ABSTRACT

BACKGROUND Dietary recommendations emphasize increased consumption of fruit, vegetables, and whole grain cereals for prevention of chronic disease.

OBJECTIVES This study assessed the effect of dietary advice and/or food provision on body weight and cardiovascular disease risk factors.

METHODS Healthy overweight men (n = 209) and women (n = 710), mean age 44.7 years, body mass index [BMI] 32.4 kg/m², were randomized between November 2005 and August 2009 to receive Health Canada’s food guide (control, n = 486) or 1 of 3 interventions: dietary advice consistent with both Dietary Approaches to Stop Hypertension (DASH) and dietary portfolio principles (n = 145); weekly food provision reflecting this advice (n = 148); or food delivery plus advice (n = 140). Interventions lasted 6 months with 12-month follow-up. Semiquantitative food frequency questionnaires and fasting blood, anthropometric and blood pressure measurements were obtained at baseline, 6 months, and 18 months.

RESULTS Participant retention at 6 and 18 months was 91% and 81%, respectively, after food provision compared to 67% and 57% when no food was provided (p < 0.0001). Test and control treatments showed small reductions in body weight (−0.8 to −1.2 kg), waist circumference (−1.1 to −1.9 cm), and mean arterial pressure (0.0 to −1.1 mm Hg) at 6 months and Framingham coronary heart disease risk score at 18 months (−0.19 to −0.42%), which were significant overall. Outcomes did not differ among test and control groups.

CONCLUSIONS Provision of foods increased retention but only modestly increased intake of recommended foods. Current dietary recommendations showed small overall benefits in coronary heart disease risk factors. Additional dietary strategies to maximize these benefits are required. (Fruits, Vegetables, and Whole Grains: A Community-based Intervention; NCT00516620) (J Am Coll Cardiol 2017;69:1103–12) © 2017 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Data from major cohort studies suggest that 82% of cardiovascular disease and 91% of diabetes risk may be prevented by changes in diet and lifestyle (1,2). To address the growing burden of chronic disease, dietary guidelines for the general public, including the Dietary Reference Intakes for the United States and Canada, focus on chronic disease reduction in addition to simple nutritional adequacy. The most recent scientific recommendations of the U.S. Dietary Guidelines Advisory committee now advocate 3 dietary patterns to prevent chronic disease: the healthy American diet, the Mediterranean diet, and for the first time, a vegetarian diet (3). All of these dietary patterns incorporate traditional advice to eat more fruit, vegetables, and whole grain cereals, plus more recent advice to eat more cholesterol-lowering “functional” foods such as oats, barley, nuts, and plant protein foods (e.g., soy and other legumes). This dietary approach fits with the recent report of the workshop convened by the World Heart Federation (4). Therapeutic diets such as the Dietary Approaches to Stop Hypertension (DASH) recommended in the AHA/ACC guidelines (5) and the dietary portfolio recommended in the Canadian Cardiovascular Society guidelines (6) to lower cholesterol also emphasize these principles and consistently result in large reductions in blood pressure and lipids when taken under metabolically controlled conditions (7–9). Yet despite efforts to encourage the general public to increase plant food consumption, the response has been slow (10).

We determined whether we could increase adherence to the DASH-type and dietary portfolio eating patterns and improve health outcomes by providing both advice and food to healthy overweight individuals.

**METHODS**

**PARTICIPANTS.** Participants were residents of the city of Toronto, 18 years or older, English speaking, and had body mass index (BMI) >25 kg/m². Individuals or families were recruited if at least 1 family member had BMI >25 kg/m², and blood pressure and thyroid medications (thyroxin) dosages, if taken, were stable for at least 1 month prior to starting the study. Exclusion criteria included pregnancy or breastfeeding; actively following a special diet or weight-loss program; major surgery or a cardiovascular event in the previous 6 months; diabetes, liver disease, renal failure, cancer (except nonmelanoma skin cancer), inflammatory bowel disease or major chronic inflammatory diseases;

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acute or chronic infections, irritable bowel syndrome; peanut or nut allergy; or a blood pressure >145/95 mm Hg on more than one occasion.

**Protocol.** Eligible participants recruited by advertisements between October 2005 and July 2009 were sent questionnaires including a semiquantitative food frequency questionnaire (11). Completed questionnaires, fasting blood, anthropometric, and blood pressure measurements were obtained at baseline and at subsequent clinic attendances at 6 and 18 months at St. Michael’s Hospital, a University of Toronto Teaching Hospital. Research Ethics boards of the University of Toronto and St. Michael’s Hospital approved the protocol. All participants provided signed consent. The trial was registered with ClinicalTrials.gov (NCT00516620).

**Dietary Interventions.** All participants received a copy of Health Canada’s Food Guide. No further advice was given to the control group. The first treatment group received additional dietary advice weekly for the first month and monthly for the following 5 months as 20- to 30-min telephone interviews with individual participants or the families’ primary shopper or cook. The advice addressed benefits, strategies for change, and barriers to change for each participating family member. Participants were encouraged to increase intake of fruit, vegetables, whole grain cereals, to reduce meat and sweets, and to increase consumption of cholesterol-lowering functional foods including soy foods, nuts, and viscous fiber sources such as oats and barley. A second treatment group received a weekly food basket (Food Share, Toronto, Ontario) for 6 months, reflecting the advice given to the first treatment group but did not receive dietary advice. A third treatment group received both the weekly food basket and dietary advice. All members of the same family were expected to follow the same treatment. Exercise patterns were recorded but no additional advice was given (Figure 1). The effect of advice to avoid sugar-sweetened beverages was also assessed using a factorial design with the addition of sugar sweetened beverage advice alone. The effect of sugar-sweetened beverage advice will be reported separately.

**Biochemical and Dietary Analyses.** Biochemical analyses were performed in the St. Michael’s Hospital (Toronto) routine laboratory. Participants’ body weight was measured without shoes in light indoor clothing on the same beam balance at each clinic visit. Blood pressure was the mean of 3 readings using an automatic sphygmomanometer (Omron HEM 907 XL, Omron Healthcare Inc., Burlington, Ontario, Canada). The original validated semiquantitative food frequency questionnaire of Willett et al. (11) was expanded to 184 food items to better capture whole grains and viscous fiber products, including oats and barley. Questionnaires were processed in the Nutrition Department, Harvard School of Public Health.

**Sample Size.** The power calculation was based on households, and randomization was planned to assess dietary change. Sample size was calculated using Student’s t-test for independent observations that required 360 controls, 120 for dietary advice, 120 for food delivery, and 120 for food delivery and dietary advice (Online Methods 1).

**Randomization.** Randomization took place between November 2005 and August 2009 to control or 1 of the 3 dietary treatment groups to achieve an approximately 3:1:1:1 ratio for the control and the 3 dietary interventions, respectively. Participants were randomized as households (assuming an average of 2 family members per household), and all members of the same household received the same treatment. A statistician not involved in the day-to-day operation of the interventions created blocks of random assignments (n = 39). Assignments were sealed in ordered, numbered, opaque envelopes. Upon consent and eligibility confirmation for the individual or household, the coordinator opened each envelope in sequence and assigned the participant to the treatment group it contained. To allow for assessment of the effect of advice to reduce consumption of sugar-sweetened beverages (to be reported separately), a factorial design was used with the addition of an extra cell of 60 households given only this advice. Their data are reported as part of the control group in the present study.

**Statistics.** Means and 95% confidence intervals (CIs) are provided. Body weight change was the primary outcome. To model change, the dependent variable was the end-of-study value with treatment (categorical) and the baseline value as independent variables in a mixed model ANCOVA (PROC MIXED), SAS version 9.4 software (Cary, North Carolina). A Tukey correction was applied for multiple comparisons where significance was found. We used an ITT (intention-to-treat) analysis that accounted for drop outs using multiple imputation (5 sets) and a monotone predictive mean matching method (PROC MI) modeled with visit, age, sex, baseline weight and height, smoking status, income, education, and baseline outcome as covariates (Online Methods 2 and 3). Results from the 5 imputations were pooled using PROC MIANALYZE. To address correlated observations within families, we added a random effect.
term to the statistical model to account for family unit. Framingham coronary heart disease (CHD) risk scores were calculated (12) using participants’ age at baseline. Dietary data were analyzed using ANCOVA, using all available data. Two further assessments of the data were also undertaken. First to assess the outcomes using household as the unit of analysis, the mean values of each household were taken and secondly those participants whose BMI was < 25 kg/m² (n = 36) were removed from the analysis, and again the data were reanalyzed.

RESULTS

SIX-MONTH OUTCOMES. A total of 919 participants were randomized (209 men, 710 women; mean age: 44.7 years, and BMI: 32.4 kg/m²) (Online Table 1). A total of 722 were randomized as single-member households, 94 as 2-member households (n = 188), and 3 as 3-member households (n = 9). A total of 685 participants completed 6 months (170 men, 515 women), equating to a 75% retention rate (Figure 1).

When “food provided” was compared to “no food provided,” a major difference was seen in retention favoring food provision, with 91% retention for those with food provision versus 67% (p < 0.0001) for those without food provision completing the 6-month active intervention.

SIX-MONTH CHANGE IN DIETARY INTAKE. At 6 months, only small increases were seen in intake of fruit (0.3 to 1.1 servings/day), vegetables (0.4 to 1.3 servings/day), and whole grains (0.0 to 1.0 servings/day) (Figure 2, Online Table 2). The increases in intake in the treatment groups compared to the control were even smaller, with only food provision plus advice showing consistent increases in fruit, vegetables, and whole grain cereals (Online Table 3). The differences were 0.8, 0.9, and 0.9 servings/day, respectively, for the 3 treatments (Figure 2). Other treatment differences, where they occurred, were small (Online Table 3).
The same pattern of very small increases was seen with the so-called functional, cholesterol-lowering, foods (nuts, viscous fiber, and soy protein foods). Thus the maximum increase in nut intake was only 6.5 g/day (under one-quarter of an ounce) following food delivery plus advice (Online Table 2).

**SIX-MONTH OUTCOMES: BODY WEIGHT AND CHD RISK FACTORS.** Overall, at 6 months, the cohort showed small reductions in body weight (−1.0 kg), waist circumference (−1.4 cm), and blood pressure (diastolic: −0.8 mm Hg and mean arterial pressure: −0.7 mm Hg) (Table 1). Similar reductions were seen on the control and individual test treatments for body weight (−0.8 to −1.2 kg), waist circumference (−1.1 to −1.9 cm), and blood pressure (diastolic: −0.1 to −1.0 mm Hg, and mean arterial pressure: 0.0 to −1.1 mm Hg) (Table 2). The within treatment differences in body weight and waist circumference were significant for the control and test treatments (Central Illustration).

The only other significant reductions were for both diastolic blood pressure and mean arterial blood pressure on control (−1.0 mm Hg, p = 0.002, and −0.9 mm Hg, p = 0.042, respectively) (Table 2). However, there were no significant treatment differences for any of the outcome measurements between any of the 4 groups (control and 3 treatments) (Online Table 4).

**DIFFERENCES AND “LEGACY EFFECTS” AT 18 MONTHS.** At 18 months, the overall retention was 65%, including 81% for those provided with food and 57% for those without food provision. Only small increases from baseline remained for fruit (0.4 to 0.6 servings/day), vegetables (0.3 to 0.6 servings/day), and whole grain cereals (0 to 0.6 servings/day). These increases were significantly reduced from the already modest 6-month increases (Online Figure 1, Online Table 5). The same pattern was seen with the cholesterol-lowering functional foods, for example, for nuts, the increase was reduced at 18 months to between 3.3 and 4.7 g/day on the test treatments, and when compared to the control increase of 3.6 g/day, these differences became negligible (−0.8 to 1.3 g/day) (Online Table 3).

For the whole cohort, the reductions in body weight, BMI and waist circumference that were seen at 6 months were maintained (Online Table 6). High-density lipoprotein cholesterol (HDL-C) rose between 6 and 18 months (0.05 mmol/l, p < 0.0001) and the total-to-HDL-C ratio was reduced. Reduction in blood pressure at 6 months was further reduced significantly between 6 and 18 months, with the reductions in the Framingham CHD risk score becoming significant at 18 months (Online Table 6). These differences were also reflected in the individual treatment responses (Online Figure 2), with no significant treatment differences either between the 18-month changes from baseline or between the 6 to 18 months differences (Online Tables 4 and 7).

**ADDITIONAL ANALYSES.** No outcome differences at 6 and 18 months were uncovered by assessing the data by using household as the unit of analysis or by eliminating those family members who had body weights in the normal range (Online Tables 8 and 9).

**ADVERSE EVENTS.** There were 24 serious adverse events according to the Code of Federal Regulations (13) (7 control, 11 food basket and dietary advice, 4 food basket only, and 2 dietary advice only) (Online Table 10). After adjustment for length of participant time in the study the difference between the pooled test and control treatments failed to reach significance (p = 0.068). However, separate assessment of gastrointestinal-related events indicated significantly more events among test participants than control participants: 7 versus 0. Adverse events were cholecystectomy (n = 3), appendectomy (n = 2), hiatal hernia repair (n = 1), and diverticulitis (n = 1), p = 0.005 (Online Table 10).

**DISCUSSION**

These data demonstrate the difficulty in effectively promoting fruit, vegetable, and whole grain cereals to
the general population, using recommendations that, when followed, decrease risk factors for chronic disease (Central Illustration). They indicate an urgent need for innovative approaches to support the implementation of current dietary advice (5,6,14,15).

Our findings are supported by a meta-analysis of smaller shorter studies, beginning in 1998, that showed no change in body weight compared to the control treatment even when fruit and vegetables were provided (16,17). However our results contrast with trials in participants at higher risk (8). One trial of 345 participants with hypercholesterolemia, many of whom had been given a statin “holiday,” showed low-density lipoprotein cholesterol (LDL-C) reductions of 13% to 14% with corresponding 41% to 46% adherence to a dietary portfolio of cholesterol-lowering foods (8), as opposed to only 12% adherence in the present study. In this respect, a very recent large (543 participants) comprehensive lifestyle peer group-based intervention on cardiovascular risk factors also found no significant effect on individual risk factors, although due to a major success in smoking cessation, a reduction in estimated cardiovascular risk was achieved (18). In that trial 31% of participants smoked compared to 7.8% in the current study. Smoking cessation, exercise, and stress management were not part of our purely dietary intervention.

ADVERSE EVENTS. Those given advice plus the food basket suffered an excess of gastrointestinal side effects. Although the diets prescribed are recommended for long-term gastrointestinal health, it is possible that the acute increase in fiber from cereals, fruits, and vegetables may have caused some abdominal discomfort and drawn attention to pre-existing conditions. The increase in fiber intake compared to the control at 6 months was 8.2 g/day extra for a 2,000 kcal diet. This fiber intake was equivalent to 4 slices of whole wheat bread daily. However, these participants were already accustomed to a reasonable fiber intake at baseline (25.4 g/day), and problems were not anticipated with higher fiber diets.

FACTORS FAVORING LIFESTYLE CHANGE. The success of dietary advice may be influenced by the perception of immediate benefit from the intervention. Further emphasis is therefore required on the longer term health advantages of sustaining a good diet for otherwise healthy people, as has been demonstrated in cohort studies with long-term follow-up (19,20). Usual diets may also represent stable “habits” that are resistant to change without specific personal and environmental supports (21). Thus more emphasis should be placed on overcoming barriers related to methods of food preparation and in illustrating those situations in which the desired foods can be eaten (meals and snacks). Addressing these issues in cafeteria trials where entire meals were fed to healthy people addressed the issue of diet adherence and demonstrated that lower body weight and blood lipids can be achieved in the long term (22). Consumption of nuts has increased considerably since the repeated demonstration of their cholesterol-lowering potential, their possible CHD risk reduction properties in cohort studies, and recently, in a randomized controlled trial (23–25). However this secular trend did not increase our success in promoting

### TABLE 1: Mean Baseline Values and Changes in Outcomes at 6 Months for All Participants*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>N</th>
<th>Mean Baseline</th>
<th>95% CI</th>
<th>Mean Change</th>
<th>95% CI</th>
<th>Pr &gt;</th>
<th>H0†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, kg</td>
<td>919</td>
<td>88.2</td>
<td>87.0 to 89.3</td>
<td>87.1</td>
<td>86.0 to 88.3</td>
<td>-1.0</td>
<td>-1.4 to -0.7</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>919</td>
<td>32.4</td>
<td>32.1 to 32.8</td>
<td>32.1</td>
<td>31.7 to 32.5</td>
<td>-0.4</td>
<td>-0.5 to -0.2</td>
</tr>
<tr>
<td>Waist, cm</td>
<td>919</td>
<td>101.4</td>
<td>100.5 to 102.3</td>
<td>100.0</td>
<td>99.0 to 101.0</td>
<td>-1.4</td>
<td>-1.9 to -0.9</td>
</tr>
<tr>
<td>Glucose, mmol/l</td>
<td>919</td>
<td>4.82</td>
<td>4.78 to 4.85</td>
<td>4.83</td>
<td>4.78 to 4.87</td>
<td>0.01</td>
<td>-0.03 to 0.04</td>
</tr>
<tr>
<td>Total cholesterol, mmol/l</td>
<td>919</td>
<td>5.06</td>
<td>5.00 to 5.12</td>
<td>5.01</td>
<td>4.94 to 5.08</td>
<td>-0.05</td>
<td>-0.10 to 0.01</td>
</tr>
<tr>
<td>LDL-C, mmol/l</td>
<td>915</td>
<td>3.23</td>
<td>3.18 to 3.28</td>
<td>3.19</td>
<td>3.13 to 3.24</td>
<td>-0.04</td>
<td>-0.08 to 0.00</td>
</tr>
<tr>
<td>HDL-C, mmol/l</td>
<td>919</td>
<td>1.28</td>
<td>1.26 to 1.31</td>
<td>1.27</td>
<td>1.25 to 1.29</td>
<td>-0.01</td>
<td>-0.03 to 0.00</td>
</tr>
<tr>
<td>Triglycerides, mmol/l</td>
<td>919</td>
<td>1.21</td>
<td>1.16 to 1.25</td>
<td>1.22</td>
<td>1.17 to 1.27</td>
<td>0.01</td>
<td>-0.03 to 0.05</td>
</tr>
<tr>
<td>Total cholesterol/HDL</td>
<td>919</td>
<td>4.16</td>
<td>4.09 to 4.23</td>
<td>4.15</td>
<td>4.08 to 4.23</td>
<td>-0.01</td>
<td>-0.05 to 0.04</td>
</tr>
<tr>
<td>Non-HDL cholesterol, mmol/l</td>
<td>919</td>
<td>3.77</td>
<td>3.72 to 3.83</td>
<td>3.74</td>
<td>3.67 to 3.80</td>
<td>-0.03</td>
<td>-0.08 to 0.01</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>919</td>
<td>114.6</td>
<td>113.8 to 115.4</td>
<td>114.0</td>
<td>113.1 to 114.8</td>
<td>-0.6</td>
<td>-1.3 to 0.1</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>918</td>
<td>73.0</td>
<td>72.4 to 73.5</td>
<td>72.1</td>
<td>71.5 to 72.7</td>
<td>-0.8</td>
<td>-1.3 to -0.4</td>
</tr>
<tr>
<td>Mean arterial pressure, mm Hg</td>
<td>918</td>
<td>86.8</td>
<td>86.2 to 87.4</td>
<td>86.1</td>
<td>85.4 to 86.8</td>
<td>-0.7</td>
<td>-1.3 to -0.1</td>
</tr>
<tr>
<td>10-yr CHD risk %</td>
<td>919</td>
<td>3.58</td>
<td>3.32 to 3.84</td>
<td>3.48</td>
<td>3.22 to 3.74</td>
<td>-0.10</td>
<td>-0.21 to 0.02</td>
</tr>
</tbody>
</table>

*To convert the values to milligrams per deciliter, divide cholesterol by 0.0259, triglycerides by 0.0113, and glucose by 0.0555.

BMI = body mass index; CHD = coronary heart disease; HDL = high-density lipoprotein; LDL = low-density lipoprotein.
<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Mean Values and Changes (95% CI) in Outcomes at Baseline and 6 Months for All Participants, by Treatment Group*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control (n = 486)</strong></td>
<td><strong>Food Only (n = 148)</strong></td>
</tr>
<tr>
<td><strong>Baseline</strong></td>
<td><strong>6 Months</strong></td>
</tr>
<tr>
<td>Weight, kg</td>
<td>88 (86.5 to 89.5)</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>32.5 (32 to 33)</td>
</tr>
<tr>
<td>Waist, cm</td>
<td>101.2 (100 to 102.5)</td>
</tr>
<tr>
<td>Glucose, mmol/l</td>
<td>4.81 (4.77 to 4.86)</td>
</tr>
<tr>
<td>Total cholesterol, mmol/l</td>
<td>5.09 (5 to 5.17)</td>
</tr>
<tr>
<td>LDL-C, mmol/l</td>
<td>3.27 (3.19 to 3.34)</td>
</tr>
<tr>
<td>HDL-C, mmol/l</td>
<td>1.27 (1.24 to 1.3)</td>
</tr>
<tr>
<td>Triglycerides, mmol/l</td>
<td>1.23 (1.16 to 1.29)</td>
</tr>
<tr>
<td>Total cholesterol/HDL</td>
<td>4.2 (4.1 to 4.3)</td>
</tr>
<tr>
<td>Non-HDL cholesterol, mmol/l</td>
<td>3.81 (3.73 to 3.9)</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>114.7 (113.6 to 115.8)</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>73.3 (72.5 to 74)</td>
</tr>
<tr>
<td>Mean arterial pressure, mm Hg</td>
<td>87.1 (86.2 to 87.9)</td>
</tr>
<tr>
<td>10-yr CHD risk %</td>
<td>3.55 (3.21 to 3.89)</td>
</tr>
</tbody>
</table>

*To convert the values to milligrams per deciliter, divide cholesterol by 0.0259, triglycerides by 0.0113 and glucose by 0.0555. Values in boldface indicate significance. Abbreviations as in Table 1.
nut intake by our group. Research must therefore continue to be funded to clearly establish the benefit of dietary strategies on health outcomes that, after publication, can be taken up by the media and hence the general public. The successful PREDIMED (PREvencion con DIeta MEDiterranea) study provided nuts and olive oil freely to participants (23). Should healthy foods also be subsidized for the general public?
population? In the present study, provision of foods very significantly increased retention. Although this approach only resulted in modest increases in consumption of recommended foods or reductions in study outcomes, retention itself may be an indication of continued adherence.

Finally, should the ecological sustainability advantages of increased plant food consumption be emphasized? Sustainability considerations are increasingly alluded to in current dietary guidelines and science advisory reports internationally (3,26), and may increase the appeal to younger and healthier people, similar to our participants.

ADHERENCE IN THE PRESENT STUDY. Using the above ideas, adherence in our study might have been improved if our participants had had compelling reasons to change their dietary habits, including raised LDL-C or elevated blood pressure (baseline LDL-C: 3.23 mmol/l, and blood pressure: 115/73 mm Hg in the present study). Furthermore, provision of complete diets or use of workplace cafeteria to provide meals incorporating DASH and portfolio dietary principles, plus a comprehensive educational program on the value of food in the maintenance of good health, might also have been helpful.

STUDY LIMITATIONS. A significant limitation of the study was the differential dropout rate between the treatment arms, with a 6-month retention of 91% in the 2 food delivery arms versus 67% when no food was provided. Similar effects of food provision have been seen in longer diet trials such as the PREDIMED trial where provision of nuts or olive oil was associated with enhanced retention (23), and high retention rates commonly observed in drug trials may relate in part to the free provision of the intervention. It is interesting that in our study there also appeared to be a “legacy effect” in that when no food was provided, prior provision of food still resulted at 18 months in an 81% retention versus 57% where no food had been provided.

A second limitation was the provision of Canada’s Food Guide, which may have had beneficial effects in increasing intake of the desired foods in the control group; however, the changes observed were small. Furthermore, we did not recruit sufficient family members to allow the assessment of family influences on dietary change. Third, as the participants were generally healthy at baseline, with 18% of participants who belonged to 2- or 3-member family units already at a healthy body weight (4% of total group), changes in risk factors may have been more difficult to detect and so limited our ability to see an effect.

STRENGTHS. One strength of our study is that it is the first to encourage specific food consumption by providing both dietary advice and a range of foods that included less familiar functional foods. It is also the first to do so in the context of DASH and portfolio dietary approaches, and determine the effects on body weight and risk factors for CHD. In addition it demonstrated that removal of certain potential barriers to consumption including availability and familiarity (e.g., soy products) was not enough to increase substantially the use of desired foods in overweight but otherwise healthy people.

CONCLUSIONS

Increasing the intake of not only fruit, vegetables, and whole grain cereals but also functional foods proved difficult (27), even when these foods were provided weekly and despite the known effectiveness of such foods in managing CHD risk factors. Healthy shifts in diet among generally well populations is likely to require a range of sustained approaches and multiple forms of communication in a process measured in decades rather than months (10).

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COMPETENCY IN SYSTEMS-BASED PRACTICE: Although fruit, vegetables, and whole grain cereals are part of dietary advice given internationally, foods containing soy protein, nuts, viscous fiber sources (oats, barley, psyllium), and plant sterols (e.g., as in enriched margarine) have been approved by the U.S. Food and Drug Administration for heart health claims since they specifically lower serum cholesterol.

TRANSLATIONAL OUTLOOK: Dietary change is difficult in relatively healthy populations and may take community-based strategies to implement effectively, but even limited patient instructions, including pamphlets and guidelines from national public health agencies may lead to reductions in body weight and coronary heart disease risk scores.
REFERENCES


KEY WORDS Body weight, cardiovascular disease, diet, dietary recommendations, risk factors

APPENDIX For an expanded Methods section and additional tables and figures, please see the online version of this article.