Improving Dietary Behavior: The Effectiveness of Tailored Messages in Primary Care Settings

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A B S T R A C T

Objectives. To achieve the *Healthy People 2000* objectives, public health professionals must develop effective dietary interventions that address psychosocial and behavioral components of change. This study tested the effect of individually computer-tailored messages designed to decrease fat intake and increase fruit and vegetable intake.

Methods. Adult patients from four North Carolina family practices were surveyed at baseline and then randomly assigned to one of two interventions or to a control group. The first intervention consisted of individually computer-tailored nutrition messages; the second consisted of nontailored nutrition information based on the 1990 *Dietary Guidelines for Americans.* Patients were re-surveyed 4 months postintervention.

Results. The tailored intervention produced significant decreases in total fat and saturated fat scores compared with those of the control group ($P < .05$). Total fat was decreased in the tailored group by 23%, in the nontailored group by 9%, and in the control group by 3%. Fruit and vegetable consumption did not increase in any study group. Seventy-three percent of the tailored intervention group recalled receiving a message, compared with 33% of the nontailored intervention group.

Conclusions. Tailored nutrition messages are effective in promoting dietary fat reduction for disease prevention. (*Am J Public Health.* 1994;84:783–787)

Introduction

The *Healthy People 2000 Objectives for the Nation* recommend that Americans decrease dietary fat to 30% or less of their total caloric intake and increase fruit and vegetable consumption to five or more daily servings in order to promote health and prevent diet-related diseases, including heart disease and certain cancers.[1] To achieve these objectives, public health professionals must find effective methods of integrating behavioral and psychosocial factors into nutrition-related behavior change programs. Because most behavior change interventions are designed for individuals who are already prepared for action, they may be inappropriate for those not yet ready to act.[2]

The Partners in Prevention–Nutrition program was designed to influence dietary intake by providing mailed, individually computer-tailored messages that address dietary and psychosocial factors and provide specific strategies for change. The intervention used a stage-of-change approach, based on the Prochaska and DiClemente transtheoretical framework,[3] to match tailored communications to the needs of participants at different points in the decision process for dietary change. We hypothesized that providing information relevant to an individual's stage of change would promote movement from earlier to more advanced stages of readiness, ultimately leading to actual behavior change. Accordingly, we conducted a randomized trial using a pretest and posttest to assess the impact of tailored vs nontailored nutrition education materials on fat, fruit, and vegetable consumption.

Methods

Study Population

Respondents were 558 adult patients (ages 18 and above) recruited from four family practices in central North Carolina between September and November 1991. Two practices served a primarily urban population and two were primarily rural. Family practice office staff recruited participants as they checked in for any type of medical appointment. Office staff excluded patients who were too ill or mentally unable to complete the baseline survey. Only one family member per household was allowed to participate.

The study sample was selected from an initial pool of 682 individuals who met eligibility criteria. A total of 124 people (18.2%) were excluded during the baseline survey phase for the following reasons: refusals (8.8%), consent form not signed (3.7%), ineligible due to age (< 18) or multiple household membership (2.2%), survey incomplete (3.4%), and participation in a related study (one individual). An additional 95 participants (13.9%) were lost during the follow-up survey phase.

Procedures

Participants were assessed initially regarding fat, fruit, and vegetable dietary intake; gender; age; race; education; marital status; physician-prescribed diets; pregnancy status (women only); stage of readi-

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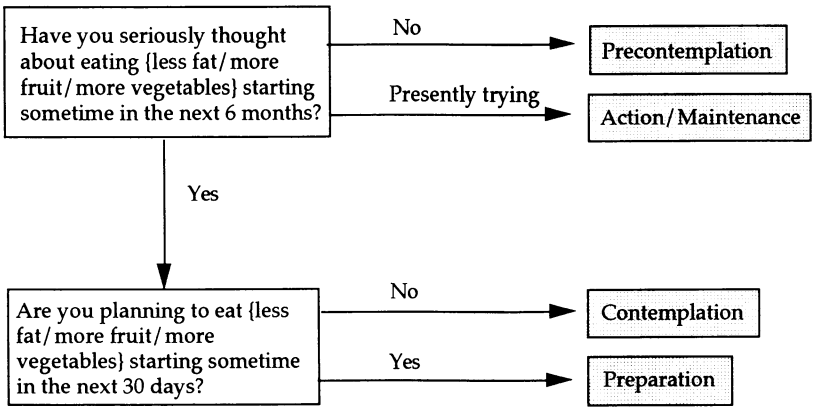


FIGURE 1—Stages of dietary behavior change.

ness to change diet; and psychosocial factors associated with dietary behavior change, such as self-efficacy (confidence in one's ability to change). The self-administered surveys were distributed and collected by family practice staff. Nearly all patients (99%) were able to complete the survey while in the family practice office; those who could not were allowed to take it home and return it using a postage-paid envelope. Participants were then randomly assigned to one of three groups: an intervention group, which received tailored nutrition messages; a comparison intervention group, which received nontailored nutrition messages; and a control group, which did not receive nutrition messages. All messages were mailed to participants within 3 weeks of baseline survey completion.

Participants were resurveyed 4 months postintervention to assess change. Household income also was assessed at follow-up. Through the use of a combined mail and telephone strategy, a final response rate of 82.3% (n = 459) of baseline participants was achieved. Telephone interviewers were blinded to participants' study group membership. Reasons for nonresponse included refusals (3.2%), passive refusals[4] (7.9%), no answer after 15 attempts (0.2%), and disconnected phone or no telephone number provided (5.7%). Four individuals (0.7%) were not resurveyed because one had moved with no forwarding address and three were found to be members of households that included another study participant. Respondents to the follow-up survey were more likely to be married than were nonrespondents; no other demographic or dietary differences distinguished respondents from nonrespondents.

Measures

Food frequency. A food frequency instrument consisting of 28 items derived from the Health Habits and History Questionnaire[5] was developed for this study. Items assessing fat intake included 13 items validated as a brief fat screener[6] plus 5 items representing high-fat foods commonly consumed by southern US populations. Ten items were used to assess fruit and vegetable consumption. Response options were presented as a checklist, with seven response choices: three or more times per day, two per day, about every day, two to four per week, once a week, one to three times per month, and rarely or never. Dietary fat and saturated fat scores were obtained by multiplying frequency of consumption (calculated as servings per day) by portion data for each item[5,7] and summing the items. Fruit and vegetable combined intake was obtained by calculating the frequency of consumption of each item and summing the frequencies to determine total daily servings.

Stage of change. Stage of readiness to change diet was measured for three consumption behaviors: decreasing fat, increasing vegetables, and increasing fruit. Based on a series of questions derived from the Prochaska and DiClemente stages of change for smoking cessation[8] (Figure 1), participants were categorized at baseline as being in one of the following stages: precontemplation (not seriously thinking about change), contemplation (seriously thinking about change within the next 6 months), preparation (planning to change within the next 30 days), or action/maintenance (currently trying to change). The stages-of-change model defines maintenance as continuing behavior change for longer than 6 months, whereas action includes behavior change efforts of less than 6 months.[8] Action and maintenance stages were combined here because our study design did not allow for long enough follow-up to assess maintenance of change. Because 91% of contemplators were planning to change within the next 30 days, the contemplation and preparation stages were also combined into one category (contemplation) for data analysis.

Psychosocial issues. Motives for change and barriers to change were assessed using questions derived from pretesting. Self-efficacy regarding ability to increase fruits and vegetables and to decrease dietary fat was measured using a 4-point scale (1 = very confident, 4 = not at all confident). For fat reduction, three subbehaviors were measured (lowering meat fat, dairy fat, and fats added to foods). Beliefs about perceived susceptibility to diet-related diseases and perceived benefit of dietary change to avoid health problems were also measured using a 4-point scale (1 = very likely, 4 = not at all likely). Participants contemplating change were questioned about past efforts to change and their continuation or relapse after those efforts. These psychosocial variables were measured for use in providing individualized computer-tailored feedback.

Intervention

The tailored intervention consisted of a one-time, mailed nutrition information packet tailored to the participant's stage of change, dietary intake, and psychosocial information. The health behavior literature indicates that tailoring can be an effective tool to address specific psychosocial issues and barriers to change.[9] Through the use of a tailored approach, individuals can be given behavior change information relevant to their stage in the decision process, whereas information not likely to be helpful at that stage can be omitted.

The tailored messages were created with Authorware Professional and Microsoft Word software for the Apple Macintosh computer. A library of text messages was developed to target each survey response choice regarding stage of change, motives, barriers, beliefs, and self-efficacy for each dietary behavior.[10] A team of nutritionists and health educators created, pretested, and revised the messages. Computer algorithms were developed to

access the appropriate text pieces based on each individual's baseline information. The computer then merged the text pieces into tailored nutrition education newsletters using a predetermined overall format.

Baseline food frequency information was used to provide individualized feedback about whether dietary change was needed. For dietary fat, participants were given feedback in graphic form depicting their current intake as "high" or "low-moderate." This evaluation was made by comparing the individual's dietary score with the 75th percentile of the distribution of fat intake in this population, as determined by pretesting with 55 family practice patients prior to the study. For fruits and vegetables, baseline information was used to show the number of daily servings the individual consumed compared with the recommended five or more servings per day.

Messages were structured according to a framework based on the stages of change and the Health Belief Model.[11] All tailored group members were mailed a packet containing a nutrition profile summarizing their current diet and level of interest in changing behavior, a tailored page regarding dietary fat intake, and a tailored page regarding fruit and vegetable intake. Each message acknowledged the participant's stage and addressed his or her beliefs about both susceptibility to diet-related diseases and perceived benefits of and motives for changing diet. Individualized diet feedback was then provided regarding baseline fat and fruit/vegetable intake. Contemplators received information designed to decrease barriers to change and to increase self-efficacy. Depending on stage of change, self-efficacy, and history of past relapse, participants also received tailored recipes and specific diet tips designed to promote skills and to provide cues to action. Those individuals who were already trying to change received tailored recipes and messages aimed at preventing relapse.

The nontailored messages appeared nearly identical to the tailored messages in format, typeface, and paper; however, no individualized dietary or psychosocial information was given. Instead, these messages provided standard risk information about the relation of diet to disease and gave dietary recommendations based on the 1990 *Dietary Guidelines for Americans.*[12] Control group members completed the baseline and follow-up surveys but did not receive any nutrition information from the Partners in Prevention–Nutrition program.

TABLE 1—Family Practice Patients' Baseline Dietary Intake, by Demographic Group and Stage of Change

		Fat (g/day)		Saturated Fat (g/day)		Vegetable/Fruit (servings/day)	
	No.	Mean (SE)	P*	Mean (SE)	P*	Mean (SE)	P*
Gender							
Male	138	51.9 (3.1)	<.001	21.5 (1.3)	<.001	2.9 (.20)	.142
Female	420	43.4 (2.2)		17.3 (1.0)		3.3 (.20)	
Race							
White	448	47.0 (2.2)	.771	19.2 (1.0)	.974	3.0 (.15)	.588
Non-White	106	47.9 (3.3)		19.3 (1.4)		3.2 (.25)	
Education, y							
12 or less	204	50.9 (2.9)	<.01	20.7 (1.2)	<.01	2.8 (.19)	<.001
>12	348	44.2 (2.4)		17.8 (1.1)		3.5 (.21)	
Age, y							
<31	137	56.3 (3.4)	<.001	20.3 (1.2)	<.001	2.9 (.20)	<.005
31–38	143	47.5 (2.8)		19.5 (1.4)		2.9 (.23)	
39–48	141	43.4 (2.6)		17.5 (1.2)		2.8 (.22)	
49+	131	44.3 (3.0)		16.9 (1.2)		3.8 (.30)	
Marital status							
Married	348	49.4 (2.5)	.074	20.1 (1.2)	.072	3.3 (.20)	.117
Nonmarried	204	45.6 (2.6)		18.4 (1.1)		2.9 (.20)	
Stage[a]							
Precontemplation	141	47.5 (2.4)	<.05	19.3 (.96)	<.01	3.1 (.19) (n = 156)	<.005
Contemplation	253	44.7 (1.8)		17.8 (.71)		3.1 (.15) (n = 217)	
Action	164	40.0 (2.0)		15.7 (.79)		3.9 (.24) (n = 185)	

[a]As shown, numbers of participants in each stage of change differed for reducing fat versus increasing fruits and vegetables. The table shows vegetable/fruit-combined consumption according to stage of change for increasing vegetables. The same variables were significant when vegetables and fruit were analyzed separately by respective stage of change.
*P values for dietary differences are based on F tests after adjustment for all effects in the model.

Analysis

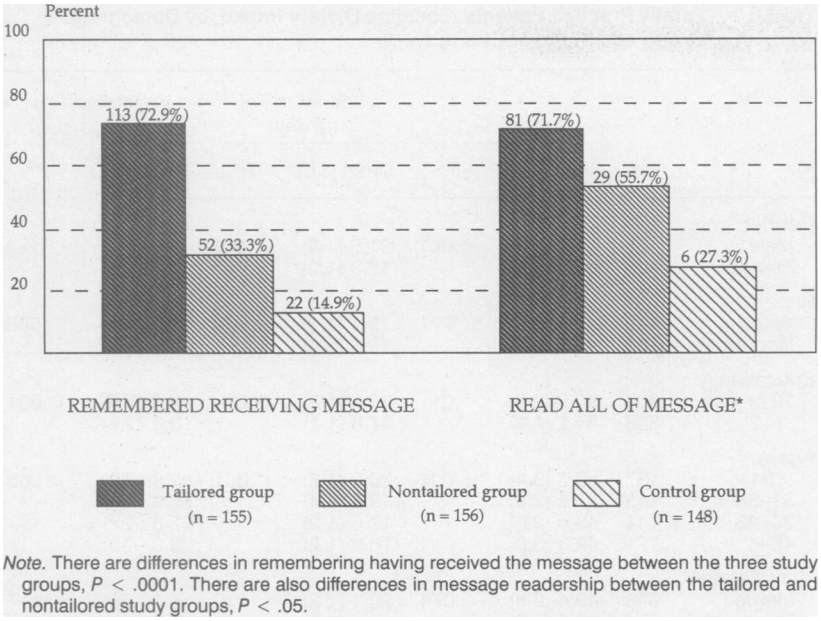
All dietary variables showed a skewed distribution and were transformed to conform more closely with a normal distribution. For fat data, least squares adjusted means were calculated after transformation by the natural logarithm ($e^{\bar{z}}$, where $\bar{z}$ = ln fat or ln saturated fat); standard error was approximated by SE = $(e^{\bar{z}})SE(\bar{z})$. For fruit and vegetable data, least squares adjusted means were calculated from square root transformed variables ($\bar{z}^2$, where $\bar{z}$, = square root daily servings); standard error was approximated by SE = $(\bar{z})^2SE(\bar{z})$. Analysis of covariance was used to test between-group differences for continuous variables, and logistic regression analysis was used to test differences among categorical variables.

Results

Descriptive Results

The study sample was primarily female (75.3%), married (62.3%), and well educated (mean = 13.6 years), with an average age of 40.8 years (Table 1). Minority enrollment was 19.0% of the sample, nearly all African Americans. Of 401 participants who reported their income (87.4% of the follow-up sample), the median annual household level was $30 000 to $39 000. There were no significant differences in demographic, dietary, or stage-of-change variables among study groups. The tailored intervention group consumed more dietary fat at baseline compared with the other two groups; this difference was not statistically significant.

We examined the relationship between stage of dietary change and baseline dietary intake scores, controlling for demographic variables (see Table 1). Self-reported stage of change was a significant predictor of baseline intake. Precontemplators and younger participants consumed significantly more total fat and saturated fat, and fewer fruits and vegetables, than did individuals in the action stage and older participants. Similarly, men and participants with up to 12 years of education consumed more fat and



Note. There are differences in remembering having received the message between the three study groups, $P < .0001$. There are also differences in message readership between the tailored and nontailored study groups, $P < .05$.

FIGURE 2—Differences between study groups in message recall and amount read.

TABLE 2—Comparison of Tailored Message, Nontailored Message, and Control Groups' Reported Consumption of Fat, Saturated Fat, and Fruits/Vegetables at 4 Months Postintervention

	Fat (g/day)		Saturated Fat (g/day)		Vegetable/Fruit (servings/day)	
	Mean (SE)	P[a]	Mean (SE)	P[a]	Mean (SE)	P[a]
Tailored group (n = 134)						
Baseline	45.6 (2.6)	.033	18.7 (1.1)	.036	3.6 (.19)	.817
Follow-up	35.3 (1.7)		13.9 (.72)		3.3 (.19)	
Difference[b]	−10.3		−4.8		−0.3	
Nontailored group (n = 136)						
Baseline	40.4 (2.4)	.157	16.1 (.93)	.110	3.6 (.20)	.968
Follow-up	36.8 (1.7)		14.4 (.72)		3.3 (.19)	
Difference[b]	−3.6		−1.7		−0.3	
Control group (n = 124)						
Baseline	41.1 (2.1)	...	16.3 (.98)	...	3.6 (.20)	...
Follow-up	39.8 (1.9)		15.8 (.81)		3.3 (.20)	
Difference[b]	−1.3		−0.5		−0.3	

Note. Group means are adjusted for baseline intake and the demographic variables of gender, age, education, race, marital status, and income. After deletion of individuals with missing demographic information, n = 394 in the final sample.

[a]*P* values for dietary differences are based on *t* tests after analyses of covariance, comparing each intervention group with the control group.

[b]Difference is computed by subtracting follow-up adjusted mean from baseline adjusted mean. Minus signs are shown to indicate the direction of change.

fewer fruits and vegetables than did women and participants with higher education.

Intervention Effects

As shown in Figure 2, study group (tailored message, nontailored message, or control) was a significant predictor of remembering having received a message ($\chi^2 = 116.35, P < .0001$). A total of 72.9% of individuals in the tailored group recalled receiving nutrition information, compared with 33.3% of the nontailored group and 14.9% of the control group (to whom no message was sent). Study group also predicted message readership among those who remembered having received a message. Members of the tailored group were more likely to report having read all the message than were those in the nontailored group ($\chi^2 = 3.98, P < .05$).

We used analysis of covariance to test the effect of study group on decrease in total fat and saturated fat intake scores while controlling for baseline intake and demographic variables (see Table 2). An overall test of study group effect was marginally significant ($F = 2.37, P < .10$), indicating that differences existed among groups. We then performed contrasts using *t* tests to examine between-group differences. For both total fat and saturated fat, the difference was statistically significant for the tailored group–control group comparison ($t = -2.14, P < .05$ for total fat; $t = -2.11, P < .05$ for saturated fat) but not for the nontailored group–control group comparison. Total fat decreased by 23% (10.3 g) in the tailored group, compared with a decrease of 9% (3.6 g) in the nontailored group and 3% (1.3 g) in the control group. The tailored group decreased saturated fat by 26%, compared with decreases of 11% in the nontailored group and 3% in the control group.

Analysis of covariance was also used to examine study group effect on increase in fruit and vegetable consumption while controlling for baseline intake and demographic variables (Table 2). Study group did not predict an increase in fruit and vegetable intake; consumption decreased by approximately one quarter of a daily serving in all groups.

Discussion

This randomized trial demonstrated a positive effect of tailored nutrition messages in promoting dietary change efforts for disease prevention. Participants who were sent tailored messages were more than twice as likely as those who were sent nontailored messages to remember receiving the information. Those who remembered receiving a message were more likely to report having read all of it if the message was tailored than if it was not tailored. At posttest, participants in the tailored intervention group had reduced their total fat and saturated fat intakes significantly compared with participants in the control group. Members of the nontailored group had reduced intake also; however, the level of change was not significant when compared with that of the control group.

Use of dietary change as an outcome measure assumes that diet modification

will reduce disease risk in the future. The *Healthy People 2000* objectives[1] recommend lowering dietary fat intake to 30% or less of total calories, compared with the current 36% to 38% of calories consumed by most Americans. This corresponds to a recommended reduction in fat intake of about 17% to 21%. In the present study, the tailored message group reduced their fat score by approximately 23% from baseline intake, suggesting that they achieved a level of change commensurate with the *Healthy People 2000* objectives. It is possible, however, that by using a brief assessment instrument, significant sources of dietary fat were missed, and this could have biased the results. The food frequency instrument was designed for self-administration by patients waiting for their physician appointment, and it included only 18 items to measure dietary fat. This instrument did not collect enough information to determine the percentage of calories consumed as fat, which would have provided a more valid and reliable estimate of dietary change. Attempts were made to reduce possible bias by using a randomized design and controlling for baseline intake in the analysis.

The descriptive findings show that the stage-of-change framework can be applied to dietary behaviors in that self-reported stage information was associated with baseline dietary intake. Precontemplators consumed the most fat and the fewest fruits and vegetables at baseline, whereas individuals in the action stage consumed the least dietary fat and the most fruits and vegetables. These results are consistent with other research demonstrating the relation of stage of change to percentage of calories consumed as fat.[13] Our findings suggest that the stages of change are also related to fruit and vegetable dietary behavior.

The observed lack of an intervention effect on fruit and vegetable consumption may have been partly due to seasonal factors. Baseline surveys were completed in the fall, and follow-up surveys were completed in the early spring with respondents being asked to recall the preceding 3 (winter) months. Seasonal variation in fruit and vegetable intake has been documented in other studies.[14] A number of participants commented during the telephone interviews that they planned to increase their intake of fruits and vegetables but were waiting until those foods came into season.

A potential bias in this study is the possibility of higher demand characteristics of the tailored messages, compared with the nontailored information. The tailored messages were personalized and provided more information than did the nontailored messages; therefore, tailored group members may have felt a stronger obligation to report positive changes at follow-up. We attempted to minimize the impact of demand characteristics, however, by designing both intervention materials similarly in terms of layout, logo, type, and paper; by sending personalized cover letters from the family physicians with all follow-up surveys; and by blinding telephone interviewers to study group membership.

The study findings have implications for public health and primary care practice. Individualized health and nutrition guidance has traditionally been provided by physicians, nurses, or nutritionists in the form of individual patient counseling, which is costly, time-consuming, and usually offered only to patients at high risk of diet-related morbidity. Standard practice is to provide nontailored written materials to patients. The present study shows that family practice patients are willing to participate in nutrition education programs designed to prevent chronic diseases, and that computer technology can be used to provide individually tailored information that is more effective than standard educational materials in promoting behavior change. Because computer-tailored education is relatively inexpensive compared with individual counseling, it can be provided to low-risk as well as to high-risk individuals who are interested in improving their health.

This study was conducted in a family practice population. Individuals who obtain care from family physicians may differ from the general public in sociodemographic characteristics and in motivation to participate in health promotion activities. The study sample was of higher education and income status than average for North Carolina. Prior research suggests that tailored mammography screening messages are more effective than nontailored messages for lower-income and minority women.[15] Future research should evaluate the impact of tailored messages in low-literacy populations. □

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