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The Impact of the Ketogenic Diet on Glycemic Control and Metabolic Parameters in Patients with Type 2 Diabetes: A Review of Current Literature

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ABSTRACT

With type 2 diabetes (T2DM) becoming a global crisis, there is an urgent need for better ways to manage the disease through nutrition. While standard low-fat diets have been the norm for years, the ketogenic diet (KD)—which replaces carbs with healthy fats—is now showing much better results. This review looks at the latest research to see how a ketogenic approach affects blood sugar and heart health in diabetic patients. The findings show that the keto diet is highly effective at lowering HbA1c levels and often allows patients to reduce or even stop their medications, including insulin. Additionally, the diet helps with significant weight loss and improves cholesterol levels by raising "good" HDL and lowering triglycerides. Although some patients struggle with early side effects like the "keto flu" or find it hard to stick to the diet long-term, the overall evidence is very strong. We conclude that for many people with T2DM, shifting the body to burn fat rather than sugar is a safe and effective way to regain control of their health.

Keywords: Type 2 diabetes, ketogenic diet, glycemic control, insulin resistance, HbA1c, nutritional ketosis, metabolic health, low-carbohydrate diet, cardiovascular risk, nutritional intervention, therapeutic carbohydrate restriction, hyperinsulinemia

1. INTRODUCTION

Type 2 diabetes (T2DM) has become one of the biggest public health problems of the 21st century, and it affects millions of individuals globally. That has caused enormous strain on the worldwide healthcare system. Fundamentally, T2DM represents a metabolic breakdown in which the cells no longer respond appropriately to insulin. It causes hyperglycemia (high blood sugar), which eventually damages the heart, kidneys, and nerves (Sami et al., 2017). Historically,

the typical medical treatment has been to prescribe a low-fat diet and to add more medications progressively. Despite these treatment approaches, many patients have continued to experience an ongoing cycle of weight gain and increasing insulin resistance.

The way we approach diabetes management has changed significantly in recent years. Many experts believe that the core issue is not simply a lack of medications, but rather chronic overconsumption of carbohydrates, which results in high insulin levels at all times. As such, we should consider the ketogenic diet (KD) a viable and scientifically valid alternative for managing our weight. A reduction in carbohydrates to below 50 grams per day causes the body to use fats and ketones for energy instead of sugar (Westman et al., 2020). Nutritional Ketosis is a state that not only lowers blood sugar levels, but also restructures one's metabolism. For the diabetic patient, this New Metabolic State translates into stabilizing energy levels and restoring the ability to metabolize their own fat (Bolla et al., 2019). This paper reviews clinical evidence regarding ketogenic dieters. Specifically, we will focus on how ketogenic diets affect patients who have not responded to conventional treatments concerning weight, glycemic control, and overall cardiovascular health (Yuan et al., 2022).

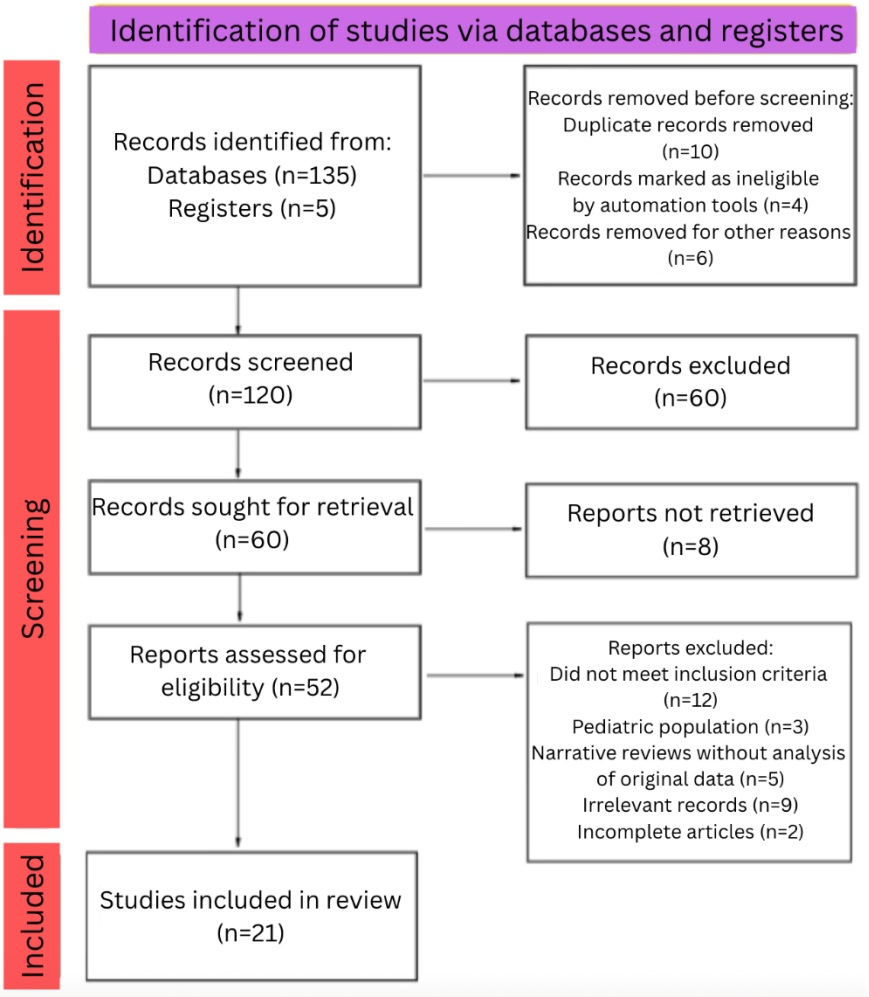

Figure 1. Flow chart

2. REVIEW METHODS

We did a systematic review of the current medical literature to provide a strong basis for this review. Our review involved using keyword searches in three major databases-PubMed, Scopus, and Web of Science-from 2015 through 2025 to find relevant articles regarding the ketogenic diet and T2DM (type 2 diabetes). We also used Google Scholar to identify additional articles relevant to our search published within the same time period. We specifically searched for clinically relevant studies with high impact and from well-established clinical research groups. We collected the data we needed using a variety of specific keywords: 'type 2 diabetes', 'T2DM', 'ketogenic diet', 'HbA1c', 'insulin sensitivity', and 'nutritional intervention'.

All studies were peer-reviewed and included only human subjects. Specifically, we searched for research that offered quantifiable outcomes related to blood glucose level, changes in medications, and cardiovascular risk. We excluded studies solely related to type 1 diabetes, studies based on animals with no research on humans, and studies that lacked detailed information about how participants adhered to their diet from our search. Eventually, we collected 21 significant articles that provide the most compelling clinical evidence of our cause of action (Figure 1).

3. RESULTS & DISCUSSION

Pathophysiology of Insulin Resistance and Carbohydrate Intake

To fully grasp why the ketogenic diet is so effective, we must look at the specific metabolic breakdown that occurs in type 2 diabetes. Insulin acts as a hormone that regulates glucose homeostasis by promoting the transport of blood sugar into cells for metabolic use. However, in patients with T2DM, this mechanism fails. The cells develop insulin resistance—a state where they essentially "ignore" the hormone signal. In response, the pancreas overcompensates by pumping out even more insulin, leading to chronic hyperinsulinemia (Hallberg et al., 2018). High insulin levels act as a metabolic switch that effectively locks fat stores, which makes it nearly impossible for the body to burn fat for fuel.

Traditional diets have long relied on high-carb meals. The problem with consuming too many carbohydrates is that they increase insulin production, creating an ongoing cycle that leads to insulin resistance. By reducing the amount of carbohydrates consumed in one's diet, one can allow one's body to use stored fat for energy rather than requiring more insulin. In addition, one will begin to lower inflammatory responses and reduce the amount of pro-inflammatory molecules produced in the body. For decades, experts promoted a high-carb diet! However, this approach creates a worsening problem. Carbs cause an enormous spike in glucose with each meal. To address the spike in glucose, the system has to produce more and more insulin. This continual state of insulin use desensitizes the cells (due to overuse) and leaves the body unaware of its fat stores, unable to access them for energy! The ketogenic diet is a solution to this problem because, by severely limiting carbohydrate intake, insulin levels fall significantly and therefore, the body has an opportunity to use its fat stores (which it has been unaware of due to excessive insulin) for energy needs. Therefore, beyond simply providing fuel for the energy needs of the body, the ketogenic diet also decreases the body ability to produce pro-inflammatory substances.

Chronic inflammation is a known driver of insulin resistance, creating a toxic feedback loop that damages the pancreas over time. By shifting the body into nutritional ketosis, we provide the metabolic system with a much-needed "rest" (Volek & Phinney, 2011). Furthermore, the production of ketones—specifically beta-hydroxybutyrate—has been shown to act as a signaling molecule that suppresses oxidative stress and helps repair mitochondrial function (Paoli et al., 2013). This dual action of lowering insulin while simultaneously reducing inflammation is what allows the body to begin reversing the damage caused by years of chronic T2DM.

Dietary Composition and the Mechanism of Ketosis

To implement the ketogenic diet effectively in a clinical setting, it is essential to know the specific macronutrient ratios required to induce and maintain nutritional ketosis. Ketogenic diet has a different calorie composition than the low-carb diet, which may just be reducing sugar consumption. A ketogenic diet is a strict ratio with 70-75% of the daily calories coming from healthy fats, 20-25% coming from moderate amounts of protein, and only 5-10% of the daily calories coming from carbohydrates (differences will exist based on the size and needs of each individual, typically less than 50 grams of carbohydrates per day). This triggers the metabolic transition from glucose to fatty acid oxidation. When the liver lacks of dietary glucose and its glycogen stores reduce, it begins to convert both dietary and stored body fat into ketone bodies—specifically acetoacetate, beta-hydroxybutyrate (BHB), and acetone (Volek & Phinney, 2011).

Patients with T2DM can benefit from using ketone bodies as their source of energy. Ketone bodies provide more energy per unit of oxygen consumed than glucose, decreasing cellular oxidative stress. High fat content provides satiety by modulating ghrelin and cholecystokinin production. This natural appetite suppression is often why patients find it easier to maintain a calorie deficit without the intense hunger pangs associated with high-carb, low-calorie diets. However, we must emphasize the importance of "well-formulated" ketosis, which prioritizes monounsaturated and saturated fats from whole food sources—such as avocados, nuts, and olive oil—while incorporating plenty of non-starchy vegetables to ensure adequate fiber and micronutrient intake (Westman et al., 2020; Paoli et al., 2013).

Impact of the Ketogenic Diet on Glycemic Parameters

The primary goal for anyone treating type 2 diabetes is to get blood sugar under control, and the ketogenic diet is perhaps one of the most powerful tools we have for this. The most visible result in clinical practice is the drop in HbA1c levels. When we compare keto to the standard low-fat diets suggested for decades, the data show that cutting carbs leads to much better long-term glucose stability (Yuan et al., 2022). It is actually quite common for patients to achieve blood sugar levels similar to those of a healthy person after only a few months on the protocol (Saslow et al., 2017).

What is even more impressive is how this diet affects the need for prescription drugs. Because the patient is no longer consuming the sugars that cause blood glucose to spike, the body no longer requires as much medical support. We have seen in various studies that a large majority of patients—especially those on insulin—can either significantly reduce their dosage or stop taking it entirely (Westman et al., 2008). It was revolutionary, as it helped them avoid the weight gain and the risk of dangerous "lows" that often come with heavy medication use (McKenzie et al., 2017).

Lastly, the diet helps protect the body by ending the constant "spikes and crashes" in blood sugar levels. Using ketones for energy provides patients with a much more consistent fuel source (Walton et al., 2019). It also makes a massive difference in how they feel day-to-day, often clearing up the mental fatigue that many people with diabetes live with (Cucuzzella et al., 2019; Myette-Côté et al., 2019).

Influence on Cardiovascular Risk Factors

For years, there were serious concerns in the medical community about how eating a high-fat diet would harm heart health, particularly among those with type 2 diabetes, because they are much more vulnerable. Presently, however, clinical data show that carbohydrate restriction changes how fats are metabolized, helping to improve the cardiovascular profile. Losing body mass and visceral fat occurs quickly, at an impressive rate. Patients who follow a ketogenic diet often experience significant decreases in body mass and fat compared to following more traditional, low-fat diets, like those of Dashti et al., (2004). The loss of central fat helps reduce the physical load on the heart and lowers pro-inflammatory cytokines that injure blood vessels. Looking more closely at bloodwork, there are frequently patterns that demonstrate to predict higher HDL levels than would have been expected based on traditional logic, but instead of seeing spikes in "bad" cholesterol, we have typically observed an increase in levels of HDL (high-density lipoprotein) that serve as scavengers of the arteries.

Triglycerides have decreased dramatically, and the decrease is statistically significant, which is a positive development, since triglycerides are a major independent risk factor for cardiovascular disease in people with diabetes (Yuan et al., 2022). LDL levels may increase slightly in some cases, but the quality of LDL particles overall will improve. On the diet, the body is shifted away from producing small, dense LDL particles (which are more likely to oxidize and form plaque) towards larger, more "fluffy" LDL particles that do not easily penetrate arterial walls (Volek et al., 2009). Blood pressure changes and vascular inflammation are additional important factors to consider. The kidneys can regulate sodium and water, which can lead to hypertension (high blood pressure). The increase in blood pressure is due to the kidneys retaining sodium and water in response to insulin. Ketosis state reduces insulin levels, allowing the body to shed excess fluid and often resulting in a rapid and lasting decrease in blood pressure (Bhanpuri et al., 2018). Ketones (especially beta-hydroxybutyrate) also act as signaling molecules that could lower systemic inflammation and oxidative stress in the endothelium (Walton et al., 2019). The combination of weight loss, improved lipid quality, and reduced blood pressure indicates that the keto diet has the potential to be an effective, multi-targeted intervention that reduces the overall risk of myocardial infarction and stroke in the diabetic population (Shai et al., 2008).

Safety and Long-term Challenges

The ketogenic diet is an effective way to repair your metabolism, but it comes with practical and physiological challenges. During the first couple of weeks after switching your body from using sugar to burning fat, you may experience a condition referred to as "The keto flu". This transition can involve a significant change in how your body manages fluids and electrolytes. Therefore, during this adjustment period, you may experience temporary fatigue, brain fog, headache, and muscle cramping (Westman et al., 2020). These symptoms are considered benign and managed with increased salt and fluid intake to mitigate their effects; however, many patients may feel discouraged and consider abandoning the intervention before fully adapting to a higher-fat diet. The bigger problem that we face is long-term compliance or adherence.

The Modern Food Environment is assembled on processed and high-carbohydrate options and therefore, it can be difficult for people following a strict ketogenic diet to eat out and socialize (Hallberg et al., 2018). There is also a risk of nutrient deficiencies,

including fiber, magnesium, and some B vitamins, when processed meats are overconsumed rather than whole foods that provide these nutrients, such as vegetables and nuts. In addition, safety is critically important when managing medications for any condition. The rapid decrease in blood sugar levels when on a ketogenic diet can put people taking insulin or sulfonylureas at significant risk for hypoglycemia if their medication doses are not lowered on time (Murphy et al., 2021). Therefore, we strongly recommend that a ketogenic diet not be initiated by individuals with type 2 diabetes on their own, but rather be used as a therapeutic option under the care of their health care provider. Despite the challenges involved, those who can implement a structured eating plan in place of chronic medication use generally experience an improvement in their quality of life and gain more control over their condition.

Based on our research, it appears that using a ketogenic diet can help control type 2 Diabetes. The possible explanation for this change in glucose control is that switching from glucose to fat as a source of energy allows for much better control of blood sugar.

The major benefits are the continuous decrease in HbA1c readings and the large number of people who can reduce or discontinue diabetes medications, including insulin. In addition to helping with blood glucose control, the Ketogenic Diet has additional benefits for cardiovascular health. In particular, by aiding significant weight loss, the ketogenic diet will help lower triglycerides and raise HDL cholesterol by improving lipid profiles in many individuals with diabetes and thus, helping reduce the cardiovascular risk associated with many diabetic patients. While there are challenges, such as the initial "keto flu" and the discipline needed to maintain the diet long-term, the metabolic rewards are substantial.

Although there are some struggles (such as the first week or so of adjusting to the ketogenic diet and having to be disciplined enough not to go off the diet), there are also great benefits from this diet for improving health. The clinical outcomes of the ketogenic diet on diabetic parameters are summarized in Table 1.

Table 1. clinical outcomes of the ketogenic diet

Parameter	Clinical Effect Observed	Impact on T2DM Management	Key Reference
HbA1c Levels	Significant reduction, often below 6.5%	Improved long-term glycemic control and potential remission	Yuan et al., (2022)
Medication Use	Reduction or total elimination of insulin and oral agents	Lowered risk of hypoglycemia and reduced healthcare costs	Hallberg et al., (2018)
Body Mass	Rapid decrease in total weight and visceral fat	Enhanced insulin sensitivity and reduced cardiac workload	Dashti et al., (2004)
Lipid Profile	Marked decrease in Triglycerides; Increase in HDL-C	Improvement in overall cardiovascular risk profile	Volek et al., (2009)
Blood Pressure	Reduction in both systolic and diastolic pressure	Decrease in hypertensive-related complications	Bhanpuri et al., (2018)
Inflammatory Markers	Suppression of oxidative stress (lower CRP)	Protection of vascular endothelium and mitochondrial health	Walton et al., (2019)

4. CONCLUSION

We conclude that a ketogenic diet is suitable and safe for people with T2DM, however, it should be under medical guidance. Changing the focus from treating symptoms with medication to addressing the root cause of the problem offers an opportunity for metabolic recovery and improved quality of life for patients.

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All data associated with this work are present in the paper.

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