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Baseline Transtheoretical and Dietary Behavioral Predictors of Dietary Fat Moderation over 12 and 24 months

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Abstract

Longitudinal predictors of dietary behavior change are important and in need of study. This secondary data analysis combined primary data across three randomized trials to examine Transtheoretical Model (TTM) and specific dietary predictors of successful dietary change at 12 and 24 months separately in treatment and control groups (N=4178). The treatment group received three TTM-tailored print interventions over 12 months between 1995–2000. Chi-square and MANOVA analyses were used to examine baseline predictors of dietary outcome at 12 and 24 months. Last, a multivariable logistic regression was conducted with all baseline variables included. Across all analyses in both treatment and control groups, the most robust predictors of successful change were for TTM-tailored treatment group, Preparation stage of change, and increased use of dietary behavior variables such as moderating fat intake, substitution of lower fat foods, and Increasing intake of healthful foods. These results provide strong evidence for treatment, stage and behavioral dietary severity effects predicting dietary behavior change over time, and for targeting these variables with the strongest relationships to outcome in interventions, such as TTM-tailored dietary interventions.

Keywords

Dietary Behavior; Dietary Fat Moderation; Transtheoretical Model; Stages of Change; Decisional Balance; Temptations; Longitudinal Prediction; Adults

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Contributors. Authors Greene, Redding, Prochaska, Rossi, Velicer, and Blissmer designed the study. Authors Greene and Redding conducted literature searches and provided summaries of previous research studies. Author Paiva conducted the statistical analysis. Authors Redding and Greene wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of Interest. All authors declare that they have no conflicts of interest.

1. Introduction

Concerns about total dietary fat and specific categories of fatty acids have been addressed in national health objectives and dietary guidance (USDHHS 2010 [2010], Healthy People 2020 USDHHS USDA [2012]). The Dietary Guidelines for Americans 2010 calls for total fat intake between 20 to 35 percent of calories and limitation of saturated fatty acids as well as reduction in trans fatty acids and solid fats (USDHHS USDA 2010). The decrease in categories of fatty acids as well as a decrease in added sugar is necessary to achieve recommended increases in fruits, vegetables, low-fat dairy products and, whole grains within an overall energy constraint with a goal of maintaining calorie balance over time to achieve and sustain a healthy weight. Proportion of energy from fat (% fat) is a strong predictor of total energy intake (Hebert et al., 2003) and can be used as an indicator of overall energy constraint. Dietary interventions focusing on reduction in % fat have been used in risk factor reduction studies (DISC, 1993; Astrup et al., 2000; Lanza et al., 2001; Barnard et al., 2005; Howard et al., 2006b; Beresford et al., 2006; Prentice et al., 2006). However, the target of reducing % fat without dietary education may lead to an inappropriate reduction in fatty acid intake among those with a low fat intake and, among those with a higher fat intake, may lead to substitution of energy from fat with energy from carbohydrates which has been associated with an increase in chronic disease risk (Sacks & Katan, 2002; Hu & Willett, 2002; Mesink et al, 2003). Thus population-based interventions should identify those “at risk” for a high-fat diet and, for those individuals, target moderation of fat intake in context of increasing consumption of healthful foods, as was done in the Women’s Health Initiative (WHI) and Women’s Intervention Nutrition Study (WINS) (Howard et al., 2010, Winters et al., 2004). Although the WINS intervention was associated with a reduction in cardiovascular disease risk factors (Winters et al., 2004) suggesting that reduction in % fat may be an appropriate target for at-risk individuals, neither WINS nor WHI was associated with reduction in cardiovascular disease (Howard et al., 2010).

Although specific dietary targets may be important, the fundamental question remains, how to achieve and maintain change in dietary behaviors over time and, more specifically, what factors are associated with successful dietary change? WHI investigators found that, in the intervention group, baseline dietary fat intake, attending intervention sessions, self-monitoring, and optimism predicted dietary change over 3 years (Tinker et al., 2007). Similar to the WHI intervention, Transtheoretical Model (TTM) tailored interventions have demonstrated efficacy in decreasing the proportion of populations at risk for a high fat diet in several studies (Jones et al. 2003, Prochaska et al., 2004, 2005; Velicer et al., 2004). However, each study has been too small for effective process to outcome analyses. Previous research combining smoking cessation studies found that the strongest predictors of outcome included dynamic variables, such as stage of change, problem severity (addiction levels), decisional balance and temptations (Blissmer et al., 2010; Sun et al., 2007; Redding et al., 2011; Velicer et al., 2007). One study examined multiple risk behaviors over time, including diet, combining treatment and control groups to predict 24 month outcomes (Blissmer et al., 2010). However, previous research has not examined naturalistic change by analyzing a no-treatment control group separately, nor examined potentially important components of

dietary change. This study will extend previous literature by examining treatment and control groups separately and by including specific dietary behaviors, to predict 12 month, in addition to 24 month outcomes. The purpose of this study was to combine 3 large randomized population-based dietary intervention studies to determine which baseline variables predict dietary outcome (estimated dietary intake ≤ 30% fat) at 12 and 24 months.

2. Method

This study is a secondary data analysis that combined data from three randomized trials evaluating home-based multiple risk behavior TTM-tailored interventions (diet, smoking and sun exposure) compared to a control group. Only subjects at risk for at least one behavior at baseline were eligible (N=9773) and this study sample was restricted to those "at risk" for diet (estimated > 30% fat) at baseline (N=6,620). Subjects were randomly assigned at baseline to a TTM-tailored treatment (N=3216) or assessment only control condition (N=3404). Although each study included a site-specific intervention component, there was no interaction between site-specific and home-based outcomes thus only home-based results were analyzed for this study. Subjects in both groups were assessed on common variables and re-assessed at 12 and 24 months. Of the N=6,620 subjects at risk for diet at baseline, N=4,178 (63%) completed both 12-month and 24-month assessments.

2.1. Samples from Three Randomized Trials

2.1.1. Study 1—The sample consisted of the parents of adolescents who were subjects in a School-based study. Based on the records provided by the 22 schools in Rhode Island, a total of 3507 eligible households were identified and N=2931 parents were contacted. One parent was recruited from each eligible household; and N=2460 parents (83.6%) participated, with N=1760 (71.5%) at-risk for a high-fat diet. Additional details about the recruitment and outcome are available elsewhere (Prochaska et al., 2004).

2.1.2. Study 2—A health insurance provider provided a list of 19,696 patient names for a multiple risk behavior (smoking, diet, sun, mammography) study. Initial screening identified a total of N=12,978 eligible households who were contacted. One patient was recruited from each eligible household, N=8539 patients (65%) participated, with N=3,558 (65.8%) at-risk for a high-fat diet. Additional details about the recruitment and outcome are available elsewhere. (Prochaska et al., 2005).

2.1.3. Study 3—The worksite sample was part of a larger multiple risk behavior study (diet, smoking, sun, and exercise). A total of 22 worksites provided subjects for this study. Of the baseline sample of N=1,906 participants, N=1,302 (68.3%) were at-risk for a high-fat diet. Additional details about the recruitment and outcome are available elsewhere (Linnan et al., 2002; Velicer et al., 2004).

2.2 Treatment

Participants randomized to the assessment only control group (N = 3,404) were assessed by phone at twelve-month intervals and received no intervention materials. Those randomly assigned to the TTM-tailored treatment group (N= 3,216) were mailed intervention materials

at baseline, 6-months, and 12-months. Responses to the phone survey generated TTM-tailored expert system reports for intervention group participants (Redding et al., 1999; Velicer et al., 1993). Mailed materials included an expert system feedback report and an integrated stage-matched multiple risk behavior self-help manual at baseline.

At six and twelve months, treatment group participants completed a survey and an expert system progress report was generated and mailed. Each three to five page report was divided into six sections: 1) stage of change; 2) feedback on the four target dietary behaviors (described below); 3) Pro's of reducing dietary fat; 4) participants' use of up to six change processes relevant to their stage of change; 5) situation specific self-efficacy to resist temptations to eat high fat foods; 6) strategies for taking small steps to progress to the next stage with references to relevant sections of the manual. At baseline, participants were compared in sections 2–5 with participants in their stage. For both follow-up reports, they were also compared to their prior assessment. More details regarding TTM-tailored intervention protocols can be found elsewhere (Redding et al., 1999; Velicer et al., 1999).

The intervention targeted the following dietary changes: 1) moderating intake of high fat foods, 2) substituting lower fat foods such as reduced fat dairy products for higher fat products, 3) modifying cooking techniques to reduce fried foods, and 4) increasing consumption of healthful foods such as fruits, vegetables and whole grains. Although this intervention was developed prior to the 2010 Dietary Guidelines, it is consistent with the Guidelines with the exception that "at risk" for a high fat diet (>30% fat) follows previous editions of the Guidelines, similar to the WHI, rather than the current target of 25–35 % kcal from fat.

2.3 Measures

All self report variables were assessed in a phone or mail survey. Demographic variables included age, education, gender, race, ethnicity and health status.

2.3.1. Stage of Change—*Stage of Change for Dietary Fat Moderation* was assessed in a 3-step process. First, intention was assessed by the following question, "Do you consistently avoid eating high-fat foods?" Subjects responding "No" were assigned to either: a) Precontemplation (PC) – "No, and I do not intend to in the next 6 months"; b) Contemplation (C) – "No, but I intend to in the next 6 months; or c) Preparation (PR) – "No, but I intend to in the next 30 days." Second, subjects responding "Yes," must have met a behavioral criterion of estimated fat intake ≤ 30% calories (based on the Dietary Behavior Questionnaire described below) to be classified into the Action (A) - "Yes but for less than 6 months" or Maintenance (M) - "Yes, for more than 6 months." Third, subjects who perceived that they consistently avoid high fat foods, but failed to meet the behavioral criterion were classified into Precontemplation, Contemplation, or Preparation based on intention to change specific eating habits (Greene et al., 1994; Greene et al., 1999).

2.3.2—*Decisional Balance for Dietary Fat* was assessed with a 6-item survey. The Pros and Cons of dietary fat consumption have been assessed reliably across many studies of adults (Greene, Rossi, Rossi et al., 1999; Prochaska et al., 1994; Rossi et al., 1994b; Rossi, Rossi,

& Hargreaves, 1997) and adolescents (Rossi et al., 2001). Coefficient alphas for both 3-item scales were good: Pros (α= .79) and Cons (α= .67).

2.3.3—*Temptations for Dietary Fat* was assessed with a 9-item survey. Temptations for dietary fat have been assessed reliably across many studies of adults (Greene et al., 1999; Prochaska et al., 1994; Rossi et al., 1994b; 1997) and adolescents (Rossi et al., 2001). Coefficient alpha for this 9-item scale was also good (α=.83).

2.3.4. Behavioral Outcome for Dietary Change—The Dietary Behavior Questionnaire is a 22-item instrument assessing food consumption over the previous month using a 5-point Likert scale ranging from 1 - never to 5 - almost always. The DBQ has four subscales: a) Substitute lower fat foods for higher fat foods (***Substitute*** - 5 items) which assesses substitution of low fat foods such as low-fat or fat-free milk for higher fat foods; b) Modify cooking techniques to reduce fried foods (***Modify cooking*** – 5 items) which assesses use of lower fat food cooking methods; c) Moderate fat intake by avoiding high fat foods (***Moderate fat intake –*** 5 items) which assesses reduction in both the frequency and amount of high fat foods; and d) Increase intake of whole grains, fruits and vegetables (***Increase healthful foods*** – 7 items) which assesses consumption of more fruits, vegetables, grains and higher fiber foods. The internal consistency with adults ranges from 0.67 to 0.84 (Mean Alpha = .75). A good fit was found for an hierarchical instrument structure with 4 first order factors (CFI=0.93; RMSR=0.05). The DBQ was significantly correlated with energy adjusted fat intake (*R*=0.52) and a regression equation was developed to estimate fat intake. This regression equation was used to estimate the behavioral criterion of fat ≤ 30 % kcal used in the staging algorithm. The total score (sum of the subscales) was significantly correlated with percent of energy from fat (*R*=.45–.48), as was each subscale. The DBQ was as sensitive to dietary change as the NCI/Block Questionnaire (Greene et al., 1996). Subscale scores were averaged (subscale score/# items) thus standardized scores range from 1 to 5, with higher scores indicating better dietary habits.

2.4 Analysis Plan

The first analyses examined differences between those retained in these studies and those not retained on baseline variables. The second analyses assessed stage at 12 and 24 months by baseline stage for treatment and control groups separately using chi-square analyses. The next set of analyses focused on individual variables rather than the development of a multivariate prediction model. Chi-squares (categorical variables) and ANOVAs (continuous variables) assessed baseline differences between those meeting criterion (A/M) and those still at risk (not in A/M) at 12 and 24 months. Except for two stage transition analyses comparing treatment to control at 12 and 24 months and the final multivariable logistic regression, analyses were conducted for the control and treatment groups separately to allow possible differences to emerge. The proportion of participants who reached Action (A) or Maintenance (M) stages for both timepoints along with effect size estimates (Cramer's Φ^2) were analyzed for each categorical variable. MANOVAs on continuous variables (TTM and dietary behavior) were conducted between participants who reached and those who did not reach A/M at 12 and 24 months on their baseline means and effect sizes (ω^2). Cramer's Φ^2 is the standard effect size for categorical measures, while Omega squared

(ω^2) is comparable to Cramer's for continuous variables. Effect size estimates are interpreted using guidelines for small (.01), medium (.06), and large (.14) effects developed by Cohen (1988), but Rossi (2012) estimated that small, medium and large effects are much smaller in population based behavior change research. Finally, a multivariable logistic regression examined predictors of outcomes at 12 and 24 months across all variables.

3. Results

3.1

A comparison of demographic and dietary variables between those lost to follow-up (N=2443) and those retained (N=4178) is presented in Table 1. Chi-squares and ANOVAs revealed that females, individuals who were married or living together, individuals in very good or excellent health, Whites, Non-Hispanics, individuals who were slightly older, and individuals with slightly healthier dietary habits at baseline were more likely to be retained in the final sample. Stage of change was unrelated to retention status.

3.2

Stage transitions from baseline to each follow-up time point are presented in Table 2 for control and treatment groups There were no differences in stage distribution by treatment group at baseline. There were consistent effects for treatment group at both follow-up timepoints. At 12 months, 21.4% of subjects in the treatment group had progressed to A/M compared to 15.0% of controls ($p<0.01$, Cohen's h=.17). Similarly, at 24 months, 24.2% of those in treatment had progressed to A/M compared to 16.9% of controls ($p<0.001$, Cohen's h=.17). Table 2 also illustrates interesting differences by baseline stage of change at both follow-up timepoints. Although the control group progressed less than the treatment group, the pattern by baseline stage was similar with a majority of precontemplators remaining stable throughout the study. Those in preparation were more likely to progress to action than those in other stages with most progress occurring in the first 12 months, but they were also more likely to regress to a previous stage than progress.

3.3 Effects for Demographics and Stage of Change

Tables 3a and 3b present the proportion of individuals within each demographic group who reached A/M in each treatment group at 12 (Table 3a) and 24 (Table 3b) months including effect size estimates. These results show movement from baseline at-risk for a high fat diet (estimated > 30% fat) to "not at risk" (operationally defined as in A/M for estimated ≤ 30% fat) at 12 and 24 months.

At both 12 and 24 month timepoints, moderately sized differences ($p<0.01$) were found for Gender, Cramer's Φ^2=.08–.12.

In the treatment group only at 12 months, a moderate effect ($p<0.01$) was found for Age Group, Cramer's Φ^2=.09. Also in the treatment group only at 24 months, a small effect ($p<0.05$) was found for Health Status Group, Cramer's Φ^2=.04,

3.4 Effects for TTM and Dietary Behavior Variables

MANOVAs assessed baseline differences on the Pros, Cons, Temptations and Dietary Behaviors between those at criterion (A/M at 12 and 24 months) and those not at criterion. Comparable results were found at both 12 (Table 4a) and 24 months (Table 4b).

12 Months: Very small differences between outcome groups were found in both Treatment and Control groups for baseline Pros, η^2=.003–.004, Cons, η^2=.003, and Negative Affect Temptations, η^2=.002 –.006.

Small to medium sized effects were also evident for all four diet behavior variables in both Treatment and Control groups: Moderate Fat, η^2=.07, Substitute, η^2=.06, Increase Healthful Foods, η^2=.02–.04, and Modify Cooking, η^2=.01.

24 Months: In the Treatment group only, very small effects were found for Pros, η^2=.007, Cons, η^2=.005, Negative Affect Temptations, η^2=.005, and Positive Social Temptations, η^2=.004. No continuous TTM effects were found in the Control Group at 24 months.

Small to medium sized effects were found at 24 months for all four diet behavior variables in both Treatment and Control groups: Moderate Fat, η^2=.07–.08, Substitute, η^2=.05–.06, Increase Healthful Foods, η^2=.02–.04, and Modify Cooking, η^2=.01–.02.

3.5 Multivariable Logistic Regression

Logistic regression assessed baseline predictors of reaching the outcome (A/M) at 12 and 24 months. Each predictor was first evaluated for univariate prediction ($p<0.10$) of outcome. Significant univariate predictors were entered into a multivariate model. Only variables that maintained significance ($p<0.05$) were retained in the final model. At 12 months, Contemplators at baseline were 1.35 times and Preparers were 1.54 times more likely to reach outcome than Precontemplators. At 24 months, Preparers were 1.44 times more likely to reach outcome than Precontemplators. Females were 1.23 times more likely to reach outcome compared to males at 24 months. Individuals in the treatment group were 1.55 to 1.57 times more likely to reach outcome compared to controls. Three Diet Behavior Subscales, all except Modify Cooking, maintained significance.

4. Discussion

This is the first study to investigate predictors of dietary change defined as progression from at-risk for a high-fat diet to not-at-risk (A/M ≤ 30% fat) in a large population over 12 and 24 months including both specific dietary behavior and TTM constructs. The study was unique in both assessing specific dietary behaviors as well as analyzing progression in intervention and control separately to identify common predictors of change. The results of this study are best understood in the context of four effects that have been found to be consistent baseline predictors of long term behavior change across multiple behaviors (Blissmer et al., 2010). These are: 1) Stage effects with participants further along in the stages at baseline (PR) outperforming those in earlier stages (PC); 2) Effort effects with those making better efforts on change variables (Pros, Cons, Efficacy) at baseline progressing more over time; 3) Severity effects with those having more severe dietary risk (less use of fat reducing

behaviors) at baseline making less progress over time, and 4) Treatment effects with the treatment group outperforming control group participants. These study outcomes are consistent with these four effects and provide more in depth analysis of how these four effects predict long term changes in risk status in a large populations with high fat diets.

For the most part, results of separate analyses between the treatment and control groups were comparable, meaning that baseline predictors of outcome within both groups were similar. Comparable to other studies in other behavioral areas (Blissmer et al., 2010; Johnson et al., 2008; Noar et al., 2007; Velicer et al., 2007), there was a moderately sized effect for baseline stage of change evident in both treatment and control groups. This stage effect was also apparent in the logistic regression at both 12 and 24 months. Those in Preparation were at least 1.44 times more likely to progress to A/M compared to those in Precontemplation.

Effort effects as operationalized by continuous TTM measures, decisional balance and temptations, were less evident in this study than they have been elsewhere. Decisional balance and temptations were not significant predictors in the logistic regression, perhaps due to their very small effect sizes at 12 months and lack of effect at 24 months in the control group. In contrast, two studies found TTM effort variables important in predicting outcome for fruit and vegetable intake (Greene et al., 2008; Nitzke et al., 2007) and baseline TTM effort variables predicted outcomes in smoking cessation and other areas (Blissmer et al., 2010; Redding et al., 2011). Future research will need to examine and sort out what effort effects are most important in this area.

Unlike previous research defining severity in terms of addiction severity, amount of time spent in the sun or estimated % fat, this study was unique in investigating the effect of specific components of baseline dietary behavior severity as defined by the Dietary Behavior Questionnaire. There were moderate effects for the Substitute and Moderate Fat Intake subscales as well as the total score, small to moderate effects for the Increase Healthful Foods subscale, and smaller less robust effects for the Modify Cooking subscale. The effects of these subscales at both timepoints were also supported by the multivariable logistic regression. When predictors of dietary change and maintenance in the intervention group of the WHI (Tinker et al., 2007) were examined, age, baseline dietary intake, attendance and self-monitoring as well as optimism predicted change in % energy from fat at 12 months and baseline dietary intake, attendance and self monitoring predicted maintenance of reduced fat intake at 3 years. Baseline intake also predicted maintenance of increased fruit and vegetable and grain intake. Attendance and completion of self monitoring logs (in WHI) reflects to some extent both the stage and effort effects found here (Blissmer et al., 2010). Both previous studies (Blissmer et al., 2010; Tinker et al., 2007) used % fat as a measure of severity. This study extended our understanding of the mechanisms of dietary change by individually examining four components of dietary change. These components were first identified by Jerome (1976) and parallel constructs were examined by Kristal and colleagues (1990). Although moderating fat intake had the largest effect size in both groups at both time points, which was confirmed by the logistic regression, other behaviors were significant in univariate and all but modify cooking in the logistic regression. This supports Jerome's (1976) theory of dietary behavior change to some extent and reinforces the

importance of substitution and increasing consumption of healthful foods. These behaviors will reduce saturated fat intake and increase intake of fruits, vegetables and whole grains in accordance with current dietary guidelines (USDHHS 2010). The lack of effect of modify cooking may reflect the limited diversity of this sample and the focus of that scale on reducing fried foods. This sample was somewhat lacking in diversity. It is likely that other more diverse populations and especially younger individuals would benefit more from an emphasis on cooking techniques. Consistent with previous dietary research, there were strong univariate effects for gender which were supported to some extent by the logistic regression.

Based on primary reports of the original studies, significant moderately-sized treatment effects were predictable (Prochaska et al., 2004, 2005; Velicer et al., 2004). One question that has not been addressed adequately is why the treatment group doesn't outperform the control group even more. One factor evident here is that the other three effects (aside from treatment) were predictors of progress within the control group as well as the treatment group. These dynamic variables can be changed on one's own without treatment, allowing control group participants to make progress, though not at the same rate as those in treatment. This is consistent with original TTM perspectives and research (DiClemente & Prochaska, 1982) that sought the most important predictors of change for both self changers and those getting any type of treatment.

There was one surprising finding. Those who progressed to Action or Maintenance had *higher* negative affect temptation scores at baseline. This effect was found in both the treatment and control groups at 12 months and in the treatment group at 24 months. Although this was no longer significant in the logistic regression, it remains a curious, counterintuitive finding. Emotional eating in response to stress or negative emotional cues has been associated with weight gain over time (Brownell & Cohen, 1995), although in this study temptation to eat emotionally was associated with decreased dietary fat consumption over time. Increased awareness of one's emotional eating is clearly important for intervention purposes, but it may function differently from initial hypotheses. Future studies are clearly necessary to help us to better understand this finding.

4.1 Limitations

The strength of this study can also be viewed as a weakness. Only a single TTM-tailored behavioral intervention was studied and these results may not generalize to other types of dietary interventions, such as telephone or in-person counseling. Even with these combined samples, sample sizes of some subgroups remained small, thus limiting the statistical power of some analyses. This large sample was limited in diversity. Although differential attrition by demographic characteristics further limits generalizability, the similarity in attrition by baseline stage of change increases confidence in results related to stage of change. However, the 37% lost to follow-up is a limitation. In addition, the use of self-report measures of dietary intake is another study limitation.

4.2 Implications for Interventions

From an intervention viewpoint, these results are very encouraging. Since demographic variables are static variables and are not modifiable, they can serve only as moderator variables. In contrast, the TTM and dietary behavior variables are all dynamic variables and are subject to intervention effects. These are variables that can be and have been used to guide the design of interventions. For example, given the strong relationship between moderation of dietary fat intake and outcome, a focus on reducing the amount and frequency of consumption of high fat foods may be seen as a first step. Likewise, the strong relationship between stage of change and outcome supports the TTM's focus on stage and stage progress in interventions.

One promising new approach to population-based dietary change has been computer-based, TTM-tailored interventions (Noar et al., 2007). Several large clinical trials have demonstrated the effectiveness of such interventions (Greene et al., 2008; Johnson et al., 2008; Prochaska et al., 2004, 2005, 2008; Velicer et al., 2004), even those targeting additional risk behaviors simultaneously, such as physical activity and stress management (Johnson et al., 2008; Prochaska et al., 2008) or smoking cessation (Prochaska et al., 2004, 2005; Velicer et al., 2004). Tailored interventions that focus on the dynamic variables with the largest effect sizes, such as stage of change and dietary behaviors can be effective at increasing dietary behavior change.

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References

Astrup A, Grunwald GK, Melanson EL, Saris WH, Hill JO. The role of low-fat diets in body weight control: A meta-analysis of ad libitum dietary intervention studies. International Journal of Obesity & Related Metabolic Disorders. 2000; 24:1545–52. [PubMed: 11126204]

Barnard ND, Scialli AR, Turner-McGrievy G, Lanou AJ, Glass J. The effects of a low-fat, plant-based dietary intervention on body weight, metabolism, and insulin sensitivity. American Journal of Medicine. 2005; 118:991–997. [PubMed: 16164885]

Beresford SA, Johnson KC, Ritenbaugh C, Lasser NL, Snetselaar LG, Black HR, et al. Low-fat dietary pattern and risk of colorectal cancer: the Women's Health Initiative Randomized Controlled Dietary Modification Trial. Journal of the American Medical Association. 2006; 295:643–654. [PubMed: 16467233]

Blissmer B, Prochaska JO, Velicer WF, Redding CA, Rossi JS, Greene GW, Paiva A, Robbins M. Common factors predicting long-term changes in multiple health behaviors. Journal of Health Psychology. 2010; 15(2):205–214. [PubMed: 20207664]

Brownell KD, Cohen LR. Adherence to dietary regimens 2: Components of effective interventions. Behavioral Medicine. 1995; 20:155–164. [PubMed: 7620227]

Cohen, J. Statistical power analysis for the behavioral sciences. New Jersey: Lawrence Erlbaum Assoc., Inc; 1988.

DISC Collaborative Research Group. Dietary intervention study in children (DISC) with elevated low-density-lipoprotein cholesterol. Design and baseline characteristics. Annals of Epidemiology. 1993; 3:393–402. [PubMed: 8275216]

DiClemente CC, Prochaska JO. Self-change and therapy change of smoking behavior: a comparison of processes of change in cessation and maintenance. Addictive Behaviors. 1982; 7:133–142. [PubMed: 7102444]

Greene GW, Fey-Yensan N, Padula C, Rossi SR, Rossi JS, Clark PG. Change in Fruit and Vegetable Intake over 24 Months in Older Adults: Results of the SENIOR Project Intervention. The Gerontologist. 2008; 48:378–387. [PubMed: 18591363]

Greene GW, Rossi SR, Reed GR, Willey C, Prochaska JO. Stages of change for reducing dietary fat to 30% of energy or less. Journal of the American Dietetic Association. 1994; 4:1105–1110. [PubMed: 7930314]

Greene, GW.; Rossi, SR.; Fava, JL.; Velicer, WF.; Laforge, R.; Willey, C.; Rossi, JS. The relationship between a dietary behavior change questionnaire and dietary intake. Paper presented at the annual meeting of the Society for Behavioral Medicine; Washington, DC. 1996.

Greene GW, Rossi SR, Rossi JS, Velicer WF, Fava JL, Prochaska JO. Dietary applications of the stages of change model. Journal of the American Dietetic Association. 1999; 99:673–678. [PubMed: 10361528]

Hebert JR, Patterson RE, Gorfine M, Ebbeling CB, St Jeor ST, Chlebowski RT. Differences between estimated caloric requirements and self-reported caloric intake in the Women's Health Initiative. Annals of Epidemiology. 2003; 13:629–637. [PubMed: 14732302]

Howard BV, Manson JE, Stefanick ML, Beresford SA, Frank G, Jones B, et al. Low-fat dietary pattern and weight change over 7 years: The Women's Health Initiative Dietary Modification Trial. Journal of the American Medical Association. 2006a; 295:39–49. [PubMed: 16391215]

Howard BV, Van Horn L, Hsia J, Manson JE, Stefanick ML, Wassertheil-Smoller S, et al. Low-fat dietary pattern and risk of cardiovascular disease: the Women's Health Initiative Randomized Controlled Dietary Modification Trial. Journal of the American Medical Association. 2006b; 295:655–666. [PubMed: 16467234]

Howard BV, Curb D, Eaton CB, Kooperberg C, Ockene J, Kostis JB, et al. Low-fat dietary pattern and lipoprotein risk factors: The Women's Health Initiative Dietary Modification Trial. American Journal of Clinical Nutrition. 2010; 91:860–874. [PubMed: 20164311]

Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. Journal of the American Medical Association. 2002; 288:2569–2578. [PubMed: 12444864]

Jerome, NW. On determining food patterns of urban dwellers in contemporary United States society. In: Arnott, ML., editor. Gastronomy, the anthropology of food habits. Paris: Mouton Publishers; 1976.

Jones H, Edwards L, Vallis TM, Ruggiero L, Rossi SR, Rossi JS, Greene G, Prochaska JO, Zinman B. Changes in diabetes self-care behaviors make a difference in glycemic control: The Diabetes Stages of Change (DiSC) study. Diabetes Care. 2003; 26:732–737. [PubMed: 12610030]

Kristal AR, Shattuck AL, Henry HJ. Patterns of dietary behavior associated with selecting diets low in fat: Reliability and validity of a behavioral approach to dietary assessment. Journal of the American Dietetic Association. 1990; 90:214–220. [PubMed: 2303658]

Lanza E, Schatzkin A, Daston C, Corle D, Freedman L, Ballard-Barbash R, et al. PPT Study Group. Implementation of a 4-y, high-fiber, high-fruit-and-vegetable, low-fat dietary intervention: Results of dietary changes in the Polyp Prevention Trial. American Journal of Clinical Nutrition. 2001; 74:387–401. [PubMed: 11522565]

Linnan LA, Emmons KM, Klar N, Fava JL, Laforge RG, Abrams DB. Challenges to improving the impact of worksite cancer prevention programs: Comparing reach, enrollment, and attrition using active versus passive recruitment strategies. Annals of Behavioral Medicine. 2002; 24:157–66. [PubMed: 12054321]

Mensink RP, Zock PL, Kester AD, Katan MB. Effects of dietary fatty acids and carbohydrates on the ratio of serum total to HDL cholesterol and on serum lipids and apolipoproteins: A meta-analysis of 60 controlled trials. American Journal of Clinical Nutrition. 2003; 77:1146–1155. [PubMed: 12716665]

Noar SM, Benac C, Harris M. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological Bulletin. 2007; 133(4):673–693. [PubMed: 17592961]

Prentice RL, Caan B, Chlebowski RT, Patterson R, Kuller LH, Ockene JK, et al. Low-fat dietary pattern and risk of invasive breast cancer: the Women's Health Initiative randomized controlled dietary modification trial. Journal of the American Medical Association. 2006; 295:629–642. [PubMed: 16467232]

Prochaska JO, Velicer WF, Rossi JS, Goldstein MG, Marcus BH, Rakowski W, Fiore C, Harlow LL, Redding CA, Rosenbloom D, Rossi SR. Stages of change and decisional balance for 12 problem behaviors. Health Psychology. 1994; 13:39–46. [PubMed: 8168470]

Prochaska JO, Velicer WF, Redding CA, Rossi JS, Goldstein M, DePue J, Greene GW, Rossi SR, Sun X, Fava JL, Laforge R, Rakowski W, Plummer BA. Stage-based expert systems to guide a population of primary care patients to quit smoking, eat healthier, prevent skin cancer and receive regular mammograms. Preventive Medicine. 2005; 41:406–416. [PubMed: 15896835]

Prochaska JO, Velicer WF, Rossi JS, Redding CA, Greene GW, Rossi SR, Sun X, Fava JL, Laforge R, Plummer BA. Impact of simultaneous stage-matched expert system interventions for smoking, high fat diet and sun exposure in a population of parents. Health Psychology. 2004; 23:503–516. [PubMed: 15367070]

Redding CA, Prochaska JO, Paiva A, Rossi JS, Velicer WF, Blissmer B, Greene GW, Robbins M, Sun X. Baseline stage, severity and effort effects differentiate stable smokers from maintainers and relapsers. Substance Use & Misuse. 2011; 46(13):1664–1674. [PubMed: 21449711]

Redding CA, Prochaska JO, Pallonen UE, Rossi JS, Velicer WF, Rossi SR, Greene GW, Meier KS, Evers KE, Plummer BA, Maddock JE. Transtheoretical individualized multimedia expert systems targeting adolescents' health behavior. Cognitive & Behavioral Practice. 1999; 6:144–153.

Rossi, JS. Statistical power analysis. In: Schinka, JA.; Velicer, WF., editors. Handbook of psychology. Volume 2: Research methods in psychology. 2. New York: John Wiley & Sons; 2013. p. 71-108.

Rossi SR, Greene GW, Reed G, Rossi JS, Prochaska JO, Velicer WF. Development of a self-efficacy questionnaire for dietary fat reduction. Annals of Behavioral Medicine. 1994a; (Suppl 16):168. (Abstract).

Rossi SR, Greene GW, Reed GR, Rossi JS, Prochaska JO, Velicer WF. Cross validation of a decisional balance measure for dietary fat reduction. Annals of Behavioral Medicine, Suppl. 1994b; 16:167(Abstract).

Rossi SR, Rossi JS, Hargreaves MK. A decisional balance model for dietary fat reduction in African-American women. Annals of Behavioral Medicine, Suppl. 1997; 17:107(Abstract).

Sacks FM, Katan M. Randomized clinical trials on the effect of dietary fat and carbohydrate on plasma lipoproteins and cardiovascular disease. American Journal of Medicine. 2002; 113(9B):13S–24S. [PubMed: 12566134]

Tinker LF, Rosal MC, Young AF, Perri MG, Patterson RE, Van Horn L, Assaf AR, Bowen DJ, Ockene J, Hays J, Wu L. Predictors of dietary change and maintenance in the Women's Health Initiative Dietary Modification Trial. Journal of the American Dietetic Association. 2007; 107(7): 1155–1166. [PubMed: 17604744]

U.S. Department of Health and Human Services. [Accessed 7/6/2012.] Healthy People 2020 Nutrition and Weight Status. 2012. http://www.healthypeople.gov/2020/topicsobjectives2020/ebr.aspx?topicId=29

U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 7. Washington, DC: U.S. Government Printing Office; 2010 Dec.

Velicer WF, Prochaska JO, Bellis JM, DiClemente CC, Rossi JS, Fava JL, Steiger JH. An expert system intervention for smoking cessation. Addictive Behaviors. 1993; 18:269–290. [PubMed: 8342440]

Velicer WF, Prochaska JO, Redding C, et al. Efficacy of expert system interventions for employees to decrease smoking, dietary fat, and sun exposure. International Journal of Behavioral Medicine. 2004; 11(S1):277 (Abstract).

Velicer WF, Redding CA, Sun X, Prochaska JO. Demographic variables, smoking variables, and outcome across five studies. Health Psychology. 2007; 26(3):278–287. [PubMed: 17500614]

Winters BL, Mitchell DC, Smicklas-Wright H, Grosvenor MB, Liu W, Blackburn GL. Dietary patterns in women treated for breast cancer who successfully reduce fat intake: the Women's Intervention Nutrition Study (WINS). Journal of the American Dietetic Association. 2004; 104:551–559. [PubMed: 15054339]

Table 1

Demographic and Dietary Descriptive Variables By Retention Status

	Retained (n=4178)		Not Retained (n=2442)		
	n	**%**	**n**	**%**	**Phi^2**
Gender					
Male	1480	35.4	945	38.7	0.001**
Female	2698	63.4	1497	61.3	
Marital Status					
Married	3069	74.2	1494	66.1	0.008**
Not Married but Living with a Partner	127	3.1	99	4.4	
Not Married	365	8.8	269	11.9	
Separated	67	1.6	66	2.9	
Divorced	399	9.6	262	11.6	
Widowed	108	2.6	71	3.1	
Health Status					
Poor	53	1.3	43	1.9	0.004**
Fair	470	11.3	316	14.0	
Good	1633	39.4	941	41.5	
Very Good	1492	36.0	749	33.1	
Excellent	493	11.9	216	9.5	
Race					
White	3968	96.0	2091	92.6	0.006**
Black	51	1.2	69	3.1	
Asian, Pacific Islander	28	0.7	31	1.4	
American Indian, Alaskan	19	0.5	14	0.6	
Other	68	1.6	54	2.4	
Hispanic					
No	4055	98.2	2191	97.0	0.002*
Yes	73	1.8	67	3.0	

Stage

	Retained (n=4178)		Not Retained (n=2442)		
	n	**%**	**n**	**%**	**Phi^2**
PC	2178	52.1	1273	52.1	0.000
C	620	14.8	361	14.8	
PR	1380	33.0	808	33.1	

	Retained (n=4178) Mean *(SD)*	**Not Retained (n=2442) Mean *(SD)***	**η^2**
Age	44.38 *(10.5)*	42.65 *(11.1)*	0.006**
Diet Behavior Variables			
Substitute	2.91 *(0.96)*	2.73 *(0.99)*	0.007**
Modify Cooking	4.03 *(0.73)*	3.91 *(0.81)*	0.006**
Moderate Fat Intake	3.14 *(0.65)*	3.07 *(0.68)*	0.002**
Increase Healthful Foods	3.19 *(0.70)*	3.08 *(0.72)*	0.006**
Diet Behavior Total	3.31 *(0.53)*	3.19 *(0.56)*	0.011**

* $p < 0.05$;

** $p < 0.01$

** p<0.01; Data collected between 1995–2000.

Table 2

Dietary Stages of Change Transitions by Treatment Group: Baseline by 12 and 24 months.

Variable	Subgroup	Treatment Baseline Stage			Control Baseline Stage		
		Precontemplation % (n)	**Contemplation % (n)**	**Preparation % (n)**	**Precontemplation % (n)**	**Contemplation % (n)**	**Preparation % (n)**
Stage 12 months	Precontemplation	51.4 (489)	32.0 (96)	22.9 (139)	62.3 (759)	33.7 (106)	26.3 (201)
	Contemplation	16.8 (160)	26.3 (79)	17.9 (109)	12.6 (154)	25.7 (81)	20.3 (155)
	Preparation	14.8 (141)	21.7 (65)	30.3 (184)	13.9 (169)	23.5 (74)	33.2 (254)
	Action	4.5 (43)	6.3 (19)	8.7 (53)	2.2 (27)	5.1 (16)	6.7 (51)
	Maintenance	12.4 (118)	13.7 (41)	20.2 (123)	9.0 (110)	12.1 (38)	13.5 (103)
				$phi^2=0.09$**			$phi^2=0.13$**
Stage 24 months	Precontemplation	51.9 (492)	30.5 (92)	25.4 (154)	61.9 (755)	38.3 (120)	27.1 (207)
	Contemplation	15.5 (147)	24.2 (73)	14.5 (88)	11.5 (140)	20.8 (65)	19.5 (149)
	Preparation	12.6 (119)	24.2 (73)	28.0 (170)	13.1 (160)	24.9 (78)	30.8 (236)
	Action	4.9 (46)	5.3 (16)	8.2 (50)	2.2 (27)	4.2 (13)	5.8 (44)
	Maintenance	15.2 (144)	15.9 (48)	23.9 (145)	11.3 (138)	11.8 (37)	16.9 (129)
				$phi^2=0.08$**			$phi^2=0.11$**

** $p<0.01$; Note: Data collected between 1995–2000.

Table 3a

Demographic Variables Relationship to Reaching A/M at 12 months in Treatment and Control Groups

		Treatment			Control		
Variable	**Subgroup**	**n**	**%**	**Phi^2**	**N**	**%**	**Phi^2**
Gender	Male	101	15.3	0.012**	93	11.4	0.006
	Female	296	24.6		252	17.0	
Health Status	Poor/Fair	45	19.5	0.001	45	15.5	0.003
	Good	148	20.3		116	13.0	
	Very Good/Excellent	201	22.8		182	16.7	
Marital Status	Married	252	15.0	0.001	305	22.2	0.005
	Living w/Partner	12	16.2		9	17.0	
	Not Married	34	18.0		26	14.9	
	Separated	4	11.1		10	32.3	
	Divorced	31	13.7		33	19.3	
	Widowed	10	15.4		11	26.2	
Employment	Employed For Wages	300	20.9	0.002	267	15.6	0.003
	Self Employed	33	26.6		22	12.0	
	Out of work > 1 year	6	20.7		4	13.3	
	Out of work < 1 year	8	20.5		5	10.4	
	Homemaker	23	23.2		16	11.9	
	Student	4	18.2		7	21.2	
	Retired	20	21.7			16.0	
Race	White	377	21.5	0.002	333	15.2	0.001
	Black	7	23.3		2	9.5	
	Asian, Pacific Islander	3	21.4		1	7.1	
	Amer.Indian/Alaskan	0	0		3	27.3	
	Other	7	22.6		5	13.5	
Income	Under 15,000	6	11.3	0.006	11	12.6	0.003
	15,000–29,999	55	19.7		39	12.7	
	30,000–39,999	58	19.0		62	15.9	
	40,000–59,999	127	23.3		82	13.5	

		Treatment			Control		
Variable	**Subgroup**	**n**	**%**	**Phi^2**	**N**	**%**	**Phi^2**
	60,000–79,999	64	20.2		59	16.5	
	80,000 and over	56	27.3		55	17.4	
Age	34 and younger	61	18.5	0.006	55	14.0	0.001
	35 – 49	214	20.0		189	14.5	
	50 and older	121	26.9		98	16.6	

** p <0.01

Table 3b

Demographic Variables Relationship to Reaching A/M at 24 months in Treatment and Control Groups

		Treatment			Control		
Variable	**Subgroup**	**n**	**%**	**Phi^2**	**n**	**%**	**Phi^2**
Gender	Male	113	17.1	.014**	105	12.9	.006**
	Female	336	28.1		283	19.1	
Health Status	Poor/Fair	52	22.6	.002*	45	15.5	.002
	Good	158	21.6		753	15.6	
	Very Good/Excellent	238	27.0		892	18.5	
Marital Status	Married	282	16.8	.002	332	24.3	.003
	Living w/Partner	11	14.9		13	24.5	
	Not Married	38	20.1		35	20.1	
	Separated	6	16.7		8	25.8	
	Divorced	35	15.4		45	26.2	
	Widowed	14	21.9		15	35.7	
Employment	Employed For Wages	351	24.4	.000	300	17.5	.002
	Self Employed	29	23.2		32	17.4	
	Out of work > 1 year	8	27.6		6	20.0	
	Out of work < 1 year	10	25.6		7	14.9	
	Homemaker	24	24.0		19	14.1	
	Student	6	27.3		5	14.7	
	Retired	20	22.5		16	12.9	
Race	White	424	24.2	.001	375	17.1	.002
	Black	9	30.0		3	14.3	
	Asian, Pacific Islander	4	28.6		4	28.6	
	Amer.Indian/Alaskan	1	12.5		0	0	
	Other	9	29.0		5	13.5	
Income	Under 15,000	10	18.2	.004	11	12.5	.003
	15,000–29,999	75	26.9		47	15.4	
	30,000–39,999	71	23.5		58	14.9	
	40,000–59,999	131	24.3		110	17.5	

		Treatment			Control		
Variable	**Subgroup**	**n**	**%**	**Phi^2**	**n**	**%**	**Phi^2**
	60,000–79,999	67	20.8		67	18.8	
	80,000 and over	59	28.6		64	20.2	
Age	34 and younger	59	18.0	.008**	57	14.4	.001
	35 – 49	252	23.5		225	17.3	
	50 and older	135	30.2		105	17.8	

* p < 0.05;

** p <0.01; Data collected between 1995–2000.

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Table 4a

Relationships between Continuous Variables and Reaching A/M at 12 months in Treatment and Control groups.

		Month 12							
		Treatment				Control			
Variable		**n**	**Mean**	**(SD)**	**η^2**	**n**	**Mean**	**SD**	**η^2**
Diet Temptations									
Positive Social	Not in A/M	1458	9.34	(2.8)	0.001	1940	9.34	(2.8)	0.000
	In A/M	395	9.12	(2.8)		345	9.29	(2.6)	
Difficult Situations	Not in A/M	1439	8.30	(2.7)	0.000	1916	8.42	(2.7)	0.000
	In A/M	386	8.26	(2.5)		339	8.47	(2.4)	
Negative Affect	Not in A/M	1461	6.75	(3.5)	0.006**	1941	6.69	(3.5)	0.002*
	In A/M	396	7.40	(3.7)		345	7.13	(3.3)	
Total Temptations	Not in A/M	1436	24.39	(6.9)	0.001	1901	24.46	(7.0)	0.000
	In A/M	385	24.82	(7.0)		339	24.89	(6.0)	
Decisional Balance									
Pros -high fat diet	Not in A/M	1442	6.85	(2.9)	0.003*	1922	6.95	(2.9)	0.004*
	In A/M	386	6.46	(2.8)		336	6.43	(2.6)	
Cons -high fat diet	Not in A/M	1448	6.65	(3.2)	0.003*	1928	6.98	(3.3)	0.000
	In A/M	388	7.10	(3.3)		337	6.93	(3.3)	
Diet Behavior									
Modify Cooking	Not in A/M	1462	4.00	(0.72)	0.01**	1953	3.98	(0.75)	0.01**
	In A/M	397	4.21	(0.66)		345	4.23	(0.67)	
Substitute	Not in A/M	1462	2.81	(0.96)	0.06**	1953	2.78	(0.96)	0.06**
	In A/M	397	3.38	(0.83)		345	3.43	(0.81)	
Moderate Fat Intake	Not in A/M	1462	3.07	(0.64)	0.07**	1953	3.05	(0.65)	0.07**
	In A/M	397	3.48	(0.57)		345	3.54	(0.57)	
Increase Healthful Foods	Not in A/M	1462	3.17	(0.70)	0.02**	1953	3.12	(0.70)	0.04**
	In A/M	397	3.43	(0.67)		345	3.48	(0.64)	

*$p<0.05$;

** p<0.01

Table 4b

Relationships between Continuous Variables and Reaching A/M at 24 months in Treatment and Control groups.

		Month 24							
		Treatment				Control			
Variable		**n**	**Mean**	**(SD)**	**η^2**	**n**	**Mean**	**SD**	**η^2**
Diet Temptations									
Positive Social	Not in A/M	1404	9.40	(2.8)	0.004**	1897	9.35	(2.8)	0.000
	In A/M	447	8.98	(2.8)		388	9.21	(2.7)	
Difficult Situations	Not in A/M	1387	8.27	(2.7)	0.000	1870	8.44	(2.7)	0.000
	In A/M	436	8.32	(2.5)		385	8.36	(2.6)	
Negative Affect	Not in A/M	1407	6.75	(3.5)	0.005**	1899	6.70	(3.5)	0.002
	In A/M	448	7.34	(3.6)		388	7.07	(3.3)	
Total Temptations	Not in A/M	1384	24.41	(7.0)	0.000	1856	24.51	(6.8)	0.000
	In A/M	435	24.69	(6.8)		385	24.61	(6.3)	
Decisional Balance									
Pros -high fat diet	Not in A/M	1388	6.87	(2.9)	0.007**	1879	6.91	(2.9)	0.001
	In A/M	436	6.33	(2.7)		380	6.68	(2.8)	
Cons -high fat diet	Not in A/M	1395	6.60	(3.1)	0.005**	1879	6.92	(3.3)	0.000
	In A/M	439	7.14	(3.4)		386	7.00	(3.3)	
Diet Behavior									
Modify Cooking	Not in A/M	1408	4.01	(0.71)	0.01**	1910	3.97	(0.75)	0.02**
	In A/M	449	4.17	(0.68)		388	4.23	(0.64)	
Substitute	Not in A/M	1408	2.80	(0.95)	0.06**	1910	2.79	(0.96)	0.05**
	In A/M	449	3.36	(0.84)		388	3.35	(0.84)	
Moderate Fat Intake	Not in A/M	1408	3.05	(0.64)	0.08**	1910	3.05	(0.65)	0.07**
	In A/M	449	3.47	(0.57)		388	3.51	(0.60)	
Increase Healthful Foods	Not in A/M	1408	3.15	(0.69)	0.04**	1910	3.11	(0.70)	0.04**
	In A/M	449	3.47	(0.65)		388	3.48	(0.64)	

* $p<0.05$

** $p<0.01$ - Data collected between 1995–2000.

Table 5

Summary of Logistic Regression Analysis for Variables Predicting Outcome at 12 and 24 months

	12 months				24 months			
Predictor	**Slope**	**(SE)**	e^B	***95% CI (e^B)***	**Slope**	**(SE)**	e^B	***95% CI (e^B)***
Age	0.001	(0.004)	1.00	*(0.99, 1.01)*	0.003	(0.004)	1.00	*(1.00, 1.01)*
Gender	0.144	(0.100)	1.16	*(0.95, 1.41)*	0.204	(0.095)	1.23*	*(1.02, 1.48)*
Treatment Group	0.436	(0.087)	1.55**	*(1.3. 1.83)*	0.453	(0.083)	1.57**	*(1.34, 1.85)*
Stage of Change								
(Contemplation vs. PC)	0.297	(0.129)	1.35*	*(1.05, 1.73)*	0.046	(0.127)	1.05	*(0.82, 1.34)*
(Preparation vs. PC)	0.432	(0.096)	1.54**	*(1.28, 1.86)*	0.366	(0.091)	1.44**	*(1.21, 1.72)*
Substitute	0.469	(0.052)	1.60**	*(1.44, 1.77)*	0.403	(0.050)	1.50**	*(1.36, 1.65)*
Modify Cooking	0.000	(0.014)	1.0	*(0.86, 1.15)*	−0.040	(0.067)	.96	*(0.84, 1.10)*
Moderate Fat Intake	0.167	(0.016)	2.31**	*(1.97, 2.71)*	0.817	(0.078)	2.26**	*(1.94, 2.64)*
Increase Healthful Foods	0.049	(0.010)	1.41**	*(1.23, 1.61)*	0.442	(0.068)	1.56**	*(1.36, 1.78)*
Constant			−7.43				−7.25	
Df			1				1	

e^B = exponentiated *B*;

* $p < 0.05$;

** $p < 0.01$; Data collected between 1995–2000.