was assessed. Questions that contributed very little to the variability were dropped from the model. Scores were generated for nutritional knowledge (knowledge score) and nutritional self-efficacy (self-efficacy score) (Schwarzer & Renner, 2000) using the 'predict' function. Fifteen nutrition knowledge questions and 11 questions about self-efficacy vs. barriers to nutrition from the KAB were included in the knowledge and self-efficacy scores.

Multiple logistic regression analyses were used to model the effect of several predictor variables on the binary response variable – dietary adequacy (DDS≥4).

Shapiro-Wilk tests were used to assess whether the sample came from a normally distributed population. Means and standard deviations were used to report data from a normally distributed population, while medians and inter-quartile ranges were reported for variables that were from a non-normally distributed population. Binary variables were reported using percentages.

Results

With respect to the first objective, **Table 1** demonstrates differences in the baseline characteristics of the intervention and control schools. The only statistically significant differences between intervention and control schools at baseline were with respect to the knowledge score and the percentage of children that consumed food from the school feeding programme (NSNP). The median knowledge score was higher in the intervention schools than in the control schools (2.27 vs. 1.83) while a greater percentage of learners in the control schools ate food provided by the NSNP than in the intervention schools (44.7% vs. 31.7%). There were no significant differences in anthropometry.

The differences between control and intervention schools at follow-up (2010) are shown in **Table 2.** The knowledge score and percentage of learners consuming foods from the NSNP were no longer significantly different. Statistically significant differences between intervention and control schools can be seen in the self-efficacy score, housing density, and food shop behaviour in 2010. Learners from the intervention schools had a higher median score for housing density (2.5 vs. 2.25), a lower median self-efficacy score (2.44 vs. 2.66), with fewer learners purchasing items from the food shop (52.9% vs. 64.9%), than learners from the control schools.

Table 3 shows how the results of the intervention and control schools changed from baseline to follow-up. In the intervention schools, statistically significant differences between 2009 and 2010 can be seen for knowledge score, self-efficacy score, obesity levels, food shop behaviour and dietary adequacy. At follow-up, median scores showed a decrease in knowledge (2.27 to 2.04) and self-efficacy (2.68 to 2.44), as well as obesity z-scores (2.75 to 2.21). An increase is shown in the percentage of learners eating food shop purchases (44.3% to 52.9%) and having an adequate diet (77.1% to 88.8%).

In the control schools, statistically significant differences between 2009 and 2010 can be seen for food shop behaviour, geographical area and dietary adequacy, in addition to the percentage of learners consuming food from the NSNP. At follow-up, the percentage of learners eating food shop purchases (48.7% to 64.9%) and having an adequate diet (77.2% to 86.9%) increased, while a reduction in the percentage of learners consuming food from the NSNP (44.7% to 31.0%) was noted in the control schools.

The percentage learners in the intervention and control schools consuming different food groups can be seen in **Table 4a**. In 2009, the only statistically significant difference between intervention and control schools was in the intake of oils and fats. A larger percentage of learners at the intervention schools consumed items from the fats and oils group compared to the control schools (76.7% vs. 64.7%). At follow-up, statistically significant differences can be seen between intervention and control schools in the percentage of learners that consumed vitamin A-rich fruit and vegetables, other fruits as well as the fats and oils group. A greater percentage of learners from the intervention

schools compared to the control schools consumed vitamin A-rich fruit and vegetables (32.3% vs. 24.9%), other fruits (28.4% vs. 21%), and fats and oils (89.3% vs. 81.3%), at follow-up. The difference in the fats and oils group between intervention and control schools was statistically significant at baseline and at follow-up.

Table 4b shows that both intervention and control schools showed an increase in the percentage of learners that consumed vitamin A-rich fruit and vegetables, other vegetables, meat/poultry/fish, fats and oils and eggs. However, a bigger increase was seen in the intervention group with respect to vitamin A-rich fruit and vegetables (15.8% vs. 8.4%), compared to the control group. The change in the percentage of learners consuming eggs was the same in the intervention and control schools (4.4%). The control group showed a bigger increase in the percentage of learners consuming meat/poultry/fish (9.8% vs. 6.5%) and fats and oils (16.6% vs. 12.6%), compared to the intervention group.

Three groups showed an increase in the intervention group and a decrease in the control group; other fruits (10.1% increase vs. -0.4%), other vegetables (7.2% increase vs. -0.2%), and legumes/pulses/nuts (1.2% increase vs. -11.2%). The percentage of learners consuming dairy products increased in the control group (by 12.3%) and decreased in the intervention group (by 1.1%).

With respect to the second objective, **Table 5** shows differences in the characteristics of learners by dietary adequacy at baseline (2009) and at follow-up (2010). At baseline, meal score, consuming breakfast and food from the NSNP are statistically significant. Those with an adequate diet (DDS≥4) had a higher mean meal score (4.53 vs. 3.99), a greater percentage of children that ate breakfast (97.5% vs. 90.7%) and consumed food

from the NSNP (42.3% vs. 28.6%), than those with an inadequate diet (DDS<4). At follow-up (2010), meal score, breakfast and consuming food from the NSNP were still statistically significant, with the addition of gender. Those consuming an adequate diet, had a significantly higher mean meal score (4.46 vs. 3.9), a greater percentage of learners that ate breakfast (95.5% vs. 87.2%), and consumed food from the NSNP (36.3% vs. 17%) and more girls than boys (55.3% vs. 42.9%), compared to those with an inadequate diet

The results of multiple logistic regression analysis using dietary adequacy (DDS≥4) as the outcome variable can be seen in **Table 6**. In 2009, the significant independent variables were meal score (odds ratio (OR) = 2.5; 95% confidence interval (CI) = 1.92-3.32), feeding programme at school (OR = 2.2; CI = 1.45-3.47) and urban area (OR = 1.5; CI = 1.01-2.28). In 2010, meal score and feeding programme at school were still significant predictors, but urban area was replaced by male gender (OR = 0.5; CI = 0.33-0.84). For both years, every additional meal eaten and consuming food from the feeding programme increased the relative odds of consuming an adequate diet. Furthermore, in 2009 learners residing in an urban area had better relative odds of consuming an adequate diet, while in 2010 girls had better odds of consuming an adequate diet.

Discussion

Nutrition interventions using a school setting are aimed at changing children's knowledge, attitudes, behaviour and nutritional status. Consistent improvements have

been found in nearly all school intervention studies recently evaluated (WHO, 2009; Steyn et al., 2009). The most successful interventions have included a curriculum component which was taught by trained educators, a supportive school environment, parental or family involvement, and healthy foods provided at school. The HealthKick programme is based on these principles (Steyn et al., 2009; Draper et al., 2010). This study has evaluated the effect that 18 months of the HealthKick intervention had on learners' dietary diversity as a proxy for dietary adequacy.

Findings show that at baseline, intervention and control schools were much the same except for significant differences in nutrition knowledge and the percentage of learners consuming food from the National School Nutrition Programme. However, contrary to expectation, the median knowledge score which was significantly higher in the intervention schools at baseline was no longer significantly different at follow-up. Of greater concern is the apparent decrease in median knowledge scores in both the intervention and the control schools' scores. Moreover, if we compare how the median knowledge scores changed from baseline measurement to follow-up, it is notable that a greater decrease occurred in the intervention schools.

There are three possible explanations for the decline in knowledge scores. The first being a real decrease occurred, which implies that education resulted in a 'loss' of knowledge. Since this is counter-intuitive, a more likely explanation is that the method was flawed. Factors in the selection and testing of the subjects and/or the tools used may have caused the knowledge scores to decrease. Since the 2010 sample did not include all the same learners as the 2009 sample, it's possible that nutrition knowledge within the samples differed as a result of random sampling error. The same hypothesis

may well apply to the self-efficacy scores that decreased in the intervention schools and increased in the control schools. Given that the knowledge and self-efficacy scores were derived from the same KAB questionnaire, this hypothesis is plausible, indicating that the results obtained may be spurious despite all efforts to obtain reliable data. Another possible explanation may be that due to the shortness of the intervention, a 'learning effect' may have taken place in the control schools. However the most likely reason is the fact that 18 months of intervention was not long enough to cause sufficient improvement in outcomes like knowledge and self-efficacy, and possibly anthropometry (BMI-for-age) as well. This will remain unknown until the third year of intervention has taken place and been evaluated.

The findings show that both the intervention and control schools experienced an increase in the number of learners purchasing items from the school food shop. Findings further show that the increase reported in the control schools was nearly double the increase in the intervention schools. This finding suggests that the healthy alternatives currently being sold at the intervention schools may not be as popular as the unhealthier items sold in the control schools. Alternatively, the cost of buying a healthy item may be greater than that of the unhealthier ones, resulting in fewer learners at the intervention schools being able to purchase from the food shop. A recent study (Abrahams et al., 2011) in the same schools but a different sample of learners, found that learners from poorer households could not afford to take a lunchbox containing healthy food items to school, but could afford to buy low cost energy-dense food items like chips/crisps and sweets available at the school food shop. In addition, studies in South Africa (Temple & Steyn, 2009; Temple et al., 2010) have found that

food is more expensive in areas where the poor reside and that unhealthy foods are easily available and considerably less expensive than the healthier alternatives.

The most positive finding of this study was in the dietary adequacy of learners. Both intervention and control schools showed a significant increase in the percentage of learners achieving an adequate diet. However, the increase was greater in the intervention schools. On closer inspection one can see an increase in the percentage of learners at intervention schools consuming items from all the food groups, except dairy. These schools showed a much bigger increase in the group's vitamin A-rich fruit and vegetables, other fruit and other vegetables, compared to control schools. Furthermore, a smaller increase in fat consumption was found in intervention schools compared to control schools. After cereals, the most commonly consumed food groups were meat, fats and oils, and eggs in both intervention and control schools. The consumption of other fruits and legumes decreased in the control schools. These positive behaviour changes are a clear sign of effective intervention.

Unlike results from a study looking at dietary diversity in adults (Labadarios et al., 2011), this study showed very low dairy consumption (12% compared to 56% reported for adults in a national study). A possible explanation for the difference could be that adults are more likely to drink milk in their tea or coffee. Alternatively, it's simply due to poverty since learners reported that they often drank tea and coffee without milk, and rarely consumed milk with cereal.

The consumption of eggs was much higher in this study (67%) than the 18% in the adult population (Labadarios et al., 2011). This may be explained by the fact that egg sandwiches are regularly found in school lunchboxes. It's interesting to note that both

studies showed a high intake of a food group containing animal protein and that the consumption of either group resulted in increased protein intake.

Significant predictors of dietary adequacy identified in this study were meal score, having consumed food from the school feeding programme (NSNP), and living in an urban area. These predictors are all related to socio-economic status, which supports results from other studies (Paulik et al., 2010; Williams et al., 2011) which found that individuals living in low income households often experience poor nutrition. In addition, Bonti-Ankomah (2001) found that many South Africans living in rural areas were food insecure (lacking access to adequate, nutritious and safe food).

Overall the results of the study were rather disappointing. This is one of very few school-based intervention studies undertaken in Southern Africa in an attempt to deal with the risk factors for non-communicable diseases (NCD), especially type-2 diabetes. Results from the formative assessment (Draper et al., 2010)], as well as subjective feedback from the researchers working on the program (unpublished observations), may explain the less than expected favourable outcomes. Most of the underlying causes relate to social problems in the school and communities. Poverty results in crime, violence, alcohol and drug addiction, child abuse and other related problems. Teachers have to deal with these problems every day and many have become immune to health concerns which are not immediately dangerous or threatening. This has resulted in a degree of apathy and lack of concern about prevention of less important health problems, even though they do acknowledge that the intervention addresses important health issues. For many the most important issue is for a child to have a full tummy as cheaply as possible and it may not be feasible or realistic to advocate for

healthier foods which cost more and are less filling. In addition, one need bear in mind that children armed with the knowledge needed to make positive behaviour changes are helpless when they are food insecure.

This study also suggests that health educators have to find new ways of addressing NCD prevention in Africa. It appears that the models which have proven to be successful in the USA and Europe are not necessarily going to work in Africa; or else the major issues around poverty need to be addressed first before striving to introduce NCD prevention at school level. It also needs to be stressed that the HealthKick intervention was not an intensive one, or a one-on-one type of intervention, but one that was developed for sustainability and low cost. This was done to enable any school to adopt the intervention. Most of the work required to run it is the responsibility of the school, and specifically the teachers.

Conclusions

After only 18 months of a three year intervention programme, learners have displayed some positive behaviour changes, although their nutrition knowledge and self-efficacy did not improve. In addition, the percentage of learners achieving an adequate diet increased in both the intervention and control schools. However, dietary adequacy is largely reliant on socio-economic determinants. For a nutrition intervention in a low income setting to make any real change, education needs to be accompanied by measures aimed at decreasing food insecurity and at other major social issues.

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Table 1: **Characteristics of learners at intervention and control schools at the baseline study (2009)**

	Intervention (n 262)		Control (n 351)		Total (n 613)	
	%	***Median (IQR)***	***%***	***Median (IQR)***	***Median (IQR)***	***P****
Knowledge score		2.27 [1.41-2.83]		1.83 [1.17-2.53]	2.06 [1.27-2.75]	**0.001**
Self-efficacy score		2.68 [1.96-3.30]		2.57 [1.79-3.30]	2.63 [1.86-3.30]	0.461
Housing density		2.5 [2.0-3.0]		2.33 [1.57-3.50]	2.5 [1.67-3.00]	0.781
Meal score		4.46 ± 0.83**		4.37 ± 0.82**	4.40 ± 0.82**	0.161
BMI-for-age		-0.10 [-0.74-0.68]		-0.21 [-0.80-0.56]	-0.16 [-0.78-0.58]	0.200
Underweight (z-score =≤ -2SD)	3.8	-2.22 [-2.29-(-2.10)]	2.8	-2.24 [-2.71-(-2.11)]	-2.22 [-2.54-(-2.11)]	0.388
Overweight (z-score ≥1 - <2SD)	10.3	1.32 [1.20-1.58]	10.8	1.56 [1.30-1.37]	1.43 [1.25-1.62]	0.995
Obese (z-score ≥ 2SD)	6.5	2.75 [2.33-3.17]	4.0	2.78 [2.46-3.27]	2.75 [2.33-3.27]	0.139
		%		***%***	***%***	
Gender is male		43.5		47.0	45.5	0.390
School in urban area		52.7		46.7	49.3	0.145
Breakfast eaten		95.4		96.3	95.9	0.587
Food shop utilized		44.3		48.7	46.8	0.275
Feeding programme at schools		31.7		44.7	39.2	**0.001**
Diet is adequate (DDS≥4)		77.1		77.2	77.2	0.975

IQR = Inter-quartile range
** P-values from t-tests*
***mean ± standard deviation reported (data normally distributed)*

Table 2: Characteristics of learners at intervention and control schools 18 months after the intervention (2010)

	Intervention (n 262)		Control (n 351)		Total (n 613)	
	%	***Median (IQR)***	***%***	***Median (IQR)***	***Median (IQR)***	***P****
Knowledge Score		2.04 [1.30-2.75]		1.80 [1.14-2.69]	1.87 [1.17-2.71]	0.105
Self-efficacy Score		2.44 [1.41-3.07]		2.66 [1.74-3.40]	2.53 [1.60-3.26]	**0.001**
Housing Density		2.50 [2.00-3.50]		2.25 [1.67-3.00]	2.50 [1.67-3.00]	**0.043**
Meal Score		4.40 ± 0.83**		4.40 ± 0.92**	4.40 ± 0.88**	0.215
BMI-for-age		-0.14 [-0.84-0.66]		0.01 [-0.84-0.74]	-0.55 [-0.84-0.69]	0.288
Underweight (z-score ≤ -2SD)	5.7	-2.28 [-2.58-(-2.06)]	3.3	-2.35 [-2.63-(-2.11)]	-2.33 [-2.59-(-2.06)]	0.061
Overweight (z-score ≥1 - <2SD)	10.1	1.36 [1.20-1.62]	12.6	1.36 [1.20-1.64]	1.36 [1.20-1.63]	0.757
Obese (z-score ≥ 2SD)	6.5	2.21 [2.13-2.48]	5.9	2.67 [2.30-2.97]	2.43 [2.14-2.88]]	0.189
		%		***%***	***%***	
Gender is male		46.1		42.8	44.4	0.360
School in urban area		55.7		55.6	55.7	0.980
Breakfast eaten		95.8		94.9	95.4	0.525
Food shop utilized		52.9		64.9	58.9	**0.001**
Feeding programme at schools		37.0		31.0	34.0	0.080
Diet is adequate (DDS≥4)		88.8		86.9	87.9	0.424

IQR = Inter-quartile range
** P-values from t-tests*
***mean ± standard deviation reported (data normally distributed)*

Table 3: Changes in characteristics of intervention and control schools from 2009 to 2010

	Intervention				Control			
	2009	2010	Size and direction of change		2009	2010	Size and direction of change	
	Median (IQR)	***Median (IQR)***		***P****	***Median (IQR)***	***Median (IQR)***		***P****
Knowledge score	2.27 [1.41-2.83]	2.04 [1.30-2.75]	↓ 0.23	**0.043**	1.83 [1.17-2.53]	1.80 [1.14-2.69]	↓ 0.03	0.784
Self-efficacy score	2.68 [1.96-3.30]	2.44 [1.41-3.07]	↓ 0.24	**0.001**	2.57 [1.79-3.30]	2.66 [1.74-3.40]	↑ 0.9	0.491
Housing density	2.5 [2.00-3.00]	2.50 [2.00-3.50]	N/C	0.622	2.33 [1.57-3.50]	2.25 [1.67-3.00]	↓ 0.08	0.145
Meal score	4.46 ± 0.83**	4.40 ± 0.83**	↓ 0.06	0.436	4.37 ± 0.82**	4.39 ± 0.92**	↑ 0.02	0.699
BMI-for-age	-0.10 [-0.74-0.68]	-0.14 [-0.84-0.67]	↓ 0.04	0.324	-0.21 [-0.80-0.56]	0.01 [-0.84-0.74]	↓ 0.2	0.166
Underweight (z-score ≤-2SD)	-2.22 [-2.29-(-2.10)]	-2.28 [-2.58-(-2.06)]	↓ 0.06	0.320	-2.24 [-2.71-(-2.11)]	-2.35 [-2.63-(-2.11)]	↓ 0.11	0.723
Overweight (z-score ≥1 - <2SD)	1.32 [1.20-1.58]	1.36 [1.20-1.62]	↑ 0.04	0.828	1.56 [1.30-1.67]	1.36 [1.20-1.64]	↓ 0.2	0.148
Obese (z-score ≥ 2SD)	2.75 [2.33-3.17]	2.21 [2.13-2.48]	↓ 0.54	**0.017**	2.78 [2.46-3.27]	2.67 [2.30-2.97]	↓ 0.11	0.277
	%	***%***	***%***		***%***	***%***	%	
Gender is male	43.5	46.1	↑ 2.6	0.518	47.0	42.8	↓ 4.2	0.253
School in urban area	52.7	55.7	↑ 3.0	0.589	46.7	55.6	↑ 8.9	**0.015**
Breakfast eaten	95.4	95.8	↑ 0.4	0.802	96.3	94.9	↓ 1.4	0.345
Food shop utilized	44.3	52.9	↑ 8.6	**0.032**	48.7	64.9	↑ 16.2	**0.001**
Feeding programme at schools	31.7	37.0	↑ 5.3	0.163	44.7	31.0	↓ 13.7	**0.001**
Diet is adequate (DDS≥4)	77.1	88.8	↑ 11.7	**0.001**	77.2	86.9	↑ 9.7	**0.001**

IQR = Inter-quartile range
N/C = no change
↑ = increase; ↓ = decrease
** P-values from t-tests*
***mean ± standard deviation reported (data normally distributed)*

Table 4a: Percentage of learners consuming selected food groups comparing intervention and control schools in Baseline and Follow-up studies

Food groups studied	2009 Baseline study			2010 Follow-up study		
	Intervention schools	Control schools	P*	Intervention schools	Control schools	P*
Cereals, roots, tubers	100	100		100	100	
Vitamin A-rich fruit & vegetables	16.5	16.5	0.971	32.3	24.9	**0.022**
Other fruits	18.3	21.4	0.351	28.4	21.0	**0.018**
Other vegetables	18.3	24.2	0.080	25.5	24.4	0.709
Legumes, pulses, nuts	48.5	55.8	0.071	49.7	44.6	0.153
Meat, poultry, fish	87.8	93.8	0.162	94.3	93.6	0.692
Oils and fats	76.7	64.7	**0.001**	89.3	81.3	**0.002**
Dairy	14.1	10.5	0.178	13.0	12.8	0.934
Eggs	61.5	65.2	0.334	65.9	69.5	0.284

** P-values from t-tests*
↑ = increase; ↓ = decrease

Table 4b: Size and direction of change in the percentage of learners consuming selected food groups comparing the Baseline study to Follow-up study in intervention and control schools

Food groups studied	Intervention Schools			Control Schools		
	2009 Baseline Study	2010 Follow-up Study	Size and direction of change	2009 Baseline Study	2010 Follow-up Study	Size and direction of change
Cereals, roots, tubers	100	100		100	100	
Vitamin A-rich fruit & vegetables	16.5	32.3	↑ 15.8	16.5	24.9	↑ 8.4
Other fruits	18.3	28.4	↑ 10.1	21.4	21.0	↓ 0.4
Other vegetables	18.3	25.5	↑ 7.2	24.2	24.4	↑ 0.2
Legumes, pulses, nuts	48.5	49.7	↑ 1.2	55.8	44.6	↓ 11.2
Meat, poultry, fish	87.8	94.3	↑ 6.5	93.8	93.6	↑ 9.8
Oils and fats	76.7	89.3	↑ 12.6	64.7	81.3	↑ 16.6
Dairy	14.1	13.0	↓ 1.1	10.5	12.8	↑ 12.3
Eggs	61.5	65.2	↑ 4.4	65.9	69.5	↑ 4.4

↑ = increase; ↓ = decrease

Table 5: Characteristics of learners in 2009 and 2010 by dietary adequacy (defined by a dietary diversity score of ≥ 4)

		Adequate Diet (DDS≥4) n 473		Inadequate Diet (DDS<4) n 140		Total n 613	
		%	***Median (IQR)***	**%**	***Median (IQR)***	***Median (IQR)***	***P****
2009	Knowledge score		2.01 [1.26-2.68]		2.21 [1.29-2.78]	2.06 [1.27-2.75]	0.206
	Self-efficacy score		2.67 [1.87-3.30]		2.54 [1.79-3.19]	2.63 [1.86-3.30]	0.440
	Housing density		2.33 [1.67-3.00]		2.50 [1.75-3.50]	2.50 [1.67-3.00]	0.078
	Meal score		4.53 ± 0.78**		3.99 ± 0.85**	4.41 ± 0.82**	**0.001**
	BMI-for-age		-0.12 [-0.75-0.60]		-0.29 [-0.86-0.49]	-0.16 [-0.78-0.58]	0.328
	Underweight (z-score =≤ -2SD)	2.7	-2.24 [-2.32-(-2.11)]	5.0	-2.19 [-2.69-(-2.10)]	-2.22 [-2.54-(-2.11)]	0.220
	Overweight (z-score ≥1 - <2SD)	10.8	1.43 [1.25-1.67]	10.0	1.47 [1.19-1.61]	1.43 [1.25-1.62]	0.199
	Obese (z-score ≥ 2SD)	5.3	2.74 [2.33-3.11]	4.3	3.00 [2.60-3.42]	2.75 [2.33-3.27]	0.181
			%		**%**	**%**	
	Gender is male		56.0		49.3	54.5	0.160
	School in urban area		50.0		45.0	49.3	0.250
	Breakfast eaten		97.5		90.7	95.9	**0.001**
	Food shop utilized		48.0		42.9	46.8	0.285
	Feeding programme at schools		42.3		28.6	39.2	**0.004**
			n 680		n 94	n 774	
		%	***Median (IQR)***	**%**	***Median (IQR)***	***Median (IQR)***	
2010	Knowledge score		1.88 [1.17-2.69]		1.85 [1.15-2.88]	1.88 [1.17-2.71]	0.622
	Self-efficacy score		2.53 [1.57-3.26]		2.49 [1.65-3.17]	2.53 [1.60-3.26]	0.925
	Housing density		2.50 [1.71-3.33]		2.00 [1.67-3.00]	2.50 [1.67-3.00]	0.759
	Meal score		4.46 ± 0.85**		3.90 ± 0.90**	4.39 ± 0.88**	**0.001**
	BMI-for-age		-0.07 [-2.61 -(-2.06)]		0.01 [-1.03-0.69]	-0.06 [-0.84-0.69]	0.741
	Underweight (z-score ≤ -2SD)	3.4	-2.35 [-2.61-(-2.06)]	8.5	-2.14 [-2.39-(-2.06)]	-2.33 [-2.59-(-2.06)]	0.974
	Overweight (z-score ≥1 - <2SD)	11.6	1.36 [1.20-1.66]	9.6	1.43 [1.25-1.48]	1.36 [1.20-1.63]	0.921

Obese (z-score ≥ 2SD)	6.0	2.38 [2.14-2.89]	7.4	2.48 [2.10-2.81]	2.43 [2.14-2.88]	0.115
		%		%	%	
Gender is male		42.9		55.3	44.4	**0.024**
School in urban area		54.7		62.8	55.7	0.140
Breakfast eaten		96.5		87.2	95.4	**0.001**
Food shop utilized		59.6		54.3	58.9	0.327
Feeding programme at schools		36.3		17.0	34.0	**0.001**

IQR = Inter-quartile range
** P-values from t-tests*
***mean ± standard deviation reported (data normally distributed)*

Table 6: Multivariate analysis of independent determinants of dietary adequacy (Adequate: DDS≥4; Inadequate: DDS<4)

		ODDS RATIO	P	95% CI
2009	Meal score	2.53	0.001	1.92 – 3.32
	Feeding programme at schools	2.24	0.001	1.45 – 3.47
	Urban area	1.52	0.045	1.01 – 2.28
2010	Meal Score	2.30	0.001	1.74 – 3.03
	Feeding programme at schools	3.97	0.001	2.19 – 7.19
	Gender is male	0.53	0.007	0.33 – 0.84

CI = Confidence Interval
Meal score = the number of meals eaten during a 24-hr period, with 6 meals reflecting the highest score

Part D: Appendices

APPENDIX 1

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E53-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
e-mail: [illegible]

20 December 2005

REC REF: 486/2005

Prof EV Lambert
Human Biology
Sports Science Institute

Dear Prof Lambert

PROJECT TITLE: SCHOOL-BASED INTERVENTIONS TO REDUCE RISK FACTORS FOR CHRONIC DISEASES OF LIFESTYLE
PHASE 1: HEALTHY EATING, PHYSICAL ACTIVITY AND TOBACCO CONTROL: DETERMINANTS AND BARRIERS STUDY

Thank you for submitting your study to the Research Ethics Committee for review.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study on the 20 December 2005.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR [illegible]
CHAIRPERSON, HSF HUMAN ETHICS

APPENDIX 2

Navrae
Enquiries
IMibuzo **Dr RS Cornelissen**

Telefoon
Telephone
IFoni **(021) 467-2286**

Faks
Fax
IFeksi **(021) 425-7445**

Verwysing
Reference
ISalathiso **20061121-0044**

Wes-Kaap Onderwysdepartement

Western Cape Education Department

ISebe leMfundo leNtshona Koloni

Dr Nelia Steyn
Medical Research Council
Francie Van Zijl Drive
PAROW VALLEY
7505

Dear Dr N. Steyn

RESEARCH PROPOSAL: A SCHOOL-BASED INTERVENTION PROGRAM TO REDUCE DIABETES RISK FACTORS IN DISADVANTAGED COMMUNITIES OF SOUTH AFRICA.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The first phase of the study is to be conducted from **1st May 2008 to 26th September 2008**.
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr R. Cornelissen at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the Principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as submitted to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Education Research.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Education Research
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.

Signed: Ronald S. Cornelissen
for: **HEAD: EDUCATION**
DATE: 29th April 2008

APPENDIX 3

HealthKick Consent Form

Dear parent/guardian

As you may know, the Medical Research Council, in partnership with the Universities of Cape Town and the Western Cape, is involved in developing a school-based programme to help learners, teachers and parents improve their lifestyles. This programme is known as HealthKick, and is sponsored by the World Diabetes Foundation. To understand the needs of our learners and teachers, and whether or not the programme is working, we are interested in finding out how learners feel and what they know about healthy eating and physical activity.
We are asking your permission to obtain the following information from your child in Grade 4:

- Weight and height measurements. They will only have to take off their shoes.
- Answer various questions about his/her eating pattern and physical activity. These will be done in the class under supervision of the teacher and researchers.
- We also want to know how fit learners are. Therefore, we are inviting them to participate in youth fitness measurement.

The people who do the measurements (fieldworkers) are very well trained and your child will not be harmed at all. The fitness measurements include: a 5-metre shuttle run, sit-ups performed in 30 seconds, a standing long jump and sit and reach seated stretching. These will not take longer then 30 minutes to complete. All the measurements will be repeated at the end of the school year, for those children willing to participate.

This study was approved by the Ethics Committee of the University of Cape Town, which makes sure that the research is acceptable, that there is no or minimal risk for any participating child and that nobody is forced to take part in a study. All information obtained will be processed confidentially without revealing any child's identity.

Consent: All children must have written permission from parents/caregivers before they can participate in this study. If you are willing to give your permission, please complete the information on the back of this page. We will also ask your child to indicate if he/she is willing to participate. Your child will be given feedback on the fitness levels and receive a small token of appreciation for completing the measurements. If you and your child decide that he/she will participate in the study, you will be free to withdraw at any time, it does not matter what the reason is. This will not count against you or your child in any way.

Thank you

Parental consent to participate:

Please sign below if you consent for your child to participate in the study.

I ……..…… (name of parent or legal guardian) give informed consent on behalf of my child ……(name of the child) to participate in this study concerning a school-based programme focused on healthy eating and physical activity and youth fitness measurements, described above. I have read and fully understand the information about the study.

Be informed that your child is free to withdraw at any time from the study, and not undergo any measurements whatsoever, without prejudice, if he or she should wish to do so.

…….

Signature of Parent or guardian **DATE:**

……..

Witness **DATE:**

Assent to participate (child):

I …… (name of child) agree that I understand what is being asked of me, to participate in this research study. I understand that I will be asked to participate in some fitness measurements including: running, jumping, sit-ups, and stretching). I understand that I can stop participating at any stage simply by saying that I would no longer like to be in the research study. This is entirely my choice, and whatever I decide is fine, and my school, my parents, my teachers, and the helpers will respect my decision.

……

Signature of child **DATE:**

APPENDIX 4

HealthKick

Questionnaire for Learners

Date					2	0	1	0
What is your name and surname?	
Are you a girl/boy	girl	boy

How old are you today? _____

Grade 5

School: _____

L-IDcode					

Tell us about yourself and your family!

1. How many people are there living in your home, including you?

Fill in the number of people: ☐

2. How many rooms do you have in your home for sleeping?

Fill in the number of rooms: ☐

3. Which of these do you have at home?

3.1 Television	**YES**	**NO**
3.2 Computer	**YES**	**NO**
3.3 Ordinary phone	**YES**	**NO**
3.4 Radio	**YES**	**NO**

4. Do you have a car that can be driven at your home? **YES** **NO**

5. Which of these are used for cooking at your home?

5.1 Fridge	**YES**	**NO**
5.2 Microwave	**YES**	**NO**
5.3 Two-plate burner	**YES**	**NO**
5.4 Stove with oven	**YES**	**NO**

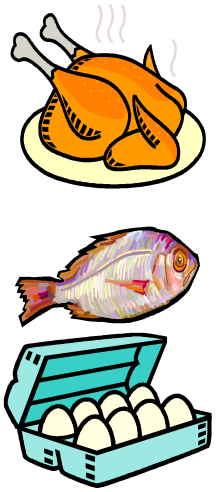
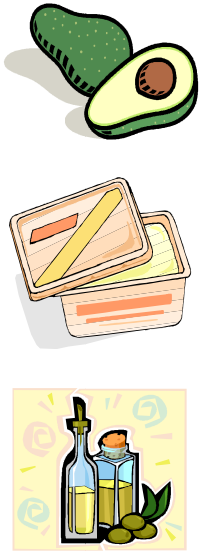
6. Does your family ever grow vegetables at home? **YES** **NO**

7. Which language is spoken at home MOST of the time?
(Tick next to the **ONE** answer you think is correct)

7.1 English ☐
7.2 Xhosa ☐
7.3 Afrikaans ☐
7.4 Other? ☐ : .....

All about food

1. **Look at the following pictures and fill in the LETTER (A, B, C, D, E, F or G)of the food group you think best fits the answer to the questions below** (You can choose a group more than once)

Meat, Chicken, Fish, Eggs	Brown Bread, Rice, Samp, Mealie meal	Vegetables	Fruit	Sugar, Sweets	Fats, oils	Milk, Maas, Yoghurt, Cheese
A	**B**	**C**	**D**	**E**	**F**	**G**
						

1.1. Choose the food group that you should eat the **MOST** of every day ☐

1.2. Choose the food group that you should eat the **LEAST** of every day ☐

1.3. Choose a food group that contains foods with **LOTS OF FIBRE (roughage)** ☐

1.4. Choose the food group that gives your body the best **ENERGY** ☐

1.5. Choose the food group that your **BODY uses to BUILD MUSCLES** ☐

1.6 Choose the food group that best **PROTECTS THE BODY AGAINST ILLNESSES** ☐

For the following questions, tick next to ONE answer only

2. Are you allowed to choose what you want to eat at home?	**YES**	**NO**	**Sometimes**	
3. Do you have school lessons where you talk about healthy eating?	**YES**	**NO**		

Fruits and "veggies"

4. To keep your body healthy, how many helpings of fruit and vegetables should you eat every day? (only tick next to the **ONE** answer you think is correct)

At least 1	1
3 or 4	3
5 or more	5
It doesn't matter how many	9

5. Why do you think eating fruit and vegetables every day is important?

5.1 Because they help our bodies to fight against illnesses like colds and flu	**YES**	**NO**	**Not sure**	
5.2 Because they help to protect our bodies against illness such as heart disease and diabetes	**YES**	**NO**	**Not sure**	
6. Do you eat vegetables?	**YES**	**NO**	**Sometimes**	

7. If you do you eat vegetables, why do you eat them?

7.1 Because you like the taste	**YES**	**NO**	**Sometimes**	
7.2 Because people at home eat vegetables	**YES**	**NO**	**Sometimes**	
7.3 Because you are told to eat them	**YES**	**NO**	**Sometimes**	
8. Do you eat fruit?	**YES**	**NO**	**Sometimes**	

9. If you do you eat fruit, why do you eat them?

9.1 Because people at home eat fruit	**YES**	**NO**	**Sometimes**	
9.2 Because you are told to eat them	**YES**	**NO**	**Sometimes**	

10. When you feel like a snack, what do you eat?

10.1 Chips	**YES**	**NO**	**Sometimes**	
10.2 Sweets	**YES**	**NO**	**Sometimes**	
10.3 Fruit	**YES**	**NO**	**Sometimes**	
10.4 Sandwich or cereal	**YES**	**NO**	**Sometimes**	

Healthy choices

For the following questions, tick next to ONE answer only

11. Is it important to eat **small** amounts of healthy fats and oils because …

11.1 fats give you energy and keep you warm?	**YES**	**NO**	**Don't know**	
11.2 fats help your body to build muscle?	**YES**	**NO**	**Don't know**	
11.3 fats help you to absorb certain important nutrients?	**YES**	**NO**	**Don't know**	

12. When you eat too much fat you can …

12.1 become fat (overweight)	**YES**	**NO**	**Don't know**	
12.2 get high blood pressure when you are older	**YES**	**NO**	**Don't know**	
12.3 have a heart attack when you are older	**YES**	**NO**	**Don't know**	
12.4 develop diabetes as you get older	**YES**	**NO**	**Don't know**	

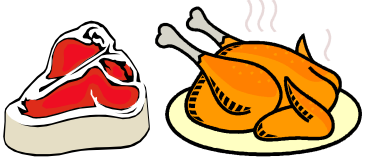
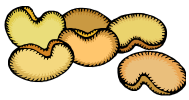
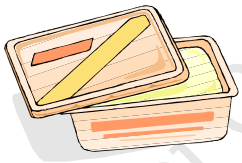
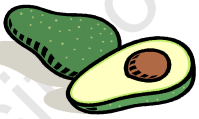
13. Eating a lot of sugar, sweets and sweet food…

13.1 Is good for health	**YES**	**NO**	**Don't know**	
13.2 Can make you fat	**YES**	**NO**	**Don't know**	
13.3 Is bad for your teeth	**YES**	**NO**	**Don't know**	
13.4 Can cause diabetes	**YES**	**NO**	**Don't know**	

14. Is it important to eat enough fibre (roughage) because…

14.1 fibre helps you go to the toilet regularly	**YES**	**NO**	**Don't know**	
14.2 fibre protects you against diseases like heart disease and diabetes	**YES**	**NO**	**Don't know**	

15. Which of the following foods contain HEALTHY fats? **Tick next to ONE answer only**

Red meat and chicken with skin		**Yes** ☐	**No** ☐	**Don't know** ☐
Chips, crisps and papa bites		☐	☐	☐
Nuts		☐	☐	☐
Soft margarine in tub		☐	☐	☐
Avocado pear		☐	☐	☐
Vetkoek and doughnuts		☐	☐	☐
Pilchards/Sardines		☐	☐	☐
Polony		☐	☐	☐

For the following questions, tick next to ONE answer only

16. Do you think you can make changes to your diet by…

16.1 putting less margarine on your bread?	**YES**	**NO**	**Not sure**	
16.2 eating fewer chips?	**YES**	**NO**	**Not sure**	
16.3 buying fruit instead of chips?	**YES**	**NO**	**Not sure**	
16.4 putting less sugar in your tea or coffee?	**YES**	**NO**	**Not sure**	
16.5 putting less sugar on your cereal/porridge?	**YES**	**NO**	**Not sure**	
16.6 eating sweets less often?	**YES**	**NO**	**Not sure**	
16.7 drinking cool drinks less often?	**YES**	**NO**	**Not sure**	
16.8 eating brown bread instead of white bread?	**YES**	**NO**	**Not sure**	
16.9 eating more vegetables?	**YES**	**NO**	**Not sure**	
16.10 eating more fruit?	**YES**	**NO**	**Not sure**	
17. Is it difficult for you to eat less fat because you like fatty food too much?	**YES**	**NO**	**Not sure**	
18. Is it difficult for you to eat brown bread because the shops close to your house only have white bread?	**YES**	**NO**	**Not sure**	
19. Is it difficult for you to eat brown bread because most of your friends prefer eating white bread?	**YES**	**NO**	**Not sure**	

Healthy eating before and during school

20. Do you eat breakfast before school?	**YES**	**NO**	**Sometimes**	
21. Can you make your own breakfast?	**YES**	**NO**	**Sometimes**	
22. Can you get up early enough to eat breakfast at home?	**YES**	**NO**	**Sometimes**	

23. Is it difficult for you to eat breakfast at home because …

23.1 the people at home do not eat breakfast?	**YES**	**NO**	**Sometimes**	
23.2 there is no food in the house to eat for breakfast?	**YES**	**NO**	**Sometimes**	

24. Do you bring a lunchbox to school?	**YES**	**NO**	**Sometimes**	
25. Is it difficult for you to take a lunchbox to school because…				
25.1 other children will want your food?	**YES**	**NO**	**Sometimes**	
25.2 there is nothing at home to put in your lunchbox?	**YES**	**NO**	**Sometimes**	
25.3 no one at home can help you to make a lunchbox?	**YES**	**NO**	**Sometimes**	
25.4 you do not have a nice container to put it in?	**YES**	**NO**	**Sometimes**	
26. Do you bring money to school?	**YES**	**NO**	**Sometimes**	
26.1 If you answered **YES**, how many days per week do you bring money to school?	**Every day (5 days)**	**2-3 times/wk**		
26.2 How much money do you bring at a time?	**R**			

Activities at school and home and in-between

For the following questions, tick next to ONE answer only

1. Are you doing physical activity when you play games, e.g. skipping, soccer?	**YES**	**NO**	**Not sure**	
2. Are you doing physical activity when you are walking, e.g. walking to school?	**YES**	**NO**	**Not sure**	
3. Is it important to do physical activity every day in order to keep your body healthy?	**YES**	**NO**	**Not sure**	
4. Do you have fun when you are doing physical activity?	**YES**	**NO**	**Sometimes**	
5. Do your teachers encourage you to do physical activity?	**YES**	**NO**	**Sometimes**	
6. Does your family encourage you to do physical activity?	**YES**	**NO**	**Sometimes**	
7. Do you go with your family to physical activity events at your school or in your neighbourhood, e.g. a fun run/walk?	**YES**	**NO**	**Sometimes**	
8. Do you take part in sport at school or for a club, e.g. soccer, netball?	**YES**	**NO**	**Sometimes**	
9. Do you do physical activity at home or in your neighbourhood after school and on weekends?	**YES**	**NO**	**Sometimes**	
10. There is organised sport at my school	**YES**	**NO**	**Don't know**	
11. My friends do not do sport	**YES**	**NO**	**Don't know**	

12. My parents do not allow me to do sport	**YES**	**NO**	**Don't know**	
13. I do not like sport	**YES**	**NO**	**Don't know**	
14. I am not good enough to be on a sports team	**YES**	**NO**	**Don't know**	
15. There are no playgrounds or sports fields near my home to play outdoors	**YES**	**NO**	**Don't know**	
16. It is not safe for children to play outdoors where I live	**YES**	**NO**	**Don't know**	
17. I can't do physical activity at home or in my neighbourhood because I have to look after my brothers and sisters or do chores	**YES**	**NO**	**Don't know**	
18. I can't do physical activity at home or in my neighbourhood because there is too much traffic	**YES**	**NO**	**Don't know**	
19. I do not know how to play sports and games very well, I am sometimes chosen last for games	**YES**	**NO**	**Don't know**	
20. Sometimes my friends make fun of me when I play sports and games outdoors with them	**YES**	**NO**	**Don't know**	

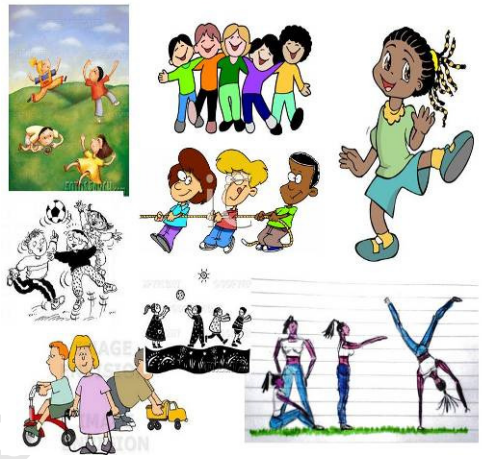
21. On a normal weekday, how long do you spend on the computer, watch TV or sit and listen to the radio? (**Tick next to the ONE answer you think is correct**)

Less than 30 minutes per day	1	
30-60 minutes per day	2	
1-2 hours per day	3	
More than 2 hours per day	4	

22. On a normal day on the weekend, how long do you spend on the computer, watch TV or sit and listen to the radio? (**Tick next to the ONE answer you think is correct**)

Less than 30 minutes per day	1	
30-60 minutes per day	2	
1-2 hours per day	3	
More than 2 hours per day	4	

23. **Look at the pictures provided below, and fill in the LETTER (A, B, C or D) of the activities which BEST answers each question**

TV watching, reading and computers	Eating with family and friends	Doing things outside e.g. playing games, gardening	Organised/team sports
A	**B**	**C**	**D**
			

23.1 Choose the activities that **YOU** like the most ☐

23.2 Choose the activities that your **FRIENDS** like the most ☐

23.3 Choose the activities that are **BEST for your health** ☐

Diabetes and my health

For the following questions, tick next to ONE answer only

1. The following questions are about diabetes

1.1 Have you ever heard of diabetes or sugar disease?	**YES**	**NO**	**Don't know**	
1.2 Do you know anyone who has diabetes?	**YES**	**NO**	**Don't know**	
1.3 Does anyone in your family have diabetes?	**YES**	**NO**	**Don't know**	

2. Which of these things can cause diabetes?

2.1 Eating lots of sugar and sweets	**YES**	**NO**	**Don't know**	
2.2 Being very fat	**YES**	**NO**	**Don't know**	
2.3 Eating fatty foods	**YES**	**NO**	**Don't know**	

3. How does someone know if they have diabetes?

3.1 They are very thirsty	**YES**	**NO**	**Don't know**	
3.2 They have to pee all the time	**YES**	**NO**	**Don't know**	
3.3 They lose weight	**YES**	**NO**	**Don't know**	
3.4 They are often hungry	**YES**	**NO**	**Don't know**	
3.5 They have sores/wounds that take a long time to heal	**YES**	**NO**	**Don't know**	
3.6 They cannot see properly	**YES**	**NO**	**Don't know**	

4. Which of the following health problems are caused by diabetes?

4.1 Bad eyesight or blindness	**YES**	**NO**	**Don't know**	
4.2 Kidney problems	**YES**	**NO**	**Don't know**	
4.3 Foot problems	**YES**	**NO**	**Don't know**	
4.4 Heart disease, e.g. heart attack	**YES**	**NO**	**Don't know**	
4.5 Stroke	**YES**	**NO**	**Don't know**	

Food list

Tick (✓) the number next to the food items that you ate during the last week

1	Red meat		
2	Processed meats		
3	Tinned meat		
4	Chicken (with skin/pieces)		
5	Fish, tinned or smoked		
6	Fish, fresh		
7	Eggs		
8	Milk/sour milk, yoghurt		
9	Cheese		
10	Legumes (kidney beans, lentils)		
11	Bread, white		
12	Bread, brown		
13	Breakfast cereals (All bran, muesli, weetbix)		
14	Breakfast cereals, oats		
15	Maize pap		
16	Rice, pap, pasta, samp, potato (mash/boiled)		
17	Oranges and naartjies		
18	Apples, bananas, pears		
19	Orange/yellow veg. (sweet potato, pumpkin, butternut, carrots)		
20	Green veg. (spinach, peas, beans broccoli)		
21	Mixed vegetables		
22	Cabbage, cauliflower, lettuce		
23	Tomato (raw, cooked)		
24	Margarine/Butter		
25	Peanut butter/ Peanuts		
26	Fried foods (chips)		
27	Fried foods, other (fat cakes, fish, chicken)		
28	Pies, sausage rolls, samoosas		
29	Organ meats e.g. liver, kidneys		
30	Sugar		
31	Chocolate		
32	Sweets e.g. boiled, lollipops, jelly		
33	Cake, biscuits, doughnuts		
34	Juice, fruit		
35	Juice (mixed, carbonated, bunny licks, Oros)		
36	Crisps (papas, pretzels)		
37	Takeaways (KFC, McDonalds)		
38	Jam, syrup, honey		
39	Popcorn		

APPENDIX 5

HealthKick

Fitness testing & Dietary intake questionnaire

Name:	Code							
School's name:				Age:				
Gender:	Male	Female						
Anthropometry								
Height (m):								
Weight (kg):								
BMI:								
Fitness								
Sit and reach – *best of 2*:	**1.** **cm**			**2.** **cm**				
Sit-ups (Number in 30 secs):								
Shuttle run (Seconds):								
Standing long jump – *best of 2*:	**1.** **cm**			**2.** **cm**				

24-Hour Recall

Date:						2	0	1	0
Day of the week:									

1	Breakfast meal at home	
2	Snack before school	
3	Snack at first break: *Lunchbox*	
	Tuckshop/Vendor	
4	School Feeding Programme	
5	Snack at second break: *Lunchbox*	
	Tuckshop/Vendor	
6	Snack on the way home, after school	
7	Meal at lunch time (home, after care, friend)	
8	Snack during early afternoon	
9	Snack during late afternoon	
10	Meal at supper time at home/friend	
11	Snack after supper	

APPENDIX 6

Author Guidelines for publishing in BMC Public Health Journal

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See below for examples of acceptable word processor and graphics file formats. Additional files of any type, such as movies, animations, or original data files, can also be submitted as part of the publication.

During submission you will be asked to provide a cover letter. Please use this to explain why your manuscript should be published in the journal and to elaborate on any issues relating to our editorial policies detailed in the instructions for authors.

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Authors will be able to check the progress of their paper through the submission system at any time by logging into My BioMed Central, their personalized section of the site.

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Software

Study protocol

Technical advance

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- Title page
- Abstract
- Background
- Methods
- Results
- Discussion
- Conclusions
- List of abbreviations used (if any)
- Competing interests
- Authors' contributions
- Authors' information (if any)
- Acknowledgements and Funding
- References

- Figure legends (if any)
- Tables and captions (if any)
- Description of additional data files (if any)

You can download a template (compatible with Mac and Windows Word 97/98/2000/2003/2007) for your article. For instructions on use, see below.

The **Accession Numbers** of any nucleic acid sequences, protein sequences or atomic coordinates cited in the manuscript should be provided, in square brackets and include the corresponding database name; for example, [EMBL:AB026295, EMBL:AC137000, DDBJ:AE000812, GenBank:U49845, PDB:1BFM, Swiss-Prot:Q96KQ7, PIR:S66116].

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This should list the title of the article. The title should include the study design, for example:

A versus B in the treatment of C: a randomized controlled trial

X is a risk factor for Y: a case control study

The full names, institutional addresses, and e-mail addresses for all authors must be included on the title page. The corresponding author should also be indicated.

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The abstract of the manuscript should not exceed 350 words and must be structured into separate sections: **Background**, the context and purpose of the study; **Methods**, how the study was performed and statistical tests used; **Results**, the main findings; **Conclusions**,

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Background

The background section should be written from the standpoint of researchers without specialist knowledge in that area and must clearly state - and, if helpful, illustrate - the background to the research and its aims. Reports of clinical research should, where appropriate, include a summary of a search of the literature to indicate why this study was necessary and what it aimed to contribute to the field. The section should end with a very brief statement of what is being reported in the article.

Methods

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