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Differences in Response to a Dietary Intervention between the General Population and First Degree Relatives of Colorectal Cancer Patients

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Abstract

Objective—To determine whether response to a dietary intervention is greater among people with family history of colorectal cancer (CRC) compared with a general population.

Design—Cohort study examining participants from two related studies.

Setting—Rural Virginia

Participants—70 people with first degree relatives (FDRs) with CRC and 113 participants from the intervention arm of a trial in the general population.

Intervention—Both studies implemented a low intensity intervention delivered via telephone and mail, including low-literacy self-help booklets and personalized dietary feedback.

Main Outcome Measures—Fat, fiber, and fruit/vegetable (FV) behavior

Analysis—Propensity score matching controlled for confounders. Mixed model ANOVAs compared samples; mediation by perceived cancer risk was assessed.

Results—Participants in both groups significantly improved fat, fiber and FV behavior at 1-month follow-up; there was significantly greater improvement in the general population sample. Cancer risk perception did not mediate the relationship between study sample and dietary change.

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Conclusions and Implications—Contrary to expectations, FDRs of CRC patients did not respond better to a dietary intervention than the general population, nor was risk perception related to dietary change. Given the role of diet in CRC risk, additional research should investigate targeted strategies to improve dietary intakes of people at higher cancer risk.

Keywords

family history; colorectal cancer; diet intervention

INTRODUCTION

Great strides have been made in reducing incidence and mortality from colorectal cancer (CRC) in the United States over the last decade. CRC rates decreased from 52.3 per 100,000 in 2003 to 45.5 per 100,000 in 2007. In addition, mortality rates decreased from 19.0 cases per 100,000 in 2003, to 16.7 per 100,000 cases in 2007.[1] However, additional work is necessary in order to achieve Healthy People 2020 (the US government's prevention agenda for building a healthier nation) objectives of reducing CRC incidence to 38.6 cases per 100,000 and deaths to 14.5 per 100,000.[2] The need for targeted intervention is particularly great in rural areas, where residents continue to manifest higher rates of CRC.[3]

Relatives of patients with CRC are at increased risk of developing the disease. A meta-analysis estimated that individuals having a first-degree relative (FDR: a parent, sibling or offspring) with CRC were more than twice as likely as those without a FDR to have the disease, highlighting the need for targeted intervention among this higher risk group.[4]

Although it is not known if increased risk of CRC in FDRs is genetic or due to common environmental exposures,[5] engaging in protective health behaviors, such as maintaining a low-fat, high fiber diet can reduce the risk of developing colon cancer in this high risk population.[6] Importantly, knowledge of susceptibility to a serious disease may increase the likelihood of engaging in preventive behaviors,[7] although knowledge alone may not be sufficient to change complex behaviors, such as dietary intake. There is evidence to suggest that relatives of cancer patients are motivated to adopt health behavior changes.[8] For example, previous investigations found that FDRs of CRC patients were more adherent to screening recommendations than the general population and had a greater response to screening interventions.[9,10] Furthermore, in a longitudinal study of FDRs of women with breast cancer, relatives increased fruit and vegetable consumption 6 months after their family members' diagnoses.[8] Similarly, twins of colon cancer patients were more likely than the general population to be screened after their co-twins'diagnoses.[11] Less is known about whether FDRs of CRC patients are more likely to adhere to preventive dietary behaviors than the general population. Indeed, the FIBERR (Families in Behavioral Intervention for Risk Reduction) study, upon which the current study is based, was the first dietary intervention specifically targeted to relatives of patients with CRC.[12] Within the FIBERR study, Fries et al[12] found that family members with higher perceived closeness to their FDR with CRC had worse dietary behaviors than those with lower perceived closeness However, greater family support was associated with healthier diets among FDRs. These results suggest that family factors influence dietary behaviors among FDRs, yet also highlight the

complexity of these relations. Given the paucity of research in this area, additional investigation into the dietary habits of FDRs is warranted. Furthermore, while there is strong theoretical support for the role of perceived risk in cancer-preventive behavior,[13,14] empirical results are mixed.[15-17] Further examination of the role of cancer risk perception in dietary change is needed.

Dietary intakes of participants from two related dietary intervention studies were examined to determine if family history status was associated with greater dietary behavior change. Specifically, results from a study of FDRs of CRC patients were examined, and compared with results from a randomized study that used the same dietary intervention in a general population. Given support for greater engagement in preventive behaviors (i.e., screening) among FDRs, it was hypothesized that FDRs of colon cancer patients would exhibit greater change in dietary behavior, in order to reduce their associated higher risk for cancer. In addition, perceived cancer risk was examined as a potential mediator of response to treatment.

METHODS

STUDY DESIGN AND PROCEDURES

This cohort study examined participants from two studies who participated in the same dietary interventions-the Families in Behavioral Intervention for Risk Reduction Project[12] and the Rural Physician Cancer Prevention Project[18] (henceforth referred to as the Family Member sample and the General Population sample, respectively). Both studies were community-based and examined the impact of the same dietary intervention. Subjects in the General Population sample made up the intervention arm of a randomized controlled trial that targeted a rural, low-education, low-literacy population, while members of the Family Member sample were the single-arm of a pilot study targeting FDRs of people with CRC. Both studies were conducted in rural counties in Virginia by the same study team, using essentially the same intervention and measures. All participants provided informed consent. Assessments were conducted via telephone at baseline, 1 and 3 months post-intervention for the Family Member sample and at baseline, 1, 6, and 12 months post intervention in the General Population sample. The current study examined baseline and 1-month post-intervention data from both studies as these represented the common assessments. The two parent studies were each approved by the Institutional Review Board of Virginia Commonwealth University.

PARTICPANTS AND RECRUITMENT

General Population sample—This study recruited healthy patients from three medical practices in rural Virginia. Eligible patients were 18-72 years old, not seriously ill or on a medically supervised diet (see Fries et al[18] for CONSORT diagram and complete study methods). Potential participants (n=4211) were sent letters from their primary care physician inviting them to participate in the study; 754 were randomized to either the dietary intervention or a control arm. Of those randomized to the dietary intervention (n=377), 224 completed the 1-month follow-up survey and were included in the current study. Participants who did not respond at 1 month were similar on race, gender, education and whether they

lived in/outside of town but were less likely to be unmarried (54% vs 69%, P=0.003) and were younger (45 years vs 49 years old, P=0.009) than respondents.

Family Member sample—This sample from the FIBERR study targeted family members of patients with CRC. Recruitment for this study has been described in detail in Bean et al.[12] Patients diagnosed with CRC (in the previous 5 years) at Massey Cancer Center and its rural outreach clinics were sent letters from their physician endorsing the study and asking for their participation (n = 474 patients); 157 provided names of FDRs. One FDR was randomly selected from each family. Of 226 FDRs, 103 were eligible and consented. Family Member sample participants were either the sibling (22%), offspring (75%), or parent (3%) of the referring patient. The current study includes the 81 subjects who completed the 1-month follow-up assessment. Participants not responding at one month were similar on age, gender, marital status and whether they lived in/outside town, but were more likely to be black (45% vs 20%) than those who responded at 1 month (P=0.014).

Dietary Intervention—The dietary intervention used in both studies was the same (except for cancer risk information, see below), and is described in detail elsewhere.[18] In brief, both studies used the same theoretically guided, low-intensity, physician-endorsed dietary intervention, designed for a rural, low-income population. After completing baseline assessments, participants received tailored dietary feedback[19] through the mail and via telephone. The personalized feedback used baseline reported dietary behaviors, with specific recommendations for how they personally could improve their diets. Calls lasted about 15 minutes. Over a 4 week period, beginning after the intervention call, participants were mailed four self-help booklets, 10-22 pages each, that were adapted from the Eating Patterns Study.[20] Booklets focused on skill-development and were tailored to a low literacy, rural audience and developed in conjunction with a Community Advisory Board. The Family Member sample also received messages about increased risk status due to having a FDR with CRC, using the personal connection of the family member for motivation to make dietary changes consistent with a low-fat, high-fiber diet.

MEASURES

Assessments were obtained via telephone by trained interviewers. All measures were completed at baseline and 1-month follow-up unless otherwise noted.

Demographics—Information on participants' gender, race, age, ethnicity, education, income, and home location (whether or not they lived in town) was collected at baseline..

Family nutritional social support—A measure of perceived family social support for healthy nutrition was developed by the study team, consisting of a sum of 5 items such as "How often has the family said something nice about what you eat?", and "How often has a family member offered you low-fat snacks when you were hungry?." Responses ranged from 1 (never) to 5 (always). Internal consistency was 0.88 in the Family Members sample and 0.81 in the General Population sample.

Dietary assessment—The 28-item Fat and Fiber Behavior (FFB) questionnaire[21,22] assessed eating behaviors associated with fat and fiber, yielding both a fat and a fiber composite score. Questions ask about specific behaviors, such as “How often do you trim visible fat from your meat?” or “How often do you eat vegetables at lunch?” Responses ranged from 1 (usually) to 3 (never). Previous studies have supported the reliability and validity of the FFB[21,22] and its responsiveness to change.[20] Note that low values of the FFB imply better dietary behavior; an improvement over time would be reflected by a decrease. Cronbach’s alpha was 0.69 for fiber and 0.85 for fat FFB in the Family Member sample[12] and 0.69 for fiber and 0.75 for fat FFB in the General Population sample.[18] The number of servings of fruits and vegetables eaten per day was determined using a question from the Food Frequency Questionnaire (FFQ).[23] Responses ranged from 1 to 11, with 11 indicating 11 or more servings per day. The FFQ has been used in previous brief assessments of fruit/vegetable intake such as in the National Cancer Institute Adult 5 a Day sites.[23]

Other dietary related behaviors assessed included number of meals participants ate outside home during a typical week, scored from 0 (no meals) to 3 (breakfast, lunch, dinner); and degree of responsibility for meal planning, food preparation and shopping, each scored from 1 (little or none) to 3 (most or all for each of planning/shopping/preparing meals), summed over the three meals for a score of 3-9. These variables reflect the control the subject might have over their dietary intake; differences between samples would be important to control in analysis.

Additional health behaviors—Hours per week watching television and months since last doctor visit were also assessed. These behaviors were included as they might reflect aspects of lifestyles that could influence diet behaviors. Differences between samples would be important to recognize and control in analysis.

Perceived health risks—Participants were asked at 1-month follow-up about their perceived risk of cancer, as follows: “On a scale of 1 to 5 where 1 would mean that you are ‘Not at all at risk’ and 5 would mean that you are ‘Very much at risk’, how much are you at risk for cancer?”

DATA ANALYSIS

Propensity score matching was used to control for confounding between the Family Member and General Population samples. A propensity score is a participant’s probability of being in each sample, conditional on the observed covariates.[24] Analysis, conditional on the propensity score allows one to obtain unbiased estimates of the expected difference in observed responses in the groups, approximating results that might have come from a randomized trial.[24]

Two-sample t-tests and chi-squared analyses were examined for continuous and categorical covariates, respectively, to determine which variables were significantly different between the studies. $P< 0.10$ was used to conservatively identify important covariates to be included in subsequent analysis. Significant variables were entered into a logistic regression model to determine the propensity score. Propensity scores in the two samples differed significantly ($P<0.001$), and did not completely overlap; values ranged from −3.05 to 0.84 in the General

Population sample, and −3.01 to 1.69 in the Family Members sample. The lack of overlap suggested that using all subjects in a conventional covariate controlled analysis could lead to bias and that a matched sample would be particularly useful.[25] Members of the two samples were matched 1:2 using caliper matching via the GMATCH macro (Kosanke, and Bergstralh, Mayo Clinic College of Medicine, 2004) with the logit of the propensity score as the matching variable, using a caliper of 0.2 × se(logit(propensity score)).[26] Mixed model analysis of variance was used for the matched sample to verify that continuous confounders were no longer significantly different, while Cochran-Mantel-Haenszel methods were used for categorical variables.

For the main analysis of dietary outcome variables, whether there was a difference in the change from baseline between the two groups was tested. Mixed model analysis of variance in a cell means model was used, as this controlled for dependencies induced by the matching, as well as the two time points (baseline and 1 month). First, whether there was a difference in the change from baseline between the two groups (test of time-x-group interaction) was tested. If results from this analysis were significant, further analysis to determine if the change from baseline was significantly different from zero was assessed separately for each sample; if non-significant the combined sample was used in a single analysis to assess change.

Perceived risk at 1 month was evaluated as a possible mediator of the relationship between study sample and change in dietary behavior variables. Three models were fit: $Y = d_Y + cX + \varepsilon_{Y.X}$; $M = d_{M.X} + aX + \varepsilon_{M.X}$; $Y = d_{Y.MX} + bM + c' X + \varepsilon_{Y.MX}$ where Y is a dependent variable consisting of the dietary outcome (fat, fiber or f/v behavior change from baseline), M is the potential mediator (cancer risk perception) and X is an indicator variable for the study group. Mediation would be represented by a change in the relationship between study group (X) and outcome (Y) when controlling for cancer risk perception (M), represented by $c-c'$ (or equivalently, indirect effect: $a \times b$).[27]

The cancer risk variable was missing for 7 in the Family Member and 8 in the General Population sample, resulting in loss of 8 matched sets. To avoid possible bias and loss of power, multiple imputation methods (M=5)[28] were used to estimate the missing risk values as well as for the estimation of the coefficients and standard errors for the mediation analysis.

For all but development of the propensity score as described above, significance level for analysis was set at α=0.05. Analyses were run using SAS v. 9.3.

RESULTS

SAMPLE DESCRIPTION

Table 1 displays a description of the original Family Member and General Population samples, and comparisons between participants from these samples. Overall, participants were on average 48.5 years old, 66% female, 67% married. Participants in the Family Member sample were more likely to be non-black, have a college education, and live in town as compared to those in the General Population sample. These significant variables,

along with the frequency of eating meals out, and number of months since visiting the doctor (both with $0.05 < P < 0.10$) were included in the propensity score. Matching resulted in 70 matched sets: 27 members of the Family Member sample had a single control and 43 had 2 controls from the General Population sample, for a total of 113 controls. After matching, the distribution of all potential confounders was similar in the two samples (Table 2).

DIETARY OUTCOMES IN THE TWO STUDY SAMPLES

Table 3 presents means and standard errors for the three dietary outcome variables at baseline and 1 month post intervention for the matched sample. There were no significant differences at baseline between the Family Member and General Population samples (P=0.80, 0.79, 0.62 for fat, fiber and fruits/vegetables respectively). While participants in both samples reported significant improvements (change from baseline) in fat, fiber and fruit/vegetable behavior, members of the General Population sample showed significantly more improvement than the Family Member sample for all three outcomes.

MEDIATION BY RISK VARIABLES

There was higher perceived cancer risk in the Family Member sample (P<0.0001 testing H_0: $a = 0$); 58.7% reporting being at risk or very much at risk for cancer, as compared to 31.6% in the General Population sample. Mean/median scores were 3.7/4.0 in the Family Member sample and 3.1/3.0 in the General Population sample.

Cancer risk perception was not significantly associated with change from baseline for any of the dietary behaviors (P=0.6654, 0.3831 and 0.2052 for fat, fiber and fruit/vegetable behavior respectively testing H_0: $b = 0$). Consistent with these null findings, there was also no mediation effect: the relation between study group and outcome remained significant when controlling for cancer risk perception (P=0.0113, 0.0448, 0.0567, testing H_0: $c' = 0$), and the relation between study group and outcome was not significantly reduced (P=0.6707, 0.3945, 0.2209, respectively testing (H_0: $c - c' = a \times b = 0$).

DISCUSSION

Both rural residents recruited from the general population and family members specifically recruited as FDRs of patients with CRC significantly improved their fat, fiber and fruit/vegetable behaviors at one month following dietary intervention, although the magnitude of improvement was actually greater in the General Population sample. Findings were contrary to hypothesized greater response to treatment among FDRs, given their increased risk status, which may be amenable to change via dietary modification. The hypothesis was based on the expectation that FDRs would have more motivation to change, due to perceived higher cancer risk, than others and would thus show greater improvement in dietary behaviors. While participants in the Family Member sample reported significantly higher perceived cancer risk than the General Population sample, perceived cancer risk did not mediate the relation between study sample and behavior change.

The Family Member sample was recruited via affected family members and was informed about their increased risk status due to family history. At 1 month post-intervention, these

participants reported significantly higher perceived risk as compared to the General Population sample, possibly due, in part, to the impact of this messaging. As noted above, however, the reported perceived cancer risk after the intervention was not associated in any meaningful way with change in dietary behavior. Although not examined in the current study, high cancer worry among FDRs might help explain this finding. For example, in a nationally representative sample, cancer risk perception alone was not associated with health protective behaviors (diet or exercise); however, among those higher in cancer-related worry, higher risk perception was associated with lower vegetable intake and less exercise, highlighting the interaction between these variables.[29] Similarly, Lerman and Schwartz[30] noted that high levels of distress can have the paradoxical effect reducing adherence to health-promoting behaviors. In treatments such as FIBERR that aim to enhance perceived risk, caution should be taken to examine and address potential iatrogenic intervention effects that might be caused by increased worry.

In addition, the Family member sample did not have significantly better baseline dietary intake compared to the General Population sample, suggesting that FDRs of patients with CRC were not self-motivated, without an intervention, to have a better diet than the general population (and that knowledge alone is not sufficient to motivate dietary change). Similar results were found for CRC by Huang et al[31] in Japan and Bronner et al[32] in Israel. Wilson et al [33] found that women with high familial risk of breast cancer tended to consume fewer fruits/vegetables. Yet Lemon et al[8] found that women improved their fruit/vegetable consumption within 6 months of learning of the diagnosis of breast cancer for a family member.[8] Results further highlight the complexity of dietary behaviors, and the need to further investigate dietary behaviors of FDRs of CRC patients.

As the premise that higher perceived cancer risk would motivate participants in the Family Sample to exhibit greater behavior change depends on the assumption that perceived cancer risk precedes behavior change, a limitation is that knowledge of this study's participants' understanding of their risk is not known. Previous studies have produced inconsistent findings concerning perceived risk and subsequent behavior change.[34-37] As Glenn et al[38] suggested, these inconsistent results may indicate more complexity in the relation between risk perception and health behavior than previously thought such that a change in risk perceptions may follow a change in health behavior rather than the inverse. Both Brewer et al[39] and Glenn et al[38] caution about the interpretation of an observed inverse relationship of perceived risk and behavior change, particularly for cross sectional studies. It might also be considered that intermediaries in the relations between perceived risk and health behavior, for example self-efficacy and knowledge, can provide additional explanatory context.

In the current study, the comparison of the two samples is strengthened by propensity score matching which controls for differences between groups.[24,25] Additionally the groups' comparability is increased by a shared study time period (2000-2002), geography (rural populations from the same general vicinity), and common outcome measures and intervention.

There are certain limitations to consider in this study. It was not known whether participants in the Family Member sample were more motivated to change because of their higher

familial risk, as motivation was not assessed. Further, while recruitment for the General Population sample was not based on family history of cancer, it is unknown if any also had family members with cancer. The small analysis sample size, a result of both the small size of the Family Member sample as well as matching, had the potential to limit some of the findings. Yet matching can increase power, allowing differences to be detected between samples for diet outcomes (effect sizes for comparison of change from baseline between samples were 0.23 for fat, 0.18 for fiber and 0.24 for fruits/vegetables). Change from baseline, while statistically significant, was rather small, so the ability to detect mediation effects by perceived cancer risk was limited.

Data are self-report and thus subject to bias; however, methods were the same in both studies; thus bias should not differ between samples. Further, use of single item measures (e.g., for fruit and vegetable intake and cancer risk) has limitations; however, given that both dietary interventions were designed to be low intensity treatments, use of brief measures were selected to be consistent with this approach. Likely the most limiting factor was the 1 month study period. It has been previously reported that improvements in fiber behavior were not sustained at 12 months in the General Population sample.[18] It is unknown whether the Family Member sample might have responded better at that time point or whether perceived risk could have mediated results in the longer term.

Results from this study showed that a low intensity dietary intervention can significantly improve dietary behaviors, even in the absence of specific risk. However, if people at higher risk of CRC require greater change, other interventional strategies may need to be added. A study design that includes a longer follow-up, stronger measures of perceived risk, and definitive guidelines of what sufficient change in an at risk population might be could provide better opportunity to observe diet and behavior change and sustainability.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This study's findings suggest that targeting an at-risk group with a low intensity diet and behavior intervention does not provide better results than those achieved in a general population. This may indicate that a more intensive intervention strategy may be warranted for an at risk population in order to achieve even greater changes in diet and behavior and further reduce cancer risk. As change across both populations is evident in response to low intensity diet intervention, it is important to determine as well what level of change is sufficient for an at risk population. Furthermore, there remains a great need to better understand perceived cancer risk, motivation to change, and its relation to health protective behaviors, particularly among family members of cancer patients.

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Table 1

Sample description of study groups and assessment of potential confounders at baseline (n=81 for Family Member sample, n=224 for General Population sample)

	Frequency (%) in full sample	Frequency (%) in Family Member sample	Frequency (%) in General Population sample	P-value comparing both samples
Demographic				
Sex				0.81
Female	200 (65.6)	54 (66.7)	146 (65.2)	
Male	105 (34.4)	27 (33.3)	78 (34.8)	
Ethnicity				0.01
Black	93 (30.7)	16 (19.7)	77 (34.4)	
Non-Black	210 (69.3)	65 (80.3)	147 (65.6)	
Marital Status				0.18
Married	203 (66.6)	49 (60.5)	154 (68.7)	
Not Married	102 (33.4)	32 (39.5)	70 (31.3)	
Education				<0.001
Not a High School Grad	37 (12.2)	4 (4.9)	33 (14.8)	
High School	93 (30.6)	16 (19.7)	77 (34.5)	
Some College or Tech School	83 (27.3)	19 (23.5)	64 (28.7)	
College or More	91 (29.9)	42 (51.9)	49 (22.0)	
Town				<0.001
In Town	82 (27.0)	36 (44.4)	46 (20.6)	
Not in Town	222 (73.0)	45 (55.6)	177 (79.4)	
Eating Out				0.08
No Meals Out	161 (54.6)	38 (46.9)	132 (58.9)	
One Meal Out	85 (28.8)	23 (28.4)	62 (27.7)	
Two Meals Out	42 (14.2)	18 (22.2)	25 (11.2)	
All Meals Out	7 (2.4)	2 (2.5)	5 (2.2)	
	Mean (SE) in full sample	Mean (SE) in Family Member sample	Mean (SD) in General Population Sample	P-value comparing both samples
Age (years)	48.5 (0.8)	46.8 (1.4)	49.1 (0.9)	0.20
Responsibility for Shopping/ Planning/Preparing Meals	7.3 (0.1)	7.5 (0.2)	7.3 (0.1)	0.46
Family Social Support (FSS)	12.8 (0.3)	12.1 (0.6)	13.0 (0.3)	0.15
Months Since Last Dr Visit	4.4 (0.6)	5.6 (0.9)	3.9 (0.4)	0.10
Weekly Hours Watching TV	13.4 (0.6)	12.2 (1.0)	13.9 (0.7)	0.22

Table 2

Description of analysis sample after propensity score matching (n=70 for Family Member sample, n=113 for General Population sample)

	Frequency (%) in full sample	Frequency (%) in Family Member Sample	Frequency (%) in General Population Sample	P-value comparing both samples
Demographic				
Sex				0.66
Female	97 (67.4)	48 (68.6)	74 (65.3)	
Male	47 (32.6)	22 (31.4)	39 (34.7)	
Ethnicity				1.00
Black	45 (24.6)	16 (22.9)	29 (25.7)	
Non-Black	138 (75.4)	54 (77.1)	84 (74.3)	
Marital Status				0.22
Married	126 (68.9)	45 (64.3)	81 (71.7)	
Not Married	57 (31.1)	25 (35.7)	32 (28.3)	
Education				0.77
Not a High School Grad	10 (5.5)	4 (5.7)	6 (5.3)	
High School	50 (27.3)	16 (22.9)	34 (30.1)	
Some College or Tech School	51 (27.9)	19 (27.1)	32 (28.3)	
College or more	72 (39.3)	31 (42.3)	41 (36.3)	
Town				0.70
In Town	59 (32.2)	26 (37.1)	33 (29.2)	
Not in Town	124 (67.8)	44 (62.9)	80 706.8)	
Eating Out				0.61
No Meals Out	96 (52.5)	37 (52.9)	59 (52.2)	
One Meal Out	56 (30.6)	19 (27.1)	37 (32.7)	
Two Meals Out	27 (14.7)	13 (18.6)	14 (12.4)	
All Meals Out	4 (2.2)	1 (1.4)	3 (2.6)	
	Mean (SE) in full sample	Mean (SE) in Family Sample	Mean (SE) in General Population Sample	P-value comparing both samples
Age	47.7 (0.9)	47.4 (1.4)	48.0 (1.2)	0.74
Responsibility for Shopping/ Planning/Preparing Meals	7.5 (0.2)	7.5 (0.3)	7.4 (0.2)	0.76
Family Social Support (FSS)	12.4 (0.4)	11.8 (0.6)	13.0 (0.4)	0.10
Months Since Last Dr Visit	4.5 (0.5)	4.4 (0.5)	4.6 (0.6)	0.74
Weekly Hours Watching TV	13.9 (0.8)	13.8 (1.3)	13.9 (0.9)	0.93

Table 3

Comparison of fat, fiber and fruit/vegetable behavior outcomes for Family Member and General Population matched samples (n=70 for Family Member sample, n=113 for General Population sample)

Outcome	Family Member Sample (F)		General Population Sample (G)		P-value comparing change from baseline in both samples*	P-value testing whether change from baseline is different from zero**
	Baseline Mean (SE)	1 month Mean (SE)	Baseline Mean (SE)	1 month Mean (SE)		
Fat Behavior	1.99 (0.04)	1.90 (0.04)	1.99 (0.03)	1.81 (0.03)	0.006	F:0.001 G:<0.001
Fiber Behavior	2.25 (0.04)	2.18 (0.04)	2.24 (0.03)	2.07 (0.04)	0.03	F:0.01 G:<0.001
FV Behavior	2.96 (0.17)	3.30 (0.17)	2.85 (0.14)	3.69 (0.16)	0.047	F: =0.02 G: <0.001

*Based on mixed models ANOVA. Lower scores imply better behavior for fat and fiber behavior. Higher values represent better results for Fruit and Vegetable (FV) behavior

**Since change from baseline is different for each sample, tests are presented separately for Family Member Sample (F) and General Population Sample(G)