

A review of school nutrition interventions globally as an evidence base for the development of the HealthKick programme in the Western Cape, South Africa

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Abstract

Aim: The aim of this study was to review all school interventions having a nutrition component, published in peer-reviewed literature between 1995 and 2006, and to document activities that were successful as well as those that were possible barriers in order to develop a best practice school intervention for the Western Cape Province, South Africa.

Methodology: A systematic review of school studies revealed 85 interventions that complied with the predetermined search criteria. The following outcome measures were considered in the evaluation of the interventions: (i) changes in nutritional knowledge, attitudes and self-efficacy and stage of change; (ii) changes in dietary behaviours; (iii) changes in clinical/physical markers such as body weight or body mass index, blood pressure or serum cholesterol concentrations; and (iv) process and/or policy outcomes.

Results: Key success factors of school-based interventions appeared to be the following: A nutrition-based curriculum offered at school by trained teachers generally improved behavioural outcomes. A physical activity programme and parental component were associated with most of the best practice clinical and behavioural outcomes. Furthermore, all best practice studies were grounded on a firm theory of behaviour, such as social cognitive, social marketing or stages of change. Most of the interventions that included a food service component had best practice behavioural outcomes.

Conclusions: Numerous school-based nutrition interventions have shown significant improvements in children's nutritional behaviours. Consequently, it is necessary to plan programmes based on existing evidence of best practice. The lessons learnt from this review have been applied in the development of the HealthKick programme initiated in schools in the Western Cape in 2007.

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Introduction

Chronic diseases of lifestyle (CDL) are a group of diseases that share similar risk factors because of exposure of people, over many decades, to unhealthy diets, smoking, lack of exercise and possibly stress. The major risk factors are high blood pressure, tobacco addiction, high blood cholesterol, diabetes and obesity. These result in various long-term disease processes, culminating in high mortality rates attributable to strokes, heart attacks, tobacco- and nutrition-induced cancers, chronic bronchitis, emphysema, renal failure, and many others.¹

The disease profile of the world is changing rapidly, especially in low- and middle-income countries. In 2005, 60% of deaths in the world were attributable to CDL. The 35 million deaths from CDL in 2005 were double the number of deaths for all infectious diseases (HIV/AIDS, tuberculosis and malaria), maternal and perinatal conditions, and nutritional deficiencies combined.² Approximately four out of five CDL deaths occurred in low- and middle-income countries, with heart disease, stroke, cancer, chronic respiratory diseases and diabetes being the main causes.^{2,3}

The South African National Burden of Diseases Study⁴ provided estimates for the level and causes of mortality in South Africa for 2000. The study estimated that in 2000 there were more than 500 000 deaths. Of these, 37% were the result of CDL, 30% were the result of HIV/AIDS, 12% were the result of injuries and 21% were the result of infectious diseases (so-called quadruple burden).

Studies from populations throughout the world have demonstrated a strong association of obesity with chronic diseases, especially type 2 diabetes, hypertension and cardiovascular diseases.^{5,6} There is strong evidence that obesity that begins in infancy and childhood persists into adulthood since body mass index (BMI) levels in childhood are strongly predictive of adult obesity.⁷ In the Bogalusa Heart Study overweight children (BMI > 95th percentile) at 2–5 years were found to be four times as likely to become overweight adults.⁸ A high-energy dietary intake is the main risk factor for obesity in both children and adults. This together with a high total fat intake, high saturated fat intake, high refined carbohydrate and free sugar intake, low fibre intake and low intake of fruits and vegetables has been classified as a typical 'Western diet', which contributes to the development of numerous chronic diseases, including cardiovascular

diseases and diabetes.⁹ With increased urbanisation in developing countries, traditional diets are rapidly being displaced by the Western diet described above. Research in Cape Town schools has already shown that children are consuming many of these unhealthy food choices.¹⁰

Overweight is a problem of significance in South Africa. Seventeen per cent of 1–9-year-olds are overweight and obese (BMI > or = 25) as are 16% of 13-year-olds, and this proportion increases to 26.4% in 19-year-olds and to 56% in urban black women.^{11–15} Furthermore, less than half of children aged 12–18 years are meeting public health recommendations for physical activity (at least 20 minutes of vigorous activity three times a week or 60 minutes of moderate activity daily – 44% and 34%, respectively).¹³ A sedentary lifestyle, in particular excessive television viewing, has been implicated in increasing rates of obesity in children and youth, and in South Africa at least 25% of children report three or more hours of television viewing daily.¹³

Schools are an established setting for health promotion activity as they have the theoretical advantages of influencing health-related beliefs and behaviours early in the ‘health career’ so that these beliefs and behaviours become established as adult patterns. Children represent a large population that is present and hence accessible over prolonged periods in a setting that is relatively sheltered and where education and learning are the norm. The ability to influence children in their formative years is a potential mechanism for influencing the culture and health beliefs of society.¹⁶ An additional potential benefit is that by improving the health of schoolchildren, educational performance and learning may be enhanced. Positive educational outcomes linked to good health in school children include improved classroom performance, school attendance, participation in school activities and student attitudes.¹⁷ There is some evidence that school health promotion programmes that involve families and communities can positively influence the wider community.^{18–20} The importance of school health promotion for the prevention of chronic disease was underlined in a recent scientific statement by the American Heart Association.²¹

The aim of this study was to evaluate published data from studies evaluated by a WHO report: (<http://www.who.int/dietphysicalactivity/summary-report-09.pdf> and <http://www.who.int/dietphysicalactivity/methods-09.pdf> on school-based interventions aimed at improving diet and consequently health in order to identify factors leading to successful interventions and to identify barriers to success, with the long-term goal of developing an intervention (HealthKick) for schools in South Africa.

Methods

Objectives

The primary objective of the present study was to find evidence of effective school-based nutrition interventions in the prevention of CDL, from a larger study undertaken by the WHO <http://www.who.int/dietphysicalactivity/summary-report-09.pdf>

Specific objectives were the following:

- To evaluate published peer-reviewed articles on school-based interventions.
- To evaluate the quality and suitability of studies based on predetermined criteria.

- To develop evidence-based best practice summaries.
- To highlight trends, determinants, barriers and conclusions for developing and implementing school-based interventions.

Overall search strategy

The methods used for this review are based on the guidelines provided by the Centre for Reviews and Dissemination of the University of York²² for finding studies for systematic reviews, the *Schema for Evaluating Evidence for Public Health Interventions: Version 4*²³ and a recently published best practice review for reducing obesity in children and youth.²⁴

Search strategy procedure followed

Studies that were published between January 1995 and July 2006, based largely on the schema presented in Table I, were searched by means of the following databases:

PUBMED; Cochrane Library; EMBASE; National Research Register; HSRProj database; CDSR; CRD ongoing reviews; DARE; and Psychological Abstracts (PsycINFO). In this article we focus on the search for nutrition-based interventions.

Table I: Schema for peer-review search strategy for nutritional interventions

Behaviour	Intervention	Objectives	Outcome measure
Nutrition and healthy diet	Intervention	Health	Best practice
Diet* intake	Programme/s	Health promotion	Effectiveness
Fruit intake	Project	Health behaviour	Environment
Fat intake	Campaign	Health practice	Evaluation
Vegetable intake	Initiative	Health knowledge	Economic evaluation
Diet* habits	Strategy	Health education	Cost-effectiveness
Diet* knowledge		Disease prevention	Decision analysis
Diet* practices			Guideline
Nutrient intake			

*Boolean term used in this search
www.who.int/dietphysicalactivity/methods-report-09.pdf

Types of intervention evaluated

For the purposes of this report, the following interventions were considered:

Systematic approaches designed to improve dietary habits (i.e. increase fruit and vegetable intake, reduce dietary and in particular saturated fat intake, prevent obesity) with the *specific* aim of reducing the risk of noncommunicable diseases.

The approaches mentioned above may have included interventions targeting changes in awareness, knowledge and/or attitudes regarding nutrition and physical activity, improving self-efficacy, skill or competency concerning these behaviours.

Interventions may also have included programmes or strategies targeting changes in social norms, policy, physical environment, health services, consumer behaviour, and so on, leading to, for example, increased consumption of fruits and vegetables, reduced dietary fat intake, reduced obesity prevalence and increased levels of health-enhancing physical activity.

Outcome measures

The following outcome measures were considered in the evaluation of the various intervention programmes:

- Changes in nutritional knowledge, attitudes, self-efficacy and intentions as well as stage of change and/or behaviours.
- Changes in clinical markers such as body weight or BMI, blood pressure or serum cholesterol concentrations.
- Process and/or policy outcomes.

In addition, factors such as intervention fidelity, sustainability, feasibility and cost-effectiveness were considered, where measured. Further, programmes demonstrated as being effective in a broader context, or specifically under-resourced settings, were also highlighted.

Quality assessment of peer-reviewed studies for inclusion

Studies were excluded at the initial screening if they did not reflect the intervention strategies or outcomes of interest, as previously described. Subsequently, studies were potentially excluded for any of the following reasons:

- The sample size of the intervention group/s was less than 50.
- The study did not include measurable outcomes.
- The primary outcomes were not related to diet.
- The intervention did not include a dietary component.
- The study was published prior to 1995 and after July 2006.
- The intervention was not clearly described and, therefore, reviewers were unable to attribute outcomes to dietary intervention strategies.
- The study design was insufficient to draw any meaningful conclusions as to the effectiveness of the intervention approach.

The quality assessment instrument used was adapted from Pomerleau et al.²⁵ Seven reviewers (four of them dietitians) were used to conduct the internal review of all the studies. All peer-reviewed studies and interventions included in the review received an overall rating of 1–3 for quality.

Measures of best practice

The intervention strategies were then evaluated and rated accordingly on the following basis defined by the World Health Organization (WHO): <http://www.who.int/dietphysicalactivity/summary-report-09.pdf>

“Best practice/most likely to be effective: This refers to studies/interventions that have typically been based on formative assessment, with a generally robust experimental design or sufficient sample size and with significant and substantive effects on specified outcome variables. They would likely be applicable in a wider variety of settings (developing or underresourced settings) and have demonstrated feasibility and sustainability in their current setting. These studies/interventions would be considered the ‘gold standard’ or ‘exemplar’ for the setting and specific outcome.

Moderately effective: This refers to studies/interventions that lack one or more of the critical components stated above but are

sufficiently robust to warrant consideration for application in specific settings or groups.

Minimally effective: This refers to studies/interventions that have significant but perhaps not clinically relevant effects in at least one of the outcome areas. However, for other outcomes, effects are not significant or were not measured. The study designs are sufficiently robust and therefore unlikely to yield different or better results through additional testing or in other settings.

Insufficient evidence/promising: This refers to studies/interventions for which there is an important trend or a significant effect but that may not be sufficiently robust in terms of experimental design or sample size. These studies/intervention models would likely benefit from further testing and research.

Insufficient evidence/not likely to be effective: This refers to studies/interventions for which the study design is not robust but the results are sufficiently unremarkable or negative as to warrant no further testing or research application.

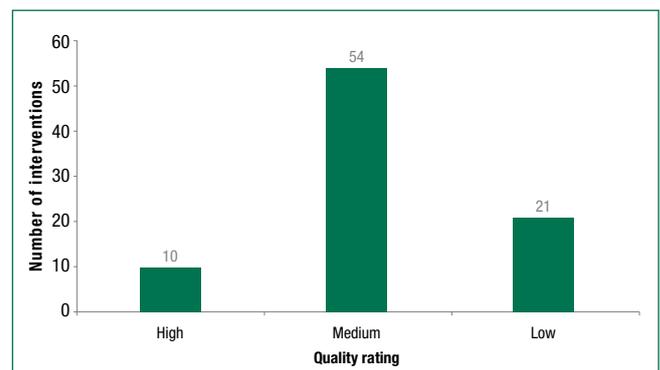
Shown not to be effective: This refers to studies/interventions with robust designs yielding negative results or showing no change.

Not reported or not measured: This refers to outcomes not measured or measured and not reported.”

Results

One hundred and twenty articles on school interventions were found. Of these 85 complied with the inclusion criteria. Ten were rated as being of high quality, 54 of medium quality and 21 of low quality in terms of study design by the dietitians who rated them (see Figure 1). From the interventions included, 11 had best practice outcomes either clinically, behaviourally or psychosocially, in other words knowledge/attitudes. A few had best practice outcomes in more than one category. These are indicated in Table II.

Figure 1: Number of school interventions rated as high, medium or low in terms of quality of research (N = 85 from 120 articles on school settings)



Two studies that can be regarded as best practice regarding *clinical* outcomes are the Know Your Body Programme (KYBP)^{26–28} and Healthy Start.^{29,30} The KYBP was undertaken in Crete among primary school children. The children were targeted over a period of six years from Grade 1 to 6. This programme was based on social learning theory and included three important components: a classroom

Table 1: School interventions with best practice outcomes- Reference: <http://www.who.int/dietphysicalactivity/evidence-tables-WW.pdf>

School programme	Best practice outcomes	Explanatory notes
<p>Know Your Body (adapted) School Health Promotion Programme (26–28)</p> <ul style="list-style-type: none"> - Crete, Greece - Primary school children (IG = 457, 24 schools; CG = 374, 16 schools) - Six-year intervention - Targeted at children first grade through to sixth grade (ages 5.5–11.5 years) - Aimed at promoting healthy lifestyle habits in order to minimise the risk of developing cardiovascular disease (CVD) in adulthood <p>Intervention:</p> <ul style="list-style-type: none"> - Curriculum – health and nutrition (13–17 classroom hours/year) - PA programme (two 45-minute sessions/week including 4–6 hours of classroom material/year) - Parental involvement (homework worksheets, leaflets and seminars) <p>Based on social learning theory</p>	<p>Knowledge and attitudes: Health knowledge scores improved in the IG, but there were no differences in the parents.</p> <p>Behaviour: After six years a significant improvement was found in dietary energy, total fat, MUF and SF in the IG; PA levels also improved.</p> <p>Clinical markers: BMI and skinfolds significantly better in the IG. Also significant improvements in LDL-C, total cholesterol: HDL ratio and LDL:HDL ratio.</p>	<p>Trained teachers provided the nutrition component of the intervention. PE teachers provided PA. Forty to 50 hours of intervention activities annually.</p> <p>High parental participation contributed to good outcomes as did the long duration of the intervention and teacher compliance in delivering the programme.</p>
<p>Healthy Start (29, 30)</p> <ul style="list-style-type: none"> - In nine Head Start centres in New York, USA - Children (n = 1 296; IG = 6; CG = three schools) - Two-year intervention - Targeted at preschool children 2–5 years old, the majority low-income African American and Hispanic - Aimed at decreasing SF content of meals to < 10% E and decreasing SF intake by preschoolers to < 10% <p>Intervention:</p> <p>Intervention done with two arms:</p> <ul style="list-style-type: none"> - Food service only - Food service plus nutrition education <p>Parental involvement</p>	<p>Behaviour: Total fat and SF intake of children decreased significantly after two years in the food service IG. School meals followed the same pattern.</p> <p>Clinical markers: Significant decrease in total serum cholesterol in IG in both food service groups (-6.0 vs. -0.4mg/dl); 30% reduction in risk of elevated cholesterol.</p>	<p>Chefs received one day of training from dietitians. Teachers were trained to deliver the educational curriculum.</p> <p>The food service intervention was successful in decreasing dietary fat and blood cholesterol values. Limited time was allocated to the education programme, which may have accounted for not providing any further benefit over and above the food service intervention. Food service intervention was modelled after CATCH.</p>
<p>CATCH (31–38)</p> <ul style="list-style-type: none"> - Four centres: San Diego, Minneapolis, Houston and New Orleans, USA - Children at 96 public schools; (n = 5 106; IG = 56 schools, CG = 40 schools) - Three-year intervention - Targeted at children in Grade 3 at baseline and Grade 5 at completion (8–11 years) - Aimed at reducing risk factors that influence cardiovascular disease. Dietary aims were to decrease total fat, saturated fat and serum lipids and to prevent obesity. <p>Intervention:</p> <ul style="list-style-type: none"> - One intervention arm with school-only component (curriculum plus PA plus food service component) - One arm with school component (curriculum plus PA plus food service component) plus family involvement. <p>Based on social cognitive theory</p>	<p>Knowledge and attitudes: Significant effects in improved knowledge, intentions, self-efficacy, usual behaviour and perceived social reinforcement for healthy food choices in IG after three years.</p> <p>Significant effects in diet knowledge and intentions still found in Grade 8 in the IG after three years.</p> <p>Significant effects in diet knowledge and intentions still found in Grade 8 in the IG.</p>	<p>Trained teachers provided the intervention. Dose effects were found for knowledge and attitudes according to parental involvement, suggesting the importance of a family component. Similarly, many positive dietary and PA effects continued up to Grade 8. General nutrition intervention wasn't sufficient to change F & V intake. Food-based targeted messages may be required. Staff training an important factor in achieving institutionalisation of these programmes. Health education programmes also need to be compatible with school policy and priorities to be adequately institutionalised.</p>
<p>PATHWAYS (39–43)</p> <ul style="list-style-type: none"> - Arizona, New Mexico and South Dakota, USA - American Indian children in 41 schools (IG = 727; CG = 682 children; n = 1 150 for psychosocial factors) - Three-year intervention - Targeted at Grade 3–5 children (8–11 years) - Aimed at obesity prevention and decreased energy and fat intake <p>Intervention:</p> <ul style="list-style-type: none"> - Classroom curriculum to promote healthy eating behaviours and PA (two 45-minute sessions over 12 weeks/year for third and fourth grades and for eight weeks during fifth grade) - Physical activity programme - Change in fat content of meals offered in canteen - Parental involvement <p>The intervention approach combined constructs from social learning theory and principles of American Indian culture.</p>	<p>Knowledge and attitudes: Significant increase in knowledge, cultural identity and food choice intentions. No difference in self-efficacy to choose healthy foods. Significant retention of knowledge over the three years</p> <p>Behaviour: Significant decrease in dietary energy (-265 kcal) and % E fat (-2.5%).</p>	<p>The programme was very comprehensive and also focused on cultural identity. Trained teachers were used to do the intervention. Several indigenous learning modes, for example storytelling, were used. A sustainable feature is the fact that teachers did the intervention, which also made it cost-effective. Of the family-based components, giving children family packs and presenting family events at school were the most successful. Process evaluation found that the interventions were successfully implemented with good reach, high extent and high fidelity.</p>

<p>CATCH Eat Smart Food Service Intervention (44–46) Four centres: San Diego, Minneapolis, Houston and New Orleans, USA</p> <ul style="list-style-type: none"> - Ninety-six schools (IG = 56 schools; CG = 40 schools) for school lunch analysis and 59 schools (IG = 35 schools; CG = 24 schools) for school breakfast analysis - Two-and-a-half-year intervention - Targeted food service staff and administrators - Aimed at lowering total fat, saturated fat and sodium in school meals whilst maintaining recommended amounts of energy and nutrients <p>Intervention:</p> <ul style="list-style-type: none"> - National School Lunch Programme and School Breakfast Programme - Training sessions, educational materials, newsletter and ongoing support visits - Also guidelines and standards <p>Training primarily devoted to lunch-related modifications</p>	<p>Behaviour: NSLP Significant reduction in % calories from total fat (-4.1%) and SF (-1.3%) of school meals in IG. Lower increase in sodium content of school meals. Breakfast Programme Decreases in both groups for % E from fat but not significantly different. Significant decrease in SF (-1.6%) Sodium goals not achieved. Maintained recommended amounts of calories and essential nutrients at lunch and breakfast. Five years post intervention 50% met guidelines for fat vs. 10% control and 17% unexposed school cafeterias.</p>	<p>School meals remained healthier five years after completion of the intervention. The CATCH Eat Smart Programme assisted school cafeterias in meeting USDA guidelines (< 30% E fat and < 10% E SF) five years post intervention. Introduced guidelines and standards for meals.</p>
<p>High-5 Project (47, 48) (One of nine community projects within NCI 5-a-Day for Better Health Initiative)</p> <ul style="list-style-type: none"> - Alabama, USA - Twenty-eight schools (N = 1 698 families) - One-year intervention - Targeted at fourth to fifth grade (8–9 year old) - Aimed at increasing F & V consumption <p>Intervention:</p> <ul style="list-style-type: none"> - Curriculum (14 lessons to fourth grade plus three short booster sessions in fifth grade) - Change in foods offered in school cafeterias (training food service staff) - Parental involvement <p>Based on social cognitive theory</p>	<p>Knowledge and attitudes: Significant effects in children on self-efficacy and knowledge Behaviour: Significant increase in F & V consumption and fibre, foliate, beta-carotene and vitamin C intake in children at year 1 and 2 Parents' F & V intake were significant at year 1 only, not in year 2.</p>	<p>Project coordinators helped by teachers to implement the intervention. They also trained food service staff and coordinated parent activities. Very effective programme in most subsamples, suggesting programme is generalisable to different groups. High implementation rates were found in the classrooms. Moderate rates were found in family participation.</p>
<p>TEENS (49)</p> <ul style="list-style-type: none"> - Minnesota, USA - Sixteen schools (n = 3 503; IG = 1 748; CG = 1 755). For 24-hour recall data n = 455 - Two-year intervention (one-year results) - Targeted at low-income children in grades 7 and 8 - Aimed at increasing F & V intake and decreasing fat intake <p>Intervention: Four incremental exposures:</p> <ul style="list-style-type: none"> - Control group - School environment (food service component) only - School environment plus curriculum (and parental component) - School environment plus curriculum plus peer leaders <p>Based on social cognitive theory</p>	<p>Behaviour:The most significant increase in F & V intake and decrease in fat intake were in the peer group plus curriculum plus environment components, followed by the curriculum plus environment group. The peer leader group reported nearly a full serving increase. The tendency to choose low-fat foods also improved significantly in the same two groups</p>	<p>Trained teachers and peer leaders presented the intervention to Grade 7 children. Peer group training proved most successful in improving F & V intake and lowering fat intake. The use of peers may be an effective and sustainable way of running programmes.</p>
<p>Eat Well and Keep Moving (50)</p> <ul style="list-style-type: none"> - Baltimore, USA - Children: n = 479; IG = 190, six schools ; CG = 289, eight schools (n = 335; IG = 173 CG = 162 for 24-hour recall data) - Two-year intervention - Targeted at Grade 4 and 5 children (91% African American) - Aimed at improving diet (decreasing fat and SF and increasing F & V), increasing PA and reducing TV viewing <p>Intervention:</p> <ul style="list-style-type: none"> - Classroom curricula (13 lessons/year) - Physical activity - Parental involvement <p>Interventions linked to the school food service, PA, families, teacher wellness programmes and classroom campaigns Social cognitive theory and behavioural choice theory</p>	<p>Behaviour: Significant decrease in % E fat (-1.4%) and % SF (-0.06%). An increased consumption of F & V (equiv 0.73 servings/day), vitamin C and fibre. No differences in PA.</p>	<p>The programme was integrated into existing school curricula using classroom teachers. Materials were integrated into maths, science, language, arts and social studies classes. This makes the programme replicable and sustainable. Teachers attended one day of training and two meetings/year. Another outcome is marginally reduced TV viewing, which has great implications for snacking and weight gain. Classroom-based materials were developed to be low cost and sustainable.</p>
<p>Squire's Quest (51–53)</p> <ul style="list-style-type: none"> - Houston, Texas - Twenty-six primary schools (n = 1 578; IG = 749; CG = 740) - Five-week intervention - Targeted at fourth grade (8–12 years old) - Aimed at increasing F & V intake in children <p>Intervention:</p> <ul style="list-style-type: none"> - Ten-session interactive multimedia game called Squire's Quest - Goals related to F & V intake set at end of every session <p>Based on social cognitive theory</p>	<p>Behaviour: Children participating in SQ significantly increased their F & V intake by one serving above the CG.</p>	<p>A psycho-educational game for children in a multiethnic environment. The development of such games is very expensive and sufficient resources are required to use this as an educational tool. Such games may therefore not be appropriate for use in developing countries.</p>

<p>Evaluation of a low-fat milk programme (54)</p> <ul style="list-style-type: none"> - New York, USA - In six elementary schools in the inner city, mainly Latino neighbourhood (n = 5 417; IG = 3; CG = three schools). - Seven–10-day intervention - Aimed at increasing consumption of 1% fat milk rather than full-cream milk <p>Intervention:</p> <ul style="list-style-type: none"> - Based on social marketing techniques including product positioning, celebrity endorsement, taste tests, advertising, point-of-purchase incentives, a slogan and entertainment activities. <p>Used the precede-proceed framework</p>	<p>Behaviour: Low-fat milk consumption increased from 25% to 57% and remained significant after three months. There was no overall decrease in milk consumption.</p>	<p>Focus on one specific eating behaviour. Latinos used as culturally appropriate role models. Food service staff made displays and encouraged consumption of 1% fat milk. Product packaging may affect product choice. Intervention does not interfere with classroom time. This is a quick and effective way to decrease saturated fat intake in a large group of children.</p>
<p>The CHIPS study (55)</p> <ul style="list-style-type: none"> - Minneapolis, USA - Fifty-five vending machines in 12 secondary schools and 12 worksites - Twelve-month intervention – each treatment four weeks <p>Intervention:</p> <ul style="list-style-type: none"> - Four pricing levels (equal price, 10%, 25% and 50% reduction) and - Three promotional conditions (none, low-fat label, low-fat label plus promotional sign) Low fat = 3 g or less per package. 	<p>Behaviour: Price reductions of 10%, 25% and 50% were associated with increases in low-fat snack sales. Low-fat snack sales increased by 9%, 39% and 93% respectively. Promotional signage was weakly associated with increases in low-fat snack sales.</p>	<p>Average profits per machine were not affected by the interventions. Pricing and promotion had similar effects for adolescent and adult populations. Another possibility is to increase pricing on high-fat snacks. One needs to make healthy food choices available at attractive prices while maintaining overall profitability</p>

References: <http://www.who.int/dietphysicalactivity/evidence-tables-WW.pdf>

IG = intervention group; CG = control group; PA = physical activity; BMI = body mass index; F & V = fruit and vegetables; SF = saturated fat; MUF = monounsaturated fat; PUF = polyunsaturated fat; HDL = high-density lipoprotein; LDL = low-density lipoprotein; E = energy; C = cholesterol

curriculum on diet and health, a physical activity programme and parental involvement. Trained teachers provided the nutrition component comprising 13–17 classroom hours and physical activity teachers provided 45–50 hours of physical activity annually. High parental participation attributed to good outcomes as did the long duration of the intervention and teacher compliance in delivering the programme.

Healthy Start^{29,30} was a two-year intervention undertaken among preschool children in New York, mainly African Americans and Hispanics. The intervention comprised two components: a food service arm and a food service with nutrition education arm. There was a significant decrease in total serum cholesterol in both intervention groups with the education component not adding additional significant benefits over and above the food service component, which was based on the Child and Adolescent Trial for Cardiovascular Health (CATCH).^{31–38} Chefs received one day of training from a dietician, and teachers were trained on the education curriculum. The food service intervention was successful in decreasing dietary fat and blood cholesterol values. Limited time was allocated to the education programme, which may have accounted for its not providing any further benefit over and above the food service intervention.

There are numerous studies that have been classified as best practice regarding behaviour, including PATHWAYS,^{39–43} CATCH,^{44–46} High-5,^{47,48} TEENS,⁴⁹ Know Your Body,^{26–28} Eat Well and Keep Moving,⁵⁰ Healthy Start,^{29,30} Squire's Quest,^{51–53} Low-Fat Programme⁵⁴ and CHIPS.⁵⁵

PATHWAYS^{39–43} took place over a period of three years and was targeted at 8–11-year-old American Indian children. The intervention used constructs from social learning theory and placed a strong emphasis on cultural identity. The programme was very comprehensive and included a curriculum offered by trained teachers, a physical activity programme and changes to meals offered in the school canteen. There was also a strong parental focus. Several indigenous learning modes, for example storytelling, were used. A sustainable feature

was the fact that teachers did the intervention, which also made it cost-effective. Of the family-based components, giving children family packs and presenting family events at school were the most successful. Process evaluation found that the intervention was successfully implemented with good reach, high extent and high fidelity. This type of programme needs to be tested on other cultural groups and in developing countries.

Another study with best practice behavioural outcomes was the CATCH Eat Smart Food Service Intervention.^{44–46} This intervention targeted food service staff and administrators to decrease total fat, saturated fat and sodium in school meals. Food service staff received special training in order to provide low-fat meals for the lunch and breakfast programmes at the participating schools. This was very successful in decreasing the fat and saturated fat contents of meals. Even after five years 50% of intervention schools still complied with the low-fat objectives compared with only 10% of schools in the control group.

The High-5 Project was very similar to PATHWAYS in terms of the focus and elements of the intervention, namely a food service component, a school curriculum and parental involvement.^{47,48} Significant increases were found in fruit and vegetable, fibre, beta-carotene and vitamin C intakes in the intervention group after one year. Project coordinators helped by teachers implemented the intervention. They also trained food service staff and coordinated parent activities. This was an effective programme in most subsamples, suggesting that the programme is generalisable to different groups. High implementation rates were found in the classrooms. A limitation of the study is that no long-term outcomes were provided.

The Teens Eating for Energy and Nutrition at School (TEENS) intervention had best practice behavioural outcomes in low-income children in grades 7–8.⁴⁹ This intervention included three arms: The first arm contained a food service component only, the second arm combined a food service component with a curriculum and parental

involvement and the third arm included all three components and additionally tested the use of trained peers. The most significant increase in fruit and vegetable intake and decrease in fat intake were in the peer group plus curriculum plus environment components, followed by the curriculum plus environment group. The peer group leader reported nearly a full serving increase per day in children. Scores for the tendency to choose low-fat food also improved significantly in the same two groups. The use of peers may be an effective and sustainable way of running such programmes.

In addition to best practice clinical results The Know Your Body programme in Greece also provided best practice behavioural outcomes.^{26–28} This six-year programme that combined a nutrition and physical activity programme with parental involvement using trained teachers resulted in significant improvements in dietary intake of energy, total fat, monounsaturated fat and saturated fat in the intervention group. Physical activity also improved significantly.

Eat Well and Keep Moving had best practice dietary outcomes in a population group who were primarily African Americans.⁵⁰ There was a significant decrease in percentage energy from fat and a significant increase in fruit and vegetable intake in the intervention group. The intervention included a nutrition curriculum, physical activity programme, parental involvement and environmental changes and was also linked with the school food service. The programme was integrated into the existing school curricula and structures using classroom teachers. Materials were integrated into maths, science, language, arts and social studies classes. This integration makes the programme replicable and sustainable. Teachers attended one day of training and two meetings a year. Another positive outcome was that the programme marginally reduced TV viewing time, which has implications for snacking and weight loss. Classroom-based materials were developed to be low cost and sustainable.

The Healthy Start^{29,30} programme was targeted at preschool children. The study tested two intervention arms: one containing a food service component only and one including a food service component and nutrition education. This intervention showed best practice behavioural outcomes since the total fat and saturated fat intake of children decreased significantly after two years in the food service group. School meals followed the same pattern.

Squire's Quest^{51–53} is an interactive game targeted at 8–12-year-old children that showed best practice behavioural outcomes when evaluated. Children had 10 sessions of an interactive multimedia game. Children participating in Squire's Quest significantly increased their fruit and vegetable intake by one serving above the control group's. The development of such a game is very expensive and sufficient resources (electricity and computers) are required to use this as an educational tool, which may make such a game impractical for use in developing countries.

Weschler et al⁵⁴ report on a low-fat milk programme tested in elementary schools in Latino districts of New York. This intervention focused on one specific eating behaviour. The researchers' aim was to increase consumption of 1% fat milk rather than full-cream milk. They based their intervention on social marketing techniques including product positioning, celebrity endorsement, taste tests,

advertising, point-of-purchase incentives, a slogan and entertainment activities. Low-fat milk consumption increased from 25% to 57% and remained significant after three months. There was no overall decrease in milk consumption. Food service staff made displays and encouraged consumption of 1% fat milk. The effect of intervention on overall fat or caloric intake is not known. The intervention did not interfere with classroom time. Hence, this is a quick and cost-effective way to decrease saturated fat intake in a large group of children.

The last study under best practice behavioural outcomes is the Changing Individuals' Purchase of Snacks (CHIPS) study.⁵⁵ This study involved changing prices on low-fat items in vending machines at 12 secondary schools. Four pricing levels (equal price and 10%, 25% and 50% reduction) and three promotional conditions (none, low-fat label and low-fat label plus promotional sign) were tested. Price reductions of 10%, 25% and 50% were associated with increases in low-fat snack sales. Low-fat snack sales increased by 9%, 39% and 93% respectively. Promotional signage (labels) was weakly associated with increases in low-fat snack sales. Average profits per machine were not affected by the interventions. Pricing and promotion had similar effects for adolescent and adult populations.

Only four interventions had best practice *psychosocial outcomes*, namely PATHWAYS,^{39–43} CATCH,^{31–38} High-5^{47,48} and Know your Body.^{26–28} Interventions that showed best practice in two or three of the outcomes measured include PATHWAYS,^{39–43} High-5,^{47,48} Know your Body^{26–28} and Healthy Start.^{29,30}

Discussion and conclusions

There were numerous school interventions that had best practice behavioural and/or psychosocial outcomes and two had best practice clinical outcomes. Key success factors appeared to be the following:

- A nutrition-based curriculum offered at school by trained teachers generally improved behavioural outcomes.
- Interventions that included a physical activity programme/ component were associated with most of the best practice clinical and behavioural outcomes.
- All the best practice studies included a parental/family component.
- All the best practice studies were grounded on a firm theory of behaviour, such as social cognitive⁵⁶, social marketing⁵⁷ or stages of change⁵⁸ theories.
- Most of the interventions that included a food service component had best practice behavioural outcomes.

The lessons learnt from this review have been applied in the development of the HealthKick programme initiated in certain schools in the Western Cape in 2007. This programme aims at improving diet and physical activity by means of a teacher-based curriculum, a parental component and a healthy school environment conducive to healthy eating and increased physical activity. This intervention programme is being tested at 8 schools in the Western Cape province and is currently in its second year of a 4 year trial.

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