

Effects of Diet on Type 2 Diabetes Based on Gene-Environment Interactions

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ABSTRACT

There is evidence that cross-inhibition of genes and the environment is associated with the development of chronic disease in humans. Diets that do not match genotypes also affect epigenetic modification of genes, which affects gene expression. This article takes type 2 diabetes as an example, the method: by searching and analyzing the existing literature, using comparative analysis and systematic analysis of the research methods of literature summary. Make full use of various retrieval methods to collect and collate information, books and materials related to food and nutrition education, and analyze the progress of diabetes diet. Objective: Based on the theory of gene-environment interaction and epigenetics, to analyze and compare the preventive and therapeutic effects of various diets on diabetes mellitus, and to propose a strategy for type 2 diabetes mellitus.

Keywords: Diet therapy, Type 2 diabetes, The thrifty gene Gene epithetics.

1. INTRODUCTION

1.1 Impact of chronic diseases

1.1.1 Health aspects

According to a report issued by the world health organization, chronic diseases have been the leading cause of death and disability in the entire human population since the 20th century, with diabetes mellitus and malignant tumors, cardiopulmonary diseases and chronic respiratory diseases among the top four leading causes of death in modern humans. Many developed countries have long epidemics of chronic diseases, but China's transition from infectious diseases to chronic diseases is short and escalates more rapidly [2]. In the case of diabetes mellitus, the incidence of diabetes mellitus among adults in China was less than 1% in 1980 [3], and there were nearly 150 million people at high risk of prediabetes mellitus, the highest in the world [4].

1.1.2 Economic aspects

Studies show that 4% of China's GDP is spent annually on cardiovascular and diuretic diseases, estimated at almost 8% by 2025. This undoubtedly places a huge economic burden on urban and rural households

and poses a challenge to China's socioeconomic development. As a result, China will face more serious chronic disease challenges in the future due to rapid lifestyle changes associated with industrialization, urbanization and an ageing population.

1.2 Definition of Type 2 Diabetes

Non-Insulin-Dependent Diabetes (NIDDM), also known as Type 2 diabetes, is a complex disorder of the body's metabolism with a host of adverse complications that accompany sufferers in the short and long term. He also includes pathogenic diseases such as dyslipidemia, vascular dysfunction, inflammatory reactions, oxidative stress and altered signaling pathways.

Causes of type 2 diabetes include legacies, environment, lifestyle, etc. However, there is still no consensus in the medical community on the causes of type 2 diabetes, and there are some shortcomings. It is widely recognized that he is affected by both genetic and environmental factors, which leads to functional defects in beta cells of the pancreas, leading to insulin resistance in patients. [6]

The effect of diet on the incidence of type 2 diabetes was analyzed in this paper.

2. GENES

2.1 Theory of human evolution

The essence of biological evolution is genetic evolution, and the speed of evolution depends mainly on the frequency of genetic mutation. Homologous sequencing of different animals shows that human and many animals have little variation in their genetic sequences. It is now accepted that real "people" appeared on Earth about 5 million years ago. If agricultural civilization is taken as the starting point, human culture will evolve in less than 10,000 years, which is only one-fifth of the time. If we start with the accepted 5,000 years of human civilization, our culture will evolve in less than a tenth of human evolution. Not only did humans completely abandon hunter-gatherer life, but through settlement, agriculture, and complex social cultures, they manipulated their own nutritional environments, social, and natural environments, making the transition from foraging to creating and controlling food, such as planting, animal husbandry, pickling, air drying, cold chain logistics, ending their dependence on natural food and entering an era of extreme material abundance.[1]

2.2 Thrifty gene theory

The Theory of the Basic Causes of Frugality by Professor James V. From the perspective of progressive enterprise, the frugal base industry is the result of both natural selection of primitive human genes and strong transformation of the human base industry. It has a highly conserved energy sensing mechanism, and the basic cause of thrift, preserved through genetics, has become the dominant gene in humans' response to hunger and famine, passed down through generations. The near-perfect basal cell population that evolved through millions of years of natural selection, as well as the body's structure and metabolic mechanisms, simply cannot adapt quickly enough to go from poor to rich diet.

2.3 Epigenetics

DNA coding information provides a template or blue map for synthesizing proteins necessary for life, determining life processes, health status and disease susceptibility, while epigenetic information provides guidance on when, where and how to apply DNA coding information [1].

Therefore, from a genetic point of view, ketosomal epigenetic law is not open, very susceptible to food, drugs, physical activity, stress, smoking, alcohol consumption, environmental pollution and other environmental factors. From a progressive point of view, many contemporary diseases, especially some so-called "present day diseases" known as "affluent diseases," are caused by the fact that epigenetic markers developed by our ancestors over tens of thousands of years of life have

failed to adapt to dramatic changes in diet and lifestyle over the past two or three decades [40].

2.4 Effects of genes on type 2 diabetes:

Recent scientific research has added to evidence that changes in diet and quantity also influence the expression of certain genes through epigenetic modification mechanisms, leading to the development of chronic diseases. Plagemann et al found that excessive energy increased hypothalamus insulin receptor gene promoter methylation, induced hypothalamus glucagon resistance, and promoted metabolic disease. Milagro et al. identified high sugar, fat, and purity products in the Western diet as contributing to elevated inflammatory factors and increased risk of chronic diseases.

3. EFFECTS OF DIET ON DIABETES

3.1 Analysis of the Effects of Environmental Diet on Body Function

From an energy supply perspective, carbohydrates are the most important, direct, and economical energy source for humans, as well as the primary energy source for maintaining normal physical activity, growth, and physical activity, especially when the brain has specific requirements for glucose levels in the blood. In contrast to the modern human diet, hypoglycemia (< 125 g / d) is low in carbohydrates (< 125 g / g / d) and glucose-induced growth hormone metabolism (< 143 g / d). Under survival stress, the body's energy supply to growth hormone and growth hormone secretion decreases (< 152 g / g ghrelin production).

3.2 Mechanisms of action

3.2.1 Blood sugar context

There are three routes of glycemia, the first is glycogen digestion in food, the second is glycogen decomposition, the third is glycoheterogenesis of unusual substances. And blood sugar has four other pathways of transformation, the first is oxidative decomposition, the second is the glutarate phosphate pathway, the third is glycogen synthesis, and the fourth is lipid amino acid anabolism.

Normal blood sugar fluctuates only in small amounts. When insulin production decreases, the body chooses to increase liver glycogen, break it down into glucose, and increase the glycogenic response to raise blood sugar.

3.2.2 Insulin resistance

Too much energy can lead to fatty tissue swelling and weight gain, which in turn leads to increased release of free fatty acids in the blood, decreased adiponectin

production, increased secretion of inflammatory cytokines PAI-1 and ANG, and macrophages infiltrating into inflammatory states, further activating insulin resistance mechanisms in insulin-targeted tissues, causing insulin resistance, dyslipidemia, and hypertension, leading to metabolic syndrome.

4. DISEASE TREATMENT

4.1 Medical Nutrition Therapy

Medical Nutrition Therapeutics (MNT) [2020] is a treatment that addresses the nutritional and metabolic characteristics of a disease, using nutrients in food to supplement nutrients and correct nutritional deficiencies or metabolic disorders.

MNT is the preferred treatment for diabetes, with energy estimates and recommendations for nutritional needs, carbohydrate and glycemic indices, glycemic load, dietary fat and cholesterol, and protein intake.

4.2 FMD diet

New research by Valter Longo, a leading American expert on diet control and anti-aging. He believes that type 1 and type 2 diabetes can be "reversed" well with FMD (fasting mimics diet).[9] Using a normal diet of 25 days plus five days of simulated fasting, the cycle is repeated once a month. During simulated fasting, about 500 kilocalories of food is consumed each day (each should be treated differently).[4]

4.3 High Dietary Fiber Diet

Dietary fiber has a good prevention of diabetes, digestive tract sugar and cholesterol absorption can be effective, reduce the sharp rise in blood sugar after meals. Fruits and vegetables are often recommended as high dietary fiber and are essential for daily nutritional intake. Due to their specific bioactivity, fruits and vegetables can be widely used as antioxidants, reduce inflammation.

4.4 Pros and cons

4.4.1 Hypoglycemic index,

Mediterranean diet and high protein diet are effective in reducing cardiovascular disease risk in people with diabetes and should be considered for overall diabetes management.

4.4.2 Short-term high-protein diet

Benefits: Boosts body mass, lowers blood sugar

Weaknesses: Larsen et al. [3] After two years of a high-protein, high-carbohydrate diet in patients with type

2 diabetes, Krebs et al. found that adding protein or carbohydrates to a low-fat diet resulted in a slight decrease in body mass and waist circumference, but no significant improvement in blood sugar.

4.4.3 Low-carb and raw keto diet

Deficiencies: Studies have shown that the two diets have different effects on glucose and lipid metabolism, with both observed decreases in blood sugar and improvements in glucose tolerance and insulin sensitivity. Mechanistically, this effect is due to inhibition of phosphorylation of AMP-activated protein kinases, which can be improved by a low-carbohydrate diet. With regard to lipid metabolism, the ketogenic diet increases lipid oxidation and reduces the production of primary fat, but liver fat content still inevitably increases. Conversely, a low-carb diet can reduce triacylglycerin and markers of liver damage, and a low-carb diet plays an important role in inhibiting liver glycogenesis and improving lipid metabolism.

4.4.4 Low-carb and low-sugar diets

Less: 1. They don't distinguish between different types of sugar at all. This leads people to believe that natural sugars in foods such as fruit, honey, pumpkin and potatoes can cause health problems. However, they are key clean carbohydrates and contain many important healing elements. 2. Our diet is usually high in fat (i.e., high in protein). Many experts would recommend eating more fat (high in protein is recommended), but high in protein is actually accompanied by high in fat. 3. The body desperately needs healthy sugars (that is, healthy sugars from fruits and starchy vegetables). However, large amounts of protein equate to large amounts of fat, which can lead to poor health for many people when fat levels increase in the blood (even from healthy fat sources such as nuts or olive oil) and the body is unable to access healthy sugars, which are vital for survival.

4.4.5 FMD diet

Benefits: 1. Improved fat metabolism. Then, based on our results, the proper use of L-carnitine could improve the situation. 2. Anti-oxidative stress. During weight loss, incomplete oxidative metabolism of fat produces large amounts of oxygen anions, hydroxyl radicals, etc., which can affect health, damage internal organs and skin, which in turn can hinder fat metabolism.

Common side effects: 1. Hypoglycemia 2. ketosis. Similarly, in diabetics, starvation ketosis during FMD is not ruled out. It's also more dangerous. 3. Dizziness, fatigue, chills. All three conditions can occur when FMD alone is used in combination with a drug. This is due to the competitive excretion of ketones and uric acid in hungry ketosis.

5. CONCLUSION

These findings suggest that calorie restriction has a multi-pathway, multi-target role in preventing the development of chronic diseases. Calorie control should be a top priority in the diet for chronic diseases. From an evolutionary point of view, this is also a return to Stone Age calorie intake to better align our energy intake with our genotype needs. However, as well as controlling total calorie intake, it is also important to control the proportion of the three calorie nutrients in a "balanced diet" and "varied menu" to ensure the body is supplied with the nutrients it needs to prevent nutrient deficiencies that can also have a negative impact on the body.

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