Module 3

Interventions to reduce consumption of energy-dense, nutrient-poor foods
Building Solutions for Preventing Childhood Obesity

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Prepared on behalf of the Prevention Research Centres:
NSW Centre for Overweight and Obesity
NSW Centre for Physical Activity & Health
NSW Centre for Public Health Nutrition

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This is one of a set of modules in the series Building solutions for preventing childhood obesity. Other modules are:

Overview module
Module 1: Interventions to promote consumption of water and reduce consumption of sugary drinks
Module 2: Interventions to increase consumption of fruit and vegetables in children
Module 4: Interventions to promote eating breakfast
Module 5: Interventions to increase physical activity in children 5 - 12 years
Module 6: Interventions to increase physical activity in adolescents
Module 7: Interventions to reduce sedentary behaviours

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Module 3 - Interventions to reduce consumption of energy-dense, nutrient-poor foods

1 Background and methods

1.1 Overview
This research report is one of a series presenting a synthesis of the recent evidence on the effectiveness of interventions to prevent weight gain and promote healthy weight among children and adolescents. This series of reports is designed to update the proposed approaches for children and families presented by the Centre for Public Health Nutrition report, ‘Best options for promoting healthy weight’.

The “Building solutions for preventing child obesity” report has been presented as a series of modules to reflect clusters in the evidence base, allow clear comparisons between similar interventions, and highlight promising approaches as well as gaps in the evidence. The methods used in preparing the report are also described in the ‘Overview Module’. The specific methods used in preparing this module on interventions to reduce consumption of energy-dense, nutrient-poor foods are outlined below.

1.2 Search strategy
Studies and interventions to reduce consumption of energy-dense, nutrient-poor foods in children and adolescents, published between January 1997 and September 2007 in peer-reviewed journals, were identified by searching Medline, Pubmed and CINAHL databases, and by consulting systematic reviews.

The databases were searched using the following terms to identify intervention evidence for this module:

(energy-dense food OR extra food OR non-core food OR junk food OR high-fat food) AND (intervention OR program OR promotion)
Limits: children and adolescents 0-18 years, humans, English Language

The same terms were also included in a GOOGLE search to identify any evaluated programs in the non-peer reviewed literature.

1.3 Exclusion and inclusion criteria
The following exclusion and inclusion criteria were applied to research papers identified through the search strategy:

Exclusion criteria

• Studies published prior to 1997
• Interventions targeting adults or young people aged over 18 years
• Sample size <16 participants
• Studies focused on the treatment or management of overweight/obesity
• Studies based in a clinical setting

Inclusion criteria

• All studies which had intake (consumption) of energy-dense, nutrient-poor foods as an outcome measure(s), with or without a weight-related outcome measure
• Studies targeting children aged 0-18 years
• Studies with randomised controlled trial (RCT) or quasi-experimental designs
• Post-only designs or studies with no controls were considered on a case-by-case basis


2 Problem analysis and rationale for intervention

The 2003 World Health Organisation report Diet, Nutrition and the Prevention of Chronic Disease indicated that the strength of the evidence for the increased risk of weight gain and obesity due to a high intake of ‘energy-dense, micronutrient-poor’ foods was ‘convincing’. These foods are those that do not fit into the five main (core) food groups, i.e. cereals, fruit, vegetables, meat and alternatives, and the milk group, and are otherwise termed ‘non-core’ or ‘extra’ foods, or sometimes ‘junk foods’. They tend to be processed foods that are high in fat and/or sugars and they generally contribute disproportionately to energy intake whilst providing few micronutrients.

It is recommended that consumption of ‘extra’ foods be limited to ‘sometimes’ for foods such as hot chips, confectionery and soft drinks (consumption of energy-dense (sugary) drinks is considered in a separate module in this report). Other foods classified as ‘extras’ are fat spreads and cooking oils which are generally consumed daily. The Australian Guide to Healthy Eating (AGHE) recommends that these foods be consumed ‘in small amounts’. An acceptable limit of consumption of ‘extra’ foods has been calculated for various age groups as 1-2 serves/day for children aged 4-11 years and 1-3 serves/day for 12-18 year olds; where a serve is defined as the amount of food containing 600 kJ. This quantity of extra foods would provide between 5-20% of daily energy intake for children aged 4-18 years.

The actual consumption of these ‘extra’ or energy-dense, nutrient-poor (EDNP) foods by Australian children has been determined using analysis of data from the 1995 National Nutrition Survey. This study showed that ‘extra’ foods contributed over 40% to the daily energy intake of 2-18 year olds in Australia in 1995. Another study which also used data from the 1995 National Nutrition Survey to determine the dietary intake of Australian children aged 5-15 years on school days, found that an average of 37% of children’s total energy intake was consumed while at school. This study found that energy-dense foods and beverages such as fat spreads, packaged snacks, biscuits and fruit/cordial drinks made a greater contribution to energy intake at school compared to out of school (P≤0.01). Fast foods and soft drinks contributed 11% and 3% of total energy intake; however, these food groups were mostly consumed out of school. Fruit intake was low and consumption was greater in school. In all, 14% of children purchased food from the canteen and they obtained more energy from fast food, packaged snacks, desserts, milk and confectionary (P< or =0.05) than non-canteen users.

Clearly EDNP foods were being consumed above recommended levels in 1995, and this intake is likely to be even higher currently due to the increased availability and choice of such foods. Indeed, a more recent cross-sectional survey of 1681 children aged 5-12 years in Victoria in 2003-2004 showed that, although fruit intake in primary schools was reasonably high, over 90% of children had energy-dense, micronutrient-poor snacks (‘junk food’) in their lunchboxes. Notably, only about 10% of children used the school canteen, but these children consumed more total energy and more energy from cakes, fast foods, and soft drinks than non-canteen users.

In conclusion, energy-dense foods and beverages are over-represented in young people’s diets, and in foods consumed at school. High consumption of energy-dense, nutrient-poor foods is likely to be contributing substantially to the energy imbalance and excessive weight gain being seen in Australian children.
3 Available intervention evidence

There are no systematic reviews available which have specifically appraised the literature on interventions to reduce consumption of EDNP foods in children. However, three recent reviews have appraised the available evidence on interventions to promote healthy eating in children. One recent systematic review of interventions to prevent childhood obesity was restricted to studies published between 1993 and 2003, with a controlled design, involving children 0-18 years, and including weight status as an outcome measure. Of the 14 interventions studies included in this review, 10 involved strategies to promote healthy eating, of which 9 were conducted in school settings and 3 targeted high-risk population groups in the US (American Indian, Hispanic and African-American). Four of these studies met the inclusion criteria for the current review.

A more recent systematic review appraised the evidence available from both intervention and non-intervention studies investigating barriers to and facilitators of healthy eating among young people. This review was restricted to community-level studies targeting young people aged 11-16 years published before 2001. Of the 22 intervention studies identified which met the inclusion criteria, only 7 were considered of sufficient methodological quality to be included in the final review. All 7 of these studies were multi-component interventions in which classroom-based strategies to promote healthy eating were complemented by school-wide and home-based initiatives. None of these studies met the inclusion criteria for the current review.

A recent non-systematic review discussed a further 3 studies which promoted cardiovascular health through healthy eating among children and adolescents. These studies were implemented in the clinical, school and pre-school settings, and all 3 met the inclusion criteria for the current review.

In total, 7 studies appraised in the above reviews are included in the current review. A further 22 intervention studies promoting reduced consumption of EDNP foods published since the reviews were identified from the literature searches for the current review. Thus a total of 29 intervention studies are included in the current review. Considerable heterogeneity in scope, target group, study design, measurement methods, and intervention quality exists across the studies. The details of the interventions are summarised in Appendix A, in alphabetical order within intervention type. The interventions are organised according to type as follows:

- School policy targeting EDNP foods
- Interventions focused on school food service
- School nutrition education
- Nutrition education in non-school settings
- Whole-of-school interventions
- Tailored nutrition advice and family-based dietary counselling

A summary and brief appraisal of each study, also organised according to intervention type, is presented below. All reported effect sizes are statistically significant (see summaries of interventions in tables in Appendix A for degree of significance) unless otherwise indicated.
3.1 School policy targeting EDNP foods

Almost all published interventions involving school food policy and food service targeting EDNP foods have been conducted in the US. A National School Lunch Program (NSLP) has been operating in the US since 1994 and 95% of children in the US are offered NSLP meals. Foods in this program must average 30% or less of their energy from fat, and menus must include two or more fruit and vegetable items daily. There are however no federal rules for competitive foods sold elsewhere in the school, such as snack bars and vending machines, and over 80% of middle schools sell a la carte (non-NSLP) food items.

3.1.1 School policy banning sale of EDNP foods in snack bars

An observational study conducted in 3 middle schools in Houston, Texas assessed the impact of school food policy banning the sale of chips, dessert foods and sweetened beverages at snack bars over one school year. Vending machines were also removed from the school cafeterias. The impact of the policy change was assessed using point-of-service (POS) sales records and children’s self-reported lunch consumption, collected on convenience samples of students over a period of two school years (Year 1 = pre-policy change; Year 2 = post-policy change). According to the students’ food records, consumption of sweetened drinks and soft drinks decreased significantly in Year 2, while consumption of saturated fat increased. The student records also showed concomitant increases in the purchase of fruit/juice, snack chips and candy from vending machines, and the consumption of sweetened drinks and soft drinks brought from home, post-policy change. On the other hand, POS data on snack bar sales showed significantly lower sales of soft drinks, candy and snack chips in Year 2, and no significant change in sales of sweetened drinks or sweets. A significant increase in ice cream sales from school snack bars was observed post-policy change.

Appraisal

The findings suggest that shifting occurred in the source of some food items, with more energy-dense foods brought from home or purchased from vending machines following the snack bar policy change. However, this was an observational, non-controlled study and only limited conclusions can be drawn about the impact of the policy change. Other limitations of this study included the use of self-report to assess dietary intake among convenience samples of students, lack of POS data from vending machines, and lack of data collected on food consumed outside of school hours. The lack of congruence between the POS data and self-reported food records may indicate limitations in the data. Nonetheless, this study highlighted the importance of targeting all food outlets in schools (i.e. a whole-of-school approach) to prevent compensation (i.e. purchase of less healthy foods from other sources within the school environment) from occurring.

3.1.2 School policy restricting EDNP foods sold in vending machines and cafeterias

A 12 month quasi-experimental, non-randomised study assessed the impact of guidelines implemented for foods sold in vending machines and on a la carte cafeteria menus in 7 high schools in Maine, USA. The guidelines indicated that all food products must provide less than 30% of calories from fat, and that sugar should not constitute more than 35% of product weight. The intervention was implemented over 1 school year in 4 intervention and 3 control schools. While data was reportedly collected on nutrient content and sales of food and beverages in school food outlets, as well as on anthropometric measures, dietary intake and physical activity levels of students, only anecdotal evidence on the acceptability of the food service changes was reported in the available paper. The findings indicated that there was some resistance to making healthy changes to the cafeteria menus (in 2 of the 4 treatment schools), due to perceived lack of food and beverage choices, and concerns about smaller portion sizes with similar cost. Food service staff expressed concern about how the changes would affect their job security, and school staff expressed concern about lack of soft drinks in faculty room vending machines. Less resistance to the vending machines guidelines was observed.
Appraisal
Without dietary intake data available, this study offers little evidence for the effectiveness of the changes at improving children’s diets, and only anecdotal evidence on intervention acceptability was available. In addition, it is possible that volunteer and allocation bias were introduced to the study through a non-randomised study design and voluntary participation in the intervention arm. The high level of interest in the study (>50 school districts offered to participate) may have been aided by monetary stipends offered to participating schools. The study team indicated that lack of data on food sales was due to the fact that many vendors did not collect or provide this information.

3.1.3 School policy banning sale of EDNP foods in all school food outlets
In another study conducted in the US, food policy banning the sale of unhealthy foods and beverages in all school food outlets (snack bars, lunch lines, vending machines, and fundraising and sporting events) was gradually implemented over a period of two school years in all elementary, middle and high schools in the San Francisco Unified School District (SFUSD). Standards were also implemented for fat, sugar and nutrient content, and portion sizes of all foods sold. The impact of the policy change was measured using school revenue data and lunch participation. A la carte/snack bar sales and participation in the paid school lunch line decreased as a result of the changes, however student participation in the federally-subsidized NSLP increased. This latter outcome may in part be explained by increased student eligibility for the NSLP. Almost half (46%) of students reported that they thought the school food tasted better post-policy change, although the majority cited free or inexpensive food as their main reason for choosing the NSLP meals.

Appraisal
This study demonstrated that changes could be made to the nutritional value of foods served in schools without reducing children’s consumption of school meals and without significant adverse effects on revenue. However, the impact of the policy change on overall school food service profits was unclear. In addition, conclusions cannot be drawn about the impact of the policy change on children’s dietary intake, as actual food consumption was not measured.

3.1.4 The Annapolis Valley Health Promoting Schools Project
In Nova Scotia, Canada, a large, population-based, cross-sectional study was conducted in 279 schools, 7 of which were involved in the Annapolis Valley Health Promoting Schools Project (AVHPSP), an intensive, co-ordinated program of school-based healthy eating recommendations consistent with recommendations from the US Centres for Disease Control. A further 73 schools reported having policies in place to offer healthy meals at school, and 199 schools reported having no nutrition policies in place. Body weight, height, dietary quality (determined by food frequency questionnaire) and physical activity levels of Grade 5 (10-11yrs) students were compared between the school categories. Results from 5,200 students showed that those children attending an AVHPSP school had lower rates of overweight and obesity and had better overall dietary quality than students in schools with no nutrition policy in place, as well as in schools that were implementing a non-AVHPSP nutrition policy. Lower fat intakes, higher levels of physical activity and lower participation in sedentary activities were also reported by AVHPSP-school students compared to students in all other schools; however these differences were not significant. No significant differences were observed between schools with and without ‘regular’ (non-AVHPSP) nutrition policies.

Appraisal
As the study was a cross-sectional analysis, conclusions cannot be drawn about the actual impact of the different categories of nutrition policies and the findings must be viewed with some caution. Nonetheless, some strengths of this study included the large sample size, measurement of height and weight (rather than relying on self-report), and a relatively high response rate (98.9% of school principals and 51.1% of students completed surveys). In addition, this analysis offers some evidence for the effectiveness of school nutrition policies and programs when they are coordinated, intensive and based on clear guidelines.
3.1.5 Middle-School Physical Activity and Nutrition Study: M-SPAN

A RCT conducted over 2 school years in 24 public middle schools in San Diego, USA evaluated the impact of school policy and environmental changes on students’ total and saturated dietary fat intake (as well as energy expenditure from physical activity) while at school. Strategies were introduced to improve the availability of low-fat food choices in school cafeterias and student stores by changing purchasing, preparation and serving practices. School food service staff received 11 hours of training. Low-fat food options were promoted to students through signage and verbal prompts at point-of-sale (POS). Strategies to assist students in bringing healthier foods from home were also implemented (approximately one third of students were estimated to bring bag lunches from home). There were no vending machines available for students at any of the participating schools. Three 90 minute policy meetings were scheduled at each intervention school over the study period, involving school principals, food service directors and managers, faculty, parents and students, and 80% of these planned meetings were held. Student health committees were set up at 8 of the 12 intervention schools to support and promote school policies through monthly activities, and parents were educated on healthy food options through newsletters, posters and PTA meetings. The primary nutrition outcome of interest was grams of dietary fat consumed on average per day per student at each school. Outcome measures included total and saturated fat sold through cafeterias (using menu and recipe documentation, food service staff interviews and sales data) and student stores (using sales data). Total and saturated fat in foods brought in bag lunches from home was assessed through direct observation of lunch. Student and parent/guardian surveys were completed at home, and included questions on student’s self-reported height and weight. No intervention effect was observed on total or saturated fat purchased at, or brought to school. A significant decrease in BMI was observed among boys attending the intervention schools (P=0.044); however as no improvements in dietary fat intake were observed, this outcome cannot be attributed to the nutrition component of the intervention.

**Appraisal**

While this study represents good practice in terms of design integrity and duration, it was not effective in reducing students’ dietary intake of fat while at school. It is possible that the lack of effect was due to inadequate implementation of the intervention. As such, the study team noted significant financial and logistical barriers to reducing availability of popular high-fat food options at schools. For example, some school districts operated under a centralised kitchen model, thereby limiting individual school control of meal ingredients and preparation. It also appeared that guidelines on food preparation and promotion were insufficiently implemented. For example, POS signage promoting low-fat options was not always possible in all schools. Confidence in the BMI findings is limited by the use of self-reported height and weight data. In addition, separate random samples of students and parents were asked to complete the surveys at baseline and post-intervention (rather than a cohort), and boys were under-represented in the survey samples (43%).

3.2 Interventions focused on school food service

Seven intervention studies which focused specifically on school food service and vending machine changes to reduce consumption of EDNP foods were identified in this review. All but two of these studies was conducted in the US and focused on the fat content of foods consumed; however the intervention strategies varied widely. Strategies included reducing the availability of high fat foods, increasing the availability of low fat foods, preferential pricing of low-fat foods, promoting low fat foods through public addresses and POS nutrition information, and setting up ‘school food groups’ to implement changes.
3.2.1 Decreasing availability of high-fat lunch options

A 1-year quasi-experimental study examined the effectiveness of limiting the availability of competing, higher-fat choices in school lunch menus on selection of low-fat lunch options in two elementary schools in Texas, USA (one treatment school, one control; total student enrolment =1,298). Initially (first semester), the availability of low-fat lunch entrees was increased to one out of three options in the intervention school. In the second semester, the availability of competing high-fat entrees was decreased from two options to one. At the end of the first semester, no appreciable difference in selection of low-fat entrees was observed between the intervention and control schools. At the end of the second semester, however, low-fat entrees were selected twice as often, and the high-fat options were selected significantly less, in the intervention school compared with the control.

Appraisal

This study offered evidence that limiting the availability of competing, high-fat choices in school lunch menus has the potential to improve students’ consumption of lower-fat foods. However, this study was limited to only two schools and the results were potentially confounded by increased student participation in the NSLP within the intervention school during the study period. In addition, food selection, not consumption, was the outcome measure and purchasing of foods from other school food outlets, such as vending machines, was not measured. Therefore, only limited conclusions can be drawn about the impact of the intervention on children’s actual dietary intake.

3.2.2 TACOS: Trying Alternative Cafeteria Options in Schools

The TACOS intervention also examined the effect of increased availability of lower-fat food options in cafeterias in the US; however it used a cluster RCT design involving a much larger sample size (10 intervention and 10 control secondary schools). This 2 year study also included school-wide promotion of lower-fat lunch options using peer leaders. Immediately post-intervention, sales of lower-fat foods had increased significantly in the intervention schools compared with the controls, and the total percentage of sales from lower-fat foods was higher in intervention schools than controls. On the other hand, there were no significant changes in student's self-reported food choices, according to student surveys. The student survey findings did however indicate greater perceived availability and normative support for lower-fat food choices among students in the intervention schools.

Appraisal

The effectiveness of this intervention was unclear, with lack of congruence between the sales data and student records. In addition, all 20 schools in the TACOS study were participating in the NSLP, therefore limiting the applicability of the findings to the NSW context. Nonetheless, it is feasible that peer-based promotion activities could be an effective complementary strategy to school food service changes. It is possible that the TACOS study was merely of insufficient intensity, and a complementary classroom-based educational component or strategies to involve students' families in the intervention may have enhanced its effectiveness.

3.2.3 Shape Up Somerville: Eat Smart, Play Hard

The effectiveness of school public address (PA) broadcasts to promote low-fat, high-fibre dishes added to school lunch menus was investigated in Somerville, Massachusetts USA. Six elementary schools were pair matched, with 1 school from each pair randomly selected to receive the PA messages, and the other acting as a control. The primary outcome of interest, measured by direct observation, was student selection of the lower-fat options over the higher-fat alternatives. Knowledge, attitudes, beliefs, social norms, preferences, and intention to choose the low-fat lunches were also measured pre- and post-test using interviewer-administered survey. Overall, students in the intervention schools were no more likely to select the low-fat options than the controls; however a significant intervention dose effect was observed when the intervention-control pairs were analysed separately. Thus, students in the intervention school that received the highest dose of the intervention (PA messages played almost daily) were 2.5 times more likely to choose the low-fat entrée options than students in their paired-control school. Students in the intervention school which received the lowest dose (PA messages played approximately once per week) were significantly less likely to choose the low-fat entrée option than students in their paired-control school (that is, the PA messages actually had a negative effect on choice).
Appraisal
This study demonstrates that PA messages at school may be promising as a promotional channel; however their ability to influence student lunch choices may be dose-dependent. Major limitations of this intervention were its short time-frame (less than four months) and cross-sectional data collection (individual students were not followed longitudinally). In addition, the intervention may not be directly applicable to NSW schools.

3.2.4 Point-of-sale nutrition information
The impact of nutrition information posted at point of selection (POS) on the food choices of high school students was investigated in a controlled, pre-test post-test study conducted in Pennsylvania, USA. The food choices of 9th-12th grade students at 4 intervention and 2 control schools were monitored over a 6 week period using food production and sales records. Slight to moderate improvements in the ‘healthfulness’ of food choices were observed among students attending the intervention schools compared to the controls, with significant increases in selection of items lower in fat and calories, and significant decreases in selection of items higher in fat and calories. While students were influenced by nutrition information on calories and grams of fat, information on carbohydrate, protein, cholesterol, fibre, vitamin A, vitamin C, iron and sodium had no significant effect on the student’s food choices.

Appraisal
This intervention offers some evidence for the effectiveness of POS nutrition information at improving food selection behaviours relating to fat and energy content. However, the study duration was short (only 6 weeks) and outcome measures were limited to food selection and sales, rather than changes in actual food consumption.

3.2.5 Vending machine strategies: Changing Individuals Purchase of Snacks (CHIPS)
This study examined the effect of reduced pricing and promotion of low-fat vending machine products in 12 schools in Minneapolis, USA. In a Latin square design, the impact of 4 levels of pricing differentials between low- and high-fat foods (equal price, 10% price reduction for low-fat snacks, 25% reduction, and 50% reduction), along with 3 intensities of POS promotion for healthy foods (no signs, signs labelling low-fat snacks, and signs labelling low-fat snacks combined with signs promoting low-fat snack choices) were explored. The 12 treatments were randomly implemented at each of the 12 schools, and each treatment remained in effect in all vending machines at each school for 4 weeks. The outcome measures were vending machine sales and profits. It was found that sales of low-fat snacks increased proportionately with increasing price reduction. Absolute number of all snack sales increased as the price differential increased by up to 50%. Labels and POS signage had a small but statistically significant positive effect on sales of low fat snacks. No effects were observed on profits. A similar study previously conducted by these authors also examined the impact on sales of low fat snacks from vending machines when their price was reduced by 50%21. This study found that sales increased by 80% over a 3-week period, however average profits fell from $116 per machine per week to $66 per machine per week. Presumably profits did not fall in the more recent study due to an overall increase in sales of all snack foods.

Appraisal
In this intervention, price reduction had a significant positive effect on sales of low-fat snacks; however it is not clear whether the observed sales increases were due to increased purchasing and consumption of snacks by existing customers due to lower prices (not a desirable outcome from an energy balance perspective), or to greater numbers of students being attracted to the vending machines (i.e. new customers). The pattern of sales volumes appears to indicate that substitution of regular snacks with low-fat snacks may only have occurred in the 10% price reduction condition. In the greater price reduction conditions (25% and 50%) it appears that either customers were increasing the absolute number of snacks they purchased or new customers were patronizing the vending machines. It would be important to assess these possible explanations in future interventions. This intervention also offered some evidence for the positive impact of point-of-sale nutrition labelling and promotional signage for healthy snacks. The intervention was short (changes were in place for only 4 weeks), and snack consumption outside of school-times was not assessed. Therefore, possible compensatory effects during the remainder of the day could not be determined. Other limitations identified by the study team were the limited type and number of low-fat snacks available, and time-delays in filling empty slots in the vending machines.
3.2.6 School food groups

The impact of introducing ‘school food groups’ (SFG’s) to implement catering interventions aimed at increasing healthy food availability and consumption in dining halls was investigated in 2 intervention and 1 control secondary schools in the United Kingdom (UK). This 2-year controlled comparative study involved students who were participating in a free school lunch program, and included peer and curriculum strategies. Data on food availability (from food production sheets) and consumption (direct observation) was collected on an on-going basis throughout the study period (in one eight-week monitoring period per term per school). Only one target relating to food availability was met in the intervention schools - increased availability of high fibre bread. Some small improvements were observed in food consumption among students in the intervention schools during the study period, with an increase in fruit and non-fried potato consumption observed in one school, and an increase in consumption of high-fibre bread observed in the other. However, only the increase in high-fibre bread consumption was sustained at the end of the two-year observation period (P<0.05).

Appraisal

This intervention resulted in no significant changes to school-based eating. It is possible that the lack of effect was due to limitations in the intervention design, including the small sample size and lack of clear guidelines given to food-services. Other limitations of this study included reliance on self-report of food production from school caterers (the study team recognised that staffing problems within the catering departments resulted in issues with regular collection of food production data), and lack of data on food consumption outside of school hours. Further, only one of the two intervention schools participated in peer- and curriculum-related activities, weakening the intensity of the intervention.

3.2.7 School food service changes with feedback and parental involvement

A 9 month cluster RCT conducted in 15 schools in Belgium evaluated the effectiveness of combining environmental changes with computer-tailored feedback, with and without the addition of parent involvement, on dietary outcomes in 2840 11-15 year olds. The program aimed to promote increased fruit and water consumption, and decreased fat and soft drink consumption among students. Food service changes included pricing reductions for fruit, reduced availability of soft drinks and increased availability of water in school. Dietary outcomes were measured by food frequency questionnaire, and computer-tailored feedback was provided to students on their fat and fruit intake. The parent component comprised of an interactive meeting at school, along with information disseminated through the school paper and newsletters, and the provision of a take-home CD with a computer-tailored intervention for parents to determine their own fat intake. Fat intake and percentage of energy from fat decreased significantly more among girls in the intervention group that received parental support than in the intervention-alone and control groups. This effect was not seen in boys. No intervention effects were seen for fruit intake, and soft drink and water consumption in any of the groups.

Appraisal

The findings indicate that providing personalised feedback on dietary intake based on behaviour change theory may be effective in supporting other school-based strategies among adolescent girls. However, further research into the effectiveness of this intervention approach among adolescent boys is required. It is possible that a number of weaknesses in the study design limited the intervention effect, including short duration, self-report of dietary intake, and lack of follow-up evaluation.

3.3 School nutrition education

Five studies were identified that focused on classroom-based nutrition education as a means of reducing consumption of EDNP foods. Three of these studies incorporated computer-based learning strategies, while 1 utilised a traffic light education tool and 1 incorporated nutrition education into classroom curriculum.
3.3.1 Traffic light education tool

A single pre- and post-test study evaluated the impact of a school traffic light nutrition tool on the knowledge, attitude and behaviour of 5-7 year olds in a state primary school in the UK. The tool encouraged children to freely eat ‘green’ (healthy) food, eat ‘amber food’ in moderation, and to stop and think before eating ‘red’ (energy-dense) food. Three weeks after nutrition education with the traffic light tool, children’s knowledge had increased significantly, positive attitude scores and asking behaviour for red food had decreased, and refusing behaviour increased. However, positive feelings and asking behaviour for green foods had also diminished.

Appraisal

This intervention was small (n=69), of short duration and very low intensity, did not involve a control group, and involved no long-term follow-up to determine sustainability of changes. As a result, the study does not provide sufficient evidence for the effectiveness of this approach. In addition, the findings were mixed, with improvements in knowledge, attitudes and behaviours relating to ‘red’ foods limited by concurrent adverse changes to attitudes and behaviours relating to ‘green’ (healthy) foods. It is not clear whether this was due to children’s misunderstandings relating to the intervention messages, deficiencies in the study methodology (such as insufficient duration, intensity or sample size), or limitations in the actual intervention strategy. It appears that there was no wider-school involvement and only partial involvement and/or support from parents.

3.3.2 School nutrition education and physical activity sessions

A RCT examined the effects of a 3-4 month school-based health, nutrition and exercise intervention on diabetes risk among 73 eight-grade (13yr old), predominantly Hispanic school students in New York City. Six 45-minute classroom nutrition sessions were delivered weekly and focused on lowering intake of fat (particularly saturated fat), sweetened sodas and juices, and ‘fast’ or ‘supersized’ food consumption. At follow-up, body fatness, BMI, insulin resistance, and circulating concentrations of C-reactive protein and IL-6 had decreased significantly in the intervention group compared to controls.

Appraisal

A major strength of this study was measurement of body fatness and BMI, among other biomedical diabetes risk factors. However, this intervention was limited by a short duration and small sample size, and the researchers felt that the intervention benefits would be unlikely to be sustained without ongoing reinforcement. Due to the study design it is not possible to determine the effectiveness of the nutrition education component, independent of the physical activity strategy. This intervention was targeted to first and second generation Hispanic immigrants to New York and some adaptation of intervention strategies may be required to be relevant to the NSW context.

3.3.3 Micro-computer nutrition education game

A 1 year RCT conducted in France assessed the effectiveness of a microcomputer nutritional teaching game at improving the dietary intake of children aged 7-12 years (n=1876) attending 16 schools within 1 school district. The intervention schools played the computer games for 2 hours each week for 5 weeks, in addition to the same conventional classroom-based nutrition education received by controls over the school year. At the end of the school year, dietary knowledge scores were significantly better in the intervention group compared with the controls. Almost one quarter (22.8%) of students in the intervention group reported that they had changed their snack consumption following the intervention, compared with 17.8% of controls. However, overall energy intake was not different between intervention and control students (as determined by 3-day diet record).

Appraisal

While this study had a large sample size and moderate duration, the intervention was of very low intensity and no differences in energy intake were observed between intervention and control students post-intervention. In addition, a significant limitation of this study was failure to collect baseline data on dietary knowledge and intake. Therefore the effect of the intervention strategy cannot be determined and the findings must be viewed with substantial caution.
3.3.4 Computer-based nutrition and lifestyle education

In a similar controlled trial involving 271 8-11 year old children in Austria, intervention schools used a computer-based teaching tool for nutrition and lifestyle education in addition to ‘traditional’ nutrition education materials over a 2 week period. Control schools received traditional nutrition education only. Nutrition knowledge, the primary outcome measure, had increased significantly in both the intervention and control schools post-intervention (there were no significant differences between intervention and control students), and the higher levels were maintained at 3 months follow-up. Younger students (aged 8-9 years) in the intervention schools had better nutrition knowledge post-intervention than older students aged 10-11 years. Student questionnaires indicated that the majority of students in the intervention schools rated the computer program as very good, and almost all (97%) indicated that they wanted to work with the computers in class again. However, follow-up focus groups revealed that students felt there was too much to read in the program and some of the words were too complicated. Teachers commented that computer-based nutrition education programs could be used in combination with traditional teaching tools to reinforce learning but were not appropriate for generating knowledge.

Appraisal

This intervention had a very short duration and was likely to be of insufficient intensity to show an effect (involving only five hours of nutrition education). In addition, there was a high drop-out rate and actual dietary consumption was not measured. Nonetheless, this study offers some evidence for the acceptability of computer-based learning strategies in school-based nutrition education (for both students and teachers), provided the computer program is well-designed. Content pre-testing with students from the target age-group would enhance acceptability.

3.3.5 Computer-based nutrition and physical activity education

A third study also compared the effectiveness of traditional and computer-based health education delivery methods at eliciting dietary behaviour change (in addition to physical activity). This 11 week study was conducted in a convenience sample of 275 adolescents from 3 schools (control, computer-based education intervention, and traditional education intervention) in South Florida, USA. Students in the computer-based intervention school received 5 x 45-minute education sessions using a validated CD-ROM program. Students in the traditional education intervention school received equivalent-length and intensity education sessions via lectures and pamphlets. Both education delivery methods resulted in increased nutrition knowledge and decreased total daily calorie intake compared to the controls, however the computer-based intervention school also showed significant reductions in self-reported fat intake, meals skipped, and average BMI, as well as significantly improved self-perceived ability to make better dietary choices. Almost all (99%) of students in the computer-based intervention group said they would prefer this method over traditional education methods, although the traditional education delivery method also received favourable ratings from participants.

Appraisal

Once again, this intervention was likely of insufficient intensity and duration to detect an effect. However, again, the study does contribute evidence for the acceptability of computer–based nutrition education.

3.4 Nutrition education and food service changes in non-school settings

3.4.1 Nutrition education in after-school care: CATCH Kids Club

The only intervention identified in this review that was conducted in the after-school-care setting was an adaptation of the Coordinated Approach to Child Health (CATCH) program (see appraisal of CATCH program later in this module) and was implemented in 16 after-school care programs in Texas, USA. In a quasi-experimental, pre-test post-test design, the effectiveness of a nutrition and physical activity education program was evaluated. Only 8 (i.e. half) of the after-school care sites involved in the program implemented the nutrition component. At these sites, food knowledge was found to be significantly higher in the intervention group post-test (after 6 months), with non-significant positive effects for food intake, behaviour and nutrition knowledge variables.
This study resulted in small (but not significant) improvements in food intake and nutrition knowledge, however, as the nutrition education component in this study was only implemented in 8 sites, the results were thought to be underpowered due to the small sample size. A more rigorous study design may have resulted in more conclusive findings.

### 3.4.2 Nutrition education and food-service changes in preschools: Healthy Start

Healthy Start was a 1 year intervention also modelled in-part on the CATCH program and conducted in New York State. Nine participating Head Start preschools were randomly assigned to Group A (nutrition education curriculum + food-service intervention), Group B (control curriculum + food service intervention) or Group C (control curriculum and no food service intervention). The aim of the food service intervention was to achieve a total fat intake of ≤30% of total energy and a saturated fat intake of ≤10% of total energy. Food service staff were trained for 1 full day on purchasing and preparation of heart healthy meals and snacks. Some parent involvement was facilitated through meetings with project staff. Dietary intake was measured by 24-hour recall at baseline and over a 2 year period. The food-service intervention was effective in reducing saturated fat consumption from preschool meals, as well as serum cholesterol levels, particularly in children at risk (i.e. with elevated cholesterol levels at baseline). The combination of nutrition education with food service modification had no additional effect on serum cholesterol; however, increases in nutrition knowledge were greatest among children in Group A (i.e children who had been exposed to both the food-service and nutrition education interventions), illustrating the effectiveness of multi-component interventions.

This study was of moderate duration and included strategies to involve parents. The findings indicated that food service changes were effective at reducing saturated fat consumption and serum cholesterol levels, however no additional benefit was achieved by combining the food service changes with nutrition education. It is possible that the nutrition curriculum was not implemented by the preschool teachers at intensity sufficient to observe changes. In addition, since all Head Centres are required by law to provide nutrition education to pupils, it may be that the extra nutrition curriculum was not of a sufficient dose to provide additional benefits.

### 3.4.3 Preschool nutrition education

A non-controlled pre-test, post-test study evaluated the effectiveness of nutrition education on healthy eating awareness and behaviours among 6,102 preschool children enrolled in the Food Stamp and Nutrition Education Program (FSNEP) in the US. The intervention consisted of 12 fortnightly nutrition lessons (i.e. over 24 weeks) covering healthy snacking, fruit and vegetable identification, and the food guide pyramid. Most lessons encompassed reading a book and tasting foods, and other activities included cassettes, videotapes, cooking, field trips, games, posters, discussion, computer lessons, songs, puzzles, art projects, and dramatic play. Pre-and post-intervention a pictorial instrument was used to collect data from the children and a survey about children’s eating habits and food attitudes was completed by parents. Significant improvements were observed in fruit and vegetable identification, healthy snack identification, willingness to taste foods, and frequency of fruit, vegetable, bread, meat, and dairy consumption. There were slight decreases in foods consumed from fats, oils, and sweets.

This intervention was short and of low intensity, however some improvements in preschool children’s eating behaviours were observed. There was no control group and no long-term follow-up evaluation was conducted, therefore it cannot be determined whether the positive changes could be sustained.
3.4.4 Community-based nutrition education

A 12 week RCT examined the effectiveness of a culturally-specific nutrition education program targeting African-American preadolescent girls aged 7-12 years (n=65) and their mothers. Participants were recruited through a community-based tutoring program and were all from low-income families living in inner-city Chicago. The treatment group attended weekly 1 hour interactive, culturally-specific educational sessions, while the control group participated in an equivalent-contact general health program. All mothers and daughters were assessed pre- and post-test using measured height and weight and dietary intake (using a computer-assisted food frequency questionnaire (QCF)). Mothers’ parental support and role modelling of healthy eating behaviours was also assessed using self-report questionnaire. At post-test, saturated fat and cholesterol intake did not differ between girls in the treatment and control groups, although percentage of calories from fat did reduce significantly more in treatment than control girls. Significant differences in mothers’ self-reported intake of saturated fat and percentage of calories from fat, and parental support and role modelling scores, were observed between the treatment and control groups. Observed differences in mothers’ dietary cholesterol intake were not statistically significant.

Appraisal

This intervention utilised a number of best-practice principles, including parental involvement and culturally-tailored strategies; however it was conducted over a period of only 12 weeks. Longer study duration may have resulted in more convincing findings. As such, while changes in the girl’s dietary behaviours in the treatment group were only minimal at the end of the study, it is possible that observed improvements in the mother’s role modelling and supportive behaviours may have influenced their daughter’s eating behaviours over a longer period of time. Other major limitations of the study design included voluntary self-selection of participants to the intervention (introducing the possibility of volunteer bias), and the selection of treatment and control groups from the same tutoring program (introducing the possibility of contamination). The measurement tools used, including the food frequency questionnaire had unknown validity and reliability, and parental support and role modelling was assessed by self-report (introducing the possibility of social desirability bias).

3.4.5 Girls Health Enrichment Multi-site Studies (Memphis GEMS)

GEMS is a multi-centre research program created in the US to assess the effectiveness of nutrition and physical activity interventions at preventing excess weight gain in pre-adolescent African-American girls. In Phase 1 of the program, 4 field centres independently developed and assessed their own pilot interventions following a set of common eligibility criteria and key measurements. All centres implemented their interventions for 12 weeks using an RCT design. The program was supported by funding from the US National Heart, Lung, and Blood Institute.

One of the four Phase 1 trials, the Memphis GEMS pilot study, was conducted in Memphis, Tennessee, and targeted both dietary and physical activity behaviours. This small, culturally-tailored, family-based pilot trial involved 54 girls aged 8-10 years and their parents/caregivers. All participants had a baseline BMI greater than or equal to the 25th percentile of the CDC growth charts, and the majority of participants were from low-income households. The principal objective of the pilot study was to assess the feasibility of the intervention approach and to determine its level of promise for preventing excess weight gain. Participants were randomised to 3 groups: a child-targeted intervention with girls-only, a parent-targeted intervention with parents-only, and a control group. The child-targeted intervention (‘GEMS Jamboree’) consisted of weekly 90 minute interactive sessions, encompassing nutrition (Munchin’ It), and physical activity (Movin’ It) components. Nutrition activities included group discussions on healthy eating, taste-testing and food preparation, food art, a modified farmer’s market and label reading. The parent-targeted intervention (EASY - ‘Eating and Activity Skills for Youth’) also involved weekly 90 minute sessions. The control group participated in 3 meetings (once per month) designed to enhance self-esteem, through art and crafts, and games. Dietary intake was assessed by 24 hour recall. Height, weight, waist circumference, percentage body fat, insulin sensitivity and glucose levels were measured, although the study was not designed to have sufficient statistical power to detect changes in physical measures. Post-intervention, the parent-targeted group showed more positive trends towards lower caloric intake from fat compared with the child-targeted group. Girls in the two intervention groups
combined did show a trend towards decreasing BMI and waist circumference, although this was not significant. Process evaluation showed that the intervention was well received and the vast majority of participants were satisfied with their participation in the program. The study team noted that many participants would have preferred a joint parent-and-child intervention, and recommended incorporation of this approach into Phase 2 of the GEMS trial.

**Appraisal**

This study’s short duration and small sample size limited the conclusions that could be drawn regarding the potential long-term effectiveness of the two intervention approaches (child-targeted and parent-targeted), although the primary objective of the study was to assess the feasibility and acceptability of the program design. Strengths of this study included its theoretical grounding in Social Cognitive Theory (SCT), the conduction of an initial 12 week feasibility study to pre-test the intervention strategies, comprehensive training of the intervention team, and the provision of child-care during parent-targeted sessions. The study also had very high retention (100%) and participation rates (88% attended at least 80% of scheduled sessions), possibly due to the cash incentives provided to participants for completing baseline and follow-up assessments. The study targeted African-American girls and their families and had culturally-specific components. Some modifications to the approach and strategies used may be necessary to be applicable to the NSW context.

### 3.6 Whole-of-school interventions

#### 3.6.1 CATCH: Child and Adolescent Trial for Cardiovascular Health

CATCH was the first multi-site field trial comprising state-of-the-science classroom, school food service, physical education, and family (home-based) interventions to test the effectiveness of a population-based approach for reducing cardiovascular disease (CVD) risk. This intervention was one of only a few conducted to measure impact on nutrient intakes and overall daily energy intake. Three years into the intervention, daily energy intake had increased from baseline in both the intervention and control schools; however the increase was significantly smaller in intervention schools. The food service program (Eat Smart) achieved significant reductions in the percent of calories from total fat and saturated fat in school lunches served. No significant differences were observed in serum cholesterol or other physiologic measures. Interestingly, the addition of a family component to the school food service component did not affect nutrient intakes in children in intervention schools. A follow-up evaluation was conducted at 5 years post-intervention in the CATCH-ON study. Further reductions in percentage of calories from total and saturated fat in school lunches were observed in former CATCH intervention schools, however former CATCH control schools (which had received the CATCH program materials and training at the end of the main trial) demonstrated significantly greater reductions in percentage calories from total and saturated fat respectively compared to former intervention schools. At the same time, former intervention schools had more closely aligned with the Eat Smart goal of<30% of calories from fat. There was some evidence for a secular trend of reduction in percentage of calories from fat, as significant decreases, although smaller, were observed in new control schools (which had no exposure to the CATCH program) as well.

**Appraisal**

The CATCH program was successful in reducing total and saturated fat content of meals served at school, although this was not supported by reductions in overall daily energy intake or serum cholesterol levels in intervention students after 3 years. The follow-up evaluation conducted 5 years after the end of the main trial was a major strength of this program. Evidence of secular trends towards decreasing fat intakes from new control schools at the 5-year follow-up restricts the strength of the findings somewhat; however it appears that positive school food service changes were maintained by former intervention schools, and were picked up by former control schools (which had received the CATCH intervention 5 years earlier at the end of the main trial). Interestingly, this study offers no evidence for the effectiveness of home-based family strategies.
3.6.2 Pathways\textsuperscript{37-38}

The Pathways study was a school-based, multi-component intervention which aimed to reduce rates of overweight and obesity in American-Indian school children (Grades 3-5) by targeting 4 key areas: school food service, physical activity, classroom curriculum, and family involvement. A number of papers have reported on the 3 year RCT, which involved 1704 children in 41 schools serving American-Indian communities in Arizona, New Mexico and South Dakota. The curriculum component involved 45 minute classroom education sessions conducted twice weekly for 8-12 weeks per school year. Lessons were designed to promote healthy eating and physical activity by integrating social learning constructs with American Indian culture and traditions. The school food service component aimed to reduce the fat content of school lunches to less than or equal to 30% calories from fat by providing training, food service guidelines and regular site visits and support from Pathways nutritionists. Strategies to involve families included family fun nights and events and family packs linked to the curriculum. Post-intervention, 24-hour recall data indicated significantly lower total daily energy intakes and percentage of energy intake from fat in the intervention group compared to the controls. Lunch observation data also showed significantly lower percentage energy intake from fat in the intervention group post-test, but indicated no difference in total energy intake between groups. Intervention children in all 3 grades demonstrated significantly greater levels of knowledge relating to healthy eating and physical activity, as well as healthy food choice intentions, than control children at follow up. Process evaluation data indicated good implementation of the curriculum (94%) and food service (78%) components, and positive feedback from family events. Notably, despite the observed behavioural changes, BMI and percentage body fat was not significantly different between intervention and control children post-test.

Appraisal

Major strengths of this study included a 3-year feasibility study conducted prior to the intervention (during which all intervention components were developed and pilot-tested), use of validated measurement instruments, the intensity of the intervention, measurement of dietary intake by 24 hour recall, use of process evaluation, and strong school and community support for the program. The 24 hour recalls were conducted only at follow-up, therefore changes from baseline could not be determined. While PATHWAYS was an example of a well implemented and evaluated project, observed improvements in dietary intake in the intervention group immediately post-intervention were not supported by changes in BMI and percentage body fat.

3.6.3 Health Promoting Schools in China\textsuperscript{40}

A 1.5 year ‘Health Promoting Schools’ (HPS) intervention conducted in Zhejiang province, China was an example of a whole-of-school initiative with a focus on nutrition education. Six intervention and six control schools were involved in the study with a combination of primary and secondary schools and a total intervention arm of 7500 students and their families, and 800 teachers and school staff. Strategies implemented in the intervention schools included the establishment of school-based working groups, nutrition training for school staff, distribution of materials on nutrition, nutrition education of students, student competitions, school-wide health promotion efforts and outreach to families and communities. The control schools continued their routine health education activities. Nutrition knowledge, attitudes and behaviour improved among all target groups within the intervention schools, with the largest increases in nutrition knowledge occurring among parents and guardians. In addition, improvements to intervention school facilities and health services, establishment of school policies and positive school climates were reported.

Appraisal

This study was based on best practice ‘Health Promoting Schools’ principles and reported positive outcomes in terms of school systems change and parental nutrition knowledge. However, children’s dietary behaviours were not assessed therefore the impact on actual consumption of EDNP foods cannot be determined.
3.6.4 APPLES

The ‘Active Programming Promoting Lifestyle Education in School’ (APPLES) program also employed the ‘Health Promoting Schools’ philosophy to target whole school communities through teacher training, changes to school food service, and the development of school action plans. Ten primary schools in Leeds, UK participated in a 12 month cluster RCT, involving 634 7-11 year old students. Measured height and weight, dietary intake (24 hr recall and 3 day food diaries), and physical activity (questionnaire) were assessed at baseline and post-intervention. Focus groups were conducted post-intervention to investigate children’s knowledge and attitudes to healthy living. Findings from these focus groups indicated that children in the treatment schools demonstrated higher levels of knowledge and understanding of the health benefits of diet and physical activity, as well as self-reported behaviour change, than children in the control schools post-intervention. These findings were not reflected in the 24-hour recall and food diary data however, which indicated no significant differences in consumption of foods high in fat or sugar between treatment and control children post-intervention. There were also no differences in BMI between treatment and control children post-intervention.

Appraisal

While improvements in knowledge and attitudes were observed among students in the intervention schools, this study did not detect changes in intervention children’s behaviours relating to consumption of EDNP foods, or improvements in weight status among intervention children. It may be that the study was of insufficient size, duration or intensity to detect behavioural changes. In addition, relatively low response rates were observed for the 3-day food records at baseline (63%) and post-intervention (64%), introducing the possibility of response bias.

3.7 Tailored nutrition advice and family-based dietary counselling

Two long-term, highly-intensive trials involving individualised family-based counselling and support aimed at reducing consumption of EDNP foods were identified in this review.

3.7.1 STRIP: Special Turku Coronary Risk Factor Intervention Project for Children

STRIP was a prospective, long-term RCT delivered in Finland and involving 1062 children aged 7 months at baseline and their parents. This intervention was resource-intensive, with parents in the intervention group receiving individualised dietary and lifestyle counselling every 1 to 3 months until their children were 2 years of age, and thereafter twice per year until 10 years of age. Intervention children also received nutrition counselling directly from 7 to 10 years of age. Control parents received basic well-baby health information at a lower intensity: biannually until 7 years, then annually thereafter. Based on a time restricted cohort (n=98) at 7 years of age, saturated fatty acid intake as a percentage of energy intake was lower in the intervention group compared with controls, and this difference was maintained at 9 years of age. At 10 years of age, overweight prevalence was significantly lower among girls in the intervention group (10%) compared with controls (19.0%). There was no difference in weight status between intervention and control boys at 10 years.

Appraisal

Considering the length and resource-intensity of this program, the outcomes were relatively unimpressive. This study offers only weak evidence for the effectiveness of individualised dietary and lifestyle whole-of-family counselling over many years.
3.7.2 DISC: Dietary Intervention Study in Children

A multi-centre RCT grounded in social-learning and social-action theory promoted adherence to a recommended diet designed to lower blood cholesterol by reducing dietary fat, saturated fat and cholesterol while increasing intake of fibre, fruits and vegetables. The study involved 663 preadolescent (8-10 year old) children with elevated low-density lipoprotein (LDL) cholesterol at baseline. While originally planned as a three year intervention, participating children were followed, on average, until the age of 17, with continuing but gradually reducing intervention intensity. A DISC-GO Guide (food wheel) was developed to assist participants and their families in easily identifying ‘go’/green foods (low in saturated fat and cholesterol) and ‘whoa’/red foods (high in saturated fat and cholesterol), while maintaining a balanced diet from all major core food groups. During an intensive first 6 months of intervention, nutritionists and behaviourists led family-oriented group sessions focused on promoting use of the DISC-Go Guide and providing practical tips on how to follow the diet. Sessions were designed to encourage learning of healthy behaviours through observation and imitation of role models (such as parents and other family members, peers and celebrities). The intervention intensity was gradually reduced, with group maintenance sessions and regular telephone contact provided until the end of the study. Throughout the intervention, emphasis was placed on individual goal setting and eating plan development, behavioural self-management, reinforcement and problem-solving. Intervention approaches were revised as the participants transitioned into adolescence. Children randomized to the usual-care (control) group received material regarding heart-healthy eating that was readily available to the public. Dietary intake in both groups was assessed by validated 24-hour recall. At the end of Year 3, the intervention group had significantly increased their relative consumption of recommended ‘Go’ foods in all food groups except fruit, and significantly decreased their relative consumption of ‘Whoa’ foods in all groups except pizza, compared to the usual-care group.

Appraisal

This study used a family-oriented approach, as well as employing theory-based behaviour change techniques, and achieved positive changes to dietary intake at the end of the first three years. The use of a food wheel to simplify each major food group into healthy (‘go’) and unhealthy (‘whoa’) foods appeared to be well accepted and utilised by participants.
4. Evidence Appraisal

4.1 Intervention evidence
The 29 intervention studies identified in this review illustrate the range of strategies that have been applied in recent years to promote reduced consumption of EDNP foods in children. On the basis of the evidence available, the range of interventions undertaken appears somewhat restricted in that the majority of them have been school-based and conducted in the US. In addition, methodological flaws are likely to have limited the potential effectiveness of many of the programs identified. There has been considerable heterogeneity in study design and quality, with many studies of insufficient intensity and/or duration to detect an effect. Few studies involved a follow-up evaluation. Outcome measures have frequently been limited to food production and sales records, lunch participation, or nutrient content of foods available at school. Few studies evaluated energy intake as an outcome measure, and only a handful looked at total daily energy intake in order to allow for possible compensatory effects in foods consumed outside of school. A number of studies failed to include a control group, or randomise children appropriately in order to avoid cross-contamination between intervention and control groups. A few studies failed to take baseline measurements, therefore no conclusions could be made about the effectiveness of these interventions.

Despite these limitations the evidence is informative in a number of ways. While there appears to be no single, well-defined intervention approach that stands out as most effective, a number of approaches have shown some promise as a means of affecting behaviour change relating to consumption of EDNP foods in children, and from the literature we know that this behaviour change has significant potential to reduce energy intake and inappropriate weight gain in this age group. The major findings and implications from the evidence are summarised below to offer a practical interpretation of the intervention studies.

4.1.1 School food policy
While the evidence available on school food policy is limited, school policy to restrict availability and consumption of EDNP foods appears to be a promising strategy, provided a coordinated and multi-strategy approach is taken. The US studies identified primarily targeted students who were eligible for the National School Lunch Program (NSLP) and are therefore not directly relevant to the NSW context, in which meals are not routinely provided at schools. Nonetheless, they do offer evidence for the potential effectiveness of school policy limiting the sale of unhealthy food options. Overall, the best available evidence indicates that school policy targeting all food outlets in schools to prevent compensation (i.e. purchase of less healthy foods from other sources within the school environment) from occurring is likely to be most effective. Further research is required to determine the more specific features of effective school nutrition policies.

4.1.2 Interventions focused on school food service
The majority of school food-service interventions identified in this review were conducted in school cafeterias in the US. Nonetheless, evidence from these interventions can be applied to the NSW context, where increasing the availability of healthy foods and limiting the availability of competing EDNP foods in school canteens and vending machines may be an effective strategy when combined with other initiatives. While foods from school canteens and vending machines constitute only a small proportion of overall dietary intake, the suggested ‘ripple’ effect might help to reduce the overall energy intake of children.45

The US studies focused on increasing the availability of low-fat options at lunch, rather than aiming to decrease the energy content of foods served. While this strategy has obvious longer term health impacts in terms of cardiovascular disease, it is unlikely to impact on daily energy intake. Since dietary intake out-of-school was not measured in most of the studies, possible compensatory effects of the lunch menu changes could not be determined.
From the limited studies available, it appears that posting POS information on the fat and calorie content of foods available may improve the dietary quality of students’ selections. Further, the use of school public address systems to promote availability of low-fat lunch options was shown to be effective in the Shape Up Somerville study\textsuperscript{[16]}, and one possible adaptation of this in the NSW context would be verbal promotion of low energy-dense foods by school canteen staff.

There is some, limited evidence to suggest that optimal pricing and promotion strategies relating to food sold in vending machines may be effective in reducing children’s consumption of EDNP foods in school. It is feasible that such strategies could be expanded to other school food outlets, such as canteens. It would be interesting to observe the profit levels that would result from raising the price of high-fat foods while keeping low-fat foods at a lower price. The challenge would be to find an optimal price increase for high-fat foods that would curb demand for these foods while maintaining sales of lower-fat foods. In this way, it is possible that minimal impacts on overall revenue could be achieved.

4.1.3 **School nutrition education**

There is some evidence to indicate that school-based nutrition education can improve dietary knowledge and behaviour among students. Simple educational tools, such as the traffic-light nutrition tool used in the UK\textsuperscript{[24]}, have the potential to be cost-effective and implemented on a large-scale. Computer-based interventions are a relatively new approach to delivering nutrition education and the evidence base is limited, particularly in regards to the effect on actual dietary intake. The available studies indicate that computer-based educational programs are likely to be well-accepted by students and can be effective in increasing knowledge; however the results are mixed as to whether they are more effective than traditional modes of education. This is a relatively resource-intensive strategy and may be outside of the capacity of some schools to deliver. As such, computer-based nutrition education may be most effective as a tool to supplement and reinforce ‘traditional’ classroom teaching methods when possible.

4.1.4 **Nutrition education in non-school settings**

There is currently insufficient evidence available regarding the effectiveness of programs to reduce consumption of EDNP in after-school care settings, with only one poorly implemented study identified which showed inconclusive results.\textsuperscript{[29]}

Two studies conducted in the preschool setting were identified, one of which successfully improved the dietary quality of foods served at preschool, and subsequently demonstrated a reduction in children’s serum cholesterol levels, particularly among children with elevated cholesterol at baseline.\textsuperscript{[30]} At the same time, this particular study did not provide good evidence for the effectiveness of nutrition education provided to preschool-aged children. The other study identified in this setting did provide some evidence of the potential for creative, practical educational strategies (including tasting sessions, cooking, field trips, games and plays) to improve knowledge and behaviour relating to healthy eating among preschoolers, however this study suffered from a number of methodological limitations.\textsuperscript{[31]}

Two studies identified in this review focused on nutrition education targeting EDNP foods in the community setting. Both were conducted in the US with Africa-American pre-adolescent girls and their mothers.\textsuperscript{[32, 33]} These studies used culturally-tailored intervention strategies and offered promising initial results. The strength of the findings were likely limited by short intervention duration, with both studies implemented for only 12 weeks.
4.1.5 Whole-of-school interventions

From the evidence available, it seems that multi-component interventions, involving multiple, complementary strategies offer the most promise for reducing children’s consumption of EDNP foods. CATCH\textsuperscript{34-36} and PATHWAYS\textsuperscript{37-39} were both large, multi-component interventions conducted in the US, which employed complementary food-service, curriculum, physical education and family-participation strategies. Both programs primarily targeted children’s dietary fat intake, although assessed changes in total dietary energy intake as well. The CATCH program successfully reduced children’s lunchtime intake of total and saturated fat, and improvements were maintained at 5 years follow-up. The CATCH program also had some, limited, success at restricting increases in total daily energy intake. The PATHWAYS program was one of few studies directly aimed at reducing overweight and obesity rates, and targeting indigenous school children. It was more successful than the CATCH program at reducing energy intakes, in addition to having positive impacts on fat and saturated fat intakes, but did not affect BMI. It is plausible that if the CATCH and PATHWAYS programs had focused their strategies on children’s energy intake, rather than on fat and saturated fat, they may have had more success at reducing children’s energy intake and achieving changes in weight status.

The Health Promoting Schools’ project conducted in China\textsuperscript{40}, and the APPLES project conducted in the UK\textsuperscript{41} both provide further evidence for the benefits of taking a whole-of-school approach. Overall, it is difficult to ascertain from these whole-of-school programs which were the most effective individual components or approaches, due to the myriad differences between the interventions and the lack of evaluation of individual components. Without such evaluation, it is possible that certain strategies within multi-component programs might be extraneous and waste limited resources. This would be particularly plausible in programs with a large number of individual strategies, as implementation intensity of some of the various activities is likely to be restricted by resource and time limitations.

4.1.6 Tailored nutrition advice and family-based dietary counselling

Two interventions involving the provision of tailored dietary counselling and advice to families were identified from the literature. The STRIP study provided only weak evidence of effectiveness, despite a very long intervention duration and high intensity.\textsuperscript{42} The DISC study, offered some limited evidence for the effectiveness of a long-term, theory-based behavioural change strategy targeting preadolescents, and utilising individual tailoring and social support.\textsuperscript{44} Once again, however, this study was cost- and labour-intensive.

Overall, the available evidence indicates that individual counseling and advice has some potential to be effective when delivered intensively and over a long period of time; however, it is unlikely to be feasible as part of a community-based program.

4.2 Clusters and gaps in the intervention evidence

The available evidence base on reducing consumption of EDNP foods in children is clustered around a small range of strategies, settings and target groups. As a result, there are gaps in the evidence base, where there may be substantial potential for effective interventions, but where there is currently very limited or no evidence available. One implication of these gaps is that the design and evaluation of new and innovative interventions to reduce children’s consumption of EDNP foods remains a high priority.

The vast majority of the interventions targeting consumption of EDNP foods have been conducted overseas and in school settings, and many studies specifically targeted lunch foods provided through school cafeterias. Very few studies on interventions in the home and community settings were identified, yet the environmental context in which children live is likely to significantly influence overall dietary intake.
As such, eating meals with family members has been identified as a factor contributing to higher quality dietary intake in children, while a lower frequency of meals eaten with the family has been linked with overweight in childhood in several recent studies (Sen 2006, Gable 2007, Taveras 2005), although the evidence is not conclusive. A US national sample of 9 to 14 year olds showed that those children who ate dinner with family members more often had higher intakes of fruits, vegetables, fibre, and food micronutrients, and had lower intakes of fried food, soda, saturated fat, trans fats, and lower glycemic load (Gillman 2000). There was however no apparent impact on intake of whole dairy foods, red meat or other snack foods in this latter study (Gillman 2000).

Parents’ capacity to implement behaviour change, such as increasing the frequency or dietary quality of family meals may be limited by their parenting skills. Therefore, enhancement of parenting skills is likely to be critically important in assisting parents to support their child in achieving changes in diet and physical activity behaviours (Robinson 1999). The limited available intervention evidence for developing healthy family meal patterns has focused on the early life period, despite current observational data suggesting that declines in family meals occur during adolescence. Therefore, pilot-testing the feasibility of interventions to increase the frequency and quality of family meals in adolescence is recommended. Further investigation of interventions to enhance parenting skills in relation to healthy eating behaviours and consumption of EDNP foods is warranted.

No interventions conducted in Australia and targeting consumption of EDNP foods were identified from the literature. Since many Australian children take a packed lunch from home to school, the relevance of the evidence from school cafeteria-based programs is limited.

Finally, while a handful of programs identified used culturally-tailored approaches, the use of age, gender and culture-specific strategies has been limited.
5 Promising and appropriate strategies

A range of strategies to promote healthy eating and reduce children’s consumption of EDNP foods have been outlined and discussed in this module, and appraised both for their level of promise and applicability to the NSW context. The following table presents strategies identified in the evidence appraisal above and based on three levels of ‘promise’ for reducing children’s consumption of EDNP foods:

1) Strategies that have shown promise based on the available evidence and are applicable to the NSW context;
2) Strategies which have shown some promise in the evidence that could be extended or adapted to suit the NSW context, and are therefore worthy of consideration;
3) Gaps in the evidence base that could be addressed through further intervention research.

The following table presents the evidence-based strategies that have been appraised in this module as showing particular or some promise for reducing consumption of EDNP foods in children at the population level and are appropriate for implementation in the NSW context, together with gaps in the evidence and thus considerations for intervention research priorities. Decisions about which particular strategies to include in any portfolio of interventions will depend on the needs of the target population, the relevance to existing programs, and the capacity for implementation.

Table. Strategies and level of promise shown in the evidence

<table>
<thead>
<tr>
<th>5.1 Promising and appropriate strategies based on available evidence</th>
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<tbody>
<tr>
<td>• Whole-of-school programs involving school food service, school environments, classroom curriculum and family-focused strategies</td>
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<tr>
<td>• School policy limiting availability of EDNP foods and promoting healthy foods in all school food-outlets</td>
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<tr>
<td>• Preferential pricing and promotion of low energy-dense foods in all school food-outlets e.g. point-of-sale signposting and verbal promotion</td>
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<tr>
<td>• School-based nutrition education, including complementary computer-based strategies</td>
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<tr>
<th>5.2 Strategies worthy of consideration</th>
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<tbody>
<tr>
<td>• Nutrition education in after-school care and preschool settings</td>
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<tr>
<td>• Community-based nutrition education strategies involving children and parents together, including focus on parenting behaviours and role modelling</td>
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<table>
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<tr>
<th>5.3 Gaps in the evidence and priority areas for future research</th>
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</thead>
<tbody>
<tr>
<td>• Interventions to reduce availability and consumption of EDNP foods at home/community</td>
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<tr>
<td>• Social marketing strategies to promote awareness and reduce appeal of ‘extra’ and EDNP foods</td>
</tr>
<tr>
<td>• Pricing, availability and point-of-sale interventions in sporting and recreational settings frequented by children</td>
</tr>
<tr>
<td>• Interventions to reduce environmental prompts for EDNP (that is, limit advertising outdoors, sports facilities, supermarkets and retail outlets)</td>
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</tbody>
</table>
6 Implications for policy and practice

6.1 Implementation considerations
The evidence from intervention research on EDNP foods is limited at this stage, but illustrates a number of promising approaches including coordinated, whole-of-school initiatives, introduction of school policy limiting availability of EDNP foods, nutrition education, and preferential pricing and promotion of low energy-dense foods in all school food-outlets.

While much of the available evidence base on reducing children’s consumption of EDNP foods has come from outside of Australia, there is significant potential for modification of promising strategies and programs to suit the NSW context. The NSW approach of banning soft drinks and limiting unhealthy food options in school canteens, for example, is consistent with available evidence on the effectiveness of school policy interventions. As a widespread policy innovation, it will be valuable to monitor and evaluate this approach in the longer term. In addition, the largely US-based evidence available on food-service changes has implications and applications to food outlets in NSW settings outside of schools, including health services, and sporting and recreational settings. Promising strategies using this approach include preferential pricing of, and promotion and point-of-sale nutrition information for low energy-dense foods in all food outlets.

From the evidence reviewed in this module, a number of key best practice principles appear to enhance potential for program effectiveness and long-term success. These include:

- Employing a mix of strategies that complement and reinforce each other (for example, taking a whole-of-school approach targeting organizational change, availability, education and promotion),
- Targeting children and parents/families together
- Targeting home and community settings, in addition to schools
- Implementing high quality interventions of sufficient size, duration and intensity to detect an effect and determine the extent to which these effects are, or are not, maintained over time
- Interventions that address energy intake and promote energy-balance, as opposed to targeting the nutrient content of foods.

6.2 Portfolio approach
It is well recognised that no single intervention alone is likely to be effective in improving children’s diets to a degree that impacts on population level obesity rates, therefore a portfolio of complementary strategies is required, and decisions about which particular strategies to include in any portfolio of interventions will depend on the needs of the target population, as well as the capacity of the communities and/or organisations implementing them. For example, efforts to reduce consumption of EDNP foods in combination with promotion of low energy-dense foods, such as fruit and vegetables, is likely to be an attractive approach for many programs and settings; therefore a portfolio of strategies that includes programs to promote fruit and vegetables along with strategies to reduce consumption of energy-dense, nutrition-poor foods, is suggested.

Generally, the implementation and effectiveness of programs will be enhanced by supplementary initiatives, such as social marketing and public education through local media and other channels, and community strategies to limit the availability and promotion of EDNP foods in settings frequented by children (such as sporting and recreational facilities, and retail outlets).
### 6.3 Translating evidence into cross-sector actions

Approaches identified as promising and worthy of consideration have been interpreted into practical actions/programs that may be relevant to areas within NSW and Australia. The relevant sectors that could contribute to implementation have also been identified:

<table>
<thead>
<tr>
<th>Promoting reduced consumption of EDNP foods</th>
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<tr>
<td><strong>DO</strong></td>
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<tr>
<td>Whole-of-school programs involving school food service changes, classroom curriculum and family-focused strategies</td>
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<tr>
<td>School policy limiting availability of EDNP foods and promoting healthy foods in all school food-outlets</td>
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<tr>
<td>Preferential pricing and promotion of low energy-dense foods in all school food-outlets</td>
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<tr>
<td>e.g. point-of-sale signposting and verbal promotion</td>
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<tr>
<td>School-based nutrition education, including complementary computer-based strategies</td>
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<tr>
<td><strong>CONSIDER</strong></td>
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<tr>
<td>Nutrition education in after-school care and preschool settings</td>
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<tr>
<td>Community-based nutrition education strategies involving children and parents together, including focus on parenting behaviours and role modelling</td>
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<tr>
<td><strong>RESEARCH</strong></td>
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<tr>
<td>Interventions to reduce availability and consumption of EDNP foods at home/community</td>
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<tr>
<td>Social marketing strategies to promote awareness and reduce appeal of ‘extra’ and EDNP foods</td>
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<td>Pricing, availability and point-of-sale interventions in sporting and recreational settings frequented by children</td>
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<td>Interventions to reduce environmental prompts for EDNP (that is, limit advertising outdoors, sports facilities, supermarkets and retail outlets)</td>
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| Sectors | C - Community services | E - Education | H - Health |
References


### Appendix. Tables summarising the available intervention evidence for reducing consumption of energy-dense, nutrient-poor foods

**Table A1. School policy targeting EDNP foods**

<table>
<thead>
<tr>
<th>Ref</th>
<th>Setting</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/ Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davee et al 2005</td>
<td>School Design: Quasi-experimental, Non-randomised Duration: 1 year</td>
<td>High schools 4 intervention schools 3 control schools</td>
<td>Guidelines on all foods sold in cafeterias and vending machines had to be low fat (&lt;30% calories from fat) and low-sugar (not more than 35% by weight of sugar)</td>
<td>Ability to provide items that met guidelines (qualitative) Acceptability of intervention</td>
<td>Healthy changes to vending machines more easily achieved than to a la carte programs. Technical assistance and ongoing support essential for successful implementation In 2 of the 4 intervention schools – resistance to the changes to the a la carte program – removal of specific items (carbonated beverages, cookies, high-fat snacks); perceived lack of food and beverage choices, smaller portion sizes with similar costs Food service staff: concerned about how the changes would affect their daily responsibilities and job security Faculty staff complained about lack of carbonated beverages in vending machines</td>
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<tr>
<td>Sallis 2003</td>
<td>School Design: RCT Duration: 2 years</td>
<td>24 public middle schools (Grades 6-8) 12 Intervention; 12 control schools (mean enrolment = 1109)</td>
<td>School policy and environmental changes aimed at improving availability of low-fat foods and increasing physical activity 3 x 90 minute school policy meetings at each school Student health committees Food services: -11hrs staff training -Goal to change purchasing, preparation and serving practices -Food service plans developed to reduce fat content of foods served - POS signage and verbal prompts for low-fat options Parent newsletters, posters and PTA meetings Healthy lunch contests</td>
<td>Primary nutrition outcome variable: Total and saturated fat grams/day/student Menu and recipe documentation Food service staff interviews Cafeteria and student store sales data Direct observation of lunch periods Student and parent/guardian surveys (including self-reported height and weight)</td>
<td>No significant effect on grams total or saturated fat purchased at school or brought from home (near null effect) Student/Parent survey findings: Significant BMI decrease in intervention boys (P&lt;0.05) No change in BMI in girls No change in student’s self-reported consumption of fatty foods or parents reported avoidance of fatty foods in meal preparation</td>
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<tr>
<td>Veuglers &amp; Fitzgerald 2005</td>
<td>Setting: School Design: Cross sectional population based comparison Duration:</td>
<td>Grade 5 students 286 schools: 7 = Annapolis Valley Health Promoting Schools Project 73 = regular nutrition policies 199 = no nutrition policy N=5200 students</td>
<td>Compared schools with and without nutrition programs. Two categories of schools with nutrition programs: Schools reporting a nutrition policy/ program in place to offer healthy menu alternatives, and schools participating in a coordinated program incorporating CDC recommendations for school-based healthy eating programs (the Annapolis Valley Health Promoting Schools Project - AVHPSP)</td>
<td>Height/Weight Dietary intake (food frequency questionnaire) Physical activities Sedentary activities</td>
<td>Students from schools participating in the coordinated AVHPSP program exhibited significantly lower rates of overweight and obesity and healthier diets (more F&amp;V, lower % fat) than students from schools without coordinated nutrition programs. AVHPSP students also reported more participation in physical activity and lower participation in sedentary activities (although not significant) than students from the other schools. Lower reported fat intakes (OR=0.36; 95% CI: (0.11, 1.13) among AVHPSP students compared to students in schools with no nutrition program were also not significant. No significant differences in dietary quality, PA, sedentary behaviour, overweight or obesity between schools with and without ‘ordinary’ nutrition programs</td>
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<tr>
<td>Weber, Cullen et al 2006</td>
<td>Setting: School Design: Observational Duration: 2 years</td>
<td>6th-8th grade students 3 middle schools N=2790 61% Hispanic, 34% white, 3% African American, 2% Asian/other</td>
<td>Year 1: No changes to school environment (pre-policy change) Year 2: Chips and dessert foods removed from snack bars by Food Service Director at all schools. Vending machines removed from cafeterias</td>
<td>Amount and source of food and beverages consumed at lunch measured by student records completed immediately following lunch Snack bar sales measured by point-of-sale machines</td>
<td>Consumption of sweetened beverages declined significantly (P&lt;0.05) and milk, calcium, vitamin A (P&lt;0.01), saturated fat and sodium (P&lt;0.05) increased significantly Consumption of snack chips and candy from vending increased and number of vending machines doubled during the study period Sales of soft drinks (P&lt;0.05), candy (P&lt;0.001) and snack chips (P&lt;0.01) from snack bars decreased. No change in sales of sweetened drinks or sweets Ice-cream sales increased significantly</td>
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<tr>
<td>Ref</td>
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<td>Wojcicki &amp; Heyman 2006</td>
<td>Setting: School Design: Before-after retrospective Duration: 2 years</td>
<td>Aptos Middle School students Grades 6-8: N=859 San Francisco Unified School District (SFUSD): Approx 2003-2004 enrolment = 59,000 21.2% African American, 34.9% Asian American, 24.3% Latin American</td>
<td>Jan 1, 2003: State policy banned soft drinks sales in all elementary and middle schools (not high schools due to lobbying, protests etc by school districts and food industry over loss of revenue) 2002-2003 school year: Gradual changes in a la carte/snack bar school lunch options at Aptos Middle School August 2003 (start of 2003-2004 school year): San Francisco Unified School District (SFUSD) implemented the Student Nutrition and Physical Fitness Plan: - Gradually eliminated sale of unhealthy foods, snacks, and beverages from all lunch lines, snack bars, and vending machine locations in all public elementary, middle and high schools. - Standards for fat and sugar content and minimum level of nutrients - Portion sizes reduced Restrictions applied to all food outlets in schools, fundraising, sports events Goal to encourage more students to go through school lunch line, where SFUSD nutritional standards applied</td>
<td>Comparison between 2002-2003 and 2003-2004 school years: School enrolment Monthly school revenue Student lunch participation Eligibility for free and reduced-price school lunch program (SLP)</td>
<td>Aptos Middle School 2002-2003: -Food sale revenue increases SFUSD 2003-2004: -Overall increased participation in federally-subsidised free and reduced-price SLP – possible explained to some extent by increased eligibility for SLP -Decreased participation in paid school lunch line -Effect of menu changes on overall profits unclear -46% of students thought food tasted better post-implementation of policy changes -Students cited free or inexpensive food offered in the cafeteria as their main reason for choosing to participate in the SLP</td>
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**Table A2. Interventions targeting school food service**

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<tr>
<th>Ref</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
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<tbody>
<tr>
<td>Bartholemew &amp; Jowers 2006</td>
<td>Setting: School, Design: Quasi-experimental, Duration: 1 year</td>
<td>2 elementary schools: One intervention (N=571), One control (N=727), Elementary school children (76% Hispanic, African American or other)</td>
<td>School lunch (entrée) modification in intervention school – both schools had identical daily 3 choices of entrée prior to intervention: Phase 1 (one semester): Increased frequency of days offering at least one lower-fat entrée (1 option out of 3) Phase 2 (following semester): Reduced availability of high-fat entrees (1 option out of 2) No change to control schools’ lunch menu</td>
<td>% of children selecting entrees of differing fat contents - low-fat (&lt;30% energy from fat), moderate-fat and high-fat (&gt;35% energy from fat)</td>
<td>Phase 1: Frequency of offering low-fat entrée option increased significantly in intervention school, but no appreciable difference in frequency of selection of these entrees between intervention and control school. Phase 2: Low fat entrees were selected more than twice as often when paired with 1 rather than 2 higher-fat options (32.1% intervention versus 13.8% control P&lt;0.01). High-fat entrée option selected significantly less in intervention school than in control (P&lt;0.01) SLP participation increased slightly in intervention school</td>
</tr>
<tr>
<td>Conklin et al 2005</td>
<td>Setting: School, Design: Pre-and-post intervention, with control group, Duration: 6 weeks</td>
<td>9-12th grade students, 6 schools (4 intervention, 2 control) Average total daily student attendance = 8,560 Mix of rural, suburban and urban locations, with mixed ethnic make-up % of NSLP meals served varied from 4-72%</td>
<td>Regular school nutrition programs conducted as usual for first 6 weeks of fall semester (once through menu cycle) During second 6 weeks, nutrition information posted at point of sale (POS) for each entrée item in intervention schools. Nutrition labels included information on serving size, calories per serve, total fat, saturated fat, cholesterol, sodium, total carbohydrate, dietary fibre, protein, vitamins A and C, calcium, and iron.</td>
<td>Student food choices (assessed by food production and sales records)</td>
<td>Slight to moderate improvements observed in students’ selection of healthier options lower fat and calories in intervention schools. No effect on food selection from other criteria (fibre, vitamin A, vitamin C, iron, and sodium, carbohydrate, protein, and cholesterol)</td>
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<tr>
<td>Ref</td>
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<td>Intervention description</td>
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<td>Folta et al</td>
<td>Setting: School</td>
<td>6 elementary schools (3 intervention, 3 control) Urban, multiethnic community</td>
<td>Intervention and control schools were pair-matched based on size, ethnic makeup and % of students receiving free or reduced NSLP meals Two new low-fat, high-fibre dishes (bean taco and bean chili) available in cafeterias were promoted in intervention schools using announcements over the school PA systems. Students in control schools received their usual morning PA announcements.</td>
<td>Choice of dried bean dishes at school lunch Secondary outcomes included knowledge, attitudes, beliefs, social norms, preferences and intentions to choose beans at school lunch.</td>
<td>When data were analysed for all school pairs, there was no difference in bean (low-fat) dish selection between the intervention and control schools. However the announcement schedule and frequency differed between the three school pairs. The children in the intervention school receiving the highest message dose (almost daily) were 2.5 times as likely to choose the bean dish compared to their control school (P&lt;0.001). Other schedules had no effect (medium-dosage of PA messages; P=0.23) or negative effect (lowest dosage; P&lt;0.001) on bean dish selection.</td>
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<td>2006</td>
<td>Design: RCT</td>
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<td>Pre-test/post-test cross-sectional data collection (children were not followed longitudinally) Duration: 1 year</td>
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<tr>
<td>French et al</td>
<td>Setting: School</td>
<td>12 schools</td>
<td>Vending machines – product availability, promotional marketing and pricing 4 levels of pricing; 3 levels of promotion – Latin square design Each of the 12 treatments implemented at each of the 12 sites in a random manner Each treatment remained in effect in all of the vending machines at a site for 4 weeks (1) Price – (a) equal price (b) 10% price reduction for low fat snacks (c) 25% price reduction (d) 50% price reduction (2) (a) no signs (b) signs labelling low-fat snacks (c) signs labelling low fat snacks combined with signs on vending machines encouraging a low fat snack choice</td>
<td>Low fat snack sales Profits in dollars per machine Sales volume</td>
<td>Sales of low fat snacks increased proportionately with increasing price reductions Labels and signage had small, but statistically significant, effects on sales of low fat snacks Average profits per machine not affected by interventions Nb. A small price reduction (10%) increased % of snacks sold that were low-fat without increasing total sales volume or absolute no. low fat snacks sold – therefore vendors might have been substituting low fat snacks for a regular snack. However, prices reduced further – absolute number of low-fat snacks sold increased as did the total sales volume – customers may therefore have increased the number of snacks purchased (not good) or more customers were attracted because of price differential. Also, don’t know what compensatory effects happening the rest of the day.</td>
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<td>Ref</td>
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<tr>
<td>French et al 2004</td>
<td>Setting: School Design: Group-RCT Duration: 2 years</td>
<td>Secondary school students 20 secondary schools (10 intervention, 10 control) Median school enrolment = 1731 students Predominantly suburban All 20 schools were participating in NSLP</td>
<td>Increased availability of lower fat food options (&lt;5g fat/serve) in cafeteria a-la-carte areas School-wide, student-based (peer) promotions of these lower-fat foods No classroom educational component or home-based family component</td>
<td>Sales of lower-fat à la carte foods Student self-reported food choices</td>
<td>Significant positive effect on sales of lower-fat foods to students: Steeper rate of increase in sales of lower-fat foods in year 1 (10% increase in intervention school vs -2.8% in control, P = 0.002) and higher % of sales of lower-fat foods in year 2 (33.6% intervention vs 22.1% control, P = 0.04) Students perceived a greater availability of lower-fat food choices in the cafeteria à la carte areas and greater normative support for lower-fat food choices at school No significant changes in student self-reported food choices</td>
</tr>
<tr>
<td>Fulkerson et al 2004</td>
<td>Setting: School Design: RCT Duration: 2 years</td>
<td>Secondary school students 10 secondary schools (the 10 schools randomised to the intervention arm of the wider TACOS study) Student enrolments ranged from 812 – 3157 (median = 1493) Predominantly suburban 6% of students eligible for free/reduced price school lunch</td>
<td>Student-led promotions to increase sales of lower-fat à la carte food options (≤ 5g fat per serving) Food service staff increased availability of lower-fat options in cafeterias and assisted with promotions Student groups recruited to plan, organise and implement promotional activities (including one faculty staff member and one member of research staff) Promotional activities included coupon kick-offs, taste-testing, public service announcements and media campaigns, poster and T-shirt contests, raffles, and student surveys Monetary incentives provided for student groups</td>
<td>Food sales (computerised POS sales data) collected weekly Information on implementation of promotional activities</td>
<td>181 promotions were implemented (49 in Year 1; 132 in Year 2) Number of promotions conducted positively associated with percentage lower-fat food sales in Year 1 (P = 0.033) but not in Year 2 (P = 0.399) Duration of promotions significantly positively associated with percentage lower-fat food sales in Year 2 (P = 0.029) but not in Year 1 (P = 0.207)</td>
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<tr>
<td>Haerens et al</td>
<td>Setting: School Design: Cluster RCT Duration: 9 months</td>
<td>11-15 years N = 2991 15 schools</td>
<td>Aimed to promote healthy food choices (increase fruit consumption to at least 2 pieces per day; reduce soft drinks consumption and increase water consumption; reduce fat intake) and PA engagement&lt;br&gt;Healthy Food Intervention:&lt;br&gt;o Fruit sold once/week at low cost or provided free&lt;br&gt;o Reduced availability of soft drinks at school&lt;br&gt;o Drinking fountains and cost differential of bottled water vs. soft drinks in canteens/vending machines&lt;br&gt;o Nutrition education&lt;br&gt;o Tailored feedback re. fat intake and fruit intake (5-6 pages)&lt;br&gt;o Extra supportive activities including classroom activities – e.g. healthy breakfast and educational games&lt;br&gt;o Parental involvement – interactive meeting at school, computer CD for fat intake&lt;br&gt;Three conditions: intervention; I + parental support; control</td>
<td>% children exceeding the fat intake of a max of 30% of energy from fat (fat intake – self-administered questionnaire)&lt;br&gt;Fruit intake (FFQ)&lt;br&gt;Soft drinks (FFQ)&lt;br&gt;Water (FFQ)&lt;br&gt;Nb. Effects on adiposity and PA not yet published</td>
<td>Fat intake – effective in girls but not boys, and only when parental involvement was included&lt;br&gt;Post-intervention, fat intake (g/day) and % of energy from fat had decreased significantly more in girls in the I + P condition compared with control (p&lt;0.0001) and intervention alone (p&lt;0.05)&lt;br&gt;Nb. No process evaluation details provided&lt;br&gt;Nb. Soft drink consumption in particular very high at baseline</td>
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<tr>
<td>Parker &amp; Fox</td>
<td>Setting: School Design: Controlled comparative study Duration: 2 years</td>
<td>3 secondary schools (2 intervention, 1 control)</td>
<td>School food groups (SFGs) were set up in the two intervention schools. All catering interventions were actioned via the SFGs&lt;br&gt;Increased availability of healthier food choices in school dining halls&lt;br&gt;Discrete promotion of healthy food choices&lt;br&gt;Improvements to dining hall environments (e.g. photo menu boards)&lt;br&gt;Peer-related and curricular activities: Drama workshops and production, planned food and health lessons including food-tasting workshops</td>
<td>Availability of healthier foods&lt;br&gt;Number of pupils consuming healthier foods and consuming foods from the school dining hall</td>
<td>No significant changes in school-based eating at the end of the study&lt;br&gt;Some dietary changes occurred at an early stage but not sustained (positive changes for fruit and non-fried potato in one intervention school and for high-fibre bread and non-cream cakes in the other)&lt;br&gt;Increased availability of high-fibre bread in both intervention schools was met – the only food availability target to be met&lt;br&gt;Availability of food items in control schools remained stable</td>
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### Table A3. School nutrition education

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<tr>
<th>Ref</th>
<th>Design</th>
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| Casazza & Ciccazzo | 2007   | High school students 13-18 years N=275 | Nutrition education intervention in adolescents comparing computer-based (CD-ROM) delivery method with traditional method (lectures and pamphlets). 3 schools: One control school, one computer-based intervention school (CBI), and one traditional intervention school (TDI). Intervention: Five 45 minute sessions, each session followed up with 5 question evaluation form. | BMI  
Self-reported food intake and physical activity  
Nutrition knowledge  
Self-efficacy (diet and exercise)  
Perceived social support | BMI ↓ significantly only in CBI school and ↑ significantly in control school. Nutrition knowledge scores ↑ significantly in both CBI and TDI. Total calorie intake ↓ in both TDI and CBI, and self-reported fat intake and meals skipped ↓ in CBI. Perceived dietary social support from family and friends both ↑ in TDI and CBI. Self-perceived ability to make healthier dietary choices ↑ in CBI. 99% of CBI participants indicated they would prefer this delivery method over traditional delivery; Both CBI and TDI gave favourable satisfaction ratings. |
<p>| Ellis &amp; Ellis      | 2007   | Students at 1 state primary school 5-7 years N=69 | School traffic light nutrition tool Children’s knowledge, attitude and behaviour tested 3 weeks before and three weeks after nutrition education | Knowledge, attitude and behaviour | At 11 weeks: Knowledge improved significantly and positive attitude scores, asking behaviour for red foods decreased and refusal behaviour for red foods increased. However, positive attitudes and asking behaviour for green foods also decreased. |</p>
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<tr>
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<tr>
<td>Kreisel 2004</td>
<td>Setting: School Design: Controlled trial Duration: 2 weeks</td>
<td>3rd and 4th grade students N=271 8-11 yrs</td>
<td>Control schools (n=7) used ‘traditional’ nutrition education materials for a total of 5 hours of class-time over 2 weeks. Intervention schools (n=8) additionally used a computer-based education tool (Cool Food Planet KIDZ) for a total of at least 50 minutes of class time within the designated 5 hours.</td>
<td>Nutrition knowledge assessed at baseline, post-intervention and at three months follow-up using questionnaire Program evaluation questionnaire</td>
<td>Nutrition knowledge increased significantly in both intervention and control schools, irrespective of the teaching tool used (P&lt;0.001) and this effect was maintained at 3 months follow up. There were no differences in nutrition knowledge post-intervention or at follow up between the two study groups. In intervention schools, younger students (8-9 years) had better nutrition knowledge than older pupils (10-11 years) at post-intervention (p=0.01). Only 57% of students successfully completed the study, due to incomplete questionnaires, coding issues and schools not adhering to the study protocol. 60% of students in intervention schools rated the Cool Food Planet KIDZ as ‘very good’. 81% indicated they would visit Cool Food Planet KIDZ on the internet. Almost all (97%) indicated that they wanted to work with the computer again in class. Students more critical about program in focus groups – comments included too much to read, font too small, sentence structure and words too complicated. In general, younger pupils seemed more enthusiastic about Cool Food Planet KIDZ. Teachers in favour of using computer-based education tools to reinforce of what students have already learned.</td>
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<td><strong>Rosenbaum et al</strong></td>
<td>Setting: School Design: RCT Duration: 3-4 months</td>
<td>8th grade students 13 yrs N=73 All subjects were the first or second generation of their family in the US. The majority had origins in the Dominican Republic</td>
<td>Lifestyle program (health, nutrition, and exercise classes plus and aerobic exercise program) delivered by study investigators. The 6 X 45min nutrition sessions held weekly focussed on lowering intake of fat particularly saturated fat, sweetened sodas and juices, ‘fast’ or ‘supersized’ food consumption.</td>
<td>Diabetes risk – body fatness (bioimpedance) &amp; BMI, insulin sensitivity, β-cell function, lipid profiles, C-reactive protein, IL-6, adiponectin, and TNF-α</td>
<td>Compared with both the control group and the baseline measures in the intervention group, at follow-up (4months) the intervention group had a significant decrease in body fatness, BMI, insulin resistance, C-reactive protein and IL-6</td>
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<td><strong>Turnin et al</strong></td>
<td>Setting: School Design: RCT Duration: 1 year</td>
<td>16 schools within one district N=1,876 Children in last 3 years of primary school 7-12 yrs (mean age = 9) 52.5% girls</td>
<td>No data collected at baseline. 16 schools randomized to intervention and control group All students received conventional nutrition teaching by their teachers. The intervention group also used microcomputer nutritional learning games (one hour twice per week for 5weeks).</td>
<td>Nutritional knowledge (school-based test) Dietary intake (3-day diet record at home) Eating habits (questionnaire filled out at home)</td>
<td>Nutritional knowledge scores significantly better in intervention group (48.8 points + 0.4) compared w/ controls (46.1 points + 0.4), P&lt;0.001. Intervention group reported eating more plain dairy products (P&lt;0.05) and starchy foods (P&lt;0.001), less delicatessen food (P&lt;0.01), and less sweetened dairy desserts and total fat at 12 months post-test (P&lt;0.0001). 22.8% of intervention students reported that they had changed their snacks following the intervention, versus 17.8% of controls (P&lt;0.05). However, no significant difference in mean daily energy intake between intervention and controls. Some other dietary improvements were reported but these seem rather dubious because there is no baseline data and many focus on calorie distribution.</td>
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### Table A4. Nutrition education and food service changes in non-school settings

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<th>Ref</th>
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<th>Intervention description</th>
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<tr>
<td>Beech et al</td>
<td>Setting: Community Design: Pilot RCT Duration: 12 weeks</td>
<td>Preadolescent (8-10 year old) African-American girls and their parents/caregivers N= 54</td>
<td>12 week feasibility study conducted prior to pilot. Participants randomized to 3 arms: 1 - Child-only intervention (GEMS Jamboree) 2 – Parent-only intervention (EASY – Eating and Activity Skills for Youth) 3 – Control</td>
<td>Height, weight, waist circumference, % body fat (DEXA scan), sexual maturation, insulin sensitivity, blood glucose levels</td>
<td>Data collected at baseline and post intervention  High retention rate (100%) and attendance rate (88% attended at least 80% of sessions)  Both intervention groups combined: Trend toward decreasing BMI and waist circumference (not significant)  Parent-only intervention group exhibited greater trend toward lower caloric intake from fat than child-only intervention group</td>
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<td>Cason</td>
<td>Setting: School Design: Pre-test/ post-test Duration: 24 weeks</td>
<td>Pre-school age children enrolled in the Food and Nutrition Services Food Stamp Nutrition Education Program N=6102</td>
<td>Pre-school nutrition education program based on the theory of multiple intelligences comprising of 12 fortnightly lessons of 40min duration.</td>
<td>Change in fruit and vegetable identification, healthy snack choices, willingness to taste foods, and eating behaviours</td>
<td>Post-intervention (24wks) there was a significant improvement in fruit and vegetable identification, healthy snack identification, willingness to taste foods, and frequency of fruit, vegetable, bread, meat, and dairy consumption. There were significant decreases in reported consumption foods from fats, oils, and sweets.</td>
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### Table: Module 3 - Interventions to reduce consumption of energy-dense, nutrient-poor foods

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<tr>
<td>Kelder et al</td>
<td>Setting: School Design: Pilot study, pre-test/post-test quasi experimental design with control group Duration: 6 months</td>
<td>School children grades K-5 N=157 Outcomes measured for grades 3 to 5 only 16 after-school day-care programs (8 in El Paso, 8 in Austin – 4 intervention and 4 control sites in each area)</td>
<td>Catch Kids Club (CKC): After-school adaptation of the CATCH program Physical activity and nutrition education programme comprising of a 5 module education component, a physical activity component and a healthful snack component</td>
<td>Self-reported food intake and physical activity Direct observation of moderate to vigorous physical activity during play-time Qualitative evaluation data by after-school program staff</td>
<td>Proportion of students exceeding recommendations for moderate to vigorous physical activity was 56.8% in the intervention group and 31.3% in controls (P=0.001) at post-test (6 months), with levels increasing for the intervention group and decreasing for controls. Only students from one site participated in the 5 module education component thus results were thought to be underpowered. Nevertheless, at that site food knowledge was higher in the intervention group at post-test with non-significant positive effects for other food intake variables.</td>
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<td>Stolley et al</td>
<td>Setting: School Design: RCT Duration: 12 weeks</td>
<td>Preadolescent (7-12 years old) African-American girls and their mothers N=65 Participants recruited through community-based tutoring program for low-income families Monetary incentives provided to mothers and daughters</td>
<td>Intervention: Weekly 1 hour interactive educational sessions using culturally-specific curriculum Activities including taste-testing, comparing foods, meal planning and recipe adaption, culturally-relevant music and dance (e.g. “Raps against fat”) Control: Equivalent-contact general health program</td>
<td>Height and weight (measured) Dietary intake (computer-assisted food frequency questionnaire) Mother’s support and parental role modelling (self-report questionnaire)</td>
<td>Drop-out rate = 22% in mothers, 17% in children Drop-out mothers had significantly lower mean weight than finishers (P&lt;0.05) 75.4% of mothers and 76.9% of children attended at least 6 of the 12 sessions Girls: No significant difference in saturated fat and cholesterol intakes between groups; however % calories from fat significantly lower in intervention group (P&lt;0.05) Mothers in intervention group reported greater increases in parental support and role modelling scores than control mothers from baseline (P&lt;0.01) Significant differences in mother’s self-reported intake of saturated fat (P&lt;0.05) and percentage of calories from fat (P&lt;0.001)</td>
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<td>Ref</td>
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<td>Williams et al 2004 Cardiovascular risk reduction in preschool children: the 'Healthy Start' Project New York, USA</td>
<td>Setting: School  Design: RCT  Duration: 1 year</td>
<td>Nine ‘Head Start’ preschool centres Preschool children (2-5 years)</td>
<td>Allocation of schools to 3 groups:  A: Control (safety and accident prevention school curricula + home materials);  B: Intervention 1 (food service modification only);  C: Intervention 2 (food service modification + nutrition curricula + home materials)  Aim of food service intervention to achieve ≤ 30% energy from fat and ≤ 10% energy from saturated fat  Staff training and guidelines  Parent meetings</td>
<td>Cholesterol levels Dietary intake (24 hour recall)</td>
<td>No differences between intervention groups therefore combined in model (nutrition curricula no effect)  Significant decrease in total serum cholesterol in children in intervention groups compared to control -6.0 versus -0.4 mg/dL  Children with elevated cholesterol at baseline – significantly more likely to have cholesterol in normal range at follow-up if attended intervention school</td>
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### Table A.5 Whole-of-school programs

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<tr>
<td>Caballero et al 2003</td>
<td>Setting: School Design: RCT Duration: 3 years</td>
<td>41 schools serving American Indian communities (20 control, 21 intervention schools) 3rd to 5th grade N=1704</td>
<td>4 components: 1) change in dietary intake, 2) increase in physical activity, 3) a classroom curriculum focused on healthy eating and lifestyle, and 4) a family-involvement program. Classroom curricula: 2x45 minute sessions each week for 8-12 weeks/year Food service component: Training, guidelines and regular site visits. Aimed to reduce fat content of school lunches to ≤ 30% calories from fat Family component: Interactive forum, take-home action packs, family events including cooking demonstrations</td>
<td>Main outcome = % body fat (Bioelectrical impedance and anthropometry) Other outcomes: BMI and weight (anthropometry) dietary intake (24 hour recall and direct observation), physical activity (motion sensor), and knowledge, attitudes, and behaviours (questionnaire) Process evaluation (attendance logs, kitchen visits, student and parent evaluation forms)</td>
<td>No significant reduction in % body fat Significant reduction in % energy from fat according to 24hr recall data (P=0.001) and direct lunch observation (P=0.005) Significant reduction in total energy intake according to 24 hr recall data (P=0.003), but not supported by direct observation data (P=0.804) Knowledge increased significantly in all 3 grades (Grades 3 and 5: P=0.001; Grade 4: P=0.013), and reported healthy food choice intentions (P=0.001) Process evaluation: 94% of classroom sessions and 78% of food service guidelines implemented</td>
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<tr>
<td>Himes et al 2003</td>
<td>Setting: School Design: RCT Duration: 3 years</td>
<td>N = 1,700 students in 41 schools (20 control, 21 intervention schools) 3rd to 5th grade</td>
<td>Intensive 3-year intervention with school food service staff – to reduce fat content of school meals (breakfast and lunch) to 30% or fewer calories from fat, without compromising dietary quality Other intervention components – classroom curriculum, new skills and activities for PE classes, activities and events with families Nutritional aspects of the curriculum and family component emphasised healthy eating and low-fat alternatives</td>
<td>School lunch nutrient intakes – what they ate, not just what they were served 24-hour dietary intakes NB BMI and physical activity levels at follow-up were not significantly different in intervention children compared to control children</td>
<td>At end of 3 years: Lunch: Significant decreases in mean % of calories from total fat (3.6%) and saturated fat (2.1%) relative to controls Significant increase on % of calories from total carbohydrate (3.7%) 24-hour: Significantly smaller total energy intakes (263 kcal), protein (9.5 g), total fat (6.0 g), saturated fat (6.0 g) and polyunsaturated fat (2.3 g), and as a % of calories, total fat (2.5%) and saturated fat (1.1%) Mean intake of carbohydrates as % of calories higher in intervention children by 2.5%</td>
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<td>Ref</td>
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| Lytle et al | Setting: School   | Sub-sample of CATCH cohort: 3rd grade (baseline N=1874) and 5th grade (follow-up N=1182) students | The CATCH Eat Smart School Nutrition Program: School food service component designed to provide students with appealing meals lower in total fat, saturated fat, and sodium while maintaining recommended amounts of energy and essential nutrients and student participation. During the trial, the Eat Smart Program targeted the food service staff and administrators through training sessions, educational materials, and ongoing support visits to effect positive changes in the nutrient content of school meals offered to students. | Mean change in nutrient intakes using 24 dietary recall before and after 3 years of intervention | Energy intake increased +40 kcal baseline to 3yr follow-up in students in treatment schools compared to +167 kcal in students in control schools (P<0.03)  
Total fat -0.4% control vs 2.4% treatment at f/up (P=0.005)  
Saturated fat -0.3% vs -1.2% (P<0.005) at f/up  
NB. Addition of family component to school component did not result in significant differences between the 2 intervention groups in terms of nutrient intakes  
No differential effects across ethnicity and sex |
| Osganian et al | Setting: School   | 3rd to 5th grade elementary school students N=56 intervention schools N=20 control schools | Targeted the school food service staff and aimed to lower the total fat, saturated fat, and sodium content of school meals. Four major areas of change in food service operations: menu planning, food purchasing, food preparation, and program promotion. | Nutrient content of school menus                       | 5 consecutive days of school menu, recipe and vendor product information collected at 3 intervals: Fall 1991, Spring 1993, and Spring 1994  
Significantly greater mean reduction in % of calories from total fat (adjusted mean difference -4.4%; P<0.0001) and saturated fat (-1.5%; P=0.003) in intervention compared with control schools at 3yr follow-up.  
% of total calories from fat decreased from 38.7% to 31.9% in intervention schools and from 39.1% to 36.7% in control schools.  
% of calories from saturated fat decreased from 14.8% to 12% in intervention schools and from 15.1% to 13.8% in control schools. |
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<tr>
<td>Osganian et al</td>
<td>Setting: School</td>
<td>Elementary schools grades 3-5:</td>
<td>5 years post-intervention follow-up of CATCH Eat Smart School Nutrition Program – No further intervention</td>
<td>Nutrient content of school menus</td>
<td>5 consecutive non-randomly selected days of school menu, recipe and vendor product information collected at 5 years follow-up Former CATCH intervention schools demonstrated further decreases in mean % calories from total and saturated fat of 0.9% (from 31.9% to 31%) and 1.6% (from 12% to 10.4%) respectively Greater decreases in these nutrients were observed in former CATCH control schools: % calories from total fat decreased by 3.5% (36.7% to 33.2%) and from saturated fat decreased by 2.8% (13.8% to 11%). However former intervention schools more closely approached the Eat Smart guidelines of 30% of total calories from fat, and this difference was significant (P&lt;0.01) Overall sodium levels rose in both intervention and control schools and did not differ significantly between the two groups at follow-up Some evidence of secular trends towards decreasing % of calories from fat (control schools levels similar to nationally-representative data collected 1998-1999).</td>
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<td></td>
<td>Design: Observational</td>
<td>56 former CATCH intervention schools</td>
<td>Former CATCH control schools had received the CATCH intervention materials and training at the end of the main trial (June 1994), and were therefore considered minimally exposed to the program. The 12 new schools had received no exposure to the CATCH program</td>
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<td></td>
<td>Duration: 4 year</td>
<td>20 former CATCH control schools</td>
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<td>12 new schools</td>
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<td>USA</td>
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<tr>
<td>Sahota et al</td>
<td>Setting: School</td>
<td>10 primary schools</td>
<td>Used Health Promoting Schools philosophy to implement whole-of-school change: Teacher training, modification of school meals, development of school action plans, curriculum changes, physical education, tuckshop and playground activities</td>
<td>BMI (anthropometry)</td>
<td>No significant differences in consumption of high fat and sugar foods</td>
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<td></td>
<td>Design: cluster RCT</td>
<td>7-11 year olds</td>
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<td>Dietary intake (24 hour recall and 3 day food diaries)</td>
<td>No significant differences in BMI</td>
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<td></td>
<td>Duration: 12 months</td>
<td>N=634</td>
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<td>Physical activity (questionnaire)</td>
<td>Improved knowledge and understanding of health benefits of diet and physical activity in intervention group</td>
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<td>Self-perception/psychological wellbeing (questionnaire)</td>
<td>Significant difference in self-reported behaviour change in intervention group</td>
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<td>Knowledge and attitudes (focus groups)</td>
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<tr>
<td>Shi-Chang</td>
<td>Setting: School</td>
<td>Students in grades 3, 4, &amp; 5 of primary schools and grades 1 &amp; 2 of secondary</td>
<td>Aim was to develop a model project for nutrition interventions for health-promoting schools (HPS) in China. Interventions schools: established school-based working groups, nutrition training for school staff, distribution of materials on nutrition, nutrition education of students, student competitions, school-wide health promotion efforts and outreach to families and communities. Control schools: Continued routine health education activities</td>
<td>Change in students', parents' and school staffs' knowledge relating to nutrients, deficiency symptoms, dietary guidelines, adequate diet principles and habits</td>
<td>Nutrition knowledge, attitudes and behaviour improved among all target groups. The largest increases in nutrition knowledge among all target groups occurred among parents and guardians. School visits revealed improvements to school facilities and school health services, establishment of school policies and a positive school climate.</td>
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<tr>
<td>2004</td>
<td>Design: Pilot RCT</td>
<td>N=7500 students and their families and 800 teachers and school staff</td>
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<td>Change in students' attitudes to nutrition and health</td>
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<td></td>
<td>Duration: 1.5 years</td>
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<td>Change in students', parents', and school staffs', breakfast behaviour and hygiene habits</td>
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<td>Story et al</td>
<td>Setting: School</td>
<td>3rd to 5th grade students</td>
<td>Pathways food service intervention aimed to reduce the fat in school lunches to no more than 30% of energy, while maintaining recommended levels of calories and key nutrients</td>
<td>Nutrient content of school food items</td>
<td>Mean % energy from fat decreased from 33.1% at baseline to 28.3% at the end of the study (3yrs) in intervention schools compared to 33.2% and 32.2%, respectively, in control schools (P&lt;0.003)</td>
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<tr>
<td>2003</td>
<td>Design: 3 years</td>
<td>N = 1,700 students in 41 schools (20 control 21 intervention schools)</td>
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<td>Duration: RCT</td>
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## Table A6. Tailored and family-based counselling interventions

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<tr>
<td>Hakanen et al 2006</td>
<td>Setting: School, Design: RCT, Duration: 10 years</td>
<td>N=1062 (7mths at baseline – 10 years old at endpoint)</td>
<td>Intervention group: Individualised counselling with children’s parents focussed on healthy diet and physical activity, every 1-3 months from age 7 months to 2 years, then twice/year until 10 years of age. Children received counselling from age of 7 yrs onwards. Families met with paediatrician, nutritionist and nurse at each visit. Controls: basic health information routinely given at well baby clinics and school health care, twice/year until 7 years of age then annually.</td>
<td>Weight status: overweight or obese</td>
<td>At age 10, overweight prevalence was lower in intervention group girls (10%) compared with controls (19.0%), P=0.043. There was no difference in weight status between groups for boys. NB: Control group received greater level of exposure to PHC services than is average in Australia</td>
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<tr>
<td>Rasanen et al 2004</td>
<td>Setting: School, Design: RCT – sub-sample from STRIP study, Duration: 1.5 years</td>
<td>N=98 (47 intervention, 51 control) 7.5-9 yrs old</td>
<td>Assessment of time-restricted cohort of STRIP study participants: Biannual nutrition counselling with parents and children from age of 7.5 years onwards (1.5 years)</td>
<td>Effects on nutrition knowledge and nutrient intakes (total energy, total fat, saturated fat, unsaturated fat, sodium) measured at 7.5 years of age and again at 8 years of age</td>
<td>At baseline of sub-study (child’s age 7yrs), intervention children consumed less total energy (P&lt;0.05) and saturated fats as a % of energy intake (P&lt; 0.01) than control children, but similar levels of total fat, monounsaturated and polyunsaturated fats, and sodium. Post-intervention (1.5yrs): Intervention group maintained lower intakes of saturated fats as a % of energy intake (P&lt;0.001), and higher intakes of polyunsaturated fats (P&lt;0.05). No difference in intakes of total energy, total fat, and monounsaturated fats between groups Boys consumed more energy and sodium than girls at baseline and post-intervention Change in nutrient intakes from 7-9yrs did not differ between groups No difference in nutrition knowledge scores between intervention and controls at 7yrs (baseline). Knowledge of fat content of foods had increased in both groups post-intervention, but significantly more in intervention group (P for difference in change = 0.02) Knowledge of quality of fat in foods increased significantly in intervention group, but decreased in controls (P&lt;0.001) No gender differences in scores</td>
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<td>Ref</td>
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<td>Intervention description</td>
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<tr>
<td>Van Horn et al 2005</td>
<td>Multicenter RCT</td>
<td>663 pre-adolescent children (8-10yrs) with elevated LDL at baseline Boys: N=363 Girls: N=301</td>
<td>Promotion of adherence to recommended diet designed to lower blood cholesterol by reducing dietary total fat, saturated fat, cholesterol while increasing fibre, fruits and vegetables. First 6 months: 6 x weekly, followed by 5 x bi-weekly family-oriented group sessions. Second 6 months: 4 group and 2 individual sessions. Years 2-3: Group maintenance sessions held 4-6 times per year along with monthly telephone contact. Year 4 onwards: 2 group and 2 individual sessions per year, with regular telephone contact. Group sessions utilised DISC-GO guide – a food wheel displaying ‘Go’ foods (low in cholesterol/saturated fat) and ‘Whoa’ foods (high in saturated fat) within each major food group - and its practical applications. Intervention grounded on social-learning and social-action theory, with emphasis on individual goal setting, eating plan development, behavioural self-management, reinforcement and problem-solving.</td>
<td>Dietary intake (validated 24 hour diet recall) &lt;4,200 dietary recalls collected over 3 years BMI and low density lipoprotein cholesterol (LDL-C)</td>
<td>End of year 3: Intervention group had significantly increased relative consumption of ‘Go’ foods in all food groups except fruit. Differences compared to control group were significant for dairy (P&lt;0.001), desserts (P=0.02) and fats and oils (P=0.04). Intervention group had also decreased relative consumption of ‘Whoa’ foods in all food groups, excluding pizza. Differences compared to control group were significant for breads/grains (P=0.02), dairy (P&lt;0.001), fats/oils (P=0.03), meat/fish/poultry (P&lt;0.001), snacks (P=0.05) and vegetables (P&lt;0.01). In boys, consumption of ‘Whoa’ desserts, snack foods and pizza was positively associated with both BMI (P=0.04) and LDL-C (P=0.01). Consumption of breads/grains in boys showed a negative association with BMI (P=0.02). In girls, servings of ‘Go’ dairy foods showed a negative association with BMI (P=0.02), as did consumption of combined ‘go’ and ‘whoa’ dairy foods (p=0.04). No significant associations were observed between food groups and LDL-C among girls. No information on retention rates</td>
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