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One-year results from a brief, computer-assisted intervention to decrease consumption of fat and increase consumption of fruits and vegetables

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Abstract

Background. Current cancer prevention recommendations include reducing consumption of fat and increasing consumption of fruits and vegetables.

Methods. Healthy women health maintenance organization members ($n = 616$) ages 40–70 were randomly assigned to either a nutrition intervention or a control intervention unrelated to diet. Intervention included two 45-min counseling sessions plus two brief follow-up telephone contacts. Counseling sessions included a 20-min, interactive, computer-based intervention using a touch-screen format. Intervention goals were reducing dietary fat and increasing fruit and vegetable consumption. Outcome measures included a food frequency questionnaire and the Fat and Fiber Behavior Questionnaire (FFBQ). Total serum cholesterol was also measured at baseline and 12 months.

Results. Twelve-month follow-up data showed improvements on all dietary outcome variables. Compared to the control, intervention participants reported significantly less fat consumption (3.75 points less for percentage of energy from fat), significantly greater consumption of fruit and vegetables combined (0.93 more servings per day), and a significant reduction in a behavioral measure of fat consumption (0.20 point change in the FFBQ). Group differences in total serum cholesterol, while in the desired direction, were not significant.

Conclusions. In appropriate circumstances, moderate-intensity dietary interventions can show significant effects for periods of at least 1 year.

Keywords: Diet; Randomized clinical trials; Computer-assisted; Fat reduction; Health promotion; Nutrition

Introduction

The current diet-related recommendations to prevent cancer, heart disease, diabetes, and other chronic illnesses are quite similar and compatible. Cancer prevention recommendations include reducing consumption of fat, meat, and alcohol; increasing consumption of plant-based foods, particularly fruits and vegetables; and maintaining a healthy body weight [1–3]. Dietary recommendations for heart disease prevention include reduction of fat consumption [2,4], increased consumption of fruits and vegetables [2,5,6], and the reduction or prevention of obesity [7]. Although there is some controversy about the specifics of dietary recommendations for particular conditions (e.g., [8–11]), there is general agreement that a diet rich in a variety of fruits and vegetables, and containing no more than a moderate amount of fat, is highly desirable as a prevention strategy [2].

The intervention tested in this study was designed to help healthy women increase their consumption of fruits and vegetables, and decrease fat consumption while maintaining or improving nutritional adequacy. Women of ages 40–70 were chosen for this efficacy study because this age–sex cohort has been responsive to intensive interventions focused on dietary fat [12,13]. Perhaps more important,

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women are key agents of population-based change where health and nutrition issues for their households are concerned [14].

One promising approach to providing personally tailored, moderate-intensity (one to four intervention contacts) dietary change interventions is the use of an interactive, computer-assisted program [15–19]. This method provides a personalized intervention approach in a medical care setting without making large time demands on clinic staff. Using a touch-screen computer system, patients respond to a series of questions about their current dietary habits (e.g., what they eat, where they eat), their willingness to change their diet, and personal barriers to making changes. Based on their responses and preferences they are presented with video segments and written materials appropriate for them [20]. This approach is popular with patients and requires less time from medical office staff than an individual counseling session and has the advantage of consistency of implementation [21].

The objectives of this study were to develop and test a moderate-intensity, interactive computer-assisted dietary intervention to reduce fat and increase consumption of a variety of plant foods among women who had recently had a mammogram—a potentially teachable moment for cancer-prevention messages. Four-month follow-up data were presented earlier [22], and the 1-year follow-up data are presented here.

Methods

Participants

This study was conducted in Kaiser Permanente Northwest (KPNW), a group-practice health maintenance organization (HMO) that provides comprehensive medical care to more than 440,000 members in the Portland, Oregon, metropolitan area. Health plan records were used to identify women HMO members of ages 40 to 70 who had negative results on a recent screening mammogram. To be eligible, an individual must also have had a total cholesterol test in the past 2 years of 200 mg/dl or more, and if more than one cholesterol test had been done in the previous 2 years, the mean must have been ≥200 mg/dl. This screening criterion of 200 mg/dl is slightly below the population mean for women in this age group [23]. The reason for selecting women in the top half of the cholesterol distribution was to increase the probability of detecting dietary change. Women who were taking lipid-lowering medications, with the exception of hormone replacement therapy, were excluded from the study.

Recruitment included a written solicitation followed by telephone contact. The recruitment materials emphasized cancer prevention and control and, to be consistent with this theme, the attention control intervention for this clinical trial focused on breast self-examination.

Screening

Baseline assessments were conducted during two screening visits approximately 2 weeks apart. At the first screening visit, volunteers completed questionnaires on demographics (age, race, household income, and education) and provided a fasting blood sample for cholesterol testing. Eligibility criteria included a total cholesterol >200 mg/dl for this additional blood test, willingness to consider changing dietary patterns, and willingness to consider regular practice of breast self-examination (BSE). Exclusions included plans to leave the area, treatment for any cancer in the previous year, current or planned participation in another research project in the next year, and eating meat, poultry, or fish fewer than four times per week (either separately or in combination). This last screening criterion was a simple way to exclude those who were already eating a very-reduced-fat diet and would be unlikely to further benefit from the intervention.

Participants also completed the Block food frequency questionnaire [24,25]. This questionnaire queries portion size and amount for calculating nutrient intake. Pictures of $\frac{1}{4}$- and $\frac{1}{2}$-cup serving sizes were provided to increase accuracy.

Final eligibility for the clinical trial was determined at the second screening visit, and those who consented to participate ($n = 616$) were randomly assigned to either the diet intervention condition or a control group. Participants were immediately notified of their assignment and then provided the first intervention session. Clinic staff conducting data collection were masked to participant treatment assignments.

Interventions

Control

Participants assigned to the control condition received an intervention focused on BSE, consisting of an individual counseling session at the research clinic plus two follow-up telephone calls. Content included a 9-min videotape produced by the American Cancer Society, “Instructions for Breast Self-Examination” [26], self-help pamphlets on breast self-exam [27,28], and barriers-based, problem-solving counseling regarding the participants interest and motivation for conducting regular BSE, but no dietary recommendations.

Dietary change intervention

The dietary intervention combined strategies from motivational interviewing [29,30], problem-solving [31], and social–cognitive theory [32,33]. Our intervention directly addressed motivation, self-efficacy, and stage of change by being patient-centered and negotiating gradual behavior change goals that participants were ready to accept. The focus of our intervention was helping participants to iden-

tify strategies for overcoming personal barriers and skills deficits interfering with dietary change or maintenance, and on providing opportunities for increasing environmental support to help sustain changes in eating habits [20,21]. The intervention was provided by experienced, master's degree-level health counselors.

First intervention session

The first 45-min individual counseling session started with an orientation and a description of the overall goals: reduction of dietary fat and increased consumption of fruits, vegetables, and whole grains. Participants were provided feedback on their baseline fat, fruit, and vegetable consumption relative to project goals and then asked to select one or two goals for the first session. If dietary fat was selected, they then completed a touch-screen computer-assisted assessment (about 20 min) followed by a discussion of personal goals and plans for change (about 25 min). The touch-screen program provided feedback on fat intake and other dietary patterns based upon the modified Fat and Fiber Behavior Questionnaire (FFBQ), which has been found to be a reliable and sensitive measure of behaviors related to fat intake [34–36]. The 21-item FFBQ assesses five dimensions of low-fat dietary habits: (1) *substitute* specially manufactured fat-modified foods for high-fat foods (e.g., use nonfat salad dressing), (2) *modify* meat to be lower in fat (e.g., remove skin from chicken), (3) *avoid* fried food (e.g., eat potatoes not fried), (4) *avoid* fat as flavoring (e.g., eat vegetables without butter or margarine), and (5) *replace* high-fat foods with fruits and vegetables (e.g., eat fruit for dessert). Responses to items were on a 4-point scale ("usually or always," "often," "sometimes," and "rarely or never") and scored so that a lower score reflects lower fat intake. Participants then answered questions about their personal barriers to dietary change [37] and were helped to select tailored strategies to address those barriers.

Our automated touch-screen program produced a personalized printout which the interventionist then reviewed with the participant. The participant took the printout with them at the end of the counseling session and also received nutrition education materials including descriptions of the desired dietary pattern, recipes, and helpful hints regarding shopping, restaurant eating, and snacking. This intervention session was patterned on an earlier computer-assisted intervention developed for diabetes patients [16,17].

Those not selecting dietary fat at the first session received an individually tailored counseling session focused on increasing consumption of fruits, vegetables, and whole grains. Intervention was individually tailored along four dimensions: most frequent type of barriers experienced or anticipated; level of self-efficacy regarding targeted dietary changes; the grain, fruit, and vegetable eating pattern that was most problematic; and stage of change.

Second intervention session

At the second 45-min visit 2–3 weeks later, participants reported on their progress toward achieving their goals developed during the first session. If they had not selected dietary fat as a target in the first intervention session, they then completed the automated program described above. Those who completed the automated program in the first session were encouraged to focus on increasing fruit and vegetable consumption. The focus was on the parts of their personal eating pattern they were most willing to change, and on the barriers encountered. By the end of this session, participants had made commitments to work on several dietary changes (at least one related to reducing fat and one related to increasing fruits/vegetables and/or grains) and identified personally tailored behavior change strategies for each.

Phone call support

Interventionist support was provided through follow-up phone calls after the second intervention session. These calls were scheduled 2–3 weeks after the second visit and again 2–3 weeks later. These 5- to 10-min calls provided ongoing support and checks on participants' behavior change plans. Calls began by assessing subjects' progress since the last contact. Participant attempts to change, or ambivalence about change, were discussed using principles of motivational interviewing [29,30,38]. Also, these phone calls provided personalized problem-solving training, based on the barriers to dietary self-care (or BSE) as identified during the baseline assessment. The interventionist reviewed the most likely challenges to low-fat eating (or BSE) for this participant and worked with them to develop at least one, and preferably two, coping responses for each problematic situation [37–39].

Follow-up data collection

All participants were asked to return to the research clinic 4 and 12 months after randomization for follow-up data collection. The 4-month outcome data have been reported [22]. The assessment procedures were somewhat different at 4 and 12 months. The 12-month assessment battery included the Block Food Frequency Questionnaire, the Kristal FFBQ survey, a questionnaire on BSE habits, and a blood draw to determine total serum cholesterol.

Analyses methods

Standard descriptive statistics were used to examine distributions, and analyses of variance were conducted to evaluate characteristics of those who dropped out vs those who were present at follow-up. To evaluate our primary hypotheses concerning between-condition differences on dietary behavior at 12 months, we used a multivariate general linear models analysis for the three outcomes of interest, with baseline values of the variables as covariates (see Table 2).

Table 1
Participant characteristics at baseline[a]

	Attention Control (n = 308)		Dietary behavior Intervention (n = 308)	
	Mean	SD	Mean	SD
Age	54.4	6.8	53.1	7.0
Weight	177.4	45.6	176.3	43.7
BMI	30.2	7.1	30.4	6.7
Minority group member (%)	8.8		5.5	
College grad or more (%)	37.3		43.2	

[a] There were no significant differences between conditions for any of these baseline measures ($P > 0.05$). Continuous measures were tested with t tests and dichotomous measures with chi-square tests.

Follow-up univariate analyses to identify sources of difference were conducted if the overall multivariate test was significant. Analyses of covariance were used to evaluate between condition effects on serum cholesterol, with baseline values serving as the covariate.

Results

The baseline characteristics of the 616 participants did not differ significantly between the dietary intervention and the attention control conditions (Table 1). Attrition was low, with 89% of the intervention and 85% of the control condition participants returning for the 12-month follow-up data collection visit. Two-way analyses of variance on participant characteristics and baseline values of dependent variables failed to reveal significant main or interaction effects of attrition status (present or absent at follow-up), group assignment, or interaction of group assignment by attrition status. Therefore, analyses were conducted on those present at follow-up.

A high proportion of participants received all of the intervention components. In the diet intervention condition, 98% of the participants received the touch-screen computer program, 96% completed the second intervention session, 86% received at least one follow-up phone call, and 74% received two follow-up phone contacts. Similar participation rates were seen in the control condition.

As can be seen in Table 2, there were consistent differences favoring intervention on all of the dietary outcomes variables. The multivariate test was highly significant [Wilks' lambda: $F = 25.6$ (df = 3, 460), $P < 0.001$], indicating an overall impact of intervention on dietary outcomes. Follow-up univariate analyses on the estimated means adjusted for baseline levels revealed significantly greater improvements among intervention than control participants on all three of the key dependent variables (each $P < 0.001$, see Table 2). The percentage of calories from fat decreased slightly in the control condition, and dropped considerably in the diet intervention group, resulting in an adjusted 3.75 percentage point difference between conditions. Mean dietary fat consumption decreased approximately 7 g/day in the attention control compared to 16 g/day in the intervention condition.

Combined fruit and vegetable consumption increased slightly in the control condition, but not nearly as much as in the intervention condition, for an adjusted mean difference between the conditions of 0.93 servings per day. Finally, the adjusted mean Kristal fat behavior score group difference of 0.20 indicated a significant effect of intervention on fat-related dietary habits.

There were significantly greater declines in consumption of saturated fat (SFA), monounsaturated fat (MUFA), and polyunsaturated fat (PUFA) in the intervention group compared to the control group. For SFA, the percentage of energy in the control group declined from 13.6% at baseline to 13.2% at 12 months, compared to 14.0 to 12.4%, respectively, in the intervention group ($P < 0.001$). For MUFA, the percentage of energy in the control group declined from 14.8 to 14.0% compared to 15.2 to 13.1%, respectively, in the intervention group ($P < 0.001$). For PUFA, the percentage of energy in the control group declined from 8.1 to 7.5% compared to 8.3 to 6.7%, respectively, in the intervention group ($P < 0.001$).

Serum cholesterol results were less clear. The ANCOVA

Table 2
Baseline means and adjusted 12-month group differences[a]

	Baseline unadjusted Mean (SD)	12-month adjusted Mean (SD)	Group diff. Inter-Cont	P
Percentage energy from fat				
Control	39.41 (6.27)	38.61 (6.57)	−3.75	<0.001
Intervention	40.60 (7.25)	34.86 (6.56)		
Servings of fruit and vegetables/day				
Control	3.21 (1.97)	3.40 (1.90)	0.93	<0.001
Intervention	3.09 (1.76)	4.33 (1.90)		
Kristal fat behavior score				
Control	1.87 (.37)	1.91 (.28)	−0.20	<0.001
Intervention	1.97 (.45)	1.70 (.28)		

[a] Adjusted for baseline covariate values of percentage energy from fat, servings of fruits and vegetables, and Kristal fat behavior score.

Table 3
Baseline and 12-month total serum cholesterol (mg/dl)

	N	Baseline mean (SD)	12-month mean (SD)	Change	Group difference	*P*
Control	271	232.08 (25.18)	225.89 (29.24)	−6.19	2.47	.400
Intervention	277	230.81 (23.17)	223.42 (26.79)	−7.39		

conducted on all participants who had cholesterol data at baseline and 12 months ($n = 548$) was nonsignificant (Table 3). However, the same analysis conducted on the subset of participants who had complete dietary data and were included in the MANCOVA above ($n = 463$) revealed significantly greater reductions in the intervention than in the control condition (mean adjusted difference of 3.82 mg/dl, $P < 0.006$).

Discussion

The magnitude of dietary change was moderate, between 0.5 and 0.6 of a standard deviation greater improvement for the intervention than control condition on the behavioral outcome measures. It was also encouraging that these differences were equally as large as the effect size observed at the earlier 4-month follow-up [22]. The 4-month group difference in percentage of energy from fat was 2.35 percentage points, the 4-month difference for servings of fruit and vegetables was 1.04 servings, and the 4-month difference in the Kristal fat behavior score was 0.24. That is, there was excellent maintenance of the intervention effect.

Such positive results have also been seen in other studies using similar, moderate-intensity dietary change interventions. Beresford et al. [40] found small but consistent reductions in dietary fat intake with an intervention consisting of written self-help materials, a brief counseling session, and a follow-up phone call. Subjects for that study were drawn randomly from the general population of patients in primary care clinics. Similar reductions in fat, and increases in fruit and vegetable consumption, were found by Kristal et al. [34], with the intervention including computer-generated tailored letters, motivational phone calls, a self-help manual, and computer-generated feedback on a self-administered food frequency questionnaire. Using a somewhat different approach, both DeBourdeaudhuij and Brug [41] and Campbell et al. [42] provided participants either individually tailored dietary advice or generic dietary advice through the mail. The individualized advice resulted in significantly greater reductions in dietary fat compared to the general advice.

Most studies [34,40,42] have found that the medical care setting was well suited to a starting point for dietary change interventions. A number of smoking-cessation studies have also reported that the medical setting provides a “teachable moment” for health behavior change [43–46]. Given that moderate-intensity interventions are of limited power, the timing for their delivery is critical. Presented at the wrong time, they may have no measurable effect; provided at the right time, they may have lasting effects. The Campbell et al. [42] and De Bourdeaudhuij and Brug [41] studies indicate that the effect may be greater if the message is tailored to the individual patient.

The results of our study, as well as those of the studies reviewed above, show that well-timed, moderate-intensity interventions can achieve modest but significant changes in dietary patterns, and that these changes persist for at least 1 year. Although longer-term follow-up and cost-effectiveness studies are needed, the benefits of these moderate-intensity interventions are clear.

The primary limitation of our current study is the reliance on self-reported dietary intake. Although we feel that this type of assessment is appropriate for brief and moderate-intensity interventions, bias of participant reports cannot be ruled out without objective verification. Unfortunately, biochemical markers of fruit and vegetable consumption are expensive and are sensitive to only some types of fruit and vegetables. Similarly, while serum cholesterol is a reasonable measure for SFA intake, it is not very sensitive to changes in total fat intake. We did use total cholesterol as a marker in the current study, but obtained an ambiguous outcome. Although self-reported total fat consumption showed a significant decline in the intervention group, the magnitude of reduction was about the same for SFA, MUFA, and PUFA, a result consistent with the cholesterol findings. There is much debate in the literature regarding the type and amounts of dietary fat (monounsaturated, saturated, polyunsaturated) that should be targeted in dietary interventions [47]. The primary dietary fat goals of the American Diabetes Association [48] and the American Heart Association [4] is to limit fat intake to less than 30% and SFA to less than 10% of energy intake. The dietary fat recommendation in the present study was to decrease percentage of calories from fat, while keeping caloric levels consistent, and simultaneously increasing fruit and vegetable intake. There is evidence that low-fat diets may be beneficial for promoting weight loss because of their reduced energy density [49] and that these dietary goals decrease the risk of arteriosclerosis, certain forms of cancer, and diabetes [50].

Other limitations of our study include the use of motivated individuals who volunteered for a research project. Also, we recruited from a generally healthy population of

women with health insurance. Efficacy in disadvantaged populations has not yet been tested. Minority enrollment in our study was low (7%), reflecting the demographics of the region. However, it is worth noting that follow-up data collection rates were higher in the minority participants than in the White participants, and that, compared to White participants, minority participants showed as much or greater dietary change on all measures at both 4- and 12-month follow-up.

The next step in our research program will be to test this type of intervention when provided in the context of primary medical care. In this model, physicians will refer their patients to a dietary counseling program that would be available either in the health care clinic (appropriate for group-practice settings) or in the community (solo-practice setting). Dietary counseling would be provided through a mix of automated programs and brief in-person and telephone sessions with a lifestyle change counselor. Over time, this type of dietary change program has the potential for considerable reach into health care systems and communities and would have the potential for transition to practice.

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