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## The ketogenic diet in the treatment of diabetes type 2

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### Abstract

Despite advances in the medical world, obesity remains a major worldwide health hazard. The majority of chronic diseases like diabetes is largely related to obesity which is

usually a product of an unhealthy lifestyle and poor dietary habits. The ketogenic diet has become an increasingly popular approach for both weight loss and as an alternative diet for type 2 diabetes mellitus (T2DM). In addition, this diet has a positive effect on body weight, blood glucose level, glycosylated hemoglobin and plasma lipid profile. This review focuses on the therapeutic effectiveness of using LCKD for the treatment of type 2 diabetes.

**Keywords:** diet, ketogenic, type 2 diabetes, obesity

## **Introduction**

Type 2 diabetes is becoming a worldwide epidemic [2]. It is estimated that by 2030, the number of individuals with diabetes will reach 578.4 million [3]. In all, 90% of diabetes is type 2 diabetes mellitus (T2DM), which is characterized by hyperglycemia and insulin resistance (IR).[3] The management of type 2 diabetes mellitus (T2D) includes lifestyle modifications that are combined with pharmacologic interventions as recommended by guidelines of international diabetes societies [4,5]. Nutrition therapy guidelines often emphasize a reduction in the excessive amounts of carbohydrates, as well as limiting fat intake to be 20–35% of total calorie intake, with a focus on a decrease in saturated fats [6]. These regimens are referred to as ketogenic diets (KD) as they result in ketosis secondary to the severe carbohydrate restriction (<50 g/day) and the excess of free fatty acids[7].

## **Aim of the study**

The aim of the study is to statistical data the literature and present the current state of the therapeutic effects of low-carbohydrate ketogenic diet in diabetes type 2.

## **Material and method**

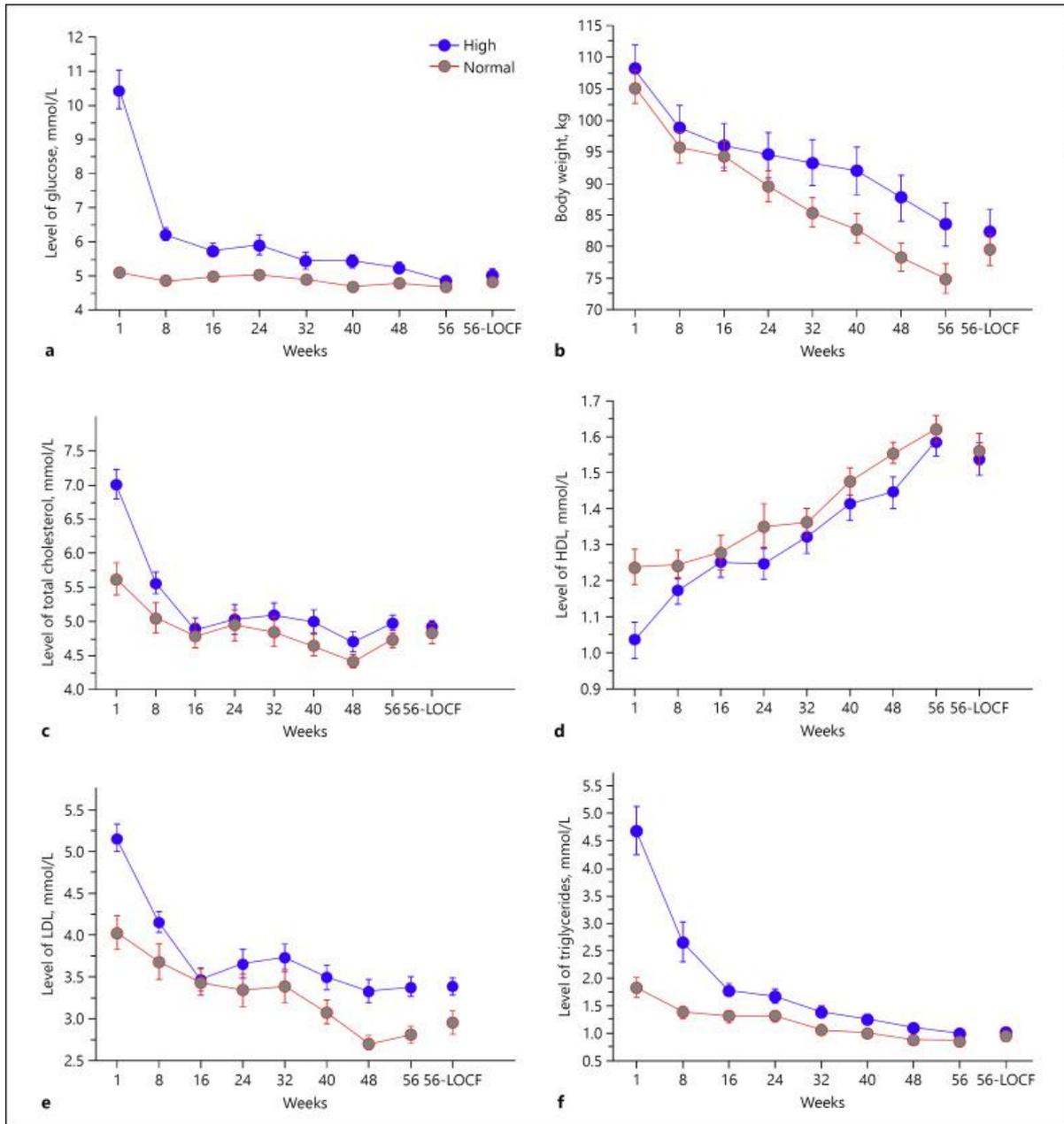
The method of study is descriptive epidemiological analysis. Information that has been used is derived from statistical data provided by the WHO. In searching for them on the WHO,

PubMed website and Google Scholar, keywords such as: diet, ketogenic, type 2 diabetes, obesity.

## Results

The study on the effect of ketogenic diet in obese diabetic subjects [8], has shown that long-term administration LCKD has significant beneficial effects on this group. 64 healthy obese subjects were divided into two groups. Group I consisting of 31 subjects with a BMI >30, having a blood glucose level >6.1 mmol/L, and group II consisting of 33 subjects with a normal blood glucose level. The body weight, blood glucose level, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides were determined before and at 8, 16, 24, 48, and 56 weeks after the administration of the ketogenic diet. All 64 subjects followed a ketogenic diet consisting of <20 g of carbohydrates and 80–100 g of proteins. Twelve weeks later an additional 20 g of carbohydrates was added to the diet.

The results of this study showed that the blood glucose, body weight, total cholesterol, LDL, and triglycerides of both the groups decreased significantly from the start until the 56th week (Fig.1;1; Table Table4). Following the administration of LCKD, in patients with high glucose level (Group 1), there was a  $24.4 \pm 6.7\%$  and  $50.9 \pm 12.5\%$  reduction in body weight and glucose level, respectively, after 56 weeks. Patients belonging to the normal glucose level also showed a reduction in the body weight and glucose level, the percentage reduction in body weight and glucose level after 56 weeks was  $27.2 \pm 6.0$  and  $7.4 \pm 11.9$ , respectively. Changes in glucose level in both the groups were statistically significant. HDL cholesterol increased significantly and LDL cholesterol decreased (Fig. 1).[10]



**Fig. 1.**

Changes in the level of blood glucose (a), body weight (b), total cholesterol (c), level of HDL (d), LDL (e), and triglycerides (f) after the administration of ketogenic diet for 56 weeks [9]. HDL, high-density lipoprotein; LDL, low-density lipoprotein.[10]

## Discussion

The incidence rate of T2DM is increasing year by year. The main environmental factors for T2DM include high calorie diet, obesity and physical inactivity. Therefore, it is important to effectively control obesity for reducing or saving relevant medical expenses .A relevant study

showed that proper dietary intervention not only caused effective weight loss, but also lowered the incidence of T2DM. [11]

The goal of the keto diet is to switch the preferred energy source of the body from available carbohydrates to stored triglycerides.[12] Thus, for the energy supply pattern of the body, the energy supply mode based on glucose was replaced by that based on ketone body, which requires fat to promote catabolism and reduce fat synthesis, while gluconeogenesis increases energy consumption. For this, the insoluble triglyceride is transformed into a water soluble ketone body (acetoacetate,  $\beta$ - hydroxybutyric acid soluble in water, and acetone insoluble in water). Therefore, The ketone body can be further excreted through the excretion of urine, carrying away energy [13]. In addition, a rise in the ketone body can suppress appetite [13], and so, the principle of the keto diet for weight loss is from many aspects [14].This may also explain why keto diet can decrease lipid metabolism indexes, e.g., triglyceride, total cholesterol, and low density lipoprotein though with high fat. [15]

The level of HbA1c is considered as a gold standard index for the diagnosis and management of diabetes and indicates the level of oxidative stress [16]. Various studies have convincingly demonstrated that administration of keto diet decreases the level of HbA1c in diabetic patients [17]. Furthermore, as HbA1c is an indicator of oxidative stress, it is suggested that ketogenic diet induces a reduction in the generation of reactive oxygen species and improves the oxidative status. Gumbiner and his colleagues [17] showed that the improvement in the blood glucose levels is due to the direct effect of the ketone bodies on the hepatic glucose output. It has also been shown that in addition to normalizing the blood glucose level, keto diet was effective in reversing diabetic associated complications [17].In summary, several studies on the effect of ketogenic diets on diabetic subjects suggest that it is safe to use ketogenic diet in diabetic subjects as well as in subjects with high cholesterol level [17].

## **Conclusions**

1. Newly diagnosed overweight or obese people with type 2 diabetes may benefit from weight loss and achieve good blood glucose control in a short term without medication.
2. The ketogenic diet can control not only weight but also blood glucose and blood lipid in patients with overweight or obese T2DM.
3. Diabetic patients who use this diet should be under close medical supervision or capable of adjusting their medication as required.

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