How a **Ketogenic Diet** and **Rebounding** Can Prevent & Cure Both Cancer and Candida

(Compiled and commented on by Scott McRae)

The following is a compilation of webpages that I came across as I did research for a friend who has cancer and appears to also have a candida overgrowth. As I searched I discovered an interesting similarity between both cancer and candida;

1. They both require sugar in one form or another to grow and

2. They both thrive in oxygen poor environments

It's also common for both cancer and candida overgrowth to occur at approximately the same time. The reason for this is probably primarily due to the fact that cancer and its modern treatments of chemotherapy and radiation therapy are so hard on the body's immune system, and therefore once it's been compromised, candida can opportunistically move into other parts of the body where it couldn't go before. This makes dealing with the cancer even more difficult since the candida itself produces about 70 different toxins which it dumps into the bloodstream which of course makes the body more toxic which in turn encourages even more cancer growth. More cancer growth calls for more chemo, etc. and in this way a vicious cycle is created. Of course it could also happen in the opposite direction with a person starting out with a candida overgrowth which sets up an

environment in the body for cancer to develop. Fortunately there is a solution to both of these cyclic problems.

The answer for a cure is a healthy very strict **Ketogenic Diet** of about 10 to 12 net carbs a day (this is for cancer and is more strict than the standard strict **Ketogenic Diet** for weight loss). It should also include coconuts or coconut oils/milk, regular **rebounding** on a mini-trampoline and the dropping of all so called "modern cancer treatments" which includes both chemotherapy or radiation therapy or any other therapy that is harming the body's immune system. The reason why this approach works is because the **Ketogenic Diet** literally starves **both** the cancer and the candida at the same time and the coconut products contain caprylic acid, a fungicide that will also kill the candida. The **rebounding** creates the circulation needed to carry oxygen throughout the body wherever cancer cells may be, and it also pumps the lymph fluid so that it can remove the toxins that both the cancer and candida produce. The net effect of following this protocol is that the cancer and candida will gradually die off and the body will become more and more oxygenated and less and less toxic, making it impossible for cancer or candida to grow.

A person wanting to prevent both cancer and candida overgrowth would not have to follow the very strict 10 to 12 net carbs a day **Ketogenic Diet** but instead could follow a moderate to liberal **Ketogenic Diet** (20 to 100 net carbs a day) and also do the **rebounding**. Not only will this keep cancer and candida

overgrowth from occurring, but it will also help to keep you from acquiring a myriad of other diseases.

The grouped webpages I've collected below are as follows and contain the following information:

1. Dr. Mercola's discussion of the reason why the **Ketogenic Diet** is the best diet to fight cancer.

2. Discussion of cancer cell metabolism and its dependence on glucose and little oxygen to survive and how the Ketogenic Diet exploits these traits.

3. Seven causes of candida overgrowth in our bodies - to much sugar in our diets is cause #1.

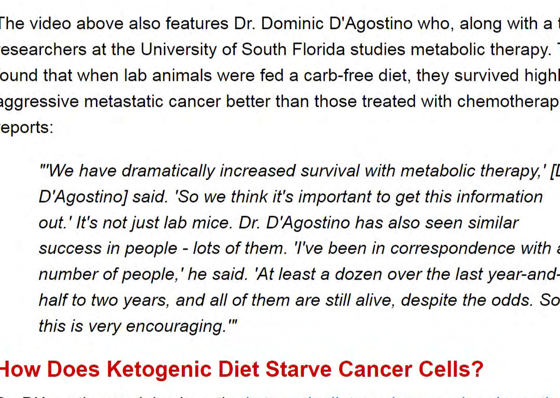
4. Discussion of how one of the main ingredients in coconuts, **Caprylic Acid**, is a fungicide against candida.

5. Discussion of the importance of **Caprylic Acid** in the **Ketogenic Diet**.

6. Discussion of the benefits of **rebounding** on a mini-trampoline and how it can cure cancer and candida.

7. Scientific paper discussing the use of the **Ketogenic Diet** to help cure brain tumors. *(Since the web version contains links to numerous other studies, I'll put the actual web link here too)*:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5110522/



Story at-a-glance

- Many cancer patients have reportedly overcome the disease by adopting a ketogenic diet, which calls for eliminating carbohydrates, replacing them with healthy fats and protein
- Animal studies have shown that mice fed a carb-free diet survived highly aggressive metastatic cancer even better than those treated with chemotherapy
- Your normal cells have the metabolic flexibility to adapt from using glucose to using ketone bodies. Cancer cells lack this metabolic flexibility, so when you eliminate carbs, which turn into sugar, you effectively starve the cancer
- Eating fat is NOT bad for your heart. Particularly beneficial fats include coconut oil, butter, organic pastured eggs, avocado and raw nuts. Most people need as much as 50-70 percent healthful fat in their diet to optimize health

By Dr. Mercola

To some, a ketogenic diet amounts to nothing less than a drug-free cancer treatment. The diet calls for eliminating carbohydrates, replacing them with healthy fats and protein.

The premise is that since cancer cells need glucose to thrive, and carbohydrates turn into glucose in your body, then cutting out carbs literally starves the cancer cells.

This type of diet, in which you replace carbs with moderate amounts of high quality protein and high amounts of beneficial fat, is what I recommend for everyone, whether you have cancer or not. It's simply a diet that will help optimize your weight and health overall, as eating this way will help you convert from carb burning mode to fat burning.

Ketogenic Diet May Be Key to Brain Cancer Recovery

The featured video shows Thomas Seyfried, Ph.D, who is one of the leaders in teasing the details of how to treat cancer nutritionally. I am scheduled to interview him shortly and hope to have that interview up later this year. In the video, Professor Seyfried discusses how, as a metabolic disorder involving the dysregulation of respiration, malignant brain cancer can be managed through changes in the metabolic environment.

> *"In contrast to normal neurons and glia, which transition to ketone bodies (beta-hydroxybutyrate) for respiratory energy when glucose levels are reduced, malignant brain tumors are mostly dependent on non-oxidative substrate level phosphorylation due to structural and functional abnormalities in mitochondria. Glucose and glutamine are major fuels for malignant cancer cells.*
>
> *The transition from glucose to ketone bodies as an energy source is an ancestrally conserved adaptation to food deprivation that permits the survival of normal cells during extreme shifts in nutritional environment. Only those cells with a flexible genome, honed through millions of years of environmental forcing and variability selection, can transition from one energy state to another.*
>
> *We propose a different approach to brain cancer management that exploits the metabolic flexibility of normal cells at the expense of the genetically defective and metabolically challenged. This evolutionary and metabolic approach to brain cancer management is supported from studies in orthotopic mouse brain tumor models and from case studies in patients.*
>
> *Calorie restriction and restricted ketogenic diets (R-KD), which reduce circulating glucose levels and elevate ketone levels, are anti-invasive, anti-angiogenic, and pro-apoptotic towards malignant brain cancer."*[1]

Current conventional cancer treatment typically involves chemotherapy and radiation therapy. Chemotherapy is a cytotoxic poison, and radiation is devastating to the human body. More often than not, the treatment is what eventually kills the patient. This can no longer be accepted as "the best we can do." As Dr. Seyfried says:

> *"The reason why we have so few people surviving is because of the*

> *standard of care. It has to be changed, if it's not changed, there will be no major progress. Period."*

Metabolic Therapy/Ketogenic Diet Being Investigated as Cancer Treatment

CBN News recently published an article on the ketogenic diet.[2] Clearly, many people are realizing that what we have been doing in terms of fighting cancer is simply not working, and we cannot afford to continue in the same way. Prevention *must* be addressed if we ever want to turn the tide on the growing incidence of cancer across all age groups. But even more astounding, in terms of *treatment*, is that cancer may respond to diet alone.

> *"Dr. Fred Hatfield is an impressive guy: a power-lifting champion, author of dozens of books, a millionaire businessman with a beautiful wife. But he'll tell you his greatest accomplishment is killing his cancer just in the nick of time,"* CBN News writes. *"The doctors gave me three months to live because of widespread metastatic cancer in my skeletal structure," he recalled. "Three months; three different doctors told me that same thing."*

Dr. Hatfield was preparing to die when he heard of metabolic therapy, also known as the ketogenic diet. He had nothing to lose so he gave it a try, and... it worked. The cancer disappeared completely, and at the time of his interview (above), he'd been cancer-free for over a year.

The video above also features Dr. Dominic D'Agostino who, along with a team of researchers at the University of South Florida studies metabolic therapy. They found that when lab animals were fed a carb-free diet, they survived highly aggressive metastatic cancer better than those treated with chemotherapy. CBN reports:

> *"'We have dramatically increased survival with metabolic therapy,' [Dr. D'Agostino] said. 'So we think it's important to get this information out.' It's not just lab mice. Dr. D'Agostino has also seen similar success in people - lots of them. 'I've been in correspondence with a number of people,' he said. 'At least a dozen over the last year-and-a-half to two years, and all of them are still alive, despite the odds. So this is very encouraging.'"*

How Does Ketogenic Diet Starve Cancer Cells?

Dr. D'Agostino explains how the ketogenic diet can have such a dramatic (and rapid) effect on cancer. All of your body's cells are fueled by glucose. This includes cancer cells. However, cancer cells have one built-in fatal flaw – they do not have the metabolic flexibility of your regular cells and *cannot* adapt to use ketone bodies for fuel as all your other cells *can*.

So, when you alter your diet and become what's known as "fat-adapted," your body starts using fat for fuel rather than carbs. When you switch out the carbs for healthy fats, you starve the cancer out, as you're no longer supplying the necessary fuel – glucose – for their growth. As D'Agostino explains:

> *"Your normal cells have the metabolic flexibility to adapt from using glucose to using ketone bodies. But cancer cells lack this metabolic flexibility. So we can exploit that."*

I've previously discussed ways to "starve" cancer, and eliminating sugar/fructose and grains (ie carbohydrates) is at the very top of the list. It's the most basic step without which few other dietary strategies are likely to succeed. In order to be effective, you must *first* STOP doing that which is promoting cancer growth (or poor health in general), and *then* all the other preventive strategies have the chance to really have an impact.

What Makes for a Cancer-Fighting Diet?

> *“ Please remember addressing your diet should be at the top of your list. Naturally, processed foods and soft drinks do not belong in a cancer-preventive diet, as they are loaded with carbs that turn into fuel for cancer cells. ”*

Carbs also raise your insulin and leptin levels, and keeping your insulin and leptin signaling healthy is imperative if you want to avoid chronic disease of all kinds, including cancer.

Processed foods may also contain trans fat – the only type of fat you *really* need to avoid like the plague. They are also loaded with omega-6 fats which the featured otherwise excellent video failed to mention. Increasing the omega-6 to omega-3 ratio is another potent way to increase your risk of cancer cell proliferation.

What About Protein?

One of my primary mentors in the importance of insulin and leptin, Dr. Rosedale. was one of the first professionals to advocate both a low-carb *and* moderate protein (and therefore high quality fat) diet. This was contrary to most low-carb advocates who were, and still are, very accepting of, if not promoting, high protein, as a replacement for the carbs.

If you or someone you know is challenged with cancer, the healthiest option may be to replace the carbs with beneficial fats, *and* limit your protein to high quality organic/pastured sources only. Dr. Rosedale advises 1 gram of protein per kilogram of lean body mass which for most people will be about 50 grams of protein a day (or 0.5 grams per pound of lean body weight). While you can take carbs to very low levels in ketogenic diets, you must have some protein every day to replace your body's requirements. The key is to add healthy fat to replace the carbs and excess protein.

- Olives and Olive oil
- Coconuts and coconut oil
- Butter made from raw grass-fed organic milk
- Organic raw nuts, especially macadamia nuts, which are low in protein and omega-6 fat
- Organic pastured egg yolks and pastured meats
- Avocados

The Fallacies of Fats and Carbs

Coincidentally, Dr. Robert Lustig – another expert on the dangers of high carb diets – was recently interviewed by NPR radio's Science Friday segment.[2] His new book, *Fat Chance: Beating the Odds Against Sugar, Processed Food, Obesity, and Disease*, tackles the persistent myths about fat that is endangering the health of millions. It's difficult to know just how many people have suffered poor health because they followed conventional low-fat recommendations, but I'm sure the number is significant.

The fact is that you've been thoroughly misled when it comes to dietary advice. Still today, many doctors, nutritionists, and government health officials will tell you to avoid saturated fat and keep fat consumption to below 10 percent while keeping the bulk of your diet, about 60 percent, as carbs. This is madness, as it's the converse of a diet that will lead to optimal health. As an example, you've probably seen the whole grain label, which is certified by the American Heart Association[3] of all things. Do whole grains support heart health? Hardly. The following outtake from the transcript addresses this head on:

> *"Flatow: ...there's something that came out yesterday released from Harvard... and it talks about one of the most widely used industry standards, the wholegrain stamp. [It] actually identified grain products [bearing the stamp] were higher in both sugars and calories than products without the stamp.*
>
> *Lustig: Absolutely. And to be honest with you, wholegrain doesn't mean much... Basically what it means is you start with a whole grain; that is the starch on the inside, the kernel, or the husk or the bran on the outside, and then whatever you want to do with it is perfectly fine. It's still a whole grain. So if you pulverize it and add sugar to it, hey it's still a whole grain because that's what you started with. But you know what? All the benefits you get from whole grain are gone as soon as you pulverize it. So.... what it means is irrelevant because the definition is not helpful."*

Other Lifestyle Factors that Influence Your Cancer Risk

Other lifestyle factors that have been found to have an impact on chronic disease and cancer include:

- **Vitamin D:** There's overwhelming evidence pointing to the fact that vitamin D deficiency plays a crucial role in cancer development. You can decrease your risk of cancer by more than half simply by optimizing your vitamin D levels with sun exposure or a safe tanning bed. And, if you are being treated for cancer, it is likely that higher blood levels – probably around 80-90 ng/ml – would be beneficial. To learn the details on how to use vitamin D therapeutically, please review my previous article, Test Values and Treatment for Vitamin D Deficiency. In terms of protecting against cancer, vitamin D has been found to offer protection in a number of ways, including:
    - Regulating genetic expression
    - allowed to replicate, could lead to cancer)
    - Reducing the spread and reproduction of cancer cells

    - Causing cells to become differentiated (cancer cells often lack differentiation)
    - Reducing the growth of new blood vessels from pre-existing ones, which is a step in the transition of dormant tumors turning cancerous

- **Getting proper sleep:** both in terms of getting *enough* sleep, and sleeping between certain hours. According to Ayurvedic medicine, the ideal hours for sleep are between 10 pm and 6 am. Modern research has confirmed the value of this recommendation as certain hormonal fluctuations occur throughout the day and night, and if you engage in the appropriate activities during those times, you're 'riding the wave' so to speak, and are able to get the optimal levels. Working against your biology by staying awake when you should ideally be sleeping or vice versa, interferes with these hormonal fluctuations.

  There's a spike of melatonin that occurs between midnight and 1am that you don't want to miss because the consequences are absolutely spectacular. Melatonin is not only a sleep hormone, but it also is a very powerful antioxidant. It decreases the amount of estrogen your body produces, and boosts your immune system. It also interacts with other hormones. So, if you go to bed after 10, it can significantly increase your risk of breast cancer.

- **Effectively addressing your stress:** The research shows that if you experience a traumatic or highly stressful event, such as a death in the family, your risk of breast cancer is 12 times higher in the ensuing five years. I believe energy psychology tools are ideal to address stressors in your life. My favorite is the Emotional Freedom Technique (EFT), but there are many others available as well.

- **Exercise:** If you are like most people, when you think of reducing your risk of cancer, exercise doesn't immediately come to mind. However, there is some fairly compelling evidence that exercise can slash your risk of cancer.

  One of the primary ways exercise lowers your risk for cancer is by reducing elevated insulin levels, which creates a low sugar environment that discourages the growth and spread of cancer cells. Additionally, exercise improves the circulation of immune cells in your blood. Your immune system is your first line of defense against everything from minor illnesses like a cold right up to devastating, life-threatening diseases like cancer.

The trick about exercise, though, is understanding how to use it as a precise tool. This ensures you are getting enough to achieve the benefit, not too much to cause injury, and the right variety to balance your entire physical structure and maintain strength and flexibility, and aerobic and anaerobic fitness levels. This is why it is helpful to view exercise like a drug that needs to be carefully prescribed to achieve its maximum benefit. For detailed instructions, please see this previous article.

Additionally it is likely that integrating exercise with intermittent fasting will greatly catalyze the potential of exercise to reduce your risk of cancer and stimulate widespread healing and rejuvenation.

You CAN Beat 'the System'...

Cancer is the second most lethal disease in the US after heart disease (not counting iatrogenic mortality, aka "death by medicine"). We all know that the war on cancer has been a dismal failure. Tragically, conventional wisdom is blind when it comes to cancer prevention and treatment and hundreds of thousands die prematurely every year as a result. They have little to no appreciation of the concepts discussed in this article. But you don't have to fall into that trap as you know better and can take control of your health and ability to treat cancer in your own hands.

The ketogenic diet, which can be summarized as a high-fat, moderate-protein, no-grain-carb diet, has brought many back to health, even after being diagnosed with aggressive cancer, and given no hope of survival. Hopefully, research by the likes of Dr. D'Agostino will become more widely known. Until then, do your own research and take control of your own health, and that of your family.

Severely limiting sugar/fructose, processed foods of all kinds, sweetened beverages (as well as diet versions), and replacing carbs with healthy fats and high quality protein can do what no medicine can – it can prevent disease from setting in, and may even be the U-turn you're looking for if you've been diagnosed with cancer or other chronic disease. Add to that appropriate sun exposure, sleep, effective stress management, and regular exercise, and you'll be well ahead of the rest of the population.

Cancer Treatments: Is a Ketogenic Diet Better?

Mainstream cancer treatments are expensive, have some pretty debilitating long-term and short-term side effects and for some people and some cancers, not as effective as advertised. What if a ketogenic diet can help improve the outcome of mainstream treatment, and if so, how does it work?

The effect that ketogenic diets have on cancer is rooted in how cells make energy to sustain themselves. Most normal cells can make energy by burning sugar or glucose in a pathway called glycolysis. Normally, glycolysis makes products which feed into mitochondria, tiny "powerhouses" in each cell. The main job of mitochondria is to make and regulate the production of ATP, the energy source that runs all living things.

In order to stay alive, cells have to be able to make ATP and maintain the "free energy" of ATP at a specific level common to all cells. If there is too little ATP, a cell will become apoptotic (suicidal) and die. If there is too much ATP, cellular respiration gets interrupted in the mitochondria and this can also kill the cell.

Normal, healthy cells have metabolic flexibility to make and regulate free energy levels through glycolysis or through mitochondrial pathways which require oxygen. Healthy cells are able to utilize all fuels, including glucose, oxygen, fatty acids, and ketones to make ATP and regulate energy flow through the cell.

In contrast, most cancer cells have mitochondria which are broken in some way. They are unable to use mitochondrial energy pathways to burn oxygen dependent fuels such as fatty acids and ketones. To maintain free ATP at the necessary levels, they must rely on glycolysis even when oxygen is available. They do this by "fermenting" glucose into a product called lactate.

This lack of flexibility means cancer cells are dependent upon and must increase the rate of glycolysis and lactate production to keep themselves alive. The lactate they produce is recycled into glucose for the glycolytic pathway in the tumor. In this circular way, cancer cells sustain themselves energetically without the oxygen needed for cellular respiration in mitochondria.

Hence, the **availability of glucose is a critical need for cancer.** Glucose is the main fuel cancer cells use to thrive, and the more glucose and insulin available in the bloodstream, the more glucose is available to allow cancer to sustain itself via glycolysis and fermentation.

Excess glucose in the bloodstream comes from eating an abundance of carbohydrates. If instead, a person with cancer adopts a ketogenic diet designed to treat tumors, it reduces the amount of carbohydrate that a person consumes, which reduces blood glucose levels. This puts cancer cells under some serious metabolic stress. As glucose and insulin levels fall, cancer cells are faced with a fuel shortage.

The important thing to understand is that because of their broken metabolism, **cancer cells are vulnerable to any diet which sharply lowers blood sugar.** It follows that prescribed cancer treatments should take advantage of this vulnerability.

Dr. Otto Warburg, one of the twentieth century's leading biochemists, discovered this preference for glycolytic fermentation in cancer cells in the 1920s. His hypothesis that cancer cells preferred glucose (blood sugar) as a fuel is called the **Warburg Hypothesis**. Recent research and some new information on cancer cell metabolism and metabolic treatments has brought Dr. Warburg's hypothesis back into focus.

Dr. Thomas Seyfried, the author of a book and a 2010 paper called Cancer as a Metabolic Disease writes: *"Emerging evidence indicates that impaired cellular energy metabolism is the defining characteristic of nearly all cancers regardless of cellular or tissue origin."*

And here's a recent independent paper highlighting that an increase in the uptake of glucose in nonmalignant human breast cells "activates known oncogenic pathways to induce malignant phenotype" (i.e. cancerous cells), which reinforces the idea that an increase in the cellular burning of sugar, a process called glycolysis, is a factor in the activation of cancer.

In this paper titled "Targeting energy metabolism in brain cancer with calorically restricted ketogenic diets" the authors concluded that calorie restricted ketogenic diets were effective in stopping the growth of brain tumor in both animals and humans, and they seem to work by stopping the tumor from creating new arteries for supplying itself with blood, reducing inflammation, and restoring the normal cell death mechanisms. (Cancer cells are known to have the ability to avoid the normal mechanisms by which damaged cells die).

And in this paper, **Dr. Eugene Fine of the Albert Einstein College of Medicine** hypothesizes that ketone bodies stop cancers by changing the availability of energy processes in cancer cells. A preliminary paper from Dr. Fine's team was published and the summary of results states that "*Preliminary data demonstrate that an insulin-inhibiting diet is safe and feasible in selected patients with advanced cancer. The extent of ketosis, but not calorie deficit or weight loss, correlated with stable disease or partial remission.*"

There's a podcast interview with Dr. Fine here.

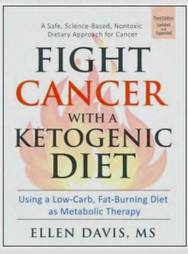
Ketosis as a Cancer Treatment

The main idea behind the use of a ketogenic diet to treat cancer is to deprive the cancer cells of the glucose and other fuels they need to survive, and provide support for the mitochondrial respiration processes in healthy tissues.

When glucose or blood sugar is lowered via the diet, normal cells can switch to burning ketone bodies for fuel and survive quite nicely, while the cancer cells are starved of the glucose they need to grow. This is not to say that mainstream treatments shouldn't be included, but a ketogenic diet does give a person with cancer some control over the disease and treatment protocols.

In fact, the research looking at the effects of ketosis on cancer cells shows there are some huge advantages in using a ketogenic diet as cancer therapy.

1. First, the diet is non-toxic to the rest of the body, and actually supports the health and metabolism of normal cells, even through mainstream cancer treatments. It literally helps the patient weather the toxic effects of chemo and radiation more easily.
2. Secondly, it increases the effectiveness of mainstream treatments. In other words, it makes tumor cells more sensitive to radiation and chemotherapy so that these treatments are more likely to be successful in killing cancer cells.
3. Third, it seems to push cancer cells to into a genetic expression which is more like normal cells.



The use of a ketogenic diet in conjunction with standard treatments is currently being explored in several trials funded by the National Cancer Institute, and more studies are being approved as interest in this "metabolic therapy" grows. Dr. Adrienne Scheck is currently involved in a clinical trial looking at the ketogenic diet as an adjunct therapy for brain cancer.

And as of March 2016, a search of pubmed.gov using the words "ketogenic diet cancer" turns up over 120 papers discussing various research studies on this subject. Don't take my word for it, go and read the research, it's there for anyone who cares to look.

Because there is so little information available about using a ketogenic diet as a cancer treatment, I have written an **eBook which explains in more detail how and why the ketogenic diet works for cancer treatment and provides details on how to implement the diet.** The book is based on Dr. Thomas Seyfried's work and the work of Dr. Dominic D'Agostino. Dr. D'Agostino is a research scientist at the University of South Florida. His team specializes in the study of ketogenic diets and ketone esters in cancer treatments and mitochondrial disease.

Following the Ketogenic Diet For Cancer

The diet prescription for those needing cancer treatment is basically the same as any ketogenic diet, in that it is a high fat, moderate protein, very low carb protocol.

However, there are some differences. Calories and certain foods which are glucose and insulin stimulating are also restricted and certain target levels of ketones and blood sugar must be met.

As Dr. Thomas Seyfried describes in his book "Cancer as a Metabolic Disease: On the Origin, Management, and Prevention of Cancer", there are target ranges of blood glucose levels and ketone levels that are optimal for stopping the growth of the cancer.

Dr. Seyfried recommends implementing a restricted ketogenic diet and balancing blood sugar and ketone levels in a ratio he calls the glucose to ketone ratio, or the G/K index. He spoke about using a ketogenic diet to treat cancer at the 2012 Ancestral Health Symposium.

Checking blood sugar and ketones levels requires using a blood sugar and blood ketone meter. There are many different brands of blood sugar meters, and just recently, several brands of blood ketone meters have been put on the market. The Precision Xtra Advanced Diabetes Management System is recommended due to it's accuracy. The meter can track both blood sugar and blood ketones with different strips. Be aware that the ketone strips are expensive.

There's an comprehensive article here by Dr. Seyfried et al on how a ketogenic diet is implemented in cases of certain kinds of cancer. And Miriam Kalamian, a nutritionist with a practice focused on supporting clients in the implementation of a ketogenic diet as cancer therapy and other metabolic diseases offers phone consultations. In addition, Beth Zupec-Kania, a dietitian with the Charlie Foundation, an organization with expertise in treating epilepsy with ketogenic diets, is also moving into helping people with cancer as well.

Finally, I strongly recommend that your doctor or a knowledgeable nutritionist be involved as much as possible in the implementation of a ketogenic diet for cancer.

More Information

Dominic D'Agostino, Ph.D, a research scientist who specializes in cancer and mitochondrial disease research, has a blog here on which he discusses the research for using a ketogenic diet for cancer treatments. Dr. D'Agostino also has more information on his new blog Metabolic Optimization. This blog features podcast interviews with leading researchers such as Dr. Seyfried, Dr. Adrienne Scheck and other information from Dr. Dominic D'Agostino and Travis Christofferson, author of Tripping Over the Truth: The Return of the Metabolic Theory of Cancer Illuminates a New and Hopeful Path to a Cure.

The Single Cause Single Cure organization has been formed to provide funding for metabolic therapy research. Mike Gopsill at the Lean Messengers blog has a great article and personal story about diet and cancer here. In addition, Dr. Georgia Ede has an excellent article here on treating cancer with diet.

You can also visit my page which talks about what causes cancer, and why cancer research has been somewhat ineffective in eradicating cancer, or even reducing the rates of cancer in the USA.

I'm a self-taught nutrition writer freely offering information about cancer treatments, nutrition and health with the hope of helping others feel better and live longer. No outside entity pays or influences me with respect to site content. If this information has helped you, consider donating to get the word out. Your donations to support these efforts are greatly appreciated, and gratefully accepted.

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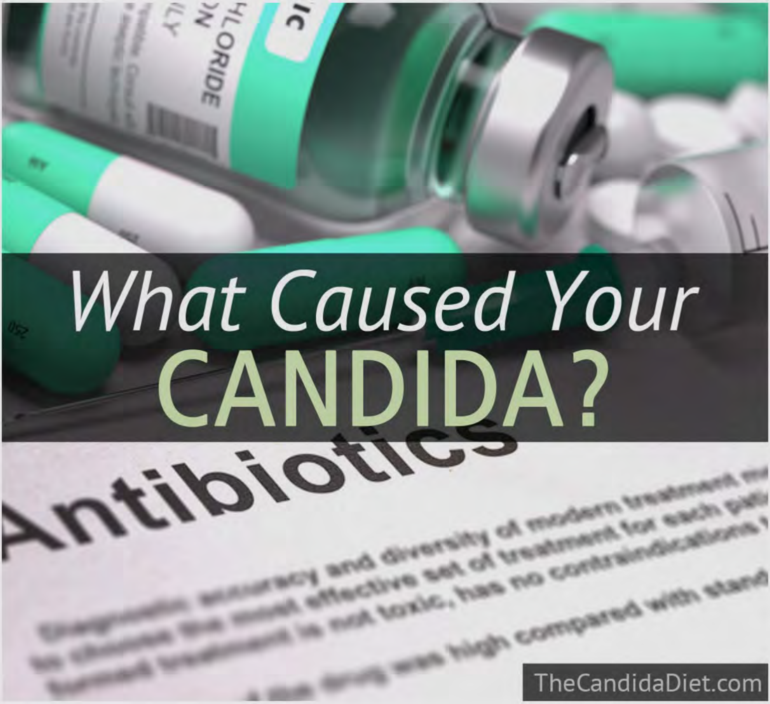
Cancer patients aren't given many options in the mainstream medical standard of care. My hope is that the ketogenic diet will give back some control to those struggling with a cancer diagnosis.

It will be a great day when there are ketogenic diet clinics in every hospital oncology department in the US, just like their are for pediatric epilepsy. At the very least, every person diagnosed with cancer should be advised to follow a low carbohydrate, high fat diet.

7 Causes Of Candida



What triggered your Candida? Was it your diet, a course of antibiotics, or a prolonged period of stress?

The causes of Candida include a high sugar diet, antibiotics, chronic stress, the contraceptive pill, chemical exposure, and diabetes. Usually, two or more of these triggers are to blame. For example, a diet full of inflammatory foods and sugars is more likely to cause a Candida overgrowth when combined with a course of antibiotics.

It's important to realize that most people have Candida albicans in their digestive tract already. It is a microorganism that is naturally present in your gut, part of the balanced system that helps you to digest food and stay fit and well.

When people talk about Candida, they are really talking about the *excess growth* of Candida. So if it's not something that you 'catch' like a virus, what causes it?

Candida Related Complex is still in the early stages of being recognized by the medical community, but there has been a surprising amount of research conducted into this illness. The consensus is leaning towards a handful of medical and lifestyle factors that seem to be triggers for a Candida overgrowth.

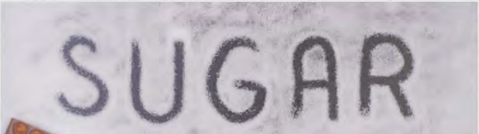
Here are the most common Candida causes:

- A high-sugar diet
- Antibiotics
- Chronic stress
- The contraceptive pill
- Mercury in your fillings
- Chemical exposure
- Diabetes

Are you are suffering from multiple Candida symptoms and looking to get your health back? Here are a few of the things that might be causing your health problems.

A High-Sugar Diet

The modern diet provides huge amounts of the sugar that Candida albicans needs to survive and thrive.



That includes sugar itself, foods containing sugar, and also anything that converts to sugar. Refined carbohydrates, like white flour, and even fruits can all contribute to Candida overgrowth.

Organisms like Candida albicans **need organic, carbon-based compounds to provide them with energy**. In practice this means sugars like glucose, fructose, and sucrose. They use this energy to grow and to build their cell walls, which are comprised 80% of carbohydrates. Candida also uses sugar to switch to its pathogenic, fungal form, and to construct the biofilms that protect it from your immune system.

A healthy immune system should be able to keep Candida at bay. However, a diet rich in sugar works to depress your immune system, leaving it vulnerable and allowing the Candida yeast to proliferate. If you're suffering from Candida symptoms like brain fog, yeast infections, and digestive issues, reducing the sugar in your diet should be one of your main priorities.

Antibiotics

Here is perhaps the most common culprit for a Candida overgrowth. Antibiotics are lifesavers, but they come with plenty of side effects.

Antibiotics

A course of antibiotics will likely kill the harmful bacteria for which it is prescribed, but it also **destroys many of the beneficial and friendly bacteria** that live in your gut. This army of bacteria plays a vitally important role in your immune system. Disturbing it can leave your body defenseless to harmful bacteria and fungi, such as the fast-growing Candida fungus that can quickly dominate the gut.

Of course there are times when you really do need that antibiotics prescription, but the truth is that doctors prescribe it for many health issues unnecessarily, like the common cold or a sore throat. Make sure there is no alternative treatment to your condition and, if you must take antibiotics, be sure to take a good probiotic supplement during and after the treatment to replenish your healthy bacteria population.

Buying organic food can help to reduce your exposure to antibiotics. An astounding 55% of the antibiotics used in the US are in the livestock industry. Herds of cattle are fed antibiotics to keep mortality rates low and profit margins high. Some of these residual antibiotics make their way on to our plates in foods like beef and milk. This has become so widespread that the European Union has banned it completely, and won't even import beef that has been raised with antibiotics.

Chronic Stress

Stress affects your body in two ways, both of which can lead to excess Candida. One of your body's first reactions to a stressful situation is to release cortisol, a hormone that depresses your immune system and raises your blood sugar level. The Candida yeast feeds on the extra sugar, while your weakened immune system is powerless to stop it. Stress gives it the chance to overpower the existing gut flora in your small intestine.

Studies have shown that psychological stress can quickly change the colonization patterns of microorganisms in your gut. And animal studies have shown how stress can lead to reduced diversity in the gut flora. Although the mechanism is not clear, emotional stress allows certain strains to colonize more effectively and aggressively than others. For this reason, some doctors recommend taking probiotics to counteract the effects of chronic stress.

The Contraceptive Pill

In other sufferers, an outbreak of Candida can be traced to the contraceptive pill. The intestines are delicate organs, containing a broad mixture of microorganisms and yeasts that all help to process and digest food. They depend on the right environment to support them, and this equilibrium can be thrown off by the hormonal imbalances caused by the contraceptive pill.

By disturbing this balance, the contraceptive pill opens the door for Candida to once again outgrow its competitors in the gut. Estrogen, the major ingredient in the contraceptive pill, is known to promote the growth of yeast. If you need evidence of how this can happen, see how many women get regular yeast infections while on the pill. It’s exactly the same principle, and it has been documented by multiple research studies.

Another contraceptive device that may contribute to a Candida infestation is the copper IUD. It has been shown that copper can increase yeast growth in much the same way as estrogen does. So be very aware of these problems when choosing your contraceptive technique!

Mercury In Your Fillings

The old-style silver amalgam fillings contain at least 50% mercury, and this is poisonous to the body. Mercury particles and vapor are continuously released in the body as you chew, grind and brush your teeth.

Mercury toxicity affects sufferers of Candida overgrowth in two ways.

Firstly, it worsens some of the symptoms associated with Candida Related Complex. Because mercury is a neurotoxin, it can cause symptoms like brain fog, fatigue, and memory loss, which are precisely the symptoms that you might be suffering from already as a result of your Candida infestation.

Secondly, mercury has been shown to weaken the immune system. This allows the Candida population to flourish without the usual immune cells working to slow it down, and also prevents recovery from a sustained Candida infestation.

There is no safe level of mercury to have in your system, so keeping it in your mouth is definitely a bad idea. If you can afford it, do take charge of your health and have them replaced by a dentist trained in mercury-removal techniques.

Chemical Exposure

Chemicals that are added to drinking water, such as chlorine and fluoride, can kill the beneficial bacteria in your gut. This weakens your immune system and has the potential to allow a small number of Candida yeast cells in your gut to grow into a Candida infestation.

Chlorine in particular can be found almost everywhere you look. Most cities add chlorine to their drinking water. This mean that you are drinking chlorine every day, bathing in it, showering in it, and using it to wash the clothes that you and your family wear. As a powerful disinfectant, it ensures that the water supply stays free of pathogens. However, the health benefits are outweighed by chlorine's effect on your gut flora and immune system.

Luckily there are ways to reduce your chlorine exposure. Once you add some filters in your house and switch to more natural laundry products, your body will take in much less of this poisonous chemical.

There are other chemicals that can deplete the immune system too. People who regularly work with toxic chemicals are particularly at risk for a weakened immune system and greater susceptibility to Candida. This can include people who work as hair stylists, painters, dry cleaners, or in industrial settings. They are exposed to a much greater toxic load than the rest of us, and this can have consequences for their immune system and their health. The more exposed they are, the more vulnerable they might be to pathogens like Candida.

Diabetes

Sufferers of diabetes are more likely to experience repeated yeast infections for two reasons.

The first reason is that diabetics have high blood sugar levels that feed the Candida yeast cells. This is either due to a shortage of insulin production in the body or because the body is not reacting to insulin as it should.

The second reason is the weakened immune system that is one of the symptoms of diabetes. According to a British study published in 2011, this is because the high levels of glucose effectively 'blind' the receptors in your immune system that identify pathogens.36 This allows the Candida yeast cells to multiply and transform into their fungal, pathogenic form.

Uncategorized

Using Coconut Oil for Natural Candida Treatment as Well as Alzheimer's

Share on Facebook Tweet on Twitter G+

Did You Know...that an **exciting new natural Candida treatment** is also **one of the best remedies for Alzheimer's prevention**?

Caprylic acid (a medium-chain triglyceride) is an anti-fungal agent found naturally in **coconuts.** It's also the active ingredient in a new medical food validated by scientific research as an *effective treatment for Alzheimer's*. The medical food is being marketed under the name Axona.

Caprylic acid works by providing the brain with an alternate source of energy. Healthy brains use glucose as their main source of cellular energy. But imaging studies show that brains affected by Alzheimer's use less glucose. If brain cells affected by Alzheimer's could be powered in some other way, symptoms of dementia could be eradicated.

The substances produced by caprylic acid in the body–known as **ketones**–can provide that essential alternative source of energy.

Candida: The Fungus You May Not Know You Have

Caprylic acid’s potential against Alzheimer’s is highly promising. Yet, its amazing effects for natural Candida treatment are equally extraordinary. For more than 40 years scientists have known about the power of caprylic acid for natural Candida treatment.

Candida albicans is a fungus (also referred to as a yeast) that causes a host of undesirable effects in the body. Candida overgrowth is a dramatically under-diagnosed condition that endangers the health of millions of people, many of whom have no idea of their condition.

Leon Chaitow, a renowned alternative health practitioner and author, says, “Candida is possibly the least understood, most widespread cause of continuing ill health currently in our midst.”

Everyone has some Candida in his or her system. Ordinarily, digestive bacteria controls Candida levels. However, if your immune system is compromised, an overabundance of Candida can occur.

The technical term for this condition is *candidiasis*–and its prevalence has climbed rapidly over the last few decades. Experts speculate that this increase stems from our modern diet of processed foods, diabetes, obesity, and excessive use of antibiotics.

Unfortunately, candidiasis is extremely tricky to diagnose. Doctors often mistake it for other conditions, such as:

- Irritable Bowel Syndrome
- Arthritis
- Chronic Fatigue Syndrome
- Athlete’s Foot
- Crohn’s Disease
- Gastroenteritis

Not only will the treatments prescribed for any of these conditions fail to address candidiasis, but they will often *increase the growth of Candida*.

Could You Have Candidiasis?

If you've been feeling generally unwell and don't know why, it could be candidiasis. This condition is difficult to identify because it affects each sufferer in unique ways, which means that patients are practically forced to self-diagnose.

The following list covers the most common symptoms of candidiasis:

- Weight gain
- Abdominal pain
- Bloating, gas, and indigestion
- Oral thrush
- Urinary tract infections
- Joint pain
- Fatigue
- Cravings (specifically for alcohol, bread, and sweets)
- Depression and mood swings
- Confusion and dizziness
- Red, itchy eyes
- Rashes and itching
- White coating on the tongue (especially in the morning)
- Acne, eczema, and other skin problems

If you have *2 or more* of the above symptoms, candidiasis could be the culprit.

Caprylic Acid Can Help

Natural health experts say that treatment with caprylic acid will vary depending on whether you are using it for Alzheimer's or for natural candida treatment.

Caprylic Acid for Alzheimer's

ACCORDING TO AN ARTICLE IN ALZHEIMER'S WEEKLY, COCONUT OIL CONTAINS ACTIVE INGREDIENTS THAT CAN PROVIDE THE BRAIN WITH THE KETONES NEEDED TO ***IMPROVE FUNCTION IN ALZHEIMER'S PATIENTS****. THE ARTICLE ADVISES, HOWEVER, THAT ALZHEIMER'S TREATMENT SHOULD ALWAYS BE SUPERVISED BY A PHYSICIAN, WHETHER THE REMEDY IS COCONUT OIL, CAPRYLIC ACID CAPSULES, OR THE PRESCRIPTION-BASED AXONA.*

Caprylic Acid for Candida

NUMEROUS STUDIES HAVE ***CONFIRMED THE EFFICACY OF CAPRYLIC ACID AGAINST CANDIDA****. SOME PRACTITIONERS RECOMMEND COCONUT OIL AS A FOOD SOURCE OF CAPYRLIC ACID. HOWEVER, CAPRYLIC ACID IS ALSO AVAILABLE IN CAPSULE FORM FOR THOSE WHO NEED HIGHER DOSES OR WHO FIND CAPSULES MORE CONVENIENT.*

CAPRYLIC ACID SUPPLEMENTS ARE AVAILABLE THROUGH HEALTH FOOD SHOPS, PHARMACIES, AND ONLINE HEALTH RETAILERS. NATURAL HEALTH PRACTITIONERS SAY THAT THE SYMPTOMS OF CANDIDA OVERGROWTH SHOULD BE GREATLY REDUCED AFTER TAKING THE SUPPLEMENT, AS DIRECTED, FOR A SHORT PERIOD OF TIME.

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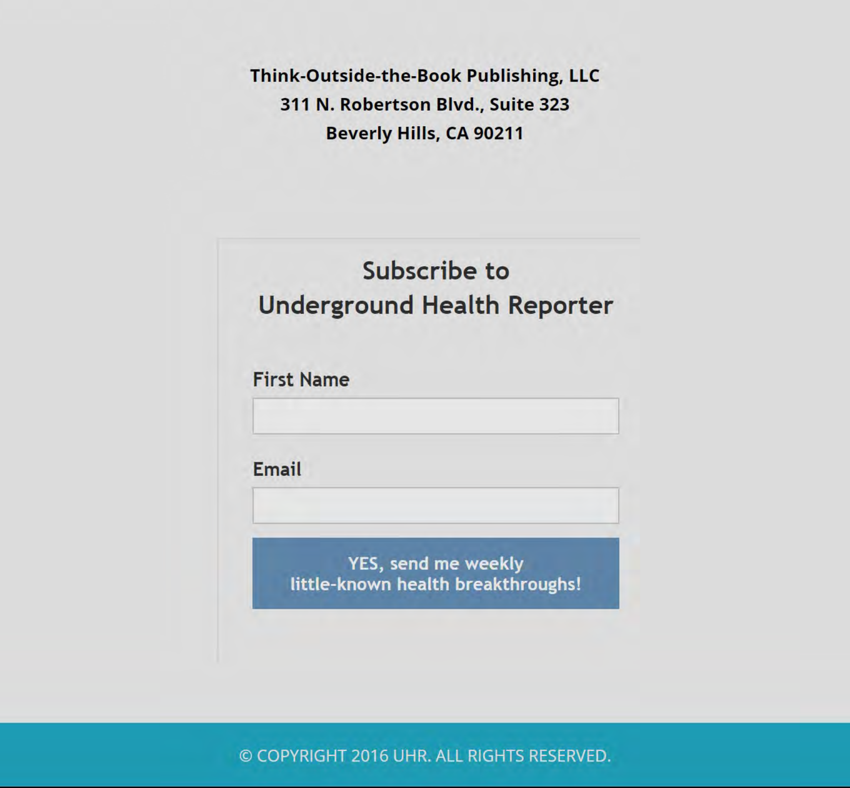

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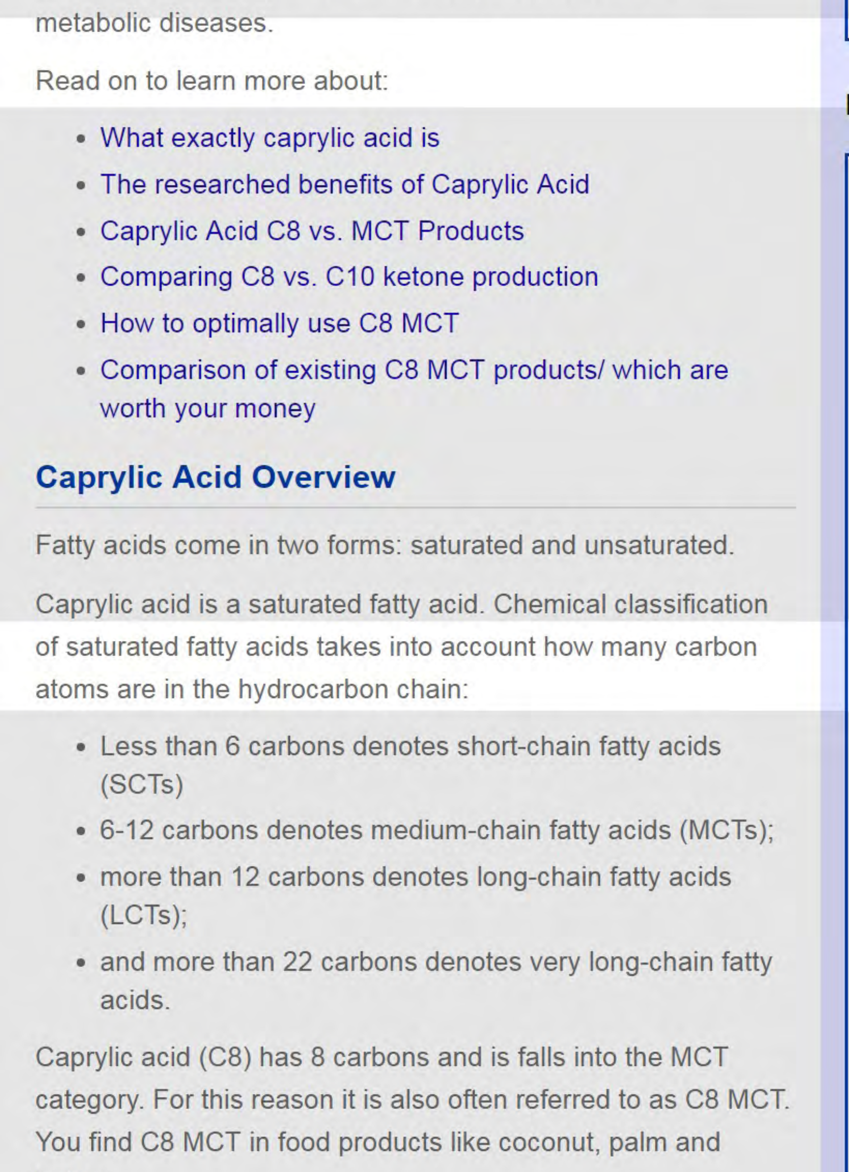
Caprylic Acid (C8)
The Research...
The Products...

Caprylic Acid (C8): Impact On Blood Ketone Levels And Evaluating Current C8 Products

2 COMMENTS

This article outlines the benefits of caprylic acid (C8) vs medium-chain triglyceride (MCT) oil and coconut oil. C8 products are refined forms of coconut and/ or palm oil that contain only caprylic acid triglycerides.

The promised benefits of C8 products are many. They include increased blood ketone levels and associated reduction in blood glucose levels, increased energy, reduced body-fat, antimicrobial activity and even reduced risk of certain



metabolic diseases.

Read on to learn more about:

- What exactly caprylic acid is
- The researched benefits of Caprylic Acid
- Caprylic Acid C8 vs. MCT Products
- Comparing C8 vs. C10 ketone production
- How to optimally use C8 MCT
- Comparison of existing C8 MCT products/ which are worth your money

Caprylic Acid Overview

Fatty acids come in two forms: saturated and unsaturated.

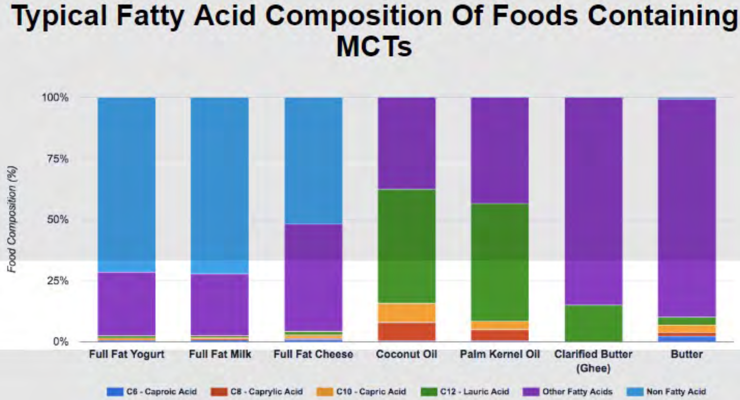
Caprylic acid is a saturated fatty acid. Chemical classification of saturated fatty acids takes into account how many carbon atoms are in the hydrocarbon chain:

- Less than 6 carbons denotes short-chain fatty acids (SCTs)
- 6-12 carbons denotes medium-chain fatty acids (MCTs);
- more than 12 carbons denotes long-chain fatty acids (LCTs);
- and more than 22 carbons denotes very long-chain fatty acids.

Caprylic acid (C8) has 8 carbons and is falls into the MCT category. For this reason it is also often referred to as C8 MCT. You find C8 MCT in food products like coconut, palm and butter.

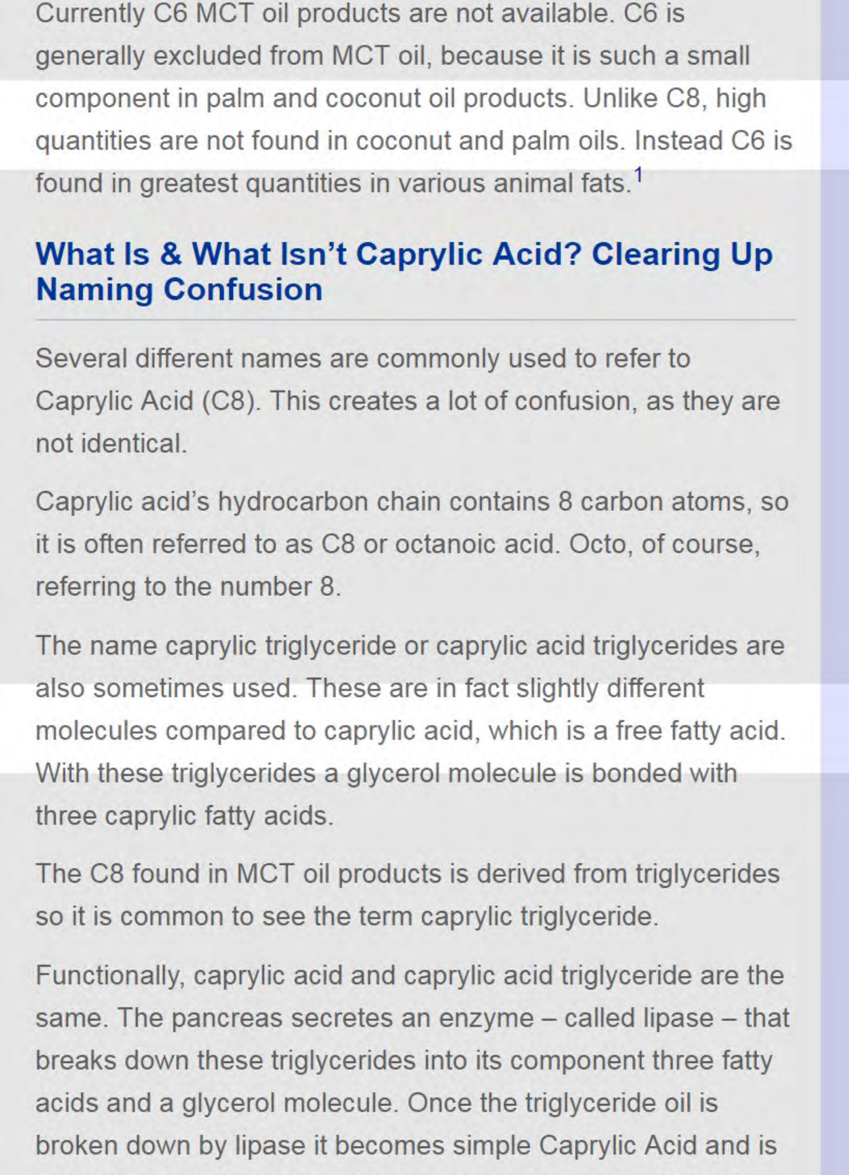
C8 MCT has fewer carbons (8 carbons) compared to capric acid (C10) and lauric acid (C12). This is noteworthy because it is likely behind its better ketone-producing profile than these longer carbon MCTs.

C8 MCT products are sourced from palm and coconut oils by removing the other fatty acids from them. The result is an oil composed of only caprylic acid.


Typical Fatty Acid Composition Of Foods Containing MCTs

Note: Values in chart are averages for food type. Different farming leads to different fatty acid make-up of the above. E.g. Grass-fed cows tend to produce butter with higher MCT content.

It's worth noting that the lowest carbon MCT, Caproic acid (C6), may be more effective at raising ketone levels than C8. This may be due to its lower carbon number. The current evidence to this is research showing that it induces higher ketone levels in animals than the other MCT oils.



Currently C6 MCT oil products are not available. C6 is generally excluded from MCT oil, because it is such a small component in palm and coconut oil products. Unlike C8, high quantities are not found in coconut and palm oils. Instead C6 is found in greatest quantities in various animal fats.[1]

What Is & What Isn’t Caprylic Acid? Clearing Up Naming Confusion

Several different names are commonly used to refer to Caprylic Acid (C8). This creates a lot of confusion, as they are not identical.

Caprylic acid’s hydrocarbon chain contains 8 carbon atoms, so it is often referred to as C8 or octanoic acid. Octo, of course, referring to the number 8.

The name caprylic triglyceride or caprylic acid triglycerides are also sometimes used. These are in fact slightly different molecules compared to caprylic acid, which is a free fatty acid. With these triglycerides a glycerol molecule is bonded with three caprylic fatty acids.

The C8 found in MCT oil products is derived from triglycerides so it is common to see the term caprylic triglyceride.

Functionally, caprylic acid and caprylic acid triglyceride are the same. The pancreas secretes an enzyme – called lipase – that breaks down these triglycerides into its component three fatty acids and a glycerol molecule. Once the triglyceride oil is broken down by lipase it becomes simple Caprylic Acid and is converted into ketones in the same way as the stand alone Caprylic Acid.

Caprylic Acid Benefits & Supporting Literature

Research has shown that caprylic acid (C8) ingestion increases ketone body production significantly.[2],[3]

Even a modest increase of 1mMol in plasma caprylic acid levels was shown to increase ketone body production five fold. Intuitively this is just what keto dieters would want since ketones are their primary source of energy.

Moreover, despite the presence of moderate amounts of blood glucose (such as when you've been eating carbohydrates or higher amounts of protein), caprylic acid is still readily absorbed from the gastrointestinal tract and rapidly oxidized.[4]

This means the C8 is converted into ketones regardless of whether you are in ketosis and following a ketogenic diet or not. However, the scientific research is still at an early stage, it is not clear yet what long-term effect elevated ketone levels when combined with a carbohydrate rich diet has on human physiology.

Other research has demonstrated that caprylic acid does indeed have strong antibacterial, antiviral, and antifungal activities,[5] and has also been shown to improve blood lipid profiles of hypertensive rats, though data in humans remains limited.[6]

However, there is little evidence supporting the postulation that caprylic acid is superior to a mixture of medium-chain fatty acids in reducing body-fat. Research on the performance-enhancing benefits of caprylic acid is also limited at this time, so hopefully, this will be explored in future studies.

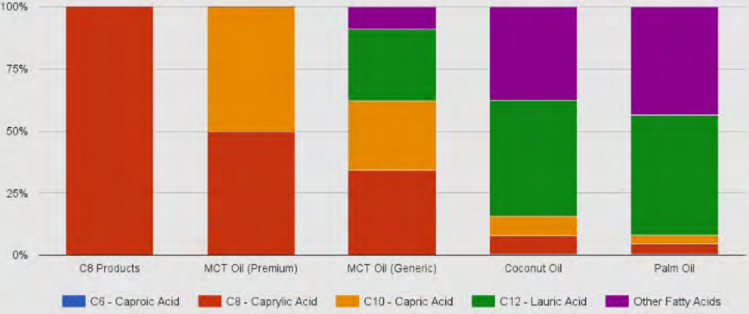
Caprylic Acid (C8) Products

Caprylic Acid (C8) Vs. MCT Oil Products

Something to consider is that most MCT oil products are generally a mixture of caprylic acid and capric / decanoic acid (C10) and sometimes lauric acid (C12). The exact ratio of each varies by product and typically contains between 50 to 75% caprylic acid).

MCT oil has accumulated a healthy amount of research in peer-reviewed literature over the past few decades, and it is safe to assume that many of its benefits are derived from caprylic acid (since caprylic acid generally constitutes the majority / 50% of the mixture). That being said, MCT products are not identical to pure caprylic acid products so be careful not to confuse the two.

Typical Fatty Acid Composition Of Oil Products (MCT, Coconut, Palm, C8)



Note: Values in chart are averages for product type. Coconut oils and palm oils differ in fatty acid makeup according to location sourced from and farming, while MCT oil products differ based on refinement process used and quality goals of product manufacturers.

C8 products are essentially a refined version of MCT oils that have had the capric acid (C10) and lauric acid (C12) removed out, leaving only caprylic acid as the fatty acid component.

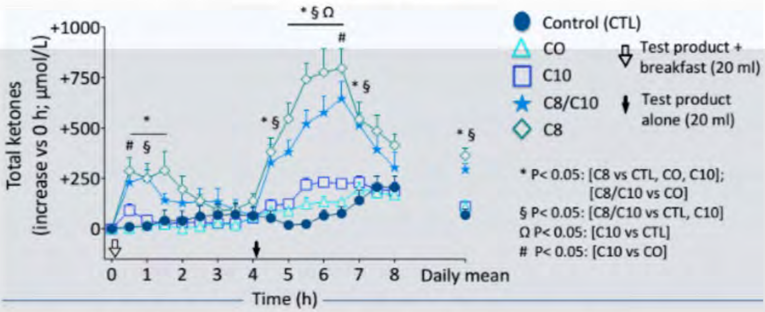
This is thought to improve GI tolerability, a significant inconvenience associated with MCT oil (i.e. GI distress, indigestion, and diarrhea can result for the less experienced or if doses over a tablespoon are taken). Caprylic acid has a shorter hydrocarbon chain than capric and lauric acids, and thus seems to pass through the GI tract quicker and so is rapidly shuttled out to the liver for enzyme metabolism. This may help to reduce the GI distress issue experienced with MCT oils.

Caprylic Acid (C8) Vs. Capric Acid (C10) Ketone Production

Recent research from Cunnane et al. [7] shows how much more effective caprylic (C8) acid is compared to capric acid (C10) in its ability to raise plasma ketone levels.

The following graph is a clear representation of the difference between caprylic acid (C8), capric acid (C10), coconut oil (CO) and MCT oil (C8/C10) on the total plasma ketone levels over an 8-hour period. C8 increases ketones by approximately 3 times more than C10.

Plasma Ketone Increases From C8, C10 And Coconut Oil Compared



This research would suggest that caprylic acid is the main contributor to elevated plasma ketone levels in MCT oil (C8/C10). C10 shows little improvement compared to coconut oil and the control sample.

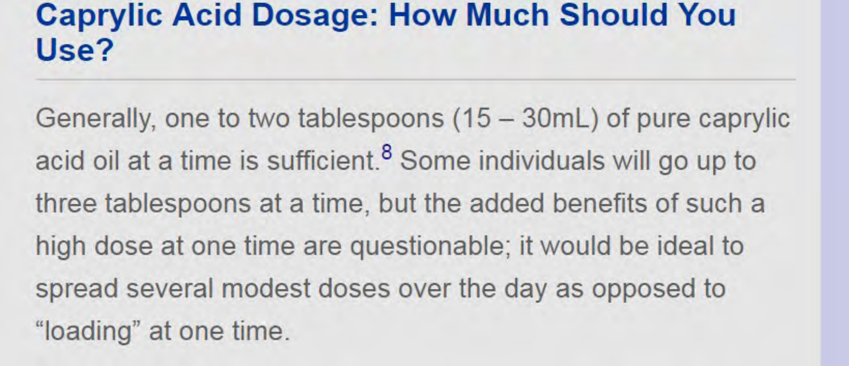
The low plasma ketone levels seen in the coconut oil sample also supports this. The very low caprylic acid levels present in coconut oil have little impact on ketone levels compared to the control sample. This also confirms anecdotal evidence that coconut oil fails to give the feeling of ketosis like MCT oil or caprylic acid.

It is also worth noting that all samples taken on an empty stomach (i.e. taken without food) had a marked improvement in plasma ketone levels when compared to the samples taken with breakfast (i.e. with a meal).

How & When To Use Caprylic Acid

To maximize the potential benefits of using Caprylic Acid follow these guidelines:

- Since caprylic acid is readily digested by the liver and used for energy it would be ideal to take it before training (roughly 30-45 minutes pre-workout) without a meal (especially for those on keto diets). If taken with a meal, give yourself at least an hour before training. The same advice goes for other energy boosting goals, e.g. mental or work related.
- C8 can be taken with meals that are higher in carbs and/or protein to reduce blood glucose spikes. Mechanistically this appears to be because insulin levels rise after ingestion of caprylic acid, due to increases in ketone body production, which increases glucose clearance. Although this can vary significantly from person to person.
- It can also be utilized at pretty much any other time of the day to fulfill your fat intake needs, however, C8 is a very “pricey” source of dietary fat.
- For antimicrobial use follow the directions on the product label and apply to the treatment area.



Caprylic Acid Dosage: How Much Should You Use?

Generally, one to two tablespoons (15 – 30mL) of pure caprylic acid oil at a time is sufficient.[8] Some individuals will go up to three tablespoons at a time, but the added benefits of such a high dose at one time are questionable; it would be ideal to spread several modest doses over the day as opposed to “loading” at one time.

naturalnews.com printable article

Originally published December 13 2009

Rebound on a Mini-Trampoline: Flow Lymph and Fight Disease

by Barbi Trejo

(NaturalNews) Rebounding is a great exercise for the entire body, especially the lymphatic system. Rebounding involves jumping on a mini-trampoline; this promotes circulation. The body contains 5-6 quarts of blood, which is circulated by the heart. But without the lymphatic system, the body cannot effectively eliminate toxins. Exercising on a rebounder for 5-20 minutes at a time will promote the flow of lymph, thereby eliminating toxins.

Poor lymph flow is common in sedentary people; this is one reason why less active individuals are more susceptible to illness. Sedentary people who live on junk food are often unwell because the body sends all the toxins and waste to the lymphatic system. The lymph flow is poor due to a lack of exercise, so toxins accumulate in the body.

The lymphatic system is a major dumping ground for toxins and waste products. The lymphatic system can only be kept flowing by 3 means:

1. Gravity,

2. Internal massage of the lymph ducts, and

3. Exercise by rebounding or similar means.

When you use a rebounder, it promotes circulation through the body's lymphatic system. As you begin to exercise, the toxins are moved to the lymph ducts, which transport the toxins to the kidney and liver. Rebounding serves as an insurance policy against many serious diseases. Rebounding is not only great exercise, but it is fun too.

Rebounding for Cancer:

According to Linda Brooks (www.wholelife.com), "The practice of rebounding against cancer is done using the 'health bounce,' where the feet are kept on the mat and a gentle bouncing motion is maintained for up to two minutes. A stabilizer bar is available for attachment to the rebounder to add security, safety, and balance when needed by those who are weak or unsteady. If endurance is low, start with less time than two minutes and work up to the optimal two minutes over a period of a few weeks."

Bouncing on a rebounder for two minutes every hour is good therapy for preventing or treating cancer. One hour after rebounding, white blood cell count normalizes. Rebounding every hour will keep your immune system in optimum running condition, as rebounding will flush the lymphatic system.

It is important to breathe deeply when using the rebounder, and you must exhale fully to allow for proper oxygenation of the blood. Practicing proper breathing techniques can help you to breathe effectively when you are exercising on a rebounder.

Rebounding for Candida:

Can exercise cure Candida? Many researchers say "yes." Jumping on a rebounder for 5 minutes is comparable to walking for 2 miles. Rebounding eliminates pressure at the joints and it promotes faster weight loss. For best results, exercise for 5 minutes; then, as you build stamina, gradually increase the time, rebounding for up to twenty minutes at a time.

Rebounding also increases white blood cell count, thereby strengthening the immune system. By increasing immunity, the body is equipped to fight off Candida naturally.

Rebounding is great for the elderly too. Adding a stability bar to the rebounder will help avoid falls. It is a fun and relaxing way to become stronger and healthier.

Benefits of Using the Rebounder:

Rebounding can ease symptoms and it cures many diseases, including allergies, arthritis, Candida, cancer, fibromyalgia, depression and stress. By using a rebounder you will increase your energy, hasten metabolism, improve your balance, build bone mass, lower cholesterol, stabilize blood pressure and increase circulation, and you will enjoy improved function of the lymphatic system.

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About the author

Barbi Trejo is a natural hygiene foodist and loves the medicine of the earth. After being diagnosed with MS and early onset dementia last year, she cured herself using herbs and juicing from the earth. She now spends her time helping others.
Barbi Trejo lives in Jordan with her cat, Baby. Barbi is writes for Suite101, Break Studios and Associated Content. She moderates four forums and six blogs in her spare time.
Barbi has just released her first eBook entitled, "Everything You Would Ever Want to Know About Black Seeds (Nigella sativa) and more. It can be seen at http://nigellasativa.weebly.com
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frontiers in Molecular Neuroscience

REVIEW
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Tumor Metabolism, the Ketogenic Diet and β-Hydroxybutyrate: Novel Approaches to Adjuvant Brain Tumor Therapy

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Malignant brain tumors are devastating despite aggressive treatments such as surgical resection, chemotherapy and radiation therapy. The average life expectancy of patients with newly diagnosed glioblastoma is approximately ~18 months. It is clear that increased survival of brain tumor patients requires the design of new therapeutic modalities, especially those that enhance currently available treatments and/or limit tumor growth. One novel therapeutic arena is the metabolic dysregulation that results in an increased need for glucose in tumor cells. This phenomenon suggests that a reduction in tumor growth could be achieved by decreasing glucose availability, which can be accomplished through pharmacological means or through the use of a high-fat, low-carbohydrate ketogenic diet (KD). The KD, as the name implies, also provides increased blood ketones to support the energy needs of normal tissues. Preclinical work from a number of laboratories has shown that the KD does indeed reduce tumor growth *in vivo*. In addition, the KD has been shown to reduce angiogenesis, inflammation, peri-tumoral edema, migration and invasion. Furthermore, this diet can enhance the activity of radiation and chemotherapy in a mouse model of glioma, thus increasing survival. Additional studies *in vitro* have indicated that increasing ketones such as β-hydroxybutyrate (βHB) in the absence of glucose reduction can also inhibit cell growth and potentiate the effects of chemotherapy and radiation. Thus, while we are only beginning to understand the pluripotent mechanisms through which the KD affects tumor growth and response to conventional therapies, the emerging data provide strong support for the use of a KD in the treatment of malignant gliomas. This has led to a limited number of clinical trials investigating the use of a KD in patients with primary and recurrent glioma.

Keywords: glioblastoma, glioma, cancer, metabolism, ketogenic diet, beta-hydroxybutyrate, ketones

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INTRODUCTION

Human malignant glioma is a uniformly fatal disease due, in part, to the limitations of currently available treatments which include surgery, chemotherapy and radiation therapy. Average survival of patients with glioblastoma multiforme (GBM) is 1.5 years, and tumors of the central nervous system are the most common solid tumor in the pediatric population. It is therefore of paramount

importance that new therapeutic strategies for brain cancer patients be developed, especially those that can enhance the efficacy of current treatment options without damaging normal brain tissue. Advances in our understanding of the biology of these tumors have led to an increase in the number of targeted therapies in preclinical and clinical trials (Roesler et al., 2010; Nicholas et al., 2011; Niyazi et al., 2011). While these therapies may prove somewhat effective, the heterogeneity of this tumor often precludes the targeted molecules from being found on all cells in the tumor thus reducing the efficacy of these treatments. In contrast, one trait shared by virtually all tumor cells is altered metabolism.

TUMOR METABOLISM

Alterations in the metabolism of cancer cells, what we now call the "Warburg effect" or aerobic glycolysis, was first described by Warburg et al. (1927). Cancer cells use glycolysis to provide energy and biomolecules regardless of the availability of oxygen. This results in the production of fewer ATP molecules per molecule of glucose, and thus tumor cells require large amounts of glucose. This shift towards increased glycolytic flux in the cytosol and away from the tricarboxylic acid cycle and oxidative phosphorylation in the mitochondria occurs very early in tumorigenesis. This allows for a rapid cell proliferation even under conditions of hypoxia and in the presence of dysfunctional mitochondria. Since Warburg's discovery, metabolism has been of interest in the cancer field but it was often overshadowed by discoveries of oncogenes, tumor suppressor genes, growth factor pathways, molecular subtypes of cancers, etc. There is a resurgence of interest in metabolism as a central theme in cancer, and we continue to find that metabolic pathways intersect and often regulate key components of tumor initiation, progression and therapy response (Clark et al., 2016; Pavlova and Thompson, 2016). In fact, altered metabolism itself has been referred to as a hallmark of cancer (Hanahan and Weinberg, 2011; Cantor and Sabatini, 2012; Ward and Thompson, 2012) in addition to being involved in virtually all of the cancer hallmarks described in the seminal article by Hanahan and Weinberg (2011) (**Figure 1**; Lewis and Abdel-Haleem, 2013).

The term "metabolic remodeling" has been used to describe metabolic changes that can occur in cancer cells (Obre and Rossignol, 2015), and oncogene associated pathways are now known to intersect with, and alter metabolic pathways. For example, the tumor suppressor protein p53 which plays a pivotal role in the cellular responses to hypoxia, DNA damage and oncogene activation is now known to regulate glycolysis and assist in maintaining mitochondrial integrity (Olovnikov et al., 2009; Madan et al., 2011; Puzio-Kuter, 2011; Kim and Kim, 2013; Iurlaro et al., 2014; Barron et al., 2016). Another important connection between metabolism and tumor growth is through regulation of c-MYC. Over-expression of c-MYC occurs in a wide variety of cancers including gliomas. c-MYC is a multi-functional transcription factor and the list of its target genes include those involved in both cell proliferation and cell metabolism (Miller et al., 2012; Zwaans and Lombard, 2014; Altman et al., 2015; Hsieh et al., 2015; Stine et al., 2015). In addition to stimulating glycolysis, c-MYC has been found to activate glutaminolysis and lipid synthesis from citrate (Obre and Rossignol, 2015).

With the advent of molecular analyses, studies of growth factor pathways seemed to overshadow the influence of metabolism on cancer growth. Over-activation of the stress responsive PI3K/AKT signaling pathway is typical in many cancers and often due to activation of growth factor signaling pathways involved in glioma growth such as platelet-derived growth factor, epidermal growth factor and insulin growth factor. We now know that these growth factor pathways are intertwined with metabolic signally pathways (Iurlaro et al., 2014; Martini et al., 2014; Courtnay et al., 2015; Dibble and Cantley, 2015; Roberts and Miyamoto, 2015). PI3K/AKT signaling has been closely linked to metabolism and under low glucose conditions results in rapid tumor cell death (Robey and Hay, 2009; Yang et al., 2009; Marie and Shinjo, 2011).

Another important "hub" linking metabolism and cancer is hypoxia-inducible factor 1 (HIF-1). HIF-1 expression is activated by hypoxia, which is typically found in high grade gliomas and other cancers. HIF-1 is a heterodimeric transcription factor that induces the transcription of a variety of genes involved in angiogenesis (vascular endothelial growth factor (VEGF) and other cytokines) in an attempt to improve tissue perfusion. This results in the formation of abnormal blood vessels that can increase inflammation and edema in brain tumors, as well as induction of the transcription of a variety of genes that promote invasion, migration and tumor growth (Fischer et al., 2002; Kaur et al., 2005; Fujiwara et al., 2007; Hayashi et al., 2007; Mou et al., 2010; Horing et al., 2012; Proescholdt et al., 2012; Yang et al., 2012; Masson and Ratcliffe, 2014; Justus et al., 2015). In addition to specific actions that relate to the tumor cell's response to oxygen availability, HIF-1 interacts with the PI3K/AKT signaling path to act as a regulator of cancer metabolism, proliferation and glycolysis (Pore et al., 2006; Wei et al., 2013; Courtnay et al., 2015; Justus et al., 2015). It also affects the activation of nuclear factor-kappa B (NF-κB), a transcriptional activator that is central to the regulation of various signal transduction pathways and to transcriptional activation events that mediate inflammation, cell proliferation, cell migration and angiogenesis. HIF-1 may, at least in part, provide the molecular basis for the Warburg effect by "reprograming" cellular metabolism in response to oxygen availability (Corbet and Feron, 2015; Courtnay et al., 2015). HIF-1 also is a central figure in alterations to the tumor microenvironment which not only affects tumor cell growth, but also response to therapy (Yamada et al., 1999; Joon et al., 2004; Amberger-Murphy, 2009; Dewhirst, 2009; Hattingen et al., 2011; Metallo et al., 2011; Yang et al., 2012; Danhier et al., 2013; Justus et al., 2015).

It is clear that cancer cell metabolism is far more complex than originally thought. A number of cancer associated mutations affect metabolism and defects in mitochondria are seen in cancer that also link metabolism with cancer initiation and progression. Recent studies have shown that changes in cellular

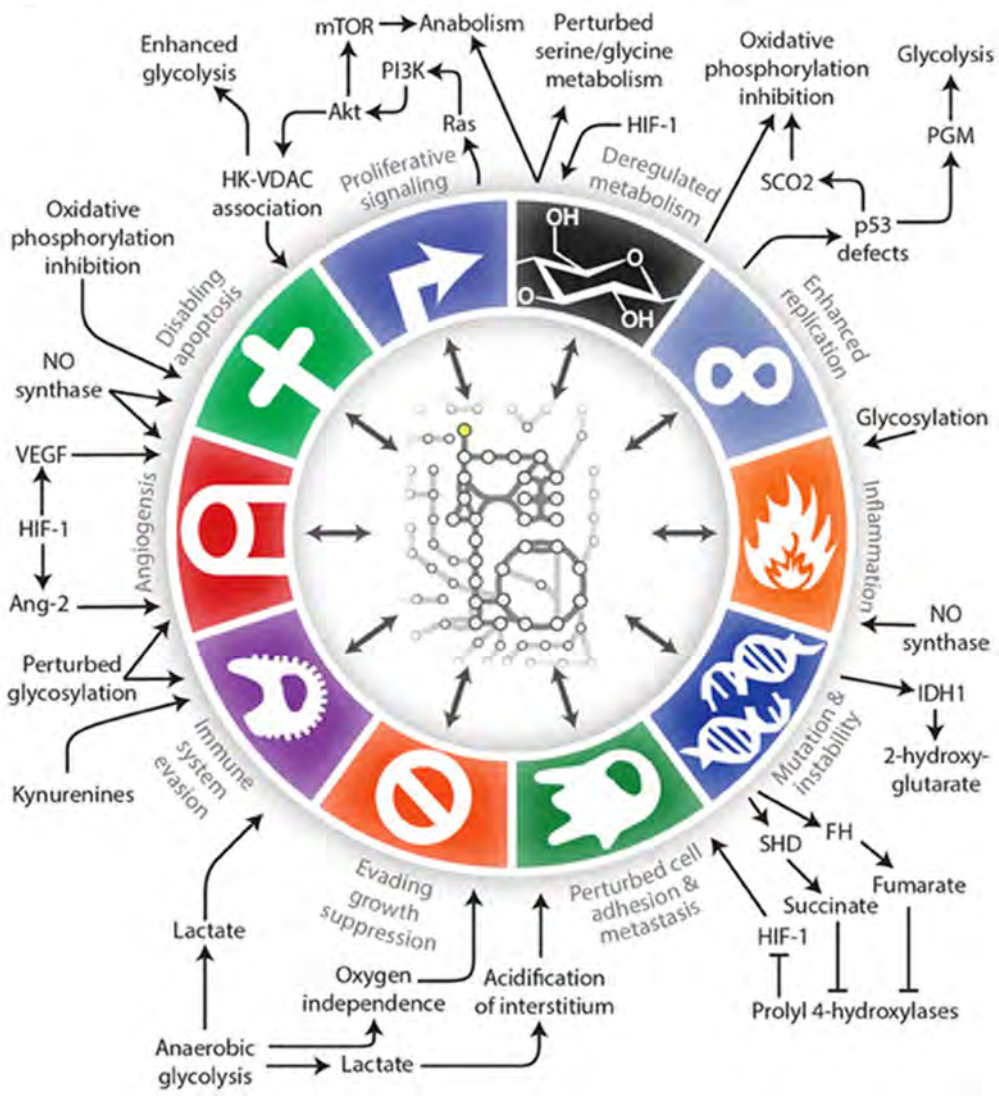

FIGURE 1 | An illustration of the interconnections between tumor metabolism with Hanahan and Weinberg's Hallmarks of Cancer (Lewis and Abdel-Haleem, 2013).

metabolism can alter the expression of specific microRNAs and promote epigenetic changes in tumor cells (Arora et al., 2015; Bishop and Ferguson, 2015; Chan et al., 2015). Although some of these interactions are mentioned above, in-depth discussions of all of the interactions that occur between cancer and metabolism are beyond the scope of this review and the reader is referred to a number of reviews on these subjects (Gatenby and Gillies, 2004; Vander Heiden et al., 2009; Cantor and Sabatini, 2012; Ward and Thompson, 2012; Semenza, 2013; Gaude and Frezza, 2014; Masson and Ratcliffe, 2014; Boroughs and DeBerardinis, 2015; Casey et al., 2015; Robey et al., 2015; Asati et al., 2016; Barron et al., 2016; Bost et al., 2016; Molon et al., 2016; Pavlova and Thompson, 2016; Pérez-Escuredo et al., 2016). The fact that metabolic dysregulation is seen in virtually all tumor cells has led to suggestions that a promising therapeutic strategy may be to exploit this feature. One potential way to achieve this goal is through the use of the therapeutic ketogenic diet (KD) or physiologically similar methods, such as caloric restriction (CR) or intermittent fasting.

THE KETOGENIC DIET: OVERVIEW AND PRECLINICAL EVIDENCE

The KD is a high-fat low protein/carbohydrate diet used to treat refractory epilepsy (Kim and Rho, 2008; Cross, 2013). It has been shown to have neuroprotective effects and there are now studies to determine its efficacy for a number of neurological disorders, including epilepsy, Alzheimer's disease, Parkinson's disease, sleep disorders, headache, traumatic brain injury, amyotrophic lateral sclerosis, pain and autism (Masino and Ruskin, 2013; Gano et al., 2014). The KD increases

blood ketones and decreases blood glucose by simulating the physiological response to fasting, thus leading to high rates of fatty acid oxidation and an increase in the production of acetyl coenzyme A (acetyl-CoA). When the amount of acetyl-CoA exceeds the capacity of the tricarboxylic acid cycle to utilize it, there is an increase in the production of the ketone bodies β-hydroxybutyrate (βHB) and acetoacetate (ACA), which can be used as an energy source in the normal brain (Veech et al., 2001; Cahill and Veech, 2003; Vanitallie and Nufert, 2003; Morris, 2005; Gasior et al., 2006). Since normal cells readily use ketones as an alternate energy source, they are unlikely to be adversely affected by reduced glucose. In contrast, the metabolic alterations found in cancer cells are generally thought to reduce their ability to be "flexible" regarding their primary energy source, and thus they require glucose (Tisdale and Brennan, 1983; Seyfried and Mukherjee, 2005; Zhou et al., 2007; Maurer et al., 2011; Seyfried et al., 2011; Seyfried, 2012). By reducing the glucose availability to cancer cells and providing ketones as an alternative energy source for normal cells, the KD may target the Warburg Effect in highly glycolytic tumors, such as malignant gliomas.

The use of metabolic alteration for the therapy of brain tumors has been championed by Seyfried et al. (2011). They used the VM (Shelton et al., 2010) and CT-2A (Marsh et al., 2008) mouse tumor models to show that a KD, especially when given in restricted amounts, extends survival. D'Agostino and co-workers have added hyperbaric oxygen and ketone supplementation to demonstrate reduced tumor cell growth and metastatic spread in the VM metastatic tumor model (Poff et al., 2014, 2015). We used the syngeneic intracranial GL261-luc/albino C57/Bl6 model to demonstrate that CR was not necessary for the anti-tumor effects of the KD (Stafford et al., 2010), particularly when a 4:1 fat:carbohydrate plus protein formulation is used (Scheck et al., 2012; Woolf et al., 2015; Lussier et al., 2016). Recently Martuscello et al. (2016) demonstrated inhibition of glioma stem cell growth *in vitro* and *in vivo* through the use of a supplemented high fat low carbohydrate diet.

The KD and similar diets used as a monotherapy have a pluripotent effect on the growth on tumors both *in vitro* and *in vivo* which may depend, at least in part, on the model system, the specific metabolic intervention and the molecular underpinnings of the tumor itself (Freedland et al., 2008; Otto et al., 2008; Mavropoulos et al., 2009; Stafford et al., 2010; Kim H. S. et al., 2012; Caso et al., 2013; Poff et al., 2013, 2015; Simone et al., 2013; Lv et al., 2014; Shukla et al., 2014; Hao et al., 2015; Woolf et al., 2015). In addition, the exact composition of the diet may also alter its effects, and there are studies in some cancers looking specifically at polyunsaturated fatty acids (PUFAs), particularly the omega-3 class, for their anti-cancer properties (Sauer et al., 2007; Pifferi et al., 2008; Wang et al., 2012, 2016; Hofmanova et al., 2013; Abel et al., 2014). The striking feature of the work done to date in a number of model systems using different dietary interventions is that alterations in metabolism have a far reaching effect on tumor cells, tumors and the tumor microenvironment. Studies have shown reductions in growth rate as one might expect however, there are also changes in the formation of reactive oxygen species and oxidative stress (Stafford et al., 2010; Milder and Patel, 2012; Allen et al., 2013), angiogeneisis (Zhou et al., 2007; Jiang and Wang, 2013; Woolf et al., 2015), hypoxia (Maurer et al., 2011; Poff et al., 2015; Woolf et al., 2015), inflammation and peri-tumoral edema (Mavropoulos et al., 2009; Woolf et al., 2015), metastasis and invasion (Gluschnaider et al., 2014; Lv et al., 2014; Hao et al., 2015; Poff et al., 2015) and the expression of various transcriptional and post-transcriptional modulators such as NF-κB (Woolf et al., 2015) and microRNAs (Pazmandi et al., 2015).

KD IN COMBINATION WITH STANDARD THERAPIES

Although evidence suggests that the KD provides anti-tumor benefits on its own, perhaps the most effective use of the KD is in combination with standard cancer therapies such as radiation and chemotherapy (Allen et al., 2014). The KD greatly enhanced survival in a mouse model of malignant glioma when combined with temozolomide (TMZ) when compared to either treatment alone (**Figure 2**; Scheck et al., 2011). Using a bioluminescent, syngeneic intracranial model of malignant glioma, the KD was shown to significantly potentiate the anti-tumor effect of radiotherapy. In fact, 9 out of 11 animals maintained on the KD and treated with radiation had complete and sustained remission of their implanted tumors, even after being switched back to a standard rodent diet (**Figure 2**; Abdelwahab et al., 2012). Allen et al. (2013) reported similar results when the KD is combined with radiation and chemotherapy in a lung cancer xenograft model. That is, they found decreased tumor growth rate and increased survival. CR and short-term fasting have also been found to be synergistic with radiation and other anti-cancer therapeutics in both preclinical and clinical studies (Raffaghello et al., 2008, 2010; Lee et al., 2010, 2012; Safdie et al., 2012; Champ et al., 2013, 2014; Saleh et al., 2013; Klement and Champ, 2014).

The effectiveness of radiation therapy is due to a number of factors including relative damage done to tumor cells vs. normal tissue and the ability of normal cells and tumor cells to repair the damage (Klement and Champ, 2014; Santivasi and Xia, 2014). KD or CR may modulate the ability of tumor and normal cells to repair radiation-induced damage (Klement and Champ, 2014). Studies have shown that CR can enhance DNA repair in normal cells (Heydari et al., 2007); however, this may not be the case in tumor cells, and the differential response of tumor cells and normal cells to genotoxic stress may be mediated by reduced Insulin-like growth factor 1 (IGF1) and glucose in the tumor cells. We and others have shown that insulin growth factor is reduced in animals maintained on a KD (Freedland et al., 2008; Mavropoulos et al., 2009; Scheck et al., 2012; Klement and Champ, 2014).

Finally, ketones and the KD have been shown to affect the immune system (Kim D. Y. et al., 2012; Husain et al., 2013; Rahman et al., 2014; Youm et al., 2015), and we have shown that the KD also reverses tumor-mediated immune suppression in a mouse model of malignant glioma (Lussier et al., 2016). As radiation-induced tumor killing is known to expose the immune

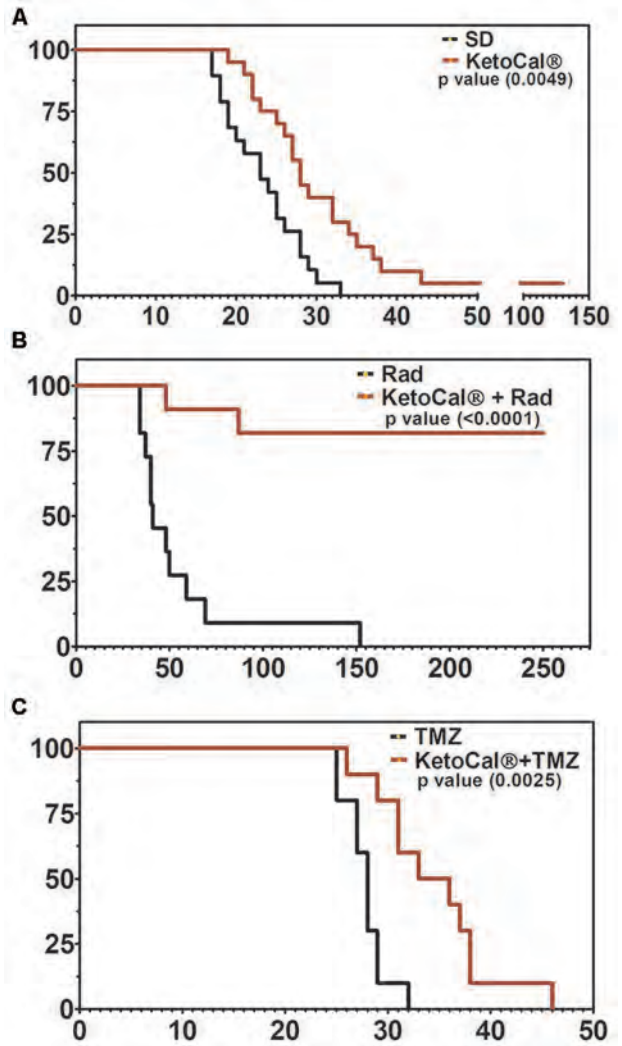

FIGURE 2 | Kaplan-Meier survival plot of animals implanted intracranially with GL261-luc2 malignant glioma cells and (A) maintained on KetoCal® [KC, the 4:1 fat:carbohydrate plus protein formulation of the ketogenic diet (KD)] vs. standard diet (SD); **(B)** treated with 2x4Gy radiation vs. KC plus radiation, and **(C)** treated with 50 mg/kg temozolomide (TMZ) vs. KC plus TMZ. Animals on KC survived significantly longer when treated with KC alone, when KC was combined with radiation, and when KC was combined with TMZ (Scheck et al., 2011; Abdelwahab et al., 2012).

system to a greater diversity of tumor antigens, it is possible that the KD as an adjuvant works to augment the effect of radiation in part by enhancing immunity against GBM.

The variety of effects seen when glucose in lowered and/or ketones are increased suggests that this may also potentiate other therapies, including newer immune- and targeted therapies. Concerns that potentiation of the anti-tumor effect of a particular therapy may also increase its effect on normal brain are valid; however, we and others have shown that the gene expression changes seen in tumor are different than those seen in normal brain (Stafford et al., 2010; Maurer et al., 2011). Further, the KD is known to have neuroprotective effects (Puchowicz et al., 2008; Lund et al., 2009; Maalouf et al., 2009; Hartman, 2012) and thus it has been postulated that this may actually help to protect the normal brain from the deleterious effects of radio and chemotherapy. Taken together, the preclinical data provides strong support for the clinical use of the KD or CR as an adjuvant therapy for the treatment of gliomas and other cancers.

β-HYDROXYBUTYRATE AS AN ANTI-CANCER AGENT

The ketone body βHB has traditionally been thought of as simply a metabolic substrate that replaces glucose during the KD, fasting or exercise; however, the effects of increased ketones go beyond simple considerations of energy availability (Newman and Verdin, 2014; Jaworski et al., 2016). *In vitro* investigations demonstrated that βHB is able to recapitulate, in part, the *in vivo* effects of the full KD (Skinner et al., 2009; Rossi et al., 2015). This suggests that the ketone bodies themselves possess antitumor effects, and that perhaps the effects of the KD are mediated, at least in part, by the ketone bodies. Additional evidence for this comes from data showing that the use of ketone supplementation can enhance the effects of the KD and may even be effective in some diseases when used alone (Veech, 2004, 2014; Kashiwaya et al., 2013; Poff et al., 2014; Shukla et al., 2014; Newport et al., 2015; Youm et al., 2015). Though the mechanisms are still under investigation, it is known that βHB is an endogenous Class I and IIa histone deacetylase (HDAC) inhibitor (Shimazu et al., 2013). HDACs primarily functions by deacetylating lysine residues on both histone and non-histone proteins, resulting in increased global acetylation and regulation of gene expression. In this way, βHB has the capacity to modulate the epigenetic environment within cells, which may contribute to the beneficial effect of the KD and CR.

Our own investigations into the interactions between βHB and glioblastoma cells have revealed insights into the molecular basis for some of the KD's effects, most notably its radio- and chemo-sensitizing effects. *In vitro* studies using βHB demonstrated that, even in the presence of high glucose, physiologically relevant doses of βHB reduced proliferation of several human glioblastoma cell lines, two human cancer stem cell lines, and a murine glioma cell line. Additionally, similar treatment with βHB resulted in potentiation of low doses of ionizing radiation therapy in both sensitive and resistant populations (Rossi et al., 2015; Silva-Nichols et al., 2015). Further, in a separate study βHB potentiated the chemotherapeutic agent 1,3-bis(2-chloroethyl)-1 nitrosourea (BCNU, carmustine) in a cell line derived from a recurrent human glioblastoma (Scheck et al., 2012). Taken together, these results suggest that ketone supplementation may provide an effective, less stringent alternative to the rigors of the KD; yet additional studies are needed to further develop this approach.

KD IN HUMANS

Studies of glucose utilization in cancer go back prior to the 1980s, including studies of metabolism and cancer cachexia (Tisdale et al., 1987; Fearon et al., 1988). These and other studies

TABLE 1 | Active clinical trials: ketogenic diet and gliomas.

ClinicalTrials.gov Identifier	Dates	Title	Location	Data (Enrollment)
01716468	First received: 9/18/12 Last updated: 4/9/16 Last verified: April 2016	Ketogenic Diet in Advanced Cancer PI: Jocelyn Tan, MD	VA Pittsburgh Healthcare System	Safety; long term tolerability; quality of life; tumor growth/spread; overall and progression free survival (17 patients)
02046187	First received: 1/17/14 Last updated: 3/5/15 Last verified: March 2015	Ketogenic Diet With Radiation and Chemotherapy for Newly Diagnosed Glioblastoma PI: Adrienne C Scheck, PhD Christopher Dardis, MD	St. Joseph's Hospital and Medical Center, Phoenix	Tolerability; overall survival; time to progression; patient quality of life (QOL); caregiver quality of life; cognitive changes; seizure activity (40 patients)
01754350	First received: 12/14/12 Last updated: 3/31/15 Last verified: March 2015	Calorie-restricted, Ketogenic Diet and Transient Fasting During Reirradiation for Patients With Recurrent Glioblastoma (ERGO2) PI: Johannes Rieger, PD Dr. med.	Johann Wolfgang Goethe University Hospitals TAVARLIN (Darmstadt, Germany)	Tolerability; progression free survival (6 months after re-irradiation); overall survival; seizure frequency; QOL; depression; attention (50 patients)
02286167	First received: 11/5/14 Last updated: 11/17/14 Last verified: October 2014	Glioma Modified Atkins-based Diet in Patients With Glioblastoma PI: Jaishri O. Blakeley, MD	Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins	Feasibility of MAD; cerebral glutamate and glutamine concentrations (MRS); dietary compliance (25 patients)
01535911	First received: 2/3/12 Last updated: 9/8/15 Last verified: September 2015	Pilot Study of a Metabolic Nutritional Therapy for the Management of Primary Brain Tumors (Ketones)	Michigan State University	Safety/Efficacy Study CT-PET scan will be used to measure changes in brain tumor size. Energy restricted ketogenic diet (ERKD) newly diagnosed GBM subjects.
01865162	First received: 5/24/13 Last updated: 11/25/14 Last verified: May 2013	Ketogenic Diet as Adjunctive Treatment in Refractory/End-stage Glioblastoma Multiforme: a Pilot Study PI: Pavel Klein, M.D.	Mid-Atlantic Epilepsy and Sleep Center, LLC Collaborator University of Pittsburgh	Safety; compliance (tolerability); survival; time to edema requiring steroids (6 patients)
02302235	First received: 11/24/14 Last updated: 11/25/14 Last verified: November 2014	Ketogenic Diet Treatment Adjunctive to Radiation and Chemotherapy in Glioblastoma Multiforme: a Pilot Study (GBMXRT) PI: Pavel Klein, M.D.	Mid-Atlantic Epilepsy and Sleep Center, LLC Collaborator Neuroscience Research Foundation	Survival; time to recurrence; time to radiological progression; tolerability (42 patients)

suggested that the KD consisting of a high percentage of medium chain triglycerides (MCT) along with various supplements resulted in weight gain and improved nitrogen balance in both animals and humans. Nebeling et al. (1995) published a case report in which they used a similar KD based on MCT oil to treat two female pediatric patients with advanced stage malignant brain tumors (Nebeling and Lerner, 1995). They demonstrated that dietary induced ketosis decreased the availability of glucose to the tumor without causing a decrease in patient weight or overall nutritional status. Furthermore, both children had long-term tumor management (Nebeling et al., 1995).

The 2nd case report was published by Zuccoli et al. (2010). This patient was a 65-year-old female with a multicentric glioblastoma. She was put on a 4:1 (ratio of fats:carbohydrate plus protein) calorie restricted (600 kcal/day) KD during radiation and chemotherapy. During this time her body weight dropped by 20%, she had reduced blood glucose, increased urinary ketones and, most importantly, no observable brain tumor by either fluorodeoxyglucose Positron Emission Tomography (FDG-PET) or magnetic resonance imaging (MRI). The tumor recurred 10 weeks after the patient resumed her normal eating habits and she succumbed to her disease less than 2 years after diagnosis. While this patient did not experience long-term tumor control after cessation of the diet, this report demonstrated that the diet could be tolerated, even when used in a calorie-restricted setting. Results of a phase 1 clinical trial were reported in 2011 by a German group (Schmidt et al., 2011). Tolerability of a restricted calorie KD was tested in 16 patients with a variety of advanced (end-stage) cancers. There were no severe side effects and 5 of the 16 patients were able to complete the 3 months treatment. These five patients had stable disease while on the diet. Two of the 11 remaining patients died early following the beginning of the trial, one was unable to tolerate the diet and dropped out immediately, two patients dropped out for personal reasons, one was unable to continue the diet for more than a month and three had disease progression

within less than 2 months of starting the diet and one dropped out to resume chemotherapy. While this trial demonstrated tolerability and favorable side effect profile, the antitumor efficacy could not be assessed due to the variety and severity of disease in the patients. Recently, Schwartz et al. (2015) reported on two patients with recurrent GBM treated with a calorie restricted KD as a monotherapy and although the diet was tolerated, both patients showed tumor progression—The first within 4 weeks and the second within 12 weeks of beginning the protocol. This group also hypothesized that an analysis of ketolytic and glycolytic enzyme levels in tumor tissue may help identify patients that are more likely to respond to a KD, although this has not yet been proven. More recently, a number of prospective clinical trials have been initiated which have been summarized in **Table 1**. These trials include studies of up-front treatment using the KD in addition to standard radiation and chemotherapy in patients diagnosed with GBM.

The case reports described above along with numerous anecdotal reports suggest that the KD may be a promising anti-cancer therapy; however, more work is needed to determine how to best utilize this, and other metabolic therapies for the treatment of tumors. Most of the information regarding the best way to use the KD comes from the epilepsy literature. Further research is needed to determine optimum blood ketone and glucose levels for anticancer effects. In addition, a variety of KDs are used for seizure control and it is not clear if one or more of the different formulations will provide the best results for cancer patients. Finally, while the KD has a long record of safety in the epilepsy community, side effects that occur when used in combination with cancer therapies may differ in type or severity. This data will come from carefully controlled clinical trials that include input from registered dietitians well-versed in the use of the KD. Patient enrollment into clinical trials requires "buy-in" from the medical community. Physicians must be educated on the therapeutic benefits of metabolic alteration as an adjuvant therapy. As with any decision regarding therapy, the patient's overall condition, including nutritional status, must be taken into account. As suggested by Klement and Champ (2014), cancer patients should be assessed for nutritional needs and tolerability of such interventions.

Concern about patients' quality of life is sometimes given as a reason not to employ KD. Compliance can be made more difficult by the use of steroids (prescribed for peritumoral edema) that often increase hunger and raise blood glucose levels. To address this, at least one clinical trial (NCT02046187) includes an analysis of both patient and caregiver quality of life. Quality of life measurements are being added to more clinical trials, as the importance of this has become recognized at the national level (van den Bent et al., 2011; Boele et al., 2013; Dirven et al., 2014). While some clinicians are concerned compliance will reduce quality of life, the patient's that do remain on the KD often comment that this allows them to participate in their own therapy. Despite these caveats, the existing preclinical data suggesting anti-tumor efficacy and a synergistic effect with standard therapies provides a strong impetus to conduct controlled clinical trials, particularly those that will shed light on the interactions between the KD and other therapies.

CONCLUSION

Improvements in the survival and quality of life for patients with malignant brain tumors require the implementation of new therapeutic modalities, especially those that increase the efficacy of current therapies without increasing toxic side effects. While the rapid accumulation of data defining the molecular and genetic aberrations present in these tumors has suggested a host of targets for the development of new therapies, targeted therapies tried to date have met with limited success. This is at least in part due to the molecular heterogeneity of these tumors that prevents any one target from being present on all cells. In contrast, metabolic dysregulation is present in virtually all tumor cells and there is increased interest in using metabolic therapies such as the KD and ketone supplementation for the treatment of various cancers, especially brain tumors. Preclinical data has demonstrated that the anti-tumor effects of the KD and CR are multi-faceted, and alterations in energy metabolism can inhibit cancer cell growth and increase the tumor's response to therapy. This provides a strong impetus to continue work designed to elucidate the mechanisms through which the KD exerts its anticancer effects, as well as suggesting the need for the design of controlled clinical trials that will shed light on the most effective way to implement metabolic therapies in combination with standard therapies for the treatment of malignant disease. This is a novel therapeutic paradigm, and we have only begun to scratch the surface of its potential.

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ECW, NS and ACS contributed to the writing of this review article.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Additional links:

Here is a YouTube link for people who think they are too old, sick or frail to use a rebounder:
https://youtu.be/4be2c8tDveo

Here's one YouTube link proving how effective the **Ketogenic Diet** is at curing cancer (be sure to click on some of the other YouTube video links which appear in the sidebar to learn more):
https://youtu.be/OxhNMzIzs3M

Here is a link to one of the best websites on the **Ketogenic Diet**.
(If it won't open, copy and paste the link into a search engine)
http://www.ketogenic-diet-resource.com

It is my sincere belief that if this protocol is followed carefully, virtually any cancer if caught in time, and candida infection (and many other diseases, including Type 2 Diabetes) can be cured. Please educate yourself so you'll personally know why this works and will stick to the protocol to cure yourself of disease.

All the best of health and happiness for you and your loved ones.

Scott McRae

PS. To make the above protocol even more effective add 2 to 4 drops of 25% or 22.4% sodium chlorite (also known as MMS) to every liter/quart of water that you drink daily until fully recovered. The sodium chlorite will be converted into chlorine dioxide in the stomach, absorb into the blood and help to kill the cancer cells and candida via its mild yet effective oxidative properties which both are sensitive to.