

School-based nutrition education: lessons learned and new perspectives

Carmen Pérez-Rodrigo MD* and Javier Aranceta MD PhD
Community Nutrition Unit, Department of Public Health, Bilbao, Spain

Abstract

Nutrition is a major environmental influence on physical and mental growth and development in early life. Food habits during infancy can influence preferences and practices in later life and some evidence suggests fair to moderate tracking of food habits from childhood to adolescence^{1–4}. Studies support that good nutrition contributes to improving the wellbeing of children and their potential learning ability, thus contributing to better school performance^{5–7}. Children and young people who learn healthy eating habits, are encouraged to be physically active, to avoid smoking and to learn to manage stress, have the potential for reduced impact of chronic diseases in adulthood^{4–8}. Nutrition education is a key element to promoting lifelong healthy eating and exercise behaviours and should start from the early stages of life^{8–11}; it should also address the specific nutritional needs associated with pregnancy, including reinforcing breastfeeding¹².

Food habits are complex in nature and multiple conditioning factors interact in their development¹³. Young children do not choose what they eat, but their parents decide and prepare the food for them. During infancy and early childhood the family is a key environment for children to learn and develop food preferences and eating habits. As they grow and start school, teachers, peers and other people at school, together with the media and social leaders, become more important. Progressively children become more independent and start making their own food choices. The peer group is very important for adolescents and has a major influence in developing both food habits and lifestyles¹³.

Community trials suggest that nutrition education is an accessible effective tool in health promotion programmes with a focus on the development of healthy eating practices^{14,15}.

Keywords
Children's food habits
Nutrition education
School meals
Evaluation

School based nutrition education

The settings approach has become popular in health promotion. This approach recognizes that there is a valuable opportunity to influence health through policy measures and education within specific settings such as schools, workplaces, hospitals or cities. Schools provide the most effective and efficient way to reach a large segment of the population, including young people, school staff, families and community members^{16,17}.

School-based nutrition education should: (a) address the needs and interests of students, the teachers and the school^{17–19}; (b) be relevant to programme goals; (c) take into account what children already know and can do; (d) be culturally appropriate^{20,21}; (e) be delivered in a way children can understand and teach the skills and knowledge required to improve or strengthen healthy eating habits^{8,19,21}.

Identifying perceived needs and barriers to healthy dietary behaviour contributes to adequate programme development²². Student input by focus groups can be useful in this respect. Student focus groups in the Gimme 5 programme reported lack of availability, lack of variety and inconsistency in taste as main barriers to increasing consumption of fruits and vegetables²². The importance of making nutrition messages developmentally appropriate and delivering specific behavioural advice to help children make informed food choices has been emphasized^{16,23}.

Identification of students' as well as teachers' attitudes towards and perceptions of food and nutrition, including motivation, is an important element in the early stages of programme development. In a study carried out in the UK key motivators for healthy eating among children and adolescent boys were identified as sports, being strong and achievement of better performance, while girls

*Corresponding author: Email bisaludpublica@jet.es

reported personal appearance as the main factor. In this study key reported factors influencing children and adolescent food choices were availability of ready to eat food, taste, perceived filling quality and appealing packaging²⁴.

The Take Five programme in the UK identified perceived practical opportunities to increase consumption of fruits and vegetables either as part of a main meal or a snack²⁵. In line with this, evaluation of school-based programmes aimed at improving consumption of fruit and vegetables or reducing cardiovascular risk factors, which incorporated an environmental-policy component, showed that effective policies to facilitate a positive school environment (including school food service) can contribute to the success of school-based nutrition education programmes^{16,23,26}. Tailoring interventions to individual characteristics, level of dietary intake, risk of poor nutrition, readiness to change, self-efficacy and sociodemographic aspects can enhance effectiveness^{16,27}.

Theoretical background for behaviour change

Previous literature reviews have identified educational strategies which are theory driven, with clear behavioural focus among the elements conducive to successful programmes²³. Recent evaluations of school-based nutrition education programmes, implemented mostly in the USA and also in some European countries, also support this idea. Framework models often referred to include the Social Cognitive Theory as described by Bandura²⁸, which emphasizes a strong behavioural component as well as environmental and individual aspects, reinforcing self-efficacy and decision making skills. A number of studies use the Stages of Change model defined by Prochaska and DiClemente²⁹ to identify characteristics of study group and design matched intervention strategies accordingly. Consciousness raising, social liberation, emotional arousal and self re-evaluation are relevant processes of behaviour change for people in pre-action stages³⁰. Increased awareness may contribute to a shift from pre-contemplation or contemplation stage to preparation as reported by Nicklas TA and colleagues³¹. Several studies use a combination of theories as background construct, particularly adding the PRECEDE planning model^{21,22} (Predisposing, Reinforcing and Enabling Causes in Educational Diagnosis and Evaluation).

Components of School-based nutrition education programmes

Several successful programmes consider a multiple component prevention model, beginning in elementary school and extending to high school. A growing number of these include an environmental element in the strategy influencing the quality of food provided by school

meals^{21,32,33} (Table 1). Intervention strategies should be carefully planned and followed up²⁷.

School curriculum

In order to succeed, nutrition education needs to be incorporated into the school curriculum actively involving teachers, family and other community professionals^{17,27,34}. School-based nutrition education should focus not only on the provision of nutrition information, but also on the development of skills and behaviours related to areas such as food preparation, food preservation and storage; social and cultural aspects of food and eating; enhanced self-esteem and positive body image and other consumer aspects. All of these areas are conducive to healthier food choices¹⁹. Recently published successful programmes have included lessons in other subjects (e.g. maths and language)^{21,22}. In these studies, teachers were responsible for curriculum implementation and were supported by qualified programme staff^{21,22,35–37}. There is a wide array of teaching methods that can be used according to learning objectives: from classroom discussions, worksheets and keeping food records; to shopping exercises, tasting, creating, or drama^{19,38}.

Extra-curricular activities are also challenging. For example, school gardening, developing cooking skills, exhibitions and other workshop activities^{19,21,22}. Incorporation of self-evaluation and feedback can be effective in interventions for older children²³. New technologies such as the Internet, the World Wide Web and CD-Roms also provide a chance for interactive learning experiences³⁹. To be effective, nutrition promotion strategies must be creative, engaging, inexpensive and widely disseminated.

Implementation

Implementation is a complex and usually slow process. Characteristics of the teachers, educational materials and support provided by programme leaders and staff determine the level of implementation within the curriculum⁴⁰. Pre-testing the curriculum allows adaptation, improvement in the design and time for the programme to gain acceptance³⁶. Teachers often complain about the lack of explicit curriculum, suitable materials or training experience^{19,24,41}. Adequate time, intensity of the intervention, resources, as well as the provision of suitable materials and teacher training opportunities are essential to programme success^{27,37,40,42}. Outcomes of the intervention depend on the degree of implementation and fidelity to the intended plan. Teacher training conceptualized as a behaviour change process with explicit teacher motivation components can promote effective implementation of behaviour change curriculum in the classroom⁴³. Pre-service as well as in-service training opportunities for teachers and educators should be in place³⁵.

Table 1 Components of selected school-based nutrition education programmes

PROGRAMME	Implementation grades	Intervention components					Duration
		Classroom	Workshops	School meals/ cafeteria	Family	Other	
NEAPS (Ireland) ¹	3–5	X			X	Physical activity	3 months
Heart Health (Crete) ²	1	X			X	Physical activity	3 years
Minnesota Heart Health ³	6	X			X	Wider community	7 years
GIMME 5 Georgia ⁴	4–5	X	X	X	X	Video	4 years
GIMME 5 Louisiana ⁵	9–12	X	X	X	X	Teacher wellness	4 years
High 5 ⁶	4	X		X	X	School based media	2 years
5-a-Day Power Plus ⁷	4–5	X		X	X	Food Industry support	2 years
CATCH ⁸	3–5	X		X	X	Physical activity	3 years
Heart Health Montreal ⁹	4	X				Smoking Collaboration health/education	2 years
Eat Well & Keep Moving ¹⁰	4–5	X		X	X	Low-income groups	2 years
Planet Health ¹¹	6–8	X			X	Teacher/staff wellness Physical activity Social services	2 years
Low-income urban area in Bilbao (Spain) ¹²	3–6	X	X	X	X	Collaboration health/education Low-income groups	3 years

1 Friel S, Kelleher C, Campbell P, Nolan G. Evaluation of the nutrition education at Primary School (NEAPS) programme. *Public Health Nutr.* 1999; **2**: 549–55.

2 Manios Y, Moschandreas J, Hatzis C, Kafatos A. Evaluation of a health and nutrition education program in primary school children of Crete over three-year period. *Prev. Med.* 1999; **28**: 149–59.

3 Kelder SH, Pery CL, Lytle LA, Kelp K. Community-wide youth nutrition education: long-term outcomes of the Minnesota Heart Health Program. *Health Educ. Res.* 1995; **10**: 119–31.

4 Baranowski T, Davis M, Resnikow K, et al. Gimme 5 fruit, juice and vegetables for fun and health: outcome evaluation. *Health Educ. Behav.* 2000; **27**: 96–111.

5 Nicklas Th, Johnson CC, Myers L, et al. Outcomes of a high school program to increase fruit and vegetable consumption: Gimme 5 – A fresh nutrition concept for students. *J. Sch. Health* 1998; **68**: 248–53.

6 Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, Person S. Increasing the fruit and vegetable consumption of fourth-graders: results from the high 5 project. *Prev. Med.* 2000; **30**: 309–19.

7 Story M, Mays RW, Bishop DB, et al. 5-a-day Power Plus: process evaluation of a multicomponent elementary school program to increase fruit and vegetable consumption. *Health Educ. Behav.* 2000; **27**: 187–200.

8 Perry CL, Bishop DB, Taylor G, et al. Changing fruit and vegetable consumption among children: the 5-a-Day Power Plus program in St. Paul, Minnesota. *Am. J. Public Health* 1998; **88**: 603–9.

9 Renaud L, Chevalier S, Dufour R, et al. Evaluation of the implementation of an educational curriculum: optimal interventions for the adoption of an educational program of health in elementary schools. *Can. J. Public Health* 1997; **88**: 351–3.

10 Gortmaker SL, Cheung LW, Peterson KE, et al. Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: Eat Well and Keep Moving. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 975–83.

11 Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 409–18.

12 Pérez-Rodrigo C, Aranceta J. Nutrition education for schoolchildren living in a low-income urban area in Spain. *J. Nutr. Educ.* 1997; **29**:267–73.

Environmental interventions

Environmental interventions are important components of intervention programmes, that contribute to the creation of opportunities for action by removing barriers to following a healthy diet²⁶. Literature reviews of successful programmes identified interventions in the school environment as an element advantageous for success²³. Comprehensive school health programmes as defined by Allensworth *et al.* include several interactive components: health education, physical education, health services, school food services, school counselling and social services, school-community efforts, faculty-staff health promotion and school environment¹⁸. Environmental interventions include changes in food supply, point of choice nutrition information, collaboration with private sector food vendors, workplace nutrition policies and incentives or changes in the structure of health and medical care related to nutrition³². School organizational characteristics can moderate effects on outcomes of

school health promotion programmes as described by Baranowski and colleagues^{44,45}.

School meals

School meals should be part of the educational process, providing a valuable opportunity to practice what children learn in the school setting, combined with other policies that facilitate a positive school environment^{46–48}. This includes a pleasant room, nice atmosphere and plenty of time to enjoy healthy food in the school, either food provided by the school or brought from home^{46–50}. The evaluation of the United States Department of Agriculture (USDA) School Meals and Breakfast Programmes⁵¹ and other European programmes⁴⁷ show their contribution to total daily intake and the potential for intervention. Participation rates and acceptance of the food offered are important contributing factors to the success of a strategy that can be improved by food service style (particularly a family

style), variety and quality of the food offered, presentation and texture of foods offered^{47,52,53}.

School meals should provide high quality foods that meet dietary requirements, consistent with dietary guidelines and positive nutrition experiences. Training of foodservice staff, school policies that enhance this framework and training of adults who have dining room supervision responsibilities are important elements in this context⁴⁶. Any other places where children can get food in the schools (e.g. vending machines, tuck shops or the cafeteria), also provide useful opportunities for intervention by modifying the quality and variety of the food offer⁴⁹.

Several programmes include media-marketing strategies applicable in schools, such as marketing stations, promotional materials, taste-testing activities, point of purchase and service signs, posters, tip sheets or student contests³³.

Family component

Family involvement enhances the effectiveness of programmes for younger children. Objectives for the family component in successful programmes focus on stimulating awareness and gaining parental support to encourage variety in the diet and availability of healthy foods at home. Methods used include brochures and activities with the Parents' Association and the Parent-Teachers' Association^{21,54,55}. The overall Child and Adolescent Trial for Cardiovascular Health (CATCH) family intervention focused on knowledge and attitudes. In this programme, evaluation of children's knowledge and attitudes showed a positive association with the number of packs completed by an adult member of the household with the child; this association was more pronounced for minority and male students⁵⁶. Many studies report the difficulty of parental involvement²¹. More suitable intervention strategies and opportunities should be explored to improve participation rates^{55,57}.

Community involvement – partnerships

Some studies show that multiple intervention components such as behavioural education in schools along community-wide health promotion strategies can produce modest but lasting improvement in adolescent knowledge and choices¹⁴. Collaboration between educational and health sectors⁴², industry support, partnerships with catering companies⁵⁴ or other groups in the community can enhance school nutrition education and contribute to success. Again, opportunities should be explored and planned accordingly⁵⁷.

Evaluation of school-based nutrition education programmes

Evaluation is often missing, incomplete or uses inadequate design to assess the effectiveness of an intervention.

Evaluation is concerned with assessing the effectiveness and efficiency of interventions. However, it is important to follow progress towards major goals and to use the results of the evaluative process to encourage and enhance the strategy.

Process evaluation

Process evaluation is an important but infrequently conducted component of evaluating the impact of health promotion interventions, which results in identification of lessons learned leading to increased efficacy. Process evaluation focuses on programme implementation, quality control and monitoring that explains study outcomes^{54,56,58}. It analyzes the extent of implementation, fidelity to the programme, reach, use of materials, environmental mediators (for example, teacher training), curriculum delivery, parental involvement, participation in family activities, attendance at evening activities, availability and accessibility of healthy foods at home⁵⁸, school food service changes, food service staff, food industry support or external factors⁵⁴. For each intervention component process evaluation measures have to be developed to assess programme dose, penetration, utilization and external competing factors^{19,33,37,40,59,60}.

Testing of curriculum with teachers and teacher training is part of formative evaluation for curriculum implementation^{36,42}. Teacher self-reporting and classroom observations can be useful tools for process evaluation⁴². Inadequate implementation contributes to attenuate the impact of school health education programmes⁶¹.

A growing number of studies are utilising process evaluation as part of programme evaluation. This helps to explain some of the weaker aspects of programme performance, variation by demographic characteristics or decline over time (Table 2). Among other procedures, focus groups, information from peer educators, classroom observations, school-meal observations, checklists, analysis of factors affecting attendance, family involvement or obstacles to dietary change have been reported to be useful strategies^{56,62}. Process evaluation should ascertain participation of subgroups with special needs or difficult to reach groups, such as ethnic minorities or lower-income families⁶². Further development in this area will contribute to a better understanding of how and why interventions achieve their effects, how best to conduct intervention programmes to maximize effects and the enhancement of internal and external validity of the studies⁶³. Process evaluation provides useful strategies for a more comprehensive approach to programme evaluation. Evaluation of process must be sensitive and involve the collaboration of all participants.

Outcome evaluation

Outcome evaluation looks into programme effectiveness. Different designs have been used although good quality

Table 2 Process dimensions and outcome evaluation in selected school-based nutrition education programmes

Programme	Grades	Process dimensions	Outcome evaluation	Observations
Heart Health Crete ⁷⁰	1	Not reported	Knowledge ↑ Food habits: ↓ fat, ↑ fruit & vegetables Physical activity: ↑ BMI: lower increase Serum cholesterol: lower levels	3 years follow-up 7 years
Minnesota Heart Health ¹⁴	6	Not reported	Knowledge ↑ Food preferences: favourable Dietary habits: restraint salt	7 years Gender differences. Girls more favourable
GIMME 5 ^{31,44,58,65}	4–5	Curriculum implementation Fidelity of implementation Teacher training Participation School Food service Family involvement	Food consumption: ↑ fruit & vegetables Psychosocial measures Knowledge ↑	4 years Ethnic differences Gender differences: Girls more favourable
High 5 ^{62,71}	4	Curriculum implementation Fidelity of implementation Teacher training Participation School Food service Family involvement	Dietary behaviour: ↑ fruit & vegetables ↑ parent's consumption of fruit & vegetables Psychosocial measurements Knowledge ↑	2 years
5-a-Day Power Plus ^{34,67}	4	Teacher lessons Food Service Staff Implementation	Diet: ↑ fruit & vegetables Health behavior	Gender differences: Girls more favourable
CATCH1 ^{5,33,37,56,69}	3–5	Curriculum implementation Fidelity of implementation Teacher training Participation School Food service Family involvement	Diet: ↓ fat Physical activity: ↑ Physiological measures: favourable Knowledge: ↑ Psychological measurements: No significant changes in: serum cholesterol, blood pressure or BMI [†]	3 years follow-up + 3 years after intervention completed
Heart Health Montreal ⁴²	4	Physical activity program Curriculum implementation Fidelity of implementation Teacher training Participation School Food service Family involvement	Not reported	Relevance of teacher's and pack characteristics for implementation
Eat Well & Keep Moving ⁶⁸	4–5	Curriculum implementation Teacher training School Food service School Food service	Dietary intake: ↓ total fat, SFA [†] ↑ Fruit & vegetables; ↑ vitamin C, fiber TV watching hours +/-	2 years

Table 2. *continued*

Programme	Grades	Process dimensions	Outcome evaluation	Observations
Planet Health ⁶⁴	6–8	Not reported	Diet: ↑ Fruit & vegetables ↓ TV watching hours ↓ prevalence of obesity (girls) Knowledge: ↑	2 years Gender differences
Low-income urban area in Bilbao (Spain) ²¹	3–6	Curriculum implementation Participation Students satisfaction School Meals Family involvement	Attitudes: favourable Skills: ↑ Health behavior: wash hands Diet: ↑ fruit & vegetable	3 years

* BMI: Body Mass Index

† SFA: Saturated fatty acids

evaluation studies are randomized, use quasi-experimental designs and include control groups with pre and post-intervention measurements.

End points

End points commonly used include increased awareness, positive attitudes and related knowledge and behaviour change (i.e. dietary habits, physical activity)⁶⁴. A variety of methods have been used for that purpose, but often food frequency questionnaires, food records or repeated 24 hour recalls have been reported. Other instruments include psychosocial measures, telephone interviews with parents, observational assessments, impact factors at home, self-efficacy scales or social norms⁶⁵. Some studies also include anthropometric measurements, biochemical or health indicators. In these studies length of follow-up ranges from 2 years up to 7 years^{14,15,21,31,62,65}.

It is important to consider qualitative and quantitative dimensions of evaluation^{21,66}. Multi-component school-based programmes, which include classroom curriculum, school food service and parental involvement have reported a significant increase in observed lunchroom intake of vegetables and fruit^{14,15,21,67–69}, positive changes in fat content of school lunches and overall children's diet as well as increased physical activity^{64,68–70}. Some studies have observed an overall increase in reported fruit consumption, but not for vegetable consumption, among fourth and fifth graders⁶⁷. A 14% increase in the usual daily servings of vegetables and fruits was observed in a high school programme, but this effect disappeared by 3rd year of follow-up³¹. Reynolds and colleagues reported increased consumption of daily servings of fruit and vegetables in fourth graders and their parents⁷¹. Many of these studies have reported gender differences in outcomes, with greater achievements among females. Poorer results have been observed in low-income²⁰ and ethnic subgroups^{31,65}.

The CATCH evaluation at 3 yr. follow-up without

further intervention suggested that behavioural changes regarding diet and physical activity initiated during elementary school years persisted into early adolescence^{4,69}. This study reported significant positive achievements in dietary behaviour and physical activity, but no significant changes were observed in physiological measures (i.e. serum cholesterol levels, blood pressure) attributable to the programme. Although short term positive effects may be rewarding and suggest the potential for intervention programmes, the problem of maintenance of changes and wider expansion of the intervention itself to benefit the wider community arises^{70,71}. Long term effects on maintenance are desirable, and larger, long-term studies in free-living populations are required to assess behaviour changes that are enduring rather than transitory³⁰.

Recent initiatives

In Europe, the World Health Organization Health Promotion Initiative has inspired a number of school-based initiatives, including the European Network of Health Promoting Schools¹⁷ and nutrition specific efforts⁶. In this context, a framework curriculum for school-based nutrition education has been developed¹⁹ along with a planning and evaluation guide⁵⁷ (the last two supported by the European Union). All of them use a comprehensive health promotion approach applied to both an individual (i.e. student) level through personal skills development, as well as to a local (i.e. school and community) level through healthy policies and supportive environments. These initiatives have encouraged further developments at the national and regional level. In the Basque Country (Spain) a collaborative group from the Departments of Education and Health including educators, nutrition experts and Public Health specialists has been set up to design and test a nutrition education curriculum for primary and secondary schools alongside an in-service teacher training programme. Similar processes have

already started in other European countries like the UK⁴¹ and the Netherlands³⁸.

The EURODIET project has addressed the potential of the school setting for the implementation of dietary guidelines⁴⁸ and the new edition of dietary guidelines for the Spanish population will specifically address this issue. In the USA, the Centre for Disease Control and Prevention issued guidelines for school and community health programmes to promote lifelong physical activity¹⁰ and healthy eating⁸ among young people in 1997; Healthy People 2010 emphasizes the role of school-based health education with a focus both on unhealthy dietary patterns and inadequate physical activity. The School Health Index for physical activity and healthy eating has been recently published as a school self-assessment and planning guide^{72,73} to implement health promotion projects.

A growing body of evidence supports the effectiveness of school-based health promotion strategies with a focus on healthy eating. There are still questions to be answered in order to improve implementation, gain family support, reach the wider community and ensure maintenance of achievements. Recent developments in this area are encouraging and indicate the potential of this approach, although further research is required.

References

- Nicklas TA, Webber LS, Srinivasan SR, Berenson GS. Secular trends in dietary intakes and cardiovascular risk factors of 10-year-old children: the Bogalusa Heart Study (1973–1988). *Am. J. Clin. Nutr.* 1993; **57**: 930–7.
- Kelder SH, Perry CL, Klepp KI, Lytle LL. Longitudinal tracking of adolescent smoking, physical activity and food choice behaviors. *Am. J. Public Health* 1994; **84**: 1121–6.
- Singer MR, Moore LI, Garrahe EJ, Ellison RC. The tracking of nutrient intake in young children: the Framingham Children's Study. *Am. J. Public Health* 1995; **85**: 1673–7.
- Resnicow K, Smith M, Baranowski T, Baranowski J, Vaughan R, Davis M. 2-year tracking of children's fruit and vegetable intake. *J. Am. Diet Assoc.* 1998; **98**: 785–9.
- Nicklas TA, Webber LS, Johnson CC, Srinivasan SR, Berenson GS. Foundations for health promotion with youth: a review of observations from the Bogalusa Heart Study. *J. Health Educ.* 1995; **26**(Suppl 2): S18–26.
- Aldinger CE, Jones JT. *Healthy Nutrition: An essential element of a Health-Promoting School. WHO Information Series on School Health. Document four.* Geneva: WHO, 1998.
- ADA. Position of the American Dietetic Association: Dietary guidance for healthy children aged 2 to 11 years. *J. Am. Diet Assoc.* 1999; **99**: 93–101.
- CDC. Guidelines for school health programs to promote lifelong healthy eating. *J. Sch. Health* 1997; **67**: 9–26.
- Hornak L, Block G, Lane S. Influence of selected environmental and personal factors on dietary behavior for chronic prevention: a review of the literature. *J. Nutr. Educ.* 1997; **29**: 306–12.
- CDC. Guidelines for school and community health programs to promote lifelong physical activity among young people. *MMRW* 1997; **46**: RR-6.
- Foerster SB, Heimendinger J, DiSogra LK, Pivonka E. The National 5 a Day – for Better Health! Program: an American Nutrition and Cancer Prevention Initiative. In: Wheelock W, ed. *Implementing Dietary Guidelines for Healthy Eating.* London: Chapman & Hall, 1997: 447–9.
- Yngve A, Sjöström M. Promotion of breastfeeding in Europe – challenges and possibilities (submitted).
- Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics* 1998; **101**: 539–49.
- Kelder SH, Perry CL, Lytle LA, Klepp KI. Community-wide youth nutrition education: long-term outcomes of the Minnesota Heart Health Program. *Health Educ. Res.* 1995; **10**: 119–31.
- Luepker RV, Perry CL, McKinlay SM, Nader PR, Parcel GS, Stone EJ. *et al.* Outcomes of a field trial to improve children's dietary patterns and physical activity. The Child and Adolescent Trial for Cardiovascular Health. CATCH collaborative group. *JAMA* 1996; **275**: 768–76.
- Roe L, Hunt P, Bradshaw H, Rayner M. *Health promotion interventions to promote healthy eating in the general population: a review.* London: HEA, 1997.
- WHO. *European Network of Health Promoting Schools. A joint WHO-CE-CEC Project.* Copenhagen: WHO-Euro, 1993.
- Allensworth D, Wyche J, Lawson E, Nicholson, eds. *Defining a comprehensive school health program: an interim statement.* Washington DC: National Academy Press, 1995: 2.
- Dixey R, Heindl I, Loureiro I, Pérez-Rodrigo C, Snel J, Warnking P. *Healthy eating for young people in Europe. Nutrition education in Health Promoting Schools.* Copenhagen: European Network of Health Promoting Schools, 1999.
- Friel S, Kelleher C, Campbell P, Nolan G. Evaluation of the nutrition education at Primary School (NEAPS) programme. *Public Health Nutr.* 1999; **2**: 549–55.
- Pérez-Rodrigo C, Aranceta J. Nutrition education for school-children living in a low-income urban area in Spain. *J. Nutr. Educ.* 1997; **29**: 267–73.
- Nicklas TA, Johnson CC, Farris R, Rice R, Lyon L, Shi R. Development of school-based nutrition intervention for high school students: Gimme 5. *Am. J. Health Promot.* 1997; **11**: 315–22.
- Lytle LA, Achterberg CL. Changing the diet of America's children: what works and why? *J. Nutr. Educ.* 1995; **27**: 250–60.
- Urbick B, Jack V, Westerhof A, Katz B. *Good nutrition for UK youth: Bridging the gap between adults and children June, 1999.* Surrey: CKC, Leatherhead Food Research Association, 1999.
- Anderson AS, Cox DN, McKellar S, Reynolds J, Lean ME, Mela DJ. Take Five, a nutrition education intervention to increase fruit and vegetable intakes: impact on attitudes towards dietary change. *Br. J. Nutr.* 1998; **80**: 133–40.
- ADA Statement. *Promoting healthy eating behaviors: The role of school environments.* Washington DC: USDA, Food, Nutrition and Consumer Services, 1999.
- Contento IR. The effectiveness of nutrition education and implications for nutrition education policy, programs and research – a review of research. *J. Nutr. Educ.* 1995; **27**: 279–418.
- Bandura A. *Social Foundations for thought and action.* Englewood Cliffs, NJ: Prentice Hall, 1986.
- Prochaska JO, Velicer WF. The transtheoretical model of health behavior. *Am. J. Health Prom.* 1997; **12**: 38–48.
- Finckenor M, Byrd-Bredbenner C. Nutrition intervention group program based on preaction-stage-oriented change processes of the Transtheoretical Model promotes long-term reduction in dietary fat intake. *J. Am. Diet Assoc.* 2000; **100**: 335–42.
- Nicklas TA, Johnson CC, Myers L, Farris RP, Cunningham A. Outcomes of a high school program to increase fruit and vegetable consumption: Gimme 5 – A fresh nutrition concept for students. *J. Sch. Health* 1998; **68**: 248–53.
- Glanz K, Mullis RM. Environmental interventions to promote

- healthy eating: a review of models, programs, and evidence. *Health Educ. Q.* 1988; **15**: 395–415.
- 33 Raizman DJ, Montgomery DH, Osganian SK, Ebzery MK, Evans MA, Nicklas TA, Zive MM, Hann BJ, Snyder MP, Clesli AL. CATCH: food service program process evaluation in a multicenter trial. *Health Educ. Q.* 1994(Suppl 2): S51–71.
 - 34 Stockley L. *The promotion of healthier eating: a basis for action*. London: Health Education Authority, 1993.
 - 35 Contento IR, Balch GI, Bronner YL. *et al.* Inservice preparation in nutrition education for professionals and paraprofessionals. *J. Nutr. Educ.* 1995; **27**: 347–54.
 - 36 Contento IR, Kell DG, Keiley MK, Corcoran RD. A formative evaluation of the American Cancer Society changing the Course nutrition education curriculum. *J. Sch. Health* 1992; **62**: 411–6.
 - 37 Edmunson EW, Luton SC, McGraw SA, Kelder SH, Layman AK, Smyth MH, Bachman KJ, Perdersen SA, Stone EJ. CATCH: classroom process evaluation in a multicenter trial. *Health Educ. Q.* 1994(Suppl 2): S27–50.
 - 38 Snel J. *et al.* *Voeding de beste basis voor school [Food: the best basis for school]. A nutrition education teaching pack for primary schools (4–12 year olds)*. The Hague (The Netherlands): Netherlands Nutrition Centre, 1997.
 - 39 DiSogra L, Glanz K. The 5 A Day virtual classroom: An on-line strategy to promote healthful eating. *J. Am. Diet Assoc.* 2000; **100**: 349–52.
 - 40 Tones K, Dixey R, Green J. *Process indicators at the local level. Part B. Developing and evaluating the curriculum of the Health Promoting Schools*. Brussels: Commission of the European Communities. World Health Organization. Council of Europe. Université Libre de Bruxelles, 1997: 1–34.
 - 41 Valentine S, Barnett A. Working Group. *Food and Nutrition. Guidance of food and nutrition in primary teacher training*. London: Department of Health, Ministry of Agriculture, Fisheries and Food, 1999.
 - 42 Renaud L, Chevalier S, Dufour R, O'Loughlin J, Beaudet N, Bourgeois A, Ouellet D. Evaluation of the implementation of an educational curriculum: optimal interventions for the adoption of an educational program of health in elementary schools. *Can. J. Public Health* 1997; **88**: 351–3.
 - 43 Kealey KA, Peterson AV Jr, Gaul MA, Dinh KT. Teacher training as a behavior change process: principles and results from a longitudinal study. *Health Educ. Behav.* 2000; **27**: 64–81.
 - 44 Baranowski T, Hearn M, Baranowski JC. *et al.* Teach Well: the relation of teacher wellness to elementary student health and behaviour outcomes: baseline subgroup comparisons. *J. Health Educ.* 1995; **26**: S61–71.
 - 45 Weber Cullen K, Baranowski T, Baranowski J, Hebert D, deMoor C, Davis Hearn M, Resnicow K. Influence of school organizational characteristics on the outcomes of a school health promotion program. *J. Sch. Health* 1999; **69**: 376–80.
 - 46 ADA. Position of the American Dietetic Association: Local support for nutrition integrity in schools. *J. Am. Diet Assoc.* 2000; **100**: 108–11.
 - 47 Aranceta J, Pérez Rodrigo C. *Consumo de alimentos y estado nutricional de la población escolar de Bilbao. Guías alimentarias para la población escolar*. Bilbao: Area de Salud y Consumo. Excmo. Ayuntamiento de Bilbao, 1996.
 - 48 Pérez Rodrigo, Klepp KI, Yngve A, Aranceta J, Stockley L, Sjöström M. The school setting: an opportunity for the implementation of Dietary Guidelines (in press).
 - 49 Caldwell D, Nestle M, Rogers W. School nutrition services. In: Marx E, Wooley SF, eds. *Health is academic*. New York NY: Teachers College Press, 1998.
 - 50 Collins Pateman B, McKinney P, Kann P, Leavy Small M, Warren W, Collins JL. School food service. *J. Sch. Health* 1995; **65**: 327–32.
 - 51 Gordon AR, Devaney BL, Burghardt JA. Dietary effects of the National School Lunch Program and the School Breakfast Program. *Am. J. Clin. Nutr.* 1995; **61**: 221S–31.
 - 52 Meyer MK. Top predictors of middle/junior high school student's satisfaction with school foodservice and nutrition programs. *J. Am. Diet Assoc.* 2000; **100**: 100–3.
 - 53 Donnelly JE, Jacobsen DJ, Legowski P, Johnson S, McCoy P. Family-style foodservice can meet US dietary Guidelines for elementary school children. *J. Am. Diet Assoc.* 2000; **100**: 103–5.
 - 54 Story M, Mays RW, Bishop DB, Perry CL, Taylor G, Smyth M, Gray C. 5-a-day Power Plus: process evaluation of a multicomponent elementary school program to increase fruit and vegetable consumption. *Health Educ. Behav.* 2000; **27**: 187–200.
 - 55 Crockett SJ, Perry CL, Pirie P. Nutrition intervention strategies preferred by parents: Results of a marketing survey. *J. Nutr. Educ.* 1989; **21**: 90–4.
 - 56 Nader PR, Sellers DE, Johnson CC, Perry CL, Stone EJ, Cook KC, Bebhuk J, Luepker RV. The effect of adult participation in a school-based family intervention to improve children's diet and physical activity: the Child and Adolescent Trial for Cardiovascular Health. *Prev. Med.* 1996; **25**: 455–64.
 - 57 Andrien M, Closset A, Cotelte B, Green J, Halbardier V, Heindl I, Loureiro I, Maree M, Pérez-Rodrigo C, Snel J, Tones K. *Planning and evaluating nutrition education in schools. A guide*. Liège (Belgium): CERES, 1998.
 - 58 Davis M, Baranowski T, Resnicow K, Baranowski J, Doyle C, Smith M, Wang DT, Yaroch A, Herbert D. Gimme 5 fruit and vegetables for fun and health: process evaluation. *Health Educ. Behav.* 2000; **27**: 167–76.
 - 59 Nicklas TA, O'Neil CE. Process of conducting a 5-a day intervention with high school students: Gimme 5 (Louisiana). *Health Educ. Behav.* 2000; **27**: 201–12.
 - 60 Perry CL, Sellers DE, Johnson C, Pedersen S, Bachman KJ, Parcel GS. *et al.* The Child and Adolescent Trial for Cardiovascular Health (CATCH): intervention, implementation and feasibility for elementary schools in the United States. *Health Educ. Behav.* 1997; **24**: 716–35.
 - 61 Resnicow K, Davis M, Smith M, Lazarus-Yaroch A, Baranowski T, Baranowski J, Doyle C, Wang DT. How best to measure implementation of school health curricula: a comparison of three measures. *Health Educ. Res.* 1998; **13**: 239–50.
 - 62 Reynolds KD, Franklin FA, Leviton LC, Maloy J, Harrington KF, Yaroch AL, Person S, Jester P. Methods, results and lessons learned from process evaluation of the high 5 school-based nutrition intervention. *Health Educ. Behav.* 2000; **27**: 177–86.
 - 63 Baranowski T, Stables G. Process evaluations of the 5-a-day projects. *Health Educ. Behav.* 2000; **27**: 157–66.
 - 64 Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, Laird N. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 409–18.
 - 65 Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, Smith M, Wang DT. Gimme 5 fruit, juice and vegetables for fun and health: outcome evaluation. *Health Educ. Behav.* 2000; **27**: 96–111.
 - 66 Achterberg CH. Qualitative methods in nutrition education research. *J. Nutr. Educ.* 1988; **20**: 244–50.
 - 67 Perry CL, Bishop DB, Taylor G, Murray DM, Mays RW, Dudovitz BS, Smyth M, Story M. Changing fruit and vegetable consumption among children: the 5-a-Day Power Plus program in St. Paul, Minnesota. *Am. J. Public Health* 1998; **88**: 603–9.
 - 68 Gortmaker SL, Cheung LW, Peterson KE, Chomitz G, Cradle JH, Dart H, Fox MK, Bullock RB, Sobol AM, Colditz G, Field AE, Laird N. Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: Eat Well and Keep Moving. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 975–83.
 - 69 Nader PR, Stone EJ, Lytle LA, Perry CL, Osganian SK, Kelder S, Webber LS, Elder JP, Montgomery D, Feldman HA, Wu M,

- Johnson C, Parcel GS, Luepker RV. Three-year maintenance of improved diet and physical activity: the CATCH cohort. Child and Adolescent Trial for Cardiovascular Health. *Arch. Pediatr. Adolesc. Med.* 1999; **153**: 695–704.
- 70 Manios Y, Moschandreas J, Hatzis C, Kafatos A. Evaluation of a health and nutrition education program in primary school children of Crete over three-year period. *Prev. Med.* 1999; **28**: 149–59.
- 71 Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, Person S. Increasing the fruit and vegetable consumption of fourth-graders: results from the High 5 project. *Prev. Med.* 2000; **30**: 309–19.
- 72 US Department of Health and Human Services. Centers for Disease Control and Prevention, CDC. SHI. School Health Index for physical activity and healthy eating. A self-assessment and planning guide. Elementary school. Atlanta 2000.
- 73 US Department of Health and Human Services. Centers for Disease Control and Prevention, CDC. SHI. School Health Index for physical activity and healthy eating. A self-assessment and planning guide. Middle school/High school. Atlanta 2000.