Weight-reducing diets: Are there any differences?

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This paper compares the efficacy of two widely used weight-loss diets differing in macronutrient composition – a low-carbohydrate diet versus a low-fat diet. Although "a calorie is a calorie" under the controlled conditions of a metabolic unit (i.e., only the level of calorie intake matters and not the source of calories), we conclude that these interrelationships are far more complex in the free-living situation. The different diet-related factors that condition energy balance, including total energy intake, satiety and hunger sensory triggers, and palatability, must be considered when assessing the efficacy of weight-reducing diets of different macronutrient composition.

INTRODUCTION

Macronutrient composition (the relative content of fat, carbohydrate, and protein) is perhaps the most distinct characteristic of weight-reducing diets and is a key marketing factor in the multibillion-dollar weight-management business. Understanding the effects of different macronutrient proportions in the diet is important for providing sound advice to individuals attempting to lose weight and to the general population. This paper compares the efficacy of two widely used diets differing in macronutrient composition for weight loss – the low-carbohydrate diet (LCD) versus the low-fat diet (LFD).

LOW-CARBOHYDRATE DIETS VERSUS LOW-FAT DIETS FOR WEIGHT LOSS

In recent years, several scientific societies and institutional reviews have recommended LFDs as the model that promotes both health and weight loss. Although guidelines to follow high-complex-carbohydrate, low-fat, energy-deficient diets to achieve weight loss are generally accepted, the persistence of the epidemic of obesity and type 2 diabetes suggests that new nutritional strategies are needed if the epidemic is to be overcome. Studies of the role of a high dietary ratio of protein to carbohydrate in enhancing weight loss and disease risk management have emerged along with increasing public interest in weight control, and considerable public interest has focused on LCDs.

After conducting a systematic review of the efficacy and safety of LCDs, Bravata et al.[1] concluded that weight loss depends, above all, on caloric restriction and the length of the dietetic treatment, and there is insufficient evidence to make recommendations for or against the use of LCDs. However, before this analysis, no randomized controlled clinical trials lasting more than 6 months had been performed to compare low-carbohydrate high-fat diets to low-fat calorie-restricted diets.

Between 2003 and 2006, several studies have been published comparing these two diets, and a meta-analysis of these randomized controlled studies has recently been published.[2] Table 1 summarizes the results. The authors of this meta-analysis[2] concluded that low-carbohydrate, nonrestricted diets appear to be at least as effective as low-fat, energy-restricted diets in inducing weight loss for

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Key words: efficacy, low-carbohydrate diet, low-fat diet, weight reducing

doi:10.1111/j.1753-4887.2009.00169.x

Table 1 **Scientific evidence of the health benefits achieved with low-carbohydrate versus low-fat diets.**

Benefit	At 6 months*†	At 12 months*†
Greater weight loss	Yes (4/5)	No (0/3)
Greater decrease in plasma triglycerides	Yes (3/5)	Yes (2/3)
Greater increase in plasma total cholesterol	Yes (2/4)	No (2/3)
Greater increase in plasma HDLc concentrations	Yes (3/4)	No (2/3)
Greater increase in plasma LDLc concentrations	Yes (0/4)	No (0/3)
Greater decrease in systolic blood pressure	No (0/4)	No (0/3)
Greater decrease in diastolic blood pressure	No‡ (1/4)	No (0/3)
Greater fat-mass loss	1/3	0/3
Greater decrease in plasma glucose and insulin	Not determined	1/1
Greater decrease in Hb A1c level only in diabetic patients	1/1	Not determined

The top part of the table describes the parameters analyzed in Nordmann et al's meta-analysis.[2] The bottom part describes the parameters not analyzed in the meta-analysis.

* Yes or No after the meta-analysis by Nordmann et al.[2]

† Numbers in parentheses are the numbers of studies showing positive effects in relation to the number of studies analyzing the effect.

‡ The diastolic blood pressure tends to decrease more in the meta-analysis.

Abbreviations: Hb, hemoglobin; HDLc, HDL cholesterol; LDLc, LDL cholesterol.

up to 1 year. However, potential favorable changes in triglycerides and high-density lipoprotein cholesterol (HDLc) values should be weighed against potential unfavorable changes in low-density lipoprotein cholesterol (LDLc) values, which have also been observed in some of these studies.

These findings are in agreement with other short-term LCD studies, which have also shown improvements in insulin sensitivity,[3] the LDLc particle size, the postprandial blood-lipid profile,[4] and the C-reactive protein concentrations.[5] These improvements can be attributed partly to the greater weight loss achieved with the LCDs.

GREATER WEIGHT LOSSES WITH LOW-CARBOHYDRATE DIETS

The explanations for why patients on LCDs lose more weight in the first months than patients on LFDs are controversial.[6] The difference in early weight loss must be due to a modulation in one of the two components of the energy balance: an increase in energy expenditure or a decrease in caloric intake. According to some investigators, weight loss occurs because energy expenditure increases when the subject is on an LCD. In fact, authors have described an increase in energy expenditure when higher protein intake replaces carbohydrates.[7] However, no significant differences in resting energy expenditure or postprandial thermogenesis have been observed recently in patients on LFDs versus LCDs.[8] Furthermore, LCDs are associated with ketogenesis in the same way that fasting is, but the amount of energy lost through the elimination of ketone bodies in the urine cannot account for more than a few calories a day.

The greater weight loss can also be explained because carbohydrate restriction depletes the glycogen stores. This depletion is associated with loss of water, so the weight loss observed in subjects on LCDs would be secondary to the loss of water, not fat mass. However, studies analyzing changes in body composition during these types of diets fail to show an exaggerated loss of fat-free-mass to support this hypothesis.[9,10]

The success of these diets might be due to their ability to reduce spontaneous energy intake. In fact, in several studies analyzing the effect of these diets, the observed weight loss matched the weight loss predicted by the spontaneous energy deficit produced after the diet had been initiated.[3,9] The mechanisms responsible for this energy deficit are not well understood, and numerous factors are probably involved.

LCDs are usually rich in protein, and several studies support the hypothesis that protein induces a stronger satiating effect than fat or carbohydrate because it alters the plasma or central satiety factors that affect appetite, thus decreasing spontaneous food intake and body weight.[11] It has also been proposed that the decrease in insulin plasma concentrations and the ketosis secondary to the restriction of carbohydrates also contribute to a decrease in appetite.[12] Finally, some authors believe that the success of these diets is due to the more restricted variety of food choices caused by minimizing carbohydrate intake.[9,11] The monotony and simplicity of the diets may inhibit appetite and food intake, especially because they are unpalatable and low in sugar content.

POTENTIAL RISKS OF LOW-CARBOHYDRATE DIETS

Usually, LCDs are low in fiber, poor in calcium, potassium, magnesium, and iron and deficient in folates, thiamine, and other vitamins.[13] In fact, it is recommended that people who use this type of diet take a multivitamin supplement. In addition, LCDs are usually rich in saturated fatty acids,[9] which explains why they induce an

increase in the LDLc particles when consumed.[2] The most frequent complaints of subjects on these diets are halitosis, constipation, and headache, which are readily explained by the reduced intake of whole-grain cereals, vegetables, legumes, and fruits. In fact, Yancy et al.[14] observed more secondary short- and long-term adverse effects in subjects on LCDs than on LFDs. Other complaints associated with LCDs are muscle cramps, diarrhea, asthenia, and lack of concentration.[13] Potential long-term risks associated with LCD diets remain to be elucidated. Future long-term controlled trials evaluating hard endpoints such as cardiovascular or cancer mortality must be conducted.

CONCLUSION

While under the controlled conditions of a metabolic unit it can be shown that "a calorie is a calorie", i.e., that only calorie intake level matters rather than the source of calories, these inter-relationships are far more complex in a free-living situation. Food properties such as energy density, satiety value, taste, metabolic response elicited, etc., are powerful determinants of the actual amount ingested, and hence of caloric intake. High-fat diets tend to be of higher energy density and may thus facilitate passive overconsumption. There is concern about the long-term health effects of high-fat diets, which have not yet been adequately studied. At least some studies have shown that LFDs are more effective for weight maintenance after a period of substantial weight loss.[15] Increasing the proportion of complex carbohdyrates in the diet seems to facilitate a reduction in dietary energy intake and an increase in weight loss, even in normal-weight individuals fed ad libitum.[16] Protein content is frequently manipulated in weight-loss diets to replace either fat or carbohydrates. Protein has a high satiety effect, and at the intake levels associated with weight-loss diets, does not appear to have a negative effect on kidney function.[17] The different diet-related factors conditioning energy balance, such as total energy intake, satiety and hunger sensory triggers, palatability, etc., must be considered when assessing the efficacy of weight-loss diets of different macronutrient composition.

Acknowledgment

Declaration of interest. The authors have no relevant interests to declare.

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