ABSTRACT. Background. Prevention of cardiovascular disease through diet and lifestyle change is strongly advocated in adults and is initiated preferably during childhood. The Dietary Intervention Study in Children (DISC) was a multicenter, collaborative, randomized trial in 663 preadolescent children (363 boys and 301 girls) with elevated low-density lipoprotein cholesterol, designed to test the efficacy and safety of a dietary intervention to lower saturated-fat and cholesterol intake while also advocating a healthy eating pattern. DISC results have been published extensively. This ancillary study reports new data regarding changes in eating patterns among this cohort.

Objective. We set out to compare children’s self-selected eating patterns and approaches to achieving adherence to the DISC fat-reduced diet intervention with children in the usual-care group.

Methods. An ancillary study was conducted to develop a detailed food-grouping system and report new analyses on dietary adherence to the recommended eating pattern. Every food in the nutrient database was ranked by its saturated-fat and cholesterol content and classified within its relevant food group as a “go” (less atherogenic) or “whoa” (more atherogenic) food.

Results. At baseline, go foods contributed ~57% of total energy intake and 12.4% to 13.1% total fat energy intake in both groups. At 3 years, go foods contributed 67.4% and 13.7% of total and fat energy intake, respectively, in the intervention group versus 56.8% and 12.8% in the usual-care group. Differences between the 2 treatment groups were significant for changes in consumption of dairy foods, desserts, and fats/oils, with the intervention group reporting a 0.2- to 0.3-serving-per-day greater increase in go foods than the usual-care group. Differences in intervention and data collection. 1–3 The study was initiated in 1987 among 6 participating clinical centers and a coordinating center, with ongoing involvement of the National Heart, Lung, and Blood Institute project office. The purpose of DISC was to determine, compared with a usual-care control group, the long-term efficacy and safety of a dietary intervention to reduce total fat, saturated fat, and cholesterol in prepubertal children with elevated low-density lipoprotein cholesterol (LDL-C) who were 8 to 10 years old at baseline. DISC was initiated before the report of the Pediatric Panel of the National Cholesterol Education Program4 (NCEP), but the study’s dietary recommendations approximately reflected what became the Step II diet of the NCEP, which recommends limits on saturated fat, total fat, and dietary cholesterol.

A variety of studies, including laboratory, clinical, pathologic, and epidemiologic, have established that the process of atherosclerosis begins in childhood.4 Elevated blood cholesterol levels signify increased risk, and diet is the cornerstone of treatment. DISC was the longest and largest (n = 663) randomized, controlled, dietary intervention study in children with elevated LDL-C levels. Previous publications from DISC have concentrated on the lipid results and...
nutrient adequacy. Assessment of dietary adherence to the DISC intervention by quantifying and comparing actual foods and food groups consumed within and between treatment groups offers the rare opportunity to document how children applied the reduced-fat criteria to their own daily intake. The foods selected by children in the intervention group illustrate their approach to following the recommended diet versus choices made by children in the usual-care group. These results can have practical implications for health care providers to predict problems with long-term adherence and to identify foods or food groups that may require special intervention approaches to achieve nutrient adequacy while reducing saturated fat, total fat, and cholesterol.

STUDY DESIGN

A total of 663 participants, 8 to 10 years old, who had elevated LDL-C levels and were prepubertal at baseline were randomized to an intervention or usual-care group. Institutional review boards from all 6 participating clinical centers and the coordinating center, an external data and safety monitoring board, and the National Heart, Lung, and Blood Institute approved the study protocol, and informed consent and assent were obtained from parents and children.

DISC was designed originally to test a 3-year intervention but followed the participants until the age of 17 years, on average, with continuing, albeit diminished-intensity intervention. The eligibility criteria, baseline characteristics, study design, intervention, and results have been described in detail elsewhere. Briefly, eligibility for the DISC trial required LDL-C levels from the 80th to <98th percentile based on age-gender distributions from the Lipid Research Clinics. Eligible ages were ~8 to 10 years at the first screening with no evidence of pubertal development based on Tanner staging criteria. Exclusion criteria included systolic blood pressure of ≥125 mm Hg or diastolic blood pressure (phase 4) of ≥80 mm Hg, documented at both the second screening and baseline visits. The primary efficacy and safety outcome measures were serum LDL-C, height, and serum ferritin.

### Recommended Diet

The DISC study was designed to lower blood cholesterol by focusing on reducing dietary total fat, saturated fat, and cholesterol while increasing fiber, fruits, and vegetables. In addition, interventionists presented nutrition education aimed at helping children meet all nutrient needs. Children and parents were advised to substitute low-fat or nonfat foods for full-fat versions of meat/fish/poultry and dairy foods. The DISC dietary recommendations were similar to the NCEP Step II diet. The recommended intake of total fat was 28% of energy, with <8% from saturated fat, up to 9% from polyunsaturated fat, and <75 mg/4200 kJ of cholesterol, not to exceed 150 mg per day (Table 1). Foods high in saturated fat were primary targets for intervention and were designated collectively as “whoa” foods, whereas lower-fat/cholesterol alternatives, including fruits and vegetables, were “go” foods. The DISC was conducted before the establishment of the Nutrition Labeling and Education Act. Thus, the use of food labels alone as a criterion for choosing appropriate foods was not possible. The DISC nutritionists created the “DISC dictionary,” which listed every food in the Nutrition Coordinating Center (NCC) nutrient database as a go or whoa food according to its cholesterol/saturated-fat content.

### DISC Food-Group Intervention

To help children and their parents achieve nutrient adequacy while reducing total and saturated-fat intake, nutritionists developed a series of intervention sessions built around the various food groups that

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**TABLE 1. The DISC Intervention and Nutrient and Food-Group Recommendations**

<table>
<thead>
<tr>
<th>Nutrient recommendations, % of total energy intake</th>
<th>DISC Intervention Diet</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein*</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total fat</td>
<td>28</td>
<td>&lt;8</td>
</tr>
<tr>
<td>Saturated fatty acids</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Polyunsaturated fatty acids</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Monounsaturated fatty acids</td>
<td></td>
<td>58</td>
</tr>
<tr>
<td>Carbohydrates†</td>
<td></td>
<td>&lt;75 mg/4200 kJ, not to exceed 150 mg/d</td>
</tr>
<tr>
<td>Cholesterol†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourage water-soluble fiber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go foods (serving sizes), recommended no. of servings per d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go meats/fish/poultry (serving = 1 oz)</td>
<td>4–7</td>
<td></td>
</tr>
<tr>
<td>Go dairy (serving = 1 cup, 8 fluid oz; 1 oz of cheese)</td>
<td>3–4</td>
<td></td>
</tr>
<tr>
<td>Go bread/grains (serving = 1 slice of bread; 1 oz of cereal)</td>
<td>6–12</td>
<td></td>
</tr>
<tr>
<td>Go vegetables (serving = ½ cup)</td>
<td>2–5</td>
<td></td>
</tr>
<tr>
<td>Go fruits (serving = 1 medium piece, ½ cup)</td>
<td>2–5</td>
<td></td>
</tr>
<tr>
<td>Go snacks (defined in the DISC dictionary in detail)‡</td>
<td>2–3</td>
<td></td>
</tr>
<tr>
<td>Go desserts (serving = 1–2 average-sized cookies, ½ cup of sherbet/ice milk or pudding)</td>
<td>1–2</td>
<td></td>
</tr>
<tr>
<td>Go fats (serving = 1 teaspoon of margarine, oil, mayonnaise, or regular salad dressing; 1 tablespoon of reduced-calorie salad dressing)</td>
<td>2–10</td>
<td></td>
</tr>
</tbody>
</table>

* Recommended: approximately two thirds animal protein and one third vegetable protein.
† Increased fiber was encouraged.
‡ Snack serving size varies by type. The recommended servings should provide no more than 2.5 g of saturated fat.
constitute a complete diet for children. Figure 1 illustrates the Go-Guide, a wheel comprised of 8 wedges that each represent a common part of a child’s diet, including dairy, meat/fish/poultry, breads/grains, vegetables, fruits, snacks (ie, snack foods), desserts, and fats/oils. Similar to the US Department of Agriculture Food Guide Pyramid,\textsuperscript{10} the Go-Guide provides recommended number of servings within each wedge. Examples of go foods are listed in green, and whoa foods are listed in red. Intervention sessions focused on each of these wedges to help children apply the saturated-fat–based recommendations to each food group while still maintaining a balanced diet.

Fig 1. The DISC Go-Guide.
Behavioral Intervention

The DISC intervention strategies were based on social-learning theory and social-action theory constructs that children learn behaviors through observation and imitation of models such as parents, siblings, other family members, peers, and celebrities.7 Table 2 summarizes the sequence and content of diet education and behavioral sessions provided. Intensive intervention during the first 6 months included 6 weekly sessions followed by 5 biweekly group sessions led by nutritionists and behaviorists during which the Go-Guide information and practical tips for how to follow the diet were provided. These group sessions were followed by 2 individual sessions with the nutritionist. During the second 6 months, 4 group sessions and 2 individual sessions were also held. These relatively intensive intervention sessions were followed by maintenance sessions, held 4 to 6 times per year during the second and third year, with monthly telephone contacts between group sessions. When the study was extended, intervention sessions consisted mostly of individual rather than group visits to accommodate the teen-aged participants’ schedules. Two group events plus 2 individual visits were planned annually from the fourth year until the end of the study, with regular telephone contacts providing motivational intervention as needed.

Usual Care

Children randomized to the usual-care group were provided educational publications on heart-healthy eating that were generally available to the public. Children in the usual-care group were examined annually for studywide comparisons, including dietary data collection by trained nutritionists who were blinded to study-group assignment.

Dietary Assessment

Dietary intake was measured by using 3 nonconsecutive 24-hour dietary recalls, including 1 weekend day, collected from the children at each key time point. Parents served as reinforcements and provided additional details as needed.2,3,8,11

The DISC dietary-assessment methods were tested and validated and are described in detail elsewhere.8,11 Briefly, the initial dietary recall was collected by specially trained, NCC-certified DISC nutritionists through a face-to-face interview with the child and then verified by the parent at the clinic, with 2 subsequent telephone recalls within 2 weeks of that visit. Because baseline data collections preceded availability of electronic methods, for consistency all dietary data obtained from the recalls were handwritten on standardized NCC forms. Multipass methods were in place with each nutritionist reviewing the recalls at least 3 times and then cross-checking with another trained nutritionist locally before shipping the edited recalls for centralized coding at NCC. Nutrient analyses were performed by NCC using mainframe database version 20 at the University of Minnesota (Minneapolis, MN). A mean of 3 days of dietary recalls was calculated per individual. For purposes of quality control, 10% of the recalls were tape-recorded and reentered by another local nutritionist.

Nutrient analyses, reported elsewhere, confirmed overall adequacy and adherence to the DISC nutri-

TABLE 2. Dietary Intervention Summary

<table>
<thead>
<tr>
<th>Session</th>
<th>Group</th>
<th>Individual</th>
<th>Nutrition Topic</th>
<th>Behavioral Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week</td>
<td>1</td>
<td>Assessment/core food list</td>
<td>Review eating pattern</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Overview and eggs</td>
<td>Goal setting/action plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Fats</td>
<td>Follow-up on goal setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dairy</td>
<td>DISC success at home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Meat</td>
<td>Follow-up on diet at home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Snacks and desserts</td>
<td>DISC success outside home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fruits and vegetables</td>
<td>Follow-up on DISC outside home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Review checklist</td>
<td>Go-Guide exercises</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Grains</td>
<td>Review behavioral principals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Lunch</td>
<td>Helping others with change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Review diet recalls</td>
<td>Review goals/action plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Review diet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Month

<table>
<thead>
<tr>
<th>Week</th>
<th>4</th>
<th>Meals in a hurry</th>
<th>Group problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Eating out</td>
<td>Assertive behavior in restaurants</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Recipe modification</td>
<td>Follow-up on group problem solving</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Review diet recalls</td>
<td>Review goals/action plan</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Shopping</td>
<td>Social reinforcement of diet change</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Parties</td>
<td>Role of planning ahead</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Review diet recalls</td>
<td>Review goals/action plans</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Parenting/cooking</td>
<td>Reinforcement, limit setting, modeling</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Cholesterol update</td>
<td>Long-range behavioral goal</td>
<td></td>
</tr>
<tr>
<td>13–36</td>
<td>2 per year</td>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td>37–48</td>
<td>2 per year</td>
<td>Motivational interviewing (in person and on the telephone)</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from J Nutr Educ. 1995;27:133–140.
ent-specific goals, but food-based changes in DISC participants have not been presented previously. For this ancillary study, food-group analyses were performed by using dietary recalls for the intervention and usual-care groups collected at the baseline and 36-month visits. For purposes of standardization across recalls and across time, all recalls were evaluated line by line by an NCC-trained, certified, registered dietitian (N.G.) to identify serving sizes, recipe modification, and food-group designation for all reported foods for children in both groups. To our knowledge, DISC is the first study with the ability to quantify serving sizes, reconstruct recipes, and analyze food-group information prospectively from multiple recalls (>10,000 total) during 7 years of follow-up to capture the self-selected approaches taken by children of this age to comply with the reduced dietary fat and cholesterol recommendations.

Designation of Food Groups

During the development phase of the DISC intervention, every food in the NCC database was ranked for its go or whoa status on the basis of saturated-fat and cholesterol content. Foods with lower saturated-fat and cholesterol content were ranked as “go,” and those foods considered more atherogenic were classified as “whoa.” To achieve nutrient adequacy for growing children, higher saturated-fat tolerance was allotted for the meat/fish/poultry group (5 g per 3-oz serving) and the dairy group (3 g per serving), whereas for fruits/vegetables and breads/grains less saturated fat was tolerated (0.75 g per serving), because these foods are typically devoid of fats. For this report, to relate food-group intake to the goals of the dietary intervention, an NCC-trained and certified nutritionist (N.G.) reviewed every recall to assign each food to a food group as defined by the wedge (Fig 1). In addition to the food-group wedges on the DISC Go-Guide, pizza was added as its own food group for these analyses because of its popularity. Because the DISC intervention emphasized the importance of modifying recipes to include more go ingredients, each recipe was also identified in the recalls and categorized according to an appropriate food group as defined by the wedge. Standardized adult-based serving sizes were designated for every food to more accurately compare changes between baseline and 36 months.

Although the majority of foods consumed by the DISC participants was categorized into 1 wedge, there were 114 foods that belonged in at least 2 wedges, such as sandwiches, soups, pasta dishes, and other mixed dishes. For example, beef vegetable stew was considered part of the meat/fish/poultry wedge but also part of the vegetable wedge. For each of these 114 foods, a determination was made as to which wedges the food belonged and also what percentages should be applied to those wedges. For example, for a serving of the beef vegetable stew, we assigned two thirds of the serving to the meat/fish/poultry wedge and one third of the serving to the vegetable wedge. Some foods fit in as many as 4 wedges on the DISC Go-Guide (eg, a Big Mac). The amount of kilojoules per serving for each of these foods was subsequently assigned by the same certified nutritionist.

Statistical Analysis

Means and SDs were calculated for the baseline characteristics. All 3-day food recalls were averaged for each child in the study. The number of servings of each go and whoa food consumed by each individual was calculated for each food group (go and whoa). The mean number of servings, mean kilojoules as a percentage of the total energy consumed (% kJ), and mean fat kilojoules as a percentage of total energy consumed (% fat) were calculated for each food group for the baseline and 3-year visits.

The changes in servings within food groups from the baseline visit to the 3-year visit were calculated. t tests were performed to compare treatment effect. The go and whoa groups were combined for each food group to indicate overall dietary pattern. Also combined into 1 category were the desserts, snack foods, and pizza food groups to examine foods particularly popular with children. The mean number of servings, mean kilojoules as a percentage of the total energy consumed (% kJ), and mean fat kilojoules as a percentage of total energy consumed (% fat) were calculated for the baseline and 3-year visits for these combined food groups.

General linear models were used to assess the association between servings of the food groups and LDL-C or BMI. All models were adjusted for treatment group and computed separately for each gender. We separated the models by gender because of gender differences in BMI and LDL-C. In models for which pubertal stage was statistically significant, pubertal stage was included as a covariate.

All analyses were performed by using SAS 9.0 (SAS Institute, Cary, NC).

RESULTS

A total of 595 children with complete dietary recall data were included in these analyses (ie, 3 days of recalls at baseline and at 3 years). Table 3 lists mean baseline characteristics of the participants by treatment group. Approximately 30% of the total DISC population reported taking vitamin/mineral supplements at baseline. There were no significant differences between treatment groups in any of these baseline characteristics.

Table 4 illustrates baseline mean servings of foods from the 8 food groups plus pizza and their respective contributions to total energy intake and total fat intake. In both the intervention and control groups, participants consumed a total of 11.5 servings of go foods and 7.8 and 7.5 servings of whoa foods, respectively, at baseline. The food groups that contributed the most fat as a percentage of total intake (% fat) were whoa meat/fish/poultry, whoa pizza, go breads/grains, whoa snacks, whoa breads/grains, and whoa desserts. Overall, in both treatment groups the energy content of whoa foods as a percentage of total consumed (% kJ) contributed ~43%, and go foods contributed ~57% of total intake at baseline.
Across all food groups, go breads/grains contributed the most kilojoules and whoa meat/fish/poultry the most fat kilojoules. Energy intake from go pizza contributed an average of 6% to 8% of total energy, and whoa pizza contributed an additional 9% to 10% of total intake at baseline. No differences were observed between treatment groups at baseline in any food group except go pizza, which showed a greater number of servings and more total kilojoules and fat kilojoules as a percentage of total intake ($P < .03, .02, \text{and} .007$, respectively) in the usual-care compared with the intervention group.

By 3 years, the intervention group reported increased intakes of go foods in each food group except fruits (Fig 2A) compared with baseline. The differences between treatment groups in changes in servings consumed from go foods were significant for dairy foods, desserts and fats/oils, with a borderline $P$ value for meat/fish/poultry. Overall, go foods contributed 67.4% of total energy intake and 13.7%...
fat kilojoules as a percentage of total intake in the intervention group versus 56.8% and 12.8% of total and fat kilojoules, respectively, in the usual-care group at 3 years (data not shown). Conversely, the usual-care group reported an increased number of servings of whoa foods and/or had less of a decrease in whoa foods compared with the intervention group for all food groups (Fig 2B). Differences between the 2 treatment groups were significant for breads/grains, dairy foods, fats/oils, meat/fish/poultry, snacks, and vegetables. Overall, % kJ and % fat intake from whoa food groups (ie, kilojoules and fat kilojoules as a percent of total intake) did not change very much from baseline (Table 4) to 3 years in the usual-care group (43.2% kJ and 20.7% fat at 3 years) but decreased in the intervention group at 3 years (32.8% kJ and 15.4% fat).

By combining go and whoa foods, the total number of servings of fruits, vegetables, dairy, and other food groups is reported in Table 5. Intake of fruits (1.5 servings per day) and vegetables (1.1 servings per day) did not change appreciably in either group, nor did dairy-food (2.1 servings per day) intake change. The dessert group contributed slightly more than 1 serving for both groups at both visits. Snack foods provided, on average, 4.0 servings per day at baseline in both treatment groups, which dropped slightly for the intervention group at 3 years (3.9 servings per day). The usual-care group, however, increased total snack food consumption at 3 years to 4.4 servings per day. Approximately 1 serving per day (0.8–1.2) of pizza was consumed on average at both baseline and 3 years in both groups. Overall, in this cohort of children, >30% kJ and >9% fat (kilojoules and fat kilojoules as a percentage of total intake) were provided by snack foods, desserts, and pizza at baseline. This increased to ~32% and 34.5% kJ and 8.1% and 10.0% fat at 3 years in the intervention and usual-care groups, respectively.

ASSOCIATIONS WITH LDL-C AND BMI

General linear models were used for each food group to determine if there were significant associations between servings of the food groups and either BMI and/or LDL-C (data not shown). Three food groups were most strongly and consistently associated with either BMI and/or LDL-C, the combined go and whoa desserts/snack foods/pizza group (as reported in Table 5), the dairy-foods group, and the breads/grains group, but gender-related differences were noted.

For boys, desserts, snack foods, and pizza combined showed positive associations with both LDL-C and BMI. There was a significant positive association between servings of whoa desserts, snack foods, and pizza (β = 1.87; P = .01) and a borderline association for the combined (go plus whoa) desserts/snack foods/pizza food group (β = .84; P = .06) with LDL-C. BMI models also showed a positive association with whoa desserts/snack foods/pizza (β = .10; P = .04) and the combined desserts/snacks/pizza (β = .15; P = .001). Also for boys, consumption of
breads/grains showed a negative association with BMI (go breads/grains \( \beta = -0.11; P = 0.02 \) and combined go and whoa dairy \( \beta = -0.16; P = 0.01 \)). For girls, servings of dairy foods showed a negative association with BMI (go dairy foods \( \beta = -0.25; P = 0.02 \) and combined go and whoa dairy \( \beta = -0.20; P = 0.04 \)). No significant associations between food groups and LDL-C were observed among the girls.

### DISCUSSION

This ancillary study involving >4200 dietary recalls collected over 3 years constitutes one of the largest longitudinal food and nutrient databases in existence among preadolescent children, allowing unique exploration of food groups and food patterns associated with adherence to a fat-reduced diet in this age group. Use of these recalls allowed detailed nutrient analyses and provided the basis for these newly constructed food groups. These food-group analyses and the associated changes within and between treatment groups provide rare clinical-trial evidence on behavioral adaptations made by children who were following a reduced-fat diet.

The DISC trial was the first long-term randomized...
trial of preadolescent children with elevated blood cholesterol levels to test the efficacy and safety of a fat-reduced dietary intervention on LDL-C, growth, and iron status. Adequate nutrient intake was a major goal, and intervention focused on balanced dietary intake across all food groups, preferably choosing the go-food alternatives from all the food groups. Children and parents were encouraged to switch from high total fat and saturated-fat sources of dairy, meat, and grain foods to low total and saturated-fat sources rather than omitting these food groups altogether. Children in the usual-care group reported increased intake of whoa breads/grains, whoa meat/fish/poultry, and whoa pizza at 3 years, whereas children in the intervention group decreased all these foods except pizza. At 3 years, compared with the usual-care group, the intervention group reported significantly reduced intake of whoa foods in the breads/grains, dairy, fats/oils, meat/fish/poultry, snacks, and vegetable food groups. The greatest changes in go-food intake between the intervention and usual-care groups occurred in the dairy, desserts, and fats/oils groups (Fig 2A).

The DISC intervention targeted LDL-C lowering. Based on these analyses, it seems that the combined intake of snacks, desserts, and pizza may be positively related to LDL-C and BMI in this population, but these associations need additional study. It is also worth noting the apparent gender-related differences in these associations. For girls, dairy intake was inversely associated with BMI, but no other food group was associated with either BMI or LDL-C. For boys, both go grains and combined go plus whoa dairy were inversely associated with these risk factors. Additional data are needed to confirm these findings.

National Eating-Pattern Changes

A brief summary of the secular trends helps to place the DISC data in context. Nationally, favorable changes in macronutrient composition in children have occurred since 1973. Total fat intake has decreased from 38% of total intake in 1973 to ~33% in 2000. Despite decreased fat intake, total intake has remained relatively constant, and the prevalence of overweight and obesity in adolescents has increased dramatically during the past decade. Increased sedentary behavior is considered a major contributing factor, but shifts in dietary patterns may further exacerbate the weight-gain phenomenon. According to Third National Health and Nutrition Examination Survey (NHANES III) data, caloric beverages alone contribute 20% to 24% of total energy intake, and soft drinks provide 8% of total energy intake in adolescents. Likewise, snacking has increased and currently contributes 1883 to 2510 J (25%) of daily energy intake per day in children nationally. Longitudinal data over 2 decades from the Bogalusa Heart Study also reported a reduced percentage of fat intake, but total intake remained the same. Reduced intake of breakfast, fewer dinner meals eaten at home, reduced total eating episodes, and the reduced time span of eating episodes were also reported.

The DISC data are in accordance with some of these findings but also show that combined intakes of snacks, desserts, and pizza accounted for approximately one third of the total daily intake for this sample of adolescents from 6 geographic locations in the United States. The energy density of these snack foods has also increased over the past decade, up from 5.67 to 6.47 kJ/g, thereby further contributing to increased risk of weight gain in this age group. Although the exact causes of this phenomenon are not known, these shifts in snacking behavior may be a consequence of fewer meals eaten at home and/or less access to home-prepared foods, as well as exposure to parents, siblings, or other role models who likewise engage in suboptimal snacking behavior.

Increased exposure to television food commercials that heavily emphasize snacks, desserts, and beverages especially targeting children may trigger eating these empty-calorie foods. Watching television while eating meals and snacks may further condition cues for children to eat these foods even when they are not hungry. Recent data report that watching television and consuming soft drinks were positively associated with obesity in 11- to 13-year-old children. Although DISC did not specifically assess snacking during television viewing, our data document substantial intake of empty-calorie foods. Sedentary behavior in both groups was also quite high. Conversely, higher physical activity was associated with lower LDL-C.

DISC Nutrition Education Influences Food Quality

These DISC food-group analyses demonstrate that nutritious substitutions were made by the intervention group rather than eliminating or avoiding recommended food groups. For example, although milk-drinking behavior is notoriously low nationally and decreases over time among adolescents, DISC intervention seems to have helped children select and maintain intake of lower-fat and/or nonfat versions of dairy and other animal-protein foods over time.

These DISC results document that snacks, desserts, and pizza collectively accounted for approximately one third of the daily energy intake of these children. Without proper guidance, such an eating pattern, left unchecked, could lead to possible displacement of dairy foods, fruits, vegetables, and whole grains from the diet. A snack/dessert-laden diet is typically high in refined carbohydrate, salt, sucrose/fructose, and hydrogenated shortening (an ingredient especially predominant in crackers, cookies, chips, snack cakes, etc) and is associated with high trans fatty acid intake and kilojoules and imposes a high glycemic load. Such an eating pattern is associated with obesity, elevated LDL-C, and insulin resistance and foreshadows development of metabolic syndrome and type II diabetes. Metabolic syndrome has a current estimated prevalence of >30% among adults >50 years old and 4% of adolescents. Targeted emphasis on fruits, vegetables, nonfat dairy, and whole-grain foods as snack foods could potentially help to improve both the nutritional quality and energy balance of children's dietary intake and per-
haps prevent the development of these cardiovascular disease risk factors.

Healthy Eating Index

In 1995, after DISC’s completion, the US Department of Agriculture’s Center for Nutrition Policy and Promotion developed the Healthy Eating Index as a way to assess the dietary status of Americans. The Healthy Eating Index includes 10 components that relate to a healthy diet. Components 1 through 5 measure adherence to the Food Guide Pyramid, and components 6 through 10 relate to total fat, saturated fat, cholesterol, sodium, and overall variety.34 Children <11 years old had better diets than other subgroups in the population.

According to NHANES III results, children 7 to 10 years old ranked lowest on their intake of fruits and vegetables (3.9 and 5.0 on a scale of 10, respectively) but scored highest in meeting grain intakes (8 on a scale of 10).35 Nationally, intake of fruits and milk was lower among both girls and boys (11–14 years old), and vegetable intake was lower and met higher among boys compared with 7- to 10-year-olds in the NHANES III sample.35 In contrast, the DISC intervention group reported increased dairy intake and decreased whoa dairy, increased go fats/oils and decreased whoa fats/oils, and decreased whoa vegetables (French fries) but no change in fruit intake compared with the usual-care group. Thus, DISC dietary intervention seems to have improved the diet quality as well as quantity in this age group.

Implications

DISC food-group analyses permit a rare opportunity to evaluate adherence to specific foods and food groups recommended in the intervention group. Compared with the usual-care group, those in the intervention group increased their relative intake of recommended go foods in all food groups except fruit. Conversely, they decreased their intake of whoa foods in all groups except pizza. Specific food groups, especially dairy (girls and boys) and grains (boys only), were negatively associated with BMI, but scored highest in meeting grain intakes (8 on a scale of 10).35 Nationally, intake of fruits and milk was lower among both girls and boys (11–14 years old), and vegetable intake was lower and met higher among boys compared with 7- to 10-year-olds in the NHANES III sample.35 In contrast, the DISC intervention group reported increased dairy intake and decreased whoa dairy, increased go fats/oils and decreased whoa fats/oils, and decreased whoa vegetables (French fries) but no change in fruit intake compared with the usual-care group. Thus, DISC dietary intervention seems to have improved the diet quality as well as quantity in this age group.

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DOCTORS AND HOSPITALS LIMIT VIDEOTAPING IN DELIVERY ROOMS

“Concerned that family videos of the birth of a child could be used against them in medical malpractice cases, doctors and hospitals are limiting videotaping in delivery rooms. ‘What once used to be really fun and warm and cozy and so forth is now a potential nail in the coffin from a liability perspective,’ said Dr. John Nelson, the president of the American Medical Association and an obstetrician. Dr. Nelson does not allow families to videotape the birth itself, but they are free to record other events, such as the mother’s first moments with the child.”

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