Module 2

Interventions to increase consumption of fruit and vegetables in children
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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 3: Interventions to reduce consumption of energy-dense, nutrient-poor foods
- 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 2 - Interventions to increase consumption of fruit and vegetables in children

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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 increase consumption of fruit and vegetables in children are outlined below.

1.2 Search strategy
Studies and interventions promoting consumption of fruit and/or vegetables 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:

(fruit OR vegetables) 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 more than 10 years old, i.e. 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 fruit and/or vegetables 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

Fruits and vegetables have high water content and are thus considered to be energy-dilute foods, as opposed to foods high in sugars and/or fats that are energy-dense. Fruits and vegetables are also high in dietary fibre. Just as a high intake of energy-dense micronutrient-poor foods and/or drinks are considered to be on the causative pathway to obesity, energy-dilute foods, particularly those high in dietary fibre, are considered to reduce the risk of obesity.\(^2\)

The mechanism by which an increase in fruit and vegetables is considered to lower the risk of obesity is by the high satiating effect due to the high fibre and water content. The consequence of these food properties is a displacement in the consumption of energy-dense foods, thereby reducing energy intake. The proposed mechanism of reduced risk of obesity has high biological plausibility and is backed up by studies linking a diet high in dietary fibre as more satiating and less energy-dense.\(^3\)

There is, nevertheless, limited evidence of a direct relationship between a higher intake of fruit and vegetables and weight status.\(^4,5\) One large cross-sectional study, an analysis of data from the Continuing Survey of Food Intakes by Individuals (CSFII) in the US, found that overweight boys consumed fewer vegetables, whereas overweight and at-risk-of-overweight girls ate less fruit.\(^6\) Another cross-sectional study of adults in Iran found that fruit consumption reduced the risk of obesity by about 40% in both men and women, and consumption of green vegetables reduced the risk by 30%, as did consumption of legumes.\(^7\)

As well as the likelihood that a high consumption of fruit and vegetables reduces the risk of obesity, fruits and vegetables are vitally important dietary components providing important vitamins such as vitamin C and folic acid. They also contain other plant substances (phytochemicals) that are considered to be important in the prevention of some diseases. Epidemiological evidence indicates that a high intake of, particularly a variety, of fruits and vegetables reduces the risk of major other chronic diseases including cancer, coronary heart disease, stroke, type 2 diabetes, diverticulitis, cataracts, macular degeneration, and chronic obstructive pulmonary disease.

Certainly the consumption of fruit and vegetables by children in Australia is well below recommendations: intake of fruit is below recommendations for 8-18 year old Australian children and adolescents; and intake of vegetables is below the recommended intake for all ages.\(^8\)

‘Fruits and vegetables’ are generally included as a single entity in most epidemiological and intervention studies. Also, many studies have included 100% fruit juice as a serve of fruit, and many also treat potatoes as a vegetable, despite the category of tubers being excluded from the group ‘fruits and vegetables’ by the World Health Organization.\(^2\)
3 Available intervention evidence

A number of recent systematic reviews have investigated the effectiveness of interventions to promote fruit and/or vegetables (F&V) to children. Collectively, 25 interventions were reported across the six reviews. Nearly all of the interventions were based in the school-setting. Papers in the reviews were reviewed up to March 2005. A review conducted for the World Health Organization included the effectiveness of F&V interventions in adults and children. The segment relating to children appears to have been rewritten into a journal publication, as this latter review is written by the majority of the same authors and reviews all of the same studies with the exception of one study. This latter review had the most stringent inclusion and exclusion criteria, only including controlled trials and only those that had a follow-up (duration) of at least 3 months. This review was also restricted to children aged 5-18 years. Two reviews were restricted to primary school age children (6-12 year olds), and only school-based studies were included in two of the other reviews. The former of these reviews was also restricted to studies involving environmental interventions. The earliest of the reviews was very limited and included only four interventions also included in the most stringent review; plus two early papers, from 1982 and 1988.

Due to the variability in the scope and exclusion/inclusion criteria of these reviews and thus the reporting of them, the majority of studies included in the reviews are included in the current review, a total of 22 interventions. Twenty-five papers aimed at increasing F&V consumption that were published since the reviews, were identified from the literature searches. One older study not included in the reviews is also discussed (the ‘Food Dudes’ intervention).

Thus a total of 48 interventions to increase fruit and or vegetable consumption in children were included in the current review. The details of the interventions are summarised in the Appendix, in alphabetical order by author within intervention type. The interventions are organised according to type as follows:

- Whole-of-school interventions involving nutrition education
  - Interventions aimed only at increasing F&V
  - Interventions aimed at increasing F&V and improving other healthy behaviours
- Nutrition education (not whole-of-school)
- Tailored nutrition advice/individual dietary counselling at school
- School food service (only) interventions
- Free school fruit (and vegetables) and paid subscription schemes
- Interventions in non-school settings

A summary and brief appraisal of each study, also organised according to intervention type but presented chronologically (by date of publication, from earliest to most recent) within each intervention type, is presented below. All reported effect sizes are statistically significant (see summaries of interventions in tables in Appendix for degree of significance) unless otherwise indicated.

3.1 Whole-of-school interventions involving nutrition education

In the late 1990s/early 2000s most interventions aimed at increasing intakes of F&V involved nutrition education curriculum as part of a ‘whole-of-school approach’, mainly in primary school-aged children in the higher grades (9-11 years). A number of these ‘whole-of-school’ (WOS) programs involving nutrition education aimed to increase F&V consumption as part of the promotion of eating healthier foods generally or specifically, such as low fat, and also often aimed to promote physical activity or reduce sedentary behaviour.
Thus interventions in this section are divided into two sub-categories: interventions aimed at increasing F&V consumption only; and, interventions aimed at increasing F&V as part of a program aimed at changing other dietary and/or physical activity behaviours also.

**Interventions aimed only at increasing F &V**

3.1.1 INTEGRATED NUTRITION PROGRAM

The INTEGRATED NUTRITION PROGRAM (INP) was an ongoing elementary school-based nutrition education program, based on educational and social cognitive theories, with the long-term goal of achieving sustained dietary behaviour change in children and families. The 4-year quasi-experimental study involving classrooms in matched primary schools (20 treatment classrooms and 17 control classrooms in year 4) aimed to increase F&V and whole grains consumption (FVG). The intervention involved 24 weekly hands-on sessions with a trained resource teacher, with parental involvement in teaching and fun nights. The nutrition education de-emphasised the health/nutritional aspects and serving sizes of FVG, instead emphasising taste and ‘eat more’ messages, and was also integrated into other subjects such as science, literacy and social studies. Six parent-taught ‘mini-lessons’ in the lunchroom were implemented in Year 4 of the program. Lunchtime intakes were determined from observations of plate waste, using tags to identify F&V taken. The intervention achieved an increase from baseline of +0.19 serves of fruit at lunchtime and +0.26 serves of F&V at lunchtime after four years, whereas the comparison group showed no change from baseline in lunchtime fruit consumption and a decrease in lunchtime F&V consumption of 0.14 serves. Another measure involving a 1-day qualitative food record, subsequently quantified, indicated that numbers or pieces of fruit eaten in Year 3 of the intervention were more (3.4 versus 2.2) and of a greater variety (2.7 versus 1.7) than in the control group.

**Appraisal**

Some of the success of the intervention was attributed to the delivery of material by a trained resource teacher. Also the framing of the nutrition messages is likely to have contributed to the success of the program. However overall effectiveness of the intervention is unknown due to poor assessment methods for lunchtime and daily F&V intake.

3.1.2 5-A-DAY POWER PLAY

The California children’s ‘5-A-Day POWER PLAY!’ campaign was a large-scale social marketing initiative across the state. The effect of adding a community component/industry involvement to school-only curricula was examined in a cohort study aimed at 9-11 year olds in 49 primary schools within the state. One of the treatments (T1) was school-only activities involving classroom curricula and the school cafeteria. The other treatment (T2) involved links with supermarkets, farmers markets, youth organisations, and media (point-of-sale advertisements and television (TV) announcements) – the ‘Salinas Valley Coalition’ – and Power Play! Day aimed at engaging and linking up with industry. After 10 months, 24-hour self-reported food diaries showed that servings of F&V increased from baseline by 0.2 servings/day in T1 (from 2.7 to 2.9) and 0.4 servings/day in T2 (from 2.9 to 3.3), compared to a decrease in the control (-0.3 servings/day; from 2.6 to 2.3), however T1 was not significantly different from T2.

**Appraisal**

‘School-only’ was not significantly different from ‘school plus community’ however, no process evaluation data are provided hence the degree of engagement with community and industry is unknown. Also, adverse weather conditions were reported to have affected the supply and cost of F&V for all treatments. [Note: The effect size of this intervention was reported as 0.7 servings/day difference between groups in one of the systematic reviews.]
### 3.1.3 5-A-DAY POWER PLUS

Industry support and involvement was part of the ‘5-A-DAY POWER PLUS’ program aimed at 9-10 year olds in Minnesota, US. This intervention achieved a high level of implementation of a number of different components: 16 teacher-implemented classroom sessions of 45 minutes twice a week for 8 weeks, parent home activities, and food service changes including point-of-purchase promotions and increased choice and availability. Skill-building and problem-solving activities were included, as were classroom competitions with small prizes. Curricula materials included comic books and adventure stories introducing new role models. Participation (except parental involvement), dose, and fidelity were high. Industry was involved (Minnesota 5-a-Day Coalition partners) in the provision of free F&V for home snack packs, classroom taste-testing, and school lunches, and classroom materials. After one school year, F&V intake at lunchtime was 0.47 servings higher in the intervention group compared with the control, mainly due to increases in fruit: 0.74 versus 0.44 servings/lunch. Daily fruit intake was also higher (24-hour recall; +0.62 servings/day; 2.75 vs. 2.13) and fruit intake as a percentage of daily energy intake was higher (+0.36 difference) in the intervention schools after this one year intervention.

**Appraisal**

This intervention was effective at increasing fruit intakes, and more so than the ‘cafeteria only’ version of the program, ‘5-A-DAY CAFETERIA PLUS’. Also, the data provide some evidence of the displacement of energy-dense foods by fruit. Some of the success is likely due to the provision of free F&V for various activities such as the home snack packs. The program was very resource intensive.

### 3.1.4 COOKSHOP PROGRAM

As in the Integrated Nutrition Program, whole grains were promoted in the ‘COOKSHOP PROGRAM’ together with vegetables, but not fruit. This intervention was aimed at infant school children, aged 4-6 years, in Central Harlem, New York City. The quasi-experimental study involved 39 classes from two schools thus intervention and comparison children were within the same schools. Classes were allocated to one of four treatments: food preparation classes only (CookShop, CS); CS plus food and environment lessons (CS+FEL); FEL only; and, control. All classes also received a school lunch intervention involving the inclusion of at least 1 CS food every day and all 13 over a 13-day cycle. All classes also received the parent and community components which included a monthly printed newsletter ‘Diets and Dollars’ including information on buying, storing and preparing food. Main effects were seen in those children in the CS program; there was no effect of FEL alone. The addition of food preparation classes to food and environment lessons (CS+FEL) decreased the amount of plate waste at lunch by 10%, in younger children, within two weeks of completing the 5-month long intervention.

**Appraisal**

The intervention showed that the effect of nutrition education lessons alone was not effective at increasing F&V consumption, at least during lunchtimes, but that cooking classes combined with the education was successful. However, the findings are limited by the measure of F&V intake and only during lunchtime, thereby providing no indication of the effect of the intervention on overall daily intake. Also, intervention and comparison classes were within the same school hence contamination between groups is likely to have occurred.

### 3.1.5 GIMME 5 High School

A food service component was included in the implementation of ‘GIMME 5’ in the high school setting (grades 9-12) in 12 schools in New Orleans, US. One of only a few programs aimed at teenagers, this 3-year intervention involved classroom workshops by trained teachers or resource staff, and competitions as well as taste-testing, point-of-purchase signs, table tents, and food service staff training. Parents were involved under the banner of ‘Raisin Teens’. Although an increase of 14% in servings of F&V servings/day was seen in the intervention schools after two years (from 2.63 to 3.00; self-reported usual intake), this difference was not seen after three years, mainly due to an increase in intake in the control schools over the third year of the program.
Appraisal

In this high school version of GIMME 5, the classroom curriculum was presented mainly by research staff thereby strengthening the implementation. The intake in F&V consumption in control schools in the third year of the intervention suggested a secular increase in consumption of F&V, or cross-contamination, although the school was the unit of randomisation in this randomised controlled trial (RCT) and there was no community component, making this latter reason less likely.

3.1.6 GIMME 5 Primary School

‘GIMME 5’ in primary school children (grades 4-5) was a 3-year intervention involving point-of-purchase education at grocery stores used by parents. Nutrition education in the first two years of the study was by 12 sessions run over 6 weeks and involved the Gimme 5 curriculum aimed at encouraging and assisting children to eat more F&V. Teachers also had handouts, posters, worksheets, newsletters and videos. Although this intervention resulted in a net effect of +0.3 servings F&V/day, this was a result of a lower decrease in consumption in the treatment group compared to the control group over the three years of the program.

Appraisal

The findings of this intervention are strengthened by the use of a rigorous measurement method (7-day food diaries), however, the curriculum component of this intervention was poorly implemented as teachers were uncomfortable with behaviour change (goal-setting, problem-solving, skills-building) curricula and there was only modest parental participation (e.g. 10% attended evening point-of-purchase grocery store activities).

This version of GIMME 5 did not include a school food environment component.

3.1.7 HIGH 5

‘HIGH 5’ was a highly successful intervention that was implemented by researchers rather than teachers in 28 matched schools with children aged 9-11 years (mean age 8.9 years at baseline) in Alabama, US. Food service staff were trained in HIGH 5 guidelines; although implementation of the guidelines was low as there was no observed effect on foods sold in the canteen. Student self-efficacy and parental involvement were targeted and activities included prizes for homework books. Despite the lack of increase in availability of F&V at school, F&V intake was higher in the intervention group after one year (0.88 serves fruit and 0.69 serves of vegetables/day, difference between groups), and after two years, although the effect was reduced in the second year (0.56 and 0.35 difference between groups for fruit and vegetables respectively). Parental involvement was high, with the majority of parents reading the newsletters, brochures and homework books ('Freggie' books) and using the shopping lists. Student self-efficacy and knowledge about F&V consumption, and parental consumption levels in the first year, were also influenced by the intervention.

Appraisal

Some of the success of this intervention was attributed to the use of research staff to deliver the curriculum, which resulted in an increase in students’ self-efficacy at the end of the intervention (after two years). This intervention also included a school food service component involving regular visits by trained nutritionists to encourage ‘High 5’ guidelines but there was no change in the foods sold in the canteen pre- and post-intervention hence the success of this intervention could not be attributed to the food service components.

3.1.8 FOOD DUDES

Mainly observational methods during lunchtimes were used to measure outcomes in the ‘FOOD DUDES’ program, a peer-modelling, rewards-based intervention in the UK. In this intervention, all primary school children, aged 4-11 years, in three schools in London had access to increased availability of F&V during snack- and lunch-times during an 8-12 day baseline phase, and during the 16-day intervention phase, when six videos of the ‘Food Dudes’ were shown over 16 days. ‘Food Dudes’ were 12-13 year old, ‘cool’, heroic peers who enjoy eating F&V. Parental involvement was encouraged and rewards were given, increasing as F&V intake per tasting increased. Rewards were delivered in such a way as to avoid coerciveness and negative associations with other foods, instead concentrating on the intrinsic virtues and enjoyment of eating F&V. The schools in these interventions had a high percentage of ethnic minority and special needs students.
One of the systematic reviews reported that this intervention was not successful at increasing F&V, but these findings were disputed by the authors of the study and as indicated subsequently in the two publications. The findings of the intervention were reported in the first publication as being very positive but implementation was slightly different among schools and the results are difficult to interpret. The overall findings did show a substantial and significant increase in the quantities of F&V consumed during snack and lunch times between the baseline phase and at the end of the 16-day intervention phase in all three schools. Consumption at home was only measured for one of the schools but showed a significant increase in consumption during weekdays. Also, the largest increases in consumption of F&V during the weekdays were observed in those with the lowest intake at baseline. The effectiveness of the intervention in a single treatment school after a 4-month ‘maintenance phase’ was reported in the second publication relating to this intervention. A difference from baseline of +0.18 servings/weekday in the single intervention school was observed, concomitant with a decrease in intakes in the single control school (-0.54 servings F&V/weekday) although it is not clear what caused this decrease in the control schools.

**Appraisal**

The study designs in both these FOOD DUDES studies had limitations hence results need to be interpreted with caution (hence no data provided here for the larger study). However the effectiveness of the larger intervention was apparently considerable (although the data presented in the paper are very selective) and are supported by the success of the implementation of the program in the smaller study. Earlier intervention results had shown that the use of rewards without peers was not effective; none of the papers have indicated the effect of the peer modelling without the rewards.

### 3.1.9 TOOTY FRUITY VEGIE (North Coast Area Health Service, NSW)

‘TOOTY FRUITY VEGIE’ (TFV) was a two-year health promotion program aimed at increasing F&V consumption among primary school children in the North Coast of NSW. The project used a WOS approach in implementing a range of evidence-based school and community strategies promoting F&V consumption in ten selected schools. These strategies included: classroom activities, children’s cooking and gardening programs, promotions and resources aimed at parents and carers, school canteens, school environments and gardens, and special TFV weeks involving the Sydney Marketing Authority. The project led to improved children’s F&V related knowledge, attitudes and preparation skills as well as their access to F&V at home and school. The results of the outcome evaluation have not been published in a peer-reviewed journal however results on the project website (www.ncahs.nsw.gov.au/tooty-fruity/) indicate that the program has been successful in increasing F&V consumption. Over the two-year intervention period, fruit consumption increased by 18% and vegetable consumption increased by 14% in the intervention schools, with comparative decreases of 14% and 4% in the control schools.

**Appraisal**

This was the only identified Australian study aimed solely at increased F&V consumption in children with publicly available outcome measures. Although results showing increased intakes in F&V have not been published in the peer-reviewed literature, evidence of effectiveness is available via the web, and substantial process evaluation points to the effectiveness of this program in increasing attitudes and knowledge surrounding F&V. The program is well-accepted by teachers, students and parents, and the supporting website contains many ideas and hints for enhancing program implementation. The fun, practical and hands-on nature of many of the TFV strategies, and the parental involvement, seem to have been key factors in the project’s success. F&V tastings, cooking lessons, gardening and videos were consistently considered to be the most successful activities and it is suggested that future implementations ensure that these activities are core components.

### 3.1.10 BASH STREET KIDS

Another WOS program aimed at F&V consumption was implemented in Scotland and involved point-of-purchase marketing in the primary school food service as well as increased availability of F&V in school lunches and the tuck shop, and tasting opportunities. Parents were involved in this intervention but there were no prizes, rewards, peer modelling or goal-setting. The intervention theme was ‘The Bash Street Kids’ – cartoon characters used in all communication and promotional materials such as child and parent
newsletters. Curriculum materials involved food preparation and tasting and were provided to children aged 6-7 years and 10-11 years. The intervention resulted in an increase in fruit intake over the 8-month intervention, but for girls only, by 50g/day in the intervention group compared with only 7g/day in the control group; however, vegetable intake decreased in both groups.

**Appraisal**

The intervention was only successful in increasing fruit intake, not vegetables, and in girls only. The intervention also resulted in children tasting more F&V, an attribute known to be associated with increased consumption in F&V; hence increases in consumption could have resulted if the intervention was maintained for longer than 8 months.

### 3.1.11 FRUITS AND VEGETABLES MAKE THE MARKS

Fruits and vegetables Makes the Marks (FVMM) was a school-based F&V intervention in 6th and 7th graders in two counties in Norway. The intervention consisted of a home economics classroom component and parental involvement, as well as encouragement in the Norwegian School Fruit Programme – a paid subscription scheme for fruit and carrots at school (the results of this latter component are discussed in section 3.5). The paper discussed here is in relation to conduct of the program in the Telemark County. Out of 19 schools that agreed to participate in the intervention, 9 were randomly assigned to receive the intervention, and 10 schools were controls. The classroom component consisted of 7 sessions, each of 3 x 45 minutes duration, delivered over a 7 month period during home economics lessons. Lessons included the health benefits of F&V, and recommended levels of consumption. Practical skills, goal-setting and taste-testing were included. As part of the intervention each school received some money to facilitate the increased use of F&V. Parental involvement was attained through a ‘kick-off’ night and the provision of six ‘themed’ (different types of fruits or vegetables) newsletters during the intervention period which included health-related information, suggested activities to increase F&V consumption, and a competition. All schools in the program were offered the School Fruit Programme. Intakes of F&V were determined by 24-hour recall soon after the end of the intervention (FU1) and 12-months (FU2) after the end of the intervention. Juices and potatoes were not included in the F&V data. Process evaluation showed that there was no relationship between either level of implementation of the curriculum, nor level of parental involvement, with F&V intakes at follow-up. No effect of the intervention was seen for intake of F&V eaten at school or all day, at FU1 and FU2. There was some indication that those pupils with higher intakes at baseline increased their intakes as a result of the intervention. The intervention did result in an increase in awareness of the 5-a-day recommendation in children, but not parents.

**Appraisal**

This was a methodologically-sound study with a reasonably extensive intervention period and the intervention components were considered by the authors of the study to be ‘state-of-the-art, yet no effect on F&V consumption was measured. The study correctly did not include juice or potatoes as F&V. Although implementation of the program was variable, this was determined not to be related to F&V intakes. Norwegian primary school children mainly bring their own lunch, usually sandwiches, to school and traditionally F&V have not been available at school as few primary schools have canteens, thus baseline levels of intake were low.

### Interventions aimed at increasing consumption of F&V and other healthy behaviours

#### 3.1.12 CATCH

The main aim of the ‘Child and Adolescent Trial for Cardiovascular Health (CATCH)’ program was to decrease consumption of high fat foods and increase physical activity. Aimed at primary schools in the US, the program also involved several food service guidelines specifically targeted at increasing F&V consumption: increase the use of fresh, canned or frozen F&V and add peas/beans to entrees and salad recipes. Also, classroom curricula and parent home activity packs included F&V behaviour as one of several intervention messages in this 3-year program; similar to the Eat Well, Keep Moving program. This intervention did not achieve any change in F&V intake, as determined by 24-hour recall, except at one of the sites.
Appraisal
The lack of intervention effect on F&V consumption is unsurprising considering that the program emphasises decreasing consumption of high-fat foods and increasing physical activity, both inside and outside of school, rather than F&V consumption.

3.1.13 PLANET HEALTH

‘PLANET HEALTH’ aimed to decrease consumption of high fat foods, increase F&V consumption to 5 servings/day, reduce TV viewing to less than 2 hours/day, and increase physical activity, in 11-12 year old students in the US. The two year randomised controlled trial, in 10 schools, involved teacher training, classroom lessons, PE materials, wellness sessions, and fitness funds. After two years, data from a FFQ and food survey in the classroom showed that the intervention had a significant effect on increasing F&V intake in girls, by +0.32 servings/day in the intervention group compared to control, although this difference was partly due to a decrease in intakes in the control group. The intervention also resulted in a decrease in prevalence of obesity in girls.

Appraisal
This program was aimed at changing multiple behaviours and was successful at increasing F&V intakes in girls only. Some of the success was due to the concomitant decrease in intakes of F&V in the control group. This was one of only a few WOS interventions with an aim to increase F&V consumption that also reported on weight status.

3.1.14 EAT WELL, KEEP MOVING

The two-year program ‘EAT WELL, KEEP MOVING’ (EWKM) was very similar to the ‘PLANET HEALTH’ program (see above). This quasi-experimental study involved 14 primary schools in Baltimore, US, also aimed to decrease consumption of high fat foods, increase F&V consumption to 5 servings/day, reduce TV viewing to less than 2 hours/day, and increase physical activity, in 11-12 year old students. The six schools in the intervention group received classroom curricula linked to the school food service and parental home activity packs, with messages for F&V involving ‘eat 3-a-day at school’ and ‘5-a-day’. As determined from the 24-hour recall post-intervention, the intervention resulted in an increase in F&V intake as a percentage of total energy intake, equivalent to +0.73 servings F&V/day, in the intervention group compared to the control group.

Appraisal
This intervention resulted in a fairly large effect size, and for all day, although this was determined from differences between groups at follow-up. Different measurement methods were used at baseline and at follow-up, limiting the usefulness of the results. However, the intervention does provide some evidence, as in 5-A-DAY POWER PLUS18, that increased intakes of F&V may have displaced other foods, as F&V intake as a percentage of total energy intake was higher in the intervention group than in the control group.

3.1.15 NEAPS

A shorter intervention of only three months, also a ‘healthy eating’ program and involving an exercise regime; was aimed at primary school children in Ireland. In this program, ‘Nutrition Education in Primary School’ (NEAPS), parent packs with family assignments were incorporated into the 20-week curriculum. Results of the intervention were modest, but significant, with 2% more children consuming four or more serves of F&V per day in the intervention group compared to the control, as determined from 5-day food diaries at the 3-month follow-up.

Appraisal
A very robust assessment method, a 5-day food diary, was used to assess intake in this intervention, and the effect although modest, was significant. The modest effect size was likely at least partly attributable to the outcome measure chosen, few children consume 4 or more servings of fruit and vegetables per day – a larger effect might have been observed if median or mean intake was recorded.
3.1.16 **APPLES**

The ‘Active Programming Promoting Lifestyle Education in School’ (APPLES) program was based on the ‘Health Promoting Schools’ philosophy and involved changes to the school food service, including tuck shops, in the UK (Leeds). This non-randomised controlled trial involved the development of school action plans by the ten individual schools, based on their perceived needs. Other intervention components included teacher training, parental newsletters and physical education. The one-year intervention in 8-10 year olds measured F&V intake using 24-hour recall and a 3-day food diary, and resulted in a weighted mean difference of 0.3 servings of vegetables/day as determined by the 24-hour recall method, which was an increase of 50% of baseline amounts. No significant changes in fruit or vegetable intakes were found from the 3-day food diary results.

**Appraisal**

The APPLES program was one of only a few which impacted positively on vegetable intake and achieved a significant increase above baseline levels. However this positive finding was only observed using the 24-hour recall method and not the more valid 3-day food diary.

3.1.17 **BE SMART/PLAY SMART**

In the ‘BE SMART/PLAY SMART’ programme in the UK (Oxford), 5-7 year old children learned about food in a ‘non-nutrition sense’ (‘Be Smart’), or in a ‘nutrition-based’ manner involving tasting sessions and ‘games’ based on ‘Gimme 5’ (Eat Smart). There was also a physical activity component ‘Play Smart’ (with and without ‘Eat Smart’). This was not strictly a WOS intervention as it was implemented through school lunchtime clubs. The intervention, run for 20 weeks over four school terms approximating a total of 14 months duration, was evaluated using parent-completed 24-hour recall and FFQs. BMI was also measured before and after the intervention. The FFQ results indicated that the program was successful in increasing fresh fruit intake but this increase was observed for children in the ‘Eat Smart’ treatment and also in the ‘Be Smart’ treatment which was the ‘control’. There was no clear effect of program type on any variables as determined by 24-hour recall. None of the treatments resulted in a change in BMI.

**Appraisal**

This intervention was not included in one of the main systematic reviews probably because of the poor study design and variable implementation levels. The lack of responsiveness to the different treatments could have been due to the latin-square design and randomisation, which was by individual children, therefore cross-contamination is likely to have occurred.

3.1.18 **TEENS**

‘Teens Eating for Energy and Nutrition at School’ (TEENS) was the only other WOS program aimed at teenagers (other than GIMME 5 in high schools). Conducted in the US, the TEENS program involved young teens aged 12-13 years and was a long-term (2-years) randomised controlled trial, randomised by schools, aimed at increasing consumption of healthy food, including F&V and lower fat foods. Sixteen schools were involved in each of the studies, and these schools had at least 20% of students approved for free or reduced price lunch. There were four treatments: control schools following the usual curriculum; school environment treatment with increased availability of healthy foods in the schools; a classroom plus school environment treatment in which the classroom component was composed of 10 lessons involving self-monitoring, goal setting, hands-on snack preparation, and skills development for choosing healthy foods and overcoming barriers; and a treatment with classroom curriculum plus school environment changes plus peer leaders. One of the publications reporting on this intervention indicates that the family was involved through the use of newsletters in parent packs. These newsletters contained behavioural notes and money prizes. The different components of the program were implemented to different levels in different treatment schools rendering comparison of results between treatments difficult.

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7 The Health Promoting Schools philosophy aims to link the school with family and community and focuses on the whole school ethos, including its policies, management style, and attitudes of staff, so that consistent health messages are given and received.
Although there were no differences in any groups after two years of intervention, an examination of the dose-response results after one year showed that a combination of ‘peer leaders plus classroom curricula plus school environment’ components was more effective than ‘classroom plus school environment’ (0.92 versus 0.44 servings of F&V/day).

**Appraisal**

The different levels of implementation of the program achieved in the various treatment schools limits the usefulness of the results. The results indicate that intensive classroom lessons alone, involving self-monitoring, goal-setting, hands-on snack preparation and skills development for choosing healthy foods and overcoming barriers, were not successful at increasing F&V consumption. The program provides some evidence of the value of peer leaders.

### 3.1.19 FRESH KIDS

The FRESH KIDS program aimed to influence dietary consumption of fruit, water and sweet drinks among inner-west Melbourne primary school students. The program has been implemented in 35 primary schools to-date however a recent outcome evaluation has been presented for only four of these schools. The four schools are located in culturally diverse and socio-economically disadvantaged urban areas. Participating schools implemented changes in three main domains according to the Health Promoting Schools framework (as used in APPLES29): School-home-community interaction and partnerships; School organisation, ethos and environment; and School curriculum, teaching and learning. Intervention strategies included free seasonal ‘Fresh Fruit Weeks’ (2 to 4 times per year), scheduling of classroom ‘fruit breaks’, nutrition curriculum activities including market tours and taste-testing, distribution of student-designed water bottles, monthly nutrition newsletters sent home to parents, bilingual parent nutrition education sessions, and development of school fruit and water policies. Lunchbox audits were conducted in all participating schools at baseline and periodically during program implementation. Two schools were followed for a period of two years, and two schools which joined the study later, were followed for 9 months. Data are presented for ‘percentage of children consuming fruit’ although this was more accurately ‘percentage of children with fruit in their lunchbox or ordered from canteen’. The percentage of children consuming fruit compared with baseline increased significantly by between 25 and 50%, mean 41%, for up to two years after initial program implementation.

**Appraisal**

This study used of a whole-of-school approach and had well-coordinated program management (external program coordination by a community dietician and a lead teacher nominated within each school), features which are likely to have contributed to the success of the program in increasing fruit brought from home in lunchboxes. In addition, the study had a very high participation rate and the effects were sustained for a long period, up to two years. Parents were not informed of the lunchbox audit dates, reducing the possibility of social desirability bias. Methodological limitations of this study include lack of a control group for comparison. Also, the outcome measure was F&V brought to school in the lunchbox (or ordered from the canteen) not what was actually eaten, and there was no measure of consumption over the whole day, thus no indication of possible compensatory effects.

### 3.1.20 APPLE Project

The APPLE Project, ‘A Pilot Programme for Lifestyle and Exercise’, was a two-year pilot nutrition and physical activity, school-based intervention program conducted in Otago, New Zealand, aimed to prevent excessive weight gain among 5-12 year old children. The nutrition education component promoted reduced consumption of sweetened drinks, and increased consumption of fruit and vegetables. Nutrition education initiatives included science lessons highlighting adverse health effects of sugary drinks and a healthy eating resource. A total of 730 children from four intervention and three control schools participated in the study, with measured height, weight, waist circumference and blood pressure, and diet and physical activity assessments taken at baseline, end of Year 1, and immediately post-intervention (end of Year 2). Dietary intake was assessed using a 3-day validated short food frequency questionnaire. Intervention children consumed significantly more fruit at the end of the intervention period (Year 2) compared to control children, by 0.8 servings/3 days. Vegetable consumption increased equally across both control and intervention groups resulting in no significant difference at the end of Year 2. Mean BMI z-scores and measured waist circumference were significantly
lower in intervention than control children post-intervention, although differences in prevalence of overweight were not significant between the two groups once adjusted for baseline values. Subgroup analyses showed that BMI reductions in the intervention group were only observed in children who were not overweight at baseline.

Appraisal
While this pilot intervention study is one of only a few to have reported measured values for children’s BMI and waist circumference, it was too small and had insufficient statistical power to determine which individual component(s) of the program led to the observed differences in outcome measures. Further, the intervention did not improve BMI z-scores in children who were overweight at baseline. While the measured evaluation components had a high response rate (81-92%), the nutrition component involved response rates of only 62% at year one and 66% post-intervention. Other limitations of the study were the non-random selection and assignment of schools and the delay of the nutrition intervention components until year two of the study. A major strength of the study was a concurrently-run process evaluation which indicated positive feedback from the school communities, and may be used to develop follow-up analyses.

3.2 Nutrition education (Not whole-of-school)

3.2.1 SQUIRES’ QUEST
‘SQUIRE’S QUEST!’ was a ten-session psycho-educational, multi-media game. This game was delivered over five weeks to children aged 10-11 years attending 26 schools in the US. Each session lasted approximately 25 minutes and was aimed to increase preference for fruit, fruit juice and vegetables through multiple exposures and associating their consumption with fun. Activities were also aimed to increase asking behaviours at home and while eating out, and improve preparation skills through making virtual recipes. At the end of the intervention, mean F&V (including 100% fruit juice) intake was higher in the intervention group, by 0.91 servings per day, than in the control group, after adjusting for baseline intake.

Appraisal
The positive findings are limited by the inclusion of 100% fruit juice not measured separately from F&V and by the very short intervention period of five weeks. However, the measurement method – four days of 24-hour recall data before and after the intervention period, was robust, and the study does show that a simple intervention has potential to achieve dietary change. Such a tool for nutrition education can ensure wide-reach without the need to include teacher training or trained resource teachers. The use of goal-setting in this intervention has been reported to have had no clear relationship with changes in dietary behaviour, and it was suggested that the pathway to behaviour change needed more careful exploration.

3.2.2 KALÈDO
An educational board game ‘KALÈDO’ played for 24 weeks by 11 to 14 year old students in 16 classrooms in 3 schools in Italy, resulted in a significant increase in nutrition knowledge and in weekly vegetable intake. The board game, designed to teach nutritional knowledge and influence dietary behaviour was played once a week for 15-20 minute long play sessions. At the end of the intervention, adjusted mean servings of vegetables per week were 3.7 in the intervention children compared with 2.8 in the control children, i.e. a significant difference of +0.9 servings of vegetables/week.

Appraisal
This study was limited by the use of children within recruited classrooms as the unit of randomisation (thus potential cross-contamination), and child self-report of intakes. Also, although it was a longer intervention than SQUIRE’S QUEST, it was a relatively small study involving only 153 intervention students and 88 control students, and baseline intakes were very low. It was, however, one of the few interventions to impact positively on vegetable intake and again shows the potential for educational games to influence dietary behaviour.
3.2.3 Nutrition in the Garden\textsuperscript{47}

A 12-week ‘nutrition in the garden’ education program in the US was successful at increasing daily F&V intakes in 6th grade students (aged 11-12 years), but only when combined with garden-based activities. Two treatment schools were involved in the study, and one control school. One treatment school received garden-based activities in addition to the nutrition education and this resulted in a substantial increase in F&V after the 12-week intervention. Three days of 24-hour dietary recall workbooks were completed by students before and after the intervention period. Fruit consumption increased by 1.13 servings/day and vegetable consumption by 1.44 servings/day resulting in a combined F&V increase of 2.6 servings/day, from 1.93 to 4.5 servings/day in this treatment. There were no changes in intakes of F&V in the school receiving only nutrition education or in the control school, indicating the obvious advantages of including garden-based activities.

\textit{Appraisal}

Limitations of the study include only one school per treatment and a very short duration; however the change in intakes was substantial, measured using a robust method, and the positive effect was for fruit and vegetables indicating the potential of gardening in schools to change eating behaviours.

3.3 Tailored nutrition advice/individual dietary counselling

3.3.1 STRIP\textsuperscript{48}

The Special Turku Coronary Risk Factor Intervention project for Children, ‘STRIP’, was a long-term study (10 years) in Finland, conducted in the family setting. The intervention involved individual dietary counselling aimed at reduction of cardiovascular risk factors, especially saturated fat, in the child. Families were encouraged to use fruits and vegetables as well as whole-grain products. Counselling by a nutritionist was provided several times a year from when the children were about 7 months old. Food records were completed by the parents for four days before a visit by the nutritionist. There was only a slight intervention effect in a longitudinal analysis of data across the 10 years. The results showed that 1-10 year old boys involved in the intervention consumed more vegetables, a mean difference of 3.18 g/day, and more fruit, a mean difference of 10.1 g/day, than control children.

\textit{Appraisal}

The small effect size on F&V consumption was not unexpected as there was limited focus on F&V; the intervention was aimed mainly at reducing saturated fat intakes. This was one of only a few interventions that achieved an increase in vegetable consumption, albeit very small, and in boys rather than girls.

3.3.2 Healthy Food Intervention\textsuperscript{49}

An extensive intervention in 15 schools in Belgium aimed to increase fruit consumption to at least two pieces per day, as well as reduce fat and soft drinks consumption, and increase water consumption and physical activity, in 11-15 year olds students. In this cluster-randomised trial, the main intervention strategy involved the provision of tailored advice to students on fruit and fat intakes. Parents were involved in the tailored advice part of the program, however only for fat consumption. There was a variety of other interventions including selling fruit at low cost, or providing it free, once per week. This 9-month intervention was not successful at increasing self-reported (FFQ) fruit consumption.
Appraisal

The intervention was aimed at fruit, not fruit and vegetables, consumption. No process evaluation data were provided and there was some indication, certainly for the soft drinks component of the intervention, that implementation was low. The lack of intervention effect for fruit could have been partly due to the lack of tailored advice to parents for this behaviour, as the addition of tailored advice to parents concerning dietary fat was successful in reducing fat consumption, in girls. Other studies have not detected any intervention effect when using a FFQ but have when using other measurement tools hence the use of the FFQ might have limited the detection of an intervention effect.

3.3.3 Internet-tailored advice and brief dietary counselling

A recent cluster-randomised trial in The Netherlands, conducted as part of the routine periodic health examination in schools, was not effective at increasing F&V consumption in 9-12 year old students. The trial involved thirty 7th grade classes (16 intervention classes, 14 control classes) in internet-tailored advice about F&V consumption. The children first filled in a survey about their food habits which was provided to the school nurse. The school nurse then provided internet-tailored advice to each student about F&V consumption and diet. Dietary counselling was also provided two weeks later, to the child and the parents. At the 3-month post-intervention follow-up there were increases in knowledge and awareness of recommended vegetable intakes and inadequate fruit intakes but no change in actual intakes as determined by self-reported recalled consumption (7-days for fruit and 24-hours for vegetables). The authors concluded that more comprehensive approaches are needed in the school setting.

Appraisal

As the intervention increased knowledge and awareness in relation to F&V, the intervention could be successful if part of a more comprehensive approach in the school setting, as was indicated by the authors of the study. However, the intervention component has low transferability to the Australian environment as it was implemented through school nurses.

3.4 School food service (only) interventions

3.4.1 Pricing Strategy

A short-term observational study in the US examined the effect of reducing the price of F&V in two high school cafeterias. One of the schools was in an urban area with a high percentage of non-Caucasian children and a large percentage of children received free or reduced price lunches. The other treatment school was suburban and comprised a much higher percentage of Caucasian children and less than 1% received free or reduced price lunches. 16% of students purchased lunch per day in the urban school and 19% in the suburban school. The 3-week intervention involved lowering the price of fruit, salad and carrot sticks by 50%. Loudspeaker announcements were made during the first week of the low price and attractive signs targeting the reduced priced items were used throughout the intervention period. The reduced price led to an increase in sales during the low price period of four-fold for fruit and two-fold for carrot sticks overall; the effect size for fruit was larger in the urban school and the effect size for carrot sales was larger in the suburban school. There was no significant effect on salad sales. The intervention resulted in no differences in the number of meal customers or dollar sales.

Appraisal

Mean sales after the low price period were not significantly different from sales before the low price period – indicating the need for sustainability of the intervention.
3.4.2 5-A-DAY CAFETERIA PLUS

The most expansive of the programs aimed only at the school food service was the ‘5-A-DAY CAFETERIA PLUS’ program, in the US. This program was the same as 5-A-DAY POWER PLUS but did not include a behavioural classroom component or parental component. The program was implemented in 26 primary schools (6-9 year olds) over two years and involved increased exposure to F&V through daily activities at the canteen, including increased attractiveness of the display of F&V, and special events such as taste-testing (monthly) and challenge weeks (with prizes). Effectiveness was measured by lunchroom observation only, and showed a significant increase in the number of servings of fruit at lunchtime, 0.16 servings more in the intervention schools than in the control schools. Process evaluation showed a significant association between verbal encouragement by food service staff and F&V put onto trays for lunch.

Appraisal
This trial had a good study design, a controlled trial randomised by school. Also, studies have shown that an observational assessment of F&V taken at lunchtime is a good proxy measure for amounts eaten at lunchtime, thus the lunchtime increases observed are likely to be valid measures of amount eaten at lunchtime. However, this study was limited by not evaluating daily intakes of F&V.

3.4.3 KIDS’ CHOICE

The ‘KIDS CHOICE’ school lunch program in the US involved a peer token reinforcement/reward system where children (mean age 8 years) could accumulate ‘holes’ in their name tag which could be traded at the end of each week for a small prize of their choice. Classes were randomised to receive token reinforcement for either fruit or vegetable intake, with a total of 188 children participating in the study. There was a 4-day baseline phase during which observations of lunchtime F&V consumption were made, followed by a short intervention period of 2 weeks and a longer term follow-up after 7 months. No statistical report was published but the authors indicated a sustained, significant positive effect of the intervention for the period that the children received the reinforcement, with a return to baseline levels at the 7-month follow-up.

Appraisal
Findings of this study are limited by the lack of specific data on intakes. The apparent positive effect was not sustained after the reward system was removed. The use of extrinsic rewards to encourage consumption is controversial.

3.4.4 Verbal Prompt

A very small, controlled study in primary schools in the US showed that the use of a verbal prompt ‘Would you like fruit or juice?’ by school food service staff at lunch was effective at increasing fruit consumption over the 2-day period of the intervention. Observational data from about 150 children in each school that purchased lunch each day showed that nearly double the percentage of students (62%) took a fresh fruit serving in the intervention school compared to the control school (38%), approximately 80% of which was eaten in both schools.

Appraisal
These data show that fruit taken at lunchtime is a good proxy for amounts eaten. Again, fruit intake was measured only at lunchtime and the study is further limited by the very short duration. Generalisability of the findings is also limited by the sample being composed of mainly Caucasian, high socioeconomic status children. Nevertheless, the results are encouraging as nearly double the number of students who received the prompt took a fresh fruit serving compared to those that didn’t.
3.5 Free School F&V or Paid Subscription Schemes

3.5.1 Subscription scheme

A short-term study in Denmark, of only 5 weeks, examined the effect of a school paid subscription scheme for F&V on intakes. Four intervention schools were offered F&V subscription comprising one piece per day at a cost of 0.3 Euros, and there were 3 control schools where no subscription scheme was offered. Fruit was offered three times per week, and vegetables were offered two times per week. F&V intakes were measured using 24-hour recall and a short FFQ involving only F&V. After the five weeks of intervention, subscribers (45%) and non-subscribers at the four intervention schools had significantly increased their intake of fruit, by 0.4 and 0.3 pieces per school day respectively, as determined using 24-hour recall. There was no effect on vegetable intake in the intervention schools and no change in intake of F&V at the control schools between baseline and follow-up.

Appraisal
The 24-hour recall questionnaire was sensitive enough to pick up the effects of the subscription, whereas the FFQ was not. This has implications for any of the interventions where FFQ was the only assessment method for intake used. Paid subscription appeared to have a 'ripple effect' also increasing intakes in non-subscribers. However, intake was only on a per school day basis, not all-day.

3.5.2 Fighting disease with fruit

A very small-scale study involving the provision of free F&V to a group of 12 disadvantaged primary school children, mainly Aboriginal, in rural Australia, did not measure actual intakes of F&V. This intervention involved the provision of fresh fruit once or twice per day, supervised by teachers, for 6 months. The intervention led to a reduction in infection rates, particularly of otitis media (‘glue ear’), and improved hearing.

Appraisal
Although the findings of this study are limited substantially by the very small sample and the lack of measurement of actual intake, the other outcomes provide indirect evidence that fruit intakes were increased, and this is likely given that the provision of fruit was supervised by teachers. The provision of free fruit to disadvantaged groups could offer significant multiple advantages to the health system, and lead to improved equity.

3.5.3 Free Fruit

A study among high school students (Grades 8-10) in Mississippi, in the US, found that the provision of free F&V during the school day combined with nutrition education activities, was effective at increasing daily intakes of fruit as determined by 24-hour recall. Despite start up and implementation challenges, this intervention resulted in an increase in the variety of F&V consumed among the study children in the five schools involved in the intervention, for all three grades. The provision of free F&V also led to an increase in fruit intake during the school day of 0.34 servings, and an increase in intake of fruit over the whole day of 0.61 servings, after about 8 months of intervention. Consumption of vegetables fell in school indicating that compensation may have occurred, i.e. a reduction in vegetable consumption in school occurred in response to an increase in fruit consumption. Intake of vegetables over the whole day remained unchanged from baseline.

Appraisal
The major limitation of this study is the study design, i.e. the lack of control. Also, the effects of the nutrition education component were not evaluated separately from the provision of free fruit. However, the provision of free F&V together with nutrition education did achieve a significant increase in fruit intake and this was for the whole day.
3.5.4 Norwegian School Fruit Programme

The provision of free school fruit (and carrots) – the Norwegian School Fruit Programme – was examined in two counties, both with similar demographics and in the same region, in Norway (Hedmark and Telemark). Grade 7 students (aged 11 or 12 at baseline) in 19 high schools in each country participated in the study. Nine of the schools that agreed to participate in the study, all from Hedmark County, were randomly selected to receive fruit and carrots at no cost. The 29 ‘control’ schools were given the opportunity to participate in the fruit scheme but at cost. A total of nine schools opted to take part in the paid subscription scheme and 20 schools opted not to participate in the paid scheme. The free fruit, paid fruit and no fruit groups included 222, 157 and 416 students respectively; and the original program lasted through one school year (approximately 8 months). The provision of free fruit (and carrots) resulted in a significant increase, compared to control, of 0.6 portions of F&V during the school day, as determined by 24-hour recall. A significant decrease in F&V consumption during the school day, by 0.1 portions/school day, was observed in children in the no fruit schools, and there was no significant change in consumption in the schools that opted for paid subscription, resulting in a significant difference in consumption during the school day between groups at the end of the intervention period, when mean intakes were 1.1, 0.2 and 0.4 portions per school day, respectively. Similar differences were observed for consumption during the whole day resulting in a significant difference between groups at follow-up. The provision of free school fruit resulted in an increase of 0.2 portions of F&V/day, although this increase was not statistically significant; whereas consumption of F&V decreased significantly by 0.3 and 0.8 portions F&V/day in the paid fruit and no fruit schools respectively.

Appraisal

The provision of free school fruit (and carrots) led to an increase in the F&V consumed at school and over the whole day, although the latter effect was not significant. Also, the difference between groups for all-day consumption was due to a decrease from baseline in the children in schools with no fruit or the paid subscription scheme. Norwegian primary school children mainly bring their own lunch, usually sandwiches, to school and traditionally F&V have not been available at school as few primary schools have canteens thus baseline levels of intake were low.

3.5.5 Norwegian School Fruit Programme

This is part of the same study reported in three other publications. The data in this paper are from the 19 schools in Hedmark County only. The 9 intervention schools received the Fruits and Vegetables Make the Marks (FVMM) educational programme described elsewhere, and subscription in the Norwegian School Fruit Programme (NSFP) at no cost to the parents for the first year of the study. In year 2 of the study, four of the nine intervention schools continued to participate in the NSFP but at a cost to parents, ‘paid fruit’, and the other five schools opted out of the programme, ‘no fruit’. There were 10 control schools which were offered ‘paid fruit’ for the two years of the study. In Year 1, 100% of intervention pupils participated (for free) in the SFP, while 11% of the control pupils subscribed. In Year 2, 31% of the pupils in the intervention group and 7% of the control pupils subscribed. A total of 517 pupils participated in a 24-hour recall at three measurement periods, at baseline, at the end of year 1 (FU1) and the end of Year 2 (FU2). The intervention significantly increased F&V intakes during the school day and all-day at FU1 and FU2 in the intervention pupils compared to the control pupils, for all-day by 0.6 and 0.5 portions/day respectively; although some of this difference was due to a decline in intakes in the control pupils from baseline. The sustained effect at FU2, 1 year after the end of the intervention, was partly explained by greater participation rates in the ‘paid fruit’ scheme. There was some indication of a larger positive effect of the standard ‘paid fruit’ programme on all-day consumption of F&V in boys, thus indicating a need for such an intervention, which increases the availability of F&V, in boys particularly; although the gender difference was not apparent for F&V intakes during the school day.

Appraisal

The study design did not allow the effects of the FVMM educational program to be evaluated separately from the effect of free and, subsequently, paid subscription hence it was not certain that FVMM was not contributing to the effectiveness of the program. Also, the paper selectively reported the more positive effects and chose to compare results in intervention versus control groups rather than differences from baseline. For example, no comment was provided on the apparent decrease in all-day consumption of F&V from baseline to follow-up 2 in the intervention group.
3.5.6 Norwegian School Fruit Programme
The purpose of this study was to evaluate the long term effects of the NSFP (see above), provided at no cost to pupils, three years after it was provided for free. This study reports on the nine schools in Hedmark County that received free fruit for one year, and treats the other 29 schools in Hedmark and Telemark counties (see above) as control schools. In this study data collected at baseline, at the end of year 1 (FU1) and three years after the end of year 1 (FU2), i.e. after the provision of free fruit in the intervention schools, were compared. At FU2 many of the pupils were at different (junior high) schools. Participation rates in the SFP at FU1 were 100% and 13% in the intervention (free fruit) and control (paid fruit) schools respectively, and 16% and 1%, respectively (both paid fruit), at FU2. Thus the data were analysed as a whole and with subscription in the SFP as part of the analyses. The results showed that pupils in the ‘free fruit’ group significantly increased F&V intake from baseline to FU1 and that this effect was sustained three years after the end of the intervention; although there was a decline in intakes in the intervention group, as well as in the control, for all measures between FU1 and FU2. For boys the estimated change in F&V intake from baseline to FU2, compared to the control group, were 0.13 portions/school day, 0.38 portions/day and 1.6 times/week for usual F&V intake. Corresponding estimates for girls were 0.15 portions/school day, 0.44 portions/day and 1.6 times/week respectively. Subscription in the scheme reduced the effect size but the effect of the intervention remained significant for all measures.

Appraisal
The intervention showed that paid subscription rates were higher in schools that had previously received free fruit. Also, the paper reports that the differences between intervention and control groups 3 years after the subscription to free fruit were significant even after adjusting for different subscription rates; thus it is likely that there had been some sort of ripple effect of the ‘free fruit’ through the schools involved. The paper considers that the effect size, attributed to be 0.38 and 0.44 portions/day for boys and girls respectively, if sustainable longer-term, is more than sufficient to render the program cost-effective, even when provided free to all children for 10 years.

3.5.7 National Schools Fruit Scheme
The National Schools Fruit Scheme (NSFS) in the UK [renamed the Schools Fruit and Vegetable Scheme during the course of this study], involved the provision of free fruit (e.g. apples, pears, mandarin oranges), only, to children in infant schools (aged 4-6). After one year, the median intake of fruit increased from 7.5 pieces/week at baseline to 14.0 pieces per week in the intervention region (113 schools); compared to an increase from 9.2 to 11.0 pieces per week in the control region (122 schools). After the second year, when free fruit was no longer provided, the median intake fell to 12 pieces per week in the intervention region, compared to an increase of 14 pieces per week in the control region. In other words, the intervention effect was not maintained post-free fruit, indeed intakes fell below those in the control at this time. A earlier evaluation of the NSFS (Wells & Nelson 2005) found that median fruit consumption in infant schools with free fruit was 117g/day higher in the intervention children compared to the control. However, in this evaluation they found no long term effect when fruit intake was examined in the same children at age 7-8 years old. However, these earlier results were from a cross-sectional study, with no randomisation to condition, and with a low response rate.

Appraisal
The study showed a significant increase in fruit consumption in children during the period of free fruit but, although some of this increase above baseline levels was maintained once the period of free fruit ended, there was also an increase in the control group at this time which hampers interpretation of the results. The authors of the study indicated that this higher intake in the control region post-intervention could have been a consequence of the higher socio-economic status of the total control population compared with those who participated in the NSFS. There were a number of methodological limitations to this study. For example, the two parentally-completed survey questions were un-validated. The study design was also unable to exclude the possibility of increased awareness of their children’s fruit intake by parents in the intervention region thus there was the possibility of reporting bias.
3.5.8  **Schools Fruit and Vegetable Scheme**

A non-randomised controlled trial of the School Fruit and Vegetable Scheme in the UK involved the provision of one piece of fruit (apples, pears, easy to peel citrus fruit, bananas, occasional seasonal items such as strawberries) or vegetables (carrot sticks, small tomatoes) to every child aged 4-6 years, each school day, in 55 intervention schools. There were 45 control schools who did not receive free F&V. Educational materials and activities were also included as part of the intervention in this trial. After 3 months, fruit intake increased by 0.5 portions per day in children aged 4 years (reception), and by 0.7 portions per day in children in Year 1. After 7 months however, this increase was reduced to 0.2 portions per day in these children. Increases in carotene intake and vitamin C intakes during the extent of the intervention were reported. There was no intervention effect on vegetable intake in children of any age. Students in Year 2 increased their intake by 0.5 portions per day after 3 months, but this positive intervention effect was not observed after 7 months after the provision of free fruit was stopped; although there was an effect of decreased sugar intake in Year 2 students at the 7 month follow-up. This same trial was previously reported by many of the same researchers indicating that children in the intervention group were 30% more likely to achieve ‘5-a-day’.

**Appraisal**

There was no evaluation of the educational and activities component of the intervention independently of the free fruit. Despite vegetables being offered on a rotational basis, there was no effect of the intervention on vegetables intake.

3.5.9  **Dutch Schoolgruiten Project**

In this intervention, the Dutch Schoolgruiten project, free fruit, or ready-to-eat vegetables (cherry tomatoes, baby carrots), were provided twice a week to 4th grade students (mean age 9.9 years) in schools in The Netherlands. The program was planned, developed and implemented by a public-private partnership of the Netherlands Nutrition Center Foundation and the promotion office of Dutch F&V producers. The intervention group was comprised of 500 students from 2 cities and the schools that these students were in were also encouraged to use a newly developed school curriculum which was designed to increase knowledge and skills related to F&V consumption. The control group was comprised of 453 students from 3 different cities and these students received neither free fruit nor were the schools encouraged to use the school curriculum. This non-randomised trial determined usual F&V intakes from parent- and child-reported, validated ‘Pro Children’ questionnaires, at baseline and at the end of the one year long intervention. The intervention had a significant effect on the fruit intake of children of Dutch ethnicity and on the vegetable intake of children of non-Western ethnicity, but these effects were found only in analyses based on the child-reported data. Vegetable intake (usual amount per day) was significantly higher (20.7 g/day difference) in children of non-Western ethnicity and fruit intake was significantly higher (0.23 pieces/day difference) in children of Dutch ethnicity, after one year of free F&V. The intervention group also reported higher perceived accessibility and some positive changes for taste preference at follow-up. Process evaluation showed that curriculum materials were used at least once only by about 40% of the intervention schools.

**Appraisal**

Although it was not a randomised trial any bias was considered to be the same in intervention and control groups. About two-thirds of Dutch schoolchildren eat at home during the lunch break in The Netherlands while other children bring all of their own food. The lack of positive effect detected by parental report indicates a lack of effect of the intervention on intake over the entire day – although parents would not have been very aware of intakes during school hours. Also the positive effect indicated by child-report could be related to over-reporting by children in the intervention group. Earlier research had indicated that children from non-Western ethnicity in The Netherlands have higher F&V intake levels hence it was hypothesised that children of non-Western ethnicity would benefit less from the intervention, however the results did not fully support this hypothesis. The results indicate a possible need to consider different intervention components for different ethnic groups, and for fruit and vegetables as separate targets for intervention.
3.6 Interventions in non-school settings

3.6.1 Eat 5 Badge

This intervention was one of two in the setting of scout troops (see also 3.6.2). The intervention, the ‘Eat 5 Badge’, was in girl scouts, was only 4-weeks long and involved 300 girls. The intervention involved sessions learning about 3-day food diaries, educational sessions including F&V exposure and preparations skills and knowledge, in addition to skills in self-evaluation, self-monitoring, goal-setting and problem-solving. Parents were involved with newsletters encouraging promotion of F&V consumption at home. After 4 weeks there was an increase in F&V intake in the girl scouts, an increase of 0.37 servings/day compared to baseline in the treatment group versus a decrease of 0.14 servings/day in the control, but this effect was not maintained 3-months post-intervention.

Appraisal

The Eat 5 Badge for girl scouts did achieve positive results that were statistically significant but these positive effects were not sustained 3-months post-intervention, as is observed in other interventions where rewards are given and then ended. This type of intervention has little application over the longer term or at the population level.

3.6.2 5-a-Day Achievement Badge

A very similar program to the ‘Eat 5 Badge’ (3.6.1) was the ‘5-a-Day Achievement Badge’, a pilot randomised controlled study involving 186 African-American boy scouts. The 8-week program was presented by dietitians and included activities to increase F&V availability and accessibility at home, preferences for F&V, and preparation skills. The intervention also included goal-setting, self-monitoring skills, and problem-solving. Immediately after the intervention total F&V (including 100% juice) intake in the intervention group was 0.8 servings per day higher than in the control group, after adjusting for baseline intake, but the difference was not statistically significant.

Appraisal

The intervention in boy scouts offers little to the evidence base alone as the F&V intake measure included 100% juice, the positive effect of the intervention lacked statistical significance, and there was no follow-up post-intervention. This type of intervention has little application over the longer term or at the population level.

3.6.3 University Teaching Lab

A very small study involving a 10-week curriculum based on social-learning theory was conducted with 9 parent-child pairs in a University Teaching Lab, aimed at increasing fruit intake in children and encouraging positive parent-child feeding strategies. Seventeen parent-child pairs served as controls, where the parents were those who expressed interest in the program but couldn’t attend the first lesson (pre-test). Children were in the 5th or 6th grade. Each one-hour lesson to children and parents was comprised of instruction aimed at enhancing knowledge about fruit, skills necessary to incorporate fruit into the diet and techniques to enhance goal-directed behaviour. Parents were instructed separately on child-feeding strategies to enhance fruit consumption in their children. Three-day food records (2 weekdays, 1 weekend day) showed that the intervention was successful in increasing daily whole fruit intake, although this included 100% juice, (vegetables were not promoted) by 0.7 half-servings per day in the intervention group compared to a decrease of 0.2 half-servings per day in the control group. The intervention also resulted in a significant decrease in the use of controlled child feeding strategies – restriction, encouragement and monitoring were taken into consideration – in the intervention group compared with an increase in the control group.

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2 Social learning theory, or social cognitive theory, recognises the complex and reciprocal inter-relationships between dietary behaviour, environmental and personal factors
Appraisal
This was one of only a few interventions outside of the school setting however the setting is not readily accessible for the majority of children and parents. The curriculum could probably be easily adapted for use in a different setting which enabled parents and children to be taught at the same time. The study had many limitations including very small sample size and the inclusion of 100% juice in the measure of fruit intake, although a robust measurement tool was used. Teaching parents and children together shows potential as a model for increasing consumption of fruit.

3.6.4 START
The ‘Students of Today Achieving Results for Tomorrow’ (START) project involved organisational policy aimed to increase F&V availability in after-school programs in public primary schools in California, US. Over the two-year study period the policy led to an increase in the number of servings of fruit available on the snack menus in the after-school programs, although this was mainly due to the increased availability of juice.

Appraisal
The study indicates the apparent success of organisational policy on increased fruit availability, one of the determinants of F&V intake; however the inclusion of 100% juice as a component of F&V limits the usefulness of the study, as does the lack of data on fruit consumption.

3.6.5 YOUTH
The YOUTH program was a health-plan based lifestyle intervention in a large health maintenance organisation in the US. This intervention was one of only a couple of interventions aimed at adolescents/teenagers but was aimed at a very specific target group: girls aged 14-16 years with low body mass index (BMI). This intervention involved bimonthly meetings, self-monitoring and quarterly coaching telephone calls aimed to increase F&V consumption to 8 serves per day, to increase dairy consumption, and to decrease soft drink consumption. The two-year randomised controlled trial was successful in increasing F&V consumption, by 0.74 and 0.79 serves/day in Year 1 and Year 2 respectively, in the intervention group compared to the control group.

Appraisal
This reasonably intensive intervention was very successful in increasing F&V consumption however the very specific target group of teenage girls with a low BMI severely limits the application of the intervention at the population level.
4 Evidence appraisal

4.1 Intervention Evidence

A large number of interventions have been aimed to increase fruit and/or vegetable consumption in children and adolescents and the vast majority of them were conducted in the school setting. However, there is considerable heterogeneity among the studies. The studies vary in terms of: reporting (some report on differences within treatment between baseline and follow-up, others report on between group differences at follow-up); methods used to assess intake (e.g. FFQ, food diaries, 24-hour recall, child self-report, parental report); duration of intervention; duration of follow-up; age of children; foods included as fruit (some include 100% juice) and vegetables (some include potatoes); and portion or serving sizes used to determine effect size. Other limitations of some of the studies include non-randomisation or randomisation by classroom or by student, inducing the potential problem of cross-contamination. Also, several studies reported intakes of F&V decreasing under the control condition sometimes together with a lesser decrease under the intervention condition, resulting in a net positive intervention effect.

A primary limitation of several studies was that they measured F&V intake only during lunchtime, not over the entire day, thereby not allowing for potential compensatory effects. In addition, only two of the interventions measured F&V consumption in the context of the whole diet, thereby the intervention evidence provides little evidence to indicate whether increased consumption of F&V is associated with a reduction in overall energy intake.

Despite these limitations the evidence is informative in a number of ways. The major findings and implications from the evidence are summarised under headings which have been chosen to offer a functional interpretation of the intervention studies.

4.1.1 Whole of school approach

Most interventions in the school setting employed a ‘whole of school’ (WOS) approach. Eleven of these WOS interventions that involved F&V promotion were aimed solely at this objective. However, nine interventions were identified that involved F&V promotion as only one component of a program aimed at changing other eating behaviours and, in five out of these nine programs, also aimed at increasing physical activity.

It is difficult to ascertain which are the most effective components or individual activities of these multi-component (MC) interventions due to the myriad differences between the interventions and the lack of evaluation, often, of the individual components. Without such evaluation, it may be that many of the components of the MC programs might indeed be extraneous and waste limited resources, particularly when implementation of some of the various activities is likely to be low as the number of activities increase.

4.1.2 Programs aimed at teenagers

Only a few programs involved children older than the 6th or 7th grade. The ‘Teens Eating for Energy and Nutrition at School (TEENS)’ program was aimed at young teens, aged 12-13 years. The study had particular limitations although there was some indication of the value of peer leaders. The GIMME 5 program in high schools was aimed at children in grades 9-12. This WOS program was effective for the first two years but not after three years. A single component intervention involving a nutritional education board game, KALEDO, was successful at increasing vegetables intake in 11-14 year olds in Italy. A reduction in price of F&V in school canteens was effective at increasing sales of F&V in high schools in the US. The HEALTHY FOOD INTERVENTION was aimed at increasing fruit and reducing fat intake in 11-15 year olds in Belgium but was unsuccessful in changing fruit consumption using tailored advice to students and sporadic free or low cost fruit.
4.1.3 Programs with limited focus on F&V
The WOS programs that were not specifically focused on increasing F&V consumption were generally less successful in increasing F&V, although methodological limitations of these studies precludes making firm conclusions. For example, in CATCH\textsuperscript{19}, the focus was on reducing fat and sodium and increasing physical activity hence, although some messages involved increasing F&V (e.g. ‘increase the use of fresh, canned or frozen F&V’, and ‘add peas/beans to salad recipes’), this aspect of the program was not effective. In contrast PLANET HEALTH\textsuperscript{24}, which was also aimed at reducing consumption of high fat foods, as well as increased physical activity and reduced TV viewing, was effective at increasing daily F&V intakes, although only in girls, perhaps because increased F&V was a specific aim of the program. The increase in the intervention group after two years was partly attributable to a decrease in consumption in the control group however. Notably, PLANET HEALTH was also effective at reducing prevalence of obesity in girls. The similar program, EAT WELL & KEEP MOVING\textsuperscript{25}, also involving specific messages relating to F&V consumption such as ‘eat 3-a-day at school’ and ‘eat 5-a-day’, was also apparently successful at increasing daily F&V intake, and as a percentage of total energy intake, although the study had some methodological limitations. The NEAPS\textsuperscript{26} program, which was a healthy eating program involving an exercise regime, also achieved very modest increases in F&V consumption, although this was measured using percentage of children achieving 4 or more serves F&V per day hence effectiveness in increasing mean or median intakes could have been larger.

4.1.4 Promotion of vegetables
Overall the results from WOS programs showed that it is generally easier to effect a change in fruit intake than vegetable intake, although most of the interventions had a larger or sole focus on fruit rather than vegetables anyway. One of the interventions that had a larger effect on vegetable than fruit consumption was GIMME 5 in primary school children\textsuperscript{28}. This was attributed to the curriculum in the first year being specifically focused on vegetables. Vegetables were again more of a focus in the ‘Active Programming Promoting Lifestyle Education in School’ (APPLES) program in the UK\textsuperscript{29} which achieved an increase in vegetable consumption but not fruit consumption. This more general program was based on the ‘Health Promoting Schools’ philosophy, and also included school food service and tuck shop changes, and was aimed at increasing consumption of healthier foods and physical activity in 8-10 year olds. The single-component program, KALÈDO, which was a nutrition education board game aimed at 11-14 years in Italy, was successful at increasing vegetable intake.

4.1.5 Inclusion of industry/community
Among the WOS programs aimed solely at F&V consumption, a number were based on the ‘5-A-DAY’ approach, that is, encouraging children to consume the recommended number of serves was the focus of the intervention messages. The majority of these types of programs were conducted in the US. Two of these programs, 5-A-DAY POWER PLAY\textsuperscript{22} and 5-A-DAY POWER PLUS\textsuperscript{18}, were both of 10-months duration, were aimed at 9-11 year olds and involved industry and community. While the addition of industry components (PowerPlay! Day aimed at engaging and linking up with industry) and community components (supermarkets, farmers markets, youth organisations, point-of-sale advertisements, TV announcements) did not significantly increase the effectiveness of the intervention in the former program; the 5-A-DAY POWER PLUS program achieved a high level of implementation and effectiveness, which was probably increased through industry involvement, including the provision of free F&V snack packs for school and home.

4.1.6 Trained resource teachers
Several WOS programs used trained resource teachers to implement the nutrition education component of the program and this was generally considered to be of considerable benefit in terms of degree of implementation of educational materials and overall program effectiveness. Interventions such as GIMME 5 in high schools\textsuperscript{20} and HIGH 5\textsuperscript{27}, where research staff or trained resource teachers were used to deliver the educational materials, and additional activities including school media and food service staff training were included, were generally more successful, at least in terms of implementation. Similarly, some of the success of the INTEGRATED NUTRITION PROGRAM\textsuperscript{23} was attributed to delivery of material by a trained resource teacher.
Conversely, the effectiveness of GIMME 5 in primary schools was hampered by low implementation of the F&V curriculum by teachers who were uncomfortable with the behaviour-change focus such as goal-setting, problem-solving and self-monitoring.

4.1.7 Parental involvement

Although the majority of the WOS programs involved the inclusion of parents, primarily with ‘kick off’ nights and the provision of newsletters, few evaluated this component of the intervention separately from the whole program. Nevertheless, achievement of high parental involvement in the promotional activities seems to be important. High parental involvement was achieved in the successful HIGH 5 intervention, resulting in an increase in parental consumption of F&V at the end of the first year. This can be contrasted, for example, with GIMME 5 in primary schools where only 10% of parents attended point-of-purchase grocery store activities. Another program, Nutrition Education at Primary School (NEAPS), involved parent packs and family assignments, and achieved very modest but statistically significant results of a 2% increase in the number of children consuming 4 or more serves of F&V per day, assessed using the robust method of a 5-day food diary. These results are encouraging as more obvious positive effects might have been observed using a more responsive outcome measure.

4.1.8 Use of rewards or incentives

The use of rewards or incentives to increase F&V consumption appears to have some promise in increasing intakes in the short-term but is unlikely to lead to longer-term changes, particularly if not associated with other intervention components. Also, the use of extrinsic rewards is controversial as there is concern that they can have a detrimental effect on food preferences in children. Nevertheless, getting children to increase their tasting of these foods is a problem that needs to be overcome as repeated exposure and tasting of F&V has been shown to lead to increased consumption and expressed preference for these foods. Rewards are thus seen as one way to overcome the problem and ensure taste exposure that could otherwise not be achieved, eventually leading to intrinsic rewards (as ‘the food tastes good’). The poor study design of the two FOOD DUDES studies limits identification of the overall usefulness of rewards as an intervention for increasing F&V consumption. Also, this program involved peer modelling as a major program component. Earlier research by these authors had shown that rewards alone were not successful at increasing F&V consumption, but the FOOD DUDES program did not determine the effectiveness of the peer modelling program independently of the rewards scheme.

Rewards were also used in the KIDS CHOICE program which was aimed mainly at activities involving the school food service. The rewards, such as stickers and badges, were obtained through the collection of tokens given for consumption of F&V during school lunch in 8-year olds. This intervention, although apparently successful during the extent of the reward period, was not sustained beyond the period of the rewards, providing more evidence that rewards alone are unlikely to be effective for achieving long-term increases in F&V consumption. This finding is supported by the evidence from a study among girl scouts, also short-term, in the US. The use of a ‘badge’ as a reward increased F&V for the duration of the scheme but this effect was not sustained 3-months post-intervention. The use of rewards over longer time periods has not been examined.

A number of WOS studies involved competitions and prizes, e.g. the successful 5-A-DAY POWER PLUS, the semi-successful GIMME 5 in high schools and the unsuccessful FRUIT AND VEGETABLES MAKES THE MARKS educational program. The effectiveness of these components is unknown as they were not evaluated separately from other program components.

4.1.9 Peer modelling

Peer models or leaders have been used in a number of the WOS interventions. One of the two WOS programs aimed at teenagers, TEENS, indicated that the introduction of peer leaders to classroom curriculum and changes to the school food environment increased effectiveness. Comic books containing ‘cool’ characters (e.g. ‘Freggie Man’) were used in the 5-A-DAY POWER PLUS program, as well as rewards/prizes. This intervention was effective, although it is not known how much the comic books were read by students, in comparison with the videos used in FOOD DUDES which were seen by all students during class time. Peer modelling (student leaders, fictional characters) is likely to be a useful component of any education program.
4.1.10 Framing of F&V messages
Although a large number of studies involved the 5-a-day message and concentrated on the health benefits of F&V, some studies moved away from the ‘eat a certain number of serves’ message and away from the ‘healthiness’ of F&V. For example in the FOOD DUDES study, care was taken that the messages were not coercive nor did they portray any foods in a negative way, thus ‘I’m going to eat my fruit because it tastes good’, and ‘I’m going to eat my vegetables because they make me strong’. The authors considered that warning children about the dire effects on their future health prospects of not eating healthy food or telling them that a particular food is healthy may reduce their acceptance of such a food. Similarly, the ‘number of serves/day’ and ‘healthy’ messages were de-emphasised in the INTEGRATED NUTRITION PROGRAM which focused more on presenting F&V as tasty and on ‘eating more’, although the effectiveness of this intervention on daily F&V intake is uncertain. The potential for the ‘5-A-DAY’ catchphrase to be a disincentive for use with children has been raised by other researchers.

4.1.11 Food preparation/cooking skills
Food preparation lessons were included in the FRUIT AND VEGETABLES MAKE THE MARKS program in Norway, which combined home economics lessons with free or subscription fruit and vegetables, however the education component overall was not deemed successful. Similarly, several other programs that included food preparation or cooking classes, for example the BASH STREET KIDS, did not evaluate the effect of this component separately and so its impact is uncertain from these studies. Nevertheless, cooking/food preparation classes were successfully included, at least among younger children, in combination with food and environment lessons in the COOKSHOP Program. Food and environment lessons alone were not successful. Cooking classes were deemed to be successful and a core component of the multi-component TOOTY FRUITY VEGIE program (North Coast Area Health Service).

4.1.12 Behavioural activities
Goal-setting appeared to have no clear relationships with dietary behaviour in the SQUIRE’S QUEST multi-media game intervention, supporting the findings from some of the WOS intervention evidence that the value of including behavioural activities such as goal-setting and self-monitoring in interventions for increasing fruit and vegetable consumption is uncertain. This is supported by the evidence from programs that involved tailored nutrition advice and individual dietary counselling to students. However, increased self-efficacy of students was a positive outcome of the highly successful HIGH 5 program and self-efficacy has been highlighted as one of the personal factors that F&V interventions among children should aim to increase.

4.1.13 Nutrition education using games
Two interventions involved the use of games to educate about F&V in schools. An educational board game, KALÊDO, played for 24 weeks by children in 11-14 year olds in Italy aimed to increase nutrition knowledge and influence dietary behaviour. It was one of the few interventions effective in increasing vegetable intake, although this was determined by child self-report and was a difference between groups at the end of the intervention period. Another game was SQUIRES QUEST, an interactive, multimedia version of GIMME 5 for 10-11 year olds, which involved virtual recipes and aimed to increase asking behaviours at home. Although servings of F&V were increased by 0.91 per day in the treatment group after 5 weeks, as determined by 24-hour recall, this measure also included 100% fruit juice. Despite the limitations of these studies the evidence indicates that the use of games is likely to be a useful component of any F&V education program, especially as they can ensure a wide reach with limited resources.

4.1.14 Gardening at school
A recent but very small study showed that garden-based activities at primary school led to a very substantial increase in servings of F&V per day above that in those students receiving only the ‘nutrition in the garden’ education program. Garden-based activities are considered to be a core component of the local TOOTY FRUITY VEGIE program.
4.1.15 Tailored nutrition advice and individual dietary counselling

Three interventions involved the provision of individual advice on dietary change including increasing F&V consumption as a primary part of the intervention. One of the studies, in The Netherlands, involved counselling in the presence of at least one parent, deemed important because the social environment is a recognised facilitator for dietary behaviour. This intervention increased children’s awareness of F&V intake levels but did not affect intake levels.40 Also, neither of the other two studies involving the provision of individual dietary counselling, the Healthy Food Intervention in Belgium49 and the STRIP intervention in Finland48, were successful at increasing F&V intakes. The Healthy Food Intervention did successfully decrease fat intake which was attributed to the inclusion of parents in the provision of dietary advice, thus replication of this aspect of the intervention with respect to F&V may have resulted in a positive effect on F&V consumption. However, the evidence indicates that individual counselling is unlikely to be effective at increasing F&V intakes, and would be resource intensive to include as a component of a broader program to increase F&V.

4.1.16 School food service interventions

A number of WOS programs were aimed to make F&V more available at schools through encouraging changes to the school food service, including canteens and tuck shops.18,22,20,29 These involved food service staff training. However, most of these did not measure the effectiveness of the intervention on foods available at school. An exception was the highly successful HIGH 5 program27 which included a school food service component involving regular visits by trained nutritionists to encourage HIGH 5 guidelines. However there was a lack of responsiveness of food service staff to implement the guidelines resulting in no changes to the foods sold in the canteen pre- and post-intervention. This program, although effective in increasing F&V consumption despite the lack of change in F&V available, illustrates the need for policy rather than guidelines to effect changes in foods on school menus. Organisational policy in an after-school program in the US, the START program66, led to increase in fruit servings on the snack menu, although this was mainly due to 100% fruit juice in this instance.

Many of the WOS programs also involved activities around availability of F&V at schools. For example, the 5-A-DAY CAFETERIA PLUS18 program involved daily activities in the canteen, including increased attractiveness of the display of F&V, and special events such as taste-testing and challenge weeks with prizes. GIMME 5 in high schools20 also involved taste-testing, table tents, and point-of-purchase (POP) signs. Point-of-purchase marketing was involved in 5-A-DAY POWER PLUS18 and the program involving cartoon characters (BASH STREET KIDS) in Scotland.41 However, the effectiveness of this intervention component is largely unknown as it was generally not evaluated separately. Process evaluation of the 5-A-DAY CAFETERIA PLUS33 program did show, however, that F&V bought from the school canteen was related to verbal encouragement by food service staff. The use of verbal encouragement by school food service staff was also successful in increasing fruit consumption in a short (2-day) intervention in primary schools in the US53 indicating the promise of verbal prompting by food service staff at POP as an intervention component.

4.1.17 Differential pricing

Only one study examined the effect of differential pricing of F&V compared to energy-dense, nutrient-poor foods (EDNP)16, but this intervention appears to show promise, especially as it is likely to also achieve a reduction in consumption of EDNP foods (cf. Module 3), at least at school. The pricing strategy was combined with loudspeaker announcements at school, and, although it was only a short-term study, sales of fruit and carrot sticks were increased substantially by reducing their price by 50% with no detrimental effect on profits or the number of meal customers.

4.1.18 Foods brought to school

There was only one intervention that aimed to change foods in lunchboxes brought to school, yet the majority of Australian children bring their recess and lunch food to school. The FRESH KIDS program44, implemented among a culturally diverse, low socioeconomic group of students in Melbourne was an intensive program based in the school, home and community. The intervention was successful at increasing the amount of fruit brought to school (or ordered from the canteen) and for a sustained period, although interpretation of the findings are limited as consumption of the F&V brought to school was not measured, nor was daily consumption.
4.1.19 Free F&V and subscription schemes in schools

The provision of free fruit (and vegetables) or a paid subscription scheme in schools has been given considerable attention in recent years in some of the Scandinavian countries, in the US and in Europe. The evidence indicates that the provision of free fruit or paid subscription is likely to be an effective strategy for increasing intakes of fruit, at least. It has been easier to effect an increase in fruit than vegetables through these schemes but this is likely a result of the infrequent offering of vegetables in those programs that did offer vegetables, and many of the programs did not include vegetables.

A paid subscription scheme alone was successful at increasing fruit intake during the school day, but not vegetables although they were offered two times per week, in a study in Denmark. Notably non-subscribers (55%) also increased their intakes of F&V, suggesting a ‘ripple effect’ through the school. A paid subscription scheme in Norway, the NORWEGIAN SCHOOL FRUIT PROGRAMME, similarly resulted in increases in fruit intake during the school day in schools with a paid subscription scheme, but a decrease in intake over the whole day. This intervention also included schools with fruit provided free and fruit intake increased at school and all-day, although not statistically significantly so, in these schools. The positive intervention effect was sustained in schools that had received free fruit for one year and followed up with a paid subscription scheme for one year, but not in those schools that did not follow-up with paid subscription. Positive effects in these schools which opted for the paid subscription scheme were sustained up to three years after the provision of free F&V ended. This latter study examined the effect of higher participation rates in the paid scheme in those schools that had previously received free fruit and found that the positive effect was still significant, although the effect size was reduced.

Two large-scale trials of free fruit to infant school children in the UK resulted in increases in fruit consumption over the whole day during the scheme, but this effect was not maintained post-intervention (of free fruit) when no paid subscription schemes were offered. In the SCHOOL FRUIT AND VEGETABLE SCHEME, the provision of free fruit resulted in an increase in the consumption of fruit after 3 months, although this effect was reduced after 7 months of free fruit, and disappeared after 7 months in those no longer receiving free fruit. As in the study in Denmark, there was no effect on intakes of vegetables despite carrot sticks or small tomatoes being provided on some days. This trial also involved a nutrition education component which was not evaluated separately. A study of free F&V together with nutrition education at high schools in the US resulted in positive changes in consumption of fruit during the school day and for the whole day after 8 months, but again the two main intervention components were not evaluated separately. The other UK trial, the NATIONAL SCHOOLS FRUIT SCHEME (renamed the School Fruit and Vegetable Scheme during the course of the intervention) provided only fruit (apples, pears, mandarin oranges, bananas, and occasional seasonal fruit such as strawberries and grapes) and this trial showed a larger increase in daily fruit intake in the control group than in the intervention group from baseline to post-intervention, suggesting a secular increase in F&V consumption; although there was some evidence that families in the control region were of a higher socioeconomic status which may have affected results. Fruit consumption was shown to decline with age in both these interventions.

The provision of free F&V in the Netherlands, the DUTCH SCHOOLGRUITEN PROJECT, showed an ethnicity difference in level of effectiveness. Vegetable intake was higher after free F&V in children of non-western descent, and fruit intake was higher in children of Dutch ethnicity. However, these differences were by self-report of children with a mean age of 9.9 years at baseline.

Of interest for other health reasons was the increase in carotene and vitamin C intakes demonstrated in the NATIONAL SCHOOL FRUIT SCHEME. A very small study involving the provision of free F&V to 17 low SES, mainly Aboriginal children, in Australia, also resulted in increased vitamin C levels and resulted in a reduction in infection rates, including of otitis media, indicating the potential of this strategy to contribute to reduced health inequalities.
Two other studies included the periodic provision of free fruit but neither evaluated this aspect of the program separately from other components. The FRESH KIDS program in Melbourne involved the provision of free seasonal fruit for 2-4 weeks each year, and the HEALTHY FOOD INTERVENTION in Belgium involved the provision of free or low cost fruit once a week for 9 months. The former program was successful in increasing the amount of fruit brought each day in school lunchboxes in primary school children but the free fruit component was only one of many different components of this school-home-community based program and was not evaluated separately. The latter program was not effective at increasing fruit intake in 11-15 year olds but this program had a larger focus on reducing fat intake. Free F&V snack packs were supplied by industry to schools and homes in 5-A-DAY POWER PLUS and this was likely a major contributory factor to the effectiveness of the intervention in increasing F&V intake.

The cost-effectiveness of the provision of free F&V at schools was determined from the studies in Norway. The analysis indicated that only a very modest effect size, certainly within the range observed in many of the programs indicated above, and if sustainable long term was necessary to make the provision of free fruit in schools a highly cost-effective measure for increasing consumption, even if provided free to all children for 10 years. In summary, the provision of free or subsidised fruit, and possibly vegetables, at schools is likely to be a cost-effective component of any program and has the potential to reduce health inequities. Its effect is likely to be enhanced if implemented in the context of a whole-of-school policy designed to promote healthy eating.

4.1.2 Other settings

Few interventions to promote F&V consumption in children have been implemented outside of the school setting and those that were have mostly been discussed above. The only other one was a study involving education to pairs of parents and children conducted in a University teaching lab. Social learning theory was applied to the educational materials in this study, as in the INTEGRATED NUTRITION PROJECT. Although this intervention was in a limited setting, the approach i.e. educating parents and children together, could be expanded to other settings; although this approach is likely to be more successful in higher socio-economic groups. The 10-week intervention was successful in increasing whole fruit consumption and reducing controlled parent-child feeding strategies, the latter an approach that has been proposed as a method to intervene independently to reduce child obesity.

4.2 Gaps in the intervention evidence

There are significant gaps in types of strategies and settings covered by the evidence base.

Particular gaps observed are:

- Nearly all interventions to increase F&V consumption identified were school-based. Very few studies on interventions in the home and community settings were identified, yet home availability and accessibility are likely to be significant factors determining intake in children.

- Although a number of the interventions which were identified aimed to increase F&V availability in school canteens, and such changes might have a ripple effect; only one evaluated study was identified that aimed to change the foods brought in school lunch boxes, yet most Australian children have a packed lunch brought from home.
• No interventions were identified targeting pre-school aged children. Exposing young children (3-4 years of age) to a wider range of fruit and vegetables has been indicated as important, for example in the FIVE FOR ALL project from the UK.\textsuperscript{75} The Tooty Fruit Vegie project for primary schools, conducted in the North Coast of NSW, has been adapted for preschools and is now in its second year of implementation (18 intervention and 13 control preschools have been through the program to-date), however only findings from a baseline evaluation have been publicly reported so far.\textsuperscript{76} Funding has recently been allocated for a state-wide program in NSW to promote healthy eating and physical activity in preschools and long day care centres, with implementation planned to begin in April 2008. A thorough process and impact evaluation is being planned as an integral part of this program, and the findings from this evaluation will add substantively to the evidence base.

• Few interventions were aimed at older teenagers.

• Most interventions had a larger focus on fruits than vegetables and thus few were effective at increasing vegetable consumption. Also, there is accumulating evidence that fruits and vegetables should not be promoted in the same way, within the same intervention.\textsuperscript{69,77} Thus new and innovative programs to promote vegetable consumption in children, separately from fruits, are required.

• Age, gender and cultural differences were rarely accounted for in the intervention components.
5 Promising and appropriate strategies

Overall, the evidence base on interventions to increase children's consumption of fruit and vegetables offers several strategies which may be promising for implementation in the NSW context. The substantial volume of studies and recent reviews provide some consistency in findings, as well as numerous considerations and lessons to guide practitioners and policymakers in implementation.

While most of the available evidence base has come from outside of Australia, there is significant potential for modification of strategies and programs to suit the NSW context.

A range of strategies targeting increased F&V consumption have been outlined and discussed in this module. 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 Area Health Services or health organisations.

The following table presents the evidence-based strategies that have been appraised in this module as showing particular or some promise for promoting F&V consumption 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.

<table>
<thead>
<tr>
<th>Promising strategies based on available evidence</th>
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<tbody>
<tr>
<td>• Education in schools (in combination with other strategies)</td>
</tr>
<tr>
<td>• Policy to increase F&amp;V availability in schools e.g. Free or subsidised F&amp;V</td>
</tr>
<tr>
<td>• Point-of-purchase prompts at school food sites</td>
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<tr>
<td>• Pricing strategies in school canteens</td>
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<table>
<thead>
<tr>
<th>Strategies worthy of consideration</th>
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<tr>
<td>• Gardening activities at school</td>
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<tr>
<td>• Taste-testing opportunities in schools</td>
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<tr>
<td>• Education of children and parents together</td>
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<tr>
<td>• Organisational policy to increase F&amp;V availability in foods in before and after school programs</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention research – gaps and priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interventions to increase F&amp;V availability and accessibility at home and in community settings</td>
</tr>
<tr>
<td>• Interventions to increase F&amp;V in school lunchboxes</td>
</tr>
<tr>
<td>• Interventions aimed to increase vegetable consumption specifically</td>
</tr>
</tbody>
</table>
6 Implications for policy and practice

6.1 Implementation considerations

6.1.1 Education in schools
While education alone is unlikely to result in an increase in F&V consumption in children, this strategy frequently forms part of any school based intervention. The evidence suggests that school education programs to increase fruit and vegetable consumption take account of the following points:

- Trained resource teachers or research staff are more likely to be effective at implementing education programs.
- Multimedia and board games can reach a large number of children, and overcome some of the issues associated with dose and fidelity in classroom teaching. If classroom teachers are used to deliver the F&V education then they need to use a variety of interactive teaching methods and have sufficient training and support.
- The evidence points to the importance of framing of messages used in education to increase F&V consumption. The need to work towards the goal of viewing F&V as crucial and primary components of our diets rather than food items that must be eaten in order to make a ‘5-a-day’ quota was highlighted in a recent editorial. The evidence presented in this module indicates that messages that promote fruit and vegetables as ‘tasty’ rather than ‘healthy’ and learning about food in a ‘non-nutrition sense’ may be of greater benefit.
- The importance of age, gender and cultural differences in message and program design has been highlighted. This is supported, for example, by anecdotal evidence which indicates that Crunch & Sip®, a NSW Health initiative involving fruit and water breaks in primary schools, is not readily acceptable to high school children.
- Behavioural activities such as goal-setting and self-monitoring may not be very important in terms of effecting increased intakes of F&V, certainly in primary school-aged children, although they may be more useful in older children.
- Integration with garden-based activities is likely to be highly effective; and the TOOTY FRUITY VEGIE website (www.ncahs.health.nsw.gov.au/tooty-fruity/), for example, has excellent resources for getting kids involved and for overcoming barriers to implementation of garden-based activities. Similarly, cooking classes are popular and likely to be of benefit if integrated with other intervention components including nutrition education.
- Educating parents and children together is worthy of consideration.

6.1.2 Availability and accessibility of F&V in schools
The increased availability and accessibility of fruit and vegetables in the school setting is important and effective.

- The evidence reviewed indicates that a mix of free and paid subscription for fruit/vegetables at school can increase consumption, at least of fruit. Most studies have been implemented through large-scale policy or programs, rather than local initiatives. A paid subscription scheme could be subsidised for disadvantaged schools or groups. Links with local suppliers should be encouraged.
- An analogous strategy is to encourage the reduced price of F&V, and concurrent increased price of energy-dense, nutrient-poor foods, in school food services, to make F&V more accessible.
• The value of organisational policy to increase the availability of F&V in schools, and in before and after school settings, is emphasised. Food service staff generally lack responsiveness to guidelines alone.

• Taste-testing has been found to be difficult for teachers to implement hence the funding of trained resource persons to visit schools could be considered. The use of rewards, such as stickers with younger children or competitions with older children, in response to taste-testing, may offer particular benefits.

• Point-of-purchase prompts are likely to encourage consumption. The use of a verbal prompt shows particular promise, although attractive displays, packaging and positioning of F&V may also be effective, and easier to implement.

6.2 Portfolio approach

It is well recognised that no single intervention alone will be effective in improving children’s diets to a degree that impacts on population level obesity rates. Indeed, the evidence regarding the limited association of fruit and vegetable consumption with rates of overweight and obesity also indicates that this behaviour should not be targeted as the primary or sole strategy for obesity prevention. However, promoting fruit and vegetables in association with efforts to reduce consumption of energy-dense, nutrient-poor foods is likely to be an attractive approach for many programs and settings (cf. Module 1); 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 communication and public education through local media and other channels, promotion and reinforcement through health professionals’ capacity to opportunistically provide accurate information and consistent advice.

6.3 Translating evidence into cross-sectoral 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 (see Table 3). The locally-based Tooty Fruity Vegie project provides evidence of successful collaboration between education, health and community.

Table 3. Sectors that could contribute to the implementation of promising approaches

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<tr>
<th>Promoting water and reducing sugary drink consumption in children</th>
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<thead>
<tr>
<th>Sectors</th>
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<tr>
<td>C - Community services</td>
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<td>E - Education sector</td>
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<tr>
<td>H - Health</td>
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</tbody>
</table>
Module 2 - Interventions to increase consumption of fruit and vegetables in children

7 References


44. Laurence S, Peterken R, Burns C. Fresh Kids: the efficacy of a Health Promoting Schools approach to increasing consumption of fruit and water in Australia. *Health Promotion International* 2007; 22(3): 2181-2226


Module 2 - Interventions to increase consumption of fruit and vegetables in children


69. Thomas J, Harden A, Oakley A, Oliver S, Sutcliffe K, Rees R, Brunton G, Kavanagh J. Integrating qualitative research with trials in systematic reviews. *British Medical Journal* 2004; 328 (7446): 1010-1012


8. Appendix. Tables summarising the available intervention evidence for increasing consumption of fruit and vegetables

Table A1. Whole-of-school intervention studies aimed solely at increasing consumption of fruit and vegetables

<table>
<thead>
<tr>
<th>Ref</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/Outcomes</th>
</tr>
</thead>
</table>
| Anderson et al 2005  | Setting: School (Scotland)  
Design: RCT  
Duration: 10 months (school year) | 6-7 year olds & 10-11 year olds  
4 schools (matched pairs)  
n=64 intervention students  
n=65 control students | Intervention theme ‘The Bash Street Kids’ graphics package developed using cartoon characters – used in communication/promotional materials  
Increased provision of F & V in schools (school lunch and tuck shop)  
tasting opportunities  
point-of-purchase marketing (posters, quizzes)  
child and parent newsletters  
teacher information sessions  
curriculum materials (food preparation and tasting) | 3-day dietary records with interview  
Knowledge, beliefs and attitudes measured by short interview with tastings | Fruit intake increased by 50g (from 113 to 183 g/day; p<0.05) in intervention compared to 7g (from 100 to 107 g/day) in controls, difference was significant for girls but not boys  
Vegetable intake had decreased by 17g, similar to decrease in controls (15g), at the end of the intervention period  
Tasted more F & V over time, greater knowledge and understanding of the concept ‘healthy’ compared with controls |
| Auld et al 1998      | Setting: School  
Design: Quasi-experimental (cross-sectional, post-test)  
Duration: 4 years | The integrated nutrition project (INP) has been going on since 1993. From 1993-1997 it has involved 1250 students in 3 schools in Denver.  
Study reports on students selected in years 3 and 4 of the intervention: n=268 treatment, n=181 control in year 3 and n=456 treatment and n=395 control in year 4 | INP – ongoing school-based program focused on increasing consumption of whole grains, F&V and establishing nutrition education in the schools through local partnerships  
24 weekly hands-on activities taught by trained resource teacher – nutrition and food preparation sessions  
6 parent-taught lunchroom “mini-lessons” Reinforcing classroom activities in maths, science, literacy, social studies  
Parent education and fun nights | Plate waste  
Food recall/record survey – 24 hour record of “servings” (=counts of F&V reportedly eaten)  
Classroom survey on attitudes and knowledge  
5-minute interview with kindergarten children about knowledge of F&V | From plate waste in year 4 of the intervention, +0.4 F&V servings/day (+0.19 F, +0.25 V) P<0.001 higher in treatment than control students  
Higher levels of knowledge in treatment students  
Nb. Lunchroom component only fully implemented in year 4 |
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<tr>
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<tr>
<td>Baranowski et al</td>
<td>Setting: School/family/grocery</td>
<td>9-11 years</td>
<td>6 weeks/12 session “Gimme 5” curriculum – encouraged and assisted children to eat more F&amp;V – provided in first 2 years of study</td>
<td>7-day food records, repeated measures (pre-program, mid-program, post-program)</td>
<td>The paper does not report any clear differences between treatments although the discussion indicates a difference of +0.2 servings F&amp;V/day as a result of the intervention after 3 years. Increases in mean consumption occurred in 2 lowest quintile groups; declines in consumption occurred in top 3 quintiles, which was less for intervention than control. No change in availability of F&amp;V in cafeteria.</td>
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<tr>
<td>2000</td>
<td>stores</td>
<td>16 elementary schools, 4th/5th grades</td>
<td>Teachers had handouts, posters, worksheets, newsletters, videos</td>
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<tr>
<td></td>
<td>Design: RCT</td>
<td>n = 1253 (for all 3 years)</td>
<td>Point-of-purchase education at shops used by parents of students</td>
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<td></td>
<td>Duration: 3 years</td>
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<td>US</td>
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<tr>
<td>Bere et al</td>
<td>Setting: School/ home</td>
<td>Mean 11.3 years (6th grade)</td>
<td>Intervention schools:</td>
<td>Portions of F &amp; V eaten at school or all day measured by 24-hour recall at follow up 1 (end of intervention) and follow-up 2 (12 months post-intervention)</td>
<td>61% completed all 3 questionnaires. No effect on intake overall. Increased awareness of five-a-day message in the intervention group but no change in other psychosocial mediators.</td>
</tr>
<tr>
<td>2006a</td>
<td>Design: RCT (school level)</td>
<td>n = 569</td>
<td>o Classroom: seven sessions (total 15.75 hours) F &amp; V information, preparation, tasting, goal setting</td>
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<td></td>
<td>Duration: 8 month intervention,</td>
<td>19 schools in Telemark county (9 intervention, 10 control)</td>
<td>o Parental involvement: six F &amp; V themed newsletters from school, meeting with project staff</td>
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<td>follow up at 12 months post-</td>
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<td>All schools, control and intervention, were eligible to participate in a Government subsidised school fruit programme where subscribing (cost to parents) pupils received a piece of fruit or a carrot each day</td>
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<td>intervention</td>
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<td>NORWAY</td>
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### Module 2 - Interventions to increase consumption of fruit and vegetables in children

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<tr>
<th>Ref</th>
<th>Design</th>
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<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/ Outcomes</th>
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</thead>
</table>
| Foester et al 1998 | Setting: Treatment 1 (T1) = school only; Treatment 2 (T2) = school, community youth organisations, supermarkets, farmers markets, mass media  
US | 4th/5th grade  
n=2684  
49 elementary schools (151 classrooms), 3 communities | T1: 8 weeks – 14 activities in school (with community links)  
T2: Salinas Valley Coalition: supermarkets, farmers markets, media, 2 community youth organisations – point-of-sale advertisements, two local TV stations aired 4 animated live-action public service announcements  
Power Play! Day engagement/sponsorship with industry – local media etc.  
Control = any nutrition activities but PowerPlay! | 24-hour self-reported food diary  
Attitudinal survey questions in classrooms | Schools in intervention communities after 10 months of intervention:  
T1 = +0.2 servings F&V/day, from 2.7 to 2.9  
T2 = +0.4 servings F&V/day, from 2.9 to 3.3  
P<0.001 compared to control  
T1 not significantly different from T2  
[Note: Knai et al report treatment effect (versus control) +0.5 in T1 and +0.7 in T2] |
| Horne et al 2004 | Setting: School/home  
UK | 5 to 11 years  
n=749 from two matched inner-city London schools  
NB. Different sample to Lowe et al 2004 – also ‘FOOD DUDES’ | Children from both schools were presented with F & V at lunchtime. 5-7 year olds also received fruit at snacktime (mid-morning). The experimental school (but not the control school) received the FOOD DUDES program consisting of:  
o peer modelling videos (six 6-min episodes)  
o ‘food dude’ stationery and certificate as rewards for eating/ tasting F & V  
o daily letter from food dudes presented by teacher  
o a homepack including parent information and F & V monitoring | Lunchtime using a 5-point observation scale  
Snacktime using a weighed measure  
At home by parental recall (subset) | In the intervention group:  
Lunchtime F & V intake after intervention and at end of maintenance phase significantly higher than at baseline (p<0.001)  
Snacktime Fruit intake after intervention significantly higher than at baseline and maintenance (p<0.001)  
Control group:  
Lunchtime Vegetable intake after intervention and maintenance phase significantly lower than at baseline. No change in fruit intake across phases in children except for lower intake after maintenance in 7-11 year olds  
Snacktime No difference  
Comparison:  
Home weekday F & V increased from baseline to post-intervention relative to the control school but no difference for weekend data (p<0.05)  
NOTE: Data presented in paper not clear. Lunchtime increases were highest among initially low consumers |
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<th>Ref</th>
<th>Design</th>
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<th>Intervention description</th>
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</table>
| Liquori et al 1998 | Setting: school/parents Design: Quasi-experimental pre-post-intervention-comparison group factorial design Intervention and comparison classes were within same schools Duration: 5 months | K-grade 3 and Grades 4-6 n=590, 19 classes in one school, 20 in another Central Harlem, New York City | Aimed to increase children’s consumption of minimally processed whole grains and vegetables (not fruit)  
Community Food Resource Centre (non-profit advocacy agency) linked schools with agency resources and community participants  
Classroom component: cookshops (CS) (food preparation), food & environment lessons (FEL)  
School lunch component: inclusion of at least 1 CS food every day, and all 13 over a 13-day cycle  
Parents and community component: monthly printed newsletter “Diets and Dollars” – buying, storing, preparing  
39 classes assigned to each of four interventions (CS only; CS+FEL; FEL only; comparison) All received school lunch interventions and all parental components | % target food consumed at lunch (visual estimate of plate waste)  
Also: preferences, knowledge, attitudes, self-efficacy, behavioural intentions | Main effects were found in those children in the CS program: after 5 months there was less plate waste in younger children (F=11.82, p<0.01) and older children (F=3.45, p<0.10)  
Those receiving both CS and FEL left least on plates  
No effect of FEL in either age group |
| Lowe et al 2004 | Setting: School Design: Non-randomised controlled trial (pre-test versus during intervention) Duration: 8-12 day baseline; 16 day intervention | 4-11 years  
n= 402  
High % ethnic minorities and special needs | 8-12 day baseline phase plus 16 day intervention phase of presentation of various fruit or vegetables at snack and lunchtimes  
During intervention phase teacher read out a Food Dude letter to the children, plus showed a 6-minute video ‘Food Dudes’ (six episodes)  
Rewards given (Food Dudes sticker, pen, pencil) if F&V eaten with reward increasing as more F&V eaten  
Implemented by school staff, not researchers | Visual estimation of snack-time and lunch-time consumption (some measured plate waste) – with inter-rater reliability and validation by weighing  
Home consumption – 24-hour recall parental over 4-5 days during first week of baseline and last week of intervention  
Questionnaire (Likert) for ‘liking’ F&V | Increases in intervention group towards end of intervention from baseline were (combined data from snacktime, lunchtime and home): +2.54 portions F&V/weekday (153g) in 4-7 year olds; +2.18 portions/ weekday (131g) in 7-11 year olds [portion size = 60g]  
Largest increases in consumption seen in those with lowest intake at baseline  
Liking higher at intervention than baseline in all instances (p<0.001)  
Note: Authors were very selective about which data they included for consumption estimates! Also, declining levels of consumption during baseline |
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<th>Ref</th>
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<tr>
<td>Newell et al, 2004</td>
<td>Setting: School (Australia) Design: 9 schools volunteered for the intervention and 3 matched control schools were recruited Duration: 2 year intervention (1998 – 2000)</td>
<td>Primary school children (n=1589, intervention group; n=1272, controls) Nb: Outcome evaluation at website: <a href="http://www.ncahs.nsw.gov.au/tooty-fruity/">www.ncahs.nsw.gov.au/tooty-fruity/</a></td>
<td>A whole school approach to promote F &amp; V involving strategies orientated towards the classroom, parents, school environment, school canteen, and sustainability.</td>
<td>Survey evaluation of project on impact indicators including children's, parent's and teacher's knowledge, attitudes, and behaviours regarding F &amp; V completed by school principals, parents, teachers, children (grades 3 to 6)</td>
<td>Impact on Intervention group compared with controls: Greater knowledge of recommended daily intakes of F &amp; V in children, parents but not teachers at follow up. Parents also perceived greater knowledge in their children. Prevalence of F &amp; V, and meals containing them, as a top-five favourite food increased. Higher levels of positive attitudes to F &amp; V, interest in fruits, and self-efficacy in preparing F &amp; V. Access to F &amp; V at school increased with some changes reported at home. Teachers and principals reported that parents were keen to assist with the project.</td>
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<tr>
<td>Nicklas et al 1998</td>
<td>Setting: School Design: RCT (matched-pair design) longitudinal intervention Duration: 3 years</td>
<td>9th-12th grade 12 secondary schools n=2213 students at baseline</td>
<td>School-wide mass media (monthly promotions incl. taste testings, point-of-service signs, table tents, competitions, posters); classroom workshops by trained teachers or research staff parent newsletters; food service training environmental component – increase VF in school meals, promote F&amp;Vs (Fresh Choices) Parental involvement (Raisin Teens)</td>
<td>Knowledge, attitudes, practices questionnaire Classroom survey of self-reported usual number of F&amp;V servings per day</td>
<td>Reported daily intake significantly higher (p&lt;0.05) in years 1 and 2, but not in year 3 14% increase in F&amp;V servings after two years, from 2.63 servings at baseline (1994) to 3.00 servings in 1996. This linear increase was not observed in the control group from 1994 to 1996. At follow-up (1997), reported consumption remained stable among the intervention group, concomitant with increased consumption in the control group. Therefore, no significant difference existed between groups at follow-up. No separate evaluation of environmental intervention components</td>
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<tr>
<td>Perry et al 1998a</td>
<td>Setting: school Design: RCT (Matched pair design) Duration: 10 months-1 year</td>
<td>4th grade students 20 elementary schools n= 1750 at baseline n= 441 at follow-up Multi-ethnic</td>
<td>Teacher implemented classroom lessons (40-45 min sessions 2x/week) parent home activities (information packs/ snack packs) environmental component - school food service changes (point-of-purchase promotions, increased choice and availability) industry support – F&amp;V supplies for school/snack packs, 30 min presentation on F&amp;V, provision of extra materials</td>
<td>Self-completed 24-hour food record for random sample (n=407) – non-quantified Lunchroom observation – items eaten at lunch and portion sizes (n=424) – same day and 24-hour recall</td>
<td>Lunchroom observation: Intervention students had higher mean intake of F&amp;V after 10 months compared with control students: 1.53 versus 1.06 servings at lunch (p&lt;0.01) Fruit intake higher (0.74 vs. 0.44, p&lt;0.01) 24-hour recall: Higher mean intake of fruits 5.24 vs. 4.66, p=0.02 Higher % of fruits / 1000 kcal</td>
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| Reynolds et al 2000 | Setting: School and parents  
Design: RCT (matched pairs)  
Duration: 2 years (follow-ups after 1 (FU1) and 2 years (FU2))  
9-11 years  
28 elementary schools  
n=1698 at baseline (69% participation rate) | 9-11 years  
28 elementary schools  
n=1698 at baseline (69% participation rate) | Curriculum 14 lessons (x30-45 minutes) – 3 consecutive days each week (one day = High 5 day – encouraged students and parents to eat 5 servings that day)  
Parents: kick-off night – encourage to complete homework book – prizes  
Food service: regular visits/training by nutritionists to encourage High 5 guidelines | 24 hour recall and cafeteria observation (only low fat/salt/sugar items included in servings; F&V and juice)  
Parents: FFQ | F&V consumption had increased by 1.35 servings/day after one year (p<0.0001); and by 0.59 servings/day after two years (p=0.0001) in the intervention group  
1.7 servings F&V/day difference between control and treatment at FU1 and 0.99 servings F&V/day at FU2  
Difference between groups at FU1 = 0.88 F/0.69 V (p<0.0001)  
Difference between groups at FU2 = 0.56 F (p<0.0001)/0.38 V (p<0.09)  
No intervention effects observed in cafeteria data  
Self-efficacy, knowledge, parental consumption influenced by intervention |
Table A.2  Whole-of-school intervention studies aimed at increasing consumption of fruit and vegetables and other healthy behaviours

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<tr>
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<tr>
<td>Birnbaum et al 2002</td>
<td>Design: RCT  Setting: School (mainly)  Duration: 2 years 16 schools: with at least 20% students approved for free/reduced price lunch, and with at least 30 students in each of 7th and 8th grades n=3503</td>
<td>TEENS: Four exposure groups (or “doses”) [See Lytle et al 2004 for more detail] (1) control group: ordinary school curriculum (2) school environment interventions only (3) classroom curriculum plus school environment interventions (4) peer leaders plus classroom curriculum plus school environment interventions</td>
<td>After 7th grade intervention: Usual F&amp;V intake (frequency of consuming) using a modified version of the Behavioral Risk Factor Surveillance System (BRFSS) measure</td>
<td>After two years, peer leaders reported the largest increases in fruit, vegetable, and lower fat food consumption = +0.92 F&amp;V servings/day (p=0.012)  Students exposed to classroom plus environment interventions also improved = +0.44 (p=0.056)  Students exposed only to school environment interventions showed trends toward choosing lower fat foods and declining fruit intake and no change in vegetable intake  Control students’ choices remained stable.</td>
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<td>Friel et al 1999</td>
<td>Setting: Schools/parents  Design: Quasi-exp, comparative study (non-randomised controlled trial)  Duration: 3 months 8-10 years 8 schools n=821 (n=453 intervention, 368 control)</td>
<td>NEAPS ‘Nutrition Education at Primary School’ 20 sessions over 10 weeks – worksheets, homework, exercise regime Parent packs – short family assignments</td>
<td>5-day food diary at baseline and at 3 months (follow-up)</td>
<td>Small significant increase – 2% difference between groups at 3 month follow-up – in the number of intervention children consuming 4 or more F&amp;V/day (p&lt;0.01)</td>
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<tr>
<td>Gortmaker et al 1999a</td>
<td>Setting: School  Design: RCT  Duration: 2 years 6th/7th grade n=10 middle schools (5 schools intervention, 5 control)</td>
<td>Teacher training, classroom lessons, PE materials, wellness sessions, fitness funds Aimed to decrease consumption of high fat foods; increase F&amp;V to 5/day; reduce TV watching to &lt;2 hours/day; increase PA</td>
<td>Food and Activity survey in classroom and youth FFQ</td>
<td>After 2 years, intervention resulted in +0.32 servings F&amp;V per day in girls (p=0.003)</td>
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<td>Ref</td>
<td>Design</td>
<td>Participants</td>
<td>Intervention description</td>
<td>Outcome variables</td>
<td>Key findings/ Outcomes</td>
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<tr>
<td>Gotzmaker et al 1999b</td>
<td>Setting: School Design: Non-randomised controlled trial (quasi-experimental) Duration: 2 years</td>
<td>4th/5th grade</td>
<td>Teacher training, classroom lessons, PE materials: “Get 3-at-school &amp; 5-a-day” Families involved. Materials provided links to school food service Aimed to decrease consumption of high fat foods; increase F&amp;V to 5/day; reduce TV watching to &lt;2 hours/day; increase PA</td>
<td>Food and activity survey in classroom at baseline 24-hour recall (X2 per student) post-intervention Nb. used different dietary methods at baseline and follow-up</td>
<td>24-hour recall data showed higher levels of F&amp;V intakes in intervention students compared to control students at the end of the two year intervention period: F&amp;V was 0.36 (CI 0.10 – 0.62) servings/4184 kJ, p=0.01, equivalent to 0.73 servings/day, higher in intervention students at follow-up</td>
</tr>
<tr>
<td>Laurence et al 2007</td>
<td>Setting: Primary schools (inner west Melbourne) Design: Interrupted time series Duration: 2 years</td>
<td>Primary school children High level of socioeconomic disadvantage and cultural diversity n = 4 primary schools (programme has since been expanded to include 35 primary schools) Follow-up = 61% total student population in participating schools</td>
<td>Aimed to evaluate the effectiveness of the HPS framework to increase fruit and water consumption among primary school-aged children. Programme interventions included: o Appointment of community dietitian to coordinate programme and nomination of lead teacher o Seasonal ‘fresh fruit weeks’ 2-4 times/year (free fruit provided for 4 days) o Monthly nutrition newsletters to parents o Bilingual parent nutrition education sessions o Scheduled ‘fruit breaks’ within classes o Development of school ‘fruit and water’ policies and annual plans o Linkages with the Municipal Public Health Plan o Nutrition education curriculum o Distribution of water bottles printed with student-designed fruit and water logos</td>
<td>Frequency of children with fresh fruit, water and sweet drinks in their lunch box (Lunchbox audit) or purchased from canteen lunch order – baseline and periodically over 2 years post-program implementation</td>
<td>Significant increase in observed proportion of children bringing fresh fruit to school for up to 2 years after program implementation (mean = 41%; range = 25-50%; p&lt;0.001) [Significant increase in observed proportion of children bringing filled water bottles to school at end of 2 year study period (15-60%)] Significant decrease in observed proportion of children bringing sweet drinks to school or ordering them from canteen at end of 2 year study period = 8-38%</td>
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<td>Ref</td>
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<td>Intervention description</td>
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<td>Lyyde et al 2004</td>
<td>Design: RCT  Setting: School (mainly)  Duration: 2 years</td>
<td>16 schools (with at least 20% students approved for free/reduced price lunch, and with at least 30 students in each of 7th and 8th grades) n=2883</td>
<td>TEENS: 'Teens Eating for Energy and Nutrition at School' aimed at lowering the percentage of fat intake and increasing F&amp;V  Group 1: Control (usual curriculum)  Intervention schools:  School environment interventions (availability of healthy foods in schools)  Classroom lessons – 10 lessons in each of 7th/8th grades (self-monitoring, goal setting, hands-on snack preparation, and skill development for choosing healthy foods and for overcoming barriers)  Family: newsletters in parent packs (with behavioural notes, money prizes)</td>
<td>24 hour recalls  Student survey F&amp;V screener  [Also: Food available at home – parent survey  Foods available and sold in canteen and vending machines Note: these latter two outcomes not reported on in this paper]</td>
<td>Different levels of implementation – examined the dose-response  No significant differences in any groups at 2-years follow-up, except students in intervention schools more likely to make lower fat choices (maybe response bias)</td>
</tr>
<tr>
<td>Perry et al 1998b</td>
<td>Setting: school and home  Design: RCT  Duration: 3 years</td>
<td>n=96 elementary schools n=1186 (participated in 24-hour recall; among 5106 in original CATCH study)</td>
<td>CATCH 'Child and Adolescent Trial for Cardiovascular Health'  Food service component targeting lower fat and lower Na</td>
<td>24 hour recalls at baseline and follow-up</td>
<td>No differences in F&amp;V consumption at 3 year follow-up (however F&amp;V intervention component was minor)  When analysed separately by site, total F&amp;V and F servings/day increased at one site</td>
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### Module 2 - Interventions to increase consumption of fruit and vegetables in children

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<tr>
<th>Ref</th>
<th>Design</th>
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<th>Intervention description</th>
<th>Outcome variables</th>
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<tbody>
<tr>
<td>Sahota et al 2001</td>
<td>Setting: School Design: RCT (randomised at school level) Duration: 1 academic year (10 months)</td>
<td>8-10 years 10 schools n=636 students</td>
<td>APPLES ‘Active Programming Promoting Lifestyles in Schools’ Based on school action plans developed by the individual schools on the basis of their perceived needs. Teacher training, school meals changes, curriculum development, physical education, tuck shops, parental newsletters</td>
<td>24 hour recall 3-day food diary Both measures used at baseline and at follow-up (10 months)</td>
<td>24-hour recall showed an increase in vegetable consumption as a result of the intervention: weighted mean difference = +0.3 servings V/day (50% of baseline intake) No significant change in fruit or vegetable intake found from 3-day food diary results</td>
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<td>Taylor et al 2007</td>
<td>Setting: Primary schools (4 intervention, 3 control) Design: Non-randomized controlled pilot study Duration: Two years (nutrition component only one year)</td>
<td>5-12 years n=730 (260 were excluded from final evaluation) Caucasian (83%), Maori (16.5%) Pacific Islander (&lt;1%)</td>
<td>Nutrition component: Nutrition education promoting reduced consumption of sweetened drinks, and increased consumption of fruit and vegetables – only in Year 2 of the intervention Strategies included science lessons highlighting adverse health effects of sugary drinks, a healthy eating resource, and provision of cooled water filters PA component: Non-curricular physical activity program run by designated activity coordinators (at recess, lunchtime and after school)</td>
<td>Self-reported food intake – 3 days (incl. one weekend day) by validated short food questionnaire (SFQ) – frequency and portion size Measured height and weight (BMI), waist circumference, blood pressure PA (accelerometer) Time spent watching TV</td>
<td>Difference between groups at end of year 2 (66% response rate) was 0.8 servings of fruit/3 days; p&lt;0.01, more in the intervention group. Vegetable intake increased in both intervention and control groups resulting in a non-significant difference of 0.3 servings/3 days at study end Mean BMI Z scores and measured waist circumference: significantly lower in intervention than control children however difference in prevalence of overweight not significant once adjusted for baseline values BMI reductions in the intervention group were only observed in children who were not overweight at baseline</td>
</tr>
<tr>
<td>Warren et al 2003</td>
<td>Setting: school lunchtime clubs Design: RCT (latin-square design by individual children) Duration: 20 weeks over 4 school terms (about 14 months)</td>
<td>5-7 year olds 3 schools n=213 (final 181)</td>
<td>‘Be Smart’ – learned about food in a non-nutrition sense (control) ‘Play Smart’ – PA ‘Eat Smart’ – nutrition ‘Eat Smart, Play Smart’ – combined nutrition and PA F&amp;V promotion using tasting sessions and games based on the ‘Gimme 5’ intervention</td>
<td>Questionnaires completed by parents on behalf of the children: 24 hour recall FFQ BMI</td>
<td>Significant increase in fresh fruit consumption in ‘Eat Smart’ and ‘Be Smart’ groups: In the Eat Smart group average weekly frequency of consumption increased from 5.9 to 6.8, and in Be Smart from 5.1 to 6.8 (note – Be Smart = control) p&lt;0.05 24-hour recall showed no differences No clear effect of program type on any variables, including BMI</td>
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### Table A.3  Interventions involving nutrition education aimed to increase consumption of fruit and vegetables (not whole-of-school)

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<th>Outcome variables</th>
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<tr>
<td>Amaro et al 2006</td>
<td><strong>Kalédo – a new educational board-game, gives nutritional rudiments and encourages healthy eating in children: a pilot cluster randomised trial</strong>&lt;br&gt;ITALY</td>
<td>Setting: School&lt;br&gt;Design: pilot cluster RCT (two group design; pre- and post-assessment; classroom was the unit of recruitment; random assignment to groups)&lt;br&gt;Duration: 24 weeks</td>
<td>15-30 minute-long play sessions once a week with Kalédo, a board game designed (after a pilot) to teach nutrition knowledge and influence dietary behaviour</td>
<td>Questionnaire to students: nutrition knowledge (31 questions); PA (6 questions); food intake (34 questions)&lt;br&gt;Anthropometric measurements</td>
<td>Children playing Kalédo showed a significant increase in nutrition knowledge (p&lt;0.05) and in weekly vegetable intake (p&lt;0.01) after 24 weeks with respect to the control&lt;br&gt;Adjusted mean no. servings F&amp;V per week was 3.7 (CI 3.5 - 4.1) in intervention children and 2.8 (CI 2.4 - 3.3) in control at post-assessment</td>
</tr>
<tr>
<td>Baranowski et al 2003</td>
<td><strong>Squire’s Quest: Dietary outcome evaluation of a multi-media game</strong>&lt;br&gt;US</td>
<td>Setting: School&lt;br&gt;Design: RCT by school (pre-test, post-test)&lt;br&gt;Duration: 5 weeks</td>
<td>Ten-session psycho-educational, multi-media game&lt;br&gt;Delivered over 5 weeks, with each session lasting approx 25 mins – aimed to increase preference for fruit, fruit juice and vegetables (FJV) through multiple exposures and associating fun with their consumption, increase asking behaviours for FJV at home and while eating out, and increase skills in FJV preparation through making virtual recipes</td>
<td>Servings of fruit, 100% juice and vegetables consumed&lt;br&gt;4 days x 24-hour recall before and after intervention</td>
<td>After five weeks:&lt;br&gt;+%0.91 servings of FJV or +%1.0 servings of total FJV + High fat vegetables&lt;br&gt;+%0.52 servings/day for fruit&lt;br&gt;+%0.24 servings/day for veg&lt;br&gt;[NB. Mixed model analysis of the intervention results reported in Cullen et al (2005) indicated that significant increases were found for fruit and 100% fruit juice as snacks and regular vegetables at lunch for intervention children compared with control] Changes different in different quartiles of baseline consumption suggesting messages be tailored to baseline consumption, e.g. “minimise decline” in higher groups and “try it” in lower groups</td>
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<tr>
<td>McAleese &amp; Rankin 2007</td>
<td><strong>Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents</strong>&lt;br&gt;US</td>
<td>Setting: School&lt;br&gt;Design: Non-equivalent control group design&lt;br&gt;Duration: 12 weeks</td>
<td>12-week nutrition education program “Nutrition in the garden” (treatment group 1)&lt;br&gt;1 treatment group also participated in garden-based activities (treatment group 2)</td>
<td>Three 24-hour food recall workbooks completed by students before-after</td>
<td>Treatment group 2: Fruit consumption increased by 1.13 servings (p&lt;0.001) and vegetables by 1.44 servings (p&lt;0.001) at post-test&lt;br&gt;Combined F&amp;V increased from 1.93 to 4.5 servings per day&lt;br&gt;No significant changes at treatment 1 or control school</td>
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<td>Ref</td>
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<td>Outcome variables</td>
<td>Key findings/ Outcomes</td>
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<tr>
<td>Haerens et al 2007</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 Healthy Food Intervention: o Fruit sold once/week at low cost or provided free o Reduced availability of soft drinks at school o Drinking fountains and cost differential of bottled water vs. soft drinks in canteens/vending machines o Nutrition education o Tailored feedback re. fat intake and fruit intake (5-6 pages) o Extra supportive activities including classroom activities – e.g. healthy breakfast and educational games o Parental involvement – interactive meeting at school, computer CD for fat intake Three conditions: intervention (I); I + parental support (P); control (C)</td>
<td>% children exceeding the fat intake of a max of 30% of energy from fat (fat intake – self-administered questionnaire) Fruit intake (FFQ) Soft drinks (FFQ) Water (FFQ) Nb. Effects on adiposity and PA not yet published</td>
<td>No effect on self-reported consumption of fruit, water or soft drinks after 9 months Fat intake – effective in girls but not boys Fat intake (g/day) and % of energy from fat decreased significantly more in girls of the I + P condition compared with control (p&lt;0.0001) and intervention alone (p&lt;0.05) Nb. No process evaluation details provided Nb. Soft drink consumption, in particular, very high at baseline</td>
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<td>Ref</td>
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</table>
| Mangunkusumo et al 2007 | Setting: Schools/school nurse  
Design: Cluster-RCT  
Duration: Once-off intervention and 3 month post-intervention follow-up | 9-12 years  
n=495  
30 7th grade classes (16 intervention; 14 control) | Two components (including routine periodic health examination):  
o Internet-tailored advice: from nurse in response to child filling in a questionnaire – advice on recommended levels, awareness of personal intake levels, stimulation of children’s liking of fruit/veg and their availability at home – advice printed out and taken home  
o Dietary Counselling: about 2 weeks after advice provided – child + parent attended brief counselling session with nurse | F & V intake (self-report – 7-day recall of fruit consumption / 24-hour recall of vegetable consumption)  
Usual daily intake for F & V  
Awareness and knowledge of recommended/ adequate intake of F & V | Intervention led to increased knowledge of recommended vegetable intake levels and awareness of inadequate fruit intake levels  
No effect on:  
- Fruit intake previous week  
- Usual daily fruit intake  
- Knowledge of rec amounts of fruit  
- Self-efficacy fruit intake achievable  
- Liking many types of fruit  
- Fruit always available at home  
- Veg intake yesterday  
- Usual daily veg intake  
- Awareness of inadequate intake previous day  
- Self-efficacy, veg intake  
- Liking many types of veg  
- Availability of ≥2 veg at dinner |
| Talvia et al 2006 | Setting: Family  
Design: prospective RCT  
Duration: 10 years | Families recruited when children aged 7 months, dietary follow-up at 10 years of age  
N = 540 intervention, n=522 control | STRIP – Special Turku Coronary Risk Factor Intervention Project for Children  
Biannual (every few months to age 2; every year after 7 years) individualised dietary counselling aimed at reduction of CVD risk factors, especially saturated fat in the child.  
Families were encouraged to use fruit and vegetables, and berries as well as whole-grain products | Food records on four consecutive days prior to visit by nutritionist | Longitudinal analysis across ages:  
Slight intervention effect only among boys: the 1 to 10 year old boys consumed more vegetables (mean difference of 3.18 g/day; CI 1.48-4.86, p<0.001); and more fruit (mean difference 10.1 g/day; CI 5.28, 14.94, p<0.001)  
% total energy intake from F&V decreased when the children grew older (P for age <0.001) |
Table A.5  Food service changes in schools as a sole intervention (not part of whole-of-school) to increase consumption of fruit and vegetables

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<th>Ref</th>
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<th>Intervention description</th>
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<tr>
<td>French et al 1997</td>
<td>Setting: School cafeteria</td>
<td>n=2 schools</td>
<td>Effect of pricing strategies on sales of F&amp;V in adolescents</td>
<td>Student sales data</td>
<td>Fruit sales increased by 400%, from 14.4 to 63.3 pieces of fruit (weekly average) (p&lt;0.0006) – effect more in urban school</td>
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<td></td>
<td>Design: observational, no</td>
<td>School 1 = 1,431 urban,</td>
<td>During the low price period, prices for fruit, salad, and carrots were lowered by 50%</td>
<td>Weekly fruit</td>
<td>Carrot sales increased 200%, from an average weekly total of 35.6 packets to 77.6 packets (p&lt;0.021) – effect more in suburban school</td>
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<td>control, pre-test, post-test</td>
<td>43% non-white, 29% free or</td>
<td>and attractive signs targeting the reduced items placed</td>
<td>Packets of carrots</td>
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<td></td>
<td>Duration: 3 weeks</td>
<td>reduced price lunch, 16%</td>
<td>PA announcements made during first week of low-prices</td>
<td>Salad sales</td>
<td>No significant effect on salad sales</td>
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<td></td>
<td></td>
<td>purchased lunch each day</td>
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<td>Baseline 1, lower price, baseline 2</td>
<td>No differences in number of meal customers, nor dollar sales</td>
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<td>School 2 = 1,935, suburban,</td>
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<td>7% non-white, 0.5% free or</td>
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<td>reduced price, 19% purchased</td>
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<td>lunch each day</td>
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<tr>
<td>Hendy et al 2005</td>
<td>Setting: School</td>
<td>First, second, and fourth</td>
<td>Token reinforcement was introduced by peers and required children to eat 1/8 cup of the</td>
<td>Parent ratings of their children’s F &amp; V</td>
<td>At baseline, children had higher preferences for and ate</td>
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<td>Design: classes randomised</td>
<td>grade students mean age</td>
<td>assigned food group (F or V) at lunch each day in order to receive a hole punched in their</td>
<td>preferences during home meals</td>
<td>more fruit compared with vegetables</td>
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<tr>
<td></td>
<td>to receive token reinforcement</td>
<td>8.0 years n=188 95% Caucasian</td>
<td>name tag. At the end of the week, 3 holes could be traded for a small prize of their choice.</td>
<td>Observation of lunchtime F &amp; V consumption</td>
<td>F &amp; V intake increased and was sustained during the</td>
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<td>for i) fruit or ii) vegetable</td>
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<td>under baseline conditions and under token</td>
<td>intervention period for the type (i.e. F or V) that children</td>
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<td></td>
<td>intake</td>
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<td>reinforcement conditions</td>
<td>received token reinforcement (P&lt;0.001)</td>
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<td></td>
<td>Duration: 4 days baseline,</td>
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<td>Child interviews at baseline and both follow</td>
<td>Compared with baseline, fruit preference (examined for</td>
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<td>12 days intervention – follow</td>
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<td>ups to evaluate effects of token reinforcement</td>
<td>those reinforced for eating fruit) and vegetable</td>
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<td>up at 2 weeks and 7 months</td>
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<td>on F &amp; V preference ratings</td>
<td>preference (examined for those reinforced for eating</td>
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<td>post-intervention</td>
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<td>vegetables) was higher at 2 week follow up, but had</td>
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<td>returned to baseline levels at 7 months follow up</td>
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<tr>
<td>Perry et al 2004</td>
<td>Setting: school</td>
<td>1st/3rd grade 26 schools</td>
<td>5-a-day Cafeteria Power Plus</td>
<td>Lunchroom observation (by trained staff) F, V,</td>
<td>Fruit consumption increased from 0.21 servings to 0.37</td>
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<td></td>
<td>Design: RCT (schools</td>
<td>n=1668</td>
<td>Cafeteria – daily activities and special F&amp;V events – availability, attractiveness, food</td>
<td>juice, potatoes consumption (items eaten and</td>
<td>servings (+0.17 servings) at lunchtime (p&lt;0.01); F&amp;V</td>
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<td>randomised within districts)</td>
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<td>service staff encouragement</td>
<td>their portion size)</td>
<td>increased from 0.92 to 1.06 (+0.14 servings) servings/</td>
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<td>Duration: 2 years</td>
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<td>Taste tests monthly, yearly challenge weeks</td>
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<td>lunchtime (p=0.03)</td>
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<td>Significant association between verbal encouragement</td>
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<td>by food service staff and F&amp;V consumption by students</td>
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<td>Intervention schools had higher verbal encouragement</td>
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<td>by school food service staff (p=0.01) and more F&amp;V on</td>
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<td>the lunch line (p&lt;0.01)</td>
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</table>
### Table A.5: Food service changes in schools as a sole intervention (not part of whole-of-school) to increase consumption of fruit and vegetables

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Schwartz</td>
<td>Setting: School</td>
<td>Primary school children participating in the National School Lunch Program</td>
<td>Standard food service offered at least 2 types of fresh or canned fruit and one or two types of juice each day</td>
<td>Observational data – parent volunteers: Did the child take fruit or juice? Did the child consume the fruit or juice? If consumed, how much was consumed?</td>
<td>Control: 60% of children chose either fruit or juice (38% took fruit and 22% took juice) Intervention: 90% (62% fruit, 29% juice) Both schools approx. 80% of children ate the fruit on their tray, resulting in 70% consuming a fruit serving in the intervention school compared to &lt;40% in control school</td>
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<td>2007</td>
<td>Design: Controlled trial – experimental school versus control school</td>
<td>n=309 intervention children; n=337 control children; with approx 50% purchasing lunch on any school day at both schools</td>
<td>Intervention school: food service staff provided verbal prompt ‘Would you like fruit or juice?’</td>
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<tr>
<td>US</td>
<td>Duration: 2 X one day</td>
<td>Mainly Caucasian, higher SES</td>
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The table outlines interventions implemented in schools to increase the consumption of fruit and vegetables, focusing on changes in the food service and their outcomes in different studies. The studies vary in duration, setting, and participants, with outcomes measured through observational data and parent volunteered responses. The interventions include verbal prompts and changes in pricing strategies, and the outcomes suggest increased consumption and preference, especially in the intervention schools compared to control schools.
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| Bere et al   | Setting: School         | 6th/7th grade (at baseline)           | Traditionally FV not available at home; Most students bring their own lunch to school – mainly sandwiches 29 schools = ‘control’ = Paid subscription (FVMM) – EUR 0.30 – for a piece of fruit or a carrot; only 12% take up in 2006; plus healthier pupils tend to subscribe – increasing inequality 9 intervention schools participated in Norwegian School Fruit Programme = Free school fruit (or carrot) for 9 months (one school year) | 24-hour FV recall (portions/day)                       | Reports on Bere 2005 and Bere et al 2006a  
For pupils in the free fruit group: Long term effects – after ~3.5 years were 0.38 (boys) and 0.44 (girls) portions F&V/day for all day (portion size = 80g)  
Also, baseline to end of free fruit = 0.13 and 0.15 portions F&V/day at school; usual intake 1.6 times/week (both sexes)  
Subscription rates in free fruit group higher after 3.5 years than in control – i.e. higher participation in paid school fruit programme following the intervention of free fruit  
Observed long-term effects on fruit consumption still significant after adjusting for individual subscriptions to the school fruit programme (nb. reduction in unhealthy snacks not sustained to 3 years) |
| 2007         | Design: RCT (school)    | n=1950                                |                                                                                          | Usual FV intake – four food frequency questions (times/week) |                                                                                       |
| Free school fruit—sustained effect three years later   | Duration: Intervention duration = 9 months (1 school year); follow-up at end of intervention period and 3 years post-intervention | Students from 38 primary schools 2 counties: Hedmark and Telemark                      |                                                                                          | Usual snacks consumption – soda/candy/potato chips – 3 FFQs                            |                                                                                       |
| NORWAY       |                         |                                       |                                                                                          |                                                                                         |                                                                                       |
| Bere et al   | Setting: School/ home   | Mean 11.3 years (6th grade)           | Year 1: Fruit and Vegetables Make the Marks as per Bere et al 2006a but free subscription to parents. 11% of the control group subscribed to the paid scheme.  
Year 2: 4 out of 9 intervention schools continued to participate in the standard School Fruit Programme (‘paid fruit’) the rest opted for ‘no fruit’ | F & V portions eaten at school or all day measured by 24-hour recall at follow up 1 (end of intervention) and 2 | End year 1 – mean F & V intake at school and all day was 0.6 portions higher in intervention than control children (0.84 vs 0.27, p<0.001; 2.47 vs 1.84, p=0.02, respectively)  
End year 2 – all day F & V intake in intervention children remained 0.5 portions higher than controls (2.09 vs 1.57, p=0.03) and intervention children at ‘paid fruit’ schools F & V intake at school was 0.4 portions more than pupils from ‘no fruit’ schools |
| 2006b        | Design: RCT (school)    | n=517                                 |                                                                                          |                                                                                         |                                                                                       |
| Free school fruit—sustained effect 1 year later        | Duration: two school years           | 19 schools in Hedmark county (9 intervention, 10 control)                                 |                                                                                          |                                                                                         |                                                                                       |
| NORWAY       |                         |                                       |                                                                                          |                                                                                         |                                                                                       |
| Bere et al   | Setting: School         | 11 – 12 years                         | Three ‘treatments’:  
o Free fruit or a carrot each school day at no cost (‘free fruit’)  
o Paid fruit subscription scheme (‘paid fruit’)  
o No free or paid fruit (‘no fruit’) | 24-h F & V recall (weekday): portions school/day and total/day FFQ: unhealthy snacks/week (sum-score 3 items) | After 8 months: F & V intake at school/day and total/day was higher for ‘free fruit’ compared with ‘paid fruit’ and ‘no fruit’. School/day but not total/day intake was higher for ‘paid fruit’ compared with ‘no fruit’.  
In low SES pupils, the ‘free fruit’ group consumed fewer unhealthy snacks (higher in sugar and/or saturated fat) compared to the ‘no fruit’ group at follow up.  
At ‘paid fruit’ schools, subscribers had higher F &V intakes than non-subscribers after 8 months |
### Table A.6: Free and paid fruit and vegetable subscription schemes in schools

#### Module 2 - Interventions to increase consumption of fruit and vegetables in children

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| **Eriksen et al** 2003 DENMARK **Effect of a fruit and vegetable subscription in Danish schools** | Setting: School  
Design: non-randomised controlled trial  
Duration: 5 weeks | 6-10 years  
N=804 from 4 intervention schools and n=689 from 3 control schools | Intervention schools were offered a fruit and vegetable subscription comprising one piece per day (fruit 3 days/week, veg 2 days/week)  
Cost 0.3 EURO/day | 24-hour recall form and FFQ including only F&V | 45% enrolment in subscription schools. Low response rate. Only 24-hour recall sensitive enough to pick up changes  
Subscribers post-intervention (after 5 weeks) = +0.4 pieces of fruit/day (p=0.019)  
Non-subscribers = +0.3 pieces fruit/day (p=0.008); +0.4 F&V / day (mainly due to consistent increase in F intake) – indication that non-subscribers affected by intervention  
No significant change in vegetable intake  
No change in intake in control schools |
| **Fogarty et al** 2007 UK **Does participation in a population-based dietary intervention scheme have a lasting impact on fruit intake in young children?** | Setting: School  
Design: Prospective: Intervention region versus control region  
Duration: 1 year intervention and 1 year follow-up | Infant school children  
n=5605, 5111, 3382 for each survey: baseline, follow-up 1 (FU1), follow-up 2 (FU2)  
113 schools in East Midlands – Intervention  
122 schools in Eastern region of England - control | Intervention schools received free fruit daily – e.g. apples, bananas, pears, mandarin oranges (National School Fruit Scheme, NSFS) – for one school year  
Control schools received no fruit | Parentally completed questionnaire using two (un-validated) questions:  
– No. days/week fruit eaten at home or at school  
– No. pieces fruit eaten/day on average  
before, during, after participation in NSFS  
Baseline to FU1: fruit (excluding juice) consumption increased by more in the intervention region (from a median of 7.5 to 14.0 pieces/week) than in the control region (from a median of 9.2 to 11.0 pieces/week)  
FU1-FU2: consumption was median 12 pieces/week versus 14 pieces/week in intervention and control respectively; *i.e. intervention effect not sustained post-free fruit* |
| **Jones & Smith** 2006 AUSTRALIA **Are there health benefits from improving basic nutrition in a remote Aboriginal community** | Setting: school  
Design: pre- and post-test; no control  
Duration: 6 months | 6-12 years  
n=12 Aboriginal students | Provision of fresh fruit once or twice per day, supervised by teachers  
Audiometry  
Vitamin C, haematology, iron | After introducing fresh fruit, antibiotic prescriptions decreased to an average of one per month and five students (42%) experienced improved levels of hearing |
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| Ransley et al 2007 | Setting: School  
Design: non-RCT  
Duration: 7 months | 4, 5 and 6 years  
N=3703 (55 I schools; 45 control schools)  
UK (north-east and north-west) | Provision of one piece of fruit or vegetable provided per child per school day  
Rota: apples, pears, easy to peel citrus fruit, bananas, occasional seasonal items such as strawberries; carrot sticks, small tomatoes  
Educational materials and activities: training video for teachers, wall charts, cooking activities, games. Information to parents as part of wider 5-a-day scheme | Usual dietary intake using validated 24-hour recall method: CADET (Child and Diet Evaluation Tool) = tick-box design completed by parents  
Baseline, 3 months, 7 months  
[students no longer eligible for free F&V at 7 months in year 2] | After 3 months: Increased F intake of 0.5 portions/day (95% CI, 0.3-0.7) in reception children and 0.7 portions/day (95% CI, 0.3-1.0) in year 1 children at 3 months  
After 7 months: 0.2 portions/day in reception and year 1 (0.4 and -0.2-0.6)  
Increases in carotene and vitamin C intakes  
Year 2 students: +0.5 portions F/day after 3 months (0.2-0.9) and -0.2 portions F/day after 7 months (-0.5-0.2)  
Note: decrease in sugar intake associated with intervention at 7 months in year 2 students  
No effect on vegetables intake |
| Schagen et al 2005 | Setting: Schools  
Design: Quasi-experimental  
Duration: 7 months  
Nb. Same trial as reported by Ransley et al (2007) | Infant school pupils, 4-6 years  
55 schools in the North East (study school) 45 schools in Yorkshire and Humber (control) | The School Fruit and Vegetable Scheme (SFVS), is one aspect of the ‘5 A DAY’ programme and provides a free piece of fruit or a vegetable to children aged four to six years, each school day. The scheme was originally piloted in more than 500 schools throughout England in 2000 and 2001.  
Expanded region by region with funding from the Big Lottery Fund; since April 2004 the Department of Health has been funding the SFVS, which is now operating throughout England | 24 hour dietary intake: A food diary, the Child and Diet Evaluation Tool (CADET)  
Pictorial pupil questionnaire to explore children’s attitudes, knowledge and awareness | The scheme significantly improved children’s consumption of fruit – 1.3 times as likely to achieve the ‘5-a-day’ in intervention group after 7 months  
In intervention group – F&V consumption declined at home but increased at school – therefore evidence of compensation  
Increased consumption of fruit not sustained when scheme ended  
Fruit consumption decreased with age in both groups |
## Module 2 - Interventions to increase consumption of fruit and vegetables in children

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<td>Schneider et al 2004</td>
<td>Setting: School  Design: one group pre-test, post-test  Duration: ~ 8 months</td>
<td>Grades 5, 8 and 10 5 schools</td>
<td>Provision of free F&amp;V during the school day and nutrition education activities to promote and support consumption of F&amp;V (note – intensity of nutrition activities varied from school to school) Start up and implementation challenges</td>
<td>24-hour dietary recall (n=191) Survey (n=660): assessed changes in: the variety of F&amp;V ever eaten by students; attitudes; willingness to try; preferences; intentions to eat</td>
<td>Student consumption of fruit in school and overall increased significantly by 0.34 and 0.61 servings per day, respectively (p&lt;0.01) among 8th and 10th graders, after 8 months Student consumption of vegetables in school decreased significantly (p=0.05) but consumption of vegetables overall did not change F&amp;V variety increased significantly among students in all 3 grades Only 8th grade students had significant increases in positive attitudes towards eating F&amp;V, trying new fruit, beliefs that they could eat more fruit Changes in degree of preference varied by grade – increased in 8th and 10th grade students</td>
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<td>Tak et al 2007</td>
<td>Setting: School  Design: Quasi-experimental pre-test, post-test  Duration: 1 year</td>
<td>4th grade  (mean age 9.9 yrs at baseline) n=500 intervention students from 2 cities in one region (232 Dutch ethnicity; 268 non-Western ethnicity) N=453 students from 3 cities in a different region (333 Dutch ethnicity; 120 non-Western ethnicity)</td>
<td>Intervention involved free fruit or ready-to-eat vegetables (cherry tomatoes or baby carrots), twice a week at mid-morning break, eaten in the classroom Intervention schools were also encouraged to use a school curriculum aimed to increase knowledge and skills related to F&amp;V consumption</td>
<td>Usual fruit and vegetable intake – assessed by parent- and child self-reported FF measures, based on validated ‘Pro Children’ questionnaires Taste preferences, knowledge of daily recommendations, availability and accessibility for fruit intake</td>
<td>There was very low implementation of the curricula by intervention schools No significant effects based on parent reports but from child self-report: Higher V intake in children of non-Western ethnicity in intervention group at follow-up: difference = 20.7 g/day Higher F Intake in Dutch children in intervention group compared to control at follow-up: difference = 0.23 pieces/day Increases in perceived accessibility (non-Western children); parent-reported taste preference of their child (non-Western children; Dutch boys)</td>
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<td>Wells &amp; Nelson 2005</td>
<td>Setting: Schools  Design: Cross-sectional survey  Duration: students had been in the scheme for between one year and 2.5 years</td>
<td>Infants 4-6 years receiving free fruit; and juniors 7-8 years who received free fruit as infant pupils n = 1492 17 schools: 8 in the NSFS (study schools) and nine not in the NSFS (control schools) Low SES</td>
<td>NSFS is a Government programme providing one free piece of fresh fruit (or vegetable) to infant school pupils</td>
<td>Fruit intake (portions/d) measured using a 24h food tick list, food frequency questions, food attitudes and questions about NSFS</td>
<td>Median fruit consumption (excludes fruit juice) in infant pupils receiving free fruit was 117g/d compared with 67g/d in controls However, no longer-term effect – no differences in total fruit consumption between junior school pupils who had free fruit as infants and those who had not</td>
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<tr>
<td>Baranowski et al 2002</td>
<td>Setting: Boy scout meetings/home</td>
<td>n=186</td>
<td>5-a-day Badge for boy scouts designed to increase their consumption of fruit, juice and</td>
<td>24-dietary recall for 2 non-consecutive days per scout</td>
<td>NB. despite random assignment – treatment group consumed 0.8 servings/FJV per day more than the control at baseline</td>
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<td>Design: pilot RCT</td>
<td>African American boy scouts</td>
<td>vegetables (FJV) – presented by trained dieticians</td>
<td>Preferences – optical scanning forms</td>
<td>After adjusting for baseline, significant changes in treatment group at post-assessment were:</td>
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<td>Duration: 8 weeks</td>
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<td>Asking skills, tastings, recipes/cooking skills</td>
<td>Knowledge – multiple choice</td>
<td>+0.8 servings FJV (p&lt;0.09) in treatment group vs. control</td>
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<td>Also included goal-setting, self-monitoring, problem solving and reward activities; comic books, newsletters</td>
<td>Parental ask: availability &amp; accessibility of F&amp;V, going out to eat and modelling, asking behaviours, outcome perceptions of scout behaviour, family environment scales, health as a value</td>
<td>+0.5 serving V (P&lt;0.09) in treatment group vs. control</td>
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<td>Food recognition form</td>
<td>Difficulty in involving parents</td>
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<td>Cullen et al 1997</td>
<td>Setting: Girl scout meetings/parent</td>
<td>n=22</td>
<td>1 session learning about 3-day food records</td>
<td>One-page modified FFQ with 12 items</td>
<td>Intervention troupes – F&amp;V intake 3.02 pre-test and 3.39 post-test (p&lt;0.0019)</td>
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<td>Design: RCT (pre-test/post-test, follow-up)</td>
<td>300 girls</td>
<td>3 sessions (1-1.5 hours) F&amp;V exposure and preparation skills and knowledge, skills in</td>
<td>Food behaviour surveys – 1 week pre-intervention, about 1 week post-intervention</td>
<td>Control troupes – 2.20 pre-test and 2.06 post-test</td>
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<td>Duration: 4 weeks with 3 months follow-up</td>
<td>n=48 at post-test</td>
<td>self-evaluation, self-monitoring, goal-setting and problem-solving; F&amp;V prepared and tasted each meeting</td>
<td>Food recognition form</td>
<td>Intervention group levels returned to pre-test levels at 3 month follow-up (p&gt;0.13)</td>
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<td>n=48 at follow-up</td>
<td>Parent info sheets sent home and parents encouraged to promote F&amp;V consumption at home</td>
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<td>Cassady et al 2006</td>
<td>Setting: After-school&lt;br&gt;Design: Case study&lt;br&gt;Duration: 2 years</td>
<td>n= 44 after-school programs serving 8000 children&lt;br&gt;Elementary school children&lt;br&gt;Low income; ethnically diverse</td>
<td>New organisational policy to increase fruit and vegetable servings during the snack period of the Students Today Achieving Results for Tomorrow (START) after-school program</td>
<td>Snack menu items&lt;br&gt;Nutrient content of snack menu</td>
<td>Availability of fruit served increased from less than one third of the recommended two servings of fruit per day, to more than half of recommended amount – however, on two-thirds of days this was fruit juice, not whole fresh fruit&lt;br&gt;Previous menu had never listed fresh fruit in 17-day snack cycle&lt;br&gt;However, new menu had no milk serves – so although saturated fat content declined, new snack menu contained significantly less calcium and vitamin A (however, those in this program also had breakfast and lunch programs – milk servings there)</td>
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<td>DeBar et al 2006</td>
<td>Setting: Large health maintenance organisation&lt;br&gt;Design: RCT&lt;br&gt;Duration: Two years</td>
<td>Girls 14-16 y, with BMI below the national median</td>
<td>“YOUTH”: Behavioural intervention – bimonthly group meetings, quarterly coaching telephone calls, weekly self-monitoring&lt;br&gt;Dietary target was to: o increase dairy consumption, o eat 8 servings of F&amp;V per day, o decrease soft drink consumption</td>
<td>Intake of calcium, vitamin D, soda, fruits and vegetables (24 telephone diet recall)&lt;br&gt;Baseline: 3 unannounced diet recalls for a 2-week period&lt;br&gt;Post-randomisation: 1 recall every two months (targeting 4 weekdays and 2 weekend days per year); averaged over each of the 12 months</td>
<td>Intervention group participants = significantly greater consumption of calcium in both years (and increased bone mass), vitamin D in the first year; fruits and vegetables in both years&lt;br&gt;Adjusted mean difference from baseline for F&amp;V in the intervention group was 0.74 (p=0.005) and 0.95 (p&lt;0.01) servings/day in years 1 and 2 respectively</td>
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<td>Gribble et al 2003</td>
<td>Setting: University teaching lab&lt;br&gt;Design: Pre-test/post-test&lt;br&gt;Duration: 10 weeks</td>
<td>10-12 years (5th/6th grade)&lt;br&gt;N=9 parent/child pairs intervention and 17 pairs controls&lt;br&gt;Recruited from 9 schools – parents who expressed interest but couldn’t attend more than first lesson (pre-test) used as controls</td>
<td>Lessons: one hour instruction to children and parents – enhancing knowledge about fruit, skills necessary to incorporate fruit into the diet, techniques to enhance goal-directed behaviour&lt;br&gt;After the lesson – children provided with pen/paper activities to reinforce learning&lt;br&gt;Parents – child-feeding strategies to enhance fruit consumption in their children&lt;br&gt;Return to lesson – sampling of fresh fruits (10 different ones)</td>
<td>Change in knowledge and preference - questionnaires&lt;br&gt;Change in intake of fruit (including 100% juice) for children – 3-day food record (2 weekdays, 1 weekend day)&lt;br&gt;Change in control (restriction, encouragement, monitoring) over child-feeding in parents – child feeding questionnaire (lower points = less controlling strategies)</td>
<td>Significant increase after 10 weeks in knowledge scores in intervention group (+3.5 ± 1.7) compared to the control group (+0.1 ± 1.1); p&lt;0.001&lt;br&gt;Significant increase in daily whole fruit intake (including 100% juice) after intervention vs. before intervention in intervention group (+0.7 half-servings/day) compared to control (-0.2 half-servings/day); p=0.02&lt;br&gt;No difference in preference scores&lt;br&gt;Significant decrease in use of controlling child-feeding strategies by parents in intervention group compared to the control group: total parental control reduced by 7.4 points in the intervention group compared to an increase of 5.2 points in the control group; p=0.01</td>
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