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# EFFECTS OF THE KETOGENIC DIET ON WEIGHT LOSS: A CONCISE REVIEW

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## Abstract

India is facing a dual burden of malnutrition (undernutrition and overnutrition) and the prevalence of obesity is continuously increasing. Obesity invites many comorbidities like type 2 diabetes, cardiovascular disease, obstructive sleep apnea, and cancer. Considering all of these issues, efficient weight loss has evolved into not only a high priority, but also a critical requirement for overall health and well-being. Nowadays ketogenic diet (KD) has become very popular for weight loss. Here different KD types are introduced and listed with details, including classic KD, medium-chain triglyceride diet (MCTD), modified Atkins diet (MAD), The High-Protein Ketogenic Diet (HPKD), Cyclical Ketogenic Diet (CKD) and more. The proportion of fat, protein and carbohydrate is different in modified ketogenic diets than in a classical ketogenic diet. Furthermore, KDs work through hormonal influence on appetite, altered lipid processes, improved metabolic efficiency, higher rates associated with gluconeogenesis, and enhanced protein thermic effects. Short-term weight management effects are evident, but long-term outcomes are uncertain. Randomized population studies, prospective longitudinal studies, proper correlation with regular diets, and even some doubts about the keto diet's safety are lacking. In addition, the lack of adequate diet subtypes, as well as having numerous labels for keto diets that follow the same principles, makes distinguishing between the different types of KDs and their therapeutic effects more difficult. This review also emphasizes on continuing a healthy lifestyle a for long-term normal body weight maintenance after weight loss. Lastly, to learn more about the true potential and safety of these diets, more research is strongly recommended.

**Keywords:** Obesity, ketogenic diet (KD), Therapeutic use, Malnutrition, Types of keto diets, Weight management.

## Introduction

Obesity affects almost 1 billion individuals worldwide, which includes 650 million adults, 39 million children, and 340 million teenagers. These numbers are still increasing. WHO stated that nearly 167 million individuals, adults and children, will be less healthy by 2025 due to being overweight or obese. The heart, liver, kidneys, joints, and reproductive system all are affected by obesity. Obesity also causes various non-communicable diseases including type 2 diabetes, cardiovascular disease, hypertension, and stroke, as well as cancer and mental health problems (WHO 2022). Considering all of these issues, efficient weight loss has evolved into not only a high priority, but also a critical requirement for overall health and well-being.

An elevation in complex/raw carbohydrates and a decrease in fat intake constitute the most typical dietary pattern for managing weight. Obese people's adherence to a high carbohydrate/low-fat diet is often difficult, as the majority have been proven to prefer foods with high-fat content. Consequently, a low-fat diet may encourage the consumption of sweets and refined carbohydrates, which can exacerbate weight problems and promote dyslipidemia, particularly in people who are insulin resistant. In recent years, there has been a spike in

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interest in purely ketogenic diets (KDs) or very low carbohydrate ketogenic diets (VLCKDs) due to the questionable efficacy of these diets(A. Paoli et al. 2013; Yeomans: Obesity Psychological approaches to understandin... - Google Scholar n.d.). In the formulation ketogenic diet amount of carbohydrate is less (<50 g/day) and it is relatively high in proportion of protein and fat (Harichandana, Bethapudi, and Tejashree 2021). The ketogenic diet has a long history of use as a treatment for intractable epilepsy. The popularity of ketogenic diets for weight loss has sparked various debates. It was hypothesized that low carbohydrate diets had no metabolic benefits and that weight loss was merely due to a reduced caloric intake, most likely due to protein's more significant satiety impact. The bulk of Librium studies, on the other hand, shows that people who followed a low calorie with low-carbohydrate diet lost more weight in the first 3 to 6 months than people who were on balanced diet (Barañano and Hartman 2008). Aside from its weight-loss benefits, this may be beneficial in certain neurodegenerative diseases, including Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis, by being neuroprotective, promoting enhanced mitochondrial function, and rescuing adenosine triphosphate pro- duction (Bueno et al. 2013).

## Types of ketogenic diet.

Various types of Keto Diets include: classic Keto Diet KD, Medium-Chain Triglyceride Diet (MCTD), Modified Atkins Diet (MAD), and Low Glycemic Index Treatment (LGIT) Cyclical Ketogenic Diet (CKD), Targeted Ketogenic Diet (TKD) High-Protein Ketogenic Diet (HPKD) (Barzegar et al. 2021; Dhamija, Eckert, and Wirrell 2021).

1. *Classic Keto Diet (**KD**)*
   Wilder defined classic KD as the most extensively utilized therapeutic diet in DRE treatment in 1921. Usually include Long-chain triglycerides fat in the diet.
2. *Medium-Chain Triglyceride Diet (**MCTD**)*
   A fat supplement made entirely of MCT fats is used in the MCT ketogenic diet (MCT oil). MCT fat can make ketones more quickly than LCT fat. Thus, it can be assimilated and supplied to the liver more readily via the portal circulation.
3. *Modified Atkins Diet (**MAD**)*
   MAD is less restrictive than the traditional ketogenic diet. Unlike the conventional KD, the MAD does not require hospitalization to begin the diet.
4. *Very Low-Carbohydrate Ketogenic Diet**(VLCKD)***
   Very low-carbohydrate ketogenic diet (VLCKD) includes 44% fat, 43% protein & < 13% carbohydrate per day.
5. *The High-Protein Ketogenic Diet (**HPKD**)*
   This diet has a higher protein content included in comparison to the classic keto diet, but it is still considered a high-fat diet.
6. *Low Glycemic Index Treatment (**LGIT**).*
   LGIT allows diets with a glycemic index of less than 50 (such as some fruits, meat, and dairy as well as whole-grain bread (Pfeifer, Lyczkowski, and Thiele 2008).
7. *Cyclical Ketogenic Diet (**CKD**)*
   Between ketogenic diet cycles, this diet includes periods of greater carbohydrate consumption. For example, a cycle might consist of five ketogenic days preceded by two high carbohydrate days.
8. *Targeted Ketogenic Diet (**TKD**)*
   During periods of intense physical activity, this diet allows for more carbohydrates.

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The classic KD, MCTD, VLCKD, and MAD, are used therapeutically in the management of several diseases and obesity. Although the composition of these different types of KD differs, their efficiency has been demonstrated to be essentially the same. CKD, TKD, and HPKD were recent additions used mainly by bodybuilders or athletes. The classic KD was the most researched and recommended (Barzegar et al. 2021; Shilpa and Mohan 2018). Furthermore, with cited sources, table-1 presents various types of keto diets with proven or hypothesised potential therapeutic use related to obesity and other noncommunicable diseases (NCDs).

| Type of keto diet | Fat, protein and carbohydrate ratio | proven or hypothesised potential therapeutic use | Reference |
|---|---|---|---|
| Medium-Chain Triglyceride Diet (**MCTD**) | 10% LCT fat, 60% MCT fat, 20% carbohydrate, 10% protein | • drug-resistant epilepsy (DRE)<br>• cardiovascular disease (CVD)<br>• management of hypertension | (Barzegar et al. 2021) |
| Modified Atkins Diet (**MAD**) | 65% fat, 10% carbohydrate, 25% protein | • drug-resistant epilepsy (DRE)<br>• thyroid function<br>• antidepressant properties | (Barzegar et al. 2021; Molteberg et al. 2020; Murphy et al. 2004) |
| Low Glycemic Index Treatment**(LGIT)** | 60% fat, 10% carbohydrate, 30% protein | • drug-resistant epilepsy (DRE)<br>• type 2 diabetes | (Barzegar et al. 2021) |
| Very Low Carbohydrate Ketogenic Diet (**VLCKD)** | 44% fat, 43% protein & < 13% carbohydrate | • management of obesity<br>• type 2 diabetes<br>• management of hypertension<br>• increase in good cholesterol.<br>• PCOS management ,<br>• Neurological diseases | (Barzegar et al. 2021; Bolla et al. 2019; Evert et al. 2019; A. Paoli et al. 2013) |
| *High Protein Ketogenic Diet (**HPKD**)* | 60.0 % fat, 35.0 % protein, and 5.0 % carbohydrates | • management of obesity<br>• for muscle building with fat loss | (Johnstone et al. 2008; Shilpa and Mohan 2018) |
| *Cyclical Ketogenic Diet (**CKD**)* | 5 days of KETO 2 days of high carbohydrate diet in week | • type 2 diabetes<br>• management of obesity | (Priti Nanda 2021) |

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| | | | |
|---|---|---|---|
| *Targeted Ketogenic Diet (**TKD**)* | 25-30 grams of simple carbohydrates excluding fructose. Given before half an hour of high-intensity workouts to replenish muscle glycogen. | • body muscle and helps in fat loss<br>• in athletes for fat loss<br>• improve training performance | (Shilpa and Mohan 2018) |

**Table 1 Various types of keto diets with proven/hypothesised potential therapeutic use related to obesity and other noncommunicable diseases (NCDs).**

## Mechanism of Ketogenic diet in obesity management

Ghrelin levels rise before meals, causing the brain to send out a hunger signal. When your fat cells are full, leptin levels rise, and your brain signals you to quit eating. After eating, once your fat cells are full, the leptin increases, and ultimately your brain asks you to stop eating (as shown in Figure1). The mechanism for this is not established, but evidence supports the direct action of KDs together with modifications in levels of hormones that influence appetite, such as ghrelin and leptin. Other theories involve lipogenesis reduction and elevated lipolysis, Reduction in resting respiratory quotient and, as a result, increased metabolic efficiency when consuming more fats, increase in metabolic costs of gluconeogenesis, and the thermic effect of proteins which ultimately leads to weight loss. However, many of the studies that support the keto diet, have limited sample numbers and only looked at the diet's short-term benefits. More research is needed to see how the diet affects weight loss over time and also whether weight is recovered when a regular diet is resumed (Leidy et al. 2015; Antonio Paoli 2014; Sumithran et al. 2013).

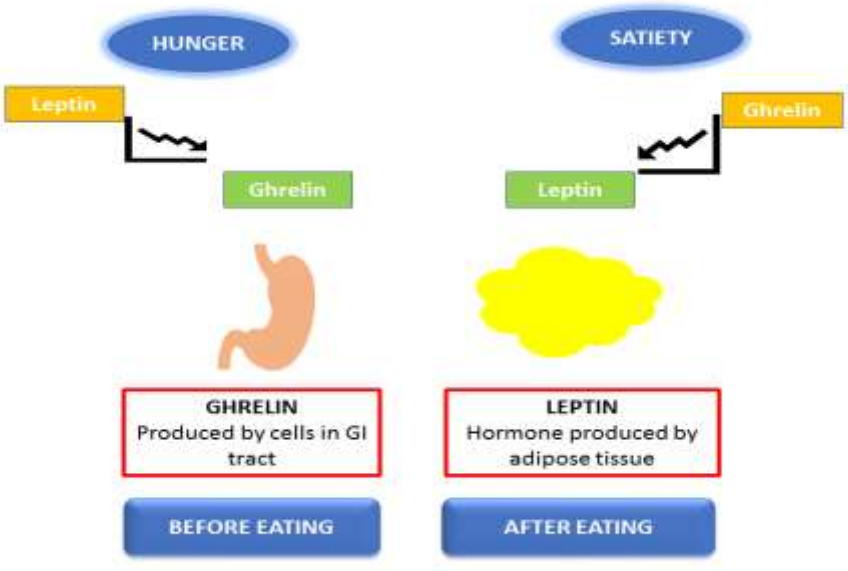


**Figure 1 Ghrelin and leptin levels before and after eating**

Besides this, ketogenic diet has a number of adverse effects on health. The side effects of the ketogenic diet include abdominal pain, fatty diarrhoea, constipation, gastroesophageal reflux,

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dizziness, headache, fatigue, nausea, vomiting, and reduced exercise tolerance are all frequent short-term adverse effects of KD. he long-term adverse effects are hepatic steatosis, vitamin insufficiency, hypoproteinaemia, kidney stones, and infectious diseases(Barzegar et al. 2021; Batch et al. 2020)

## Conclusion

The ketogenic diet has recently attracted considerable popularity as a weight-loss approach. There are a few theories on how the keto diet aids weight loss; however, evidence and studies support these theories. There is significant evidence of short-term effects on weight management and obesity, which can be concluded from the substantial weight loss effects of various keto diets; however, no data on their long-term outcomes is available. As a result, once a weight limit is achieved, it is recommended to maintain a healthy lifestyle (a well-balanced eating pattern and physical activity) for long-term body weight maintenance. Even though different keto diets have been shown to have proven or hypothesized potential therapeutic uses, there is a lack of population studies (randomized population studies), prospective longitudinal studies, proper correlation with regular diets, and even some doubts about the keto diet's safety. Contrary outcomes from the same KDs and diseases make it much more challenging to reach a single conclusion. Furthermore, the absence of adequate diet subtypes and the many various labels for keto diets that follow the same approaches make recognizing the types of KDs and their therapeutic effects more challenging.

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