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Scientific Analysis and Comparison Between Bigu and Keto Diet

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Abstract: Chinese Taoists have a long traditional practice of "Bigu", which has a similar process and results as the ketogenic diet, or Keto, that has recently become popular. These diet regiments make people lose weight, reduce their appetite, increase energy, and think clearly. Keto was used in the twentieth century to treat epilepsy and later became a popular form of health practice - a rich-fat, moderate protein, and minimal carbohydrates diet that forces the human body to burn fat rather than carbohydrates as the primary calorie source. In 2016, Prof. Koizumi of Japan provided the scientific basis of the ketogenic diet and won the Nobel Prize. “Bigu”, which means “Avoid Grain” in Chinese, has been a way of health preservation in China for thousands of years. There are surprisingly few research projects comparing these two popular diet practices. This paper surveys and analyzes the recent researches to compare the differences between Bigu and Keto, proposes new bigu standards, and recommends future research directions.

Keywords: Ketogenic, Bigu, Diet Regiment, NeoBigu, Longevity, Low-carb, Taoism

Introduction

Bigu (Pregadio, 2008), or “Avoiding Grains” has been a dietary tradition in China for over a thousand years. Bigu is a fasting method where grains (wheat, rice, barley, millet, sorghum, etc.) are eliminated from the diet and the person survives on a small amount of highly nutritious superfoods including foraged raw foods, medicinal herbs, and minerals. It is believed to slow down aging, reduce weight, clear the mind, detoxify the body, clean the digestive system, and balance the body’s “energy”. It originated from the pre-Qin Dynasty, and the earliest record was derived from "Zhuangzi·Happy Travel." Master Hongyi also wrote about his experience of Bigu: "No dreams, no worries, peaceful, light body." Most people use Bigu as short-term treatment, lasting as short as three and as long as 30 days.

Keto (Wheless, 2008) “Ketogenic” is a term for a low-carb diet. The idea is to get more calories from protein and fat and less from carbohydrates. The Keto diet requires one to cut back drastically on carbs that are easy to digest, like sugar, rice, pastries, and white bread. Eating less than 50 grams of carbs a day, the body eventually runs out of fuel (blood sugar) it can use quickly. This typically takes 3 to 4 days. Then the body starts to break down protein and fat for energy, which can lead to weight loss. This is called ketosis. More people use Keto as short-term treatment, but long-term Keto diet has been gaining popularity. It is common practice to include intermittent fasting as part of the Keto - only eat two or even one meal per day and occasionally do

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not eat at all one day a week. *In this paper, we assume the Keto diet includes intermittent fasting.*

While Bigu, Keto, and many other fasting traditions, such as Ramadan, during which most Muslims don't eat or drink anything between sunrise and sunset for a whole month, are conduct for religious and wellness reasons, their benefit is well documented (Cabo, 2019). The physiology of them are not known until recent scientific discoveries. The most notable research is by professor Ohsumi who is awarded the 2016 Nobel Prize for discovering and elucidating mechanisms underlying "autophagy", a fundamental process for degrading and recycling cellular components. (Nobel Prize, 2016)

The word autophagy originates from the Greek words auto-, meaning "self", and phagein, meaning "to eat". Thus, autophagy means "self-eating". Ohsumi used baker's yeast to identify genes essential for autophagy. He then went on to elucidate the underlying mechanisms for autophagy in yeast and showed that similar sophisticated machinery is used in human cells when nutrition is severely limited. Ohsumi's discoveries led to a new paradigm in our understanding of how the cell recycles its content. His discoveries opened the path to understanding the fundamental importance of autophagy in many physiological processes, such as in the adaptation to starvation or response to infection.

Separating Bigu myths from the practical Bigu regime is crucial. There are a lot of old Bigu faritells describing that people can live on air and the "energy from the universe" alone for a long period of time, and can achieve immortality. Even in modern times, some "Bigu gurus" vastly exaggerated their practice and results, leading many to question the Bigu practice. In this research project, we only analyze results from credible, evidence-based publications.

Sciences of Bigu and Keto

Autophagy - Bigo and Keto regiment lead to autophagy (Trumpfeller, 2020). Autophagy is a form of cellular housekeeping where misfolded proteins, damaged organelles, and pathogens are degraded and removed from cells. As the process of autophagy begins, a structure (or autophagosome) starts to form. Once fully enclosed, the autophagosome fuses with a lysosome—an organelle containing enzymes that can degrade and destroy molecules. The fusion of both organelles creates an autolysosome, where the degradation of cellular parts occurs. Other parts are recycled and reused for cellular repair. (Jing, 2012) Autophagy plays a vital role in the homeostasis of cellular health, as the outcome leads to healthier cells and the death and clearance of damaged and dysfunctional ones. Autophagy plays a critical role in many areas of health, including the prevention of numerous diseases like cancer, diabetes, autoimmune disorders, infections, and neurodegenerative and cardiovascular diseases. Like many physiological processes in the body, autophagy declines with age, but various animal and cell studies indicate that increased activation of autophagy may lead to improved longevity and a longer lifespan.(Bagherniya, 2018)
Though autophagy has been occurring in humans for thousands of years, the process is a relatively recent discovery. It all began in 1963 when Belgian biochemist Christian de Duve launched an investigation into the effects of insulin on the liver. In the course of his studies, de Duve discovered an unheard-of process. He found that some cells cannibalized portions of their structure through organelles called lysosomes. In 1974, de Duve won the Nobel Prize in Physiology or Medicine, piquing public

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interest in autophagy and how this mysterious process could benefit the body. Then, in 1983, Japanese biologist Yoshinori Ohsumi identified specific genes that regulate the autophagy process. Ohsumi discovered that these genes are what catalyzes the autophagy process and that without them, cells would not be able to repair themselves. His findings resulted in his own Nobel Prize in 2016 and a Breakthrough Prize in Life Sciences in 2017.

Insulin and Insulin resistance - (*Insulin Resistance & Prediabetes | NIDDK*, n.d.)]

Insulin is a hormone made by the pancreas that helps glucose in your blood enter cells in your muscle, fat, and liver, where it's used for energy. Glucose comes from the food you eat. The liver also makes glucose in times of need, such as when you're fasting. When blood glucose, also called blood sugar, levels rise after you eat, your pancreas releases insulin into the blood. Insulin then lowers blood glucose to keep it in the normal range.

Insulin resistance is when cells in your muscles, fat, and liver don't respond well to insulin and can't easily take up glucose from blood. As a result, your pancreas makes more insulin to help glucose enter your cells. As long as one's pancreas can make enough insulin to overcome the cells' weak response to insulin, the blood glucose levels will stay in the healthy range. However, when insulin resistance increase, the pancreas can no longer make enough insulin, diabetes and overweight start.

Physical activity and losing weight may help the body respond better to insulin. Taking small steps, such as eating healthier foods and exercise more to lose weight, can help reverse insulin resistance and prevent or delay type 2 diabetes in people with prediabetes. The National Institutes of Health-funded research study, the Diabetes Prevention Program (DPP), showed that for people at high risk of developing diabetes, losing 5 to 7 percent of their starting weight helped reduce their chance of developing the disease.3 That's 10 to 14 pounds for someone who weighs 200 pounds. People in the study lost weight by changing their diet and being more physically active.

Similarities and Benefits

Avoid Carbohydrates is the core practice in both Bigu and Keto. (Tang, 2021) Traditional Bigu not only reduces grain to the minimum, but it also reduces the overall calorie intake to about 150-180 calories per day during the Bigu period, usually three, seven, or 21 days. Generally, in a state of Bigu, individuals are abstaining from grains and meat, significantly cutting off the supplement of food to less than the minimum required to maintain normal activities, and living on water, leafy vegetables, nuts, and Chinese herbal medicine. (Wang, 2017)

With the development of the economy, chronic diseases such as "three highs" and obesity have become common diseases globally - Hypertension, hyperlipidemia, and hyperglycemia are the main risk factors for cardiovascular and cerebrovascular diseases, which seriously endanger the health and quality of life of patients. However, the treatment of many chronic diseases mainly relies on a lifelong administration of chemical drugs to control the symptoms and delay the progress. There is almost no cure.

Studies have shown that a high-sugar diet, which become common when a country's economy grows, can quickly change the intestinal flora, reduce the concentration of short-chain fatty acids, and increase the incidence of ulcerative colitis. We all know that the occurrence of many chronic diseases is closely related to poor diet. A

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reasonable diet can help us reduce the occurrence of many diseases.

Researchers have followed the "Bigu" population for many years and found that through the guidance of methods, after 21 days of "Bigu" (the daily intake of calories is less than 150 kcal, which is about 1/10 of the basic metabolic needs of the human body), many patients reduced the “three-highs” that they have suffered for many years. The symptoms can be quickly improved and reach normal levels; insulin-dependent patients can also get rid of insulin dependence, and the glucose tolerance test fully meets the standard. (HKT, 2021)

Generally, Keto involves limiting carb consumption to around 20 to 50 grams per day and filling up on meat, fish, eggs, nuts, and healthy oils. It’s also important to moderate the protein consumption. This is because protein can be converted into glucose if consumed in high amounts, which may slow your transition into ketosis. Keto also often involved intermittent fasting - evidence is accumulating that eating in a 6-hour period and fasting for 18 hours can trigger a metabolic switch from glucose-based to ketone-based energy, with increased stress resistance, increased longevity, and a decreased incidence of diseases, including cancer and obesity.

Keto has generated lots of research in recent years. Similar to Bigu, it provides several health benefits:
There is evidence to suggest that a Keto can help with weight loss, visceral adiposity, and appetite control. The evidence also suggests that eating a high-fat diet improves lipid profiles by lowering low-density lipoprotein (LDL), increasing high-density lipoprotein (HDL), and lowering triglycerides (TG). Due to the Warburg effect, Keto is used as an adjuvant treatment to starve cancer cells, making them more vulnerable to chemotherapy and radiation. The benefits are well described in (Gunnars, 2018) listed below:

Reduce Appetite

Hunger tends to be the worst side effect of dieting. It is the main reason why many people feel miserable and eventually give up. Low-carb eating leads to an automatic reduction in appetite. Studies consistently show that when people cut carbs and eat more protein and fat, they end up eating far fewer calories.

Weight Loss (in the beginning)

Cutting carbs is one of the simplest and most effective ways to lose weight. Studies illustrate that people on low-carb diets lose more weight, faster, than those on low-fat diets — even when the latter are actively restricting calories. This is because low-carb diets act to rid excess water from your body, lowering insulin levels and leading to rapid weight loss in the first week or two. In studies comparing low-carb and low-fat diets, people restricting their carbs sometimes lose 2–3 times as much weight — without being hungry.

A Greater Proportion of Fat Loss Comes From Your Abdominal Cavity

The two main fat types are subcutaneous fat, which is under the skin, and visceral fat, which accumulates in the abdominal cavity and is typical for most overweight men. Visceral fat tends to lodge around your organs. Excess visceral fat is associated with inflammation and insulin resistance — and may drive the metabolic dysfunction so common in the West today. Low-carb diets are very effective at reducing this harmful abdominal fat. In fact, a greater proportion of the fat people lose on low-carb diets seems to come from the abdominal cavity.

Triglycerides Tend to Drop Drastically

Triglycerides are fat molecules that circulate in your bloodstream. It is well

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known that high fasting triglycerides — levels in the blood after an overnight fast — are a strong heart disease risk factor. One of the main drivers of elevated triglycerides in sedentary people is carb consumption — especially the simple sugar fructose. When people cut carbs, they tend to experience a very dramatic reduction in blood triglycerides. On the other hand, low-fat diets often cause triglycerides to increase.

Increased Levels of 'Good' HDL Cholesterol

High-density lipoprotein (HDL) is often called the "good" cholesterol. The higher your levels of HDL relative to "bad" LDL, the lower your risk of heart disease. One of the best ways to increase "good" HDL levels is to eat fat — and low-carb diets include a lot of fat. Therefore, it is unsurprising that HDL levels increase dramatically on healthy, low-carb diets, while they tend to increase only moderately or even decline on low-fat diets

Reduced Blood Sugar and Insulin Levels

Low-carb and ketogenic diets can also be particularly helpful for people with diabetes and insulin resistance, which affect millions of people worldwide. This is particularly important benefit since when a country developed, the rate of diabetes increases dramatically. Studies prove that cutting carbs lowers both blood sugar and insulin levels drastically. In one study in people with type 2 diabetes, 95% had reduced or eliminated their glucose-lowering medication within six months.

Reduce Insulin Resistance

Reducing insulin resistance improves promptly for most people when they begin a Bigu/Keto diet, and the effect appears to be attributable to the ketones per se, not just the reduced intake of carbohydrates. If an individual loses a substantial amount of weight, insulin resistance can be further reduced. The degree to which this improved insulin sensitivity remains long-term is dependent upon the individual. While it may not be necessary for everyone to remain in Bigu/Keto long-term, some individuals will find that to (Newman, 2014)

May Lower Blood Pressure

Elevated blood pressure, or hypertension, is a significant risk factor for many diseases, including heart disease, stroke, and kidney failure. Low-carb diets are an effective way to lower blood pressure, which should reduce your risk of these diseases and help you live longer.

Reduce Several Brain Disorders

Your brain needs glucose, as some parts of it can only burn this type of sugar. That's why your liver produces glucose from protein if you don't eat any carbs. Yet, a large part of your brain can also burn ketones, which are formed during starvation or when carb intake is very low. This is the mechanism behind the ketogenic diet, which has been used for decades to treat epilepsy in children who don't respond to drug treatment. Very low-carb diets are now being studied for other brain conditions as well, including Alzheimer's and Parkinson's disease.

Differences and Side Effects

Length of the diet - Bigu, usually a short-term regiment, is practiced occasionally. Many individuals practice a Bigu period, three, seven, 14, or 21 days only a couple of times a year. Keto, on the other hand, can be a permanent lifestyle change. For the Keto diet to show effect, it usually takes about 10-14 days. Some stay on Keto for 1 to 6 months to improve their health. Some show evidence and advocate a long-term, even permanent practice of Keto.

Food selection - Traditional Bigu not only avoids all grains but also drastically reduces

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all calories intake, following Taoist tradition, no meat or fat is allowed. Water and foraged leafy vegetables are the only thing one can take. The modern Bigu, interestingly, follows the original definition, avoiding all types of grains, which is similar to Keto. Keto restricts calories, it strictly limits carbohydrates, encourages fat and moderates proteins.

Exercise and meditation - Bigu usually combines with meditation so the practice not only detox the physical body but also clears the mind. Most Bigu practices includes Tai-Chi, a daily low-intensity movement, and no additional exercise is required. Keto focuses on diet and does not recommend changing exercise routines.

Both practices might cause negative effects similar to starvation. (Kubala, 2021) Other than the obvious negative effects of hunger and craving, especially during the initial stage, there are some negative effects:

Headaches and lightheadedness

Some people experience headaches and lighheadness, especially those who are prone to them before the Bigi and Keto practices. Researchers have suggested that low blood sugar and caffeine withdrawal may contribute to headaches during intermittent fasting.

Digestive issues

The reduction in food intake that comes along with Bigu and Keto regimens may negatively affect your digestion, causing constipation, diarrhea, nausea, and bloating. Plus, changes in diet associated with intermittent fasting programs may cause bloating and diarrhea. Dehydration, another common side effect related to intermittent fasting, can worsen constipation. For this reason, it's essential to stay properly hydrated while practicing intermittent fasting. Choosing foods rich in fiber may also help prevent constipation.

Irritability and other mood changes

Some people may experience irritability and other mood disturbances when they practice Bigu and Keto. This is probably due to low blood sugar. Low blood sugar, or hypoglycemia, can occur during periods of calorie restriction or over periods of fasting. This can lead to irritability, anxiety, and poor concentration. Interestingly, the researchers found that, although the women were more irritable, they also experienced a higher sense of achievement, pride, and self-control at the end of the regiments than when they start them.

Fatigue and low energy

Studies show that some people practicing various methods of intermittent fasting such as Bigu and Keto experience fatigue, tiredness, and low energy. Plus, intermittent fasting may lead to sleep disturbances in some people, which can cause tiredness during the day. However, many studies show that Bigu and Keto can actually reduce fatigue, especially as your body becomes adapted to the regimens.

Bad breath

Bad breath is an unpleasant side effect that can occur in some people during Bigu and Keto. This is caused by a lack of salivary flow and the rise of acetone in the breath. The Bigu and Keto cause your body to use fat for fuel. Acetone is a by-product of fat metabolism, so it increases in your blood and breath during fasting. What's more, dehydration — a symptom associated with intermittent fasting — can cause dry mouth, which may lead to bad breath. So it is important to drink enough fluid regularly during the practices of Bigu and Keto.

Individuals should stop Bigu and Keto if they experience the followings:

- extreme hunger
- nausea
- irritability

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- headaches
- fatigue
- faintness

NeoBigu - suggestions for combining the benefits of Bigu and Keto

According to the investigation and analysis, we recommend the "NeoBigu" for most individuals who would like to try the regiment to improve their health. The NeoBigu including the following practices:

1. Reduce carbohydrate - this is the essential element of the regiments. One should reduce the carbohydrate intake per day to less than 50 grams. Or simply, limit your rice, noodle, and sugar to no more than the size of your fist.
2. Skip one meal per day - after getting used to reduce the carbohydrate intake, the individuals will experience a less sense of hunger so skipping one meal per day is not difficult. Most people were surprised by this after they started the regiments.
3. Increase fat and moderate protein - while individuals reduced carbohydrates intake, they should increase their fat intake to gain enough calories. Food like nuts, avocados, grass-fed beef, wild-caught salmon, eggs are good choices.
4. Choose vegetables wisely - one should choose non-starchy, fiber-rich vegetables such as broccoli, asparagus, green beans, okra, tomato, eggplant, etc. Sweet fruit should be avoided.
5. Fluid in-take - Drink no-calorie fluid, water, tea, and coffee regularly to ensure the body is hydrated.
6. For intensive fasting - similar to traditional Bigu, one should practice it occasionally - one to four times a year, 3 to 7 days each time. During fasting, one should avoid any food and only drink no-calorie fluid. If absolutely necessary, one can have some nuts and non-starchy leafy greens.
7. Exercise - The individual should exercise regularly. For most, NewBigu recommends
    a. 15-30 minutes of low-intensity exercise such as Tai-Chi every morning
    b. 45-60 minutes of mid-intenstiy exercise such as fast walking, biking or jogging three times a week. Mid-intensity means during the exercise, the intensity level should prevent you to have normal converstion
    c. High-intensity exercise - optional, during the mid-intensity exercsei in b., you should try to push as hard as possible for 30-60 seconds every 15 minutes.

The NeoBigu regiment is based up the scientific observation that the autophagy process initiates in humans after 18-20 hours of fasting. The maximum benefits are believed to begin occurring once the 48-72 hour mark has been reached. (Rittig, 2017)

Conclusion

The millennium-long practices of Bigu and the recently popular Keto both have a lot of similarities, including some of the major

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benefits: reduced weight, clear minds, reduced cardiovascular diseases. This paper, surveys many scientific research papers and trusted sources, compares the similarities and differences, lists the benefits and side effects, and recommends the "NeoBigu" to combine both regimens for most people who desire to improve their health via these diet regimens. While many new research

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Conflict of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper.

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