

A Randomized Intervention Since Infancy to Reduce Intake of Saturated Fat

Calorie (Energy) and Nutrient Intakes Up to the Age of 10 Years in the Special Turku Coronary Risk Factor Intervention Project

Sanna Talvia, MSc; Hanna Lagström, PhD; Minna Räsänen, PhD; Mari Salminen, MSc; Leena Räsänen, PhD; Pia Salo, MD, PhD; Jorma Viikari, MD, PhD; Tapani Rönnemaa, MD, PhD; Eero Jokinen, MD, PhD; Tero Vahlberg, MSc; Olli Simell, MD, PhD

Objective: To evaluate the longitudinal impact of dietary counseling on children's nutrient intake.

Design: A prospective, randomized, clinical trial.

Participants: Children were recruited to the study between December 1, 1989, and May 30, 1992. At the age of 7 months, children were randomized to the intervention group (n=540) or the control group (n=522) and were followed up until the age of 10 years.

Intervention: Families in the intervention group have, since randomization, received regularly individualized counseling about how to modify the quality and quantity of fat in the child's diet, the goal being an unsaturated-saturated fat ratio of 2:1.

Main Outcome Measures: Nutrient intakes between the ages of 4 and 10 years based on annual 4-day food records.

Results: The fat intake of the intervention children was

constantly around 30% of the calorie (energy) intake, while that of the control children was 2 to 3 calorie percentage units higher ($P<.001$). The intervention children received 2 to 3 calorie percentage units less saturated fats and 0.5 to 1.0 calorie percentage unit more polyunsaturated fats than the control children ($P<.001$ for both). However, neither group reached the 2:1 goal set for the unsaturated-saturated fatty acid ratio. The vitamin and mineral intakes of the intervention and control children closely resembled each other despite the marked differences in fat intake.

Conclusion: Individualized, biannually given, fat intake-focused dietary counseling that began at the child's age of 8 months continued to influence favorably the diet of 4- to 10-year-old intervention children without disadvantageous dietary effects, but the 2:1 goal for unsaturated-saturated fat ratio was not reached.

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From the Research Centre of Applied and Preventive Cardiovascular Medicine (Mss Talvia and Salminen and Dr Lagström) and the Departments of Medicine (Drs Viikari and Rönnemaa), Biostatistics (Mr Vahlberg), and Pediatrics (Dr Simell), University of Turku, Turku; the Tampere School of Public Health, University of Tampere, Tampere (Dr M. Räsänen); the Division of Nutrition (Dr L. Räsänen) and the Hospital for Children and Adolescents (Dr Jokinen), University of Helsinki, Helsinki; and Raisio Life Sciences Ltd, Raisio (Dr Salo), Finland.

THE SPECIAL TURKU CORONARY Risk Factor Intervention Project (STRIP) is a prospective, randomized, intervention trial aimed at the reduction of coronary heart disease risk factors after a child's first year of life.¹ The intervention children, with their families, were recruited to the study from the Finnish well-infant clinics in Turku at the routine 5-month visit. Families in the intervention group have, since the child was aged 8 months, received at least biannually individualized counseling about how to modify the quality and quantity of fat in the child's diet.

It was previously shown that individualized dietary counseling markedly changed the fat intakes of the STRIP children between the ages of 8 months and 4 years.² The fat intake of the intervention children was continuously around 2 calo-

rie (energy) percentage units lower, and the saturated fat intake was 3 calorie percentage units lower, than that of the control children, while the polyunsaturated fat intake of the intervention children was constantly 1 calorie percentage unit higher than that of the control children.

By using annual food records, we studied how calorie and nutrient intakes developed when the intervention and control children continued in the study from the age of 4 to 10 years. We analyzed whether the differences in fat intake of the intervention and control children persisted during the prepubertal years, when biannual counseling continued in the intervention families. Finally, we compared children's vitamin and mineral intakes with the intakes suggested in the Nordic Nutrition Recommendations,³ which consist of the official recommendations approved by the Nordic Council

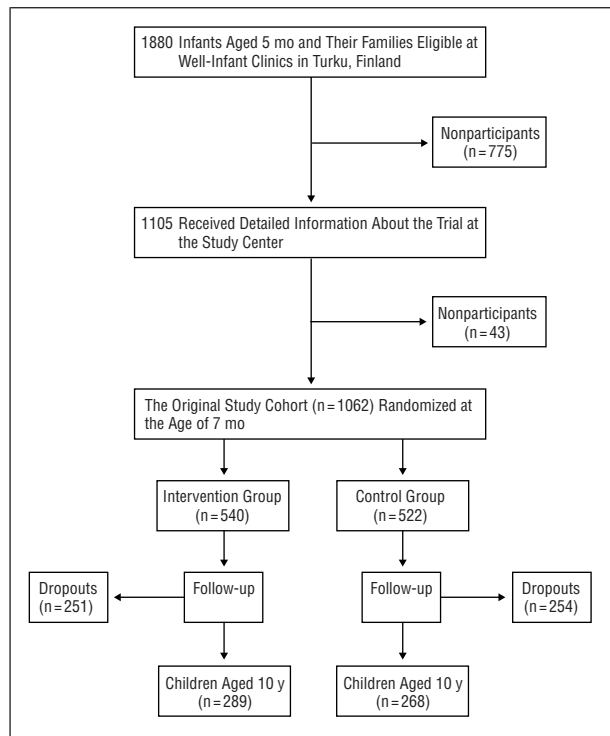


Figure 1. Flowchart of the Special Turku Coronary Risk Factor Intervention Project trial.

of Ministers in 1996 and are based on comprehensive background documentation on the recommendations compiled by a Nordic expert group.

METHODS

DESIGN AND SUBJECTS

In a prospective, randomized, coronary heart disease risk factor intervention trial (STRIP), families were recruited to the study by nurses at the well-infant clinics in Turku at the infants' routine 5-month visit, between December 1, 1989, and May 30, 1992, as described.^{1,4,5} The 1062 infants were allocated into an intervention group (n=540) or a control group (n=522) by random numbers at the 7-month visit (**Figure 1**). Informed consent was obtained from the families. At the age of 4 years, 820 children, and at the age of 10 years, 558 children visited the study center. The percentage of children who had withdrawn from the study was similar among the intervention and control children at both of these time points. We examined the nutrient intakes of the children when they grew from 4 to 10 years. The number of children with adequate food records was 752, 701, 668, 626, 627, 571, and 481 at the ages of 4, 5, 6, 7, 8, 9, and 10 years, respectively. The STRIP study has been approved by the Ethics Committee of Turku University and Turku University Central Hospital.

COUNSELING

The counseling was based on a constructivist theory of learning: the child and the family had an active role in counseling and their previous knowledge and experiences influenced the counseling session. A nutritionist met the intervention families at 1- to 3-month intervals until the child was aged 2 years, and biannually thereafter. In the beginning of the study, the counseling was given mainly to the parents, but after the child

was aged 7, separate sessions were organized for the child and the parents.

Nutrition counseling was aimed at the reduction of the child's saturated fat intake. The optimal diet was defined to contain the following: calories without any restrictions; protein, 10% to 15% of all calories; carbohydrates, 50% to 60% of all calories; and after the age of 2 years, fat, 30% of all calories (between the ages of 1-2 years, 30%-35% of all calories). An unsaturated-saturated fatty acid ratio of 2:1 was desired.

The implementation was individualized (eg, by using the child's food record as the basis for counseling and discussing questions that were specific to each family). A fixed diet was never ordered. Instead, the families were encouraged to gradually change the child's diet toward a better composition. Suggestions were made to replace products that contained large amounts of saturated fat with products that contained either less saturated fat or unsaturated fat instead of saturated fat (eg, cream with modified fat). The families were also encouraged to use vegetables, fruits, berries, and whole-grain products.

From the age of 7½ years onward, the child did paper-pencil, plastic model, or picture-based tasks at each visit. The age of the child was considered when the child-targeted counseling was implemented. Most of the material used in counseling was specially developed for the project because ready-made counseling materials for children are sparse.

The parents were carefully informed each time about the tasks the child had performed during the counseling session, and they were encouraged to further discuss the same food-related topics with the child at home. Between the biannual visits in the project, 1 or 2 letters were sent home to children to increase the interest in food and nutrition. The letters contained paper-pencil, cut-glue, or food preparation tasks and recipes.

The control families were seen biannually until the child was aged 7 years and thereafter, only once a year. The families did not routinely receive any detailed counseling focused on the risk factors of atherosclerosis. At the age of 12 months, cow's milk with at least 1.5% fat was recommended. Later, no other detailed suggestions concerning the quality or quantity of fat were given, and dietary issues were discussed only briefly.

FOOD RECORDS AND SOCIOECONOMIC STATUS

Food consumption data were obtained close to each visit by using food records on 4 consecutive days, including at least 1 weekend day. In this study, only one 4-day food record by year was used for each child (ie, the record kept at the age of 4, 5, and 6 years and beyond).

In the beginning of the study, parents or other caregivers reported the child's intake. When the children started day care and school, the personnel were asked to help the children in food recording. School-aged children had more responsibility for the recording, but parents were still informed to help the child when needed.

In the beginning of the study, parents received detailed instructions on how to keep the food diary. A new diary form was sent to the families 3 to 4 weeks before each follow-up visit. It included instructions and drawings, which helped the record keeping and the estimation of the amounts of the foods. The amounts were mainly estimated using household measures (spoons, cups, or glasses) or the foods were weighed on a home scale. The parents and other caregivers also recorded the type, brand, and preparation method of all foods used.

A nutritionist reviewed the food records for completeness and accuracy during the follow-up visit. If needed, she added missing data after discussion with the family. Some extra information about foods was checked, if needed, from schools, restaurants, and manufacturers.

Table 1. Daily Intakes of Calories (Energy) and Nutrients and Unsaturated-Saturated Fat Ratio in the Intervention and Control Girls

Variable	Age, y*						P Value for the Interaction Between Age† and Group‡	Mean Difference (95% Confidence Interval)‡	P Value‡
	4		7		10				
	Intervention Girls (n = 173)	Control Girls (n = 187)	Intervention Girls (n = 144)	Control Girls (n = 151)	Intervention Girls (n = 110)	Control Girls (n = 116)			
Calories	1253 (217)	1286 (227)	1492 (240)	1515 (237)	1669 (320)	1638 (291)	.74	-134 (-275 to 6)	.06
% of daily calorie intake									
Total fat	29.8 (4.3)	32.2 (4.6)	30.4 (4.3)	31.8 (4.7)	29.5 (4.5)	32.1 (4.6)	.22	-2.5 (-3.1 to -1.8)	<.001
Saturated fat§	11.8 (2.5)	14.3 (2.8)	11.8 (2.2)	13.7 (2.7)	11.1 (2.4)	14.0 (2.6)	.01	NA	NA
Monounsaturated fat	10.2 (1.7)	10.4 (1.8)	11.0 (1.9)	10.9 (1.8)	10.8 (2.0)	10.9 (1.9)	.73	-0.23 (-0.46 to -0.01)	.05
Polyunsaturated fat	5.3 (1.2)	4.8 (1.3)	5.6 (1.3)	5.1 (1.2)	5.7 (1.4)	5.0 (1.2)	.27	0.47 (0.32 to 0.62)	<.001
Linoleic acid	4.1 (1.0)	3.8 (1.1)	4.4 (1.1)	4.1 (1.0)	4.6 (1.3)	4.0 (1.1)	.24	0.33 (0.20 to 0.46)	<.001
Linolenic acid	0.8 (0.2)	0.7 (0.2)	0.9 (0.3)	0.8 (0.2)	0.9 (0.2)	0.7 (0.2)	.70	0.13 (0.10 to 0.16)	<.001
Protein	16.1 (2.3)	15.6 (2.1)	16.4 (2.4)	15.9 (2.1)	16.2 (2.4)	16.1 (2.5)	.86	0.49 (0.15 to 0.83)	.005
Carbohydrate	54.1 (4.2)	52.2 (4.8)	53.2 (4.3)	52.2 (4.8)	54.3 (4.6)	51.9 (5.2)	.14	2.0 (1.3 to 2.6)	<.001
Sucrose	9.7 (3.0)	9.6 (3.2)	9.2 (3.2)	9.5 (2.7)	9.4 (3.1)	9.3 (2.9)	.99	-0.11 (-0.51 to 0.30)	.61
Unsaturated-saturated fat ratio§	1.36 (0.3)	1.10 (0.3)	1.43 (0.3)	1.19 (0.2)	1.53 (0.3)	1.16 (0.2)	.01	NA	NA

Abbreviation: NA, data not applicable.

*Data are given as mean (SD).

†The quadratic term for age (age × age) was used.

‡General linear models were used for longitudinal data. The difference between intervention and control girls from the age of 4 to 10 years is given.

§Because of the interaction between the quadratic term for age and group, the differences between intervention and control groups were calculated at the ages of 4, 7, and 10 years with contrasts from the full model. The mean differences (95% confidence intervals) for saturated fat were as follows: at the age of 4 years, -2.7 (-3.2 to -2.2); at the age of 7 years, -2.2 (-2.7 to -1.8); and at the age of 10 years, -2.9 (-3.4 to -2.3). The mean differences (95% confidence intervals) for unsaturated-saturated fat ratio were as follows: at the age of 4 years, 0.27 (0.21 to 0.32); at the age of 7 years, 0.24 (0.20 to 0.29); and at the age of 10 years, 0.36 (0.29 to 0.42). $P < .001$ for all differences.

Food and nutrient intakes were calculated using a program (Micro Nutrica) developed at the Research Center of the Social Insurance Institution, Turku.⁶ The program is based on the Food and Nutrient Database of the Social Insurance Institution, and originally calculates 66 nutrients in 1208 foods and 890 dishes commonly used in Finland. The program used in STRIP has been updated with new foods and recipes that have come to the market during the study. The intake of nutrients from vitamin and mineral supplements was not included in the intake calculations.

The socioeconomic status of the parents and the family was examined by a structured self-administered questionnaire in autumn 1999, when the children were aged 8 to 10 years. The variables studied included years of education (0-8, 9-12, or >12 years), annual income of the family (categorized into 9 different categories), unemployment after the birth of the child attending the study (no unemployment, unemployed consecutively for <1 year, or unemployed consecutively for ≥1 year), number of children in the family (1, 2, 3, 4, or more children), and family structure (single-parent family, stepfamily, or nuclear family).

STATISTICAL ANALYSIS

In the analysis of the differences in nutrient intake between the intervention and control groups, sexes were analyzed separately. Follow-up data from children aged from 4 to 10 years were analyzed using general linear models for longitudinal data (repeated measurements).⁷ In the full model, age (continuous variable), group, interaction between age and group (age × group), quadratic term for age (age × age), and interaction between quadratic term for age and group (age × age × group) were included. If there was significant interaction between age and group or between the quadratic term for age and group, then differences between groups at the ages of 4, 7, and 10 years were calculated with contrasts from the

full model. Otherwise, the difference between groups was estimated from the model without these interactions. Because of the skewed distribution, vitamin A and D intakes were log transformed before analysis. The differences in the socioeconomic variables between groups were tested using the χ^2 test. The results are shown as means and SDs with 95% confidence intervals. $P < .05$ was considered statistically significant. The statistical analyses were performed using SAS statistical software, release 8.02 (SAS Institute Inc, Cary, NC).

RESULTS

The calorie intake did not differ between the 2 groups of girls (**Table 1**). However, the control boys had a modestly higher calorie intake than the intervention boys (**Table 2**).

The calorie-adjusted intakes of the calorie-yielding nutrients remained rather constant between the ages of 4 and 10 years (**Figure 2** and Tables 1 and 2). The differences between the intervention girls and the control girls were closely similar to the differences between the intervention boys and the control boys. The total fat intake of the intervention children was constantly around 30% of the calories, while that of the control children was constantly 2 to 3 calorie percentage units higher ($P < .001$). The low fat intake of the intervention children was compensated for by increases in carbohydrate and protein intake; the carbohydrate intake was about 1 to 2 calorie percentage units higher ($P < .001$) and the protein intake was around 0.5 calorie percentage unit higher ($P = .005$ and $P < .001$ for girls and boys, respectively) in the intervention children than in the control children. The control boys had a slightly higher sucrose intake than the intervention boys ($P = .002$),

Table 2. Daily Intakes of Calories (Energy) and Nutrients and Unsaturated-Saturated Fat Ratio in the Intervention and Control Boys

Variable	Age, y*						P Value for the Interaction Between Age† and Group‡	Mean Difference (95% Confidence Interval)‡	P Value‡
	4		7		10				
	Intervention Boys (n = 198)	Control Boys (n = 194)	Intervention Boys (n = 164)	Control Boys (n = 165)	Intervention Boys (n = 118)	Control Boys (n = 137)			
Calories	1348 (216)	1404 (252)	1629 (238)	1662 (274)	1796 (306)	1890 (349)	.27	-231 (-376 to -86)	.002
% of daily calorie intake									
Total fat	30.6 (4.9)	32.3 (4.5)	30.7 (4.6)	31.6 (4.5)	30.5 (4.7)	32.2 (5.6)	.64	-1.9 (-2.4 to -1.3)	<.001
Saturated fat§	11.9 (2.6)	14.5 (2.7)	11.5 (2.2)	13.6 (2.5)	11.4 (2.5)	13.5 (2.8)	.80	-2.3 (-2.6 to -2.0)	<.001
Monounsaturated fat	10.6 (2.1)	10.5 (1.9)	11.3 (2.1)	10.8 (1.9)	11.3 (2.1)	11.1 (2.2)	.91	0.03 (-0.21 to 0.27)	.79
Polyunsaturated fat	5.4 (1.2)	4.7 (1.1)	5.7 (1.3)	5.1 (1.3)	5.9 (1.3)	5.4 (1.5)	.11	0.53 (0.39 to 0.68)	<.001
Linoleic acid	4.3 (1.0)	3.7 (0.9)	4.6 (1.1)	4.1 (1.2)	4.7 (1.2)	4.4 (1.4)	.09	0.39 (0.26 to 0.52)	<.001
Linolenic acid	0.8 (0.2)	0.7 (0.2)	1.0 (0.3)	0.8 (0.2)	0.9 (0.3)	0.8 (0.2)	.09	0.16 (0.13 to 0.19)	<.001
Protein	16.2 (2.2)	15.4 (2.1)	16.6 (2.5)	15.6 (2.1)	16.4 (2.6)	16.1 (2.5)	.15	0.64 (0.34 to 0.94)	<.001
Carbohydrate	53.2 (4.9)	52.3 (4.9)	52.8 (4.3)	52.8 (4.5)	53.1 (5.0)	51.8 (5.8)	.80	1.2 (0.6 to 1.8)	<.001
Sucrose	9.5 (3.1)	10.1 (3.2)	9.0 (3.0)	10.1 (3.1)	9.3 (3.0)	9.7 (3.4)	.17	-0.67 (-1.1 to -0.2)	.002
Unsaturated-saturated fat ratio§	1.38 (0.3)	1.08 (0.2)	1.51 (0.3)	1.19 (0.2)	1.56 (0.4)	1.25 (0.3)	.69	0.29 (0.26 to 0.33)	<.001

*Data are given as mean (SD).

†The quadratic term for age (age × age) was used.

‡General linear models were used for longitudinal data. The difference between intervention and control boys from the age of 4 to 10 years is given.

but in girls, the intake did not differ between the intervention and control groups ($P = .61$).

The intervention children received 2 to 3 calorie percentage units less saturated fats ($P < .001$) and 0.5 to 1.0 calorie percentage unit more polyunsaturated fats ($P < .001$) than the control children (Figure 2 and Tables 1 and 2). Also, the intakes of linoleic acid ($P < .001$) and linolenic acid ($P < .001$) were higher in the intervention children than in the control children. The calorie-adjusted intake of monounsaturated fatty acids showed only a minor difference in girls, the intake being slightly higher in the control children ($P = .05$). The intervention children had a more favorable unsaturated-saturated fatty acid ratio than the control children ($P < .001$) (Figure 2 and Tables 1 and 2).

The intervention children had a slightly higher intake of vitamins D ($P < .001$), E ($P < .001$), and C ($P < .001$ and $P = .004$ for girls and boys, respectively) than the control children (Table 3 and Table 4). In the intervention girls, the folate intake was higher than the intake in the control girls ($P = .004$). The 10-year-old control boys had higher riboflavin and calcium intakes than the intervention boys ($P < .001$ and $P = .001$, respectively). Vitamin A, thiamine, iron, and zinc intakes did not differ between the intervention and control children. Vitamin D (intake, 2-3 $\mu\text{g}/\text{d}$) was the only micronutrient, the intake of which was markedly inferior to the 5- μg value suggested in the Nordic Nutrition Recommendations. There were no differences between the intervention and control groups for any of the socioeconomic factors studied (see the "Food Records and Socioeconomic Status" subsection of the "Methods" section) (data not shown).

COMMENT

This study shows that individualized infancy-onset dietary counseling influenced the intervention children's

diet favorably without disadvantageous dietary effects. The changes in fat intake observed earlier, during the first 4 years of life,² persisted between the ages of 4 and 10 years. Our findings in healthy children are consistent with those of the Dietary Intervention Study in Children,⁸ which tested the efficacy of an individualized, family-based, cholesterol-lowering dietary intervention in US children with an elevated serum low-density lipoprotein cholesterol level between the ages of 8 and 18 years.

The biannually given counseling led to a constantly lower calorie-adjusted fat intake in the intervention children vs the control children. When comparing these data with data from earlier Finnish studies,^{9,10} the calorie-adjusted intake of fat in the intervention and control children has markedly decreased in recent decades, while the intake of carbohydrates has increased.

Despite the promising results of the individualized dietary counseling on fat intake, the calorie-adjusted intakes of monounsaturated and polyunsaturated fats only poorly reached the 10% to 15% and 5% to 10% of all calories, respectively, listed in the Nordic Nutrition Recommendations,³ and the intake of saturated fat was higher than the recommended 10% of total calorie intake in both groups and in both sexes. Even though the unsaturated-saturated fat ratio was higher in the intervention children than in the control children, the intervention failed to reach the 2:1 goal of the study.

Serum lipid responses to the counseling-induced dietary changes have differed markedly in the STRIP children between the sexes.¹¹ This study shows that the differences in fat intake between the intervention and control children did not markedly differ between the sexes. Therefore, the interesting finding about the differences in lipid responses by sexes still remains unexplained.

Reduced fat intake has been proposed to result in children with a compensatory increase in sucrose in-

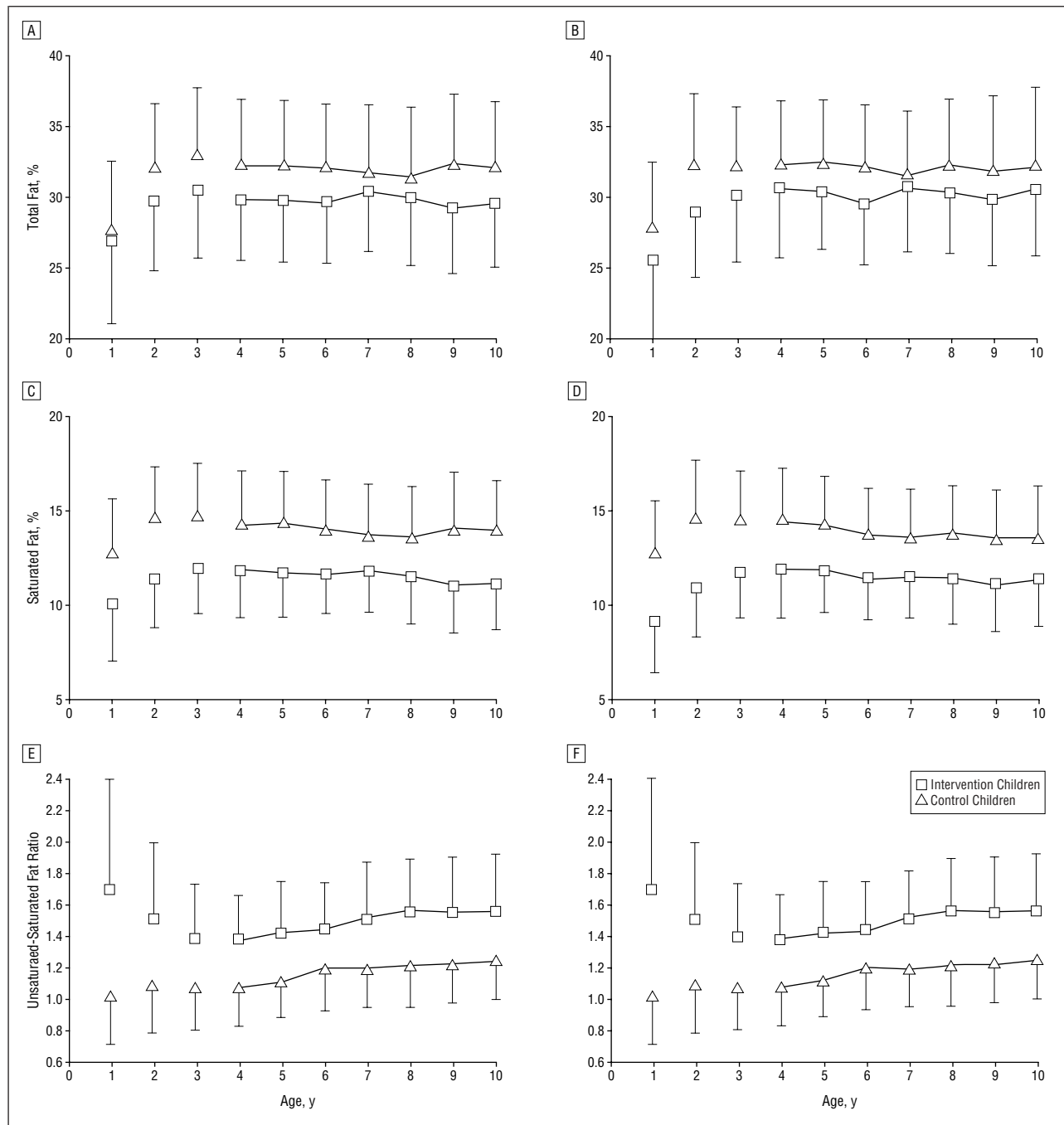


Figure 2. Mean (SD) data for girls (A, C, and E) and boys (B, D, and F) in the intervention and control groups, observed from the age of 13 months to 10 years. For total fat and saturated fat, percentage means the percentage of total calories. Data between the ages of 13 months and 4 years have been presented for clarity,² but have not been connected with a line to the new data presented herein. Data are excluded from the 8-month point, which was the time of the first dietary counseling session, because many of the children were breastfed and accurate dietary records could only be obtained from bottle-fed infants.

take.^{12,13} However, this study, like the study of Lee et al,¹⁴ showed that a reduced fat intake did not alter the sucrose intake of the intervention children. In our trial, the intake remained at about 10% of the total calorie intake, the upper limit recommended in the Nordic Nutrition Recommendations.³

The intakes of vitamins and minerals were in general either higher in the intervention children than in the control children or did not differ between the groups. Thus, dietary counseling and fat modification had no detrimental effects on the intake of vitamins and minerals,

a finding that is in accord with the findings in the Child and Adolescent Trial for Cardiovascular Health, a school-based intervention study,¹⁵ and the Dietary Intervention Study in Children, a study⁸ in children with an elevated low-density lipoprotein cholesterol level. Also, in other US¹⁴ and European^{10,13} studies, the consumption of a low-fat diet did not compromise the intake of other nutrients by the children.

Vitamin D was the only micronutrient, the intake of which was clearly below the Nordic Nutrition Recommendations³ in the intervention children and the con-

Table 3. Daily Intakes of Vitamins and Minerals in the Intervention and Control Girls

Nutrient	Age, y*						P Value for the Interaction Between Age† and Group‡	Mean Difference (95% Confidence Interval)‡	P Value‡
	4		7		10				
	Intervention Girls (n = 173)	Control Girls (n = 187)	Intervention Girls (n = 144)	Control Girls (n = 151)	Intervention Girls (n = 110)	Control Girls (n = 116)			
Vitamin A, retinol equivalent	962 (1561)	991 (953)	889 (829)	993 (1499)	1010 (1634)	761 (465)	.54	0 (-0.07 to 0.07)§	.99
Vitamin D, µg	2.3 (1.1)	1.9 (0.9)	2.9 (1.3)	2.4 (1.2)	2.8 (1.2)	2.4 (1.2)	.45	0.18 (0.13 to 0.23)§	<.001
Vitamin E, mg	5.7 (1.7)	5.3 (1.7)	7.2 (2.0)	6.5 (1.2)	7.8 (2.5)	6.8 (1.9)	.76	0.54 (0.30 to 0.79)	<.001
Thiamin, mg	0.9 (0.2)	0.9 (0.2)	1.1 (0.2)	1.1 (1.7)	1.2 (0.3)	1.2 (0.3)	.91	0.02 (-0.01 to 0.05)	.27
Riboflavin, mg	1.7 (0.5)	1.6 (0.4)	1.9 (0.4)	1.9 (0.5)	2.0 (0.6)	2.0 (0.5)	.99	0.04 (-0.02 to 0.11)	.19
Folate, µg	165 (42)	155 (36)	196 (45)	191 (46)	216 (52)	206 (54)	.61	8.3 (2.6 to 14.1)	.004
Vitamin C, mg	75.2 (40.8)	66.6 (35.0)	83.8 (40.4)	75.6 (37.0)	86.7 (49.2)	83.2 (48.8)	.20	8.1 (2.6 to 13.6)	<.001
Calcium, mg	879 (221)	855 (218)	1030 (249)	1011 (260)	1091 (287)	1100 (358)	.67	15 (-21 to 51)	.40
Iron, mg	7.6 (3.1)	7.7 (3.2)	8.9 (2.2)	9.0 (2.6)	9.9 (2.6)	9.2 (2.1)	.73	0.20 (-0.11 to 0.51)	.21
Zinc, mg	7.4 (1.7)	7.3 (1.5)	8.9 (1.8)	8.8 (1.8)	9.7 (1.9)	9.5 (2.1)	.99	0.03 (-0.21 to 0.28)	.79

*Data are given as mean (SD).

†The quadratic term for age (age × age) was used.

‡General linear models were used for longitudinal data. The difference between intervention and control girls from the age of 4 to 10 years is given.

§Values were log transformed for the analyses.

Table 4. Daily Intakes of Vitamins and Minerals in the Intervention and Control Boys

Nutrient	Age, y*						P Value for the Interaction Between Age† and Group‡	Mean Difference (95% Confidence Interval)‡	P Value‡
	4		7		10				
	Intervention Boys (n = 198)	Control Boys (n = 194)	Intervention Boys (n = 164)	Control Boys (n = 165)	Intervention Boys (n = 118)	Control Boys (n = 137)			
Vitamin A, retinol equivalent	871 (809)	1030 (1118)	1093 (866)	1028 (948)	908 (874)	1021 (1263)	.11	-0.06 (-0.13 to 0.02)§	.14
Vitamin D, µg	2.4 (1.0)	2.2 (1.3)	3.0 (1.2)	2.6 (1.3)	3.2 (1.6)	3.0 (1.7)	.12	0.17 (0.12 to 0.22)§	<.001
Vitamin E, mg	6.2 (1.8)	5.5 (1.6)	7.9 (2.1)	7.0 (2.1)	8.8 (2.9)	7.9 (2.3)	.68	0.62 (0.37 to 0.87)	<.001
Thiamin, mg	1.0 (0.2)	1.0 (0.3)	1.2 (0.3)	1.2 (0.3)	1.4 (0.4)	1.4 (0.3)	.94	0 (-0.04 to 0.04)	.90
Riboflavin, mg	1.8 (0.4)	1.8 (0.5)	2.1 (0.5)	2.1 (0.5)	2.1 (0.5)	2.3 (0.6)	.01	NA	NA
Folate, µg	168 (4.0)	166 (42.9)	207 (43)	202 (50)	230 (59)	226 (54)	.40	4.4 (-1.8 to 10.5)	.16
Vitamin C, mg	72.8 (36.1)	71.4 (40.2)	84.3 (45.2)	78.0 (44)	91.1 (49.5)	80.2 (48.9)	.33	8.3 (2.6 to 13.9)	.004
Calcium, mg	929 (212)	944 (254)	1103 (281)	1092 (264)	1114 (306)	1236 (342)	.03	NA	NA
Iron, mg	8.0 (2.2)	8.0 (2.5)	9.8 (2.2)	9.4 (2.3)	10.5 (2.4)	10.6 (2.6)	.33	0.08 (-0.21 to 0.38)	.59
Zinc, mg	8.1 (1.7)	8.0 (1.8)	10.0 (1.8)	9.5 (2.0)	10.7 (2.3)	10.9 (2.3)	.16	0.04 (-0.21 to 0.30)	.73

Abbreviation: NA, data not applicable.

*Data are given as mean (SD).

†The quadratic term for age (age × age) was used.

‡General linear models were used for longitudinal data. The difference between intervention and control boys from the age of 4 to 10 years is given.

§Values were log transformed for the analyses.

||Because of the interaction between the quadratic term for age and group, the differences between the intervention and control groups were calculated at the ages of 4, 7, and 10 years with contrasts from the full model. The mean differences (95% confidence intervals) for riboflavin were as follows: at the age of 4 years, -0.04 (-0.13 to 0.04) (P = .29); at the age of 7 years, -0.03 (-0.11 to 0.06) (P = .52); and at the age of 10 years, -0.24 (-0.36 to -0.12) (P < .001). The mean differences (95% confidence intervals) for calcium were as follows: at the age of 4 years, -22 (-66 to 23) (P = .35); at the age of 7 years, -16 (-63 to 30) (P = .48); and at the age of 10 years, -118 (-188 to -47) (P = .001).

trol children. Other studies suggest that vitamin D intake indeed is low in Finland; in a recent study,¹⁶ the daily vitamin D intake was below 5 µg in girls between the ages of 9 and 15 years. To improve the average vitamin D intake by the population, the amounts of vitamin D added to commercially produced milk, buttermilk, and certain margarines were increased in Finland in February 2003.

The children dropping out from long-lasting prospective trials like this one easily create analytical problems for the study. In STRIP, the proportion of children

dropping out from the intervention and control groups has been closely similar through the years. Furthermore, when we compared, at each age, the children who dropped out before the next visit with the children who continued at least to the next age point, we found no differences in total fat or saturated fat intakes or other primary response variables of the study between the 2 groups. These and previous analyses^{1,2,4,5,17} suggest that the impact of the dropout phenomenon on the final conclusions of this study is probably small.

What This Study Adds

Aiming at decreasing exposure of the intervention children to known environmental atherosclerosis risk factors, STRIP has previously shown that individualized dietary counseling, which begins in infancy and continues through the first 4 years of life, influences markedly the quality and quantity of fat consumed by the intervention children. We investigated whether the induced changes in fat intake persisted when biannual counseling continued to the age of 10 years.

The counseling continued to influence children's fat intake favorably without causing any detrimental effects on the intake of other nutrients. Targets in total fat intake were easily achieved, but new methods are needed to reach the 2:1 unsaturated-saturated fat ratio at this age.

There were no differences in the socioeconomic factors between the intervention group and the control group that could explain the differences in the nutrient intake observed in this study. We hypothesize that repeatedly given individualized dietary counseling since childhood may permanently influence dietary habits. Law¹⁸ states, using a duration of exposure basis for risk calculation, that dietary fat and serum cholesterol concentrations in childhood directly influence cardiovascular disease risk later in adult life. The possible persistence of the healthy eating habits learned in childhood through later life might so substantially reduce the risk of atherosclerosis.

We believe that the general principles of nutrition counseling used in this study are probably effective in many different cultural settings, assuming that the facilities for repeated meetings with the families are possible. However, many economic and cultural differences have to be considered when practical counseling is being adopted locally.

In conclusion, the changes in children's diet induced by biannually given individualized dietary counseling that began in infancy were almost similar between the ages of 4 and 10 years as those previously shown between the ages of 13 months and 4 years. The goals for mean fat intake were achieved, but the unsaturated-saturated fat ratio in the diet remained clearly below the target.

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Corresponding author: Sanna Talvia, MSc, Research Centre for Applied and Preventive Cardiovascular Medicine, Kiinamyllynkatu 10, FIN-20520 Turku, Finland (e-mail: sanna.talvia@utu.fi).

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