RELATIONSHIP OF SELF-EFFICACY TO CHOLESTEROL LOWERING AND DIETARY CHANGE IN HYPERLIPIDEMIA[1,2]

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ABSTRACT

This study examined whether self-efficacy was associated with lipid lowering and dietary change among men undergoing dietary counseling to lower cholesterol levels. Twenty-five hyperlipidemic men (total cholesterol ≥220 mg/dL) participated in four weeks of dietary instruction. Plasma lipids were measured prior to treatment, at posttreatment, and at three- and twelve-month follow-up. Dietary intake and self-efficacy as measured by the revised Eating Self-Efficacy Scale (ESES-R) were assessed at pretreatment, posttreatment, and three-month follow-up. Pretreatment to posttreatment increases in self-efficacy in situations characterized by negative affect were related to extent of lipid lowering and dietary change. Although subjects showed significant reductions in cholesterol levels following treatment, by one year, lipid levels had returned to pretreatment values. Factors related to long-term maintenance of dietary change and lipid lowering among hyperlipidemics merit further research.

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INTRODUCTION

An estimated five million people in the United States have coronary heart disease (CHD), and CHD accounts for over half a million deaths in the U.S. each year (1). Although CHD continues to be the leading cause of death in the United States, there has been a marked decline in CHD mortality since the mid-1960s. This decline has been paralleled by changes in several cardiovascular disease risk factors, including plasma cholesterol (2,3).

Plasma cholesterol level has been identified as a modifiable risk factor for CHD, for which dietary therapy is the recommended first step in treatment, followed by lipid-lowering medications, if needed (4,5). Dietary recommendations for lowering elevated plasma cholesterol include reducing dietary saturated fat and cholesterol and increasing soluble fiber intake (4–7). These modifications, when adhered to, can reduce plasma cholesterol levels by as much as 10–20% (7). However, adherence to such dietary changes is difficult (8–12).

To date, few studies have examined factors related to the maintenance of dietary modifications among people with elevated plasma cholesterol levels. The lack of data in this area may impede efforts to develop strategies to enhance dietary maintenance among hyperlipidemic individuals. Thus far, such strategies, which generally embrace cognitive–behavioral formulations of behavior change, have been based on inferences from the literature on weight reduction (11). The present article begins to address this problem by testing the applicability of the self-efficacy construct to individuals receiving dietary counseling to lower elevated plasma cholesterol levels.

Self-efficacy refers to the belief that one can execute a certain behavior required to produce particular outcomes (13). Although self-efficacy theory was originally invoked to explain how different modes of psychotherapy lead to change among individuals with phobic conditions, self-efficacy has also been shown to predict the ability to initiate and maintain changes in a variety of health-related behaviors (14–16).

Among the various health outcome studies which have included measures of self-efficacy, a number have shown that self-efficacy predicts success in obesity treatment programs. Self-efficacy has been shown to predict extent of weight loss (17–22) and attrition from weight loss programs (17,23). Consistent with original formulations of self-efficacy and treatment (14), self-efficacy has been found to increase as a result of successful participation in weight loss programs (17,19,20). Given that self-efficacy predicts success among individuals dieting to lose weight, it seemed reasonable to expect that self-efficacy would be as-

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sociated with dietary change and lipid lowering in hyperlipidemic individuals receiving dietary counseling.

In the present article, a revised version of the Glynn and Ruderman (20) Eating Self-Efficacy Scale (ESES) was administered to men in dietary treatment for hyperlipidemia. We predicted that increases in self-efficacy would be associated with the extent of lipid lowering and dietary change.

METHOD

Subjects

Thirty-three hyperlipidemic men and their spouses participated in the Heart Healthy Partners Program, a study offered through the Northwest Lipid Research Clinic which was designed to examine behavioral factors related to maintaining diet-induced changes in plasma lipid concentrations. Two subjects did not complete classes due to time and scheduling conflicts and were dropped from the study. The remaining 31 subjects attended dietary classes and completed the postclass assessment. Three of these subjects did not complete the three-month follow-up assessment. Of the 28 subjects completing the three-month follow-up assessment, 3 did not complete self-efficacy assessments at all visits. Thus, data are available on 25 subjects who completed the self-efficacy measure at pretreatment, posttreatment, and three-month follow-up. Their mean age at the time of entry into the study was 49.5 years (range 34 to 63 years).

Procedure

Participants were recruited through newspaper advertisements announcing a cholesterol-lowering study. Blood samples for lipid analyses were obtained from an antecubital vein following a twelve-hour fast and were analyzed at the Northwest Lipid Research Laboratory. Based on a screening blood sample, men were accepted into the study whose total cholesterol level equalled or exceeded 220 mg/dL, and who were not taking medications known to affect lipid levels (e.g. lipid-lowering drugs, thyroid medications, certain antihypertensive agents). Blood samples were obtained before initiating dietary class instruction (pretreatment), following completion of four weeks of dietary classes (posttreatment), and again three months after the last class (three-month follow-up). Participants completed four-day food records and the self-efficacy measure at pretreatment, posttreatment, and three-month follow-up. One year after the last class (twelve-month follow-up), 21 of the 25 participants returned to the clinic for a follow-up lipid determination. At this visit, the self-efficacy measure was readministered.

Dietary Intervention

Participants and their spouses met with a dietitian weekly for four weeks, in groups of four to seven couples. Participants were randomized to receive either dietary instruction alone, or dietary instruction plus behavioral self-management. The latter consisted of setting dietary goals each week and monitoring dietary intake. Both groups received instruction in the relationship between diet and blood cholesterol level, and were provided with dietary guidelines which would limit fat intake to 25% of total daily calories and limit daily cholesterol intake to less than 200 milligrams. Class presentations and discussions focussed on specific food groups and how to purchase and prepare foods within these groups which would meet the dietary guidelines. Because no significant differences were found between the two groups on measures of self-efficacy, the data are not presented by intervention group assignment.

Lipid Analyses

Cholesterol and triglyceride analyses were performed enzymatically on an Abbott Spectrum Analyzer. At pretreatment and the three-month follow-up assessment, high-density lipoprotein (HDL) cholesterol was separated from whole plasma using a chemical precipitation technique, and low-density lipoprotein (LDL) cholesterol was calculated using the Friedewald equation (24). Lipoprotein analysis at posttreatment was confined to the measurement of total cholesterol and triglycerides.

Dietary Intake

Subjects completed four-day food records on which they recorded everything eaten during the period of recording which consisted of three consecutive workdays and one adjacent weekend day. They were instructed to record portion sizes, specific brands, preparation methods, and, in the case of homemade dishes, specific recipes. Food records were completed prior to the first class, after the last class, and at the three-month follow-up visit. Each subject reviewed his food record individually with a dietitian who asked for clarification of recorded information when necessary. The food records were then coded and entered into a computer by a dietary technician, and analyzed using a database from the Nutrition Coordinating Center, University of Minnesota (database version 13) programmed for local use at the Northwest Lipid Research Clinic. Nutrient information obtained from the food records included total calories, percent of calories from saturated and polyunsaturated fat, and dietary cholesterol.

Self-Efficacy

The revised Eating Self-Efficacy Scale (ESES-R) is a 15-item version of the original 25-item ESES developed by Glynn and Ruderman (20). Items on the original scale were revised to be more appropriate to an older, working population. The revised items were written by a clinical psychologist and a dietitian with several years experience counseling hyperlipidemic patients. To keep the number of items manageable, some similar items from the Negative Affect scale of the original ESES were combined to yield single items. For example, the original items "Overeating when you feel upset" and "Overeating when tense" were combined to yield a single item, "Feeling upset or tense." The instructions in the revised ESES asked that respondents rate the degree of confidence that they could resist "going off their diet" in the specific situations presented.

The 26 revised items were administered to 440 hyperlipidemic men employed by the Boeing Company who were participating in the Dietary Alternatives Study to lower their plasma lipid levels (25). The items were subjected to factor analysis, and items retained on the basis of this analysis formed the final version of the 15-item ESES-R scale (Tables 1 and 2). Two major factors emerged from the factor analysis. These two factors resembled the two identified by Glynn and Ruderman (20); hence, the labels Negative Affect (NA; possible range 9–81) and Socially Acceptable Circumstances (SAC; possible range 6–54) were retained for the first and second factors, respectively. Coefficient alphas for the NA and SAC scales were .94 and .88, respectively.

In a separate study of the test–retest reliability of the ESES-R, 20 subjects participating in four weeks of dietary class instruction to lower plasma lipid levels completed identical forms of the ESES-R during the second and third weekly class (Table 2). For NA, the test–retest correlation was .73. For SAC, the

TABLE 1

Factor Loadings, Item-Total Correlations, and Alpha Coefficients for the Revised Eating Self-Efficacy Scale (ESES-R)

Item	Factor Loadings		Item-Total Correlations	
	NA	SAC	NA	SAC
Depressed	.948	.060	.84	
After an argument	.881	−.024	.83	
Angry at yourself	.868	.023	.81	
Annoyed/angry with someone	.848	−.016	.82	
Feeling upset or tense	.843	.030	.77	
Tired	.817	.039	.75	
Feeling restless or bored	.703	.040	.70	
Want to cheer up	.640	.000	.73	
Coming home after work	.424	−.090	.57	
At friend's house for dinner	.007	.876		.69
At restaurant with friends	.068	.825		.74
Around holiday time	.103	.699		.59
At party with food	−.041	.621		.71
Celebrating with others	.024	.541		.72
Throwing a party	.090	.481		.61
Eigenvalues	12.0	2.7		
Percent variance	46.2	10.5		
Alpha coefficients			.94	.88

Note: NA = Negative Affect; SAC = Socially Acceptable Circumstances.

TABLE 2

Means (M) and Standard Deviations (SD) on the Revised Eating Self-Efficacy Scale (ESES-R) for Subjects in Two Validation Samples

Sample	Negative Affect (9–81)		Socially Acceptable Circumstances (6–54)	
	M	SD	M	SD
Dietary Alternatives Study (N = 440)	67.7 (9–81)	12.5	36.9 (9–54)	8.9
Test–Retest Reliability (N = 20)				
Time 1	47.7 (17–79)	13.3	27.4 (6–45)	9.3
Time 2	49.1 (25–81)	12.6	26.7 (8–44)	10.6

Note: Subscale ranges shown in parentheses. Higher scores indicate greater self-efficacy.

correlation was .87. Thus, both subscales have adequate test–retest reliability.

Data Reduction and Analysis

Differences between pretreatment, posttreatment, and three-month follow-up in self-efficacy, lipids, and dietary intake were analyzed using repeated-measures MANOVA. Significant MANOVA effects were evaluated further using Tukey's pairwise comparisons. Twelve-month follow-up data on lipids and self-efficacy are available on 21 of the 25 subjects, and are analyzed separately.

Associations between self-efficacy and lipids were based on changes in lipids from pretreatment. Associations between self-efficacy and dietary intake were based on the Keys equation, which was derived empirically to predict changes in serum cholesterol based on changes in intake of dietary cholesterol, polyunsaturated fats, and saturated fats (26,27). Predicted changes were based on the following formula:

$$\text{Predicted chol} = 1.3(2S_{1\text{-}2} - P_{1\text{-}2}) + 1.5(c_1 - c_2)$$

where $S_{1\text{-}2}$ = change in percent of calories from saturated fat between pretreatment and the postclass or follow-up period, $P_{1\text{-}2}$ = change in percent of calories from polyunsaturated fat, and c_1 and c_2 = the square roots of dietary cholesterol (in mg/day/1,000 calories) consumed during pretreatment and postclass or follow-up, respectively. Higher Keys scores indicate greater predicted change in cholesterol based on dietary intake.

Pearson correlations were computed to examine associations between changes in self-efficacy and changes in lipids and dietary intake (Keys score), and between levels of self-efficacy and changes in lipids and dietary intake.

RESULTS

Scores on the ESES-R during treatment are shown in Table 3. NA self-efficacy increased steadily from pretreatment to three-month follow-up ($F(2,48) = 4.48$, $p < .02$). Changes in SAC self-efficacy over the course of treatment showed a similar pattern, but this failed to attain statistical significance ($F(2,48) = 2.93$, $p < .07$). Significant pretreatment to posttreatment decreases were seen in total cholesterol ($F(2,48) = 9.66$, $p < .001$) and triglycerides ($F(2,48) = 3.58$, $p < .04$). LDL cholesterol also decreased from pretreatment to three-month follow-up, but this decrease was not statistically significant. By twelve-month follow-up, all lipids and NA and SAC self-efficacy had returned to near pretreatment levels (data not shown).

Dietary cholesterol intake decreased from pretreatment to posttreatment and increased slightly at three-month follow-up,

TABLE 3

Means (M) and Standard Deviations (SD) of Self-Efficacy, Lipids, and Nutrient Intake at Pretreatment, Posttreatment, and Three-Month Follow-up

Variable	Pretreatment	Posttreatment	Three-Month Follow-Up
Eating Self-Efficacy			
Negative Affect			
M	61.4_a	$65.8_{a,b}$	68.2_b
SD	14.3	12.7	8.6
Socially Acceptable Circumstances			
M	30.3	33.8	34.6
SD	10.2	9.3	9.8
Total Cholesterol (mg/dL)			
M	241.3_a	219.6_b	228.4_b
SD	35.8	28.4	30.5
LDL Cholesterol (mg/dL)			
M	158.0	–	149.0
SD	32.6	–	28.6
Triglycerides (mg/dL)			
M	188.4_a	153.0_b	$176.6_{a,b}$
SD	115.7	94.1	125.5
Dietary Cholesterol (mg)			
M	261.0_a	155.7_b	165.4_b
SD	106.2	68.6	81.2
Saturated Fat (g)			
M	22.8_a	15.6_b	17.3_b
SD	6.6	8.2	8.2
Polyunsaturated Fat (g)			
M	18.4	16.8	16.3
SD	5.3	7.7	5.4

Note: Different subscripts indicate significant differences between time points (p's < .05), based on Tukey's pairwise comparisons.

TABLE 4

Relationships Between Increases in Negative Affect Self-Efficacy, Reductions in Cholesterol, and Dietary Change Based on the Keys Equation

	Change in NA Self-Efficacy	Keys Score Posttreatment	Keys Score Follow-up
Posttreatment			
Total Cholesterol	.56**	.76***	.72***
Three-Month Follow-Up			
Total Cholesterol	.52**	.59**	.45*
LDL Cholesterol	.60**	.57**	.41*
Keys Score Posttreatment	.57**		
Keys Score Follow-up	.32		

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

but not to pretreatment levels (F(2,44 = 14.14, $p < .001$). Similarly, intake of saturated fat decreased at posttreatment and increased slightly at three-month follow-up, but not to pretreatment levels ($F(2,44) = 9.88$, $p < .001$). Polyunsaturated fat intake did not change appreciably. The predicted change based on the Keys score was 11.6 ± 11.3 mg/dL at posttreatment, and 8.9 ± 14.1 mg/dL at three-month follow-up. This decrease in predicted change in cholesterol based on the Keys score from posttreatment to three-month follow-up was not statistically significant. As expected, changes in total and LDL cholesterol were associated with predicted change based on the Keys score (Table 4).

Correlational analyses were conducted to determine whether changes in self-efficacy from pretreatment to posttreatment were associated with reductions (from pretreatment) in total and LDL cholesterol, triglycerides, and dietary change as reflected in the Keys score. As predicted, increases in NA self-efficacy (pretreatment to posttreatment) were correlated with reductions in total cholesterol at posttreatment ($r = .58$, $p < .01$) and the extent of the dietary change based on the Keys score ($r = .57$, $p < .01$) at posttreatment. Pretreatment to posttreatment increases in NA self-efficacy were related to three-month follow-up changes in total cholesterol ($r = .54$, $p < .01$) and LDL cholesterol ($r = .62$, $p < .001$). NA self-efficacy was unrelated to the three-month follow-up Keys score. The relationship between increases in SAC self-efficacy during treatment and posttreatment reductions in total and LDL cholesterol and dietary change were in the expected direction, but were not statistically significant. Changes in triglycerides at posttreatment and the three-month follow-up were unrelated to changes in either NA or SA self-efficacy during treatment. Changes in self-efficacy from pretreatment to follow-up were unrelated to extent of lipid lowering at twelve-month follow-up.

Self-efficacy measured at pretreatment, posttreatment, and three-month follow-up (as opposed to increases in self-efficacy) was not significantly associated with changes in total or LDL cholesterol, except for an unexpected negative correlation between NA self-efficacy prior to treatment and posttreatment reduction in total cholesterol ($r = -.57$, $p < .003$). Similar negative correlations between NA self-efficacy at pretreatment and extent of dietary change at posttreatment ($r = -.65$, $p < .001$) and three-month follow-up ($r = -.43$, $p < .05$) were observed. Self-efficacy measured at three-month follow-up was inversely associated with extent of dietary change at three months ($r = -.47$, $p < .05$). To further explore this unexpected finding, the relationship between NA self-efficacy at pretreatment and change in NA self-efficacy from pretreatment to posttreatment was determined. There was a significant negative correlation between NA self-efficacy at pretreatment and increases in NA self-efficacy from pretreatment to posttreatment ($r = -.54$, $p < .01$).

DISCUSSION

Overall, these findings suggest that changes in self-efficacy during treatment are related to the extent of lipid lowering and dietary change in hyperlipidemic individuals undergoing dietary therapy for cholesterol reduction, at least in the immediate posttreatment period. It has been noted that self-efficacy expectations are learned from various sources, including performance accomplishments, vicarious experience, verbal persuasion, and physiological state (16). It appears likely, in the current context, that self-efficacy is enhanced through small successes in making dietary changes during the period of formal dietary instruction. This possibility could be tested by assessing self-efficacy at several points during treatment and determining if incremental increases in self-efficacy are associated with specific performance accomplishments. One could argue that the correlation between pretreatment to posttreatment self-efficacy and pretreatment to posttreatment decreases in plasma cholesterol levels is attributable to an increase in confidence as a result of successful lipid lowering. However, subjects completed the self-efficacy questionnaire when blood samples were obtained for pretreatment and posttreatment blood tests. Thus, knowledge of changes in cholesterol levels could not have influenced the assessment of self-efficacy expectations. The more likely explanation is that increased self-efficacy reflected changes in dietary behavior, which in turn resulted in greater lipid lowering. This is supported by the observation that dietary change, reflected in the Keys score, was associated with changes in self-efficacy and changes in lipids.

Interestingly, in the present study, increased self-efficacy in situations characterized by negative affect, but not for situations in which dietary lapses are socially sanctioned, was related to lipid lowering and dietary change. The factor structure of the ESES-R is very similar to its parent instrument, with conditions in which people question their ability to maintain dietary changes falling into the categories of social situations and situations characterized by negative affect. Among other health behaviors, including smoking (28,29), and drinking (30), social situations and negative internal states have been identified as situations which place individuals at high risk for reverting to previous, unhealthy behaviors.

Recently, another scale which assesses self-efficacy for eating behaviors was described (31). This 61-item scale differs considerably from the present instrument. In addition to being considerably longer, items address a number of specific eating behaviors thought to reflect "heart healthy" eating (e.g. "Stick to low-fat, low-salt foods when traveling," and "Cut down on gravies and cream sauces"). The instrument described in the current study is more general in that respondents are asked to indicate their confidence that they can resist "going off the diet" in a number of situations which are traditionally thought to place individuals at high risk for relapse. We view our more general instructions as having the potential for wider applicability to a range of chronic diseases where dietary modifications may be necessary (e.g. phenylketonuria, renal disease). Additionally, the dietary modifications currently recommended to achieve lipid lowering encompass a range of changes in food intake. Current recommendations are not simply to eat low-fat foods and avoid high-fat ones, but to replace saturated fats with monounsaturated and polyunsaturated fats, increase soluble fiber intake, and decrease dietary cholesterol intake (7).

The finding that level of negative affect self-efficacy at pretreatment was inversely associated with extent of cholesterol lowering and dietary change warrants comment. This finding appears counter-intuitive, because one would expect that higher self-efficacy at pretreatment would be associated with greater cholesterol reduction and dietary change. We can think of several possible explanations for this finding. First, it may be that individuals expressing a high degree of confidence in their ability to follow the diet during situations characterized by negative affect prior to treatment have unrealistic expectations concerning their ability to make dietary changes. Another related possibility is that individuals with initially low expectations regarding their ability to follow their diet during situations characterized by negative affect may have exhibited greater coping efforts in such situations. Both of these possibilities are supported by the finding of an inverse association between Negative Affect self-efficacy at pretreatment and pretreatment-to-posttreatment change in Negative Affect self-efficacy. In the current study, subjects with high levels of self-efficacy at pretreatment showed little further increases over the course of dietary instruction and tended to do worse overall. Bandura has cautioned against assessing self-efficacy at a single point in treatment as though it were a static factor. He noted that participants' ratings may be a function of "wishful thinking, belief in the potency of the procedures, and faith in the therapist," rather than a function of self-perception of mastery of certain behaviors (14). The current results support this caution. A related possibility is that prior to treatment, before the requirements for following a low-fat, low-cholesterol diet are clearly outlined, people may underestimate the extent of dietary change necessary to achieve plasma lipid lowering, thereby overestimating their ability to make dietary changes. Another possibility is that subjects in the present study had already made substantial changes in their diet prior to enrolling in the classes which were offered. This interpretation is supported by the food record data from pretreatment, which indicated that subjects were already on a fairly fat-restrictive diet. The extent of lipid lowering in the study was small, and may reflect a substantial number of pretreatment dietary changes. These may be the same subjects who reported high self-efficacy at the outset of treatment. These interpretations are admittedly post hoc. However, it should be noted that Glynn and Ruderman (20) also reported that only changes in ESES scores during treatment, rather than ESES scores at any specific point in time, were correlated with weight loss among subjects in an obesity treatment program.

Another consideration raised by the current results is whether blood cholesterol level and reported fat intake on a four-day food diary are an accurate reflection of dietary behavior. To the extent that either of these measures are several steps removed from actual dietary behavior, it may be difficult to see relationships between them and a measure of self-efficacy. Blood cholesterol levels will be minimally related to self-efficacy for specific high-risk dieting situations if lipid levels are determined largely by a combination of genetic influences and day-to-day dietary influences unrelated to specific high-risk situations. Similarly, food intake as reported on four-day food diaries may reflect a combination of experimental demand characteristics and the effects of self-monitoring on behavior. However, the finding of strong associations between the Keys score, which is based on estimates of fat and cholesterol intake from the food records, and changes in plasma cholesterol levels lends support to the food records as measures of actual dietary intake.

The findings from this study have implications for the dietary management of hyperlipidemia. The fact that changes in self-efficacy predicted at least initial extent of lipid lowering and dietary change suggests that cognitive–behavioral approaches to treatment which enhance self-efficacy may be beneficial. In particular, the finding that increases in self-efficacy in situations characterized by negative affect predicted outcome suggests that such situations may be particularly important targets for intervention. Another implication from the present study, somewhat more sobering, is the poor long-term maintenance of cholesterol lowering. Although the initial 9% reduction in plasma cholesterol levels is consistent with previous reports concerning the extent of lipid lowering that can be expected with dietary modifications of the type achieved in the present study (7), at twelve-month follow-up, plasma lipids had returned to pretreatment levels. It is unclear whether this was due to reverting to previous dietary habits or perhaps a function of less biologic sensitivity to dietary changes over time.

Of the estimated 50% of the adult population in the U.S. at risk for coronary heart disease by virtue of elevated blood cholesterol levels (32), many may be able to achieve some degree of desirable dietary change with minimal special assistance other than the advice of a physician or through public health education efforts (33). However, those individuals with significant elevations in plasma cholesterol concentration who have not been able to lower lipid levels through self-initiated dietary changes will require special intervention (4,5). Empirical tests of interventions which attempt to maximize dietary adherence through enhancing self-efficacy are the next logical step in addressing the long-term maintenance of dietary change among hyperlipidemic individuals.

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