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Ketogenic diets: An overview of metabolism within the body and their effects

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Abstract

The ketogenic diet helps, when carbohydrate or sugar levels are low to 20 grams, the body works to find an alternative source of nutrition in order to provide the energy required to carry out daily vital activities such as various metabolic processes such as breathing, metabolism, movement, blood pumping, etc., In addition, one reason against eating a high-fat diet is that it leads to obesity. Because fat has a higher caloric content than carbohydrates, it is expected that a high-fat diet will result in greater calorie intake. However, the review concentrates on the benefits and adverse effects on the body, as well as explaining the metabolic pathways that occur in people and some animals following a ketogenic diet.

Keywords: Ketogenic diet, low carbohydrate/sugar levels, alternative source of nutrition

Introduction

Despite continuing medical improvements, obesity remains a major global health problem, accounting for up to 2.8 million adult deaths each year. This ubiquitous issue is intimately linked to the evolution of chronic diseases such as excessive blood sugar levels, diabetes, and heart disease [1]. However, applying properly customized diet regimens for weight loss can help to alleviate the Obesity to some extent. Showing many of these diets, the ketogenic diet has emerged as a very low-carb, high-fat diet as a high-energy diet. successful method for quick weight reduction [2].

The fasting or keto diet is a nutritional plan that stresses high-fat and low-carbohydrate intake in order to stimulate weight loss, improve mental clarity, and boost energy levels [2]. Through drastically reducing carbohydrate consumption while increasing fat and protein intake, this diet induces ketosis, a metabolic state in which the body uses fat as its main form of energy rather than carbs. The ketogenic diet's main aim is to reduce total body fat while enhancing metabolic function. A new study reveals that there may be benefits in reducing the risk of certain diseases, such as type 2 diabetes, hyperlipidemia, heart disease, and cancer [3]. The purpose of this review is to explain the body's normal response to increased ketone bodies, the side effects and benefits of using a ketogenic diet, and to review some animal studies involving the ketogenic diet.

Metabolism During Ketosis

When glucose levels fall due to carbohydrate limitation, fasting, or strenuous activity, the body uses a variety of mechanisms to maintain itself. Fatty acids are essential during periods of hunger or low carbohydrate intake since they are the primary source of energy [4]. The liver transforms extra acetyl CoA from fatty acids into ketone bodies, which are water-soluble units of energy that can be delivered through the bloodstream to energy-seeking tissues. Ketone molecules, such as acetone, acetoacetic acid, and β -hydroxybutyric acid, are necessary for brain function as fatty acids cannot penetrate the blood-brain barrier (figure 1). Ketone bodies are transportable units of energy that can cross through the blood brain barrier and be utilized by the brain [5].

Gluconeogenesis is a method of generating glucose from non-carbohydrate sources, such as free amino acids. Some amino acids can be converted to pyruvate or oxaloacetate, whereas

others are transformed directly into oxaloacetate [6]. Alanine and aspartate can be converted to pyruvate and oxaloacetate, accordingly. Glycerol, a byproduct of triglyceride metabolism, can also cause gluconeogenesis. However, glucose cannot be reversed; glycerol must first be transformed to pyruvate. Other non-carbohydrate substrates

for gluconeogenesis involve recycled pyruvate, lactate, and ketone bodies, which can be transformed into oxaloacetate. Gluconeogenesis is crucial during hunger because it provides glucose to red blood cells and certain brain cells that cannot use ketone molecules [7].

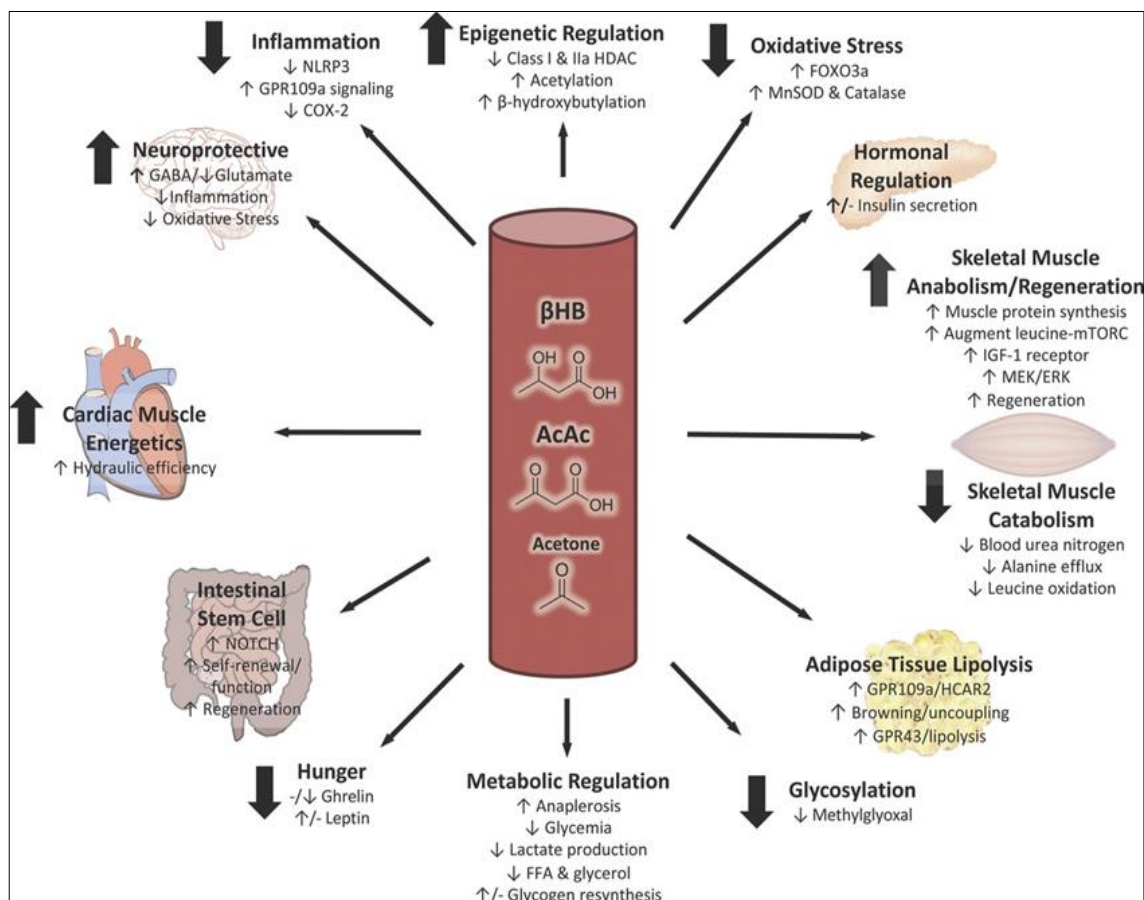


Fig 1: Metabolism of ketone bodies in body [8]

Ketones in the Brain

Fats have important roles in brain functions such as nerve impulse transmission, memory storage, and tissue structure. Acetoacetate and β -hydroxybutyrate are two of the three ketone molecules that the organism can use as fuel. The heart and renal cortex favor ketone bodies over glucose as a source of energy. Acetoacetate is the brain's primary reserve of energy during hunger [9]. Ketone bodies have lately been related to neuroprotective properties, making them potentially effective in the treatment of epilepsy, Alzheimer's, and Parkinson's diseases. Glutamate, an essential neurotransmitter, has excitatory properties but has also been related to neurological disorders such as stroke, epilepsy, trauma, and Alzheimer's disease. Excess glutamate can cause excitotoxicity and neuronal death by generating reactive oxygen species (ROS). Researchers studied the antioxidant capabilities of β -hydroxybutyrate and acetoacetate for reducing glutamate excitotoxicity [10]. Researchers think that ketone bodies protect the brain from neurological disorders by reducing free radical generation and combating oxidative stress. They discovered that ketones boost the NAD⁺/NADH ratio, resulting in more NADH oxidation, lower glutamine-induced ROS, and improved mitochondrial respiration in neurons, thereby explaining ketones' neuroprotective influence [11].

Adverse effects of a ketogenic diet

To explain why the ketogenic diet does not work well over term, you must first understand how it works. The ketogenic diet is the process of obtaining a little amount of carbs, which are one of the body's essential sources of energy. High energy comes from the breakdown of carbohydrates and lipids. After carbohydrate stores run out, the body turns to lipids for energy. It alters the food supply of sugar. In turn, ketone bodies are generated, and this situation lasts for roughly a week, which is dependent on fats as a source of energy in the diet, as well as ketone bodies [12].

According to [13], This nutritional adjustment is typically accompanied by a slew of symptoms, including weariness, lethargy, concentration issues, nausea, poor breathing, abdominal pain, sleeping troubles, indigestion, depression, and many others. However, they may have unforeseen consequences that are unpleasant or even harmful to one's well-being or health. Recognize the importance of eating a nutritious diet. To deprive your body of other beneficial foods creates a disparity in the system, which contributes to health issues. If the body experiences a long-term nutritional deficit, it may face a multitude of risks to its general health. Nutrient deficiencies can result in dehydration, including the well-known hepatic encephalopathy. Ketogenic diets aim to be low in fiber and nutrients like calcium, magnesium,

potassium, and vitamins A, B, and B6. Furthermore, it should result in increased consumption of water [14].

Contact a doctor for proper therapy to help prevent a variety of health issues caused by a nutritional deficit. Nonetheless, lifespan is the key concern with this diet. When it deprives the body of its preferred meals, it may develop cravings for more, leading to the abandonment of the diet. When getting back to once more eating routinely, the recuperation putting on weight may likewise be exceptional. It very well might be trailed by antagonistic impacts too when the body begins to adjust as indicated by glucose as the essential energy source. In this multitude of elements, the Ketogenic-diet ought not be utilized as an extensive term weight decrease system. To weight reduction in a hurry for the close to term, however will encounter excruciating impacts, looking for the approach will be capable. However it very well might be much harder to make this diet a sustainable and extended term choice for weight reduction.

Animal studies involving ketogenic diet

Ketone bodies, which are formed from acetate during fat metabolism, are reused by converting them back into acetate. Horses, which derive more than 60% of their energy from acetate, can burn surplus acetate before it is converted to ketones or efficiently recycle ketones back to acetate, fat, or both. The equine keto diet, which claims to be more nutrient dense, recommends timothy, orchard grass, or alfalfa hay, which contains less carbohydrates and more fiber than fescue, brome, or Bermuda. With the exception of an antioxidant, the diet does not include cereals or supplements. However, horses fed this diet do not produce increased ketone levels. To address this, extra ketones and oil-based medium chain triglycerides (MCTs) are available, which can result in higher ketone levels due to the lack of a carrier entering the mitochondria. Even famine, when body fat is the only fuel, does not generate considerable ketosis in horses [15].

Studies in rodents (obese or non-obese) indicate that KD is helpful for weight loss [16], Nonetheless, it is vital to monitor body composition changes. Losing fat mass is always better to losing lean muscle mass.

Moreover, KD-fed mice had a larger fat mass percentage than regular-chow fed mice. However, there was no variation in the percentage of lean body mass across diets [17].

The investigation on medium-chain triglyceride consumption in dogs has the ability to improve the administration of ketogenic diets for neurological disease models while also opening up novel study paths for developing better diet therapies with enhanced neuroprotective effects [18].

Conclusion

The keto diet has many advantages, including weight loss, decreased triglyceride levels, enhanced diabetes symptoms, and decreased polycystic ovary disease symptoms in women, protection against atherosclerosis, and brain preservation. It also increases focus and energy in the long term, reduces the incidence of epileptic seizures in children, reduces acne appearance, and reduces cancer cell growth. However, the concluded from this review, an understanding of metabolic processes and their interference with other processes, as well as their effects on humans and animals.

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