School-based fruit and vegetable schemes:

A review of the evidence

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SUMMARY

This report presents a systematic review of the effectiveness of interventions to promote fruit and/or vegetable consumption in children in schools worldwide. The results show that school-based schemes are effective at increasing both intake of, and positive knowledge and attitudes to fruit and vegetable intake. Of the 35 studies included, 65% of studies in both younger and older age groups showed statistically significant increases in fruit and vegetable intake at follow, with none decreasing intake. There was marked heterogeneity in study design, measurement and reporting of intake which makes comparisons of effect size or meta-analysis difficult. Differences in intervention effect ranged from +0.14 servings/day to +0.99 servings/day. 25 studies had follow up periods greater than 1 year and this review provides evidence that both large (national) and smaller (local) scale FV schemes can have long term impacts on consumption. One study showed that free school fruit and vegetable schemes can also help to reduce inequalities in diet. Only one study showed an effect on both increasing fruit and vegetable intake and decreasing overweight in the same scheme. It was unsurprising that other studies showed no impact on overweight or obesity, as changes to weight would be expected to occur at longer time scales that changes in dietary intake.

This review concludes that school fruit and vegetable schemes work. Effective school programmes have used a range of approaches and been organised in ways which vary nationally depending on differences in the food supply chain and education system.

INTRODUCTION

Why are fruits and vegetables important for health?

Low fruit and vegetable (FV) intake is known to be associated with a range of poor health outcomes, particularly non-communicable diseases such as cardiovascular disease and some cancers [1]. The burden of chronic non-communicable disease is increasingly rapidly worldwide and is expected to be responsible for 60% of the disease burden and 73% of all deaths by 2020 [2]. This is not only a public health problem in high-income countries, as a recent analysis estimated that chronic diseases were responsible for 50% of the total disease burden in 23 low and middle-income countries [3].

The Global Burden of Disease study for the year 2000 estimated that up to 2.7 million deaths worldwide, and 1.8% of the total global disease burden may be attributed to inadequate levels of fruit and vegetable consumption [1]. This estimated that increasing individual fruit and vegetable intake could reduce the burden of ischaemic heart disease by 31% and ischaemic stroke by 19%. For stomach, oesophageal, lung and colorectal cancer the potential estimated reductions were 19%, 20%, 12% and 2% respectively. These results supported similar findings which had estimated that low fruit and vegetable consumption was responsible for 2.4%, 2.8% and 3.5% of the burden of disease in New Zealand, Australia and the European Union respectively [4-6].

In 2002, an expert consultation for the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) assessed the strength of the evidence for the relationship between fruit and vegetable intake and health, and recommended a daily intake of fresh fruit and vegetables of at least 400 to 500 grams per day (g/d) [7]. This amount is generally considered to be equivalent to five servings of fruit and/or vegetables (80g is the internationally recognized standard serving size). However, there is clear variation in the understanding of serving size. Current international recommendations thus propose the intake of a minimum of 400g of fruit and vegetables per person per day (excluding potatoes and other starchy tubers). Recognising the evidence that most diets that are protective against cancer are mainly made up from food of plant origin, the recent World Cancer Research Fund Report advises a population average consumption

of at least 600g per day of non-starchy vegetables and/or fruit and a personal consumption of at least 400g/day [8].

The link between childhood fruit and vegetable intake and health

With the emerging epidemic of childhood obesity, and consequent increased risk for non-communicable diseases, there is recognition that children's eating habits need to be improved. There is emerging evidence of a direct positive effect of childhood FV consumption on adult disease from the Boyd-Orr Cohort. This has shown a potential association between higher childhood vegetable intake and lower risk of stroke [9] and higher childhood fruit intake and risk of cancer in adulthood [10]. There is also evidence of other nutrition and health benefits. It has been established from longitudinal studies that eating behaviours track from childhood through adolescence to adulthood[11], and that eating recommended dietary guideline amounts in childhood positively influences healthy eating in adult life [12]. Diets high in fruits and vegetables have also been proposed as reducing the risk of overweight and obesity [13].

Current fruit and vegetable consumption

Despite a wide range of public health promotion campaigns world wide focusing on dietary intake of fruits and vegetables, including '5 a day' type programmes, the evidence suggests that they have not had much influence on changing consumption. Survey data and availability statistics from FAO suggest that most adult populations are not meeting the minimum FV intake goals of 400g/person/day [14]. Similar patterns are seen in children. In a recent survey of FV intake among European schoolchildren in 9 countries, none of the countries met national or international guidelines for FV intake [15].

Improving fruit and vegetable intake in children

Schools appear to be an ideal environment to focus interventions designed to increase FV intake. In many countries, the majority of children will attend school and spend a large proportion of their day in a school environment, usually eating at least one meal there. The school environment provides an opportunity to integrate a range of different components of an intervention i.e. educational, nutritional, parental involvement. Several

countries have school FV programmes or healthy school nutrition programmes, and the potential importance of this approach has been recognised by the European Union who are currently considering proposals for an EU School Fruit and Vegetable funding scheme to be introduced in 2008[16].

This report presents the findings of a literature review conducted between August and October 2007 on the effectiveness of school fruit and vegetable schemes. Its aim was to consider how school FV schemes can improve FV consumption in children, to help inform development of future FV programmes worldwide. Several previous literature reviews have looked at the effectiveness of childhood FV interventions [17] [18], but only two previous reviews have concentrated on school-based interventions. One focused only on 7 US studies [19], while another older review only included primary school interventions [20]. This current review is more comprehensive in geographical scope, age range and intervention types and updates the evidence-base as many studies have been published in the intervening period.

METHODS

The aim of this literature review was to systematically collect and synthesise worldwide evidence from published and unpublished literature on interventions to promote fruit and/or vegetable consumption in children in school-based settings.

Criteria for considering studies

This review aims to consider all interventions, whether applied to individuals or populations, encouraging fruit and/or vegetable consumption where the primary outcome was measured. The primary outcome could be either change in intake or change in knowledge, attitudes or preference. Study inclusion was conditional on the presence of a control group for comparison as well as a follow-up period of at least 3 months to ensure the effect was sustained. The intervention had to promote a diet high in fruit and vegetables. Secondary outcomes such as impact on other dietary intake (including fat intake and junk food consumption) and Body Mass Index (BMI) were also considered. Finally, the intervention had to be based in a school or pre-school setting and subjects had to be of less than 18 years of age.

Search strategy

In August 2007, after consultation with the senior librarian at the London School of Hygiene and Tropical Medicine, a range of databases and other information resources was searched to locate published and unpublished relevant literature. In addition, the bibliographies of retrieved documents were searched for further studies. The following databases were searched from the earliest record – Pubmed, CAB Direct, The Cochrane Library, Web of Knowledge, IBSS, Psycinfo (BIDS), Embase, Biomed Central. The search strategy was developed for Pubmed (MEDLINE) and adapted for the other databases (appendix A). The database search was complemented by a comprehensive search for grey literature and other relevant material including the use of 'Google' search engine to search the internet. 34 experts from all regions of the world were contacted for references to studies not identified by the database search process. This included contact with organisations in countries known to have '5 a day' type FV programmes.

Selection of documents

Papers published in any language were initially considered. Titles and abstracts were screened by one reviewer and rejected if it was clear that the article did not report on a fruit and vegetable intervention in a school setting or if the inclusion criteria were met. If there was any uncertainty, the full text was obtained and studies were read by two reviewers who agreed on final study inclusion. All included studies were read by both reviewers. Disagreements among reviewers were resolved by discussion.

Analysis of study findings

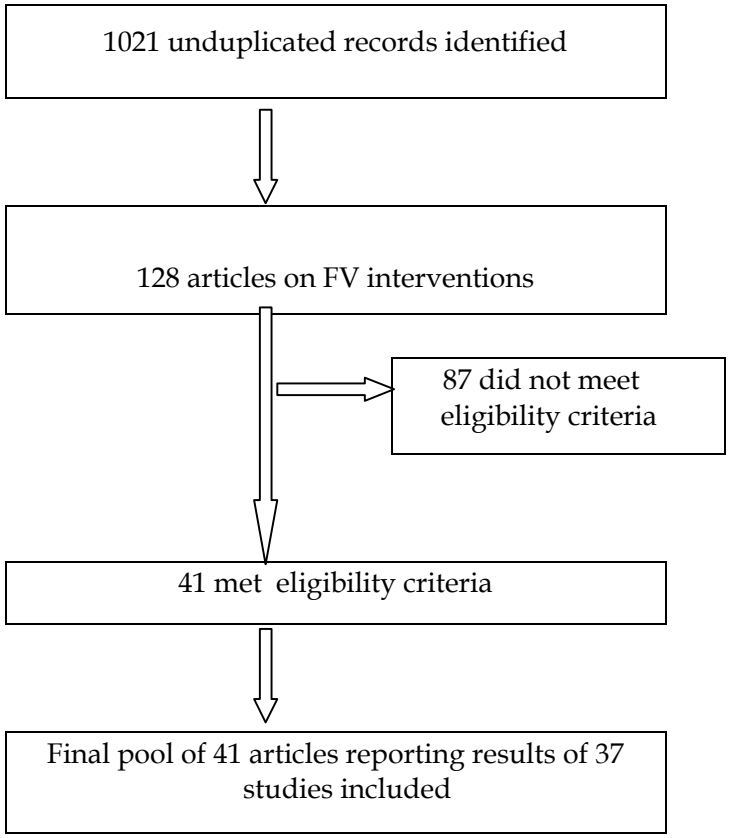
Meta-analysis was not attempted due to marked heterogeneity of populations, interventions and outcome measures among included studies. Findings were compared according to age group and also according to intervention type.

RESULTS

Retrieval of papers

A total of 1021 unduplicated records were identified for review from the literature searches and contacts with experts. After review of the abstracts 128 articles were found to report on fruit and vegetable interventions in school-based settings. After full review 87 studies were excluded as they did not meet inclusion criteria. The final pool consisted of 41 articles reporting on 37 studies (see Figure 1).

Figure 1: Summary of the papers identified by the literature review



Overview of included study characteristics

A summary of the general characteristics of the included studies including study design, intervention type, length of follow up and measurement methods is given in Table 1. For analysis we divided the studies by age group into two groups: 5-11 year olds and 11-18 year olds to coincide closely with primary and secondary school age groups in most countries. Three studies did not fit into these age- categories and were assigned to the 'younger' or 'older' group depending on the age of the majority of the children [21-23]. Further details on the studies in these two groups can be found in Appendices B and C.

Overall evidence of effectiveness

Twenty-four studies(65%) reported a significant positive intervention effect on FV intake at follow-up. Differences in intervention effect ranged from +0.14 servings/day to +0.99 servings/day. Studies did not measure or report changes in intake in similar ways (see table 1) which makes comparisons of effect size or meta-analysis difficult. In addition, five studies reported significant effects on intake at some point during the study though this was not maintained at follow-up. Statistically significant results for changes in nutrition knowledge or preferences were reported in 9 out of 11 studies. No studies found overall decreases in FV intake following interventions, although one study found decrease in one of the five study schools during one measurement period[24].

Table 1: Summary of included studies

School age group	Primary (5-11 years)	Secondary (11-18 years)
Total number of studies	27	10
Countries	Ireland (2) Netherlands (3) Norway (1) New Zealand (1) Spain (1) UK (7) USA (14)	Belgium (1) Greece (1) Italy (1) Norway (2) UK (1) USA (4)
Study design		
Randomised controlled trial	13	9
Non-randomised controlled trial	14	1
Number of participants		
<100	0	1
100-499	7	2
500-999	8	1
>1000	12	6
Intervention components		
FV provision (free or subsidised)	7	3
Classroom based (e.g. curriculum)	20	9
School-wide (e.g. inc FV exposure) and policy	14	5
Teacher involvement (e.g. training)	7	3
Peer leader involvement	2	1
School food service involvement	9	4
Parent involvement	12	4
School nutrition policy	2	3
Community involvement	5	0
Length of follow-up		
3 - 5 months	6	1
6 - 11 months	3	2
12 - 17 months	7	1
18- 24 months	6	4
>24 months	5	2
FV intake measurements		
food frequency questionnaire	11	8
food record/ diary	5	0
24hr recall	11	4
plate waste	4	0
Observation of intake	9	1
survey	2	3
interview	1	0
parent questionnaire	4	2
Other outcomes measured (apart from FV intake)		
Knowledge/attitudes/preferences	8	2
Psychosocial variables	2	0
Determinants of FV intake	3	0
Micronutrient intake	0	2
Cholesterol	1	0
Anthropometry/BMI	5	4
Physical activity	5	4
Reduced TV viewing hours	2	1

Note: numbers of countries in which studies were in younger children >27 as one study was multi-sited (Pro children, te Velde et al).

Results by age group

Twenty-seven studies were aimed at younger children, while ten targeted older children. Fourteen studies out of 27 in the younger age group were carried out in the United States, six in the UK, one in New Zealand and the rest in other countries in Europe. In the older age group, four were carried out in the United States and the rest in Europe. All studies involved both boys and girls with participant numbers varying from 99 students to over 4,000 students. Follow-up times varied from 3 months to 6 years (Table 1).

The majority of studies (27) were classified in the 'younger' or primary school age category. These evaluated a range of interventions. All measured fruit and vegetable intake and there were no statistically significant decreases in fruit and vegetable intake after any of the interventions. 22 reported a statistically significant increase in fruit and/or vegetable consumption at some stage during the intervention and this was maintained at follow-up in 19 studies (70%). Of the other 5 studies that did not report increase in intake, two reported a significant increase in knowledge of the health benefits of FV consumption [21] [25]. A further two studies were primarily targeted at obesity prevention and reported a decrease in consumption of high fat foods [26] [27], and a further study prevented a continuing decline in FV intake [28] (see Appendix B for full details of included studies in the younger/primary school age group)

In the older age group, five studies (50%) reported statistically significant increases in fruit and/or vegetable consumption. Three further studies reported increases in intake during the intervention which was not sustained at follow-up [24] [29-32] and another, primarily targeted at obesity, reported increased physical activity and decreased fat intake in girls [33] [34] (See Appendix C for full details of included studies in the older/ secondary school age group).

Results by intervention type by component

There were several main intervention approaches and most interventions or programmes consisted of a number of different components. These are outlined below and are summarised in tables according to the two age group categories in Appendix D. Most interventions or studies combined several approaches to increasing intake. It is not possible to attribute success to any one particular element, as most studies did not set out to evaluate the impact of different components separately. However, there are some overarching findings that should be noted.

Fruit and vegetable provision was common especially among national schemes. Free or subsidised fruit or vegetables were part of 11 studies, most notably the large scale experience and long term follow up of the English school scheme and the Norwegian scheme. These both operate on a national basis and have recently been evaluated at 3 years [35 36] showing statistically significant increases in consumption during [35 36] and after the programmes [36] As accessibility and availability have been found to be important determinants of childhood FV intake [37], it is logical that such provision should have a positive effect. Though fruit and vegetables were not provided directly as part of other studies, accessibility was increased through other interventions such as school food service modification [38], tasting or cooking sessions in class [28]and two projects involved school garden schemes [22 25].

An education component was delivered in the majority of studies targeted at both age groups. In older children, 9 out of 10 studies had some educational component and in younger children, this was 22 out of 27 studies. Many studies delivered a specifically tailored education resource or curriculum component, although some schemes ran concurrently with other national curriculum initiatives on healthy eating in schools . Educational interventions were usually delivered alongside other elements such as tasting, provision, school food policy changes and school food service involvement.

Parental involvement was a feature of 12 studies in younger children and 5 in older children. In the younger age group primarily the aim was to ensure that coherent messages to be displayed in both home and school environments. Parents were

involved in a variety of ways from helping with homework [39] to monitoring their own fruit and vegetable intake by using similar tools to their children [40].

A motivational and/or reward component, for example in the form of peer or fictional role models, or rewarding children for increasing intake, produced positive impact on intake in 3 studies [29-31 38 41 42] in both age groups. This approach has been used in a pilot of the Irish national programme in younger age groups which has seen sustained results at 1 year [42]. The use of rewards or incentives was only effective in some studies [38 41 42] whereas in others, the positive effect was not maintained at follow-up [28 43].

Though most of the included studies had improving intake or knowledge, attitudes and preferences as their main aim, some studies were primarily targeted at obesity reduction, with FV intake as a secondary outcome. Only one study managed to produce positive results in both reducing obesity and increasing FV intake [23]. The other studies produced significant positive results in other aspects related to obesity reduction for example lower fat intake.

LIMITATIONS OF THE REVIEW

Although increasing FV intake in children is likely to have health benefits worldwide the geographical scope of the included studies covers only the developing world, particularly Europe and North America. Obviously some studies may have been missed though the search was extensive and experts were contacted to ensure that all relevant literature was captured. It was felt that this was mainly due to the inclusion criteria as many studies from both developing and developed countries either did not have a sufficiently long follow-up period or did not include a control group in their evaluation. Studies that did not meet the inclusion criteria were not incorporated in the final pool for analysis although some are mentioned for interest. Examples of these interventions included the introduction of a salad bar in 3 schools demonstrating a significant increase in the frequency of fruit and vegetable consumption after 2 months [44]. There are also promising opportunities for after-school interventions such as work done with boy and girl scouts in the US [45 46]. Studies in developing countries tended to focus on

micronutrient intake, reflecting the focus on malnutrition to overcome problems with basic nutrition. However, there were some novel interventions including school gardening projects. Some national programme evelauations were also excluded, for example, the New Zealand Fruit in School initiative whose one year evaluation showed both increases in FV consumption and decreases in the amount of TV children watched [47].

There was heterogeneity of both FV intake measurement and reporting which made comparison of intake very difficult across studies. There are many difficulties with data collection in children, especially younger children who may not be able to fill out reporting forms. The validity of self-reporting in children has also been questioned with some researchers implying that children may want to give 'socially desirable' answers [48]. Observational reports and weighed reports remain the most robust measures of intake though there may be issues of observer bias as well as participants being aware of observation and therefore exhibiting different behaviour.

Not all studies used the same international standard definition of what to include in the measurement of fruits and vegetables [7]. Studies varied in reporting using both grams/day and servings/day, and definitions of serving sizes were also not consistent. It is relevant to discuss what may be counted as fruit and vegetables by different studies. WHO recommendations are fresh, frozen, chilled, canned and dried fruit and vegetables and only one portion of 100% fruit juice [7]. It does not include potatoes which are classified as starchy food. Some studies included potatoes as well as more than one portion of fruit juice/smoothies.

DISCUSSION

The findings of this review confirm and support the evidence that school-based fruit and vegetable schemes work. A majority of the studies reported significant positive effects on fruit and vegetable intake as well as improvements in knowledge, attitude to and preference for fruits and vegetables. Earlier reviews have been limited in scope or geographical setting [20 49-51] and many new studies have been published recently, leading to the need for this more comprehensive review.

It is generally accepted, from the body of evidence, that fruit and vegetable interventions do not have a negative impact on intake, as concluded in this paper. A systematic review in the UK pooled 19 studies into a meta-analysis and found that fruit and vegetable interventions aimed at children increase fruit and vegetable intake by one-fifth of a portion per day [52] . Knai et al [18] in their previous review of FV interventions for children in all settings estimated an effect size of +0.3 to +0.99 servings/day from 15 studies. This positive effect was replicated by a recent meta-analysis of 7 studies in the US, which found that school-based fruit and vegetable interventions produced a net difference of 0.45 servings/day (95% CI 0.33 to 0.59) [19].

Several lessons can be learnt from the review findings for increasing FV consumption in children. Much of the current focus for obesity and nutrition policy is on younger children, with the perception that diets of younger children are easier to change[53]. This review show that increasing FV intake is possible across a wide age range (50-70% of studies in both age groups). This is particularly important in teenagers when fruit and vegetable intake decreases dramatically, with the knowledge from tracking studies that eating behaviour in adolescence influences eating behaviour in young adults[12].

School fruit and vegetable schemes can also have the added benefit of reducing health and social inequalities. Children from low socio-economic (SES) backgrounds traditionally have lower FV intake. One Norwegian study directly compared the effect of providing fruit through a subsidised subscription or free scheme. The free scheme was used by all groups whereas the subsidised scheme was mainly used by traditional

high consumers (high SES). Compared to the subscription scheme, the free scheme reduced differences in FV intake between socio-economic groups, with increases in FV intake sustained 3 years after the free programme [36 54].

Do school FV schemes result in long term dietary changes? 25 studies had follow ups greater than 1 year. Evaluations of the English and Norwegian school programmes have follow up periods of 3 years and provide evidence that large scale schemes that simply increase FV availability can have long term impacts on consumption.

In terms of outlining the successful elements of a school fruit and vegetable schemes, this is not an easy task. Although many interventions had similar components, (Appendix D) there were differences in the range, mix, intensity and duration of components. It is possible to draw some conclusions about major components involved. Free or subsidised fruit provision increases availability and accessibility for children, which has been shown to be an important determinant of intake. This review shows that increasing children's access to FV can also be achieved in a number of ways within schools; changing school meals, snack provision, gardening, cooking or tasting programmes.

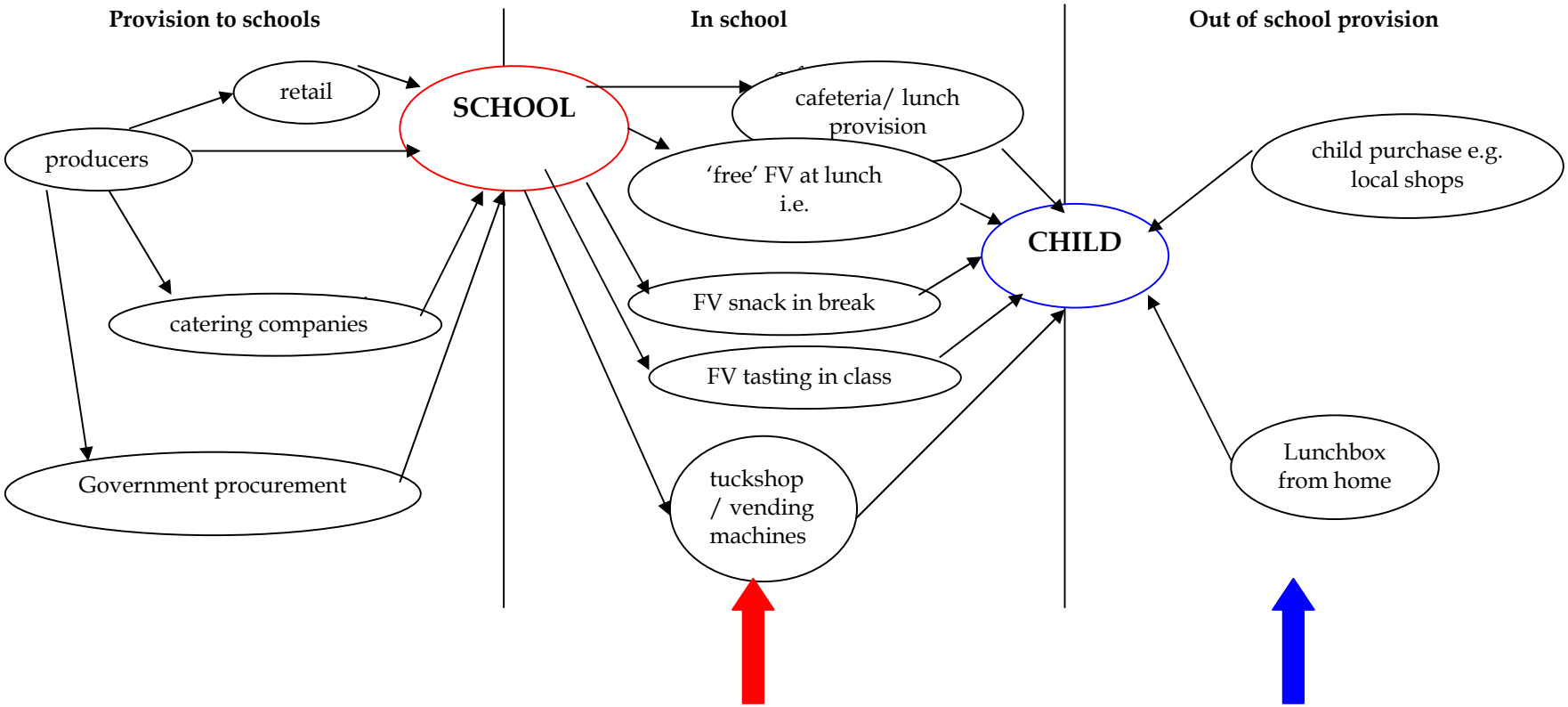
Even if increasing availability was a major focus of an intervention, it should be noted that all schemes had some element of education, either as a core part of the intervention or through a simultaneous 'healthy eating' type initiative in the curriculum that indirectly supported the FV scheme. Parental involvement, particularly in interventions involving the younger age group, ensured that a similar educational message is given across different environments.

The review can conclude that there is not one 'ideal' model for school FV schemes. It is important to recognise that school FV schemes can and have been organised in various ways (Figure 2) and factors for successful implementation vary nationally depending on differences in the food supply chain and education system. For example, the review showed that schemes differed in whether the school or government was the purchaser, and whether FV was supplied direct from producers, wholesalers or retailers. The

education systems of countries vary widely. Some countries provide cooked school lunches while others provide no meals with all children bringing food from home. National school food policies vary in terms of dietary guidelines and policies on what food can be provided (e.g in school lunch programmes) or consumed in schools (e.g. limits on 'junk food', soft drinks or vending machines). Educational curricula also differ in whether they include nutrition education and cooking skills, and how long children are taught these subjects for. School FV programmes must have the potential to be flexible and adaptable to the varying national contexts. This is illustrated by the Pro Children intervention study which was conducted in three countries with different school systems [40]. The study combined free FV provision with educational initiatives and parental support. However, the timing of the FV provision differed between countries, as Norway and the Netherlands have no school meal provision. A strong partnership approach to implementation ensured that the intervention was adapted to the different country environments, resulting in an average 20% increase in FV consumption in intervention schools after 1 year.

A final lesson is that sustainable funding is essential to provide healthy foods and supportive school based nutrition activities. Some national FV schemes (such as Denmark) initially failed due to lack of recurrent government resources and reliance on private industry and parental contribution. To date there has only been one Norwegian modelling study which attempted to measure the potential cost-effectiveness of school FV. Despite methodological limitations this appears to show that offering FV in schools will be cost effective even if it results in only very small lifelong increases in consumption [55].

FIGURE 2: Stages in the Organisation and Delivery of School Fruit and Vegetable Schemes



POLICY RELAVENCE

Increasing attention has been paid to the role of schools in promoting healthier diets in children as a result of the rise in overweight and obesity among young people worldwide. The school environment has the broad potential to impact on childrens food choices and dietary quality worldwide, although this may be limited in countries where school attendance is not high. For example in 2002, it was estimated that 113 million children were not in school, with the majority of these living in sub-Saharan Africa and South-East Asia. School FV schemes could be seen as both sensible health and consumer policies, as they aim at increasing intake of the produce amongst a new generation of consumers, and also supports several other international policy agendas, including healthy nutrition, obesity and addressing health inequalities. National and international bodies are starting to implement school food and nutrition guidelines, in some cases reinforced by legal requirements, on school nutrition. For example, in response to a federal government recommendation, 34 states in the USA have introduced legislation limiting the types of food and beverage sold in schools and providing specific guidelines on what should be available to school children. Bodies such as the Caroline Walker Trust in the UK provide practical and nutritional guidelines on healthy eating for children and other vulnerable groups, which have helped form the basis of a new school meal programme in England. Interestingly, developing countries are also leading on implementing legislative requirements for school food environments for example in Brazil, where both state and private schools are required to adhere to policies banning high-sugar beverages and offering at least two portions of fruit and vegetables to their students every school day.

CONCLUSION

There can remain little doubt that eating fruit and vegetables is beneficial for children. The body of evidence on benefits both to immediate and future health status continues to grow. This review shows that school-based fruit and vegetable schemes do work both by increasing intake and changing knowledge and attitudes. To implement effective interventions, careful consideration of context-specific factors must be made such as

differences in education systems, school meal programmes, producer organisations, supply chains and food cultures.

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APPENDIX A: Search strategy

The search strategy was adapted from the search strategy used in Pomerleau et al, Effectiveness of interventions and programmes promoting fruit and vegetable intake, WHO, 2005

MEDLINE

The Pubmed search covered the date range 1950 – August 2007. The search was carried out on 13 August 2007 and identified 563 records. Results were then excluded if earlier than 1987.

1. exp Diet/ [MeSH] or diet.mp.
2. exp Food Habits/ [MeSH] or food habits.mp.
3. exp Food Preferences/ [MeSH] or food preferences.mp.
4. 1 or 2 or 3 limit to humans
5. exp Fruit/ [MeSH] or fruit.mp.
6. exp Vegetables/ [MeSH] or vegetable$.mp.
7. 5 or 6 limit to humans
8. 4 and 7
9. Intervention Studies/ [MeSH] or "Early Intervention (Education) [MeSH] or intervention$.mp. limit to humans
10. 4 and 7 and 9
11. Health Education/ [MeSH] or health education.mp.
12. Health Promotion/ [MeSH] or health promotion.mp.
13. Health Knowledge, Attitudes, Practice/ [MeSH] or health knowledge.mp.
14. Health Behavior/ [MeSH] or health behavior.mp.
15. health behaviour.mp.
16. health practice.mp.
17. Evaluation Studies/ [MeSH] or evaluation.mp.
18. Counseling/ [MeSH] or counseling.mp.
19. counselling.mp.
20. "Clinical Trial[Publication Type]"/ [MeSH] or clinical trial.mp.
21. "Meta-Analysis/ [MeSH] or meta-analysis.mp.
22. Cost-Benefit Analysis/ [MeSH] or cost-effectiveness.mp.
23. economic evaluation.mp.
24. Decision Support Techniques/ [MeSH] or decision analysis.mp.
25. 9 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 limit to humans
26. 4 and 7 and 25
27. exp Schools/ [MeSH] or exp Schools, Public Health/ [MeSH] or school.mp.
28. exp Education/ [MeSH] or education.mp.
29. exp Nurseries/ [MeSH] or nursery.mp.
30. preschool.mp.
31. 27 or 28 or 29 or 30
32. exp Child/ [MeSH] or child$.mp.
33. exp Infant/ [MeSH] or infant$.mp.

34. exp Adolescent/ [MeSH] or adolescent$.mp.
35. 32 or 33 or 34
36. 10 and (31 or 35)
37. 10 and 31 and 35
38. 26 and (31 or 35)
39. 26 and 31 and 35

CAB Direct

The CAB Direct search covered the date range 1973 to 2007 and was carried out on 13 August 2007 and identified 174 records.

1. (fruit*, vegetable*)
2. diet*
3. intervention*
4. (fruit, vegetable*) AND intervention*
5. intervention* OR evaluation* OR "health promotion" OR "health education" OR "health knowledge" OR "health behaviour" OR "health behavior" OR "health practice" OR counseling OR counselling OR "health informatics" OR "clinical trial" OR "meta-analysis" OR "cost-effectiveness" OR "economic evaluation" OR "decision analysis"
6. (fruit, vegetable*) AND (intervention* OR evaluation* OR "health promotion" OR "health education" OR "health knowledge" OR "health behaviour" OR "health behavior" OR "health practice" OR counseling OR counselling OR "health informatics" OR "clinical trial" OR "meta-analysis" OR "cost-effectiveness" OR "economic evaluation" OR "decision analysis")
7. school* OR educat* OR nurser* OR preschool
8. child* OR infant* OR adolescent*
9. (fruit, vegetable*) AND intervention* AND ((school* OR educat* OR nurser* OR preschool) OR (child* OR infant* OR adolescent*))
10. (fruit, vegetable*) AND (intervention* OR evaluation* OR "health promotion" OR "health education" OR "health knowledge" OR "health behaviour" OR "health behavior" OR "health practice" OR counseling OR counselling OR "health informatics" OR "clinical trial" OR "meta-analysis" OR "cost-effectiveness" OR "economic evaluation" OR "decision analysis") AND ((school* OR educat* OR nurser* OR preschool) OR (child* OR infant* OR adolescent*))
11. (fruit, vegetable*) AND intervention* AND (school* OR educat* OR nurser* OR preschool) AND (child* OR infant* OR adolescent*)
12. (fruit, vegetable*) AND (intervention* OR evaluation* OR "health promotion" OR "health education" OR "health knowledge" OR "health behaviour" OR "health behavior" OR "health practice" OR counseling OR counselling OR "health informatics" OR "clinical trial" OR "meta-analysis" OR "cost-effectiveness" OR "economic evaluation" OR "decision analysis") AND (school* OR educat* OR nurser* OR preschool) AND (child* OR infant* OR adolescent*)

The Cochrane Library

The Cochrane Library search covered the date range 1800 to 2007 and was carried out on 13 August 2007and revealed 167 records. 44 were Cochrane reviews, 8 were

other reviews, 112 were clinical trial, 1 was a technical brief and 2 were economic evaluations.

#1 (diet* or (food next habit)) and (fruit* or vegetable*)
#2 intervention*
#3 (intervention* or evaluation* or (health next promotion) or (health next education) or (health next knowledge) or (health next behaviour) or (health next behavior) or (health next practice) or counseling or counselling or (clinical next trial) or meta-analysis or (cost next effectiveness) or cost-effectiveness or (economic next evaluation) or (decision next analysis)
#4 INTERVENTION STUDIES single term [MeSH]
#5 EVALUATION STUDIES single term [MeSH]
#6 HEALTH PROMOTION single term [MeSH]
#7 HEALTH BEHAVIOR single term [MeSH]
#8 HEALTH EDUCATION single term [MeSH]
#9 PUBLIC HEALTH PRACTICE single term [MeSH]
#10 META-ANALYSIS single term [MeSH]
#11 COST-BENEFIT ANALYSIS single term [MeSH]
#12 DECISION SUPPORT TECHNIQUES single term [MeSH]
#13 (#3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12)
#14 (#1 and #2)
#15 (#1 and #13)
#16 (school* or educat* or preschool or nurser*)
#17 SCHOOLS explode [MeSH]
#18 EDUCATION explode [MeSH]
#19 NURSERIES explode [MeSH]
#20 (#16 or #17 or #18 or #19)
#21 (child* or infant* or adolescent*)
#22 CHILD explode [MeSH]
#23 ADOLESCENT explode [MeSH]
#24 INFANT explode [MeSH]
#25 (#21 or #22 or #23 or #24)
#26 (#1 and #2 and (#20 or #25))
#27 (#1 and #13 and (#20 or #25))
#28 #1 and #2 and #20 and #25
#29 #1 and #13 and #20 and #25

Web of Knowledge (Web of Science)

The Web of Science database search covered the date range 1987 to 2007 and was carried out on 13 August 2007 and identified 401 records.

1. TS = (intervention*)
2. TS = (intervention* OR evaluation* OR health promotion* OR health education* OR health knowledge OR health behaviour* OR health behavior* OR health practice OR counselling OR counseling OR clinical trial OR meta-analysis OR cost effectiveness OR decision analysis OR economic evaluation
3. diet* OR food habit*

4. fruit* OR vegetable*
5. (diet* OR food habit*) AND (fruit* OR vegetable*)
6. school* OR educat* OR nurser* OR preschool
7. child* OR infant* OR adolescent*
8. #1 AND #5
9. #2 AND #5
10. #1 AND #5 AND (#6 OR #7)
11. #2 AND #5 AND (#6 OR #7)
12. #1 AND #5 AND #6 AND #7
13. #2 AND #5 AND #6 AND #7

IBSS (International Bibliography of the Social Sciences)
The IBSS database search covered the date range 1951 to 2007 and was carried out on 13 August 2007 and identified 1 record.

1. (fruit* or vegetable*) and (diet* or food habit*)
2. intervention*
3. intervention* or evaluation* or "health promotion" or "health education" or "health knowledge" or "health behaviour" or "health behavior" or "health practice" or counseling or counselling or "clinical trial" or meta-analysis or "cost-effectiveness" or "economic evaluation" or "decision analysis"
4. #1 and #2
5. #1 and #3
6. school* or educat* or nurser* or preschool
7. child* or infant* or adolescent*
8. #1 and #2 and (#6 or #7)
9. #1 and #3 and (#6 or #7)
10. #1 and #2 and #6 and #7
11. #1 and #3 and #6 and #7

Psycinfo (BIDS)

The PsycINFO database search covered the date range 1872 – 2007 and was carried out on 13 August 2007 and identified 91 records.

1. (fruit* or vegetable*) and (diet* or food habit* or food preference*)
2. intervention*
3. intervention* or evaluation* or "health promotion" or "health education" or "health knowledge" or "health behaviour" or "health behavior" or "health practice" or counseling or counselling or "clinical trial" or meta-analysis or "cost-effectiveness" or "economic evaluation" or "decision analysis"
4. #1 and #2
5. #1 and #3
6. school* or educat* or nurser* or preschool
7. child* or infant* or adolescent*
8. #1 and #2 and (#6 or #7)
9. #1 and #3 and (#6 or #7)

10. #1 and #2 and #6 and #7
11. #1 and #3 and #6 and #7

Embase

The Embase database search covered the date range 1980 to 2007 and was carried out on 13 August 2007 and identified 240 records.

1. fruit.mp. or exp FRUIT/ [MeSH]
2. vegetable.mp. or exp VEGETABLE/ [MeSH]
3. 1 or 2
4. diet.mp. or exp DIET/ [MeSH]
5. food habit.mp. or exp Feeding Behavior/ [MeSH]
6. food preference.mp. or exp Food Preference/ [MeSH]
7. 4 or 5 or 6
8. intervention.mp. or INTERVENTION STUDY/ [MeSH]
9. health promotion.mp. or Health Promotion/ [MeSH]
10. health education.mp. or Health Education/ [MeSH]
11. health knowledge.mp. or Health/ [MeSH]
12. health behaviour.mp. or Health Behavior/ [MeSH]
13. health behavior.mp.
14. health practice.mp.
15. counseling.mp. or COUNSELING/ [MeSH]
16. counselling.mp.
17. Clinical Trial/ [MeSH]
18. Meta Analysis/ [MeSH]
19. clinical trial.mp.
20. meta-analysis.mp.
21. cost effectiveness.mp. or "Cost Effectiveness Analysis"/ [MeSH]
22. economic evaluation.mp. or Economic Evaluation/ [MeSH]
23. decision analysis.mp.
24. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
25. 3 and 7
26. 3 and 7 and 8
27. 3 and 7 and 24
28. school.mp. or exp SCHOOL/ [MeSH]
29. education.mp. or exp EDUCATION/ [MeSH]
30. nursery.mp. or exp NURSERY/ [MeSH]
31. preschool.mp.
32. 28 or 29 or 30 or 31
33. Child/ [MeSH]
34. child.mp.
35. Infant/ [MeSH]
36. infant.mp.
37. Adolescent/ [MeSH]

38. adolescent.mp.
39. 33 or 34 or 35 or 36 or 37 or 38
40. 3 and 7 and 8 and (32 or 39)
41. 3 and 7 and 24 and (32 or 39)
42. 3 and 7 and 8 and 32 and 39
43. 3 and 7 and 24 and 32 and 39

BioMed Central
The BioMed Central search covered the date range 1997 - 2007 and was carried out on 14 August 2007 and identified 417 records.

1. fruit* OR vegetable*
2. intervention*
3. intervention* OR evaluation* OR health promotion* OR health education* OR health knowledge* OR health behaviour* OR health behavior* OR health practice OR counseling OR counselling OR clinical trial OR meta-analysis OR cost effectiveness OR decision analysis OR economic evaluation
4. (fruit* OR vegetable*) AND intervention*
5. (fruit* OR vegetable*) AND (intervention* OR evaluation* OR health promotion* OR health education* OR health knowledge* OR health behaviour* OR health behavior* OR health practice OR counseling OR counselling OR clinical trial OR meta-analysis OR cost effectiveness OR decision analysis OR economic evaluation)
6. school* OR educat* OR pre-school OR nurser*
7. child* OR infant* OR adolescent*
8. (fruit* OR vegetable*) AND intervention* AND ((school* OR educat* OR pre-school OR nurser*) OR (child* OR infant* OR adolescent*))
9. (fruit* OR vegetable*) AND (intervention* OR evaluation* OR health promotion* OR health education* OR health knowledge* OR health behaviour* OR health behavior* OR health practice OR counseling OR counselling OR clinical trial OR meta-analysis OR cost effectiveness OR decision analysis OR economic evaluation) AND ((school* OR educat* OR pre-school OR nurser*) OR (child* OR infant* OR adolescent*))
10. (fruit* OR vegetable*) AND intervention* AND (school* OR educat* OR pre-school OR nurser*) AND (child* OR infant* OR adolescent*)
11. (fruit* OR vegetable*) AND (intervention* OR evaluation* OR health promotion* OR health education* OR health knowledge* OR health behaviour* OR health behavior* OR health practice OR counseling OR counselling OR clinical trial OR meta-analysis OR cost effectiveness OR decision analysis OR economic evaluation) AND (school* OR educat* OR pre-school OR nurser*) AND (child* OR infant* OR adolescent*

APPENDIX B: Details of studies in younger children/ primary schools

Study	Design	Participants	Data collection	Intervention	Results
Bash Street kids intervention, Dundee Anderson et al, 2005	Cluster randomised controlled trial Follow up: 10 months	2 intervention schools (511 children) 2 control schools (464 children) groups of children 6-7 and 10-11	Age appropriate assessments. Food diaries Interviews	- increased provision of FV in schools (tuck shops and school lunches) - tasting opportunities - point-of-purchase marketing - newsletters for parents - curriculum materials control: no exposure	Intervention children tasted more FV over time ($p<0.001$)22.4/32 to 27 no of foods tasted Also tasted several FV that had not been tasted at baseline. Weight of fruit intake increased in both groups. Intervention (+50g) p=0.042 Control (+7g)
Integrated Nutrition Project (INP), USA Auld et al, 1998	Non-randomised controlled trial Follow up: 4 years	1250 children in 3 Denver schools only reports on year 3 and 4	1) plate waste assessment 2) food recall/record 3)classroom survey on knowledge and attitudes to FV 4)5 min interview with kindergarten kids about knowledge of FV	1) 24 weekly special resource teacher-taught classes that included food prep and eating 2) teacher training 3) parent education 4) community nutrition/food resource development control: no exposure	treatment students consumed significantly more FV than comparison students: 0,19 more F serving, 0.25 more V servings and 0.4 FV servings in total. treatment children demonstrated higher levels of knowledge
Integrated Nutrition Project (INP), USA Auld et al, 1999	Non-randomised controlled trial Follow up: 4 months	~38 classes ~760 students 2^{nd} – 4^{th} grade	Plate waste Classroom survey Classroom observations Teacher interviews	'reduced dose intervention' 16 lessons alternation between special resource teacher/class teacher also lunchroom 'mini lessons' by parents control: no exposure	Treatment group ate more fruit, 30% more V and 0.36 MCI serving of FV in total. Treatment children had higher levels of knowledge than comparison students.
Gimme 5, USA Baranowski et al 2000	Randomised controlled trial Follow up: 3 years	1253 children in 4^{th} and 5^{th} grade from 16 elementary schools	7 day food record	12 sessions over 6 weeks including handout,s posters, worksheets, newsletters, videos, point of purchase education at shops. Control: no exposure	lower decrease in intervention vs control group: net effect of +0.3 servings/day
5 a day power play! Campaign, USA Foerster et al, 1998	Non-randomised controlled trial Follow up: 1 school year	49 schools 151 classrooms (4^{th} and 5^{th} grade) 2684 cases established 15 schools control T1 19; T2 15 schools	California Children's Food Survey – 24 hr recall self-reported food diary	T1 – power play! Activities conducted on ly in school. School Idea and Resource Kit T2 – power play! Activities in schools, community youth organisations, farmers' markets, supermarkets, mass media Control : no nutrition activities	Both intervention sites reported significant increases in self-reported FV intake compared with control site but not with each other. Increases highest for T2 (0.4 serving, from 2.9 to 3.3) compared with 0.2 serving (from 2.7 to 2.9 in T1).

APPENDIX B (continued): Details of studies in younger children/ primary schools

UK school fruit, Fogarty et al, 2007	Non-randomised controlled trial Follow up: 3 years	random sample of 113 schools in East Midlands and 122 schools in Eastern region 2003 – 10470 students 2004 – 10104 2005 – 8386	questionnaire completed by parents	Free piece of school fruit every day for 4-6 year old children NSFS implemented in different regions of the country over a period of 2 years (02-04). Control: no fruit (eastern region)	May 2004 proportion eating F every day in intervention was markedly higher +11% (95% CI +7.4 to 14.6) But in May 2005 proportion fell to less than the control region (-2.8%)
Nutrition education at primary school (NEAPS), Ireland Friel et al, 1999	Non-randomised controlled trial Follow up: 3 months	821 children aged 8-10 ears from 8 schools in urban and rural areas 453 intervention 368 control	5 day food diary also assessed knowledge and preferences	20 sessions over 10 weeks including worksheets, homework and exercise regime; parent involvement Control: no exposure	More intervention children consumed 4 or more FV/day intervention group demonstrated significant changes in reported behaviour and food preferences overall($p<0.01$)
Eat Well and Keep Moving, USA Gortmaker et al, 1999	Non randomised controlled trial Follow up: 2 years	6 intervention schools, 8 matched schools for control 470 students initially	Student food and activity survey and 24 hr recall and youth food frequency questionnaire	Classroom-based. Food school service and family involved Control: no exposure	an increase in the consumption of FV (0.36 servings 4184 KJ 95% ci, 0.1-0.62 P=0.01) = ~0.73 servings/day
Kids Choice school lunch program, USA Hendy et al, 2005	Randomised controlled trial Follow up: 7 months	346 children 1st, 2nd and 4th grades	Observed FV intake Interviews with children	All children given same FV at lunch (2 choices f and V) Half classrooms randomly assigned to receive token reinforcement for fruit or vegetable consumption if they ate at least 1/8cup of assigned food group. Control: no reward	Intake increased during Ix but not measured after Preferences increased for range FV 2 weeks after but returned to baseline at 7 months (greater fruits than veg)
Food Dudes, UK Horne et al, 2004	Non-randomised controlled trial Follow up: 4 months	2 inner city London Primary Schools 794 Children 5-11 y o	Observation Home using parental 24 hr recall, plus subset of parents interviewed (paid £35)	16 day Ix: 6x 6min episodes of video homepacks, rewards for eating FV at snack and lunch some maintenance ix control: received free FV	

APPENDIX B (continued): Details of studies in younger children/ primary schools

Food Dudes, Ireland, Lowe et al, 2007	Randomised controlled trial Follow up: 1 year	2 experimental schools, 1 control 435 children	Observation, weighed measures	16 day intervention featuring video, rewards, letters from FD homepacks and help with maintenance period control: free FV	At 12 month followup children in experimental school were provided with and consumed significantly more lunchbox FJV
Netherlands, Mangunkusumo et al, 2007	Randomised controlled trial Follow up: 3 months	30 7th grade classes 16 intervention 14 control total of 675 children	Internet-administered questionnaire	School based intervention Combination of internet tailored advice for children followed by internet-supported brief dietary counselling by the nurse in the presence of at least one parent. Control: no internet advice	FV intake did not differ significantly between intervention and control However knowledge was significantly different in treatment group
School gardening, USA Morris et al, 2003	Non-randomised controlled trial Follow up: 6 months	3 schools from local school district. 3 4th grade classes at each site 213 students	Nutrient knowledge questionnaire (30 MCQ) and vegetable preference survey	1 school no nutrition or gardening education 2nd school only nutrition lessons(NL) 3rd school nutrition and gardening, with hands on gardening activities (NG)	NL and NG nutrition knowledge scores significantly greater than CO ($p<0.0005$) maintained at 6 month follow up ($p<0.0005$) Also some V preferences increased
Paradis et al, USA 2005	Non-randomised controlled trial Follow up: 6 years	N=458 in 1994 N=420 in 2002 2 community elementary schools	7 day food frequency Anthropometric measurements Physical activity questionnaire	Health education curriculum delivered in grades 1-6 in community's 2 elementary schools. Community activities School nutrition policy Control: no exposure	Some early positive effects on skinfold thickness but not BMI, physical activity,fitness or diet. Key high fat and high sugar foods consumption decreased
5 a day power plus Perry et al, USA 1998	Randomised controlled trial Follow up:10 months	Children in 4th grade from 20 ethnically, culturally and economically diverse schools n= 1750 initially	Health behaviour questionnaire for all; self-completed 24h food record for random sample; lunchroom observation	1) behavioural curricula 2) parental involvement 3) school food service changes 4) industry support control: no exposure	Intervention students had a higher mean intake of FV than control. Difference was 0.4 servings/day at follow up
5 a day cafeteria power plus Perry et al, USA 2004	Randomised controlled trial Follow up: 2 years	1668 students in 1st and 3rd grades form 26 elementary schools	Observations by trained staff	School food service involvement, daily activities and special FV events Control: no exposure	Significant increase of FV intake ($p=0.02$) verbal encouragement by lunch staff significantly associated with higher intakes. Difference ~+0.3 servings/day

APPENDIX B (continued): Details of studies in younger children/ primary schools

CATCH Perry et al, USA 1998	Randomised controlled trial Follow up:3 years	5106 students initially of which subset of 1186 students were followed	24 h recalls at baseline and follow up; 30 min face to face interviews also	Modifications in school food service, physical education, classroom curricula and parental involvement Control: no exposure	No difference at follow-up
UK School Fruit and Vegetable Scheme Ransley et al, 2007	Non randomised controlled trial Follow up: 2 years	Infant and primary schools in N England 3703 children aged 4-6	CADET (child and diet evaluation tool)	1 portion of F or V provided per child on each school day between Feb and Dec 2004 control: no fruit	inc FV intake across reception and year 1 of 0.5 portions (95% CI 0.3-0.7) and 0.7 portions (CI 0.3-1.0) at 3 months which fell to 0.2 at 7 months in reception and 0.2 in year 1 Impact on year 2 inc FV intake of 0.5 portions (0.2-0.9) 3 months fell to -0.2 at 7 months. (no longer eligible for free FV) No long term impact on V intake
Know Your Body, USA Resnicow et al, 1992	Non randomised controlled trial Follow up: 2.5 years	Tracked students from grades 1-4 5 elementary schools. Schools assigned to condition by district 3066 children 3 of 4 NYC schools ix 2 comparison schools	- total cholesterol - ht/wt/BMI - BP - health knowledge (age-appropriate instruments) - food frequency questionnaires	1) classroom curriculum 2) school-wide activities – in food service, inc fibre and dec fat content control: no intervention	Longitudinal – inc in V intake but not significant. Improved health knowledge Post-test - lower total cholesterol and systolic BP and significantly higher health knowledge scores significantly higher V consumption and heart healthy foods
High 5, USA Reynolds et al, 2000	Randomised controlled trial (matched pair design) Follow up: 2 years	28 elementary schools pair-matched 1698 children	1) 24 hr recall 2) cafeteria observations 3) parents – food frequency questionnaire	14 lesson curriculum delivered on 3 consecutive days each week. Components: classroom, parent, food service. Control: no intervention	Intervention group had higher intakes of FV at 2 years ~+0.99 servings/day ($p<0.0001$) Differences in psychosocial variables
APPLES: Active programme promoting lifestyles in schools, UK Sahota et al, 2001	Randomised controlled trial Follow up: 1 year	10 primary schools in Leeds 634 children aged 7-11 years	24hr recall 3 day food diary growth measures physical activity questionnaire	Teacher training, school meal changes, curriculum development, physical education, tuck shops Control: no intervention	Intervention children had increased intake of vegetables by ~+0.3 servings/day but no sig change in F intake

APPENDIX B (continued): Details of studies in younger children/ primary schools

Schwartz et al, USA 2007	Randomised controlled trial Follow up: 3 months	2 comparable elementary schools 309 intervention 337 control	Observation by parent volunteers	Regularly offered children a choice of at least 2 types of fresh or canned fruit and 1 or 2 types of 100% juice every day Intervention: verbal prompt by food staff Control: no prompt	More likely to take fruit and eat it after verbal prompt.
'Schoolgruiten', Netherlands Tak et al, 2007	Non randomised controlled trial Follow up: 1 year	565 children of Dutch ethnicity 388 children of non-Western ethnicity mean age 9.9 years at baseline	Validated pro-children questionnaires Questions on intake and determinants Children and parents completed questionnaires	i) availability and accessibility of FV at school Free fruit/veg twice a week at morning break ii) inc exposure to FV iii) school curriculum changes control: no exposure	Children of non-western ethnicity in intervention group reported significantly higher V intake (+20.7g per day CI 7/6-33.7). Dutch children 0.23 F pieces per day (CI 0.07 – 0.39) No significant effects based on parent reports Significant positive effects also found for perceived accessibility among children of non-Western ethnicity.
APPLE program, New Zealand Taylor et al, 2007	Non-randomised controlled trial Follow up: 2 years (FV only 1 year)	730 children aged 5 – 12 years 4 intervention schools 3 control schools	Measurements of height, weight, waist circumference, blood pressure, physical activity. Diet by validated short food questionnaire	i) Community activity co-ordinators ii) teacher resources, cooled water filters iii) science lessons, healthy eating resource, interactive card game during 2nd year	BMI significantly lower in intervention children (due to differences in relative weight) Fruit intake increased by 0.8 servings over 3 days in intervention children ($p<0.01$) No effect on V intake
'Be Smart' Warren et al, UK 2003	Randomised controlled trial Follow up: 14 months	Children recruited from 3 primary schools in oxford, aged 5-7 years n=213	- anthropometry - nutrition knowledge - physical activity questionnaire - dietary assessment by parents - 24hr recall, food frequency questionnaire	1 control group, 3 intervention groups nutrition groups, physical activity group, combined nutrition and physical activity group	Significant improvements in nutrition knowledge were seen in all children ($p<0.01$) Overall FV intake increased significantly $p<0.01$ and $p<0.05$
Wells et al, UK 2005	Non randomised controlled trial Follow up: 8 months	17 schools 8 NSFS 9 control n = 4192 students	24 hr ticklist food frequency questionnaires	Free piece of school fruit for kids aged 4-6 in pilot schools every day Control: no fruit	117g/d and 67g/day if FJ excluded (=2/3 apple) for intervention vs. control
Pro children study Norway, Netherlands, Spain, Te Velde et al, 2007	Cluster randomised controlled trial Follow up: 2 years	n = 2106 students 62 schools in three European counties	Pro-children questionnaires	Classroom curriculum Parental involvement Free FV during intervention control: normal curriculum, FV dependent on country	Short-term and long-term increases in FV consumption and preferences

APPENDIX C: Details of studies in older children/ secondary schools

Study	Design	Participants	Data collection	Intervention	Results
KALEDO board game, Italy Amaro et al, 2006	Randomised controlled trial (pre-test, post-test) classroom as unit of recruitment Follow up: 6 months	241 subjects from 3 middle schools 153 intervention 88 control aged 11-14	Questionnaires assessing knowledge, intake, physical activity Anthropometry, BMI	24 weekly sessions playing educational board game. Control: no game	Nutrition knowledge – significant difference Dietary intake - Significant difference at post-assessment for V intake 3.7 (3.5-4.1 servings/week BMI and physical activity – no significant difference
Norwegian School Fruit Programme Fruit & Vegetables Make the Marks Bere et al, 2006	Cluster randomised controlled trial Follow up: 1 year	9 intervention schools 10 control schools 369 pupils age 11.3 at baseline	Survey questionnaire 24hr FV recall parental questionnaire Food frequency questionnaire	Pupils receive free piece of F/carrot each day. - free fruit and educational programme Control: no intervention	FV all day and at school 0.6 portions higher in intervention Sustained in 2nd year (no longer had free fruit or education)
Norwegian School Fruit Programme Bere et al, 2005, 2007	Cluster randomised controlled trial Follow up: 3 years	9 schools - free fruit 9 schools - paid 20 schools no fruit total:1950 students	Survey Questionnaire	Initially free subscription to scheme then paid (€0.30) Control: no subscription scheme	Free fruit – sustained effects on FV intake 3 years after intervention. Inc by 30-35 g/day
TEENS study, USA Birnbaum, Lytle et al, 2002, 2006	Randomised controlled trial Follow up: 2 years	16 schools with at least 20% of students approved for free and reduced price lunch and at least 30 students in each of 7th and 8th grades. ~3600 students	Behavioural risk factor surveillance 24hr recall	4 groups group 1: control Group 2: school environment interventions only Group 3: as 2 but with classroom lessons Group 4: as 3 but with peer leaders	Significant increase in intervention group 4 (+0.9 servings/day, p=0.012) at interim evaluation but no significant effect at 2 year follow up.
Planet Health USA Gortmaker et al, 1999	Randomised controlled trial Follow up: 2 years	5 intervention & 5 control schools 1295 ethnically diverse grade 6 and 7 students	Food frequency questionnaires (also measured obesity, TV viewing hours)	School based interdisciplinary intervention. Teacher training, classroom lessons, physical activity, wellness sessions Control: usual curriculum	Higher increase in intervention group +0.32 servings/day (p=0.003) but only in girls
Belgium Haerens et al, 2006, 2007	Cluster randomised controlled trial Follow up: 2 years	5 schools intervention with support 5 schools intervention no support 5 schools control ~ 2840 pupils	Food frequency questionnaires 1 subset completed assessments of physical activity	Increasing fruit to 2 pieces/day decreasing soft drinks, decreasing fat intake. Environmental change focus with tailored computer feedback Control: no intervention	No statistically significant difference in fruit intake. Statistically significant decrease fat intake in girls. Increase in physical activity at year 2 for both sexes

APPENDIX C (continued): Details of studies in older children/ secondary schools

Greece Hassapidou et al, 1997	Randomised controlled trial (classroom as unit of randomisation) follow up: 10 months	2 secondary schools in Pierias country 1 urban, 1 rural 126 students	1 week food frequency questionnaires 1 24 hr recall	Nutrition education over 10 weeks by dietitians, workbooks, info for parents, food models, educational games. Control: no intervetion	Small effects – boys increased bananas, grapes, juices. Girls increased raw veg. No statistically significant difference in height/weight
School Garden project, USA McAleese et al 2007	Non-randomised controlled trial Follow up: 12 weeks	6th grade students at 3 elementary schools. 99 students	3×24hr recalls	1 group – control 1 group – nutrition education 1 group – nutrition education plus gardening activities	Gardening students increased FV servings more than others. Combined FV intake inc to 4.5 servings/day from 1.93
Gimme 5, USA O'Neill et al, 2002	Randomised controlled trial (matched pair design) Follow up: 3 years	9th grade students in 12 schools (6 matched pairs) ~2210 students	Knowledge, Attitudes and Practice questionnaire	Gimme 5 measurement questionnaire + intervention - school wide media campaign, classroom activities, school meal modification Control: measurements without intervention	No difference at follow-up. Initially reported consumption of FV servings was significantly higher in intervention schools but not sustained.
Peterborough Schools Nutrition Project, UK Parker et al, 2001	Randomised controlled trial Follow up: 2 years	3 secondary schools in Peterborough ~3200 students	Observation	School food groups, increasing food availability Peer-related and curriculum activities Control: no intervention	1 school did achieve 50% increase in vegetables in final monitoring period. Otherwise no significant difference

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