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Behavioral Treatment of Hyperlipidemia: Techniques, Results, and Future Directions

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The present review examines the role of several target behaviors in the treatment of hyperlipidemia, including diet, exercise, cigarette smoking, Type A pattern, and medication adherence. Modification of the typical American diet (high in cholesterol, fat, and sodium) is emphasized in the treatment of hyperlipidemia since a multitude of laboratory, clinical, and epidemiological studies have shown that diet plays a crucial role in the pathogenesis of this condition and an increase in coronary risk. Factors affecting patient compliance such as health beliefs and family support are discussed in terms of their impact on behavior change efforts aimed at reducing plasma lipids through dietary and drug regimens. Intervention studies are reviewed in the behavioral treatment of hyperlipidemia. These programs have focused on diet modification, exercise, and medication adherence to reduce plasma lipids and coronary risk. The role of other target behaviors (i.e., Type A pattern and smoking) is explored not only in determining coronary risk but also in terms of their direct impact on plasma lipids. Further research is necessary to clarify the relationship between these target behaviors and plasma lipid levels and to investigate the effects of innovative family- and group-based intervention procedures in promoting and maintaining habit change related to coronary risk reduction.

KEY WORDS: hyperlipidemia; behavioral intervention; compliance.

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INTRODUCTION

Atherosclerotic coronary heart disease with resulting myocardial infarction and stroke occur at epidemic rates throughout most of the industrialized world. In the United States, almost 40 million persons are afflicted with some form of cardiovascular disease or hypertension, which account for almost 1 million deaths per year or almost 54% of deaths from all causes (American Heart Association, 1979). Major risk factors for cardiovascular disease include elevated plasma cholesterol, high blood pressure, and cigarette smoking (Intersociety Commission for Heart Disease Resources, 1970; Stamler, 1974). Excessive body fat, which has a major impact on both plasma lipids and blood pressure, is affected by caloric intake and physical activity (American Heart Association, 1974; Blackburn, 1974). Thus, a diet high in calories, saturated fat, and cholesterol, high blood pressure, smoking, and a sedentary life-style are related to coronary risk.

Abnormal elevations in plasma cholesterol and/or triglycerides (i.e., hyperlipidemia) not only represent major coronary risk factors but also are considered a disease process in their own right. Thus, if successful, the behavioral treatment of hyperlipidemia would have a dual role in reducing plasma lipids and coronary risk. The following review first examines the literature regarding the role of diet in the development and treatment of hyperlipidemia, and then focuses on the impact of other target behaviors—exercise, Type A pattern, smoking, and medication adherence—in the behavioral treatment of hyperlipidemia.

Hyperlipidemia: The Disease

The term "hyperlipidemia" refers to abnormal elevations in plasma cholesterol (above 220 mg/dl) and/or triglyceride levels (above 140 mg/dl) (Frederickson, 1972). The disease process of hyperlipidemia has been subdivided into five "types," depending on the malfunction in lipid metabolism and pattern of elevated lipoprotein concentrations (Frederickson, 1972; Gotto *et al.*, 1979). Types I and V, for example, are characterized by excessive blood fats in the form of chylomicrons. These large lipoprotein particles appear in the blood after fatty meals and are, in these disorders, inadequately removed. The plasma cholesterol levels in both of these "types" of hyperlipidemia are elevated and triglyceride concentrations are extremely high (above 1000 mg/dl). In Type II hypercholesterolemia, a common form of hyperlipidemia, the plasma cholesterol level is high and triglyceride is normal. Type II hyperlipidemia involves, at times, an excess production and inadequate clearance of low-density lipoproteins (LDL). In both Types III and IV, the metabolism of very low-density lipoproteins (VLDL) is abnormal. The most common expressions of hyperlipidemia are Types II and IV. Hyperlipidemia may be related to both genetic and dietary factors. However, even if genetically derived, the condition can still be made worse or better dependent upon diet.

While coronary risk is increased with most forms of hyperlipidemia, other symptoms may also occur such as pancreatitis, abdominal pain, xanthomas, and coexisting adult-onset diabetes, dependent upon the nature of the lipid abnormality (Connor and Connor, 1977). Hyperlipidemia often results from other diseases such as hypothyroidism, nephrotic syndrome, and poorly controlled diabetes mellitus. While genetic predisposition determines the range of plasma lipid levels in primary hyperlipidemia, environmental factors such as a diet high in cholesterol and saturated fat, excessive caloric intake, and alcohol abuse also dramatically influence lipid concentrations.

The two major courses of treatment of hyperlipidemia are behavioral and pharmacological, specifically via the low-cholesterol—low-fat diet (including weight control) and lipid-lowering drugs. Diet treatment is considered a cornerstone of therapy for all types of hyperlipidemia (Connor and Connor, 1972, 1977). Lipid-lowering medications such as cholestyramine are generally not used until dietary treatment has first been carried out.

Dietary (Behavioral) Treatment of Hyperlipidemia

Laboratory and epidemiological research has shown that dietary factors are paramount in the development of hyperlipidemia (Doyle, 1966; Katz and Stamler, 1953). Elevated plasma cholesterol is associated with excessive intake of dietary cholesterol, saturated fatty acids, and total calories (Connor and Connor, 1972). Obesity resulting from excessive caloric intake and inadequate physical activity occurs frequently along with hyperlipidemia, necessitating a multifaceted dietary treatment approach.

The aim of dietary treatment is fourfold: (1) to reduce elevated plasma cholesterol and triglycerides, (2) to prevent or treat atherosclerosis of the major arteries, (3) to prevent episodes of pancreatitis and abdominal pain, and (4) to treat or prevent xanthomatous skin and tendon deposits (Connor and Connor, 1977). The basic dietary goals are common to all "types" of hyperlipidemia. Cholesterol intake is restricted to 100 mg/day, especially to decrease the total cholesterol and low-density lipoprotein (LDL) concentrations and VLDL cholesterol. Reduction in the total fat content of the diet is required to decrease chylomicrons prevalent in Types

I and V hyperlipidemia. Severe restrictions in saturated fatty acids are intended to control further the levels of total cholesterol and LDL concentrations. Finally, caloric reductions have a positive effect in reducing triglyceride concentrations.

In recent years, the "single-diet" regimen in the treatment of hyperlipidemia has been followed rather than prescribing several diets for different "types" of hyperlipidemia. One such single-diet approach, referred to as the "Alternative Diet," has been developed by Connor and Connor (1977). Basically, the Alternative Diet recommends the reduction of cholesterol intake from the typical American level of 500—700 to only 100 mg/day. Additionally, dietary fat is restricted from 40% of the total calories to 20%. The majority of fat reduction is in the saturated fatty acids. Acknowledging the behavioral obstacles involved, the Alternative Diet has been designed in a three-phase sequence. Phase I calls for the avoidance of food extremely high in cholesterol and saturated fats such as egg yolks, butterfat, lard, and organ meats. Phase II calls for a reduction in meat consumption from the American average of 12—16 oz/day to 6—8 oz and the reduction of high-fat cheeses. Meat is deemphasized as the center of the meal and meatless sandwiches are introduced. Phase III involves the further reduction of meat consumption to a level of 3—4 oz/day and the exclusive use of low-cholesterol cheeses. The diet at this point consists mainly of cereals, legumes, fruits, vegetables, and low-fat dairy products (i.e., skim milk), with meat used primarily as a "condiment."

Weight problems frequently appear along with hyperlipidemia due to caloric excesses, sedentary life-style, and genetic factors. Elevated triglycerides (hypertriglyceridemia) are frequently seen in adults who gain more than 10 kg of weight (Connor and Connor, 1977). Controlled clinical studies have demonstrated reductions in plasma lipids resulting from weight loss alone (Hall *et al.,* 1972; Stamler *et al.,* 1972).

Dietary Compliance Issues

In the typical medical setting, hyperlipidemic patients are often given dietary instructions along with recipes and menus in one or two sessions and then asked to achieve dietary adherence as quickly as possible, mainly on their own. The household cook is often not involved in this consultation since many of these patients are males who, in many families, play a minor role in cooking, shopping, and food selection. Yet these dietary prescriptions call for substantial reductions in cholesterol, saturated fats, and total caloric intake over several years to produce the desired clinical changes in plasma lipids. These changes in eating and life-style affect not only the identified patient but also the family, particularly the spouse or family member who prepares the meals. The process of diet change is further complicated by the fact that hyperlipidemic patients are often asymptomatic in the early course of their disease and have no illness-generated motivation for behavior change. The issue of dietary compliance then becomes a question of whether or not a person who might be asymptomatic or minimally symptomatic will undertake a dietary life-style change over a long-term period with the major motivating factor being the avoidance of only a potential eruption of acute coronary disease in the remote future.

Even with a treatment regimen involving much less life-style change for greater immediate benefit (e.g., following a coronary episode), patient compliance has not been satisfactory according to the medical compliance literature (Sackett and Haynes, 1976). Among the principal factors shown to influence patient compliance have been the quality of the patient—doctor relationship (Becker *et al.,* 1974), the amount of information the patient needs to learn about the disease and treatment (Sackett and Haynes, 1976), and the complexity of the instructions or prescriptions transmitted to the patient (Svarstad, 1976). It is not unusual for hyperlipidemic patients to become confused about the nature of their disease, the exact pattern of their lipoprotein profile, and specific dietary prescriptions. Other important factors contributing to compliance problems include the absence of family support or social isolation (Baekelund and Lindwall, 1975), stressful life events (Gunderson and Rahe, 1974), the presence of psychopathology such as clinical depression (Beck, 1967; Paykel, 1974), and health beliefs that conflict with treatment recommendations (Becker and Maiman, 1975). The amount of life-style change demanded of the patient with related inconvenience or response cost factors additionally determines how well a patient will follow a medical regimen (Dunbar and Stunkard, 1979; Henderson *et al.,* 1979). As suggested previously, the degree of life-style change involved in the dietary treatment of hyperlipidemia is considerable, requiring extensive follow-up by health professionals as well as family cooperation and support. But considerable economic and manpower *resources,* both governmental and private, are needed to sustain such long-term intensive intervention. The cost-effectiveness question then arises.

Intervention

Several large-scale intervention programs have been conducted to modify the dietary intake of cholesterol and saturated fats and reduce coronary risk. Several studies have included diet modification within a multifaceted intervention trial aimed at reducing other concurrent risk factors such as cigarette smoking, sedentary life-style, Type A behavior, and medication adherence. The subjects in some of these studies were individuals at high risk for coronary heart disease (e.g., Haback *et al.*, 1974). In other studies, free-living individuals, varying in their degree of coronary risk, were included (Foreyt *et al.*, 1979). In still another study (Matarazzo *et al.*, 1982), the targets of intervention were family units randomly selected from the community.

There have been three nationwide intervention trials aimed at modifying coronary risk factors. The National Diet-Heart Study (1968) tested the effects of dietary intervention in preventing coronary heart disease among "normal" free-living male volunteers. The Multiple Risk Factor Intervention Trial (Kuller *et al.*, 1980; MRFIT, 1976) and the Lipid Research Center Study (Haback *et al.*, 1974) were both aimed at reducing coronary risk in groups of high-risk males. MRFIT, still in progress, is evaluating the effectiveness of reducing plasma cholesterol, hypertension, and cigarette smoking on subsequent mortality and morbidity due to coronary heart disease. The LRC study investigated whether males with elevated plasma cholesterol levels could reduce their risk of coronary heart disease by lowering their plasma cholesterol levels via diet and, in some cases, pharmacologic treatment.

The results of both the National Diet-Heart and the LRC studies indicated that initial habit changes and reductions in biologic endpoints were achieved, followed by subsequent backsliding. The results of MRFIT are continuing to be investigated to date, as planned in the protocol. The design of this massive study will enable the principal investigators to examine the impact of intervention on coronary disease morbidity and mortality. However, it will not be possible to determine the individual contributions of reducing plasma lipids through diet change, lowering blood pressure through diet and pharmacologic treatment, or promoting smoking cessation. Despite methodological problems discussed elsewhere (e.g., Kolata, 1975), these nationwide intervention trials have demonstrated the feasibility of designing and implementing large-scale programs designed to modify diet and other life-style habits related to coronary risk. The fact that reductions in biologic endpoints such as plasma lipids were not maintained in the two studies in which longitudinal data were available serves to point out the need for developing more effective methods for preventing backsliding and maintaining healthy life-style changes.

In three other studies, *behavioral* procedures were compared with other approaches in modifying the typical American high-fat, high-cholesterol diet and other coronary risk factors. Meyer and Henderson (1974) compared group behavioral modification with individual nutrition counseling and individual consultation by private physicians in modifying diet, smoking, and exercise habits. Foreyt *et al.* (1979) compared a more traditional diet instruction group with a modified nutrition group discussion approach involving several behavioral procedures (i.e., self-monitoring, stimulus control, and contingency management). In the Stanford Three Community Study (Meyer *et al.*, 1980b; Stern *et al.*, 1976) behaviorally oriented face-to-face instruction was employed in conjunction with a mass media campaign and compared with mass media alone in modifying diet, smoking, and exercise with high-risk individuals.

In all three studies, behavioral procedures appeared to be initially superior to the other approaches. During follow-up, however, which ranged from only 3 months in Meyer and Henderson's study to 3 years in the Stanford Three Community Study, the superiority of behavioral methods in facilitating maintenance of habit changes in diet, smoking, and exercise was not clearly demonstrated. Still, each of these studies made unique and important contributions to the coronary heart disease prevention literature. Meyer and Henderson (1974) were successful in recruiting employees from an individual corporation, demonstrating the utility of involving local businesses and corporations as the bases for coronary risk reduction programs. Foreyt *et al.* (1979) addressed the problem of motivating individuals with "normal" lipid levels to change their eating habits. They stressed the importance of differentiating "normal" American lipid levels, which are related to increased coronary risk, from lower healthier lipid values. Another solution to this motivation problem may be to emphasize the need for individuals at lower risk to maintain their low-risk status through continued diet change, exercise, and smoking cessation. Regarding the Stanford Three Community Study, methodological shortcomings and problems in the interpretation of the data have been discussed elsewhere [see the critiques by Kasl (1980) and Leventhal *et al.* (1980) and the rebuttal by Meyer *et al.* 1980a]. Still, the Stanford study demonstrated the feasibility and impact of an innovative and cost-effective method for facilitating life-style change among the general public via mass media.

Finally, at the Oregon Health Sciences University, a 5-year diet intervention program is currently being conducted to investigate the acceptance of the Alternative Diet, proposed by Connor and Connor (1977) and described earlier in this review, among free-living families and to examine the effects of dietary change longitudinally on plasma lipids, blood pressure, and body weight (Matarazzo *et al.*, 1982) A *family-group* model of intervention is being employed in which participants attend monthly group sessions conducted by psychologist-dietician coleaders. The critical features of this study are its focus on the family unit and the gradual, phased approach to nutritional life-style change.

In summary, the role of dietary factors in the development of hyperlipidemia has clearly been established in the literature. Several dietary interventions have been conducted within the context of cardiovascular risk reduction trials. Unfortunately, there has been a lack of a standardized diet across interventions. Behavioral techniques employed in these interventions have included reinforcement, modeling, stimulus control, guided practice, and use of group and family support. The use of mass media represents a promising approach to community intervention. The studies aimed at reducing coronary risk have demonstrated that immediately following intervention plasma lipids can be reduced through dietary change. However, behavioral procedures have *not* been shown to be clearly more effective than other methods of intervention (e.g., pharmacological). In addition, the statistical artifact of regression to the mean for initially elevated biomedical endpoints must be considered in interpreting lipid-change data. Finally, long-term results have usually yielded backsliding trends in both health habits and biological endpoints.

Weight Control

The role of weight reduction in reducing plasma lipids has been documented in the literature. For example, weight loss has been related to the lowering of plasma triglyceride concentrations (Gotto *et al.*, 1977; Kuller *et al.*, 1980) as well as decreased plasma cholesterol (Gailbraith *et al.*, 1966). Weight reduction currently appears potentially to be best achieved by behavioral methods in contrast to pharmacological or other procedures (Stunkard *et al.*, 1980). Inasmuch as the extensive literature on behavioral approaches to weight control has been recently reviewed elsewhere (e.g., Franks and Wilson, 1979; Stuart, 1980), it will not be repeated here. However, two major questions that have arisen from this area of research have been: (1) How can weight loss or habit change related to weight control be permanently maintained? What role does the family play in either hindering or facilitating weight control and maintenance of weight loss?

Early studies gave rise to an initial optimism regarding behavioral approaches to weight control, showing that behavioral self-management procedures (i.e., self-monitoring, stimulus control, and contingency contracting) were more effective than standard dietary counseling, group support, or insight-oriented psychotherapy utilized singly (Franks and Wilson, 1975; Stuart and Davis, 1972). A few studies reported a statistical superiority of behavioral approaches when average weight losses were only 10 lb (Harris, 1969; Wollersheim, 1970). Other investigations derived more positive results with average weight losses of more than 20 lb (Jeffrey *et al.*, 1975; McReynolds *et al.*, 1976). However, much of this treatment outcome research has been plagued by methodological problems including a lack of specificity of the procedures employed, an overreliance on college students and mildly obese individuals as subjects, inadequate control of therapist characteristics and nonspecific treatment factors, a failure to report attrition rates, unexplained between-subject differences in response to treatment, and a lack of standardization in measuring weight loss from one study to another (Jeffrey, 1974; O'Leary and Wilson, 1977; Stuart, 1980).

The critical test of treatment effectiveness in the weight control area is the successful maintenance of treatment effects. The behavioral literature shows less than satisfactory results in this regard, with many studies showing less than clinically meaningful weight loss or less than 10 lb at follow-up (Brightwell, 1976; Hall, 1972; Jeffrey, 1976; Martin and Sachs, 1973). In a review of 19 studies, Hall and Hall (1974) found only 2 of the 19 that reported follow-up of more than 6 months to 1 year after treatment. In other studies, the follow-up data showed that patients regained most of the weight they had lost during treatment (Hall, 1973; Murray *et al.,* 1975). In comparing follow-up results between behavioral and nonbehavioral procedures, some studies suggested that behavioral approaches were superior at posttest but not at follow-up due to extensive backsliding (Hall *et al.,* 1977; Kelly and Curran, 1976). Concern over this problem of backsliding has led several investigators to focus more attention on follow-up techniques designed to facilitate the maintenance of treatment effects. These techniques have included the use of group "booster" sessions for continued therapist and peer support (Beneke and Paulsen, 1979), encouraging continued physical activity and related life-style changes (Jeffrey, 1976), teaching and rehearsing stress management skills (Mahoney and Mahoney, 1976), and instructing family members in providing support (Mahoney, 1973).

The role of family support and cooperation in facilitating weight loss has received closer scrutiny in the more recent behavioral literature. In an early study, Stuart and Davis (1972) described mealtime interactions between obese women and their husbands. While the small sample size precluded definitive interpretations of their data, it was concluded that the husbands exerted a critical influence on their wives' weight loss efforts. Mahoney and Mahoney (1976) also examined the role of family involvement in the treatment of obesity. They found a significant relationship between treatment outcome and a social support index based on attendance at treatment sessions and therapists' rating of cooperation. However, in a carefully controlled study, Wilson and Brownell (1978) found that spouse involvement did not contribute significantly to treatment effects. In explaining their results, the investigators proposed that simply having spouses attend meetings and receive instructions may be insufficient to change their behavior toward overweight patients. In a similar study with

29 obese subjects (Brownell *et al.,* 1978), spouses were trained in modeling, record keeping, and reinforcement techniques. At 3- and 6-month follow-ups, subjects in the spouse-training condition lost significantly more weight than individuals attending treatment sessions alone. In the former group, weight losses at follow-up averaged nearly 30 lb. Subjects with cooperative spouses (i.e., agreeing to participate in spouse training) who attended treatment sessions alone did no better than subjects whose spouses refused to participate in spouse training. Further support for the importance of spouse training in the treatment of obesity was provided by Pearce *et al.* (1979). Their results indicated that spouse training did not augment treatment effects at posttest, but contributed to superior maintenance of weight loss at 3-, 6-, 9-, and 12-month follow-ups.

In summary, most behavioral weight control programs have been shown to produce only modest weight loss over relatively short periods of time, extending up to 1 year, but long-term results have been less than satisfactory (Jeffrey *et al.,* 1978; Stunkard, 1977; Stunkard and Mahoney, 1976). Exceptions to this rule have been studies incorporating spouse involvement (e.g., Brownell *et al.,* 1978). Innovative intervention approaches need to be designed to facilitate the successful maintenance of weight loss. The crucial role of weight control in the treatment of hyperlipidemia is pointed out by the number of obese or overweight hyperlipidemic patients for whom weight loss contributes to lipid reduction. An emphasis has been placed on maintenance of treatment gains via permanent habit change and family support in the behavioral treatment of obesity. These same treatment issues are important in the overall (medical-behavioral) management of hyperlipidemia.

EXERCISE, SMOKING, TYPE A BEHAVIOR, AND PLASMA LIPIDS

Physical Exercise and Plasma Lipids

As described earlier, the principal treatment of hyperlipidemia is accomplished through diet (low fat—low cholesterol) and weight control. Physical exercise can influence plasma lipids by facilitating weight loss. The role of exercise has been increasingly emphasized in the treatment of obesity (e.g., Stalonas *et al.,* 1978). Other studies have shown that physical exercise can also produce a temporary decrease in triglyceride levels. In one study, this lipid reduction was found to occur shortly after a single period of physical activity and lasted 2 days or more (Holloszy *et al.,* 1964). Oscai *et al.* (1972) studied the effects of exercise on plasma triglycerides in seven hyperlipidemic men, monitoring plasma triglycerides daily during a 2-week period. Plasma triglyceride levels dropped during 4 days of exercise, then returned to baseline levels during the next week. Oscai *et al.* hypothesized that exercise reduces triglycerides either by decreasing blood sugar, thereby diverting carbohydrates to working muscles, or by increasing the activity of lipoprotein lipase which plays a central role in the breakdown of plasma triglycerides.

Physical exercise has also been shown to be related to increased levels of high-density lipoprotein (HDL) cholesterol, known to be inversely related to cardiovascular risk. In a retrospective study, Wood *et al.* (1976) examined the effects of heavy exercise on HDL cholesterol in 41 males who ran at least 15 mi/week for 1 year. The plasma lipid and lipoprotein determinations of these men were compared with those of a control group of less active men over the same period. The results indicated increases in HDL cholesterol concentration for the heavy-exercise group but not for the control group. However, the two groups of men also differed in terms of the proportion of cigarette smokers, alcohol intake, and adiposity. None of the heavy exercise group smoked, compared with 41% of the control group. In addition, alcohol intake and adiposity levels were lower for the heavy-exercise group. Wood *et al.* concluded that heavy exercise, alcohol consumption, and maintenance of body weight all contributed to increase HDL cholesterol.

Physical exercise has been shown not only to affect plasma lipids but also to decrease coronary risk. The relationship between physical activity and reduced cardiovascular risk is well documented in epidemiological research. Paffenbarger *et al.* (1970) showed that the amount of work activity in longshoremen was related to morbidity rates resulting from coronary heart disease and stroke. Specifically, the mortality rate of men with more sedentary jobs was one-third higher than that for active cargo handlers. When the longshoremen's work load was studied on a prospective basis, the coronary death rate for high-activity workers was almost one-half the death rate for low-activity workers (Paffenbarger and Hale, 1975).

Thus, physical exercise has been shown to provide multiple health benefits, directly influencing plasma lipids and overall coronary risk. Still, compliance problems commonly occur and backsliding is more the rule than the exception—even with cardiac patients in rehabilitation programs (Carmody *et al.*, 1980; Oldridge *et al.*, 1978). Several studies have investigated the role of behavioral procedures to promote increases in physical activity. Harris and Hallbauer (1973) employed behavioral self-management techniques to modify eating and exercise habits in a 12-week weight control program. The addition of an exercise component did not enhance weight reduction at posttest, but facilitated further weight loss during the 7-month follow-up period.

Heinzelmann and Bagley (1970) studied factors that influence participation in physical activity programs among 239 middle-aged men involved in supervised exercise programs. An important motivational factor in these exercise programs was group support. Almost 90% of the sample reported that they preferred to exercise with a group or another person. Also, the wife's attitudes about the project was a significant factor in predicting the husbands' attendance. The crucial role of the spouses' attitudes in promoting husbands' attendance in this exercise program further suggests the importance of family support in facilitating habit change.

More recently, Stalonas *et al.* (1978) studied the effects of physical exercise and self-reinforcement in the behavioral treatment of obesity. In the exercise component of treatment, overweight subjects were encouraged to increase their level of physical activity from 150 to 400 cal/day over a 10-week period. Neither the physical exercise nor self-reinforcement procedures enhanced weight loss at posttest or 12-month follow-up when compared to a basic behavioral self-management condition. However, there was a tendency for physical activity to promote greater weight loss after 1 year and for initial weight loss to be maintained to a greater extent.

In summary, research on the effects of physical exercise on hyperlipidemia leads one to conclude that a prudent exercise regimen can play a potentially valuable role in the treatment of this chronic disease condition, particularly as a means of preventing backsliding.

Cigarette Smoking and Plasma Lipids

The harmful effects of cigarette smoking on the respiratory and cardiovascular systems have been well documented (U.S. Department of Health, Education and Welfare, 1979). More recently, the relationship between cigarette smoking and plasma lipids has received more attention in the research literature. Cigarette smokers have been shown to have increased heart rates, higher cholesterol levels, and increased LDL and decreased HDL cholesterol concentrations (e.g., Heyden *et al.*, 1979). Several studies have shown that smokers have higher plasma triglyceride levels on the average than nonsmokers (e.g., Goldbourt and Medalie, 1977). In a recent study comparing baseline plasma lipids of smokers and nonsmokers in the Oregon Health Sciences University Family Heart Study, cigarette smokers were found to have significantly higher levels of triglycerides, higher VLDL and LDL cholesterol concentrations, and lower HDL cholesterol concentrations (Brischetto *et al.*, 1980). In summary, these results support previous research suggesting a positive relationship between cigarette smoking and plasma lipid abnormalities. Thus, the role of smoking reduction techniques in the treatment of hyperlipidemia must be considered.

The behavioral smoking intervention literature is extensive and has been reviewed comprehensively elsewhere (e.g., Bernstein and McAlister, 1976; Franks and Wilson, 1979; Lichtenstein and Danaher, 1976). The aversive conditioning technique of rapid smoking has been generally shown to be an effective method for smoking cessation (Lichtenstein and Danaher, 1976). However, the health risks of this aversive technique due to nicotine poisoning and potential cardiac complications have been indicated in several controlled studies (e.g., Russell *et al.,* 1978). Thus, it is not appropriate to employ the rapid smoking procedure with individuals at risk for coronary heart disease due to elevated lipid levels or the presence of other risk factors. One promising aversive technique related to rapid smoking is the satiation procedure in which subjects smoke to satiation during supervised smoking sessions. Lando (1977) reported impressive results using a multicomponent treatment approach consisting of satiation, self-control training, contingency contracting, group support, and booster sessions (i.e., a 76% abstinence rate at 6-month follow-up). More long-term follow-up studies are needed to examine the effects of maintenance strategies such as stress management and spouse training to prevent backsliding in smoking cessation programs with hyperlipidemic patients. To summarize, there is suggestive evidence of a relationship between cigarette smoking and various lipids and lipoprotein fractions, particularly in HDL cholesterol concentrations, with HDL concentrations significantly lower for cigarette smokers than for nonsmokers. The smoking cessation literature suggests that a combination of behavioral procedures is probably the most effective in facilitating total abstinence, although backsliding is still a prevalent problem during follow-up (e.g., Hunt and Matarazzo, 1973).

Type A Behavior and Plasma Lipids

An association between the Type A behavior pattern and coronary heart disease has been demonstrated in retrospective epidemiological research (Friedman *et al.,* 1964). The cornerstone of evidence, however, was derived from the prospective 9-year Western Collaborative Group Study (Rosenman *et al.,* 1964), in which morbidity rates due to coronary disease among Type A individuals were twice those of Type B subjects. Type A behavior is characterized by time urgency, speed and impatience, aggressiveness, drive, and competitiveness. Although an association was shown between Type A behavior and coronary heart disease in the same

Western Collaborative Group Study, correlations between Type A behavior, measured on the Jenkins Activity Survey, and plasma lipids were minimal. In several other studies, no consistent relationship has been found between Type A behavior, measured by interview or Jenkins questionnaire, and elevated plasma lipids (Glass, 1977). However, a recent study by Lovallo and Pishkin (1980) showed that the plasma cholesterol levels of men who scored "extremely" high on interview measures of Type A behavior were significantly higher than the cholesterol concentrations of "extreme" Type B subjects. These differences in plasma lipid levels were not found when *all* Type A subjects were compared with all Type B individuals. In other studies, Type A males have been shown to have elvated plasma lipids (Rosenman and Friedman, 1963) and faster blood clotting than Type B subjects (Simpson *et al.,* 1974). In summary, the evidence suggesting a relationship between Type A behavior and elevated plasma lipids has been mixed.

On the other hand, behavioral interventions aimed at the modification of Type A behavior in two pilot studies have resulted in plasma lipid reductions. For example, Roskies *et al.* (1979) compared a 14-week behavioral intervention consisting of relaxation training and stress management with insight-oriented psychotherapy in the modification of Type A behavior among 27 professional and executive volunteers. Pre- and posttest measures included plasma lipids, blood pressure, and self-reported job satisfaction, anxiety, exercise, smoking, and diet. Significant changes were reported in plasma lipids and psychological variables for both groups at posttest. Reductions in plasma cholesterol were greater for the behavioral group. However, a direct assessment of changes in Type A behavior was not undertaken. In addition, a no-treatment control group was not employed, nor was a follow-up assessment conducted to measure maintenance of treatment gains. Despite these methodological problems which the authors acknowledged, this study addressed the important issue of how to motivate executives to modify behavior patterns which had helped them achieve career success by suggesting that treatment procedures would aid them in increasing job efficiency.

In the second intervention study, Suinn and Bloom (1978) studied the effects of "anxiety management training" in modifying Type A behavior in subjects employed in managerial—professional positions. Intervention consisted of only six sessions over a 3-week period. Behavioral procedures included relaxation exercises, identification of muscular cues related to anxiety, and rehearsal of alternative behaviors in responding to stress. The results indicated significant reductions in self-reported anxiety and the "speed and impatience" dimension of Type A behavior measured on the Jenkins Activity Survey. Reductions in Type A behavior, blood pressure, and plasma lipids were in the expected direction but *not* statistically significant. Thus, the lipid-lowering effects of behavioral intervention aimed at modifying Type A behavior were not convincingly demonstrated in this study.

ADHERENCE TO LIPID-LOWERING PHARMACOLOGIC REGIMENS

Lipid-lowering medications are often used in the treatment of hyperlipidemia along with dietary regimen. The most commonly used drugs in the treatment of hyperlipidemia include the bile acid binding resins (e.g., cholestyramine), clofibrate, and nicotinic acid (Gotto *et al.,* 1979). Neither the mechanisms of action nor the side effects of all lipid-lowering medications are completely known. Cholestyramine or colestipol is often used in treating Types IIa and IIb hyperlipidemia. This drug increases bile excretion, enhancing LDL turnover and catabolism (Gotto *et al.,* 1979). Clofibrate (Atromid) enhances triglyceride clearance and sterol excretion into the bile. This drug is often used in treating Types III, IV, and IIb hyperlipidemia.

Patient adherence to medication regimens in the treatment of hyperlipidemia has not been studied extensively. However, adherence is generally judged to be poor, a major concern to clinicians attempting to treat this disorder (Witters *et al.,* 1976).

In the drug treatment of another major disease and cardiovascular risk factor, hypertension, patient compliance issues have been studied extensively (e.g., Henderson *et al.,* 1979). Several important factors have been found to influence the patient's ability to follow a prescribed medication regimen including increased cost, inconvenience, complexity, and number of dosages (Blackwell, 1973). In addition, the quality of the patient-health professional relationship, particularly in terms of the continuity of care, has been described as another critical factor determining compliance (Caldwell *et al.,* 1970). The amount the patient knows about his/her disease and treatment has been suggested as an additional factor determining compliance. However, the data on this issue are mixed, depending on the type of education campaign employed and the emphasis given to treatment procedures (McKinney *et al.,* 1973). In this regard, Leventhal (1973) has pointed out that education for positive health practices not only must provide information about the debilitating aspects of disease to enhance motivation but also must attend to the detailed analysis of habit change and the environmental—behavioral factors involved. The complexity of the instructions regarding medication management can also affect compliance (Joyce *et al.,* 1969). Svarstad (1976) reported that some of the physicians involved in a survey study of compliance were unclear in their instructions regarding hypertension medication. As discussed previously, in reference to dietary adherence and weight control, the presence or absence of support and cooperation from family members and significant others can have a dramatic effect on patient compliance. In a major literature review of dropout rates in the treatment of alcoholism, hypertension, and psychiatric illnesses, Baekelund and Lindwall (1975) described 19 studies which suggested that lack of social support was related to the discontinuation of treatment.

The conclusions drawn from the more general patient compliance literature provide at least a framework within which to better understand the compliance picture with lipid-lowering medication. Surprisingly, only a handful of studies have attempted to examine the effects of behavioral and other intervention procedures designed to facilitate compliance with lipid-lowering medication regimens. Zifferblatt (1975) first discussed the potential benefits of applying behavioral techniques to the problem of medication compliance. Among the procedures suggested by Zifferblatt were self-monitoring, cueing, and reinforcement techniques. Dunbar and Agras (1979) compared a multicomponent behavioral intervention with an attention placebo procedure involving self-monitoring and a test—retest control group in a study of lipid-reducing medication compliance enhancement. Their subjects were 60 hyperlipidemic males taking either cholestyramine or a placebo. Behavioral intervention consisted of self-monitoring, attribution therapy to enhance motivation, and social reinforcement from the counselors. Medication compliance was measured twice a month using packet counts. The results showed that a higher percentage of subjects in the behavioral intervention rose above a 75% compliance level than in the two control groups at the end of 6 weeks. At 4-month follow-up, however, the results indicated that initial reductions in plasma cholesterol for the behavioral intervention group were not maintained. At 6- and 8-month follow-ups, differences in medication compliance and lipid-change values between the behavioral and the attention placebo groups were minimal. Thus, the long-term effects of the multicomponent intervention were *not* demonstrated. Moreover, self-reports by clinicians of how well they adhered to the intervention procedures in the experimental and attention placebo control groups revealed compliance rates varying from 54.5 to 93.0%.

The issue of medication adherence in the treatment of hyperlipidemia is a critical one since it further focuses our attention on factors that influence compliance and on the study of intervention procedures designed to improve compliance. The role of medication adherence in the treatment of hyperlipidemia is paramount in those cases where pharmacological treatment is indicated. The evidence regarding the success of behavioral techniques to improve medication adherence is still inconclusive.

FUTURE RESEARCH DIRECTIONS

Preventing Backsliding

The overall results of the research literature exploring behavior—plasma lipid relationships suggest avenues for future research both in terms of documenting the relationship between plasma lipids and various behaviors such as exercise, smoking, and Type A behavior and in terms of exploring effective intervention procedures to prevent backsliding, which is so prevalent across these target behaviors. The behavior changes required in the successful treatment of hyperlipidemia are no doubt both complex and extensive, particularly in the area of dietary habits. To date, efforts to promote and maintain selected aspects of such habit changes have yielded less than satisfactory results. Although behavioral approaches appeared to hold considerable promise in the area of diet, weight control, and smoking, the reported long-term treatment effects of such programs have generally been minimal due to the backsliding problem. Thus, continued research is needed to understand better the psychological and life-style factors involved in habit change and to determine the most cost-effective ways of permanently altering dietary and other habits in the long-term management of hyperlipidemia. Our literature review has suggested that some variables appear more promising than others. A discussion of these variables follows.

Use of the Family in Treatment

Family cooperation seems to be a critical factor in determining successful habit change in the areas of diet, weight control, smoking, and drug adherence (e.g., Brownell *et al.,* 1978; Pearce *et al.,* 1979). Particularly in the area of diet modification, the family treatment approach seems appropriate, especially when the patient plays a minor role in the family cooking and grocery shopping. In many cases, the inclusion of family members in treatment is indicated due to the familial—genetic aspect of certain types of hyperlipidemia (e.g., familial Type IIa hypercholesterolemia). In addition, excessive dietary habits related to hyperlipidemia occur in several generations of certain families through learning, imitation, or modeling.

The desirability of involving younger family members in dietary intervention may also be important since atherosclerosis has its origin in an asymptomatic, cryptic phase which may begin decades before actual symptoms emerge. For example, autopsy data from the casualties in the Korean and Vietnam wars indicated the presence of extensive atherosclerosis in many Americans between 18 and 30 years of age (Enos *et al.*, 1955). Additionally, extensive studies of children under the age of 20 years have indicated the widespread presence of elevated plasma cholesterol, blood pressure, and obesity. In the Muscatine Study in Iowa (Lauer *et al.*, 1975), 50% of the 5000 children studied had plasma cholesterol levels above 180 mg/dl. Twenty-seven percent had levels of 200 mg/dl or greater, and 9% had elevated levels of 220 mg/dl or greater. In the same sample, 16% of the children had blood pressure levels which were elevated by adult standards, and 23% were obese.

The family unit can serve as a laboratory for numerous studies of family behavior and interpersonal dynamics and their relationship to the development and treatment of hyperlipidemia. Families with more than one hyperlipidemic, hypertensive, or obese member can be examined to study relationships between genetic and behavioral factors and their effects on coronary risk. Several interesting research questions might be posed in this way. For example, how are high-cholesterol or high-fat eating habits learned withing the family and how are these food preferences maintained and reinforced? What is the effect of individual or family stress within the family on eating patterns and other health-related behaviors? It would appear that many of these questions can be answered within the context of a clinical research program in which extensive biochemical and psychological assessments are conducted with family units on a longitudinal basis instead of focusing only on individual patients, as has been the practice.

Group Support

Group support is another factor that has been identified as critical in facilitating behavior change in the areas of diet, weight control, physical exercise, and smoking cessation (e.g., Jeffrey, 1976; Wollersheim, 1970). Inherent in the group intervention approach is the opportunity for peer support and reinforcement where patients can discuss their successes and failures regarding behavior changes in diet, exercise, smoking, Type A patterns, or medication adherence and receive feedback, suggestions, and support from other participants in the group. This peer-based support has been considered to be crucial for treatment maintenance in the weight control area (Jeffrey, 1974; Mahoney and Mahoney, 1976). In addition, the group approach is more cost effective than individual treatment methods. Although focusing such group treatment on the entire family unit may be more costly in terms of time and inconvenience, the overall treatment efficiency picture can be tremendously improved, by both treating single families as a unit and, to utilize more fully the therapeutic power of groups, by combining families in groups.

Behavioral Shaping and Engineering

One of the basic tenets of behavioral self-management is that habit change can best be shaped in small, workable steps in which initial changes in behavior are more likely to occur and lead to positive reinforcement. In the area of diet modification, for example, the gradual three-phase approach employed in the Connors' Alternative Diet lends itself to such a process of habit change. Gradual change encourages realistic goal setting in modifying behavior, maximizes opportunities for early success experiences, prevents information overload and confusion, and engenders confidence in the patient for making more difficult changes in the future. Within the context of this gradual-change approach, the modification of multiple health habits such as diet, smoking, and exercise necessitates careful planning and comprehensive analyses of the complex interactions among these various behaviors. For the obese, hypertensive patient with elevated plasma lipids who smokes two packs of cigarettes per day, for example, it may be inappropriate to demand immediate changes in all of these areas too quickly. However, it is widely recognized that dietary weight control efforts are enhanced by increases in physical exercise, and therefore a mild exercise program could be introduced as the first therapeutic prescription with other behaviors targeted next. In the behavioral treatment of hyperlipidemia, future studies could examine the positive and negative interactive effects among the various target behaviors related to plasma lipids modification and coronary risk reduction on both the behavioral and the biochemical levels.

Length of Follow-Up

The critical issue of long-term follow-up has been addressed repeatedly in the behavioral literature. In early studies, follow-up consisted of the assessment of changes in treatment effects several weeks or months after intervention ended. From a perusal of the treatment outcome studies described in this review, it appears that in a few cases intervention procedures were continued for an extended period of time to prevent relapse or backsliding (e.g., MRFIT). However, in most cases, it was the follow-up period which extended for several months or years, and not intervention (e.g., Foreyt *et al.,* 1979). It is clear from our literature review that some form of intervention needs to continue during follow-up, whether it be periodic "booster" reinforcement during clinic visits or group support sessions.

Social Policy Issues

The long-term management of hyperlipidemia and extensive habit changes that are involved necessitate innovative solutions that may go beyond traditional biobehavioral and biomedical treatment approaches and into the realms of community-wide action, local, state, and federal regulation, and third-party insurance involvement. It may be the case that the extensive dietary changes involved in reducing plasma lipids could be facilitated by (1) government regulations regarding food composition and availability of certain foods, (2) the collective voice of consumer groups advocating low-cholesterol—low-fat food products, and (3) reward contingencies developed by the private business sector for successful dietary adherence, regular physical exercise, and other preventive health behaviors. The feasibility of such community, social, and political actions needs to be seriously considered and tested on a pilot basis.

Biologic and Behavioral Interactions

The role of dietary change in the treatment of hyperlipidemia and resulting atherosclerotic coronary heart disease has been well documented. The importance of adhering to a lipid-lowering drug regimen has also been emphasized. The impact of physical exercise, cigarette smoking, and Type A behavior on plasma lipids and lipoproteins is still unclear, although, as shown in prospective studies, these health-related behaviors clearly represent coronary risk factors. Further studies are needed to document the relationship between these target behaviors and the biological risk of hyperlipidemia. In addition, factors such as exercise, Type A behavior, and cigarette smoking may have an interactive effect on each other from a life-style or habit-change perspective. Such interactive effects should be explored in future research which carefully examines longitudinal patterns in smoking, exercise, Type A behavior, and dietary patterns in relation to the biological endpoints of plasma lipids, lipoproteins (e.g., HDL cholesterol), and blood pressure. Regarding the relationship between cigarette smoking and diet, for example, it has been hypothesized that smokers exhibit taste preferences for certain high-fat foods. The study of biobehavioral interactions between life-style, psychological, and biological risk factors could prove to be extremely fruitful not only in clarifying the determinants of effective habit change in the treatment of hyperlipidemia but also in better understanding the interactions among the biological and behavioral risk factors for atherosclerotic coronary heart disease.

SUMMARY AND CONCLUSIONS

The disease condition known as hyperlipidemia, characterized by elevated plasma lipids and abnormalities in lipoprotein metabolism, represents a major risk factor for atherosclerotic coronary heart disease. Laboratory, clinical, and epidemiological studies have shown that dietary and environmental factors are paramount in the development and treatment of hyperlipidemia in most patients. There is suggestive evidence that exercise, smoking, and Type A behavior also affect plasma lipids. Therefore, major intervention trials in coronary disease prevention have been aimed at the modification of diet, exercise, and smoking, as well as Type A behavior. The treatment of hyperlipidemia, per se, has focused on diet modification and medication adherence. It is suggested that these other target behaviors—exercise, smoking, and Type A patterns—also be studied in terms of their potential role in the behavioral treatment of hyperlipidemia.

The intervention outcome research to date has *failed* to provide consistent evidence of the effectiveness of *behavioral* procedures in maintaining habit changes in diet and other behaviors sufficient to sustain clinically meaningful reductions in plasma lipids over an extended period of time. Nevertheless, some factors which appear to influence compliance with diet and drug regimens include family cooperation, stress, inconvenience, confusion regarding treatment instructions, quality of the patient-health professional relationship, and various personality—attitude characteristics of the patient. Further research is needed to (1) clarify the relationship between exercise, smoking, and Type A behavior as they influence plasma lipids; (2) document the effects of psychological and life-style factors on the patient's ability to undertake habit changes in the behavioral treatment of hyperlipidemia; and (3) study the effects of innovative intervention procedures in promoting and maintaining habit changes in diet, drug adherence, and the other target behaviors associated with hyperlipidemia and coronary heart disease and possibly in interaction effects among these variables. In conducting such research, the costs of implementing major risk reduction trials must be weighed against their benefits based on a realistic assessment of intervention effectiveness as documented in the behavioral and health psychology literature. The potential benefits of such investigations have only begun to be realized.

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