

Changing food habits in children and adolescents Experiences from intervention studies

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Abstract

The purpose of this review was to assess the current state of knowledge concerning interventions aimed at food habit change in children and adolescents and to identify implications for further practice and research. The review was restricted to school- or community-based studies conducted with an experimental or quasi-experimental design during the 1980's and early 1990's. A number of intervention programmes was identified, of which most were based on the Social Learning Model. The majority of programmes were aimed at behaviour change, but nutrition knowledge and attitudes towards healthy foods were targeted in some programmes. Most studies reported only modest changes in the outcome measures, and only three reported maintenance of intervention effects. The lack of maintenance of effects may be due to the use of intervention periods of short duration. Even moderate changes in dietary risk factors for CVD may be beneficial if maintained through long periods. Thus, future research should concentrate on how the effects of an intervention programme can be maintained, in addition to studying the outcomes immediately after the intervention.

Introduction

Epidemiological research demonstrates that a diet high in total fat, saturated fat, and cholesterol is linked to elevated cholesterol levels and an increased risk for heart disease in adults (1). It is thought that this relationship also holds true for children and adolescents (e.g. 2). Although food habits of individuals are not stable and unchanging, a base for healthy food habits can be created in early childhood (3). Adolescence is a time when barriers to and opportunities for eating habits undergo rapid changes. Therefore, the benefits of primary prevention aimed at reducing the risk for cardiovascular and other diet related diseases (e.g. non-insulin dependent diabetes, some types of cancer, obesity) would most likely be optimised if introduced at an early stage of behavioural development. Given population-wide increases in risk, community-wide strategies appear reasonable and necessary. Community health education methods have been tested in a number of international settings (e.g. 4). Primary prevention programmes among children and adolescents are central to a community approach. While chronic cardiovascular diseases are rarely found among youth, early patterns of increased risk are found among children in high-risk cultures. Also, school-based programmes have been tested in many studies. The advantage of commu-

nity-wide interventions is that they reach a large population and involve not only children and adolescents, but also their families. However, school-based programmes make it easier to assure that the delivered intervention actually reaches the target individual.

In order to enhance the outcome of programmes promoting healthy eating among youths and to improve cost-effectiveness, it is essential that the development of intervention and evaluation strategies be based on results from already established successful and methodologically sound research studies. An up-to-date review of intervention studies aimed at improving child and adolescent eating habits would facilitate the development of such primary prevention strategies in Sweden. This review examines and discusses major intervention studies conducted internationally during the 1980's and early 90's.

The aims of this review were 1) to assess the current state of knowledge as described in the literature and 2) to identify implications for further practice and research. The following questions were asked: What is the extent of research on dietary interventions in children and adolescents? Which theoretical frameworks have been used? What types of intervention were used? Which were the aims of the interventions? Which were the main findings?

Method

Medline and UnCover databases were used in the literature search. Furthermore, the articles found in these databases

referred to other sources of relevant information. The keywords used were: *health education, children, adolescents, food, nutrition, intervention, education, eating, patterns, change, prevention, promotion, modification, treatment*. These keywords were combined in a multitude of ways. Studies were included provided they were published in international peer-reviewed journals, were school- or community-based, had both control or comparison and treatment groups (i.e. were either experimental or quasi-experimental), did examine behavioural outcomes as well as other variables, and provided sufficient data to evaluate variables of interest. Further, all studies including other than "healthy" individuals were excluded.

Results

Twenty-four articles fulfilling the inclusion criteria were identified and reviewed. Tables 1, 2 and 3 present the details of the studies. A short description of some of the intervention programmes is given in Table 4. Several studies consist of programmes for modifying not only dietary but also other health related behaviours (e.g. smoking, physical activity). The present work only reviews those parts of the interventions that concern nutrition.

Theoretical frameworks underlying the research

The Social Learning Model (5) was the most frequently employed theoretical framework in the reviewed studies (Table 1). This model assumes that behaviour is a

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function of a number of psycho-social determinants; behavioural factors (social and behavioural skills, direct reinforcement of healthy eating), environmental factors (social support, social norms, opportunities for or barriers to healthy eating, role models) and individual factors (knowledge, self-efficacy, values, locus of control) (as defined in (6)). Typically, peer-leaders are used as informers and role-models. *Walter et al.* (7) employed the Health Belief Model and cognitive development theory in addition to Social Learning Theory (Table 2). Nine studies reported no theoretical background (Table 3). *Resnicow et al.* (8) reported using Social Cognitive Theory and *Hølund* (9-11) had selected elements from a variety of models (Table 2) that were combined into a conceptual model.

Interventions

Several types of interventions were employed (Tables 1-3). The majority of the programmes were evaluated in only one study, but the following were examined in several studies: The Slice of Life (6,12,13), Hearty Heart and Friends (HH) and Hearty Heart Home Team (HT) (14,15) and the Know Your Body Programme (7,16,17). All of these programmes were based on the Social Learning Model and they employed all of its three characteristic elements (behavioural, individual and environmental). These programmes, among others, are described in more detail in Table 4 (Tables 1, 2 and 3 for remaining programmes).

The majority of studies were aimed at reducing cardiovascular riskfactors in the form of a decreased consumption of saturated fat, total fat, cholesterol, sodium, and sugar and an increased consumption of complex carbohydrates. Most of the studies concerned both behavioural changes and changes in attitudes and knowledge. In some studies, the objective was to change only attitudes towards healthy foods (8,10,18), to increase knowledge of healthy nutrition (9,19) or to alter beliefs concerning healthy nutrition (9). (The three papers by *Hølund* are all based on the same study but different outcome measures are reported in different papers). In two of the studies, a change in children's snack food consumption was the objective (20,21).

Main findings

The results from the studies evaluating the Slice of life and Hearty heart and friend programmes (Table 4 for further details) either alone (13,14) or in combination with other interventions (6,12,15) showed clear changes of children's dietary behaviour, the changes being greater in females than

Table 1. Studies employing of the Social Learning Model/Theory.

<u>Reference</u>	(23) <i>Baranowski et al. (1990)</i>
Aim	To reduce sodium, saturated fat and total fat consumption. (CVD risk factors)
Intervention	One 1.5 hour session/week on nutrition for 14 weeks (2 fitness sessions/week) including 4 educational activities (behavioural counselling, group education, aerobic activity, healthy snack). The content was changed after the seventh week because of attrition.
Subjects	64 Black American children (and their families) in the intervention (mean age=10.6) and 56 in the control group (mean age=10).
Intervention delivered by	Trained nutritionist or health educator
Results (methods)	Changes in behaviour (food frequency), nutrition knowledge, skills and self-efficacy. (questionnaires, interview)
Conclusions	Less frequent consumption of high sodium foods in the intervention group (especially boys).
<u>Reference</u>	(16) <i>Bush et al. (1989)</i>
Aim	To reduce CVD risk factors
Intervention	Know Your Body Programme *
Subjects	431 students who were in grades 4-6 at baseline (complete data before and after 2 year intervention. 1041 students were studied at the baseline)
Intervention delivered by	Teachers
Results (methods)	Changes in behaviour (snacks and home milk consumption), health knowledge (nutrition) and psychosocial attributes (health locus of control and self-esteem) after two years. (questionnaires, physiological measures)
Conclusions	The only significant effect was found for health knowledge (increased).
<u>Reference</u>	(24) <i>Coates et al. (1981)</i>
Aim	To increase consumption of complex carbohydrates, and decrease consumption of saturated fat, cholesterol, sodium and sugar, and to generalise these changes to other family members (CVD risk factors).
Intervention	Heart Healthy programme: Nutrition education for three 45-minute periods per week for four weeks, each class emphasising a different meal and target for behaviour change.
Subjects	Seventy-two 4th grade students and 89 5th grade students (a time series, multiple-baseline design was employed)
Intervention delivered by	Teachers
Results (methods)	Behaviour, knowledge and attitude changes. (direct observations, questionnaires)
Conclusions	Substantial changes of eating behaviour at school, knowledge about heart health, food preferences and family eating patterns (as reported by parents)
<u>Reference</u>	(25) <i>Klepp and Wilhelmsen (1993)</i>
Aim	To increase consumption of fresh fruits, vegetables, whole-wheat bread and low-fat dairy products and to reduce consumption of high-sugar and high-fat snack foods.
Intervention	Educational programme consisting of different activities: How to prepare favourite foods with healthy recipes, plan and prepare dinners for the family, group work concerning how to improve local food availability (fast food outlets, grocery stores), role-play with peer leaders.
Subjects	447 students at baseline and the first follow up, 415 students at baseline and second follow-up
Intervention delivered by	Home-economics teachers. Peer leaders
Results (methods)	Changes in behaviour and knowledge. (questionnaire)
Conclusions	It is feasible to integrate activities designed to modify student's eating behaviour in home economics course. The changes were more favourable among females.
<u>Reference</u>	(27) <i>Moberg and Piper (1990)</i>
Aim	To decrease consumption of salt, sugar and fat, increase the consumption of fibre and calcium.
Intervention	The Project Model Health*.
Subjects	115 eighth graders in the intervention and 82 in the control group.
Intervention delivered by	Teams of college age-instructors
Results (methods)	Changes in knowledge, behaviour, intentions, attitudes and the perception of the frequency of the target behaviour among peers. (questionnaire)
Conclusions	Inconsistent results at the immediate post-test, while the 20-month follow-up showed improved food choices.
<u>Reference</u>	(22) <i>Nader et al. (1989)</i>
Aim	To decrease the whole family's intake of high salt, high fat foods.
Intervention	Intensive weekly intervention (3 mo), followed by maintenance sessions (9 mo). Intensive intervention consisted of: Separate child and adult education and discussion, family behaviour management and a social time with healthy snacks.
Subjects	206 families with one or more children in 5th/6th grade. (Intervention group n=103, control group n=103).
Intervention delivered by	Two graduate students
Results (methods)	Behaviour change, increased nutritional skills. (questionnaire, physiological measures, direct observations)
Conclusions	A food frequency index showed improved eating habits and direct observation of eating behaviours suggested generalisation of behaviour changes. Involvement of families utilising school-based resources is feasible and effective.

continued

Table 1. Studies employing of the Social Learning Model/Theory (continued)

<u>Reference</u>	<u>(14) Perry et al. (1985)</u>
Aim	To change the fat, salt and complex carbohydrate consumption.
Intervention	Hearty Heart and Friends.*
Subjects	172 third and fourth grade children in the intervention and 199 in the control group.
Intervention delivered by	Teachers and interns
Results (methods)	Behaviour change. (questionnaire)
Conclusions	A significant reduction in consumption of foods high in fat and salt, and an increase in consumption of complex carbohydrates in the intervention group.
<u>Reference</u>	<u>(13) Perry et al. (1987)</u>
Aim	To decrease consumption of saturated fat and salt, and to increase the intake of complex carbohydrates.
Intervention	Slice of Life*
Subjects	173 ninth graders in the intervention group and 97 in the control group.
Intervention delivered by	Peer leaders and university staff
Results (methods)	Changes in healthy eating behaviour, knowledge, intention and skills. (questionnaire)
Conclusions	The females reported a significant improvement of knowledge and awareness regarding their diet as well as actual eating habits. Males gained nutrition knowledge and appeared to modify their salt use.
<u>Reference</u>	<u>(15) Perry et al. (1989)</u>
Aim	To change particular eating habits by introducing fruits, vegetables, complex carbohydrates, low-fat dairy products and lean meats into diets. To compare long-term outcomes of four different programmes (HH) (HT), both HH and HT in sequence, or no-treatment control group)
Intervention	Hearty Heart Programme and Hearty Heart Home Team*
Subjects	2250 third-grade students (the number of participants in the different conditions not reported).
Intervention delivered by	Classroom teachers (parents)
Results (methods)	Behaviour change (direct observations, anthropometric measures, 24-hour dietary recall by 15 students from each school, an overnight urinary sodium-sample by the same 15 students, food self inventory at selected students' homes).
Conclusions	Students in the home-based programme reported more behaviour change at post-test. These changes were not maintained after one year. These data stress the importance of parental involvement for initiating behaviour change with children of this age.
<u>Reference</u>	<u>(18) Petchers et al. (1987)</u>
Aim	Changes in health knowledge, attitudes and simulated shopping behaviour. Also, a comparison between the parental participation and no parental participation groups.
Intervention	Body Power Programme student curriculum (nutrition module). Through role playing, peer discussion and record keeping the knowledge and attitude domains are intended to reinforce one another (activity sheets and health logs). Also a family programme which consist of same material
Subjects	647 students (mean age 11.1) and 322 parents.
Intervention delivered by	Teachers
Results (methods)	Changes in attitudes, knowledge and behaviour. (questionnaire)
Conclusions	Parental involvement had no effect on student knowledge or behaviour.
<u>Reference</u>	<u>(34) Puska et al. (1981)</u>
Aim	To reduce total fat consumption, dietary cholesterol, sodium and to increase intake of PUFA and fibre content of the diet and to increase health knowledge. This paper describes the background, methods and study design.
Intervention	Alterations in school cafeteria selections and a general county wide intervention
Subjects	At the baseline 967 children, their parents and teachers
Intervention delivered by	Health care personnel. School teachers (leaflets, posters, written recommendations, a project magazine, mass media were also used as informers)
Results	Baseline data.
Conclusions	The results confirmed a very high level of the CVD risk factors among the 13-year old population. Thus, an intervention to reduce these risk factors is needed.
<u>Reference</u>	<u>(35) Puska et al. (1982)</u>
Aim	To reduce total fat consumption, dietary cholesterol, sodium and to increase intake of PUFA and fibre content of the diet and to increase health knowledge
Intervention	Alterations in school cafeteria selections and a general county wide intervention
Subjects	851 children, their parents and teachers (Intensive Intervention (II) n= 294, county-wide intervention (CI) n= 283, controls n=274).
Intervention delivered by	Health care personnel. School teachers (leaflets, posters, written recommendations, a project magazine, mass media were also used as informers)
Results (methods)	Changes in behaviour and health knowledge. (questionnaire, physiological measures)
Conclusions	The nutritional programme was more effective among girls than boys. Among girls the dietary changes were also reflected in respective changes in serum cholesterol levels.

continued

in males in three of the papers (6,12,15).

The Know Your Body Programme (KYB) (Table 4 for more details) was used in three studies (7,16,17). The results by Resnicow et al. showed that the programme had significant effects on knowledge, and that these changes were clearly dose dependent. Also, Bush et al. (16) observed changes in health knowledge but not in dietary intake. Walter et al. (7) also observed an increasing level of knowledge related to prevention of cardiovascular diseases (CVD). In addition, some changes of dietary intake were observed (7).

Two of the studies aimed at changing the dietary habits of entire families (22,23). These studies differed from the rest also in that they included Black Americans (23) and Mexican-Americans (22) instead of only white Anglo-Americans and that they were centre-based. Both emphasised family interactions. The study by Baranowski (23) showed less frequent consumption of high sodium foods in the program participants, especially boys. The attrition rate was high and the results from this study should be interpreted with caution. Nader et al. (22) reported significantly improved eating habits in both ethnic groups, but the intakes of fat and sodium were lower among the Anglo-Americans. The results also showed a maintenance of the intervention effects up to one year beyond the completion of the programme. Also, Coates et al. (24) aimed at a generalisation of the intervention effects to the whole family, even though the Heart Healthy Programme was school-based. The results showed substantial changes of eating behaviours at school, increased knowledge and altered food preferences. Also, parents reported changes of family eating patterns. This was one of the few studies where direct observations of children's eating habits were performed.

Klepp and Wilhelmsen (25) incorporated behaviour change strategies into home economics courses in their programme. The outcome was that the females receiving the intervention reported healthier eating habits both 5 months after the intervention and at a 12 month follow-up. Only short term effects were found in the males. Another study by Klepp et al. (26) reported on a follow-up study. The short term effects of the intervention were not maintained after 12 years. Moberg and Piper (27), on the other hand, reported positive long-term, but not short term changes in adolescent food choice in a study evaluating a programme called Project Model Health (Table 4 for more details). Byrd-Bredbenner et al. (28) reported changes in nutrition knowledge and attitudes but no changes in food beha-

viour in a study of a programme called Nutrition in a changing world: Concerns for young adults (Table 1). Also, Lewis et al. (29) reported improvements in adolescent nutrition knowledge and attitudes as a result of a curriculum intervention (Table 1). No significant change in dietary behaviour was observed.

A model for teaching nutrition to teenagers with the objective of having them teach young children, learning by teaching (Table 4 for more details), was tested in two different studies. The results showed significant effects on adolescents knowledge (9,19), sugar consumption (11) and modest changes in attitudes (10).

In four of the studies, alterations were made in the school cafeteria menus in order to reduce cardiovascular risk factors in children. The study by Goldberg et al. (30) combined such changes with nutrition education. The outcome was that knowledge in the intervention group was substantially improved while there were no changes in physiological measures (Table 3). In addition to serving low-fat entrees in the school cafeteria (the serving was started before the intervention in both the intervention and control school), Whitaker et al. (31) made this change clearly visible on menus that the children carried home (in the intervention school only). The results showed that the availability of the low fat entrees alone (before the indications were made on the menus) increased their selection by 30%. The intervention resulted in a small further increase. Also, Simons-Morton et al. (32,33) altered the foods served in school in order to decrease sodium and fat intakes. The menu changes were combined with a short classroom education module. The results indicated significant changes of the intake of fat, saturated fat and sodium (measured by 24 hour dietary recall) in the intervention group. The study by Puska et al. (34,35) was included in the international Know Your Body health survey but the intervention programme consisted mainly of modification of school lunches. Baseline data for the 13-year old North Karelian population indicated that the level of CVD risk factors was high (34). After two years of intervention, Puska et al. (35) reported a significant increase in health related knowledge, a significant decrease in the amount of fat from milk and butter in both girls and boys and significant decreases in serum cholesterol in girls.

In a study by Resnicow et al. (8), the intervention consisted of a screening programme, combined with a short classroom health curriculum. The effect of the programme on knowledge, attitudes and health behaviour was measured. The results

Table 1. Studies employing of the Social Learning Model/Theory (continued)

<u>Reference</u>	(17) Resnicow et al. (1992)
Intervention	Know Your Body Programme*
Subjects	1st -6th grade students. Longitudinal cohort (n=1209), a post-test only cohort (n=3045) and a comparison group (n=?)
Intervention delivered by	Teachers. Peer leaders
Results (methods)	Changes in physiological measures, health knowledge and food frequency. (questionnaire, physiological measures)
Conclusions	The KYB programme can have a significant positive impact on the knowledge, behaviour and selected risk factors and that efforts to disseminate and evaluate school health education programmes should include strategies to monitor and enhance teacher implementation.
<u>Reference</u>	(32) Simons-Morton et al. (1988)
Aim	To increase nutritional knowledge and to decrease fat and sodium intake. (To assess the extent of implementation of the intervention)
Intervention	Go For Health Programme*
Subjects	Two elementary schools in the intervention and two in the control group.
Intervention delivered by	Teachers, food service staff
Results	Chemical analyses of selected food items. The number of learning activities implemented.
Conclusions	Results after one year of intervention showed that the intervention program was implemented but not completely.
<u>Reference</u>	(33) Simons-Morton et al. (1991)
Aim	To increase nutritional knowledge and to decrease fat and sodium intake. (Intervention effects after two years)
Intervention	Go For Health Programme*
Subjects	Two elementary schools in the intervention and two in the control group.
Intervention delivered by	Teachers, food service staff
Results (methods)	Changes in behaviour and nutritional knowledge (nutrient analysis of school lunches and 24-hour dietary recalls.)
Conclusions	Results after two years of intervention showed that children's diet can be improved by substantially modifying school lunches.

* More details in Table 4.

Table 2. Studies combining different theoretical backgrounds (or with other than Social Learning Model/Theory as theoretical framework).

<u>Reference</u>	(9) Hølund (1990a)
Theoretical background	Michigan Group Dynamics Approach and Theory of Cognitive Dissonance
Aim	To examine the structure of attitudes towards healthy food in a group of adolescents and to evaluate the impact of a health education programme on these attitudes.
Intervention	Learning by Teaching*
Subjects	64 eighth grade children in the intervention and 63 in the control group
Intervention delivered by	Teachers. Teenagers themselves
Results (methods)	Changes in attitudes (questionnaire)
Conclusions	Attitudes toward healthy food consist of three dimensions (pro health, taste and significant others). The programme had a significant effect on pro health. The change in attitudes can be explained by dissonance arousal and discrepancy between personal attitudes in group norms. Future programmes should emphasise affection rather than cognition.
<u>Reference</u>	(10) Hølund (1990b)
Theoretical background	Selected elements from different models were combined into a conceptual model (Michigan Group Dynamics Approach, Theory of Cognitive Dissonance, Health Belief Model, Social Learning Theory, Theory of Reasoned Action and Problem Behaviour Theory)
Aim	To promote a limited intake of sweet and fat food, especially between meals
Intervention	Learning by Teaching*
Subjects	64 eighth grade children in the intervention and 63 in the control group
Intervention delivered by	Teachers. Teenagers themselves
Results (methods)	Behaviour change. (interview)
Conclusions	Adolescents sugar consumption can be changed by means of group discussion and role-playing.
<u>Reference</u>	(11) Hølund (1990c)
Theoretical background	Health Belief Model, Social Learning Theory and Theory of Cognitive Dissonance
Aim	To increase knowledge of sugar and caries, and sugar and nutrition, and to change beliefs about susceptibility and self efficacy.
Intervention	Learning by teaching*
Intervention delivered by	64 eighth grade children in the intervention and 63 in the control group Teachers Teenagers themselves
Results (methods)	Changes in knowledge and beliefs. (questionnaire)
Conclusions	The only variable effected by the programme was knowledge of sugar and nutrition.

continued

Table 2. Studies combining different theoretical backgrounds (or with other than Social Learning Model/Theory as theoretical framework). (continued)

Reference	(6) <i>Kelder et al. (1995a)</i>
Theoretical background	Social Learning Theory and Problem Behaviour Theory
Aim	To reduce consumption of saturated fat and sodium, to increase consumption of polyunsaturated fat, and vegetables.
Intervention	The Lunch Bag Programme* for sixth and Slice of Life* for 10th graders (The subjects were studied for 6 consecutive years. Thus, they received both programmes). Also, a community wide intervention.
Subjects	1342 sixth grade students in the intervention and 1034 in the matched reference community. (At baseline)
Intervention delivered by	Teachers. Peer-leaders. Health professionals (at the community level)
Results (methods)	Changes in behaviour, food preference and knowledge (<i>questionnaire</i>)
Conclusions	Behavioural education in schools coupled with community wide health promotion strategies may produce modest but lasting improvements in adolescents knowledge and choices of heart healthy foods. Improvement most notable among females.
Reference	(12) <i>Kelder et al. (1995 b)</i>
Theoretical background	Social Learning Theory and Problem Behaviour Theory
Aim	To reduce consumption of saturated fat and sodium, to increase consumption of polyunsaturated fat, and vegetables. This paper studied the gender differences
Intervention	The Lunch Bag Programme* for sixth and Slice of Life* for 10th graders (<i>cf. Kelder et al., 1995a</i>). Also, a community wide intervention.
Subjects	1342 sixth grade students in the intervention and 1034 in the matched reference community. (At baseline)
Intervention delivered by	Teachers. Peer-leaders. Health professionals (at the community level)
Results (methods)	Gender differences in changes in behaviour, food preferences and knowledge (<i>questionnaire</i>)
Conclusions	Girls may be more receptive than boys to social influences models of health education.
Reference	(8) <i>Resnicow et al. (1993)</i>
Theoretical background	Social Cognitive Theory
Aim	To determine the impact of a school based CVD risk factor screening programme on the knowledge, attitude and behaviour of elementary-grade schoolchildren and their families.
Intervention	Six-session classroom health curriculum, containing three pre- and three post-screening activities (height/weight, total blood cholesterol, RR, physical fitness).
Subjects	1166 elementary school students in the intervention and 408 in the control group.
Intervention delivered by	Trained research assistants
Results (methods)	Health knowledge, perceived severity and susceptibility to heart disease, nutrition attitudes, locus of control, behaviour change. (<i>questionnaire</i>)
Conclusions	School-based risk factor screening programmes can positively influence the knowledge, attitude and behaviour of school-children and their parents.
Reference	(7) <i>Walter et al. (1988)</i>
Theoretical background	Health Belief Model, Cognitive Development Theory, Social Learning Theory
Aim	To reduce consumption of dietary total fat, saturated fat, cholesterol and sodium; increased consumption of complex carbohydrates and fibre; increased ratio of polyunsaturated fat to saturated fat; maintenance of ideal body weight. To increase health knowledge.
Intervention	Know Your Body Programme*
Subjects	1769 fourth grade students from two different populations (1104 in the intervention and 665 in the control group) in 37 different schools (22 intervention and 15 control). The unit of the intervention was the school.
Intervention delivered by	Teachers
Results (methods)	Changes in behaviour (dietary intake), and knowledge after five years. (<i>24-h dietary recall interview, physiological measures, questionnaires</i>)
Conclusions	Some changes in dietary intake of total fat, saturated fat and complex carbohydrates were observed. Also, the level of prevention related knowledge was increased.
Reference	(37) <i>White & Skinner (1988)</i>
Theoretical background	Activated Health Model, self-management technique, problem solving process and goal setting concept.
Aim	Improvement of one individually selected nutrient intake (increase or decrease depending on the chosen nutrient: calcium, iron, sodium, vitamin A and C, folic acid)
Intervention	An individualised 41-day behavioural change programme with specific goals for each student, including self-management, feedback, relapse prevention. Each student responsible for his/her own changes.
Subjects	159 fifteen-year-old adolescents (51 in the behaviour change, 58 in the behaviour change plus and 50 in the control group) (pre-/postassessment, treatment/control group experimental design with two treatment groups. One received only the behaviour change strategy and one received the strategy and a traditional knowledge oriented component)
Intervention delivered by	Research staff (the first author)
Results	Changes in behaviour (nutrient intake), knowledge and attitudes.
Conclusions	Changes in nutrient intake were not related to changes in attitudes and knowledge. The adolescents who set a goal related to calcium, vitamin A, and vitamin C reported increased intakes and those who set a goal related to sodium reported decreased intake. However, those adolescents who chose iron and folic acid as goals reported no changes.

* More details in Table 4.

showed a significant decrease in consumption of high fat foods. Further, significant changes in health knowledge and attitudes regarding nutrition were achieved.

Petchers et al. (18) studied the effects of the Body Power Programme (Table 4) on health knowledge, attitudes and behaviour preference (the participants anticipated how they would shop in the future) in children and their parents. Outcomes were compared between programmes with or without parental involvement. Some changes were achieved in all the outcome measures. Parental involvement did not seem to have any effects on students' health knowledge or behaviour. Three other studies (15,22,24) reported that parental involvement had positive effects on child food habits. *Vandongen et al.* (36) compared the effects of school- and home-based nutrition programmes alone and in combination. Some significant changes in nutrient intakes were reported, but no clear differences were found to the advantage of any programme over another.

Two of the studies employed methods clearly different from those reviewed above. The study by *Stark et al.* (21) tested the effect of reinforcement and cueing, and *Friedman et al.* (20) the effects of correspondence training on children's snack food choice. These studies differed from those reviewed above also in that they were small scale studies with only 8 subjects. Both reported substantial changes in children's food selection and the authors suggested that the interventions would be feasible for use in a larger group of children in school settings. However, it remains to be demonstrated whether this kind of methodology can be successfully used in a larger population. An important aspect of the study by *Friedman et al.* (20) was that only the children who really needed to change their snack-food selection (those who selected non-nutritious snack foods in more than 40% of the baseline measurement situations) were included in the study. This may have contributed to the impressive results.

The study by *White and Skinner* (37) was based strictly on a behaviour change programme (Table 1). They employed self-management techniques, problem solving and concrete goal setting. The programme was highly individualised for each student. Individual needs for dietary change were identified by letting the students fill out a three day food record. The behaviour changes were impressive for most of the goal nutrients.

Discussion

All the reviewed studies reported at least some significant changes in the outcome measures. Therefore, it is difficult to point

out any particular programme as more effective than others. However, the pros and cons of the different programmes will be discussed.

The effect of parental involvement in the intervention was investigated in a number of studies (15,18,22-24,36). Positive effects of parental involvement could be expected as increased social support has been shown to facilitate behavioural change. Also, the parents set an important outer limit especially for younger children's food choices and preferences by making certain foods available to them. The studies reviewed in the present paper reported inconsistent results regarding the influence of parental involvement.

The majority of the studies were, at least to some extent, teacher delivered, but only one of them investigated whether the extent to which the teachers actually implemented the intervention programme had any effect on the outcome (17). The results indicated a clear dose-response effect. The teachers should therefore be carefully "supervised" in order to assure that the intervention programme is adequately implemented. Also *Simons-Morton et al.* (32) investigated the extent of implementation of the intervention programme. After one year of intervention, the programme was still not completely implemented. These results indicate that it is extremely important to study the extent of implementation in order to be able to better interpret results from intervention studies. Further, as the implementation of intervention programmes takes such a long time, it seems necessary to develop programmes that are longer in duration in order to be able to get long-lasting effects.

The effects of the intervention were reported to be more positive in females in six of the studies (6,12,13,25,35,36), while two reported more notable changes in boys with respect to consumption of high sodium foods and salt use (13,23). These results suggest that the intervention programmes should differ between girls and boys, but the differentiating characteristics remain unknown. In the study by *Klepp and Wilhelmsen* (25), the intervention was incorporated into the mandatory home economics course. Preparing favourite foods with healthier recipes was one of the intervention elements. It may be that girls are more interested in cooking and more often cook foods for themselves than do boys. This could explain the more positive results among females in this study.

Information alone was used in the study by *Goldberg et al.* (30) and the effects of nutrition education alone was compared to effects of correspondence training by *Fried-*

Table 3. Studies with no theoretical background reported.

<u>Reference</u>	<u>(19) Anliker et al. (1993)</u>
Aim	To increase nutrition knowledge, especially knowledge of food groups and nutrients
Intervention	A five-lesson curriculum (Learning by teaching): Increasing awareness of own eating habits and presenting different food groups by discussions, games and nutritious snack recipes.
Subjects	17 in the intervention and 19 in the control group (14 yr.)
Intervention delivered by	Teenagers
Results (methods)	Nutrition knowledge (<i>questionnaire</i>)
Conclusions	The programme was well received and the teenagers made substantial gains in their own nutrition knowledge by teaching nutrition to younger children.
<u>Reference</u>	<u>(28) Byrd-Bredbenner et al. (1988)</u>
Aim	To determine effects of nutrition instruction on nutrition knowledge, selected food/nutrition attitudes, and food behaviours.
Intervention	Nutrition in a changing world, concerns for young adults: Five to six weeks of instruction in nutrition. The programme is not described in detail in the paper but is available as "Nutrition curriculum activities kit".
Subjects	Over 600 students enrolled in senior high school home economic courses. A quasi-Solomon four group experimental design was employed. One of the experimental and control groups was pre-tested and the other groups were not.
Intervention delivered by	Teachers
Results (methods)	Nutrition knowledge, attitudes and behaviour. (<i>nutrition knowledge test, food/nutrition attitude instrument, food behaviour assessment form.</i>)
Conclusions	Nutrition knowledge and attitudes were significantly improved in the experimental groups. However, no changes in food behaviour were observed.
<u>Reference</u>	<u>(20) Friedman et al. (1990)</u>
Aim	To enhance the choice of healthy snack foods.
Intervention	Nutrition education and correspondence training
Subjects	8 third grade children
Intervention delivered by	Research staff
Results (methods)	Behaviour change (<i>direct observations</i>)
Conclusions	The results indicate that correspondence training may be an efficient and cost-effective way to improve dietary habits of young people
<u>Reference</u>	<u>(30) Goldberg et al. (1980)</u>
Aim	To increase consumption of complex carbohydrates, and decrease consumption of saturated fat, cholesterol, sodium and sugar and to generalise these changes to other family members.
Intervention	Nutrition education (during a three-year period). Alterations in the school cafeteria selections.
Subjects	68 children in the intervention (mean age 10.5) and 23 in the control group (mean age 12.6). Internal non-intervention control-groups 1A (n=154, mean age 10.8) and 1B (for different years of the study, n=229)
Intervention delivered by	Teachers
Results (methods)	Changes in physiological measures (serum cholesterol, RR, height, weight, skin fold thickness) and knowledge. (<i>physiological measures, questionnaire</i>)
Conclusions	No major significant changes in physiological measures were found, while there was a significant increase in knowledge in the intervention group.
<u>Reference</u>	<u>(26) Klepp et al. (1994)</u>
Aim	To decrease consumption of sweets, fat, salty snack foods, butter/ margarine, salt and to increase consumption of low-fat milk, bread, fruits and vegetables. The follow up aimed at investigating the maintenance of the changes observed after the intervention.
Intervention	Oslo Youth Study health education programme. A school-based nutrition education programme consisting of 12 sessions. To involve parents, home visits were conducted by nutritionists.
Subjects	515 subjects who had participated in the baseline survey in 1979 participated in a 12 year follow-up
Intervention delivered by	Research staff
Results (methods)	Behaviour change (<i>questionnaire</i>)
Conclusions	School-based education programmes can have a positive short-term effect on eating behaviour, but these effects tend to disappear over time.

continued

man et al. (20). Also, *White and Skinner* (37) compared two intervention groups: one receiving the intervention alone and the other receiving intervention plus a traditional knowledge oriented component. The nutrition information did not have any effects on the outcome measures in either of these studies. Information may be a necessary part of nutrition interventions but it should not be used alone.

This has implications for existing school health curricula, which often consist of nutrition education (information) alone.

The three studies strictly based on behaviour modification techniques (20,21,37) showed great potential in changing food choice and nutrient intake. However, the studies by *Friedman et al.* (20) and *Stark et al.* (21) were based on small groups of children. The feasibility of this

Table 3. Studies with no theoretical background reported. (continued)

Reference		(29) Lewis et al. (1988)
Aim		To examine change in students nutrition knowledge, attitude and behaviour due to the curriculum intervention and to identify the variables in the school setting most closely related to positive changes.
Intervention		National Dairy Council's Food...Your Choice curriculum (Not described in detail in the paper).
Subjects		1476 seventh through tenth grade students in the intervention and 223 in the control group.
Intervention delivered by	Teachers	
Results (methods)		Changes in food-choice behaviour, nutrition knowledge and attitudes (nutrition knowledge test, nutrition attitude instrument, food choice inventory, three-day food record)
Conclusions		Some changes in nutrition knowledge and attitudes were observed. The treatment group students reported eating slightly more high-nutrient foods as compared to the non-treatment group but these differences were not statistically significant. The support provided to the teachers from external and internal sources was closely related to the positive changes observed in the students
Reference		(21) Stark et al. (1986)
Aim		To modify young children's snack food choices
Intervention		Nutrition training and contingent (stickers) cueing (cueing defined as any statement made by the children to evoke positive comment from the snack leader) The snack foods were divided into red (bad) and green (good) foods. After the child had chosen a food, nutritional feedback was given.
Subjects		8 children, (mean age 4 years 4 months).
Intervention delivered by	Research staff	
Results (methods)		Behaviour change (direct observations of the children's snack food selection.)
Conclusions		Children's healthy snack choices increased in the pre-school training setting, the changes were generalised to other settings only when procedures to programme it were implemented. The best results were achieved with individually tailored generalisation procedures.
Reference		(36) Vandongen et al. (1995)
Aim		To increase the intake of fruit, vegetables, whole-grain bread, cereals, to decrease consumption of fatty, sugary and salty foods. (Comparison of fitness and nutrition programmes alone and in combination, a comparison of school based and home-based nutrition programme).
Intervention		The school-based 9 months nutrition programme consisted of 10 1-hr lessons. The home-based nutrition programme (9 mo) presented five nutrition messages using comics containing educational material for the children and the parents who were encouraged to get involved with their child's nutritional education.
Subjects		869 ten to twelve year olds from 30 schools (743 in different intervention groups and 126 in the control group)
Intervention delivered by	Teachers. Written material (in the home-based programme)	
Results (methods)		Changes in behaviour, knowledge and attitudes. (questionnaire, physiological measures.)
Conclusions		Teacher implemented packages are feasible but the programmes should differ between boys and girls.
Reference		(31) Whitaker et al. (1994)
Aim		To increase selection of low-fat foods in school lunches
Intervention		The monthly menus carried home by the students indicated the low fat entree and compared the fat content of both entrees. Parents received a mailing with information on the intervention and were asked encourage their children to select low-fat entrees.
Subjects		8 schools served as an intervention and 8 as a control group. (The school was the study unit, 249 861 student meal selections were the basis for computing the outcome)
Intervention delivered by	Written information. Parents	
Results (methods)		Increased selection of the low-fat foods in school lunches. (The amount of the low-fat entrees selected. In one school, a telephone survey was conducted 1 month after the intervention mailing to assess the recall and impact of the intervention).
Conclusions		More than 30% of elementary students spontaneously selected a low-fat entree for school lunch when available. There was a small increase of the selection in the intervention schools.

* More details in Table 4.

kind of behaviour modification in a larger population and the generalisation of the result to a larger range of foods remain to be investigated.

Individual goal setting led to impressive changes in the study by White and Skinner (37). An interesting finding was that the changes in nutrient intake were not related

to changes in attitudes and knowledge. However, this study did not aim at reducing CVD risk factors as did most of the other studies. Consumption of the selected target nutrients (e.g. vitamin A and C, calcium) may be regarded as more easily changed as compared to fat and complex carbohydrates. The authors

argue that because experience from the behaviour change process was acquired by the adolescents participating in the study it should be possible for them to apply this to another goal after they successfully achieved the first (37). Therefore it seems reasonable to start with "easier" goals and advance gradually towards more "difficult" goals.

The Learning by teaching approach employed by Anliker et al. (19) and Hølund (9-11) may be effective in changing adolescent nutrition knowledge. However, since increased knowledge does not necessarily translate into dietary practices it should not be expected to automatically lead to a change in food habits. Neither of these authors studied the effect of nutrition education given by the adolescents on the younger children but this approach was suggested by Anliker et al. (19). Also, it would be interesting to see whether the extent to which the teenagers managed to forward the educational message to the younger children is related to the increase in their own knowledge.

When considering all the three elements of Social Learning Theory, (individual, environmental and behavioural aspects), its potential seems obvious. It is reasonable to think that if the barriers to behaviour change were removed from the environment, if social support and role models were provided, if the individual was equipped with skills needed to implement the behavioural changes, and specific goals for these changes were set, it would most likely lead to changes of eating habits. However, the studies based on the Social Learning Model did not report stronger effects than the other studies. This could be due to several factors. Firstly, even if the circumstances were "perfect", the "message" does not necessarily reach the individual. Secondly, the individual may not be willing to make the expected changes. Prochaska et al. (38) have argued that intervention programmes should be individualised according to the individual's readiness for behaviour change. If the individual is in the pre-contemplation stage, e.g. has never thought of decreasing fat intake, there is no use teaching him how to do this. The "Stages of change" model was initially developed for changing drinking and smoking behaviours, but has been successfully implemented in food choice research during recent years (e.g. 39,40). This approach has proven successful among adults, and there is good reason to believe that it would be applicable also to children and adolescents. The impressive results achieved in the programmes using individualised goals (37) and including only children who really needed to change

their diets (20) further emphasise the need for individualised programmes.

Only three of the studies (22,25,27) reported persistence of the intervention effects (5-20 months), *Moberg* and *Piper* (27) reporting long term effects only. All of these programmes were based on the Social Learning Model. There were also some other aspects that were common to these three studies. The participants discussed problem solving strategies, specific goals for eating behaviour changes were set and the participants were encouraged to support each other. In the studies by *Klepp* and *Wilhelmsen* (25) and *Nader* et al. (22), the participants were actively engaged in preparing "healthy foods".

Peer-leaders were included in five of the studies (6,12,13,17,25). This was done in order to achieve a direct impact on the social environment in the classes, to provide positive role models and to help change the norms regarding eating. The results showed significant improvements in actual eating habits and nutritional knowledge (6,12,13,17,25), especially in females (6,12,13,25). However, whether these positive effects are due to peer-leader involvement or to some other elements of the programmes (or a combination of these) remains to be seen.

The majority of the studies had behavioural change as an outcome measure. However, only ten of the studies used other methods than self-reports for measuring outcome, typically physiological measures (Table 1). Behavioural observations were used in six studies. When behaviour is measured by self-report there is always a risk for over/under reporting among the intervention participants. This problem was addressed by the majority of the authors.

The methodological strengths and weaknesses of the reviewed studies will not be explicitly discussed. However, only studies with experimental/quasi-experimental design were included in order to facilitate conclusions about the effectiveness of the different programmes. All but two studies used random assignment of the participants to the study groups. Although necessary to secure the internal validity, random assignment may also create problems. This was noted by *Baranowski* et al. who reported a decreasing interest by the participants after the seventh week in the centre-based family intervention study. The families had been randomly assigned to the intervention condition and some of their close friends or relatives were assigned to the control group. Thus, a natural, already existing support mechanism was interfered with.

Table 4. A short description of some of the intervention programmes.

Learning by teaching (*Holund* 1990a,b,c)(9-11)

The aim was to make 14 year-old students learn about nutrition and dental health by actively taking a position in favour of healthy food in the presence of younger pupils. The programme consisted of 25 lessons. The 14-year-olds made dietary interviews with 10-year-olds. They were then divided into 4 different groups with different tasks: The computer group analysed the 10-year-olds' diet, the culture group examined local supermarkets, the food and fashion group did analysis of commercials, and the health group made an analysis of their own caries prevalence and school factors influencing health. All groups produced posters which were then presented for the 10 year-olds.

The Lunch Bag Programme (*Kelder* et al. 1995a,b) (6,12)

A one-session intervention that introduced the basic components of a heart healthy diet and focused on how to build a heart healthy lunch.

The Slice of Life (*Perry* et al. 1987; *Kelder* et al. 1995a,b) (13,6,12)

A 10-session peer-lead curriculum designed to promote healthy eating and physical activity patterns with adolescents. Videotapes involving interviews with teenagers introduced recommended heart health eating, environmental influences on eating and weight control management. These videotapes formed the basis for other activities throughout the programme. The students assessed and analysed their own food habits, set goals on how to improve their habits, and prepared heart healthy snacks. Analyses were made of social pressures and ways to resist pressures. Also, environmental influences on eating patterns were analysed and strategies for change were suggested.

Know Your Body Programme

(*Bush* et al. 1989; *Resnicow* et al. 1992; *Walter* et al. 1988)(16,17,7)

The programme consists of two components 1) classroom curriculum (at least once a week for 30-45 minutes for the entire school year) and 2) school-wide activities (changes in the school-cafeteria menus). KYB seeks to facilitate positive health choices through a series of school-wide health activities and environmental modifications. Other activities include peer leader training, student health committees, food tasting parties, nutrition posters and essay contests.

The Project Model Health (*Moberg* and *Piper*, 1990)(27)

64 sessions of classroom instruction and activities (nutrition only one part). Major strategies: 1) Use of instructors who are role models for the students, 2) focus on understanding and interpreting media messages, 3) role-plays, 4) information on peer norms, 5) emphasis on short term effects, 6) public commitment to change one's own behaviour and 7) students advocating healthy behaviours in their school and community.

Hearty Heart and Friends (HH) and Hearty Heart Home Team (HT)

(*Perry* et al. 1985;1989)(14,15)

Developed as a 10-week, 20 session curriculum. Two related 55-minute sessions were taught every week. The first weekly session introduced new information and the second session built skills related to food preparation. Latter developed to a 5 week 15-session curriculum. It emphasises food differentiation, modelling of healthful eating habits (cartoon characters) and goal-setting with direct reinforcement. Hearty Heart Home Team (equivalent in content and exposure time to HH) is a 5-week correspondence training involving the students and their parents.

Go for Health Programme (*Simons Morton* et al. 1988;1991)(32,33)

The intervention includes: 1) classroom health education consisting of six behaviourally based modules, 2) New School Lunch which was designed to provide lower-fat, lower-sodium lunches within the context of the existing school lunch programme.

All of the included studies, except that of *Baranowski* et al. (23) reported low attrition rates and the attrition was mostly due to absenteeism or moving. The high response rate is clearly an advantage that school-based studies have over centre-based or community-wide interventions. However, this does not mean that community-wide or centre-based interventions should not be employed in the future. Instead, groups with specific needs within the community should be identified and the intervention programmes should be individualised for each group to meet these needs.

In their review of school based nutrition

education research studies conducted during the 1980's, *Contento* et al. (41) concluded that general nutrition education programmes seem to have minimal effect on behaviour. More specifically targeted behavioural programmes seem to have more positive effects but the results were judged to be inconsistent. Parental involvement seems to enhance the effects of classroom instruction for younger children and preparation of teachers increased the time they spent in nutrition education. The majority of the studies reviewed here were not reviewed by *Contento* et al. (41). However, their conclusions are well in accordance with those of the present review.

Conclusions – implications for the future research

The majority of the studies reported at least some changes in dietary behaviour, knowledge or attitudes. Changes in nutritional knowledge and attitudes do not, however, necessarily translate into changes in behaviour. This was proven by White and Skinner (37) who showed that the changes in attitudes and knowledge were not related to changes in dietary behaviour. Therefore, studies reporting changes

in dietary behaviour are most valuable for the planning of future research in the area of food habits in children. Most of the reported changes in dietary behaviour were modest. However, it has been argued that even moderate changes in dietary risk factors for CVD may be beneficial if maintained for long periods. Thus, future research should concentrate on how the effects of an intervention programme can be maintained, in addition to studying outcomes immediately after the intervention.

Although no clear differences in results

employing different intervention strategies could be shown, the impression is that the most promising are the programmes focusing on the individual student, actively involving them in discussions and a variety of activities and by setting specific behavioural goals.

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