Q Can you provide an update on research related to carbohydrate-modified diets and weight loss?

A There is a growing body of scientific evidence regarding modified carbohydrate diets. Such diets are characterized by an increase in protein at the expense of carbohydrate, while dietary fat intake remains within the public health recommendations of ≤35% energy. These more moderate diets (which would include *The South Beach Diet*™ and *The Zone*™ diet) have been touted as providing a 'balance' of macro-nutrients, with protein typically representing 20% to 30% of energy and carbohydrate representing approximately 35% to 45% of energy, with a preference toward less processed sources of carbohydrate such as whole grain breads and cereals, as well as vegetables and fruits. In some instances, the Glycemic Index is recommended as a tool to identify slower digesting sources of carbohydrate. Food choices on a modified carbohydrate diet allow much more flexibility than more restrictive, low-carbohydrate diets (Figure 1).

Figure 1: ***Sample One-Day Meal Plan for Modified Carbohydrate Diet***

Breakfast:	Grapefruit Toasted whole wheat bread with reduced-fat cheese and egg
Lunch:	Chef's salad with vinaigrette dressing Low-fat or fat-free milk
Snack:	Apple with peanuts
Dinner:	Baked fish with vegetables Spinach salad

In 1999, one of the first well-controlled, randomized dietary intervention studies (1) on modified carbohydrate diets demonstrated that overweight and obese men and women following the diet *ad libitum* (amounts as desired) lost significantly more weight after 6 months versus a normal carbohydrate control diet (20 lbs vs. 11 lbs, respectively). This corresponded to a significant drop in fat mass and serum triglycerides versus control. There were no differences in compliance or attrition between groups, nor were there any significant differences found with respect to negative side effects such as abdominal discomfort, constipation or fatigue. What was different was reported energy intake. Subjects following the modified carbohydrate diet voluntarily consumed fewer calories than the higher carbohydrate group, which sufficiently explained the larger weight loss in the modified carbohydrate group.

Other studies have reported similar results, in which subjects following a modified carbohydrate diet *ad libitum* reduced body weight (2, 3). Aude et al studied 60 adults who were randomly assigned to either the National Cholesterol Education Program (NCEP) diet or an isocaloric modified carbohydrate diet, which was lower in total carbohydrate but higher in protein, monounsaturated fat and complex carbohydrate than the NCEP diet (2). Study participants were evaluated every 2 weeks over the course of 12 weeks. Results showed significantly greater weight loss in the modified carbohydrate diet group than in the NCEP diet group (13.6 lb vs. 7.5 lb, respectively). While no significant differences in blood lipid levels were found between the study groups, favorable changes (e.g., decreased waist-to-hip ratio) were seen within the modified carbohydrate diet group.

Weigle et al measured appetite, energy intake, body weight and fat mass in 19 healthy adults (Body Mass Index averaged 26.2 ± 2.1 at the start of the study) to determine whether increasing the protein content of the diet while maintaining the carbohydrate content would lower body weight (3). Serving as their own controls, participants rotated through the following diet-phase sequence: 2-week weight-maintenance diet (15% protein, 35% fat, 50% carbohydrate), 2-week isocaloric diet (30% protein, 20% fat, 50% carbohydrate) and 12-week *ad libitum* diet (30% protein, 20% fat, 50% carbohydrate). Satiety increased during weeks 3 and 4, as participants rotated onto the isocaloric high-protein diet and continued through the start of the final diet phase. A significant decrease in energy intake throughout the duration of the *ad libitum* diet resulted in a loss of 4.9 ± 0.5 kg of body weight, with a decrease in fat mass of 3.7 ± 0.4 kg. The decrease in energy intake during the *ad libitum* phase was sufficient to account for the weight loss.

In another approach to evaluating modified carbohydrate diets for weight loss, some have proposed that a reduced-glycemic-load eating plan (achieved by combining moderate carbohydrate restriction and choosing low-glycemic index foods) may be helpful for those trying to lose excess body weight (4-6).

A recent randomized controlled study compared use of an *ad libitum* reduced-glycemic-load (RGL) diet to a reduced-calorie, low-fat diet to determine effects on body weight in overweight and obese adults (7). Subjects following the RGL protocol were counseled to eat until satisfied, following a low-carbohydrate eating plan during the first two weeks and adding low-glycemic-index carbohydrate choices for the remainder of the trial. Those in the control group were counseled to reduce fat intake and cut-back on portion sizes to achieve a 500-800 kcal/day energy deficit. After 12 weeks (end of weight-loss phase), the RGL group had lost significantly more weight than the control group (-4.9 and -2.5 kg, respectively); at 36 weeks (end of weight-maintenance phase), there was no significant difference between the two groups (-4.5 and -2.6 kg, respectively). In addition to the initial weight-loss benefit, the RGL group had a larger mean positive change in HDL blood cholesterol (3.8 and 1.9 mg/dL, respectively). These findings suggest that a RGL diet may be a reasonable option to a reduced-calorie, low-fat diet for weight management.

The exact mechanisms responsible for weight loss on an *ad libitum* modified carbohydrate diet remain unknown. One potential explanation may relate to higher intakes of dietary protein. Protein is known to promote satiety and reduce food intake as compared to carbohydrate or fat (8). In addition, numerous studies have shown elevated thermic responses to meals and higher 24-hour energy expenditure with increased protein intake (8). Other factors may also favor reduced calorie intake during a modified carbohydrate diet. Reduced variety of food choices on a modified carbohydrate diet could contribute to reduced energy intake, as greater variety and palatability of food choices have been associated with increased energy intake and body fat (9).

It remains to be determined whether modified carbohydrate diets are effective and sustainable over the long term. With any weight loss program, adherence to a sustained reduction of energy intake is key to success. Recent evidence from two studies testing a number of different weight loss programs supports dietary adherence as the main predictor of weight loss irrespective of the macronutrient composition of the diet (10, 11). Therefore, a more appropriate question may be h*ow do health professionals predict what weight loss intervention may be most successful for an individual?* Just as there are marked differences in responses to therapeutic interventions (e.g., fat or sodium restriction), it is highly likely that individuals will respond differently to dietary interventions for weight loss (12). This may be a function of many factors including, but not limited to, body weight distribution, prior history of dieting, food preferences, physical activity or other genetic variants in physiological and psychological processes (12, 13). Future research will help identify those predictive elements that may facilitate weight loss success on an individual basis. In the meantime, modified carbohydrate diets appear to be an effective option for those working toward their desired body weight.

References:

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