Medicine & Science in Sports & Exercise: Volume 31(8) August 1999 pp 1129-1134

How effective are traditional dietary and exercise interventions for weight loss?

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Section Editor(s): Gaesser, Glenn A.; Miller, Wayne C.

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Submitted for publication February 1998.

Accepted for publication November 1998.

Support for this paper was provided by the Women's Exercise Research Center (WERC) of the George Washington University Medical Center.

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ABSTRACT TOP

How effective are traditional dietary and exercise interventions for weight loss? *Med. Sci. Sports Exerc.,* Vol. 31, No. 8, pp. 1129-1134, 1999. Health care professionals have used restrictive dieting and exercise intervention strategies in an effort to combat the rising prevalence of obesity in affluent countries. In spite of these efforts, the prevalence of obesity continues to rise. This apparent ineffectiveness of diet and exercise programming to reduce obesity has caused many health care providers, obesity researchers, and lay persons to challenge the further use of diet and exercise for the sole purpose of reducing body weight in the obese. The purposes of this paper were to examine the history and effectiveness of diet and exercise in obesity therapy and to determine the best future approach for health promotion in the obese population. A brief survey of the most popular dieting techniques used over the past 40 yr shows that most techniques cycle in and out of popularity and that many of these techniques may be hazardous to health. Data from the scientific community indicate that a 15-wk diet or diet plus exercise program produces a weight loss of about 11 kg with a 60-80% maintenance after 1 yr. Although long-term follow-up data are meager, the data that do exist suggest almost complete relapse after 3-5 yr. The paucity of data provided by the weight-loss industry has been inadequate or inconclusive. Those who challenge the use of diet and exercise solely for weight control purposes base their position on the absence of weight-loss effectiveness data and on the presence of harmful effects of restrictive dieting. Any intervention strategy for the obese should be one that would promote the development of a healthy lifestyle. The outcome parameters used to evaluate the success of such an intervention should be specific to chronic disease risk and symptomatologies and not limited to medically ambiguous variables like body weight or body composition.

Article Outline

According to data from the National Health and Nutrition Examination Surveys (NHANES), the prevalence of overweight individuals in the U.S. population has increased by 8% from 25-33% over the past 10 yr (33). Furthermore, if a body mass index (BMI) of 25 is used as the cutoff for being considered overweight, 97 million Americans or 55% of the adult population is overweight (41). Although the experts do not all agree on exactly how to define overweight or obese (11,17,32,33,41,53), it is well accepted that the prevalence of obesity is increasing in the United States. With this in mind, specific cutoff criteria for being overweight and obese are not defined in this article, although the focus of the article is to evaluate the effectiveness of traditional dietary and

exercise interventions in reducing weight. The issue of not being able to define clearly obesity may seem even more confusing because the common outcome variable in obesity therapy has always been weight loss or some other measure of body size such as BMI, percentage of excess weight, or body fat content. It seems that although obese individuals may have different therapeutic objectives (e.g., to reduce disease risk, to ameliorate disease symptomatology, to build self-esteem, to increase functional capacity), the immediate measurable outcome variable of body weight becomes the focus of intervention (38). Therefore, in accordance with what has been evaluated as effective therapy in the past, weight loss (or more importantly weight-loss maintenance) will be used as a measure of effectiveness for obesity intervention in the context of this paper.

DIETING AS A WEIGHT-LOSS STRATEGY TOP

Total fasting was used to reduce body weight quickly in the massively obese during the late 1950s and early 1960s. Weight loss at a rate of about 1.0 $kg \cdot d^{-1}$ occurred during the first month of fasting, with this leveling off to about 0.5 $kg \cdot d^{-1}$ thereafter (19). Although the desired outcome of rapid weight loss was achieved through fasting, serious medical conditions such as loss of lean body mass (LBM), depleted electrolytes, and death caused total fasting to wane in popularity (4,7,19).

By the late 1960s and early 1970s the focus had shifted to high-protein, low-carbohydrate diets. Popular diets of the time were the Atkins (6,20) and Stillman (20,58) diets, which provided about 2100 kcal (8.79 MJ) and 1300 kcal (5.44 MJ), respectively. More noteworthy than the energy content of these diets was that they were characterized by their low carbohydrate content (5-10% of energy) and relatively high fat content (50-70% of energy). The theory behind this type of diet composition was that the high protein content would prevent muscle catabolism, while the low carbohydrate content would keep the body in a ketogenic state, which helps suppress appetite. The carbohydrate restriction caused rapid weight loss because of depleted glycogen stores and diuresis, but side effects included nausea, hyperuricemia, fatigue, and refeeding edema (68).

In the mid 1970s, very low-calorie liquid diets became available. These diets were also known as protein-sparing-modified fasts or liquid-protein diets. Their extremely low energy content (300-400 $kcal \cdot d^{-1}$ or 1.25 to 1.67 MJ·d) caused rapid weight loss. However, in spite of medical supervision, high quality protein, and potassium supplementation, deaths caused by ventricular arrhythmia occurred. Ironically, one of the most popular of these diets was called the "last chance diet" (20,56). The 58 deaths that were reported in 1977 and 1978 caused the Food and Drug Administration and the U.S. Centers for Disease Control to terminate the use of very low-calorie weight reduction regimens until further studies could assure their safety (56).

The 1980s spawned the second generation of very low-calorie diets (VLCD). These new commercial formula products became part of medically-supervised programs that included patient support and counseling for weight maintenance after initial weight loss. Clients were first only offered 450- to 500-kcal programs (1.88-2.09 MJ), but later 800-kcal (3.35 MJ) programs became available for men and women who wanted to be more active. The two most common programs that emerged during this era were Optifast and Health Management Resources. These new VLCD were compositionally different from the low-carbohydrate diets of the 1960s and 1970s in that the fat content of the new VLCD was very low (2-18% of energy; Health Management Resources Inc., Boston, MA; Sandoz Nutrition Inc., Minneapolis, MN). Health risks associated with the VLCD, however, were gallbladder disease and cardiac problems (21,24,62,67).

The 1980s also brought about prepackaged low-calorie diets from franchises such as Nutri/System and Jenny Craig. Composition of these prepackaged diets, by energy value, was 20% protein, 20% fat, and 60% carbohydrate (Jenny Craig Inc., Del Mar, CA; Nutri/System Inc., Horsham, PA (65)). The fact that meals were prepackaged and the daily energy intake was 1100-1200 kcal (4.60-5.02 MJ) inspired better program compliance than that seen with the VLCD. However, the same health problems that were present with the VLCD soon became apparent with these prepackaged low-calorie diets (10).

For the past two decades, fat-free diets and fat-free versions of food have become increasingly popular. Several low-fat diet books have become bestsellers (Pritikin (51), T-Factor (29), *Fit for Life* (18), *Eat More Weigh Less* (46)). The Ornish diet itself was originally designed as a rehabilitation diet for cardiovascular disease (44,45) but now has resurfaced as a weight-loss diet (46-48). Only about 10-15% of the 1200-1700 kcal (5.02-7.11 MJ) in these diets typically comes from fat (18,20,29,44-48). The singular focus on reducing fat in the diet may have backfired, however, as data from the latest National Health and Nutrition Examination Survey indicate that while the percentage of fat in the diet has decreased, total energy intake has increased (14). Furthermore, Miller et al. (39) have shown that obese men and women consume a greater percentage of their sugar energy from refined or added sources when compared with their lean counterparts. These researchers have also shown that the obese consume less dietary fiber than the lean (39).

EFFECTIVENESS OF DIETING IN WEIGHT CONTROL TOP

Despite the immense popularity of dieting over the past 40 yr, the effectiveness of these programs must be questioned. A review of the VLCD programs suggests that 12-16 wk of dieting produces a 20-kg weight loss, of which a 10-13 kg loss can be maintained after 1 yr (61). Individual reports vary as to their success claims, and it

is difficult to interpret the results because dropout rates can be as high at 80% in some VLCD programs (43). However, the initial weight-loss success seen with VLCD is followed by gradual weight regain to the point that VLCD programs show no more success long-term than other forms of therapy (42). Results from programs with more moderate dietary restrictions seem less promising than those from the VLCD. The conventional 1200-kcal (5.02 MJ) diet will produce a weight loss of 8.5 kg in 20 wk and 66% of this can be maintained at 1 yr (61). However, as time progresses, weight is regained until prediet weights are reached within 5 yr (12,31).

Nutrition education and behavior modification have been touted as having self-empowering capabilities. During the average 18-wk behavior modification program, one can expect to lose about 10 kg, but 33% of this is regained during the first year post diet with a 95% relapse after 2 yr (22,31). Similar relapses have been seen with community education programs, worksite interventions, and home correspondence courses (28). Initial weight loss in these programs is marginal and maintenance after 1-3 yr is negligible (28). Behavior modification programs focusing on reducing dietary fat and sugar have induced weight losses of 7-9 kg in 6 months, but these programs have not yet reported any long-term data (36,40,57). Other programs restricting dietary fat and/or focusing on behavior modification have reported conflicting results for weight-loss maintenance and are generally no more effective than traditional dieting techniques (16,63).

Data to support the weight-loss effectiveness claims of the commercial weight-loss industry were requested by the National Institutes of Health (NIH) and U.S. Food and Drug Administration at the 1992 NIH Technology Assessment conference on methods for voluntary weight loss and control (27,43). Material was received from only five companies, three representing nonphysician-directed programs, and two representing physician-directed programs. For the non-physician-directed programs, one company submitted a study showing reduced cardiovascular risk with short-term use of their program along with several abstracts that were judged as being scientifically inadequate because of poor study design, high dropout rates, small sample sizes, and inadequate follow-up (27). The second company submitted four studies for review but later withdrew them. The third company submitted information that was judged as being inadequate (27).

For the physician-directed programs, one company submitted 55 publications that were well designed and well controlled. However, the studies showed that the major program benefits were not weight loss but better control of diabetes and reduced cardiovascular risk (27). The second company submitted three published articles showing beneficial metabolic and weight responses to the program, but further data were deemed necessary to draw conclusions (27). Hence, the paucity of weight-loss effectiveness data received from the industry was judged to be inadequate, questionable, and inconclusive (27).

Schachter (52) hypothesized that the poor weight-loss results seen in clinical research studies and commercial programs is molded largely by a self-selected group of people who, unable or unwilling to help themselves, go to therapists for help, thereby becoming the only easily available subjects for studies of recidivism and addiction. Regardless of whether it is true that only the most difficult obesity cases come to professionals for help, the argument remains that no commercial program, clinical program, or research model has been able to demonstrate significant long-term weight loss for more than a small fraction of the participants. Given the potential dangers of weight cycling and repeated failure, it is unscientific and unethical to support the continued use of dieting as an intervention for obesity (5,10,25,26).

EFFECTIVENESS OF EXERCISE IN WEIGHT CONTROL TOP

Although for decades exercise has been prescribed as an adjunct to diet in traditional obesity interventions, exercise scientists did not enter the field of obesity research until the 1960s. There were two technological advances in the 1960s that were responsible for launching the exercise/obesity research-the advent of hydrostatic weighing for body composition analysis and the development of automated indirect calorimetry systems for making metabolic measurements. The two equations used almost exclusively for body fat determinations in hydrostatic weighing were derived by Brozek et al. (13) and Siri (54) about 35 yr ago. Given the widespread use of these equations for determining body composition, it is important to appreciate how these equations were derived and acknowledge their inherent limitations.

For example, the Brozek et al. (13) equation [(457÷Body Density) - 414.2] is used frequently for pre- to post-body composition measurements in weight-loss programming. Such use, however, is in direct contradiction to what the authors state in their original research article. In fact, not one, but three separate and distinct equations were derived by Brozek et al.; the first equation was to be used only for individuals who had recently gained weight, the second equation was to be used for persons who had lost weight, and the third for individuals who were weight stable. Moreover, the original subject sample of Brozek et al. included only three men who were all of average adiposity (15.3% body fat), and data for some of the variables necessary for the derivation of the equations was absent for two of these men (13). The third equation, intended for use only with weight-stable individuals, is the only one cited in exercise physiology textbooks and lab manuals (1,15,23) and typically the only one used in exercise scientists' obesity research. The possibility of spurious results in weight-loss studies is obvious and suggests that caution must be used when the weight-stable equation of Brozek et al. that was derived from incomplete data on three men of normal weight is applied to obese women before and after a weight-loss intervention. Brozek et al. were fully aware of this limitation, and concluded that: "It appears that no universally valid formulas for densitometric estimation of the fat content can be offered." Using the Siri equation

(54) for weight-loss intervention may even be worse than using the equation of Brozek's group, in that the Siri equation is based totally on a theoretical model. Siri arbitrarily set the body fat content of the reference man at zero. In other words, a fat-free body was used as the reference body rather than the 15.3% fat reference body of Brozek et al. (54).

Automated indirect calorimetry has given exercise physiologists the ability to prescribe metabolically specific exercise programs for the obese population. Although exercise prescriptions for weight control vary, the literature reveals that exercise effects on body weight are rather small, but significant. Weight loss of about 2.0 kg has been reported for various exercise programs of differing lengths (30,64). A recent meta-analytical review reported that exercise causes body weight to decrease at a rate of about 0.2 $kg \cdot wk^{-1}$ and that people do not lose as much weight as would be expected from the prescribed exercise (37). Furthermore, the data indicate that the effectiveness of exercise for weight loss is directly related to the initial degree of adiposity and the total number of kilocalories (kJ) expended (8).

The long-term effects of exercise in weight control seem to be the most promising, but the follow-up data for exercise intervention are scanty for the first couple of years post intervention and nonexistent after 5 yr. One of these longer-term exercise studies that is often cited in the literature compared body weight changes of police officers participating in an 8-wk-diet or diet-plus-exercise program consisting of 35-60 min of aerobic activity, calisthenics, and relaxation techniques 3 $d \cdot wk^{-1}$ (50). Those who did not exercise during the follow-up period gained about 60% of their weight back by 6 months post treatment and gained 92% back by 18 months post treatment. There were no significant gains in body weight at 18 months post intervention for those who exercised through the follow-up period. A meta-analysis of the past 25 yr of exercise research also suggests that exercise is critical to weight-loss maintenance (37). Weight loss during the average 21-wk exercise program reviewed in this meta-analysis was only 2.9 ± 0.4 kg, but at 1 yr follow-up the net weight loss had increased to 6.1 ± 2.1 kg. On the other hand, weight loss in the average 13-wk diet-plus-exercise program amounted to 11.0 ± 0.6 kg with a 22% regain in weight after the first year (37).

HEALTHY WEIGHT MANAGEMENT PARADIGM TOP

Some scientists and health care professionals favor the notion of abandoning completely the use of energy-restrictive diets in obesity treatment while using exercise only as a means to improve health rather than weight loss (26,66). These scientists contend that it is difficult to find any scientific justification for the continued widespread use of dietary treatments for obesity (26,66). The NIH Technology Assessment Conference on methods for voluntary weight loss and control concluded that long-term weight loss following any type of intervention was limited to a small minority of the obese people studied (43). The American Dietetic Association (ADA) has recognized the ineffectiveness of dietary treatments for obesity and suggested reallocating resources currently invested in developing, applying, and studying dietary treatments that have little rational hope for success (4). Recently, the ADA advised that the goal of obesity treatment should be refocused from weight loss alone to healthy weight management and that the challenge to dietitians is to teach persons how to be healthy without restriction and deprivation (5). The association recognizes that the vast majority of people who lose weight by dieting can only maintain the reduced body weight by dramatically restricting energy intake for the rest of their lives (3). The ADA further declares that if food- and weight-related behavior alone are the focus of treatment, interventions are likely to be counterproductive rather than therapeutic. The ADA suggests that overweight women may benefit more from counseling about body image and about how to stop the pursuit of thinness than from weight-loss therapy itself (35). In support of the ADA position, the Society for Nutrition Education chartered a new division called Nutrition and Weight Realities, with the purpose to help nutrition educators and dietitians incorporate the new healthy weight paradigm into their work (49).

Some of the support for a healthy weight management paradigm, rather than the traditional weight-loss management paradigm, comes from exercise scientists. The American College of Sports Medicine acknowledged that obese individuals could reap health benefits from exercise without demanding that the exercise meet the traditional intensity requirements suggested for weight loss (2). The Surgeon General's Report on Physical Activity and Health declared that physical activity need not be vigorous to improve health and that 30 min or more of moderate-intensity physical activity on most days of the week-a level unlikely to result in significant weight loss-could reduce disease risk and symptomatology significantly (60).

Morbidity and mortality rates attributed to obesity may be related more to exercise behaviors than to BMI or fatness (9,40,59). Researchers at the Cooper Institute for Aerobics Research (9), for example, reported that after following 25,389 men of varying levels of fitness and adiposity for an average of 8.5 yr, mortality rates were significantly related to fitness level but not to BMI. Men in the highest BMI tertile (> 30) and who were classified as at least moderately fit had an all-cause death rate that was the same as moderately-to-highly fit men in the two lighter BMI tertiles and had all-cause death rates significantly lower than unfit men in any of the BMI tertiles.

Normalization of body weight or body fat is not necessary to improve the health of obese individuals with metabolic disorders thought to be weight related. For example, researchers at Laval University monitored the metabolic profile of obese women participating in a 29-month low-fat diet-plus-exercise program (59). After intervention, the women were still considered obese (81.1 ± 19.0 kg, 41 ± 9% body fat), but their serum total-

and low-density lipoprotein cholesterol levels were the same as a sample of nonobese women. Furthermore, plasma glucose and insulin levels during a glucose tolerance test were the same for the obese and nonobese groups. Similarly, Miller et al. (40) found that a simple diet and exercise monitoring tool called the NonDiet Diet assisted obese men and women to achieve a healthy cardiovascular risk profile. Following the 6-month self-administered health promotion program, subjects remained obese (90.3 ± 4.9 kg, 31.0 ± 1.6% body fat), but their serum cholesterol, triglycerides, systolic blood pressure, diastolic blood pressure, and resting heart rate all dropped from an abnormally high range to the normal range (40). Other researchers have shown that a 6-month exercise program consisting of four to five weekly 90-min exercise sessions at 55% of $V\square O_{2max}$ improved the metabolic profile of obese women in spite of the fact that these women gained 2.3 kg body weight and 2.8 kg of body fat during the same time period (34). Specifically, glucose tolerance and insulin sensitivity in these obese women were improved significantly following the aerobic exercise training. The authors concluded that aerobic exercise training *per se,* irrespective of changes in body composition, promotes beneficial effects on both carbohydrate and lipid metabolism which may reduce the risk of coronary artery disease and diabetes in obese women (34).

CONCLUSIONS TOP

Despite the meager data base to support claims that diet and/or exercise are effective in long-term weight control for the majority of obese persons and the lack of definitive information to suggest that any type of diet and exercise programming will decrease body weight or adiposity level of obese persons to a level that is considered average or normal, this should not deter the pursuance of health intervention strategies for the obese. It might be more prudent for health care professionals to ask "how can we help people of all sizes be healthy?" rather than "how can we make fat people thin?" (55). Any universal intervention strategy for the obese should be one that would be beneficial for the whole population. For example, people of all sizes can benefit from a healthy eating and exercise program, not just the obese. With regard to obesity intervention *per se,* the intervention should be one that focuses on developing healthful behaviors and one that uses behaviors and/or physiologic parameters, not body weight, as outcome variables to evaluate the effectiveness of intervention. An outline of such a prototype has recently been proposed (38):

1. Pre-evaluation. Before intervention, the client's medical history as well as his/her behavioral history with regard to weight-loss attempts and restrictive dieting should be reviewed. This should be done to identify potential problem areas as well as to identify the appropriate outcome variables that should be measured as determinants of success for each individual client.

2. Program design. Design the program according to individual outcome variables desired for each client. Success of the intervention will now depend upon achieving the desired outcome variables.

3. Exercise and activity. Encourage formal exercise as well as increased activity. The exercise prescription should be individualized with a focus on helping the client become more active through frequent, regular activity that is enjoyable.

4. Normalize food intake. Emphasize developing healthier eating behaviors where the client learns to regulate the quality and quantity of food intake according to internal cues of hunger, appetite, and satiety.

5. Psychological component. The cognitive goal of treatment should be refocused from weight loss alone and the pursuit of thinness to developing self-acceptance and a positive body image in the context of overall health. Our cultural obsession with thinness and its prejudice against large persons should be challenged. The client should learn to develop internal direction for maintaining new behaviors, including the option of the points heretofore mentioned.

6. Maintenance plan. The focus of the maintenance plan should be on maintaining the healthier lifestyle established during intervention. The client should be involved in structuring the maintenance plan and feel comfortable with its structure.

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Keywords:
OBESITY; DIETING; OBESITY THERAPY; DISORDERED EATING; WEIGHT LOSS; BODY FAT