Third Edition
Updated and Expanded

A Safe, Science-Based, Nontoxic Dietary Approach for Cancer

FIGHT CANCER WITH A KETOGENIC DIET

Using a Low-Carb, Fat-Burning Diet as Metabolic Therapy

ELLEN DAVIS, MS

~ Praise for *Fight Cancer with a Ketogenic Diet* ~

"Like her website, ketogenic-diet-resource.com, Ellen Davis's book is an absolute treasure trove for anything and everything you could possibly want to know about how and why to implement a ketogenic diet for yourself or a loved one in fighting cancer. She explains complex science in down-to-earth, plain English so you'll feel reassured that while this is the cutting edge of novel therapeutic strategies, it is most certainly rooted in fundamentals of human biochemistry and physiology. Ellen has done cancer patients and their loved ones a huge service. This is a one-of-a-kind resource."

~ Amy B.

"I was continually frustrated in trying to navigate through the overwhelming amount of information out there on low-carb, Atkins, Paleo, and keto diets and trying to tease out the information that applied to me. I wish I had found Ellen's book sooner, because it's all here. This is a valuable resource for anyone working on understanding how to make dietary and lifestyle changes in the face of a cancer diagnosis."

~ Alix H.

"Ellen—thank you so much for this work that you did writing this book. It is quite perfect … It is probably impossible for you to grasp just how helpful you and people like Tom Seyfried are for so many. I am very grateful to you."

~ Janet S.

"The ketogenic cancer diet book is excellent. It enabled me to feel confident in every respect of application, and I am so glad I purchased it. The charts in the appendix have been incredibly helpful, as is the information throughout."

~ Sarah H.

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Foreword

"Cancer growth and progression can be managed by following a whole-body transition from fermentable metabolites, primarily glucose and glutamine, to respiratory metabolites, primarily ketone bodies. This transition will reduce tumor vascularity and inflammation while enhancing tumor-cell death."

~Thomas Seyfried, PhD

Emerging evidence indicates that cancer is primarily a type of mitochondrial metabolic disease. Although the scientific evidence supporting the mitochondrial origin of cancer is strong, many of those working in the academic and pharmaceutical oncology fields cling to the opinion that cancer is primarily a genetic disease. The therapeutic approach to cancer management is different depending on whether cancer is viewed as a metabolic disease or as a genetic disease. Most of the therapies developed to treat cancer today are based on the gene theory and have been toxic, expensive, and largely ineffective in stopping tumor-cell spreading or metastasis, the primary cause of death for most cancer patients. Indeed, it is unclear how many cancer patients die from the disease and how many die from the toxic treatments used to manage the disease.

Therapeutic strategies used for cancer management based on the mitochondrial metabolic origin are designed to deprive tumor cells of fermentable fuels. Tumor cells are less capable than normal cells in producing energy through mitochondrial respiration. Consequently, tumor cells are more dependent than normal cells on the availability of fermentable fuels like glucose and glutamine. As glucose (blood sugar) is an abundant fermentable fuel for many tumor cells, reduction of blood-glucose levels becomes a viable therapeutic strategy for cancer management. The calorie-restricted ketogenic diet (KD-R) is one strategy that can help reduce circulating glucose levels while elevating levels of ketone bodies, a respiratory fuel derived from fat metabolism that tumor cells cannot use effectively for energy. Consequently, a transition of the whole body from carbohydrate metabolism to fat metabolism can help starve tumor cells of a primary fermentable fuel that drives their growth and survival.

Ellen Davis does an excellent job discussing the science behind the ketogenic diet (KD) as a nontoxic cancer therapy in this book. It is important to recognize that the science behind this diet is evolving rapidly, and we can anticipate identification of new mechanisms of action by which the KD-R will be able to help manage cancer.

The KD should always be consumed in restricted amounts, as excessive consumption can cause dyslipidemia and accelerated tumor growth. The KD should, therefore, be viewed as medical food, not simply as a health-promoting diet.

Ms. Davis describes effectively the mild adverse effects of the diet that some people might experience as they transition into therapeutic ketosis, i.e., the state of reduced blood glucose and elevated ketone bodies. She also stresses the importance of having health professionals monitor cancer patients closely as they transition into therapeutic ketosis for disease management. Good record keeping is, therefore, essential when considering the KD-R as a cancer therapy.

Ms. Davis does an excellent job covering all of the "essentials" for cancer patients who would consider the KD as part of their therapy. She also highlights differences between therapeutic ketosis and ketoacidosis, and she distinguishes pathological weight loss due to toxic drugs or cachexia from the therapeutic weight loss seen with the KD. Several health-care professionals familiar with the ketogenic diet are listed in her book, including Miriam Kalamian, Beth Zupec-Kania, and Drs. Dominic D'Agostino, Rainer Klement, and Colin Champ. The information in Ms. Davis' book will be important for both cancer patients and their health-care providers when considering the KD as a complimentary or alternative approach for cancer management.

It is necessary to recognize that the therapeutic response to the KD will not be the same for all cancer types. Some tumor cells appear more dependent on the amino acid "glutamine" than on glucose for growth. The most effective cancer therapies will, therefore, require the targeting of both glucose and glutamine. While the KD-R does a good job in targeting glucose it is less effective in targeting glutamine. We are currently investing therapeutic strategies that can simultaneously target both glucose and glutamine for cancer management. Ketogenic diets will play a key role in the development of diet/drug cocktails for the eventual nontoxic resolution of cancer. Hence, Ellen Davis's book goes far in providing a valuable resource for managing cancer through metabolic therapy.

Thomas N. Seyfried, professor, Boston College
Author, *Cancer as a Metabolic Disease: On the Origin, Management, and Prevention of Cancer*

Introduction

Hello and thank you for your interest in this book. My name is Ellen Davis, and I am the author of Ketogenic Diet Resource, a website that showcases how ketogenic diets can be used to reverse many disease conditions. One of the diseases for which the ketogenic diet is an effective treatment is cancer, and this book is a result of my research to answer reader questions about using the diet for cancer treatment. My goal is to provide a resource with answers to those questions and help those affected by cancer utilize a ketogenic diet to manage the disease and better tolerate the chemotherapy and radiation protocols they may face.

Currently, this dietary cancer treatment is being called "metabolic therapy." With his generous permission, I have based some of the information in this book on the work of Dr. Thomas Seyfried. His groundbreaking book *Cancer as a Metabolic Disease: On the Origin, Management, and Prevention of Cancer* is highly recommended. It is jam-packed with information found nowhere else and offers the technical details of Dr. Seyfried's assertion that cancer is not a genetic disease but is, instead, a metabolic disease, which can be treated with diet.

Additional information in this book comes as a result of the work of Miriam Kalamian, an independent nutritionist specializing in the implementation of ketogenic diets for individuals with cancer; Dr. Colin Champ, a radiation oncologist at the University of Pittsburgh; and the research of Dr. Dominic D'Agostino at the University of South Florida–Morsani College of Medicine. Dr. D'Agostino's team has done extensive research on the effect of ketogenic diets as cancer therapy. The results these individuals have seen in working with various patients include improvements in quality of life and a reduction in cancer markers.

The dietary information in this book is also based in part on a book titled *Ketogenic Diets, fifth edition* by John Freeman, MD, Eric Kossoff, MD; Zahava Turner, RD; and James Rubenstein, MD. These individuals are the principals of the Ketogenic Diet Clinic at Johns Hopkins Hospital in Baltimore, Maryland. While their book was written for adults and children with epilepsy, it has dietary information that is equally useful for individuals fighting cancer. Hopefully, someday, there will be similar teams in every major hospital who are trained in implementing ketogenic diets to treat people diagnosed with cancer.

Although I have a master's degree in applied clinical nutrition, I am not a physician, and I recommend that your physician be involved in the application of information in this book. However, I also believe that each individual should have the final say in

his or her personal care. This book is intended to provide a way for cancer patients to achieve that personal care through dietary options.

One last thought to keep in mind is that research on the use of a ketogenic diet for cancer treatment is in flux, and experts are still pinning down the details of how and why the diet is so effective. Hence, the information in this book is "cutting edge," with new research papers being published just about every month. And while a ketogenic diet has been shown in multiple animal studies to be an effective tool in fighting cancer, I do not and cannot guarantee that following a ketogenic diet will stop cancer. I can say that the small amount of current human research shows that the ketogenic diet does work to slow disease progression, and it also helps to diminish the unpleasant side effects of chemotherapy and radiation treatments. These results alone can significantly improve the quality of life for people diagnosed with cancer.

I also believe that each day is a new opportunity for a better health outcome. I hope the information in this book will help you achieve that objective.

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Cancer and Ketogenic Diets

Now that we've shared some personal success stories, let's explore some general information on how ketogenic diets work, how cancer cells work, and how a ketogenic diet and various food types can disturb cancer cells and tumor progression. We will also discuss how being in ketosis can improve treatment outcomes for people diagnosed with cancer.

What is a Ketogenic Diet?

In addition to water and micronutrients in the form of vitamins and minerals, our bodies need three main food macronutrients that provide calories or energy to sustain life. These are fat, protein and carbohydrate.

- *Fats and oils* are found in foods such as butter, avocado, cocoa butter, coconut oil, lard, and olive oil. Fats provide about nine calories per gram.
- *Protein* is found in foods such as meat, poultry, fish, and eggs and, to a lesser extent, beans, nuts, and seeds. Protein provides about four calories per gram.
- *Carbohydrates or "carbs"* are found in sweet and starchy foods such as beans, flour, sugar, potatoes, breads, pasta, fruits and vegetables. Carbohydrates provide about four calories per gram.

A ketogenic diet (KD) emphasizes foods rich in natural fats and protein and restricts foods high in carbohydrate. In particular, the ketogenic diet for cancer is higher in fat, moderate in protein, and very low in carbohydrate. It differs from an Atkins-style diet in that protein allowances are lower, and medium-chain fats, such as coconut oil, are emphasized to increase ketone levels.

When carbohydrate containing foods (sugars and starches) are digested, they are broken down into glucose which then enters the bloodstream. High blood glucose

can be toxic to the body, so there are metabolic processes that push that sugar into our cells and convert it into energy. Only after this influx of glucose has been metabolized can the body turn to using stored or dietary fat for energy needs.

Reducing carbohydrate intake not only reduces blood-glucose levels, but also the amount of *glycogen* (a form of stored glucose) in the liver. This causes our internal biochemical pathways to switch to metabolizing fat and using the resulting products for energy. These fat-derived substances are called *ketone bodies*, and there are several types. The major ketone bodies we will discuss in this book include *acetoacetate* (AcAc), *beta-hydroxybutyrate* (BOHB) and a third, more volatile molecule called *acetone*. All three have different effects on body systems, but overall, once the body is using ketones as a main fuel source, there are some profound and positive health benefits. Ketogenic diets are great for weight loss and addressing minor health issues such as heartburn and achy joints. However, they are much more powerful than those popular uses would suggest.

In other words, this diet is not a fad. It is a potent regulator of metabolic derangement, and, when formulated and implemented correctly, it can be extremely effective as a cancer therapy. In this book, we will explore the details of this dietary approach and discuss how it works, why it works, and how to implement it.

Cancer Cells Are Sugar Addicts

In 1928, Dr. Otto Warburg, a Nobel Prize–winning physician and biochemist, published a paper in which he proposed the hypothesis that cancer is a metabolic disease.[1] Dr. Warburg showed in his studies that cancer cells exhibited a preference for the utilization of sugar (glucose) as a fuel, even when the oxygen that normal cells use for energy creation was available. During a 1966 Nobel Laureates meeting,[2] he commented:

> *Cancer, above all other diseases, has countless secondary causes. But, even for cancer, there is only one prime cause. Summarized in a few words, the prime cause of cancer is the replacement of the respiration of oxygen in normal body cells by a fermentation of sugar.*

Until recently, Dr. Warburg's hypothesis (known as the Warburg Effect) has been marginalized by the persistent belief in the oncology world that cancer is a genetic disease. However, in his research and book *Cancer as a Metabolic Disease: On the Origin, Management, and Prevention of Cancer*, Dr. Thomas Seyfried proposes the idea that Dr. Warburg was correct, and that cancer is, instead, a metabolic disease.[3] Furthermore,

he argues that the genetic markers on which the cancer research community has so fiercely focused are just downstream effects of the defective metabolism of cancer cells. This idea is supported by the failure of the Cancer Genome Atlas Project (CGAP), a multimillion dollar, worldwide effort that was supposed to map the genetic mutation profiles of all types of cancer and find the genes that could be targeted for drug-based cures. Instead, the CGAP found that there are literally millions of random genetic mutations associated with individual cancers, and there were no overall, defining patterns in those mutations.

The story of the Cancer Genome Atlas Project and the apparent failure of the genetic theory of cancer are explored in detail in Travis Christofferson's excellent book *Tripping Over the Truth: The Return of the Metabolic Theory of Cancer Illuminates a New and Hopeful Path to a Cure*. Mr. Christofferson does an excellent job of elucidating the reasons why oncology research funding should shift focus from genetic causes towards metabolic treatments for cancer.

Cancer's Metabolic Problem

In real terms, what does it mean to say that cancer is a metabolic disease? Metabolic diseases are conditions in which the metabolism, or the making of energy from the food we eat, is broken or abnormal in some way. Normal body cells are able to create energy by using the food we eat and the oxygen we inhale to complete normal cellular "respiration" and make ATP (adenosine triphosphate), our main cellular energy source. While some energy production happens in the main cell body or cytoplasm, cells make most of their energy in *mitochondria*, tiny organelles known as the "powerhouses" of the cell.

There are two primary types of food-based fuel that our cells can use to produce energy. The first cellular fuel is *glucose*, which is commonly known as blood sugar. Glucose is a product of the starches and sugars (carbohydrates) in our diet, and it is converted into energy in our cells via a process called *glycolysis*. In normal cells, glycolysis is an initial metabolic pathway in the cytoplasm that provides substrate molecules to the mitochondria so that the more effective "oxygen dependent" cellular respiration can be completed.

The second type of cellular fuel comes from *fatty acids*. There are various kinds of fatty acids, and they come from the fats we eat or from the metabolism of stored fat in our fat cells. When blood glucose is low, fatty acids can be broken down by the liver into products called ketone bodies or ketones. Ketones can be used by the mitochondria of most cells to produce energy. The process of creating ketones in the liver

is called ketogenesis, and the metabolic state that favors using ketones as the primary source of energy is called *nutritional ketosis*.

This is where the ketogenic diet comes into the cancer-fighting picture. Most normal cells can use either glucose or ketone bodies as a fuel source. Ketones allow normal cells to be metabolically flexible, so to speak, because when blood glucose is low, ketones can be used as an alternate fuel source. Even the brain and nerve cells, which are heavily dependent on glucose, can utilize ketone bodies for fuel. This ability of most normal cells to use ketones (when glucose is unavailable) indicates that their mitochondria are healthy and functioning properly.

In contrast, most cancer cells have broken mitochondria and limited metabolic flexibility. Without functioning mitochondrial energy pathways, cancer cells can't utilize oxygen or metabolize ketones, and this lack of flexibility leaves them dependent on glycolysis and other less efficient forms of glucose-based energy production. In fact, rapidly growing cancer cells may burn glucose at rates up to 200 times higher than a normal cell.[4] However, a cancer cell's broken mitochondria, metabolic inflexibility and dependence on glucose is why a ketogenic diet can have a suppressive effect on tumor growth. By lowering glucose and increasing ketone levels in the blood, the ketogenic diet exploits the Achilles heel of cancer cells by choking off glycolytic fuel flow.

Blood Glucose, Insulin and Food

While our normal cells are fuel-flexible and our brain does depend on glucose for part of its energy needs, some cells, such as our red blood cells, are entirely dependent on glucose for survival. So the availability of some blood glucose is crucial for life. Hence, there are several metabolic processes in place to ensure that blood-glucose levels are optimal. One of those metabolic pathways involves *insulin*.

Insulin is the primary hormone involved in the regulation of glucose levels in the body. Insulin is made by cells in the pancreas, mostly in response to a rise in glucose levels that accompanies the digestion of foods containing carbohydrates. Insulin's function is to remove excess glucose from the bloodstream and "push" it into cells where it can be metabolized for cellular energy via glycolysis. This process is dominant until a few hours after a meal. At that point, insulin has completed its job, and blood-glucose levels begin to fall. If blood-sugar levels fall below optimal status, (for instance, if the next meal is skipped or delayed), a different hormone, *glucagon*, calls on the liver to provide glucose to the bloodstream by breaking down stored glycogen. The liver may also produce new glucose from "precursor" molecules in a process called *gluconeogenesis*. Either way, the release of glucagon triggers a rise in blood sugar to support brain function.

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The Scientific Evidence

Is cancer a genetic or a metabolic problem? Mainstream oncology dogma asserts that healthy cells become cancerous because a gene in the nucleus of the cell mutates and causes the cell to act abnormally. But as I mentioned earlier, the Cancer Genome Atlas Project couldn't find an definitive genetic cause for any type of cancer.

In contrast, the metabolic theory of cancer holds that cancer develops in cells that have defective mitochondria and impaired respiration. Many people say the jury is still out, and the oncological world is moving very slowly to consider the new research which supports the metabolic approach. However, it is a fact that Dr. Seyfried has shown that if the nucleus of a tumor cell (containing a defective genetic mutation) is put into a normal cell with healthy mitochondria, that cell does not turn into a cancer cell. But if cytoplasm containing damaged mitochondria is put into a normal cell with a healthy nucleus, that cell begins to change into a cancer cell.[3]

In layman's terms, cancer cells are like zombies. They live despite injuries that would kill normal cells. With broken mitochondria, these abnormal cells should commit suicide (*apoptosis*) as a normal cell would, but they don't. Instead, they find a way to live by ramping up the speed and intensity of glycolysis and producing more lactate, an acidic cellular product which can be recycled to feed the glycolytic pathway. It's the classic vicious circle. The cancer cell's turbo-charged glycolytic pathway feeds itself, and the excess lactate it produces acidifies the tumor microenvironment, which increases inflammation and tumor *angiogenesis* (a process in which the tumor grows more blood vessels to supply itself). While the genetic markers for various cancers are varied and inconsistent, most, if not all tumors have broken mitochondria and all tumors produce lactate. In addition, research has also found that as the production of lactate rises, so does tumor growth and aggression.[6]

These ubiquitous features provide support for the metabolic theory of cancer, which in turn supports the use of a ketogenic diet to treat these metabolic factors.

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About the Author

Ellen Davis has a Master's degree in Applied Clinical Nutrition from New York Chiropractic College. She created Ketogenic-Diet-Resource.com, a website showcasing the research on the positive health effects of ketogenic diets and has written articles about ketogenic diets for Well Being Journal, Terry's Naturally and Healthy Living magazines.

In addition to *Fight Cancer with a Ketogenic Diet*, Ellen has authored several other books, including *Conquer Type 2 Diabetes with a Ketogenic Diet* and *The Ketogenic Diet for Type 1 Diabetes*, both written with her coauthor, Keith Runyan, MD, a physician who manages his type 1 diabetes successfully with a ketogenic diet. Her latest book, *The Ketone Cure*, will be published in 2017.

Visit

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for more information about the research on and applications for ketogenic diets, and to purchase additional books by Ellen Davis:

The Ketogenic Diet for Type 1 Diabetes

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The Ketone Cure (2017)

Health

Minimize the unpleasant side effects of chemotherapy and radiation.

Use the Warburg Effect to treat cancer at the metabolic level.

Improve the success rate of your standard treatment program.

The ketogenic diet is a natural, nontoxic metabolic therapy being studied and utilized for cancer prevention and treatment. It works because cancer cells are dependent upon a constant supply of blood sugar (glucose) to stay alive. Normal cells can make energy from both glucose and ketones (metabolic by-products of burning fat), but most cancer cells can only use glucose. Avoiding carbohydrates (starch and sugar) while enjoying delicious and healthy protein and fats will lower blood glucose and increase blood-ketone levels, resulting in a normal body state called nutritional ketosis. Research has shown that nutritional ketosis starves cancer cells while nourishing normal cells and strengthening total body health.

This essential, fully referenced book is a practical guide for physicians, patients and caregivers, and provides step-by-step instructions for customizing the diet and clear explanations of the cutting-edge research on ketogenic therapies being done by Dr. Dominic D'Agostino's team at the University of South Florida and Dr. Thomas Seyfried's team at Boston College. The ketogenic diet for cancer is based on the consumption of whole, fresh foods and it can be used in addition to standard care or as a stand-alone treatment in wait-and-see situations.

Ellen Davis, MS, is an expert on ketogenic nutrition and is an accomplished author and alternative-health advocate. Her website, Ketogenic Diet Resource, offers information and books on how to treat diabetes, cancer and other diseases with a ketogenic diet and provides a comprehensive source of information and tools for customizing a ketogenic diet plan to fit a range of health goals.

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