

# Nutrition knowledge and food intake of seven-year-old children in an atherosclerosis prevention project with onset in infancy: the impact of child-targeted nutrition counselling given to the parents

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**Objective:** To compare nutrition knowledge and food intake in 7-y-old intervention and control children in an atherosclerosis risk factor intervention trial after 6.5 y of nutrition counselling given to the parents.

**Design, subjects and methods:** Intervention families in the Special Turku Coronary Risk Factor Intervention Project received child-oriented nutritional counselling one to three times a year since child's age of 7 months, aimed at reduced saturated fat and cholesterol intake. Children's nutrition knowledge was analysed in a time-restricted cohort of 70 seven-y-old (34 boys) intervention children and 70 control children (40 boys) with a picture identification test. For comparison, children's food intake was evaluated using scores developed for the project that reflected quality and quantity of fat and quantity of salt in children's two or three 4-day food diaries recorded between 5.5 and 7 y of age.

**Results:** Child-targeted nutrition counselling of the intervention families only slightly increased intervention children's knowledge of heart-healthy foods (42.6% vs 34.9% correct answers by the intervention and control children,  $P=0.057$ ). Only  $\leq 20\%$  of the children were able to adequately justify their answers in the test. The food diaries of the intervention children comprised more foods low in saturated fat and high in unsaturated fat than those of the control children (57.1% vs 41.7% of the maximum score for low fat foods,  $P=0.0001$ ; 48.9% vs 37.7% for high unsaturated fat foods,  $P=0.0009$ , respectively), but the intervention and control children consumed similar amounts of low-salt foods ( $P=0.23$ ). Nutrition knowledge and food use scores correlated poorly ( $r = -0.20-0.35$ ).

**Conclusions:** Child-targeted nutrition counselling repeatedly given to the parents during and after child's infancy strongly influenced food choice scores of the 5.5–7-y-old children but failed to influence children's salt intake or scores in a nutrition knowledge picture test.

**Descriptors:** prospective; randomised; intervention; nutrition counselling; food choice; nutrition knowledge  
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## Introduction

As 4 to 7-y-old children already comprehend at least some abstract concepts related to food, eating behaviour and health (Singleton *et al*, 1992), children's understanding of nutrition and health aspects of foods in pre-school age has probably been commonly underestimated. Children begin

in this age to understand concepts like nutritive value, nutrient function, and the impact of nutrition on health (Lee *et al*, 1984), and their nutritional awareness correlates with the quantity and quality of food- and nutrition-related information delivered by the parents (Anliker *et al*, 1990). However, concepts such as 'low-fat food' and 'low-sodium food' are abstract expressions for most of the young children, suggesting that child-targeted nutrition education should probably combine theoretical information with real food and snack experiences to teach the children what to eat and what to avoid (Contento, 1981).

The development of a child's eating habits is strongly influenced by the family, particularly the parents. As children are born without innate ability to choose a nutritious diet, they learn their food habits through experience and education (Koivisto *et al*, 1994; Contento *et al*, 1995). The parents may reduce the availability and amount of foods with low nutritional value in the child's diet (Kesges *et al*, 1991)

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and support healthy food choices in various social circumstances (Shannon *et al*, 1994; Tershakovec *et al*, 1998). Parental monitoring as well as threat of parental monitoring decrease the number of non-nutritious foods that children choose (Klesges *et al*, 1991), but the strong parental impact at a young age (Oliveria *et al*, 1992) usually fades off with child's increasing age (Petchers *et al*, 1987). In practice, nutrition education for pre-schoolers and children up to the age of 5–10 y is usually delivered via the parents, but the impact of such child-oriented nutrition counselling of the parents on children's nutrition knowledge and food intake has remained poorly characterised.

In the prospective randomised Special Turku Coronary Risk Factor Intervention Project for Children (the STRIP project), child-targeted nutrition counselling has been regularly given to the parents in the intervention families since the child's age of 8 months, whereas child's nutrition was discussed with the parents of the control children only superficially without any detailed advice. The intervention children have continuously had lower intake of saturated fat and cholesterol than the control children have during the first 5 y of life. Total fat intake of the intervention children has also been slightly lower than that of the control children, and the differences in serum cholesterol concentration has been between 3% and 10% during the follow up (Lapinleimu *et al*, 1995; Niinikoski *et al*, 1996; Lagström *et al*, 1997). To elucidate how strongly child-targeted nutrition counselling given to the parents during the previous 6.5 y influences children's nutrition knowledge and recorded food intake at the age of 7 y, we selected a time-restricted cohort of the intervention and control children from the STRIP project and used a picture-identification knowledge test developed for the project and children's food diaries to compare outcome in these two groups of children.

## Subjects and methods

The study children are participants in Special Turku Coronary Risk Factor Intervention Project for children (the STRIP project), which is a prospective, randomised long-term coronary heart disease risk factor prevention trial. Altogether 1062 families were recruited to the trial by the nurses at the well-baby clinics in the city of Turku, Finland, at the infant's routine 5-month visit between March 1990 and June 1992 as described (Lapinleimu *et al*, 1995; Niinikoski *et al*, 1996). The children were randomised to an intervention group ( $n=540$ ) or a control group ( $n=522$ ) at 7 months of age. We now studied 70 consecutive 7-y-old intervention children (34 boys and 36 girls) and 70 consecutive 7-y-old control children (40 boys and 30 girls) who had a scheduled visit in the project between October 1997 and March 1998.

### *Nutrition counselling in the STRIP project*

At each visit the families met a paediatrician, a nutritionist and a nurse. In all cases, counselling was given to the

parents when their children were in the same room playing, drawing etc. Nutrition counselling was aimed at reduction of child's saturated fat and cholesterol intake, first at child's ages of 8, 13 and 18 months and then at 6-month intervals. The optimal diet of the child was defined to contain energy *ad libitum*, protein 10–15% of energy (E%), carbohydrates 50–60 E%, and fat 35–45 E% before the age of 2 y, and then 30 E%. The polyunsaturated/monounsaturated/saturated fatty acid ration (P:M:S) was planned to be 1:1:1. In practical counselling, the goal was a ratio of (P + M):S = 2:1.

Detailed suggestions were made to replace products that contained large amounts of saturated fat with products that contained fats of better quality or smaller amounts of fat. The nutritionist suggested detailed dietary changes in the diet according to child's food records and family's dietary history. A fixed diet was never ordered, but the families were encouraged to make small changes at a time, thus gradually improving the composition of child's diet. Use of low-fat meat products, low-fat sour milk products (eg yoghurts with  $\leq 1\%$  fat), ice-cream and cream made using vegetable oil-based fat and ample use of vegetables and fruits were encouraged. Use of skim milk as the only milk source, soft margarine as table fat and vegetable oil (in practice low-erucid-acid rapeseed oil) in food preparation was also advised.

The control children received the basic health education routinely given at Finnish well-baby clinics. Cow's milk with at least 1.5% fat was suggested for use. No other detailed suggestions concerning the quality or the quantity of fat were given, and dietary issues were discussed only briefly.

### *Measurement of food and nutrient intakes*

Food and nutrient intakes of the children were analysed at the ages of 5.5, 6, 6.5 and 7 y using food records kept by parents and other caregivers (eg staff at day care centres and at schools) on four consecutive days containing at least one weekend day. Food consumption was estimated using household measures (spoons, cups and glasses) or the foods were weighed on a home scale. The records were reviewed by the nutritionist for completeness and accuracy item by item during the follow-up visit. If needed, missing data (eg portion sizes, food descriptions, food preparation methods) were added after a discussion with the parent.

Food and nutrient intakes were calculated using the Micro Nutrica<sup>®</sup> program developed at the Research Centre of the Social Insurance Institution, Turku, Finland (Hakala *et al*, 1996). This program uses the Food and Nutrient database of the Social Insurance Institution in Finland and calculates 66 nutrients of 1208 commonly used foods and 890 dishes in Finland. The program has been updated with 85 new commercial fat- or salt-modified foods and 430 dishes between 1996 and 1998. The database is also able to separate foods into 98 groups according to fat quantity and quality.

As occasional food diaries were not delivered by the families, from two to three 4-day recordings (intakes of 8 food record days of 13 children and 12 food record days of

127 children) were used to calculate the mean intake of selected informative foods (see below). These informative foods were used in this study instead of nutrients because they probably more directly reflect children's (and parents') food decisions and thus were expected to show better correlation with the results of the picture knowledge test. The intakes were measured in grams without correcting for child's weight or other measures. A simple food intake score was then developed based on the Nordic Nutrition Recommendations (1996), the Recommendations of the European Society of Paediatric Gastroenterology and Nutrition (ESPGAN Committee on Nutrition, 1994), the Finnish Nutrition Recommendations (1998) and the aims of the STRIP project intervention (Table 1). Intake of 38 food items, eg skim milk, cheeses containing 18–28% fat etc, was used in the calculation of each child's food intake score. The selection also included several commonly used snacks because children probably select such foods first on their own. The foods were categorised according to their estimated heart-healthiness in three groups, foods that are healthy for the heart, moderately healthy for the heart and less healthy for the heart. The child got food intake points within the 11 food items listed (Table 1) based on the food type that was used most within each food item (eg type of milk). Thus, if most of the milk used by child according to his/her food diary was skim milk, ie a healthy for the heart choice, the child got 2 points. The final food intake score was the sum of these scores (maximum 22). Consequently, the higher was the food score the healthier the diet was for the heart.

For further analysis of children's food selection, the food score was divided to three subscores, which corresponded to subscores in the nutrition knowledge test (see below). The low-fat subscore comprised five items, including milks, yoghurts and other sour milk products, cheeses, puddings and sausages and cold cuts (maximum 10 points); the low-salt subscore comprised two items, salt and salty snacks (maximum 4 points); and the heart healthy subscore comprised four items, oils, spreads, creams and ice-creams (maximum 8 points).

#### *Picture identification test for measurement of nutrition knowledge*

A picture identification test developed for the project composed of 21 questions was used to measure children's nutrition knowledge. Each question was based on two or three pictures of food alternatives and a picture of a question mark. The test resembles the 'Minnesota Home Team' test (Perry *et al*, 1988) used for third grade students, the 'Go For Health' test (Parcel *et al*, 1989), used for fourth grade students, and the 'Know Your Body' test (Resnicow & Reinhardt, 1991), used for first to twelfth grade students.

In the nutrition knowledge test (Table 2) the child classified foods according to their fat or salt quantity ('which one has higher or the highest content of fat' and 'which one has higher or highest content of salt') and the child's knowledge of the association of the concept of 'heart healthiness' with fat or salt quantity or fat quality in the food ('which one is more or most healthy for the

**Table 1** The scoring system for foods used by the study children

<i>Healthy for the heart (foods containing low amounts of saturated fat and sodium and high amounts of unsaturated fat); 2 points/item</i>	<i>Moderately healthy for the heart (foods containing average amounts of saturated fat, sodium and low amounts of unsaturated fat); 1 point/item</i>	<i>Less healthy for the heart (foods containing high amounts of saturated fat, sodium and low amounts of unsaturated fat); 0 points/item</i>
Skim milk	Milk with 1% fat	Milk with 3.5% or 1.5% fat
Sour milk products with fruit or jam containing 1.5% fat or plain sour milk products containing $\leq 1.5\%$ fat	Sour milk products with fruit, jam or plain containing 1.6–2.5% fat	Sour milk products containing $> 2.5\%$ fat
Cheese with $\leq 17\%$ fat or containing modified fat	Cheese containing 18–28% fat	Cheese containing $> 28\%$ fat
Pudding or pudding containing modified fat, 0–9.9 g/day	Pudding or pudding containing modified fat, 10.0–19.9 g/day	Pudding or pudding containing modified fat, $\geq 20.0$ g/day
Cold cuts	Soft processed sausages containing 13–20% fat	Soft processed sausages and metwurst containing $> 20\%$ fat
Proportion of table salt intake of total salt intake, $\leq 40.0\%$	Proportion of table salt intake of total salt intake, 40.1–49.9%	Proportion of table salt intake of total salt intake, $\geq 50.0\%$
Salty snacks, 0–4.9 g/day	Salty snacks, 5.0–9.9 g/day	Salty snacks, $\geq 10.0$ g/day
Oil, $\geq 10$ g/day	Oil (5.0–9.9 g/day)	Oil (0–4.9 g/day)
Soft margarines containing 70–80% fat	Low-fat spreads (margarine or butter) containing 25–69% fat	Butter or spread (butter) containing 70–80% fat
Cream with modified fat	Cream with low fat content	Full cream
Ice-cream made from modified fat	Ice-cream made from milk	Ice-cream made from cream

Food items defining foods healthy for the heart, moderately healthy for the heart and less healthy for the heart are shown. If child's mean daily consumption in grams comprised, for example in the milk item skim milk, the child scored 2 points; if he consumed mainly milk with 3.5 or 1.5% fat, his score was 0. When a particular food item was not used at all, the scores were given as follows: in case of oils, spreads and milks the child scored 0 points and in case of hard margarines, yoghurts, sour milk products, cheeses, creams, ice-creams, puddings, sausages, cold cuts, salts and salty snacks the child scored 2 points. The theoretical range of food choice score was 0–22. In the intervention children the median was 14 (min 8, max 18) and in the control children 11 (min 4, max 18).

**Table 2** Questions used in the figure-based nutrition knowledge test

Which one has higher or the highest content of fat?	
1	Apple—yoghurt
2*	Cold cut, ham—metwurst sausage
3	Sour milk with 1% fat—sour milk with 2.5% fat
4	Fat-free yoghurt—yoghurt
5*	Skim milk—milk with 1% fat—milk with 1.5% fat
6	Cheese—cucumber
Which one has higher or highest content of salt?	
7	Bread with vegetables—bread with metwurst sausage
8	Tomato—apple—potato chips
9*	Bread with vegetables—pizza
10*	Mineral salt—herbal salt—salt
11	Potato—mashed potato—French fries
Which is more or most healthy for the heart?	
12	Ice-cream made from modified fat—ice-cream made from cream
13	Potato—French fries
14*	Oil—butter
15	Cold cuts, ham—metwurst sausage
16	Fish—red meat
17	Margarine—butter-margarine mixture—butter
18	Skim milk—milk with 1.5% fat—milk with 3.5% fat
19	Cold cut, ham—medium-fat sausage—metwurst sausage
20	Fat-modified cream—low-fat cream—full cream
21*	Fat-free yoghurt—yoghurt—high-fat pudding

For questions marked with an asterisk, the children were also asked to justify their choice (Why?).

heart'). Reasons for child's decisions ('why') were also asked for and registered.

The children performed the nutrition knowledge test during the family's visit to the Research Centre. The stress of the test situation was minimised by introducing the test as a game ('Garfield's food problems') in which the child could help Garfield to solve a food problem. The child was informed that some questions might be difficult, he/she did not have to know the answers and he/she could always choose a question mark picture ('I don't know'). To ensure that the child correctly identified the foods in the pictures, the child was first asked to name each of the foods shown on the cards. The child first also explained what he/she understood with the term 'heart healthy', and an explanation 'heart healthy means that it is healthful for your heart' was always provided. The term 'heart healthy' had been frequently used in the previous nutrition counselling sessions attended by the parents and the children. After having selected a picture, the child was asked whether he/she was certain of the answer, and in case of uncertainty he/she was reminded of that selection of a question mark picture was also possible.

A correctly selected picture scored one point, and points of the questions were summed up. For comparison of the nutrition knowledge scores and the food intake scores, the knowledge test questions were first rearranged so that the 'fat score' consisted of questions related to fat quantity in the foods (questions 1–6, 13, 15, 18, 19 and 21, maximum 11 points), 'salt score' of questions related to salt quantity of the foods (7–11, maximum 5 points) and 'heart healthiness score' of questions related to fat quality (12, 14, 16, 17 and 20, maximum 5 points). Total knowledge score, con-

sisting of the sum of these three scores, was maximally 21 points.

Children's explanations in the nutrition knowledge test were judged dichotomously as either accurate or inaccurate. For an accurate explanation the child had to select the correct picture and know at least one valid explanation for the described food. Three independent nutritionists evaluated the explanations. In cases of disagreement, a consensus was reached by voting.

### Statistical analyses

Because the nutrition knowledge and food intake scores showed skewed distribution, the nonparametric Wilcoxon two-sample-test was used to evaluate differences in the food intake and nutrition knowledge scores between the intervention children and the control children and between the boys and the girls. Children's explanations to the answers they gave in the nutrition knowledge test and intake of specific foods were tested using the chi-square test.

As the maximum obtainable scores in the analysis of food intake and in the nutrition knowledge tests varied, the mean scores were calculated as percentages of the maximum points in order to make the different scores comparable. Spearman correlation coefficients were used to evaluate the association between children's nutrition knowledge and their food intake. The internal consistency of the nutrition knowledge score was evaluated using Cronbach alpha coefficient. Nutrient intakes, which were all normally distributed, were analysed using two-sample *t*-tests and the results are shown as means  $\pm$  s.d. The SAS program package, release 6.08 (SAS Institute, Cary, NC) was used for the analyses. Differences were considered significant at  $P < 0.05$ .

### Ethical approval

The Joint Ethics Committee of the University of Turku and Turku University Central Hospital has approved the study. Informed consent was obtained from all parents.

## Results

### Nutrient intakes

The intervention children consumed similar amounts of energy, total fat, monounsaturated fatty acids, polyunsaturated fatty acids and sodium compared with the control children, but markedly less saturated fatty acids (11.6 E% vs 13.3 E%,  $P < 0.001$ , Table 3). In absolute values, the boys consumed daily more energy and sodium than the girls (1660 vs 1550 kcal,  $P < 0.001$ ; 2570 mg vs 2310 mg,  $P < 0.001$ ).

### Food intake

The intervention children ate more foods with low content of saturated fat and high content of unsaturated fat than the control children ('fat scores', 71.4% vs 56.9% of maximum,  $P = 0.0001$ ; 'heart healthy scores', 48.9% vs 37.7%,

**Table 3** Nutrient intake (mean  $\pm$  s.d.) in the intervention children ( $n = 70$ ) and the control children ( $n = 70$ ) and in the boys ( $n = 74$ ) and the girls ( $n = 66$ )

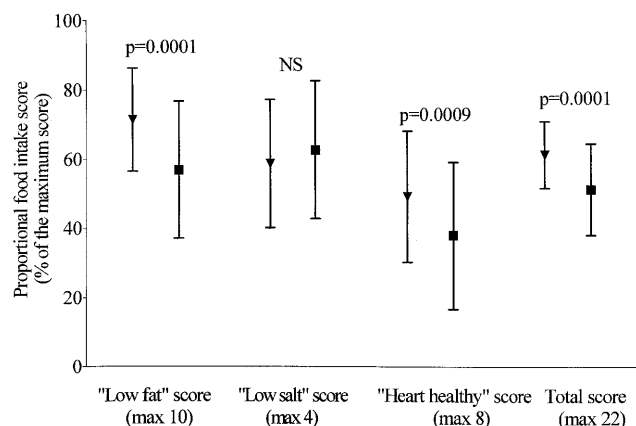
	Intervention children	Control children	Boys	Girls
Energy (MJ)	6.4 $\pm$ 1.0	6.8 $\pm$ 1.1	7.0 $\pm$ 0.8	6.5 $\pm$ 1.2
(kcal)	1550 $\pm$ 240	1630 $\pm$ 270	1660 $\pm$ 190	1550 $\pm$ 300*
Fat (E%)	30.3 $\pm$ 4.6	31.6 $\pm$ 5.1	30.9 $\pm$ 5.1	30.9 $\pm$ 4.7
Saturated fat (E%)	11.6 $\pm$ 2.3	13.3 $\pm$ 3.1*	12.4 $\pm$ 2.9	12.5 $\pm$ 2.8
Monounsaturated fat (E%)	11.1 $\pm$ 2.0	10.8 $\pm$ 2.0	11.0 $\pm$ 2.2	11.0 $\pm$ 1.8
Polyunsaturated fat (E%)	5.6 $\pm$ 1.6	5.2 $\pm$ 1.3	5.4 $\pm$ 1.5	5.4 $\pm$ 1.4
Sodium (mg)	2440 $\pm$ 450	2440 $\pm$ 500	2570 $\pm$ 460	2310 $\pm$ 450*

Significant difference between the intervention children and the control children or between the boys and the girls: \* $P < 0.001$ .

$P = 0.0009$  and 'low-fat scores', 57.1% vs 41.7%,  $P = 0.0001$ ). Low-salt foods were used in equal amounts by the intervention and the control children and the boys and the girls. (Figure 1). The intervention children more often used spreads that were regarded as the most healthy product than the control children (81.4% vs 54.3% of the children,  $P < 0.001$ ). Similarly, they used more low-fat milk (75.7% vs 38.6% of the children,  $P < 0.001$ ), low-fat yoghurts/other sour milk products (75.7% vs 38.6%,  $P < 0.01$ ) and cold cuts (67.1% vs 48.6% of the children,  $P < 0.05$ ). Children in the two groups used the most healthy alternatives of creams, ice-creams, puddings, oils, cheeses, salty snacks and salts as often.

*Nutrition knowledge*

The vast majority of the children regarded the test as quite easy. The Cronbach alpha coefficient for the sum of all three scores used in the nutrition knowledge score (0.71) indicated good internal consistency. The intervention children tended to be more aware of fat quality of the foods



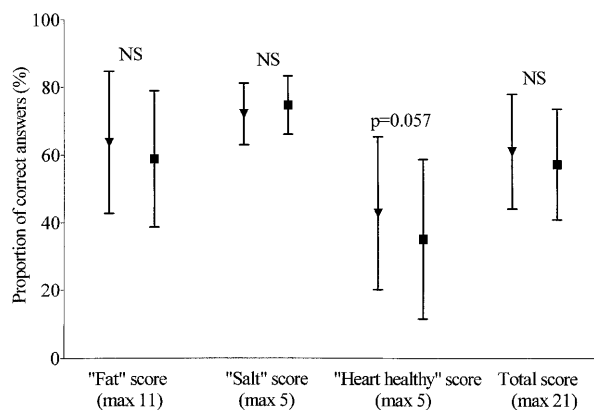
**Figure 1** Proportional food intake scores of the intervention and control children according to different aspects of healthiness of the foods (see Table 1 for details). Note that the maximum scores shown at the bottom differed markedly between the items, and their weight in calculation of the total score (on the right) varied accordingly. The means  $\pm$  s.d. values are shown. Solid triangles, intervention children; solid squares, control children.  $P$ -values for the difference in the scores between the two groups of children are also shown.

than the control children (correct answers in 42.6% vs 34.9% of the questions,  $P = 0.057$ ), but knowledge of the fat quantity (63.7% vs 58.8%) and salt content of foods (72.0% vs 74.6%) were similar in the two groups of children (Figure 2). The knowledge data showed no differences between the genders.

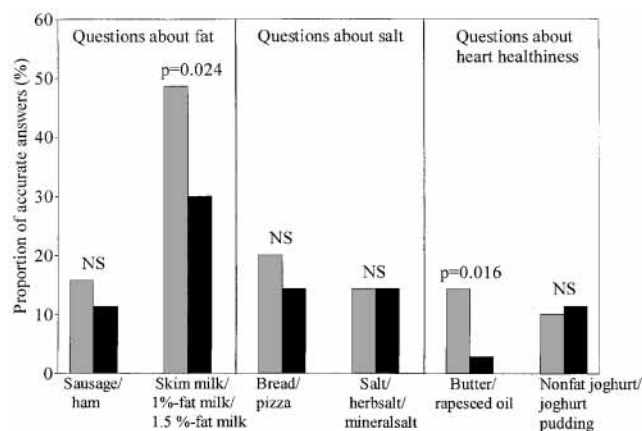
Both groups had difficulties in explaining their choices in the picture test, as most children answered that 'I can't explain, but I'm sure of my answer' (Figure 3). The intervention children were more often able to explain their answers accurately than the control children in two of the questions (milk questions answered correctly by 48.6% vs 30.0% of the intervention and control children,  $P = 0.024$ ; butter vs rapeseed oil, correct answer in 14.3% vs 2.9% of the children,  $P = 0.016$ ). The accurate explanations in other questions varied from 10% to 20% in the intervention children and from 5% to 18% in the control children.

*Correlation between food intake and nutrition knowledge*

Correlation between food intake and nutrition knowledge was analysed in the intervention and control children separately and in all children combined. Children's knowledge of fat quality and quantity in the foods and knowledge of nutrition as a whole (sum score of all knowledge tests)



**Figure 2** Mean  $\pm$  s.d. proportion (in percentages) of correct answers from maximum in the nutrition knowledge test. Solid triangles, intervention children; solid squares, control children.  $P$ -values for the difference in the scores between the two groups of children are also shown.



**Figure 3** Proportion of children explaining their answers accurately in different nutrition knowledge picture tests. Shaded bars indicate mean values of the intervention children and dark bars values of the control children.

correlated with intake of low-fat foods and with the overall healthiness of food intake in the control children and when all the children were analysed together. Knowledge of the salt quantity of the foods also correlated with intake of low-fat foods in the control children. In the intervention children only knowledge of fat quantity correlated with intake of low-fat foods. (Table 4).

## Discussion

Nutrition counselling in the STRIP project focused on replacing products that contain large amounts of saturated

fat with products that contain smaller amounts of fat or with fats in which at least part of the saturated fat had been replaced by monounsaturated and polyunsaturated fats. The counselling was focused on child's nutrition, but it was given mainly to the parents. The intervention succeeded in decreasing the intake of saturated fatty acids mainly by replacing them with foods low in saturated fat and high in unsaturated fat. Differences between the intervention and the control children in the types of spreads, milks, yoghurts or other sour milk products and sausages used were not unexpected. Consumption of other foods and groups of foods by the intervention and control children closely resembled each other, possibly because of the higher price of some of the low-fat products (eg cheeses), difficulties in changing a familiar product to a product with different texture (eg soft margarine to vegetable oil in food preparation) or because some of the foods are ingested infrequently or only at celebrations or as weekend snacks (eg cream, ice-cream and pudding). The counselling given to the parents failed to decrease children's intake of salt and salty snacks. Sodium intake was particularly high in boys, who consumed more energy than the girls.

Our food intake scores comprised 38 foods or groups of foods (accounting for 39% of all groups of foods) comprising a major source of daily intakes of fat (> 70%), saturated fat (> 70%), unsaturated fat (> 60%) and salt (> 60%) by 7-y-old children. Thus, groups of foods chosen for the analysis probably reflect quite well changes in the nutritional risk of development of atherosclerosis.

Dietary interventions which begin in childhood have several potential advantages. Firstly, at least part of dietary habits are often established in childhood, as parental

**Table 4** Correlation coefficients (r) between nutrition knowledge test and heart healthy score

Nutrition knowledge	Food choice			Whole score
	'Low fat' score	'Low salt' score	'Healthy healthy' score	
<b>Intervention group</b>				
'Fat' score	0.25*	-0.20	0.01	0.13
'Salt' score	0.05	-0.01	-0.08	-0.04
'Healthy healthy' score	0.10	-0.06	0.13	0.10
Total score	0.13	-0.19	0.04	0.10
<b>Control group</b>				
'Fat' score	0.26*	0.16	0.03	0.28*
'Salt' score	0.24*	0.04	-0.15	0.13
'Healthy healthy' score	0.26*	-0.10	-0.06	0.19
Total score	0.35**	0.07	-0.04	0.30*
<b>Whole group</b>				
'Fat' score	0.29***	-0.02	0.05	0.24**
'Salt' score	0.13	0.03	-0.14	0.03
'Healthy healthy' score	0.26**	-0.08	0.08	0.24**
Total score	0.32***	-0.05	0.04	0.27**

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ . All other coefficients were non-significant ( $P > 0.05$ ).

control of children's actual diet clearly influences children's later preferences. Therefore, parents have a possibility to provide children with a healthy diet, and to increase their later acceptance of healthy foods (Wardle, 1995). Secondly, longitudinal studies of eating habits indicate that food preferences consolidate early, as children tend to strongly prefer familiar to unfamiliar foods (Birch, 1998; Koivisto Hursti, 1999).

Early experiences with food and social learning from family and culture are the primary modes for acquisition of a repertoire of beliefs and behaviours related to food and health, and become well established long before children can actually deal with abstract concepts (Lewis & Lewis, 1992). Our data suggests that early experience is indeed important as the intervention children used more 'heart healthy' foods than the control children, although the nutrition knowledge as well as the explanations of the answers were similar between the two groups of children.

Most knowledge test developers, to simplify and reduce the number of items, divide foods into only two categories, good and bad, whereas most foods are actually on a continuum in terms of healthiness (Contento, 1991). In our nutrition intervention, a fixed diet was never ordered, but instead the counselling encouraged the families to make small changes which were based on each family's individual goals. However, as only the optimal answer (eg skim milk is the most 'heart healthy' milk) was categorised as the right one in the knowledge test, the compromised answers were regarded as ignored, even though in terms of healthiness they often were almost as good as the optimal answers (eg milk with 1% fat is not accepted as the most 'heart healthy' milk choice).

The reason for children's difficulties in understanding nutrient-based classification of foods has been suggested to be insufficient cognitive development (Michela & Contento, 1998). Although young children (kindergarten to second grade) use terms such as 'low fat' or 'low sugar', they may have difficulty in naming foods with those characteristics (Lytle *et al*, 1997). The amount of parental instruction and information is probably fundamental to children's understanding of abstract associations in nutrition (Anliker *et al*, 1990). In the STRIP study, the terms 'low fat', 'low salt' and 'heart healthy' have been frequently used in parental nutrition counselling, but, without an intention to make the children understand these terms. Thus, when these expressions were used in the nutrition knowledge test, familiarity and understanding of the relationship of these terms to actual food choices probably depended heavily on previous parental guidance at home. It is obvious that most parents have not considered it necessary to transfer nutritional issues discussed at the counselling sessions to the child, but instead thought that observational learning is sufficient. Thus, even though 42.6–72.0% of the intervention children and 34.9–74.6% of the control children knew the right answers in the nutrition knowledge test, only 5–20% of the children (in milk questions 30.0% and 48.6% of the children) could explain their answers in the test. One possible explanation

is that the children have chosen the right answer due to familiarity of the food package without actually understanding the meaning of the different modifications of the food questioned.

Several aspects of this study suggest that the nutrition knowledge test and the food intake score are probably meaningful methods for evaluation of children's nutritional skills and behaviour. The calculated Cronbach alpha of 0.71 shows that the internal reliability in the nutrition knowledge test was reasonably high. The nutrition knowledge test and the food intake scores in this study looked at the same foods and showed closely similar levels of specificity.

Our data show that the results of the nutrition knowledge test correlated only modestly with the healthiness of the foods consumed and that this association was tighter in the control group children. As children's knowledge of low-fat foods correlated with their intake of low-fat foods, parents probably have discussed the quantity of fat in foods with their children. Meanwhile, knowledge of 'heart healthy' foods, containing large amounts of unsaturated fatty acids, and intake of these foods showed poor correlation, implying that qualities of fat are discussed less often in the families, or that these terms are more difficult for the children to understand. In public heart disease prevention, quantity of fat is clearly regarded as a more important issue than that quality of fat in the diet, which may explain part of our results. The children may also have chosen their food as they have been taught to do, but without proper knowledge or the children may have known which foods are healthy for their heart, but they may have chosen at home other foods, because 'heart healthy' foods were not offered to them during the days when food consumption was recorded at home.

Many elementary school-aged children make nutritional choices based upon the perceived healthy effects of foods (Michela & Contento, 1998). The fat content of foods and fat-content labelling may also affect the food preferences and choices of pre-adolescent children (Engell *et al*, 1998). When children grow up and start to choose their food independently according to their own individual criteria, interventions should probably be targeted to children themselves to increase their nutrition knowledge and to help them to take health aspects into account when they decide what foods they select.

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