Published in final edited form as:

J Am Diet Assoc. 2008 December ; 108(12): 2059–2065. doi:10.1016/j.jada.2008.09.006.

Design of a Mediterranean Exchange List Diet Implemented by Telephone Counseling

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Abstract

A Greek-Mediterranean dietary pattern has two distinct aspects that differ relative to average intakes in the United States: a high intake of monounsaturated fats and a high intake of fruit and vegetables. The purpose of the study was to develop and test an exchange list Greek-Mediterranean diet that could be used in future clinical trials of breast cancer prevention. A total of 69 women, ages 25 to 59 years, were randomized to either continue their own usual diet or follow an intervention diet for 6 months during 2004 through 2005. Intervention goals were to decrease usual fat intakes by about half and to replace those fats with olive oil and other high-monounsaturated fatty acid foods; increase fruit and vegetable intakes to 7 to 9 servings/day, depending on energy intake; and consume at least one serving per day each of culinary herbs and allium vegetables. Registered dietitians provided exchange goals and individualized telephone counseling, and diets were self-selected using a Mediterranean exchange list developed specifically for this study. Changes in diet were assessed by 7-day food records. Results demonstrated that counseling using the Mediterranean exchange list was effective for large dietary changes relative to the nonintervention group. Repeated measures analysis of variance indicated a statistically significant 48% increase in dietary monounsaturated fat with no appreciable change in total fat intake, and a significant increase in fruit and vegetable intake from 4.0 to 8.6 servings/day ($P < 0.05$).

A Greek-Mediterranean type of eating pattern has been associated with multifaceted health effects, including lower risks of both cardiovascular disease and cancer. Initial observations found a remarkably low incidence of coronary artery disease on the Greek island of Crete (1). In more recent, large European studies, Mediterranean eating patterns have been shown to decrease all-cause mortality and increase longevity (2,3). Epidemiological evidence also points to the protective effects of a Greek-Mediterranean diet on risk of breast and other cancers (4-6).

Eating patterns in Greece are changing, but breast cancer mortality in Greece remains low, while fat intake is still relatively high relative to other Western countries including the United States, United Kingdom, and Denmark (7). A prominent feature of the Greek diet is a high monounsaturated fatty acid (MUFA) intake in a diet that was fairly high in total fat (40% of energy from fat), although some estimates for total fat intake are lower (8). The traditional

Cretan diet had a polyunsaturated fatty acid (PUFA)-to-saturated fatty acid (SFA)-to-MUFA ratios of 1:2.7:9.7 in 1960 and 1:3.3:5.7 in 1988, stemming largely from the use of olive oil (9). In contrast, data from the United States in 1999 through 2000 indicate the average American diet had a PUFA:SFA:MUFA ratio of 1:1.6:1.9 (10).

Another prominent feature of the traditional Greek diet was a high consumption of fruit and vegetables. The 1960s diet of Crete included >700 g/day of fruit and vegetables in a wide variety, which would correspond to about 4 cups/day (11-15). The traditional Greek diet also included 20 g/day of wild greens that are rich in lutein (16). Wild greens are generally not used as a food in the United States, but dark green vegetables and herbs are high in lutein and could be targeted for increased consumption.

In order to test the cancer preventive effects of a Mediterranean dietary pattern, intervention studies need to be conducted (17,18). For such studies, effective methods are needed to elicit diet change. The studies done thus far rarely targeted both fat and fruit/vegetable intakes, many were very small, and the extent of dietary change achieved varied widely (19,20). The largest study done was in a Mediterranean population that might be expected to have good adherence (21). None of the studies formalized the counseling approach into an exchange list, therefore, an exchange list diet that would target both a desirable type of fat intake and plentiful fruits and vegetables was designed using Western foods. The long-term goal for developing the Mediterranean exchange list is to test the diet in studies of breast cancer prevention. The elements of the exchange list diet are reported here, as are changes in dietary intakes in women using data from 7-day food records. The hypothesis was that telephone counseling would result in large dietary changes because this type of counseling has been used in other studies that targeted increases in fruit and vegetable consumption (15,22).

METHODS

Subjects

The Mediterranean Eating Study was approved by the Institutional Review Boards of Wayne State University and the University of Michigan. Women ages 25 to 65 years were eligible and gave written, informed consent to participate. Advertisements in community newspapers and at health fairs were used as well as flyers and employee newsletters. Recruitment spanned April 2004 to August 2005.

Diets considered as eligible exhibited a fat intake of at least 23% of calories from 7-day food records, with no more than 48% of fat intake being from MUFA. With lower fat diets, including a substantial amount of fat from olive oil would be difficult without increasing overall fat content of the diet. Fruit and vegetable intakes considered as eligible were <5.5 servings/day, not including white potatoes and iceberg lettuce. For this calculation, the serving sizes given in Figure 1 were used. The eligibility cutoff was set to allow people with typical American intakes to be eligible, while still affording an increase of at least two servings/day by the intervention.

Other eligibility criteria included being in good general health, currently a nonsmoker, and in the normal to overweight range (body mass index [BMI; calculated as kg/m^2]=18.5 to 30). Exclusion criteria included people who reported having chronic diseases, such as diabetes mellitus, autoimmune disease, or high blood pressure; being on medically prescribed diets; taking dietary supplements >150% of Recommended Dietary Allowances; being pregnant or lactating; or being treated with therapies or supplements that could obscure the ability to detect diet effects.

Study Design

The 6-month study was conducted by three registered dietitians (RDs). Subjects were stratified by race and menopausal status prior to randomization using a block size of six. All participants filled out demographic questionnaires, were measured for weight and waist circumference, and were asked to return 7-day food records at baseline, 3 months, and 6 months. Height was measured at baseline only. All data was entered or exported into Microsoft Excel files (Excel 2002, 2002, Microsoft Corp, Redmond, WA), 5% of records were randomly spot-checked for accuracy by the study director by comparison to the original paper forms that the subjects filled out, and all data were reviewed again for accuracy using summary statistics to identify any unusual records that needed additional review for accuracy.

Diet Assessment—Food records were analyzed using the Nutrition Data System Research software from the University of Minnesota (database version 35 and software version 5.0, May 2005, Minneapolis, MN). Data for 7 days of intake was averaged for each subject, except in a few instances where all 7 days were not recorded or there was a highly unusual day because of illness.

Anthropometrics—Subjects were weighed in light clothing on a Health-O-Meter professional beam balance (Health-O-Meter, Boca Raton, FL) to the nearest 0.1 kg, height was obtained with a stadiometer to the nearest 0.5 cm, and waist circumference was obtained to the nearest 0.5 cm using a flexible tape measure taking care to capture the curve of the back. Written instructions were provided to trained observers in the General Clinical Research Center for taking these measurements consistently for this study. All measures were taken once at each of three visits. BMI was calculated as kg/m^2 .

Nonintervention Diet—Women assigned to this group did not receive any dietary counseling. If their intake of any vitamin or mineral was <67% of Recommended Dietary Allowances, they were given a list of foods that are rich in that nutrient. The National Cancer Institute's *Action Guide to Healthy Eating*, which emphasized fruits and vegetables, whole grains, and reduced fat intake, was given to all women in this group (National Institutes of Health publication no. 95-3877, May 1995). As an incentive, they were offered one free dietary counseling session after their participation ended.

Intervention Diet: Modified Mediterranean Diet—The diet goals were based on considerations of Greek intakes and on the types of foods available in the United States. The fruit and vegetable goal was 7 to 9 servings/day, depending on energy intake, and the fat intake goal that was both feasible and reasonably close to the Greek intakes was a PUFA:SFA:MUFA ratio of 1:2:5. This fat goal was to be reached by reducing usual fat intakes by half using lowfat foods, and then adding olive oil or other high-MUFA foods to the diet to keep energy and total fat intakes at baseline levels. In particular, it was important to limit PUFA intake because it is PUFA intakes that are very high in Western foods and greatly affect the desired fat ratio.

To achieve change in the type of fat consumed, subjects were asked to choose “very lean” meats and “lean” meats from the exchange list and to limit meat intake overall. Margarine and other high-PUFA foods were largely eliminated, and commercially prepared foods with polyunsaturated fats were limited to minimal usage. Fats were added to the diet from olive oil and high-MUFA plant foods (Table). Foods were defined as a “high-MUFA food” on the exchange list if the polyunsaturated content of the food was 10% of energy or less and MUFA content was 54% of energy or more (eg, PUFA:SFA:MUFA ratio of 1:1.6:8.7 for olive oil). The moderate MUFA foods contained up to 23% of energy from PUFA and 18% to 53% of energy from MUFA (a PUFA:SFA:MUFA ratio of 1:0.5:3 for almonds). Finally, the “MUFA fats with high PUFA” were foods containing 24% to 30% of energy from PUFA and 31% to

60% of energy from MUFA (a PUFA:SFA: MUFA ratio of 1:0.4:1.6 for peanuts). Participants were taught to use olive oil in salad dressings, on breads, with vegetables, and in the preparation of foods. Subjects received 3 L extra-virgin olive oil at both baseline and 3-month visits.

Increase in fruits and vegetables while maintaining baseline energy intake was accomplished by substituting fruits and vegetables for other carbohydrates. To ensure a fruits and vegetables intake near that of the traditional Cretan diet (11,12), the goal was to consume 7 to 9 servings of fruits and vegetables per day, depending on energy intake: 7/day for <1,700 kcal/day; 8/day for 1,700 to 2,000 kcal/day; and 9/day for >2,000 kcal/day (note: 7 servings can weigh about 600 g). Variety was achieved using exchange lists that divided fruits and vegetables into eight categories, which was a modification of what we and others used previously to increase carotenoid intakes (15,23). A brief version of the exchange list, together with serving sizes, is shown in Figure 1. Initially, subjects kept food records and enumerated all exchanges daily for about 1 month. After subjects became adept at enumerating exchanges, they were given a fast-track checklist to use daily that only enumerated the high-MUFA fats and fruit/vegetable categories.

RDs determined exchange goals for each subject at the baseline visit. The goals met the study requirements while maintaining each subjects' own reported caloric and total fat intakes. A typical diet contained 30% of energy from fat, 20% of energy from protein, and 50% of energy from carbohydrates. Participants also received 7 days of example menus for their own particular caloric and fat intake level. The intervention was implemented using telephone appointments and subjects were asked to mail or fax their self-monitoring records to the RD before the call (15,24). The counseling was weekly for the first 3 months and biweekly thereafter. The counseling at baseline and 3 months was in person. This individualized counseling was sensitive to the needs and abilities of each individual. Participants were counseled not only on home-eating patterns, but also on special topics, such as restaurant eating, parties, holiday eating, social support, and eating at work. The study director conducted a case review monthly to ensure that the counseling was done appropriately for each subject.

Statistical Methods

Demographic characteristics of the two diet groups at baseline were compared by two-sample *t*-tests for continuous measures such as age, BMI, weight, waist circumference, and by χ^2 tests for comparing proportions, such as ethnicity (white or not), marital status (currently married or unmarried), employment status (employed or unemployed), and family history of cancer. For variables where an observed cell frequency fell below 5, the χ^2 test was replaced by Fisher's exact test. Changes in dietary intakes from 7-day food records at each time point were modeled using repeated measures analysis of variance. The main grouping variables of diet arm, time, and diet×time interaction were used as factors in all models with different dietary intake measures as outcomes. The correlation between the measurements at baseline, 3 months, and 6 months within each subject was modeled using a completely unstructured variance-covariance matrix, thereby providing a robust option. The mixed-model approach used all available data from each subject, yielding an intention-to-treat analysis. In contrast to an analysis that includes only subjects who completed the study, an intent-to-treat analysis has better power and is more effective in reducing selection bias. All post hoc tests used a Bonferroni correction protecting overall type I error at 5%. Similar analyses were carried out to evaluate changes in body weight and waist circumference over time. The analyses were all carried out using SPSS 15.0 (2006, SPSS Inc, Chicago, IL) with a significance level of 0.05.

RESULTS AND DISCUSSION

Subjects

A total of 69 women were enrolled in the study and 60 completed 6 months of participation (Figure 2). The mean BMI of enrolled women was 24 (range=19 to 30) and mean age was 44 years (range=25 to 59 years). Most (59 of 69) of the women were white and most (40 of 69) were married. Six of the women in the study had some college while 31 were college graduates and 32 had a graduate degree, perhaps because university-affiliated medical centers were a major source of recruitment. The high education levels of the subjects may have facilitated adherence to the counseling. There were no statistically significant differences in any of these demographic characteristics between the two diet groups, or between the nine women who did not complete the study and the 60 women who did ($P>0.3$ in each case).

Weight and Waist Circumference

Mean body weight at baseline was not substantially different in the two diet groups (66.2 kg in the nonintervention and 67.3 kg in the Mediterranean group). Both groups exhibited small, nonsignificant weight loss while in the study. In the nonintervention group, mean weight loss with respect to baseline was 0.27 and 0.24 kg at 3 and 6 months, respectively. In the Mediterranean group, mean weight loss was 1.35 and 1.21 kg at those respective time points. Both diet groups also were similar in mean waist circumference at baseline and 6 months, and both groups decreased waist circumference slightly during the study period. Mean waist circumference decreased in the nonintervention group by 1.3 and 1.8 cm at 3 and 6 months, respectively, and the decreases were 1.7 and 2.2 cm in the Mediterranean group. These changes were not statistically significant relative to baseline.

Dietary Intakes

There were no statistically significant differences between the two groups in dietary intakes at baseline, indicating that the randomization was effective. There were, however, statistically significant differences between the groups at 3 and 6 months, indicating an intervention effect.

The analysis of variance indicated that there were both between-group and within-group differences. Overall, the intervention was effective in maintaining significant differences between the two diet groups in mean intakes of several nutrients during the entire study period. Compared to the nonintervention group, the Mediterranean group had a significantly higher intake of MUFA, fruit, vegetables, α -tocopherol, lutein, lycopene, α -carotene, β -carotene, and β -cryptoxanthin when averaged over time (ie, the Diet main effect in the Table). With respect to SFA and γ -tocopherol, on the other hand, the mean intake in the Mediterranean group during the study period was considerably lower than in the nonintervention group. All the significant differences were observed at the 3-month visit and were maintained at 6 months. There were no significant differences between the diet arms at the baseline.

When averaged across the diet arms, there was a substantial Time main effect from analysis of variance with respect to a variety of nutrients (Table). It is evident that this change was effected largely by the changes within the Mediterranean group, with only small to no changes observed within the nonintervention group. With regard to changes in diet with time, there were large changes within the Mediterranean group, with either no or small changes within the nonintervention group. This finding is consistent with the intent of the intervention. The only statistically significant changes in the nonintervention group were in total fat intake and SFA, both of which declined slightly during the study period. This could be due to the interest that people who volunteer for diet studies have for improving their diets. Within the Mediterranean group, carotenoid and vitamin C intakes showed substantial increases with time (at 3 and 6 months). This indicates that the intervention was successful in increasing the categories of fruit

and vegetables that were targeted by the exchange list. Specifically, while beta carotene is found in most fruits and vegetables, lutein is high in dark green vegetables and herbs, alpha carotene in dark orange vegetables, lycopene in tomatoes, and β -cryptoxanthin and vitamin C are high in many fruits (23).

Mean intake of α -tocopherol increased slightly in the Mediterranean diet group at 6 months, but γ -tocopherol decreased substantially at both 3 and 6 months. α -Tocopherol is common in supplements and fortified foods, but the major form of vitamin E in foods is γ -tocopherol. The decrease of γ -tocopherol was, therefore, likely influenced by decreased consumption of oils that are rich in vitamin E. Although this may appear to be a detrimental effect, this is not necessarily the case. Polyunsaturated oils, such as corn oil, are more easily peroxidized than monounsaturated oils; therefore, there is a greater need for antioxidants in polyunsaturated oils to preserve stability (25,26). Olive oil also is plentiful in other phenolic antioxidants (25).

Total fat intake and percentage of energy from fat did not change substantially in the Mediterranean group, although the percentage of energy from fat did increase slightly. PUFA and SFA intakes, however, both decreased considerably, by about 30%, and MUFA intake increased by about 45% (Table). Changes in these fat intakes were evident at 3 months and were maintained to 6 months. These results indicate that the targeted fat intakes were largely met in the Mediterranean group using the exchange list diet.

These results are encouraging since the intervention required simultaneous changes in many foods to achieve a modified Mediterranean pattern. In order to increase MUFA substantially while keeping total fat content constant, only low-fat foods can be consumed other than those with high MUFA content, as given on the exchange list (Figure 1). Likewise, to increase fruit and vegetable intakes without increasing total energy intakes, intakes of other carbohydrates need to be reduced. This then results in a completely different dietary pattern with changes in many nutrients. Previous intervention studies using Mediterranean interventions provided foods or meals to study participants and/or counseled study participants on increasing intakes of specific types of foods (19-21,27-30). These aforementioned studies did not utilize an exchange list as a tool for effecting a change in diet. There were also few intervention studies done in northern America where availability of foods may differ from that in southern Europe, and most of the studies were done in southern Europe.

Limitations

The present exchange list approach for changing type of fat intake and increasing fruit and vegetable intakes requires a fair amount of daily record-keeping by subjects, and it generally limits use of commercially prepared or restaurant foods. This may have contributed to the greater withdrawal rate from the intervention arm (23%) vs the nonintervention arm (3%). The women who did complete 6 months of participation in the intervention arm, however, were able to make large dietary changes. An important limitation is that most of the women recruited to the study had a college education, which may have facilitated implementation of the intervention. Limitations of the intervention design include its small size, lack of specific goals for foods high in n-3 fatty acids that were quite high in traditional Greek diets, the short time frame of the study, and the fact that waist measures were performed by multiple observers. The approach could be further modified for subsequent studies, and the optimal extent of counseling determined. With longer studies, dietary changes may become more automatic and therefore easier to maintain without as much record-keeping.

CONCLUSIONS

A Mediterranean exchange list diet was developed to target an increased amount and variety of fruits and vegetables, and an increased relative proportion of monounsaturated fats. RDs

used the exchange lists to plan a diet for each subject that maintained baseline caloric and fat intakes, and subjects were asked to track exchanges consumed from each food category. Telephone counseling by RDs provided subjects with continuing support for making the requested changes. Subjects were able to reach the goals of the Mediterranean diet within 3 months, and they maintained this change to 6 months of study. The nonintervention group made few changes in diet. The Mediterranean exchange list was therefore helpful in assisting women to make large changes in diet: increased MUFA, fruit and vegetable intakes with no change in energy or total fat intakes. The exchange list allowed women to meet the study goals while giving them flexibility in food choices within the food exchange categories. This self-selected diet may be useful for interventions that seek to decrease cardiovascular and cancer risks, and for people seeking to follow a Mediterranean style of eating using Western foods.

Acknowledgements

This work was funded by the American Institute for Cancer Research, grant number 03B043. Additional support was obtained from National Institutes of Health (NIH) Cancer Center Support Grants CA-22453 and CA-46592, the Chemistry Laboratory of the Michigan Diabetes Research and Training Center (MDRTC) and the General Clinical Research Center (GCRC) at the University of Michigan. The Michigan Diabetes Research and Training Center is funded by NIH5P60 DK20572 from the National Institute of Diabetes and Digestive and Kidney Diseases. The GCRC is funded by grant M01-RR000042 from the National Center for Research Resources (NCRR), a component of the NIH. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of NCRR or NIH.

We thank the women who volunteered to participate in the Mediterranean Eating Study. Barbara Poore helped prepare this manuscript and Jason Blythe provided data and sample management for the study. Heather Sirko, Kristen Mar, and Adrienne Wagener provided technical assistance as part of the Undergraduate Research Opportunity Program.

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Category	Goal amount	Foods
High-MUFA ^a fats	8-10/day	Olive or hazelnut oil (1 tsp), avocado (1/6), macadamia nuts (3-4), hazelnuts (10), pesto (1 Tbsp), olive tapenade (1 Tbsp), trail mix with macadamia or hazelnuts (4 Tbsp, count as 2 fats and 1 fruit)
Moderate-MUFA fats	Maximum twice/day	Butter (1 tsp), almond/cashew butter, almonds/cashews (6), pecans (4 halves), chocolate (1/2 oz or 1 Tbsp chips), light cream cheese (1 Tbsp)
MUFA fats with high PUFA ^b Low-MUFA fats	Maximum twice a week Avoid	Canola oil (1 tsp), peanuts (10), peanut butter (2 tsp) Brazil nuts, corn oil, shortening, margarine, peanut oil, pine nuts, pumpkin seeds, safflower oil, sesame oil, sesame seeds, soy bean oil, soy nuts, sunflower oil, sunflower seeds, tahini, vegetable oil, walnuts, walnut oil, hydrogenated oil, partially hydrogenated oil or shortening
Dark green vegetables	1 serving or more per day	Broccoli, Brussels sprouts, chard, dark green lettuce, greens, grape leaves, kale, nori (seaweed), *peas, spinach, watercress, zucchini (with skin)
Allium vegetables Green herbs	Use liberally once or more/day 1 Tbsp or more per day	Garlic, green onion, leeks, onions, scallions, shallots Basil, bay leaves, chervil, chives, cilantro, dill weed, marjoram, mint, oregano, parsley, peppermint, rosemary, sage, savory, tarragon, thyme
Red vegetables	1 serving or more/day	*Catsup (2 Tbsp), salsa (1/4 c), *spaghetti sauce (1/4 c), tomatoes, tomato juice (1/2 c), tomato paste (2 Tbsp), tomato sauce (1/4 c), **tomato soup (1 c), vegetable juice
Yellow/orange vegetables	1 serving or more/day	Baby carrots (4), peppers (red, orange, yellow), carrots (1 med), carrot juice (1/4 c), *pumpkin, tangerines (2), *winter squash, *plantain, canned vegetable soup (1 c), vegetable juice
Other vegetables	1 serving or more/day	Artichoke, asparagus, baby corn, bamboo shoots, bean sprouts, beets, bok choy, cabbage, cauliflower, celery, *corn, cucumber, eggplant, green beans, green peppers, kohlrabi, mushrooms, okra, *parsnip, pea pods, **potatoes, radish, rhubarb, rutabaga, sauerkraut, sugar snaps, *taro root, turnips, water chestnuts
Vitamin C fruits	1 serving or more/day	Cantaloupe, grapefruit, guava, kiwi fruit, lemon, orange, mango, papaya, strawberries, tangerine (2)
Other fruits	1 serving or more/day	Apple, apple sauce, apricot (4), banana, berries, cherries (12), dates (3), figs (2), grapes (15-20), 100% fruit juice, melon, nectarine, pineapple, plums (2-3), prunes (3), *raisins, peach, pear, starfruit, any other

Figure 1.

A brief version of the Modified Mediterranean Exchange List that was provided to intervention group participants. In addition to the categories shown, participants were asked to consume two to three exchanges of low-fat dairy foods, 5 to 6 oz of lean or very lean meat or other protein, and 6 to 11 carbohydrate exchanges each day, with amounts adjusted to maintain baseline energy and fat intakes. Unless otherwise indicated, one serving of fruits and vegetables was defined as 1 cup raw, 2 cups loose leafy greens, 1/2 cup cooked, 1/4 cup dried, 1 medium vegetable or fruit, or 1/2 cup juice (count up to two servings/day for juice, the rest of the goal was to be met from whole foods). Starred foods were to be counted as both 1 fruit/vegetables exchange and 1/2 (*) or 1 (**) carbohydrate exchange. ^aMUFA=monounsaturated fatty acid. ^bPUFA=polyunsaturated fatty acid.

Figure 2.
Subject recruitment and retention in the Mediterranean Eating Study.

Table

Dietary intakes of nutrients, fruits, and vegetables with time in women assigned to the two diet groups using 7-day food records (the nonintervention group was asked to follow their own usual diet; the Mediterranean group was asked to use the Mediterranean exchange list diet to increase the proportion of monounsaturated fatty acid in their diet and intakes of fruits and vegetables in specified variety)

Intake	Nonintervention Group			Mediterranean Group		
	Baseline (n=34)	Month 3 (n=34)	Month 6 (n=33)	Baseline (n=35)	Month 3 (n=27)	Month 6 (n=27)
Energy (kcal/d)	1,842 (77)	1,735 (62)	1,685 (66)	1,795 (75)	1,722 (68)	1,715 (71)
Total fat ^a (g/d)	72 (3.8)	67 (3.2)	61 (3.3)	68 (3.7)	68 (3.5)	69 (3.5)
% Fat ^a (% of energy)	35.1 (1.0)	34.3 (1.1)	32.9 (1.1)	34.1 (1.0)	35.5 (1.2)	36.2 (1.2)
PUFA ^{abc} (g/d)	14.7 (0.9)	13.9 (0.7)	12.5 (0.7)	15.2 (0.9)	10.7 (0.8)	10.1 (0.7)
MUFA ^{acde} (g/d)	27.6 (1.5)	25.4 (1.5)	23.2 (1.7)	25.4 (1.5)	36.0 (1.7)	37.6 (1.9)
SFA ^{cef} (g/d)	25.4 (1.4)	23.4 (1.2)	21.6 (1.2)	23.6 (1.4)	17.1 (1.3)	17.4 (1.3)
Fruit ^{ace} (svgs/d)	1.56 (0.16)	1.53 (0.20)	1.33 (0.22)	1.65 (0.15)	3.29 (0.23)	3.65 (0.25)
Vegetables ^{ace} (svgs/d)	2.74 (0.16)	2.81 (0.27)	2.87 (0.25)	2.37 (0.16)	5.14 (0.30)	4.92 (0.28)
Vitamin C ^{ace} (mg/d)	99.7 (8.1)	92.4 (10.9)	91.4 (8.9)	85.5 (8.0)	166.5 (12.1)	173.3 (9.9)
α -Tocopherol ^{de} (mg/d)	9.9 (0.9)	7.8 (0.7)	7.3 (0.8)	8.1 (0.9)	10.9 (0.7)	11.8 (0.8)
γ -Tocopherol ^{ace} (mg/d)	14.3 (0.8)	13.2 (0.8)	11.8 (0.8)	14.1 (0.8)	7.0 (0.9)	6.4 (0.9)
Lutein ^{ace} (μ g/d)	2,858 (323)	2,885 (539)	2,926 (560)	2,541 (318)	5,725 (605)	5,735 (620)
Lycopene ^{ce} (μ g/d)	3,710 (492)	4,265 (680)	5,247 (791)	4,164 (485)	8,304 (762)	8,362 (876)
α -Carotene ^{ace} (μ g/d)	570 (110)	730 (178)	866 (167)	513 (108)	1,566 (200)	1,402 (185)
β -Carotene ^{ace} (μ g/d)	3,498 (367)	3,743 (528)	4,330 (510)	3,325 (362)	7,703 (592)	7,138 (564)
β -Cryptoxanthin ^{ace} (μ g/d)	138 (22)	179 (58)	221 (101)	137 (22)	440 (65)	534 (112)

^aThese variables had a significant ($P < 0.05$) Diet $\times$ Time interaction in the repeated measures analysis of variance (ANOVA), indicating a difference between the two groups in the pattern of change over time. Fruit and vegetable servings were enumerated using the serving sizes given in the exchange list (Figure 1).

^bPUFA=polysaturated fatty acid.

^cSignificant change in dietary intake over time (ie, a significant Time main effect from the ANOVA). Changes that occurred by 3 months remained stable to 6 months.

^dMUFA=monounsaturated fatty acid.

^eDietary intake was significantly different between diet arms (ie, a significant between-group effect).

^fSFA=saturated fatty acid.

*Significantly different than intake at baseline specific to that diet arm. All post hoc tests used a Bonferroni correction with 5% overall Type I error.