

# Ketogenic Diet Modifies the Risk Factors of Heart Disease in Obese Patients

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## INTRODUCTION

It is generally believed that high-fat diets may lead to the development of obesity and several other diseases such as coronary heart disease, diabetes, and cancer. This view is based on studies carried out in animals that were given a high-fat diet rich in polyunsaturated fatty acids. However, various recent epidemiologic studies have not explained a specific causal relation between dietary fat and obesity or obesity-associated diseases.<sup>1</sup>

Further, contrary to the common notion, a high intake of carbohydrates was found to increase the levels of triacylglycerols, total cholesterol, and low-density lipoprotein (LDL) cholesterol and decrease the level of high-density lipoprotein (HDL) cholesterol. Elevated levels of triacylglycerols and low levels of HDL were associated with hyperinsulinemia. Also, an elevated triacylglycerol level, particularly a high ratio of triacylglycerols to HDL, is an important predictor of heart attack.<sup>2</sup>

Recent studies have quite evidently shown that the ketogenic diet is a natural therapy for obesity and obesity-associated diseases. However, there are very few studies that have addressed the long-term influence of a ketogenic diet in modifying various obesity-associated diseases. Hence, the purpose of this study was to investigate the long-term effect of a ketogenic diet on the activation and modification of heart disease risk factors in obese patients.

## MATERIALS AND METHODS

A prospective study was carried out at the Academic Department of Surgery, Consultation and Training Center, Faculty of Medicine, Kuwait University in 102 (42 male and 60 female) obese subjects whose body mass index was  $37.4 \pm 0.7$ . Mean age was  $40.8 \pm 1.0$  y (58.8% female and 41.2% male). Fasting blood tests were carried out for all the subjects. Initially all the patients were subjected to liver and renal function tests. Their glucose and lipid profiles from fasting blood samples and complete blood count were performed. Thereafter, their fasting blood samples were tested for total cholesterol, HDL cholesterol, LDL cholesterol, triacylglycerol, and blood sugar at 4, 8, and 12 wk.

All 102 subjects received a ketogenic diet consisting of 20 to 30 g of carbohydrate in the form of green vegetables and salad and

80 to 100 g of proteins in the form of meat, fish, fowl, eggs, shellfish, and cheese. Polyunsaturated and monounsaturated fats were included in the diet. Twelve weeks later, an additional 20 g of carbohydrate was added to the meal, for a total of 50 g of carbohydrate. Micronutrients (vitamins and minerals) in the form of 1 capsule/d were given to each subject.

Statistical differences between various parameters before and after the administration of the ketogenic diet were analyzed by paired Student's *t* test with Statview 4.02. Weight, body mass index, and all biochemical parameters are expressed as mean  $\pm$  standard error.

## RESULTS

The changes in the level of the various physical and biochemical parameters examined are shown in Table I. The level of triacylglycerols showed a significant decrease from before treatment to 12 wk after treatment. The initial level of triacylglycerol was  $2.4 \text{ mM/L} \pm 0.2$ ; at 12 wk the level decreased to  $1.2 \text{ mM/L} \pm 0.1$ . The level of total cholesterol decreased from week 1 to week 12. HDL cholesterol increased significantly, whereas LDL cholesterol decreased significantly.

The changes in various other physical and biochemical parameters observed before and after the treatment period with the corresponding *P* values are given in Table I. There was a significant reduction in body weight. The level of fasting blood sugar decreased significantly. In conclusion, consuming a ketogenic diet for 12 wk is safe, and it favorably modified the risk factors of heart disease in obese patients.

## DISCUSSION

One argument against the consumption of a high-fat diet is that it causes obesity. Because fat has a caloric density higher than that of carbohydrate, it is thought that consumption of a high-fat diet will be accompanied by a higher energy intake. On the contrary, recent studies including those from our laboratory have confirmed that the ketogenic diet is a natural therapy for obesity.

In contrast, several current studies have pointed to the fact that a diet with a high glycemic load is independently associated with developing cardiovascular diseases, type 2 diabetes, and certain form of cancers.<sup>1</sup> Another study carried out in the United States showed that the risk of dietary glycemic load from refined carbohydrates is independent of other known risk factors of coronary diseases.<sup>3</sup> Now it is quite evident that high-carbohydrate diets

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TABLE I.

CHANGES IN THE LEVEL OF VARIOUS PHYSICAL AND BIOCHEMICAL PARAMETERS AT THE END OF THE TREATMENT PERIOD (WEEK 12)			
Physical and biochemical parameters	Week 1*	Week 12*	<i>P</i>
Weight (kg)	99.2 ± 2.1	85.9 ± 2.6	<0.0001
Body mass index	37.4 ± 0.7	33.0 ± 0.8	<0.0001
Cholesterol (mM/L)	5.4 ± 0.1	4.9 ± 0.1	0.0022
HDL (mM/L)	1.2 ± 0.04	1.3 ± 0.04	0.0022
LDL (mM/L)	4.0 ± 0.1	3.5 ± 0.1	0.0160
Triacylglycerols (mM/L)	2.4 ± 0.2	1.2 ± 0.01	<0.0001
Glucose (mM/L)	7.0 ± 0.3	5.4 ± 0.1	0.0009

\* Data are expressed as mean ± standard error.

HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol

increase fasting plasma triacylglycerol concentration<sup>4</sup> and decrease HDL cholesterol concentrations.<sup>5</sup>

The data presented in this study showed that a ketogenic diet, in addition to acting as a natural therapy for weight reduction in

obese patients, significantly decreases the level of triacylglycerols, total cholesterol, LDL cholesterol, and glucose and increases the level of HDL. These results, therefore, indicate that the administration of a ketogenic diet for a relatively long period is safe and favorably modifies the risk factors of heart disease in obese patients.

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