

## Review

# LOW CARBOHYDRATE DIET IN MANAGEMENT OF OBESITY – A SHORT REVIEW

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### ABSTRACT

There is a global rise in obesity in the form of epidemic. In view of obesity epidemic low carbohydrate diets are becoming popular. These diets claim to be effective at producing weight loss despite ad libitum consumption of fatty meat, butter, and other high-fat dairy products, restricting only the intake of carbohydrates. Low-carbohydrate diets have been regarded as fad diets, but recent research questions this view. A systematic review of low-carbohydrate diets found that the weight loss achieved is associated with the duration of the diet and restriction of energy intake, but not with restriction of carbohydrates. Trials had showed better weight loss on the low-carbohydrate diet after 6 months, but no difference after 12 months. The apparent paradox that ad-libitum intake of high-fat foods produces weight loss might be due to severe restriction of carbohydrate depleting glycogen stores, leading to excretion of bound water, the ketogenic nature of the diet being appetite suppressant, the high protein-content being highly satiating and reducing spontaneous food intake, or limited food choices leading to decreased energy intake. Long-term studies are needed to measure changes in nutritional status and body composition during the low-carbohydrate diet, and assess fasting and postprandial cardio vascular risk factors and adverse effects. Without that information, low-carbohydrate diets cannot be recommended.

**KEY WORDS :** Low Carbohydrate diets; Atkins diet; Obesity.

### INTRODUCTION

With the evolution of human being, the body mechanism developed an efficient energy storage system for survival during the period of limited food supply but the same system produces adverse health consequences in form of obesity in nutritional abundance. A global rise in overweight and obesity

has intensified the search for an effective weight losing diet as the obesity epidemic persists despite efforts aimed at decreasing fat intake.

The conventional dietary approach for obesity is high carbohydrate, low fat, energy deficient diet but weight loss is not substantial as processed starchy foods and sugars in these diets prevent effective weight loss (1). Low carbohydrate diets have been popular since 1860 when William Banting claimed to lose weight without feeling hunger (2). The most popular diet among them is Atkins diet which is the most widely prescribed low carbohydrate diet. Whereas the Atkins diet permits no more than 5-10% of calorie intake from carbohydrate, Willett's new food-pyramid (with which the Atkins diet is often confused) allows 40-45% of calorie intake from whole-grain foods, fruit, and vegetables (4-6).

### ATKINS NEW DIET REVOLUTION (7)

Eating plan in new diet revolution describes not simply a diet but a "life time nutritional philosophy" with vitamin and mineral supplementation and regular exercise. It consists of four phases.

- Induction – In induction phase there is carbohydrate restriction to 20gm/day in form of salads and non starchy vegetables.
- Ongoing weight loss – Calories are added in form of nutrient dense and fibre rich food by increasing carbohydrate to 25gm/day for first week, 30gm/day next week and so on until weight loss stops then subtract 5gm from the earlier so that continued sustained moderate weight loss occurs.
- Pre-maintenance - Transfer from weight loss to weight maintenance phase. Increase intake in 10gm increment each week till gradual weight loss is maintained.
- Life time maintenance – Select from wide variety

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of food while controlling carbohydrate to ensure weight maintenance and sense of well being.

### **PUTATIVE MECHANISM OF WEIGHT LOSS ON LOW CARBOHYDRATE DIET**

**Fat/bound Water Depletion** - During severe carbohydrate restriction, glycogen stores and associated bound water are depleted, hence weight loss could primarily be fluid. However, two studies measured body composition by dual energy X-ray absorptiometry had failed to demonstrate excessive reduction in lean body mass, so greater weight loss seems to be attributable to fat loss supported by beneficial effects of cardiovascular risk factors (8-10).

**Ketosis** - Depletion of glycogen stores causes ketosis similar to starvation and ketones might also be an appetite suppressant, mimicking anorexia of starvation. However, loss of energy in urinary ketones excretion can account for only few kilojoules. Also there appears to be no association between urinary ketone excretion and weight loss.

Atkin's hypothesized that weight lost on ad libitum diet is because of increased energy expenditure but there are no studies for measuring daily energy expenditure and also there is no evidence that these diets are thermogenic. Fat has a low thermogenic effect, and although a high-protein diet might increase 24-h energy expenditure by 2—3 %, such an effect cannot account for more than a small fraction of the observed weight loss (11). High protein content induces a stronger satiating effect than fat and carbohydrate (12). Although high protein diet might increase 24 hours energy expenditure, this accounts only for a small fraction of weight loss.

Weight loss on the low-carbohydrate diet is probably caused by a combination of restriction of food choices and the enhanced satiety produced by the high protein content, which would decrease ad-libitum food intake and body weight (13). This hypothesis remains to be confirmed. A high-protein diet is not necessarily a high-fat diet.

### **EARLIER STUDIES ON LOW CARBOHYDRATE DIET**

A systematic review of low carbohydrate diet reported that the weight loss is associated with only the duration of diet and restriction of energy intake, not with carbohydrate restriction itself (6). On review of 107 articles prior to 2003 of it was found that only

56 studies had follow up of more than 90 days and none were randomised control trials and had no control group. This constituted insufficient evidence to make recommendations (14).

In 2003, three randomised trials reported the longer-term effect of low-carbohydrate diets. In the first study, 132 severely obese individuals (39% had type 2 diabetes, and 43% had metabolic syndrome) were randomised to either an ad-libitum low-carbohydrate diet or an energy-restricted low-fat diet for 6 months (15). Those on the low-carbohydrate diet had lost 3-9 kg more weight after 6 months (95% CI 1-6 to 6-3 kg), but at 12-months the difference was no longer significant (1.9 kg, —1.0 to 4.9) (16). In another 6-month study, 53 obese women were again randomised to comparative diets (9), and the low-carbohydrate group again lost more weight (8.5 [SD 1.0] vs. 3.9 [SD 1.0] kg after 6 months).

The third study of over 12 months, randomised 63 non-diabetic participants to the Atkins diet or an energy-restricted diet with an energy content of 25% fat, 15% protein, and 60% carbohydrate (9). After 6 months the low carbohydrate group did better, with a weight loss of 7.0% (SD 6.5) versus 3.2% (5.6, p=0.02), but after 12 months the difference between the groups was again no longer significant (4.4% vs 2.5% [6.3])

Although these studies provide evidence that a low-carbohydrate diet does produce increased weight loss over 3—6 months and might be superior to the recommended calorie-reduced low-fat diet, the 12-month studies also indicate that the low-carbohydrate diet may be no better in the longer term. The studies also had important limitations. Adherence to the diets was low, and drop out rates were high. Furthermore, the low-fat diet used by Sahama et al (15) provided 33% of total calorie intake as fat, which is more than the 20-30% energy intake normally indicative of a low-fat diet. In addition, dietary compliance was not assessed by Foster et al.(9). The three studies are important, but are not evidence that low-carbohydrate diets in the long term are superior to the energy-restricted low-fat diet.

### **CRITICS AND SIDE EFFECTS OF LOW CARBOHYDRATE DIETS**

In 2000 experts at University of Kentucky analysed Atkins diet and found that it has 59% of fat which is high based on recommendation by US dietary guidelines and had fewer servings of grains, vegetables and fruits (17).

The American Heart Association (AHA) in 2001 issued a report about the health consequences of high protein diets. According to the AHA, restricting carbohydrate levels while consuming large amounts of protein-rich foods that are high in fat can increase the risk of heart disease, high cholesterol, diabetes, stroke and certain kinds of cancer (18).

A study recently reported in the American Journal of Kidney Disease found that very low-carbohydrate diets deliver a marked acid load to the kidneys that increases the risk for kidney stone formation and the potential for bone loss contributing to osteoporosis (19).

The American Kidney Fund (AKF), in 2002 warned that high-protein diets have the potential to cause scarring in the kidneys, which have to process more wastes from excess protein. Based on new research conducted on endurance runners whose kidneys were studied after being on a high-protein diet, AKF stated: "We have long suspected that high-protein weight loss diets could have a negative effect on the kidneys and now we have research to support our suspicions. Dehydration forces the kidneys to work harder to clean toxins from the blood" (20).

According to the 1997 report of American Institute of Cancer Research (AICR) and the World Cancer Research Fund entitled "Food, Nutrition and the Prevention of Cancer: a global perspective", diets high in saturated fat increase the risk of prostate and colon cancer. In addition, high-protein diets tend to be low in protective dietary fibre, which has been linked to a lower risk of lung, oral, esophageal, stomach and colon cancer.

The American Diabetes Association (ADA) has also cautioned against the use of low-carbohydrate diets. In its statement, the ADA said: "Studies in healthy subjects and those at risk for type 2 diabetes support the importance of including food containing carbohydrate from whole grains, fruits, vegetables and low-fat milk in the diet" (21).

## **FUTURE RESEARCH**

The mechanisms responsible for producing weight loss with the low-carbohydrate diet require clarification. Although there is no solid evidence for advising against these diets as long as weight loss occurs, but future research for assessment of effect on thrombo-atherosclerotic disease is required to ascertain its long term risk.

There is an urgent need for larger and longer studies in obese and moderately overweight individuals to assess weight loss efficacy of low carbohydrate diet, with careful assessment of energy balance and body composition, cardiovascular and diabetes risk factors, constipation, markers of kidney and bone health, nutritional adequacy, dietary compliance and quality of life.

The studies should be sufficiently long to enable careful monitoring of cardiovascular risk factor during weight stability phase and should also include obese individuals with impaired glucose tolerance to examine the potential of low carbohydrate diets to prevent type 2 diabetes.

## **CONCLUSION AND RECOMMENDATIONS**

There is no clear evidence that low carbohydrate diets are better than conventional diets. Although they can promote short term weight loss without hunger, their long term effect on health and disease is not known.

Although long term safety is not guaranteed, these diets seem to be safe for short term use as long as weight loss occurs. Scientifically most solid recommendations for achieving weight loss is a switch to a diet reduced in calories and fat along with exercise, which will also reduce the incidence of type 2 diabetes and myocardial reinfarction among high risk individuals (22, 23).

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## **REFERENCES**

1. Daniels SR. Abnormal weight gain and weight management: are carbohydrates the enemy J Pediatr 2003; 142: 225-7.
2. Banting W. Letter of corpulence. 4th edition London: Harisson, 1869.
3. Atkins RC. Dr. Atkins' new diet revolution. New York. Simon & Schuster; 1998.
4. Freedman MR. King J, Kennedy E. Popular diets: a scientific review. Obes Res 2001; 9: 1S-40S.
5. Sears B. The zone. New York. Harper Collins, 1995.
6. Krauss RM, Eckel RH, Howard B, et al. AHA dietary guidelines: revision 2000. A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. Circulation 2000; 102: 2284-99.

7. Atkins Nutritionals, Inc. Introducing Atkins at home. Aug 5, 2004: <http://atkins.com/Archive/2001/12/15-325810.html> (accessed Aug 5, 2004).
8. Brehm BJ, Seeley RJ, Daniels SR, D'Alessio DA. A randomized trial comparing a very low carbohydrate diet and a calorie-restricted low fat diet on body weight and cardiovascular risk factors in healthy women. *J Clin Endocrinol Metab* 2003; 88: 1617-23.
9. Foster GD, Wyatt HR, Hill JO, et al. A randomized trial of a low-carbohydrate diet for obesity. *N Engl J Med* 2003; 348: 2082-90.
10. Willi SM, Oexmann MJ, Wright NM, Collop NA, Key LL Jr. The effects of a high-protein, low-fat, ketogenic diet on adolescents with morbid obesity: body composition, blood chemistries, and sleep abnormalities. *Pediatrics* 1998; 101: 61-67.
11. Mikkelsen PB, Toubro A, Astrup A. The effect of fat-reduced diets on 24-h energy expenditure: comparisons between animal protein, vegetable protein, and carbohydrate. *Am J Clin Nutr* 2000; 72: 1135-41.
12. Porrini M, Santangelo A, Crovetti R, Riso P, Testolin G, Blundell JE. Weight, protein, fat, and timing of preloads affect food intake. *Physiol Behav* 1997; 62: 563-70.
13. Skov AR, Toubro A, Rønn B, Holm L, Astrup A. Randomized trial on protein versus carbohydrate in ad libitum fat reduced diet for the treatment of obesity. *Int J Obes* 1999; 23: 528-36.
14. Bravata DM, Sanders L., Huang J, et al. Efficacy and safety of low-carbohydrate diets. *JAMA* 2003; 289: 1837-50.
15. Samaha FF, Iqbal N, Seshadri P, et al. A low-carbohydrate as compared with a low-fat diet in severe obesity. *N Engl J Med* 2003; 348: 2074-81.
16. Stern L, Iqbal N, Seshadri P, et al. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: one-year follow-up of a randomized trial. *Ann Intern Med* 2004; 140:778-85.
17. Anderson JW and others. Health advantages and disadvantages of weight-reducing diets: a computer analysis and critical review. *Journal of the American College of Nutrition* 19:578-590, 2000.2
18. Effect of low-carbohydrate high-protein diets on acid-base balance, stone-forming propensity, and calcium metabolism. *Am J Kidney Dis* 2002.
19. Dietary Protein and Weight Reduction: A statement for Healthcare Professionals from the Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism of the American Heart Association, 2001;104: 1869-74.
20. The American Kidney Fund: American Kidney Fund Warns About Impact of High-Protein Diets on Kidney Health: 25 April 2002.
21. Evidence-Based Nutrition Principles and Recommendations for the Treatment and Prevention of Diabetes and Related Complications. *Diabetes Care* 25: 148-198, 2002.
22. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346: 393-403.
23. Singh RB, Dubnov G, Niaz MA, et al. Effect of an Indo-Mediterranean diet on progression of coronary artery disease in high risk patients (Indo-Mediterranean Diet Heart Study): a randomised single-blind trial. *Lancet* 2002; 360: 1455-61.