Published in final edited form as:

J Nutr Educ Behav. 2010 ; 42(6): 380–388. doi:10.1016/j.jneb.2009.08.006.

Low Social Support Level is Associated with Non-Adherence to Diet at 1-Year in the Family Intervention Trial for Heart Health (FIT Heart)

Brooke Aggarwal, Ed.D., M.S.¹, Ming Liao, B.S.¹, John P Allegrante, Ph.D.², and Lori Mosca, M.D., M.P.H., Ph.D.¹

¹Columbia University Medical Center, New York, NY

²Teachers College, Columbia University, New York, NY

Abstract

Objective—Evaluate the prospective relationship between low social support and adherence to diet in a cardiovascular disease (CVD) lifestyle intervention trial.

Design—Prospective sub-study of participants enrolled in a randomized controlled trial.

Setting and Participants—Blood relatives/cohabitants of hospitalized cardiac patients enrolled in NHLBI FIT Heart (n = 458; 66% female, 35% non-white, mean age 50) who completed a 1-year follow-up.

Main Outcome Measures—Non-adherence to diet using the validated MEDFICTS tool; social support using the ENRICH Social Support Instrument.

Analysis—Logistic regression models were adjusted for confounders.

Results—Significant predictors ($p < .05$) of non-adherence to diet recommendations at 1-year included low social support, increased BMI and waist size, lower physical activity, depression, pre-action stages of change, assignment to the control group, and being male. Those with low social support at baseline were 2.7 times more likely to be non-adherent to diet at 1-year vs. those with higher social support (95% CI = 1.1 – 6.4); there was no interaction by group assignment.

Conclusion and Implications—Low social support at baseline was independently associated with non-adherence to diet at 1-year in family members of cardiac patients, suggesting that individuals with low social support may be at heightened CVD risk due to poor dietary adherence.

Keywords

dietary adherence; cardiovascular disease; social support; saturated fat; prevention

© 2009 Society for Nutrition Education. Published by Elsevier Inc. All rights reserved.

Correspondence: Dr. Lori Mosca, Professor of Medicine, Columbia University Medical Center, Director, Preventive Cardiology Program, NewYork-Presbyterian Hospital, 601 West 168th Street, Suite 43, New York, NY 10032, Phone: 212-305-4866, Fax: 212-342-5238, Ljm10@columbia.edu, copy Lmr2@columbia.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

INTRODUCTION

Dietary patterns that are low in saturated fat and cholesterol are associated with a reduced incidence of cardiovascular disease (CVD) (1–2). Although a heart-healthy diet can reduce risk of CVD, adherence to such diets is often suboptimal for reasons that are not well-established (3–4). Psychosocial factors, such as lack of social support, have been associated with increased morbidity and mortality for CVD, and although the mechanism is not fully defined, lifestyle factors may be a contributing factor (5–6). In a cross-sectional study, we have documented that higher social support is associated with increased physical activity and increased HDL-cholesterol (7). Some studies have demonstrated a positive link between social support and healthy eating practices (8–9); however, they have been limited by their cross-sectional design, and have not evaluated dietary adherence specific to CVD prevention recommendations. Social support can also play a role in the processes of change as a behavioral moderator, potentially buffering the effects of stressors encountered while making lifestyle changes (10).

The purpose of this study was to prospectively evaluate the relationship between low social support and non-adherence to a nationally recommended diet for heart health in a diverse population of family members of recently hospitalized cardiac patients, enrolled in a randomized controlled lifestyle intervention trial. A secondary aim was to determine the prevalence and predictors of non-adherence to a heart-healthy diet among family members eligible for the prevention of CVD.

METHODS

Design and Subjects

This was a prospective 1-year sub-study of 458 participants enrolled in the National Heart, Lung, & Blood Institute's Family Intervention Trial for Heart Health (FIT Heart), a randomized controlled clinical trial designed to test the effectiveness of a hospital-based standardized screening and educational intervention to increase adherence to national CVD prevention goals versus usual care. Participants in this study completed both the baseline and 1-year follow-up examination, out of a total of 501 participants. The 1-year follow-up rate was 94% for the trial. The FIT Heart trial enrolled family members of patients who had been admitted to New York-Presbyterian Hospital/Columbia University Medical Center between January 2005 and June 2007; approximately 20 participants were enrolled per month. The study population consisted of adult family members of cardiac patients who were recruited (via staff visits to patient rooms and family waiting areas) at the time of hospitalization for atherosclerotic CVD. A family member was defined as a blood relative, spouse, or other individual that currently lived with the index case or had been a co-habitant for a minimum of 1 year within the previous 5 years, or for 10 years in the past. English and Spanish-speaking men and women between the ages of 20–79 years were eligible. Exclusion criteria included established CVD, diabetes, active liver disease, or chronic kidney disease. Only one family member per family was enrolled in the study and randomized, to avoid non-independence of observations.

Theoretical Framework

In this study the Transtheoretical Model of behavior change was used as the theoretical framework for a stage-matched lifestyle intervention. Since its inception, the model has been modified to help explain various health-related behaviors such as dietary change (11). This clinical trial was designed to provide behavioral counseling on diet, physical activity, and other lifestyle factors, specifically using the stage of change construct of the model. Diet counseling was matched to stage of readiness, in order to optimize the effectiveness of the intervention while recognizing that individuals vary on their motivation levels. Other constructs of the

Transtheoretical Model (processes of change, decisional balance, and self-efficacy) were addressed through dietary counseling in order to help move participants along the stages of change as appropriate.

Intervention

The full lifestyle intervention has been described in detail (12). Following a baseline screening evaluation, participants were randomly assigned to either a control group that received brief, general health messages about lifestyle and CVD prevention, or a special intervention (SI) group that received personalized CVD risk factor assessment, stage of change-matched diet/lifestyle counseling, regular follow-up, and progress reports sent to primary physicians. SI participants received individualized instruction about CVD risk factor goals during a 1 hour structured educational session during the hospital baseline visit.

Prevention counselors (master's level health educators) assessed motivation and stage of readiness for lifestyle change, and then discussed food preferences, typical eating patterns, and collaboratively selected appropriate goals based on the participant's interest and willingness to change behavior. Once participants' stage of change had been identified, prevention counselors used diet counseling techniques tailored to their stage. Strategies used included increasing self-efficacy or confidence to change behaviors in the pre-contemplation stage, working through the pros and cons of current dietary behaviors in the contemplation stage, setting a plan and problem-solving in the preparation stage, reinforcing coping skills and planning rewards in the action phase, and encouraging self-liberation and continued goal-setting in the maintenance phase.

Participants were taught lifestyle approaches to risk reduction based on national CVD prevention guidelines, including the National Cholesterol Education Program (NCEP) Expert Panel recommendations for achieving optimal blood cholesterol levels via a diet low in saturated fat, specifically the Therapeutic Lifestyle Changes (TLC) diet (1). Education focused on avoiding foods that contain saturated fat, cholesterol, partially hydrogenated fats, trans fats, refined sugars, and recommendations to eat ≥ 2 servings of fruits, ≥ 3 servings vegetables, and ≥ 20 grams of fiber per day. The counseling focused on foods rather than nutrient intake. A registered dietitian was available as a resource to SI participants throughout the study. Each participant in the SI group was followed on a regular basis by a prevention counselor and contact was made in person (or over the phone if not able to return for visit) at 2 weeks, 6 weeks, 3 months, 6 months, and 9 months. At each follow up visit, the prevention counselor reinforced adherence to the TLC diet, addressed any questions, and discussed progress toward goals and any potential barriers. At the 6 week and 6 month follow up points the MEDFICTS dietary assessment was given and results were used to counsel the subjects. All results for SI subjects were made available to their primary care physicians in the form of regular progress reports. All participants were required to give written informed consent and the study was approved by the Institutional Review Board of the institution.

Traditional Risk Factor Measurements

Trained research assistants collected standardized demographic and cardiometabolic risk factor information in all participants at baseline and 1 year including height, weight, body mass index (BMI), and waist circumference. Bilingual staff members were available to assist participants and all forms were available in English and Spanish. Each participant completed a standardized questionnaire including socio-demographic data (i.e., age, gender, race/ethnicity, education, and current medical status), past medical history, lifestyle habits, medication use, and family history of CVD. Smoking status and exposure to environmental smoke was assessed using validated questions from the Behavioral Risk Factor Surveillance System (BRFSS). Carbon monoxide monitoring was performed to validate self-reported smoking behavior.

Physical activity was assessed using standardized questions which have been adapted from the BRFSS survey questionnaire and validated (13). The questions collected data about the number of days per week participants engaged in physical activity, as well as the number of minutes per day. The following questions were included: “At least once a week, do you engage in any regular physical activity (brisk walking, jogging, bicycling, etc.) long enough to work up a sweat?”, “If yes, how many days per week do you engage in physical activity that works up a sweat?”, “For each time you engage in physical activity, how many minutes do you exercise for?”

Height and weight were measured by standard protocol and BMI was calculated directly by the formula: Weight (kg)/Height (m)². Overweight was defined as BMI 25.0–29.9 kg/m² and obesity was defined as BMI ≥ 30 kg/m² in accordance with national guidelines (14). Increased waist circumference was defined as > 35 inches in women and > 40 inches in men (14).

Dietary Assessment

Participants were prescribed the NCEP Adult Treatment Panel (ATP) III TLC diet and adherence was assessed at baseline and 1 year using the NHLBI MEDFICTS dietary assessment tool previously validated in this population tool against the full-length Block 98 Food Frequency Questionnaire (15). The MEDFICTS questionnaire gives information about level of saturated fat intake and consists of 8 food categories: Meats, Eggs, Dairy, Fried foods, fat In baked goods, Convenience foods, fats added at the Table, and Snacks (16). Numeric values are assigned to each food group, with weightings based upon weekly consumption and serving size. Scores range from 0 to 216 points. The MEDFICTS tool is recommended by the NCEP ATP III guidelines as a method to assess adherence to the TLC diet or the Heart Healthy diet. A score of <40 indicates adherence to the TLC diet (< 7% of calories from saturated fat, < 30% of calories from total fat, and < 200mg dietary cholesterol/day) (15). Recognizing that some, but not all, participants may find the TLC difficult to adhere to, we sought to capture all levels of adherence by also assessing adherence to the Heart-Healthy diet. A score of 40–70 indicates adherence to the Heart-Healthy diet (< 10% of the day’s total calories from saturated fat, 30% or less of the day’s total calories from fat, and < 300 milligrams of dietary cholesterol a day). Scores ≥ 70 indicate dietary non-adherence and changes need to be made in order to decrease saturated fat and cholesterol intake.

Psychosocial Measures

Social Support—Social support was measured using the ENRICH Social Support Inventory (ESSI) (Figure 1), a 7-item, self-report measure used in the Enhancing Recovery in Coronary Heart Disease Patients (ENRICH) trial (17–19). It was originally developed to assess social support among post-myocardial infarction patients, and the ENRICH trial included a large, diverse population. The ESSI was chosen for use in this study because of its high test-retest reliability, good convergence with standard emotional support measures, and its link to cardiac outcomes. The ESSI is also recommended for use when a short screening instrument is desired, as in the case of this study. A sample question from the ESSI is, “Is there someone available to you whom you can count on to listen to you when you need to talk?” Responses are rated as: none of the time (1), a little of the time (2), some of the time (3), most of the time (4), and all of the time (5). The scoring criterion for low social support is based on the participant’s score on 5 out of 7 items (items 1, 2, 3, 5, and 6). Items 1, 2, 3, 5, and 6 on the ENRICH Social Support Instrument assessed whether patients had someone available to them that they feel close to, someone available to listen, give advice about problems, show love and affection, talk over problems, trust and confide in. To qualify as having low social support, patients must have had a score of ≤ 2 on at least 2 of the 5 items, and a total score of ≤ 18.

Stages of change—The stage of change survey was used in this study to define a participant's level of readiness to change dietary behavior. Readiness to change was measured using a simple validated staging algorithm to classify stage of change for reducing saturated fat consumption (20). This algorithm classified stages of change based on self-reported behavior and intention. Participants' level of readiness was measured by asking, "Have you ever changed your eating habits to decrease the amount of saturated fat in your diet?" Those who had never changed their eating habits, or were not currently limiting their saturated fat intake and lacked some confidence that they would begin to make changes within the next month were categorized into the pre-contemplation or contemplation stage. Those who intended to make dietary changes and felt somewhat or very confident that they could begin to make these changes within the next month were categorized into the preparation stage. Participants who had been limiting saturated fat intake for 6 months or less were categorized into the action stage and those who had been limiting it for 7 months or longer were categorized into the maintenance stage.

Depression—Level of depressive symptoms was assessed by the Beck Depression Inventory – Second Edition (BDI- II) (21). This 21-item self report instrument for measuring the severity of depression in adults is the most widely used self-report measure of depression for clinical patients. Respondents are asked to circle the statements that best describe how they are feeling, covering the time frame of the past two weeks, consistent with the DSM-IV criteria for major depression. The BDI-II is scored by summing the ratings for the 21 items. Each item is rated on a 4-point scale ranging from 0 to 3, and total scores range from 0 (no depression) to 63 (severe depression). Low depression score is considered < 10, and has been associated with decreased risk for cardiac morbidity and mortality (22).

Data Management and Statistical Analyses

All data were collected on standardized forms and double entered into a Microsoft Access database then exported to SAS software version 9.1 (2008, SAS Institute Inc., Cary, NC). Categorical data are presented as frequencies and percentages. Continuous data are presented as means and standard deviations. Difference of proportion tests were used to show differences between the percent of participants who were adherent to diet at baseline and 1 year, and percent of participants at each stage of change at baseline and 1 year. Paired *t* tests were used to show differences between overall diet scores at baseline and 1-year, and differences between level of social support at baseline and 1 year. Odds ratios were calculated using chi-square tests for adherence to diet, social support, and stage of change. Potential predictors of dietary non-adherence were assessed using logistic regression, with dietary adherence (yes vs. no) as the dependent variable indicating adherence to the Heart-Healthy diet, TLC diet, or both. Significant univariate predictors of non-adherence were included in the multivariable logistic regression model. A test for interaction between level of social support and group assignment in the randomized controlled trial was performed by including a term *social support* × *group assignment* in the multivariable model. Statistical significance was set at *p* < .05.

RESULTS

Characteristics of the 458 participants included in this analysis are shown in Table 1. The mean age was 49 ± 13 years, two-thirds were women and one-third were racial/ethnic minorities (24% Hispanic, 6% African American, 4% Asian, and 1% Pacific Islander). Mean BMI was 28.1 ± 5.9 and mean days of physical activity per week was 1.8 ± 1.9. Approximately 60% of participants had greater than high school education levels.

The percent of subjects who were adherent to diet and in various stages of change at baseline and 1-year is shown in Table 2. Approximately 40% of participants were classified as being

in the pre-contemplation, contemplation, or preparation stages of change at baseline, and about 60% were in the action or maintenance stages. At 1-year, participants were much more likely to have moved into the maintenance stage of change (OR = 2.22, $p < 0.0001$), and moved out of the preparation (OR = 0.39, $p < 0.0001$) and pre-contemplation stages (OR = 0.39, $p < 0.0001$).

Approximately 12% of this ethnically diverse population reported low social support at baseline, and there was no significant change in the prevalence at 1-year (Table 2). In univariate analysis, low social support was associated with a diet score ≥ 70 (Table 3). In multivariate models adjusted for significant confounders (Table 4), participants with low social support at baseline were 2.7 times as likely to be non-adherent to the Heart-Healthy or TLC diets at 1-year versus those with higher social support (95% CI = 1.1 – 6.4), independent of age, gender, race/ethnicity, or assignment to the control group. There was no interaction between baseline level of social support and group assignment on dietary adherence at 1 year.

Other univariate associations between risk factors for CVD and non-adherence to the TLC diet (score ≥ 40) are shown in Table 3. They included elevated BMI at baseline and 1 year, increased waist circumference at baseline and 1 year, low physical activity levels at baseline and year, smoking at baseline and 1 year, stage of change as pre-contemplation, contemplation, or preparation at baseline and 1 year, younger age, assignment to the control group, and being male.

Univariate predictors of non-adherence to the Heart-Healthy diet or TLC diet (having a score ≥ 70) at 1 year included elevated BMI at baseline and 1 year, increased waist circumference at baseline and 1-year, low physical activity levels at 1 year, depression at 1 year, stage of change as pre-contemplation, contemplation, or preparation at baseline and 1 year, assignment to the control group, and being male.

DISCUSSION

The main findings of this study are that in this ethnically diverse population, low social support was an independent predictor of lack of dietary adherence at 1 year in a lifestyle intervention trial for family members of patients with CVD. Stage of change, depression, elevated BMI and waist circumference, low physical activity levels, and male sex were also significantly associated with non-adherence to heart-healthy and TLC diets at 1 year. These data suggest that individuals with low social support may be at heightened CVD risk due to dietary factors, and targeted educational efforts may be beneficial in reducing their risk. These findings are important because family members of cardiac patients may be at increased risk for CVD due to genetic and lifestyle risk factors (23,24). Therefore, efforts to provide dietary counseling are paramount, and individuals with low social support may need special attention.

Our findings are consistent with previous studies documenting a link between low social support level and poor dietary behaviors (25,26). Social support may be useful in helping patients overcome barriers such as finding time to prepare heart-healthy meals, and resisting unhealthy foods (26). Very few studies have examined diet adherence in family members of cardiac patients. One other study that was a qualitative analysis of 10 families with a family member previously hospitalized for coronary bypass surgery found that changing family traditions toward healthy eating behaviors required mutual family agreement and social support, and that unhealthy dietary habits were usually a result of shared family dietary patterns, as opposed to individual patterns (27). Previous research has shown mixed results for the role of social support in the healthy eating practices of Hispanic adults (28,29); however, we did not find any variations in social support or its effect on adherence by racial/ethnic group.

Marital status is sometimes used as a proxy measure for social support (30), and 66% of our sample reported being married. In our study, lack of social support was significantly associated with dietary non-adherence, but we did not observe a relation between marital status and dietary adherence. Therefore, one's *perception* of social support (feeling cared about, valued, and loved) may be more important than the simple presence of a spouse or partner. The level of social support reported by married men did not differ from that of married women in our study. In addition, recent research has documented that the support of a spouse or partner may or may not be helpful (31). Close relationships as a form of social support are generally thought to be favorable in terms of CVD risk, but adverse relationships might increase the risk for CVD. Men and women in a close relationship who are exposed to negative aspects of these relationships (such as poor marital quality) have a higher risk of incident coronary events (32).

Approximately 12% of our population experienced low social support, which may reflect the large proportion of spouses and family members with caregiving responsibilities. Caring for an ill spouse or family member with CVD has been associated with lower levels of social support (33). At baseline, dietary adherence rates ranged from 47% (TLC diet) to 80% (Heart-healthy diet), yet only 44% of participants were classified as being in the maintenance stage of change. This discrepancy may be due to the fact that the MEDFICTS diet tool is highly sensitive in identifying adherent participants, yet less specific, and may incorrectly screen non-adherent patients as adherent in some cases (15).

It has been suggested that the positive effect of social support on cardiovascular health is mediated through the autonomic nervous system (34) and/or improvement in unhealthy lifestyle behaviors (35). Our study lends support to the theory that a potential pathway through which lack of social support works to increase CVD risk is through its association with lack of adherence to diet. In our prior research, social support was linked to higher HDL-cholesterol levels through increased physical activity, suggesting exercise may be another mechanism through which social support may reduce CVD risk (7). In our current study social support was linked to diet adherence independent of physical activity, suggesting there may be potential additive effects for lifestyle behaviors to reduce CVD risk.

The major strengths of this study were the high recruitment rates of women and minorities, its prospective design, the 94% follow-up rate in a lifestyle intervention trial, and the ability to carefully adjust for potential confounders. Potential limitations include the self-reported data on the dietary assessment, and that the same dietary tool was used for both evaluation and counseling. However, we have validated the MEDFICTS assessment tool against the 98 Block Food Frequency Questionnaire (15), and we are currently validating it against participants' 3-day food records.

IMPLICATIONS FOR RESEARCH AND PRACTICE

We showed that family members of cardiac patients in a lifestyle intervention trial were less likely to adhere to a heart-healthy diet after 1 year of the family member being hospitalized with CVD if they had low social support at baseline, regardless of group assignment. Non-adherence to diet was significantly associated with other lifestyle and psychosocial factors, including pre-action stage of change, depression, overweight, and physical inactivity. Our findings suggest that individuals with low social support may be at increased CVD risk due to dietary factors, independent of several important confounders. These results may provide insight for dietitians, health educators, and other healthcare providers working with patients and their families to improve lifestyle and reduce CVD risk. Healthcare providers aiming to increase patients' adherence to diet recommendations should attempt to address modifiable barriers to adherence, such as depression, stage of change, and social support. Screening

patients for depression may be an important component of assessment, and patients with positive results should be referred as appropriate. Healthcare providers can also use specific counseling techniques to assist patients in moving through the stages of change. For example, participants in the pre-contemplation stage may benefit from being educated about the advantages of a healthy diet in maintaining optimal lipid levels. Those in the contemplation stage should be guided through the benefits and drawbacks of their current dietary behaviors, and participants in the preparation stage may need support in developing their specific plans for creating dietary changes (where to buy appropriate foods, etc.). Finally, healthcare providers should address level of social support since family involvement in meal planning and preparation may enhance dietary compliance. New dietary habits are often integrated more smoothly when the family is treated as a whole.

The current findings suggest several areas for future research. First, future studies should address whether efforts to increase social support can improve adherence to diet and reduce clinical CVD. In a recent multi-center randomized controlled clinical trial investigators attempted to use cognitive-behavioral treatment to improve depression and increase social support in a highly diverse sample of cardiac patients (17). The trial produced moderate quality of life improvements, as well as significant improvements in both depression and social support in the treatment patients; however the event-free survival rate did not significantly increase over the usual-care group (both BDI and ESSi scores also improved substantially in the usual-care group). Consistent with the conclusions of the present work, the investigators noted that although low social support has been identified as an independent risk factor for CVD, efforts to treat it may not successfully reduce cardiac morbidity and mortality unless the underlying mechanisms (behavioral or biological) are affected as well. Although the autonomic nervous system was mentioned as a possible pathway through which social support may work to reduce risk for CVD, and it is a plausible explanation according to previous research, it should be noted that this mechanism was not tested in our study.

Secondly, future studies should focus on the nature of the relationship between family members and spouses with the cardiac patient. Social support levels may vary by the type of relationship between family members and patients.

Lastly, future research should emphasize investigations of the relationship between dietary adherence and social support using other measures of social support. Social relationships serve unique functions, such as providing emotional and/or instrumental support, and using a variety of measures may help to quantify how social support influences adherence to diet in more detail.

Acknowledgments

This study was funded by a grant from the National Heart, Lung, & Blood Institute (RO1HL075101) awarded to Dr. Mosca. This work was supported in part by an NIH research training grant to Dr. Aggarwal (T32 HL007343-27).

Funding: The FIT Heart Trial was funded by a grant from the National Heart, Lung and Blood Institute (RO1 HL075101).

IRB: The study was approved by the Institutional Review Board of Columbia University Medical Center.

REFERENCES

1. National Cholesterol Education Program (NCEP). Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III): Final Report. *Circulation* 2002;106:3143–3421. [PubMed: 12485966]
2. LaRosa JC, Hunninghake D, Bush D, Criqui MH, Getz GS, Gotto AM Jr, et al. The cholesterol facts: A summary of the evidence relating dietary fats, serum cholesterol, and coronary heart disease. A joint

statement by the American Heart Association and the National Heart, Lung, and Blood Institute. The Task Force on Cholesterol Issues, American Heart Association. *Circulation* 1990;1721–1733. [PubMed: 2184951]

3. Miller RR, Sales AE, Kopjar B, Fihn SD, Bryson CL. Adherence to heart-healthy behaviors in a sample of the U.S. population. *Prev Chronic Dis* 2005;2(2):A18. [PubMed: 15888229]
4. Haynes, RB. Improving patient adherence: state of the art, with special focus on medication taking for cardiovascular disorders. In: Burke, LE.; Okene, IS., editors. *Patient Compliance in Health Care Research: American Heart Association Monograph Series*. Armonk, NY: Futura Publishing Co; 2001. p. 3-21.
5. Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation* 1999;99:2192–2217. [PubMed: 10217662]
6. Berkman LF, Leo-Summers L, Horwitz RI. Emotional support and survival after myocardial infarction. A prospective, population-based study of the elderly. *Ann Intern Med* 1992;117(12):1003–1009. [PubMed: 1443968]
7. Fischer Aggarwal BA, Liao M, Mosca L. Physical Activity as a Potential Mechanism through which Social Support May Reduce Cardiovascular Disease Risk. *J Cardiovasc Nurs* 2008;23(2):90–96. [PubMed: 18382248]
8. Tang TS, Brown MB, Funnell MM, Anderson RM. Social support, quality of life, and self-care behaviors among African Americans with type 2 diabetes. *Diabetes Educ* 2008;34(2):266–275. [PubMed: 18375776]
9. McNicholas SL. Social support and positive health practices. *West J Nurs Res* 2002;24(7):772–787. [PubMed: 12428894]
10. Lazarus, RS.; Folkman, S. *Stress, Appraisal, and Coping*. New York, New York: Springer; 1984.
11. Curry SJ, Kristal AR, Bowen DJ. An application of the stage model of behavior change to dietary fat reduction. *Health Ed Res* 1992;7:97–105.
12. Mosca L, Mochari H, Liao M, Christian AH, Edelman D, Aggarwal B, Oz M. A Novel Family Based Intervention Trial to Improve Heart Health (FIT Heart): Results of a Randomized Controlled Clinical Trial. *Circ Cardiovasc Qual Outcomes* 2008;1:98–106. [PubMed: 20031796]
13. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Questionnaire. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2000.
14. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults - The Evidence Report. National Institutes of Health; *Obes Res*. 1998. p. 51S-209S.
15. Mochari H, Gao Q, Mosca L. Validation of the MEDFICTS Dietary Assessment Questionnaire in a Diverse Population. *J Am Diet Assoc* 2008;108(5):817–822. [PubMed: 18442505]
16. Kris-Etherton P, Eissenstat B, Jaax S, Srinath U, Scott L, Rader J, et al. Validation for MEDFICTS, a dietary assessment instrument for evaluating adherence to total and saturated fat recommendations of the national cholesterol education program Step 1 and 2. *J Am Diet Assoc* 2001;101:81–86. [PubMed: 11209589]
17. Berkman LF, Blumenthal J, Burg M, Carney RM, Catellier D, Cowan MJ, et al. Effects of treating depression and low perceived social support on clinical events after myocardial infarction: the Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD) Randomized Trial. *JAMA* 2003;289(23):3106–3116. [PubMed: 12813116]
18. ENRICHD Investigators. Enhancing Recovery in Coronary Heart Disease (ENRICHD) study intervention: rationale and design. *Psychosom Med* 2001 Sep–Oct;63(5):747–755. [PubMed: 11573023]
19. ENRICHD Investigators. Enhancing recovery in coronary heart disease patients (ENRICHD): study design and methods. *Am Heart J* 2000;139:1–9. [PubMed: 10618555]
20. Greene GW, Rossi SR, Reed G, Wiley C, Prochaska JO. Stages of change for dietary fat reduction to 30% of energy or less. *J Am Diet Assoc* 1994;94:1105–1110. [PubMed: 7930314]
21. Beck AT, Steer RA, Ball R, Ranieri WF. Comparison of Beck Depression Inventories -IA and -II in psychiatric outpatients. *J Pers Assess* 1996;67(3):588–597. [PubMed: 8991972]

22. Lloyd-Jones DM, Nam BH, D'Agostino RB Sr, Levy D, Murabito JM, Wang TJ, Wilson PW, O'Donnell CJ. Parental cardiovascular disease as a risk factor for cardiovascular disease in middle-aged adults: a prospective study of parents and offspring. *JAMA* 2004;291(18):2204–2211. [PubMed: 15138242]
23. Higgins M. Epidemiology and prevention of coronary heart disease in families. *Am J Med* 2000;108:387–395. [PubMed: 10759095]
24. Burg MM, Benedetto MC, Rosenberg R, Soufer R. Presurgical depression predicts medical morbidity 6 months after coronary artery bypass graft surgery. *Psychosom Med* 2003;5:111–118. [PubMed: 12554822]
25. Laitinen J, Ek E, Sovio U. Stress-related eating and drinking behavior and body mass index and predictors of this behavior. *Prev Med* 2002;34(1):29–39. [PubMed: 11749094]
26. Barbiera AM, Attree M, Todd C. Understanding eating behaviours in Spanish women enrolled in a weight-loss treatment. *J Clin Nurs* 2008;17(7):957–966. [PubMed: 18321293]
27. Heitman LK. The influence of social support on cardiovascular health in families. *Fam Community Health* 2006;29(2):131–142. [PubMed: 16552290]
28. Wen LK, Parchman ML, Shepherd MD. Family support and diet barriers among older Hispanic adults with type 2 diabetes. *Fam Med* 2004;36(6):423–430. [PubMed: 15181555]
29. Gleeson-Kreig J, Bernal H, Woolley S. The role of social support in the self-management of diabetes mellitus among a Hispanic population. *Public Health Nurs* 2002;19(3):215–222. [PubMed: 11967108]
30. Husak L, Krumholz HM, Lin ZQ, Kasl SV, Mattera JA, Roumanis SA, et al. Social support as a predictor of participation in cardiac rehabilitation after coronary artery bypass graft surgery. *J Cardiopulm Rehabil* 2004;24(1):19–26. [PubMed: 14758099]
31. Trief PM, Ploutz-Snyder R, Britton KD, Weinstock RS. The relationship between marital quality and adherence to the diabetes care regimen. *Ann Behav Med* 2004;27(3):148–154. [PubMed: 15184090]
32. De Vogli R, Chandola T, Marmot M. Negative Aspects of Close Relationships and Heart Disease. *Arch Intern Med* 2007;167(18):1951–1957. [PubMed: 17923594]
33. Aggarwal B, Liao M, Christian A, Mosca L. Influence of caregiving on lifestyle and psychological risk factors among family members of patients hospitalized with cardiovascular disease. *J Gen Intern Med*. 2008 Nov 8; [Epub ahead of print].
34. Uchino B, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. *Psychol Bull* 1996;119(3):488–531. [PubMed: 8668748]
35. Wolfe WA. A review: maximizing social support - a neglected strategy for improving weight management with African American women. *Ethn Dis* 2004;14(2):212–218. [PubMed: 15132206]

SOCIAL SUPPORT						
For each question, CHECK the number that BEST describes your current situation.						
QUESTION	Never or almost never the case	A little of the time	Some of the time	Most of the time	Always or almost always the case	
1. I have someone to confide in, who can help me with my problems, who you can rely on.		1	2	3	4	
2. I have someone to help me get going when I feel like giving up.		1	2	3	4	
3. I have someone to help me when I am alone and I feel lonely.		1	2	3	4	
4. I have someone who helps me when I get stuck or confused.		1	2	3	4	
5. I have a person who is able to provide me with advice and support when I have problems or feelings that are not a relief.		1	2	3	4	
6. The people around me can help me if I have serious problems or if I am in a desperate situation.		1	2	3	4	
7. I have someone who is living with me, or who is very close to me, and who can help me when I need it.		1	2	3	4	
8. I have someone who is living with me, or who is very close to me, and who can help me when I need it.		1	2	3	4	

Figure 1.
ENRICHD Social Support Instrument.

Table 1

Characteristics of Participants at Baseline (N = 458)

Characteristic	Prevalence	
	%	Mean ($\pm$ SD)
Age $\geq$ 50	48	49 $\pm$ 14
Non-Hispanic White	65	-
Female	66	-
> High school education	62	-
Employed/Student	73	-
Married/Living with Someone	67	-
Group Assignment: Control	50	-
Current Smoker	9	-
Overweight (BMI $\geq$ 25 kg/m ²)	64	28 $\pm$ 6
Waist Circumference > 40 in. (Men) or > 35 in. (Women)	37	36 $\pm$ 6
Depression (BDI Score $\geq$ 10)	33	8 $\pm$ 8
Physical Activity $\leq$ 3 days/week	78	2 $\pm$ 2

Note: BMI = Body Mass Index, BDI = Beck Depression Inventory.

Table 2

Prevalence of Dietary Adherence, Low Social Support, and Stage of Change at Baseline and 1-Year

	Baseline	1-Year	OR (p-value)
			(1-Year vs. Baseline)
Adherent to TLC diet (score 0–40)	47%	64% **	2.02 **
Adherent to Heart Healthy or TLC diet (score 0–70)	80%	91% **	2.59 **
Low Social Support	12%	12%	0.99
Stage of change: Maintenance	44%	64% **	2.22 **
Stage of change: Action	14%	15%	1.10
Stage of change: Preparation	18%	8% **	0.39 **
Stage of change: Contemplation	5%	5%	0.91
Stage of change: Pre-Contemplation	18%	8% **	0.39 **

Note: Low social support defined as ≤ 2 on at least 2 out of the 5 questions (question 1, 2, 3, 5, and 6) and a total social support score ≤ 18 on the ENRICH Social Support Inventory.

* $p < .05$

** $p < .001$ for 1 year versus baseline.

Table 3

Univariate Predictors of Non-Adherence to the TLC and Heart Healthy Diets at 1 Year

Predictor Variables	Outcome Variables	
	Non-adherent to TLC diet (≥ 40 vs. < 40) OR (95% CI)	Non-adherent to Heart-Healthy diet (≥ 70 vs. < 70) OR (95% CI)
Social Support score (low vs. higher) at Baseline	1.32 (0.72, 2.40)	2.67 (1.17, 6.06)*
Social Support score (low vs. higher) at 1-Year	1.13 (0.61, 2.09)	1.24 (0.46, 3.35)
Change in Social Support from Baseline to 1-Year	1.03 (0.97, 1.09)	0.98 (0.89, 1.08)
Stages of Change (PC, C, P vs. A, M) at Baseline	4.27 (2.79, 6.54)**	5.75 (2.56, 12.96)**
Stages of Change (PC, C, P vs. A, M) at 1-Year	5.43 (3.26, 9.07)**	5.16 (2.55, 10.44)**
WC >40 in. (Men) or >35 in. (Women) at Baseline	1.51 (1.00, 2.29)*	2.67 (1.33, 5.36)*
WC >40 in. (Men) or >35 in. (Women) at 1-Year	1.95 (1.30, 2.94)*	3.34 (1.55, 7.18)*
BMI (≥ 25 vs. < 25 kg/m ²) at Baseline	2.05 (1.33, 3.12)*	5.38 (1.87, 15.52)*
BMI (≥ 25 vs. < 25 kg/m ²) at 1-Year	2.14 (1.34, 3.36)*	4.50 (1.56, 13.02)*
Depression (yes vs. no) at Baseline	0.73 (0.47, 1.13)	1.28 (0.63, 2.60)
Depression (yes vs. no) at 1-Year	1.34 (0.86, 2.10)	2.51 (1.23, 5.11)*
Physical Activity Days/week (≤ 3 vs. > 3) at Baseline	1.80 (1.07, 3.01)*	1.48 (0.59, 3.65)
Physical Activity Days/week (≤ 3 vs. > 3) at 1-Year	1.79 (1.11, 2.87)*	4.60 (1.38, 15.32)*
Physical Activity Minutes/day (< 30 vs. ≥ 30) at Baseline	0.95 (0.63, 1.41)	0.93 (0.47, 1.85)
Physical Activity Minutes/day (< 30 vs. ≥ 30) at 1-Year	2.16 (1.43, 3.27)*	1.62 (0.81, 3.25)
Smoking (yes vs. no) at Baseline	4.91 (1.72, 14.07)*	2.20 (0.61, 7.99)
Smoking (yes vs. no) at 1-Year	4.47 (1.68, 11.90)*	2.96 (0.93, 9.41)
Group Assignment (Control vs. SI)	1.79 (1.19, 2.69)*	4.63 (1.98, 10.83)*
Age (< 50 vs. ≥ 50) at Baseline	1.42 (0.72, 2.80)*	1.38 (0.72, 2.63)
Gender (Male vs. Female)	2.92 (1.91, 4.46)**	2.77 (1.38, 5.53)*
Race/ethnicity (Minority vs. White)	1.03 (0.68, 1.56)	0.97 (0.47, 1.97)
Education ($\leq$ High School vs. $>$ High School)	1.30 (0.86, 1.97)	0.93 (0.46, 1.90)
Marital status (Not Married vs. Married)	1.14 (0.75, 1.74)	1.46 (0.73, 2.93)

Note: Stage of Changes: PC = pre-contemplation, C = contemplation, P = preparation, A = action, M = maintenance; WC = waist circumference; BMI = body mass index; Depression defined at BDI score > 10 .

* $p < .05$

** $p < .001$

Table 4

Multivariable Logistic Regression Model: Predictors of Non-Adherence to the Heart-Healthy and TLC Diets at 1 Year (≥ 70 vs. < 70)

	Base Model (adjusted for age)	Expanded Model (adjusted for age, gender, race/ethnicity, and being in the control group)	Full Model (adjusted for expanded model, plus stage of change, WC, BMI, depression, physical activity)
Variables	OR (95% CI)	OR (95% CI)	OR (95% CI)
Social Support score (low vs. higher) at Baseline	2.66 (1.17, 6.05) *	2.66 (1.10, 6.44) *	2.14 (0.74, 6.17)
Age (≥ 50 vs. < 50) at Baseline	0.78 (0.39, 1.57)	1.05 (0.48, 2.32)	1.58 (0.63, 3.92)
Gender	-	2.81 (1.32, 5.99) *	2.91 (1.18, 7.15)
Race/ethnicity	-	0.87 (0.40, 1.91)	0.69 (0.27, 1.75)
Control Group assignment	-	4.53 (1.91, 10.72) *	4.38 (1.63, 11.80) *
Stage of Change (PC, C, P vs. A, M) at Baseline	-	-	2.85 (1.07, 7.55) *
Stage of Change (PC, C, P vs. A, M) at 1-Year	-	-	2.48 (1.03, 5.99) *
WC > 40 in. (Men) or > 35 in. (Women) at Baseline	-	-	1.34 (0.42, 4.47)
WC > 40 in. (Men) or > 35 in. (Women) at 1-Year	-	-	1.69 (0.45, 6.32)
BMI (≥ 25 vs. < 25 kg/m ²) at Baseline	-	-	3.82 (0.35, 4.45)
BMI (≥ 25 vs. < 25 kg/m ²) at 1-Year	-	-	0.41 (0.04, 4.66)
Depression (yes vs. no) at 1-Year	-	-	1.89 (0.75, 4.76)
Physical Activity Days/week (≤ 3 vs. > 3) at 1-Year	-	-	2.50 (0.66, 9.49)

Note Stage of Changes: PC = pre-contemplation, C = contemplation, P = preparation, A = action, M = maintenance; WC = waist circumference; BMI = body mass index.

*
 $p < .05$