

Low carbohydrate high fat diet: history and its impact on health

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Received: 04 July 2026

Revised: 10 August 2026

Accepted: 12 August 2026

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ABSTRACT

The low carbohydrate high fat (LCHF) diet is a way of eating that restricts the amount of carbohydrates and increases the amount of healthy fats that you eat to optimize your health and nutrition. Consuming fats has very little direct effect on blood glucose levels and, as a result, does not lead to an increase in insulin levels. The principle of the LCHF diet is to replace carbohydrate intake with fat, thus reducing insulin levels and increase the body's ability to utilize its own fat stores for energy.

Keywords: Low carbohydrate high fat diet, Metabolic changes, Energy source

INTRODUCTION

Food-based nutrients significantly affect how well the body functions. Essential nutrient requirements change with age, gender, physiological status, physical activity, and stress. Proteins, fats, and carbohydrates are the macronutrients that provide us with energy. Proteins and carbohydrates both give 4 kcal per gram, while fats provide 9 kcal.¹

HISTORY

Diets low in carbohydrates has a history dating back many years. For example, Greek Olympic competitors may have followed a diet high in protein and low in carbohydrates in 776 BC to preserve their power, muscle mass and athletic prowess. However, these eating practices did not spread widely until the second half of the 19th century, marking the beginning of broader interest in carbohydrate restriction.²

Around the turn of the 20th century, the interest in carbohydrate restriction continued. Sir William Osler

(1849-1919), known as the "Father of Modern American Medicine," suggested that people with diabetes have a diet high in fat (65%), protein (32%), and carbohydrates (3%), while avoiding all fruits and garden produce.³

With the introduction of insulin, the diabetes care underwent a paradigm shift from severe dietary carbohydrate restriction to efficient blood glucose control with insulin therapy. The sulfonylurea (SU) carbutamide, the first oral anti-diabetic drug, was introduced in 1955. Subsequently, other medications from the same family were released.⁴

William Banting advocated for the advantages of a low-carb diet for weight loss and optimum health in his Letter on Corpulence, addressed to the Public, which was published in 1863. Banting is now referred to as "The Father of the Low-Carb Diet."^{2,3}

In the early 20th century, doctors recognized the benefits of carb restriction on children with epileptic symptoms, which led to the rise of the ketogenic diet (KD).² Before the development of antiepileptic drugs like diphenylhydantoin (Phenytoin in 1938), the KD was a

medical strategy for treating epilepsy that was widely popular. Its popularity declined when anti-seizure drugs became more widely available.⁵

In the 1990s, the KD made a comeback and established itself as a treatment option for drug-resistant epilepsy. The KD has attracted a lot of interest in recent years due to its favourable benefits in a variety of conditions, including neurological disorders, obesity, T2DM, cancer, intestinal disorders and respiratory compromise.⁵

Vilhjalmur Stefansson, an Arctic explorer, began endorsing a 15%-20% carbohydrate diet in 1927. He did this based on his observations of the daily routines of Inuit people in the Arctic.^{2,3}

The Inuit in the Arctic, the Bison People of the North American Great Plains, and the Masai ranchers in Central Africa are current examples of these low-carbohydrate nomadic cultures.²

Dr. Arthur Agatston advised consuming primarily meals with low glycemic index and glycemic load (items that don't typically increase blood glucose levels) in his 2003 book *The South Beach Diet*. This was quickly followed by Dr. Michael Mosley's *The Blood Sugar Diet*, which advocated a low-carb Mediterranean diet with or without intermittent fasting days and the choice to cap daily calorie consumption at 800.^{2,3}

A low-carb diet is defined as one that contains 25 g to 125 g of carbohydrates per day.²

A few books by Gary Taubes and Dr. Jason Fung served as essential references for the LCHF diet. This highlights how the LCHF diet is secure and beneficial for a healthy life. Along with the LCHF diet, Dr. Jason Fung also recommended intermittent fasting to his patients for successful outcomes.

Recently, the WHO and other national authorities have pushed for restrictions on daily carbohydrate intake, particularly for easily digestible carbohydrates like starches and sugars. For reducing the risks of diabetes, obesity, and heart disease, these recommendations are crucial.^{5,6}

Carbohydrates only rank 2nd in terms of energy yielding nutrients, while fat in importance for human nutrition. Widespread disorders in which carbohydrates may play a pathophysiologic role include obesity, T2DM, dyslipoproteinemia, hypertension, metabolic syndrome (MetS), coronary heart disease, and cancer. Consequently, altering carbohydrate consumption may have a preventive effect.⁷

According to Jeff S. Volek and Stephen D. Phinney's book "*The Art and Science of Low-Carbohydrate Living*," The primary stimulator of insulin release from the pancreas is

dietary carbohydrate. Your body becomes more dependent on insulin to maintain proper metabolic homeostasis if you consume a high-carbohydrate diet, especially one that contains lots of quickly absorbed sugars and refined carbohydrates. A low-carbohydrate diet switches the body's fuel source to primarily fat.

Thus, it allows less dependence on insulin to maintain metabolic health. In another way, if we view insulin resistance as a condition of carbohydrate intolerance, dealing with dietary carbs becomes a burden and reducing this burden allows the body to function more normally.⁸

Feinman et al recommended dietary carbohydrate reduction as the initial step in controlling diabetes. The favourable effects, which include an increase in insulin sensitivity/needs and significant weight loss, are supported by a multitude of studies, according to the authors.⁹

Low carbohydrate diet is defined as "the intake of carbohydrate <26% or 130 g/day" by the National Centre for Biotechnology Information (NCBI), National Library of Medicine (NLM) Bookshelf.¹⁰

Dr. Annika Dahlqvist, a general practitioner in the Sweden, promoted the LCHF diet. The Swedish government has approved this diet as suitable for people with T2D as well as helpful for anyone trying to lose weight or the maintain a healthy weight due to its reduced insulin requirements.⁹

The LCHF Diet is a way of eating that limits the quantity of carbohydrates you consume while increasing the consumption of healthy fats to improve your nutrition and overall health. Consuming lipids does not significantly raise insulin levels since they have no direct impact on blood glucose levels. The foundation of the LCHF diet is the substitution of fat for carbohydrates, which lowers insulin levels and improves the body's capacity to use its own fat reserves for energy.¹⁰

In the 1970s, R. Atkins recommended using an LCHF diet to manage MetS and insulin resistance (IR). IR is a component of MetS, which increases the risk of obesity, T2D, fatty liver, and a host of other diseases. The MetS can be effectively treated/prevented by adopting an LCHF dietary approach since it lowers insulin levels.⁹

As seen in Figure 1, when following an LCHF diet, there is not enough glucose taken into the blood stream each day to maintain the glycogen stores in the liver and muscles. This leads to a decrease in glycogen storage, glucose release and ultimately a decrease in blood glucose levels.

The body interprets this as stress and will exert every effort to burn fat as much as possible in order to minimize the requirement for glucose, which is largely required for the CNS and RBCs. An abrupt drop in insulin and a rise in stress hormones are used to achieve this.¹¹

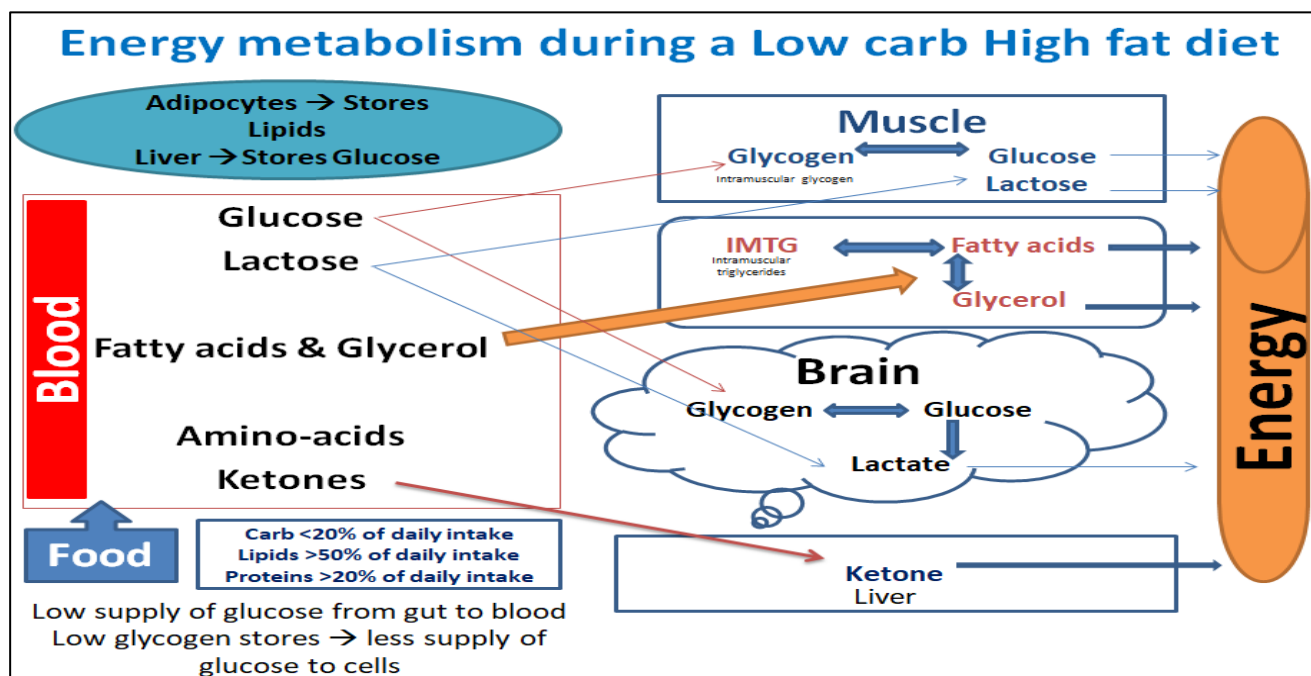


Figure 1: Schematic representation of the metabolic processes in the LCHF diet.

As a result, there is an excess supply of fatty acids, which causes a metabolism that is only partially complete and resulting in the production of ketones (ketogenesis) from some of the acetyl-CoA that is made. The brain and muscles can then use these ketones as an alternative fuel source to glucose. This is important for the brain because

glucose and ketones may cross the blood-brain barrier, but fatty acids cannot. The brain cells and neurons can utilize ketones as a substitute fuel source when there is a shortage of glucose. Additionally, amino acids, which are converted into glucose by gluconeogenesis, make a minimal to moderate contribution.¹¹

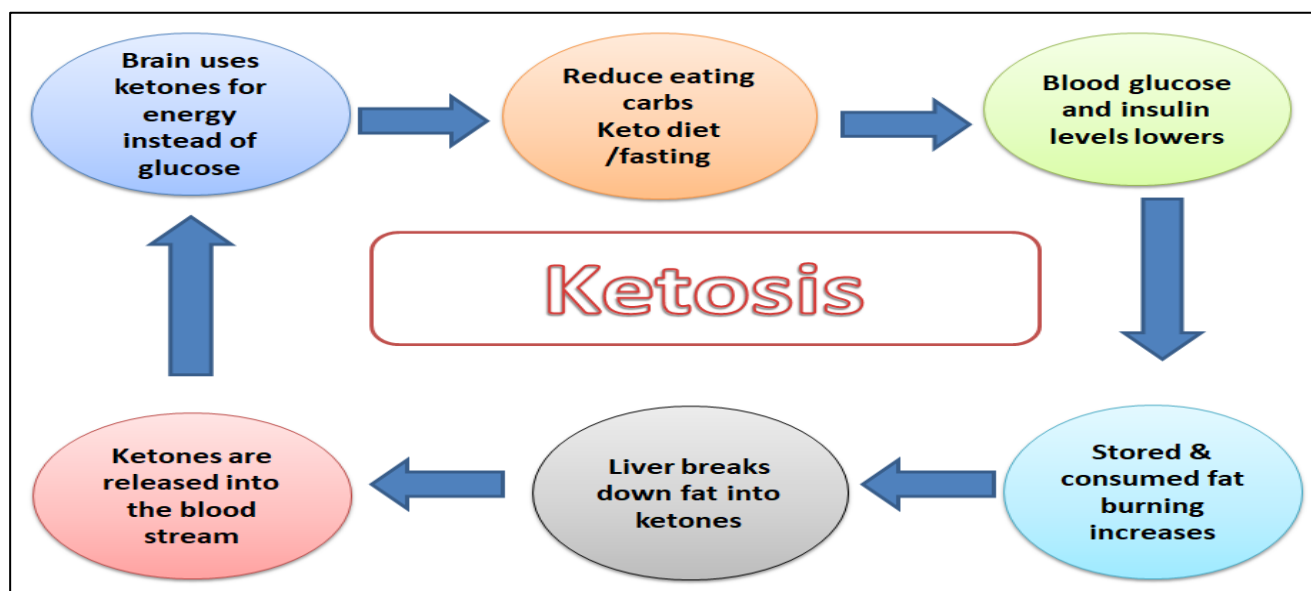


Figure 2: What is ketosis?

Benign nutritional ketosis is an insulin-controlled process which results in a slight release of fatty acids and a moderate conversion of fatty acids to ketone bodies.

Diabetic ketoacidosis is a condition in which insulin is unavailable, either because the pancreas cannot make it

(T1D) or body cells are insulin-resistant (T2D). As a result, blood glucose rises & excessive quantities of ketones are produced in an unregulated biochemical state.

The table below shows ketone concentrations in the body to help differentiate between ketosis and ketoacidosis.¹³

Table 1: Quantity of Ketones produced in different conditions.

Body condition	Quantity of ketones being produced
After a meal	0.1 mmol/l
Overnight fast	0.3 mmol/l
Ketogenic diet (Nutritional ketosis)	1.0-8.0 mmol/l
>20 days of fasting	<10.0 mmol/l
Diabetic ketoacidosis	>10.0-15.0 mmol/l

Table 2: Difference between nutritional ketosis and diabetic ketosis.^{2,12}

Nutritional ketosis	Diabetic ketoacidosis
Nutritional ketosis is an insulin regulated process which results in a mild release of fatty-acids and a moderate conversion of fatty acids to ketone bodies.	Diabetic ketoacidosis is a condition in which insulin is unavailable, either because pancreas cannot make it (Type 1 diabetes) or body cells are insulin resistance (Type 2 diabetes).
In this, your body uses fat for energy. During this phase, the body breaks down fats into ketones, and used by the body for energy.	While, nutritional ketosis is absolutely normal, ketoacidosis is a complication of diabetes where the blood sugar levels and ketones are really high due to lack of insulin in the body.
The person following a ketosis diet will have high amounts of fats and low amount of carbs in their diet. Nutritional ketosis can help a person lose fat more effectively and at a faster rate.	Ketoacidosis is often found in people with Type 1 diabetes as their bodies are not capable of producing enough insulin

Fats are also an important component of the diet and serve a number of functions in the body. Fat is a concentrated source of energy and it supplies twice the energy as protein/carbohydrates. It also imparts palatability to a diet and retards stomach emptying time.¹

According to Dr. James Dinicolantonio and Dr. Joseph Mercola's book, super fuel-fixing our fat balance helps us stay free of chronic illness/to help recover from them.¹⁴

In addition to the quantity and quality, the mode of consumption of fats appears to influence the elevation of cholesterol in the blood. Small frequent consumption of fats during a day has been shown to cause less elevation of blood cholesterol content compared to. The quantity of fat that should be included in a well-balanced diet, unlike proteins, is not known with any degree of certainty.

For deciding the desirable level of fats in the diet, we should keep the following views in mind:⁷ The minimum amount of fat to meet the essential fatty acid requirement. The amount needed to promote the absorption of fat-soluble vitamins, providing palatability to food, the undesirable effects of excessive fat intake.

WHAT DO ALL THESE MEAN

Cutting back on refined carbohydrates is a great strategy for weight loss, but for people who can't imagine life without carbs, the type of fat they eat will help them offset a little indulgence. And paying attention to the kind of fat you eat is particularly important for those with T2D or IR.¹⁴

For those individuals who consume foods with more omega-3s (sea foods and flax seeds), medium-chain triglycerides (coconut oil) and monounsaturated fats (avocados, olive oil, nuts) may facilitate greater fat loss and improvement in insulin sensitivity compared to foods that contain trans-fats, industrially produced oils, etc.¹⁴

The scientific literature reports that individuals with prediabetes or diabetes who swiftly switch to an LCHF diet benefit in a number of ways, including weight loss, greater insulin sensitivity, fewer blood glucose fluctuations, and lower fasting blood glucose levels. With such changes, the risk of cardiovascular diseases is decreased.¹⁴⁻¹⁷

Some of the concerns of LCHF diet are hunger, a lack of food variety, nutritional deficiencies (such as a lack of certain vitamins and minerals) are a few issues with the LCHF diet, weight loss due to increased water loss (at first): Headache, exhaustion and muscular cramps (Low carb flu) and sustainability.⁹

The overall macronutrient distribution in some studies is 50%-60% from fat, <30% from carbohydrates (CHO), and 20%-30% from protein, with 100 g of CHO per day.¹² The ADA and NCBI-NLM literature define low carb as <26% or 130 grams of carbohydrates per day.²⁰

LC diets like the Atkins and ketogenic diets are included in the LCHF category. For instance, to achieve ketosis, a state in which the body turns to using lipids for energy instead of carbohydrates, a typical ketogenic diet typically contains 75 percentages fat, 20 percentages protein and only 5 percentages carbs.^{18,19}

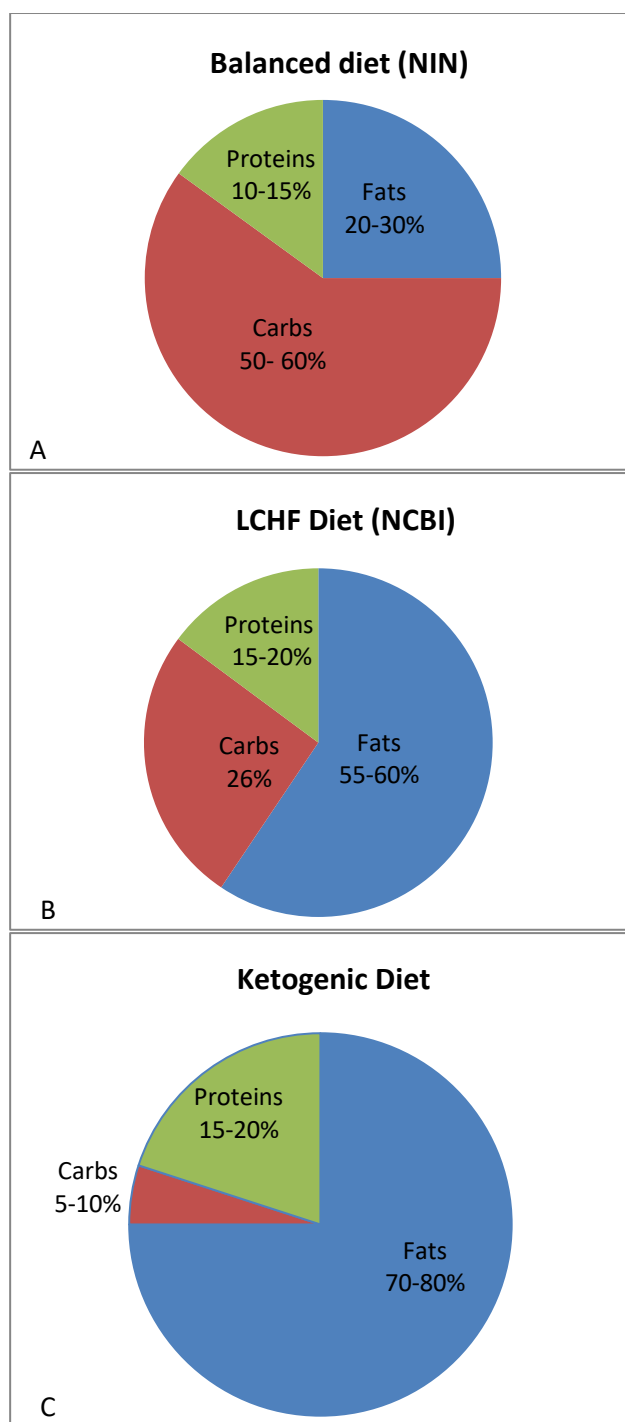


Figure 1 (A-C): Difference between balanced diet, LCF diet and ketogenic diet.

CONCLUSION

This article describes the significance of macronutrients and their ratios in relation to various medical disorders. The review discusses its many applications, potential consequences, and impact on the body's metabolism. Additionally, this article emphasizes the significance of nutrition and nutrient intake for bodily processes as well as how they can be used to treat or manage specific medical conditions and avoid them.

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Cite this article as: Patchva LD, Kurli S. Low carbohydrate high fat diet: history and its impact on health. *Int J Basic Clin Pharmacol* 2026;15:1103-8.