

The Ketogenic Diet

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There are many misunderstandings about the ketogenic diet, ranging from the conditions for which it can be useful to the right way to adopt it. Many people claim to be eating a ketogenic diet who are not doing so, and many of the claims currently being made about the diet are patently false.

The ketogenic diet is a high-fat, low-carbohydrate diet that has been used since 1921 as an effective treatment for several forms of epilepsy. While primarily used for children, there is some evidence that some epileptic adults may benefit too. The best experts on the diet are at Johns Hopkins Children's Center.

The mechanism of action that explains the efficacy of the ketogenic diet is that it mimics a fasting state, and fasting has been known to be an effective treatment for seizures since ancient times.¹ Within a short time after beginning a fast, the body stops using glucose and converts to using stored fat for fuel, a state known as ketosis. During ketosis, ketones are produced, which are useable as a substitute source of energy for both the body and brain. The ketogenic diet results in the same effect. Restricted carbohydrate intake results in burning dietary fat for fuel, which allows for an extended period of time in a fasting state. Fat stores are used up within a relatively short period time, while living off of dietary fat intake can continue for much longer periods of time.

Research shows that the diet works when implemented properly. A 2001 study at Johns Hopkins showed that 75 out of 83 epileptic children who consumed a ketogenic diet for a year had either partial or full resolution of their symptoms and improvement was sustained after stopping the diet.²

In another study, 65 epileptic children between 18 and 24 months of age were assessed before starting and after one year on the diet. For those who remained on the diet (52%), mean seizure frequency decreased from an average of 25 seizures per day prior to the diet to less than 2 per day, and was accompanied by significant improvements in both attention and social functioning.³

A meta-analysis of 11 studies showed that 16% of children experienced complete resolution of seizures, 32% experienced a 90% reduction, and 56% had a greater than 50% reduction in seizures.⁴

While ketogenic diets can be effective, there are side effects. One study of pediatric patients treated with the Johns Hopkins protocol showed that during the first 4 weeks, dehydration and gastrointestinal complications were common, and infectious diseases, aspiration pneumonia, hyperuricemia, hypoglycemia, electrolyte imbalances, acidosis, hepatitis, and acute pancreatitis have been reported. After 4 weeks, patients remain

prone to all of these complications except dehydration, pancreatitis, and hyponatremia. In almost 15% of patients, osteopenia, kidney stones, hydronephrosis, iron deficiency anemia, and cardiomyopathy developed after one month in ketosis. Some patients dropped out of the study due to the side effects of the diet.⁵ Vomiting, constipation, kidney stones and an increase in plasma cholesterol are common. Kidney stones can be prevented by supplementing with potassium citrate, and cholesterol levels return to normal after the diet is stopped.⁶

The bottom line is that while the diet is effective for most children who adopt it, there are side effects, and patients must be carefully monitored while using the diet for medical treatment. The diet is only adopted for a short period of time, and for many parents of epileptic children, the benefits outweigh the risks since drugs used to treat epileptic children are often ineffective and have even more side effects.

Interest in ketogenic diets has increased recently, in part because of the positive effects fasting has been shown to have on cancer patients. Animal studies have shown that fasting is effective for reducing the side effects of chemotherapy, and for decreasing circulating IGF-1 levels, a known risk for cancer.⁷ The same effect has been shown in human subjects.⁸ Fasting can be an effective strategy for both preventing and treating cancer because cancer cells are weakened and normal cells are strengthened in response to food restriction.⁹ The reason is that humans have historically lived for long periods of time with limited food and sometimes no food at all. Normal cells are adept at surviving under these circumstances, converting to burning ketones for fuel, while cancer cells cannot live on ketones.

Water-only fasting can be undertaken by many people for a few weeks, and obese people can fast for several months. But people cannot fast indefinitely, and some aggressive cancers, particularly brain cancers like glioblastoma, do not completely resolve after a few weeks of fasting. Traditional treatments are notoriously ineffective for these patients, who have grim prognoses and usually only a few months to live after diagnosis.

Thomas Seyfried, Ph.D., has spent his career studying the use of metabolic therapies to manage mainly chronic and difficult-to-treat conditions like epilepsy and brain cancer. In his book, *Cancer as a Metabolic Disease*, he provides extensive documentation showing that cancer is not a genetic disease, but rather a mitochondrial metabolic disease. This is not a new idea, but one that was largely forgotten as very profitable cancer treatments such as surgery, chemotherapy and radiation became standard practices. He proposes the use of several therapies which include calorie restriction, fasting, and a ketogenic diet for addressing difficult-to-treat cancers. He presented a lecture on this topic during our 2016 conference, citing a few case reports, one of whom was a woman who lived for 7 ½ years after her diagnosis, almost unheard of for glioblastoma patients.

And this brings me to the current misunderstandings about the ketogenic diet, which originate both from those who advocate a plant-based diet and those who promote Paleo and other diets.

First, the Paleo diet and the Atkins diet are not ketogenic diets. Just eating animal foods while restricting grains and beans, or eating a high-saturated fat diet will not result in ketosis, which is required for the diet to have any therapeutic effect. A ketogenic diet requires the assistance of well-trained professionals because the macronutrient make-up of the diet must be exact and consistently maintained. A keto monitor is required, and patients must test themselves several times per day to make sure they remain in ketosis.

Second, due to the side effects of the diet, some of which are quite serious, the ketogenic diet should only be adopted by patients for whom the benefits outweigh the risks. For example, a glioblastoma patient with only a few months to live is better off staying alive while taking potassium supplements to avoid kidney stones than dying with low plasma cholesterol levels. On the other hand, the risks of side effects from the ketogenic diet are not warranted for a person who wants to lose weight or reverse type 2 diabetes. Low-fat, plant-based diets have been proven to be effective for these purposes without the negative side effects.

On the other hand, advocates of plant-based diets can become almost apoplectic when the ketogenic diet is mentioned for treatment. A diet high in fat and that restricts healthy carbohydrate foods like potatoes seems like heresy to them. They think that a very low-fat plant-based diet is the answer for everything. It's the answer for a lot of things, but not everything. Those who take this stance - a one-size-fits-all approach to treating patients - are both practicing reductionism and abandoning the use of clinical judgment, which is desperately needed in the practice of medicine today. People are not all the same, and their age, limitations, medical history and current state of health must all be considered when making any health-related recommendations, including those concerning diet.

Dietary advice must be tailored to the particular condition of the patient, and often must be combined with other treatments that include dietary supplements, cognitive therapy, exercise, physical therapy, and some conventional treatment. It is important to avoid dogmatic adherence to ideas, and to think outside the box as we seek solutions for our healthcare crisis.

In summary, the ketogenic diet is an option to be considered for very specific situations for a very small percentage of people. It requires a rigorous and disciplined approach in order to be effective, and almost always involves hiring an expert for assistance. The diet has serious side effects, which should be disclosed to patients before adopting the diet, and which make it a good choice only when the potential therapeutic benefit outweighs the risks.

¹ Huffman J, Kossoff E. "State of the ketogenic diet(s) in epilepsy." *Curr Neurol Neurosci Rep* 2006 Jul;6(4):332-340

² Freeman J, Kossoff E. "Ketosis and the ketogenic diet, 2010: advances in treating epilepsy and other disorders." *Adv Pediatr* 2010;57(1):315-329

³ Pulsifer M, Gordon J, Brandt J, Freeman J. "Effects of ketogenic diet on development and behavior: Preliminary report of a prospective study." *Dev Med Child Neurol* 2001 May;43(5):301-6.

⁴ Lefevre F, Aronson N. "Ketogenic Diet for the Treatment of Refractory Epilepsy in Children: A Systematic Review of Efficacy." *Pediatrics* 2010 Apr;105(4)

⁵ Kang H, Chung D, Kim D, Kim H. "Early- and late-onset complications of the ketogenic diet for intractable epilepsy." *Epilepsia* 2004 Sep;45(9):1116-1123

⁶ Freeman J, Kossoff E. "Ketosis and the ketogenic diet, 2010: advances in treating epilepsy and other disorders." *Adv Pediatr* 2010;57(1):315-329

⁷ Lee C, Safdie FM, Raffaghello L, et al. "Reduced levels of IGF-I mediate differential protection of normal and cancer cells in response to fasting and improve chemotherapeutic index." *Cancer Res* 2010 Feb 15;70(4):1564-72

⁸ Safdie F, Dorff T, Quinn D et al. "Fasting and cancer treatment in humans: A case series report." *Aging (Albany NY)* 2009 Dec; 1(12): 988–1007.

⁹ Brandhorst S, Longo V. "Fasting and Caloric Restriction in Cancer Prevention and Treatment." *Recent Results Cancer Res* 2016;207:241-266