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

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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.

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 3-month visit, between December 1, 1989, and May 30, 1992, as described. 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, 538 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.

**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. 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 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). 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 χ² 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 units 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 1. Daily Intakes of Calories (Energy) and Nutrients and Unsaturated-Saturated Fat Ratio in the Intervention and Control Girls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention Girls (n = 173)</th>
<th>Control Girls (n = 187)</th>
<th>Intervention Girls (n = 144)</th>
<th>Control Girls (n = 151)</th>
<th>Westward Difference (95% Confidence Interval)†</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>1253 (217)</td>
<td>1286 (227)</td>
<td>1492 (240)</td>
<td>1515 (237)</td>
<td>−134 (−275 to 6)</td>
<td>.06</td>
</tr>
<tr>
<td>% of daily calorie intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fat</td>
<td>29.8 (4.3)</td>
<td>32.2 (4.6)</td>
<td>30.4 (4.3)</td>
<td>31.8 (4.7)</td>
<td>29.5 (4.5)</td>
<td>.22</td>
</tr>
<tr>
<td>Saturated fatty acids</td>
<td>11.8 (2.5)</td>
<td>14.3 (2.8)</td>
<td>11.8 (2.2)</td>
<td>13.7 (2.7)</td>
<td>11.1 (2.4)</td>
<td>.01</td>
</tr>
<tr>
<td>Monounsaturated fatty acids</td>
<td>10.2 (1.7)</td>
<td>19.4 (1.1)</td>
<td>11.0 (1.9)</td>
<td>19.0 (1.3)</td>
<td>10.8 (2.3)</td>
<td>.01</td>
</tr>
<tr>
<td>Polyunsaturated fatty acids</td>
<td>5.3 (1.2)</td>
<td>4.8 (1.3)</td>
<td>5.6 (1.3)</td>
<td>5.1 (1.2)</td>
<td>5.7 (1.4)</td>
<td>.01</td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>4.1 (1.0)</td>
<td>3.8 (1.1)</td>
<td>4.4 (1.1)</td>
<td>4.1 (1.0)</td>
<td>4.6 (1.3)</td>
<td>.24</td>
</tr>
<tr>
<td>Linolenic acid</td>
<td>0.8 (0.2)</td>
<td>0.7 (0.2)</td>
<td>0.9 (0.3)</td>
<td>0.8 (0.2)</td>
<td>0.9 (0.2)</td>
<td>.70</td>
</tr>
<tr>
<td>Protein</td>
<td>16.1 (2.3)</td>
<td>15.6 (2.1)</td>
<td>16.4 (2.4)</td>
<td>15.9 (2.1)</td>
<td>16.2 (2.4)</td>
<td>.86</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>54.1 (4.2)</td>
<td>52.2 (4.8)</td>
<td>53.2 (4.3)</td>
<td>52.2 (4.8)</td>
<td>54.3 (4.6)</td>
<td>.14</td>
</tr>
<tr>
<td>Saturated fatty acid ratio§</td>
<td>1.36 (0.3)</td>
<td>1.10 (0.3)</td>
<td>1.43 (0.3)</td>
<td>1.19 (0.2)</td>
<td>1.53 (0.3)</td>
<td>.01</td>
</tr>
</tbody>
</table>

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 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 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.
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 group, 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 µg/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).

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, 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, 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, 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. The changes in fat intake observed earlier, during the first 4 years of life, 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, 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.

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age, y*</th>
<th>Intervention Boys (n = 198)</th>
<th>Control Boys (n = 194)</th>
<th>P Value for the Interaction and Group‡</th>
<th>Mean Difference (95% Confidence Interval)‡</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>4</td>
<td>1348 (216) 1404 (252) 1629 (238) 1662 (274) 1796 (306) 1890 (349)</td>
<td>27 -231 (-376 to -86) 0.002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of daily calorie intake</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fat</td>
<td></td>
<td>30.6 (4.9) 32.3 (4.5) 30.7 (4.6) 31.6 (4.5) 30.5 (4.7) 32.2 (5.6)</td>
<td>.64 -1.9 (-2.4 to -1.3) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturated fat</td>
<td></td>
<td>11.9 (2.6) 14.5 (2.7) 11.5 (2.2) 13.6 (2.5) 11.4 (2.5) 13.5 (2.6)</td>
<td>.80 -2.3 (-2.6 to -2.0) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monounsaturated fat</td>
<td></td>
<td>10.6 (2.1) 10.5 (1.9) 11.3 (2.1) 10.8 (1.9) 11.3 (2.1) 11.1 (2.2)</td>
<td>.91 0.03 (-0.21 to 0.27) .79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyunsaturated fat</td>
<td></td>
<td>5.4 (1.2) 4.7 (1.1) 5.7 (1.3) 5.1 (1.3) 5.1 (1.3) 4.8 (1.3)</td>
<td>.69 0.29 (0.26 to 0.33) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linoleic acid</td>
<td></td>
<td>4.3 (1.0) 3.7 (0.9) 4.6 (1.1) 4.1 (1.2) 4.7 (1.2) 4.4 (1.4)</td>
<td>.09 0.39 (0.34 to 0.45) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linolenic acid</td>
<td></td>
<td>0.8 (0.2) 0.7 (0.2) 1.0 (0.3) 0.8 (0.2) 0.9 (0.3) 0.8 (0.2)</td>
<td>.09 0.16 (0.13 to 0.19) &lt;.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td>16.2 (2.2) 15.4 (2.1) 16.6 (2.5) 15.6 (2.1) 16.4 (2.6) 16.1 (2.5)</td>
<td>.15 0.64 (0.34 to 0.94) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrate</td>
<td></td>
<td>53.2 (4.9) 52.3 (4.9) 52.8 (4.3) 52.8 (4.5) 53.1 (5.0) 51.8 (5.8)</td>
<td>.80 1.2 (0.6 to 1.8) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sucrose</td>
<td></td>
<td>9.5 (3.1) 10.1 (3.2) 9.0 (3.0) 10.1 (3.1) 9.3 (3.0) 9.7 (3.4)</td>
<td>.17 -0.67 (-1.1 to -0.2) .002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsaturated-saturated fat ratio</td>
<td></td>
<td>1.38 (0.3) 1.08 (0.2) 1.51 (0.3) 1.19 (0.2) 1.56 (0.4) 1.25 (0.3)</td>
<td>.69 0.29 (0.26 to 0.33) &lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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.
However, this study, like the study of Lee et al., 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,13 and the Dietary Intervention Study in Children, a study8 in children with an elevated low-density lipoprotein cholesterol level. Also, in other US14 and European10,13 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 control children. 

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, 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.
control children. Other studies suggest that vitamin D intake indeed is low in Finland; in a recent study, 19 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 was below 5 µg in girls between the ages of 4 and 10 years is given.

These and previous analyses 1, 2, 4, 5, 17 suggest that 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, −0.03 (−0.11 to 0.06) (P = .29); at the age of 7 years, −0.03 (−0.11 to 0.00) (P = .32); 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).

The 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.

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

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Age, y*</th>
<th>Intervention Girls (n = 173)</th>
<th>Control Girls (n = 187)</th>
<th>Intervention Girls (n = 144)</th>
<th>Control Girls (n = 151)</th>
<th>Intervention Girls (n = 110)</th>
<th>Control Girls (n = 116)</th>
<th>P Value for the Interaction Between Age† and Group‡</th>
<th>Mean Difference (95% Confidence Interval)‡</th>
<th>P Value$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A, retinol equivalent</td>
<td>4</td>
<td>962 (1561)</td>
<td>991 (953)</td>
<td>889 (829)</td>
<td>993 (1499)</td>
<td>1010 (1634)</td>
<td>761 (465)</td>
<td>.54</td>
<td>0 (−0.07 to 0.07)</td>
<td>.99</td>
</tr>
<tr>
<td>Vitamin D, µg</td>
<td></td>
<td>2.3 (1.1)</td>
<td>1.9 (0.9)</td>
<td>2.9 (1.3)</td>
<td>2.4 (1.2)</td>
<td>2.8 (1.2)</td>
<td>2.4 (1.2)</td>
<td>.45</td>
<td>0.18 (0.13 to 0.23)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Vitamin E, mg</td>
<td></td>
<td>5.7 (1.7)</td>
<td>5.3 (1.7)</td>
<td>7.2 (2.0)</td>
<td>6.5 (1.2)</td>
<td>7.8 (2.5)</td>
<td>6.8 (1.9)</td>
<td>.76</td>
<td>0.54 (0.30 to 0.79)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Thiamin, mg</td>
<td></td>
<td>0.9 (0.2)</td>
<td>0.9 (0.2)</td>
<td>1.1 (0.2)</td>
<td>1.1 (1.7)</td>
<td>1.2 (0.3)</td>
<td>1.2 (0.3)</td>
<td>.91</td>
<td>0.02 (−0.01 to 0.05)</td>
<td>.27</td>
</tr>
<tr>
<td>Riboflavin, mg</td>
<td></td>
<td>1.7 (0.5)</td>
<td>1.6 (0.4)</td>
<td>1.9 (0.4)</td>
<td>1.9 (0.5)</td>
<td>2.0 (0.6)</td>
<td>2.0 (0.5)</td>
<td>.99</td>
<td>0.04 (−0.02 to 0.11)</td>
<td>19</td>
</tr>
<tr>
<td>Folate, µg</td>
<td>7</td>
<td>165 (42)</td>
<td>155 (36)</td>
<td>196 (45)</td>
<td>191 (46)</td>
<td>216 (52)</td>
<td>206 (54)</td>
<td>.61</td>
<td>8.3 (2.6 to 14.1)</td>
<td>.004</td>
</tr>
<tr>
<td>Vitamin C, mg</td>
<td></td>
<td>75.2 (40.8)</td>
<td>66.6 (35.0)</td>
<td>83.8 (40.4)</td>
<td>75.6 (37.0)</td>
<td>86.7 (49.2)</td>
<td>83.2 (48.8)</td>
<td>.20</td>
<td>8.1 (2.6 to 13.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Zinc, mg</td>
<td></td>
<td>7.4 (1.7)</td>
<td>7.3 (1.5)</td>
<td>8.9 (1.8)</td>
<td>8.3 (1.8)</td>
<td>9.7 (1.9)</td>
<td>9.5 (2.1)</td>
<td>.99</td>
<td>0.03 (−0.21 to 0.28)</td>
<td>.79</td>
</tr>
</tbody>
</table>

*Data are given as mean (SD).
†The quadratic term for age (age²) 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

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Age, y*</th>
<th>Intervention Boys (n = 194)</th>
<th>Control Boys (n = 194)</th>
<th>Intervention Boys (n = 164)</th>
<th>Control Boys (n = 165)</th>
<th>Intervention Boys (n = 118)</th>
<th>Control Boys (n = 137)</th>
<th>P Value for the Interaction Between Age† and Group‡</th>
<th>Mean Difference (95% Confidence Interval)‡</th>
<th>P Value$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A, retinol equivalent</td>
<td>4</td>
<td>871 (809)</td>
<td>1030 (1118)</td>
<td>1093 (866)</td>
<td>1028 (948)</td>
<td>908 (874)</td>
<td>1021 (1263)</td>
<td>.11</td>
<td>−0.06 (−0.13 to 0.02)</td>
<td>.14</td>
</tr>
<tr>
<td>Vitamin D, µg</td>
<td></td>
<td>2.4 (1.0)</td>
<td>2.2 (1.3)</td>
<td>3.0 (1.2)</td>
<td>2.6 (1.3)</td>
<td>3.2 (1.6)</td>
<td>3.0 (1.7)</td>
<td>.12</td>
<td>0.17 (0.12 to 0.22)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Vitamin E, mg</td>
<td></td>
<td>6.2 (1.8)</td>
<td>5.5 (1.6)</td>
<td>7.9 (2.1)</td>
<td>7.0 (2.1)</td>
<td>8.8 (2.9)</td>
<td>7.9 (2.3)</td>
<td>.68</td>
<td>0.62 (0.37 to 0.87)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Thiamin, mg</td>
<td></td>
<td>1.0 (0.2)</td>
<td>1.0 (0.3)</td>
<td>1.2 (0.3)</td>
<td>1.2 (0.3)</td>
<td>1.4 (0.4)</td>
<td>1.4 (0.3)</td>
<td>.94</td>
<td>0 (−0.04 to 0.04)</td>
<td>.90</td>
</tr>
<tr>
<td>Riboflavin, mg</td>
<td></td>
<td>1.9 (0.4)</td>
<td>1.8 (0.5)</td>
<td>2.1 (0.5)</td>
<td>2.1 (0.5)</td>
<td>2.1 (0.5)</td>
<td>2.3 (0.6)</td>
<td>.01</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Folate, µg</td>
<td></td>
<td>168 (42)</td>
<td>166 (42.9)</td>
<td>207 (43)</td>
<td>202 (50)</td>
<td>230 (59)</td>
<td>226 (54)</td>
<td>.40</td>
<td>4.4 (−1.8 to 10.5)</td>
<td>.16</td>
</tr>
<tr>
<td>Vitamin C, mg</td>
<td></td>
<td>72.8 (36.1)</td>
<td>71.4 (40.2)</td>
<td>84.3 (45.2)</td>
<td>78.0 (44)</td>
<td>91.1 (49.5)</td>
<td>80.2 (48.9)</td>
<td>.33</td>
<td>8.3 (2.6 to 13.9)</td>
<td>.004</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td></td>
<td>929 (212)</td>
<td>944 (254)</td>
<td>1103 (291)</td>
<td>1092 (264)</td>
<td>1114 (306)</td>
<td>1236 (342)</td>
<td>.03</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Iron, mg</td>
<td></td>
<td>8.6 (2.2)</td>
<td>8.0 (2.5)</td>
<td>9.8 (2.2)</td>
<td>9.4 (2.3)</td>
<td>10.5 (2.4)</td>
<td>10.6 (2.6)</td>
<td>.33</td>
<td>0.08 (−0.21 to 0.38)</td>
<td>.59</td>
</tr>
<tr>
<td>Zinc, mg</td>
<td></td>
<td>8.1 (1.7)</td>
<td>8.0 (1.8)</td>
<td>10.0 (1.8)</td>
<td>9.5 (2.0)</td>
<td>10.7 (2.3)</td>
<td>10.9 (2.3)</td>
<td>.16</td>
<td>0.04 (−0.21 to 0.30)</td>
<td>.73</td>
</tr>
</tbody>
</table>

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.

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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REFERENCES