



The Roles of Nutrients in Fruits in the Prevention and Intervention of Obesity

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Abstract. Obesity is a chronic health-threatening disease caused by many factors, and it has become one of the most prevalent diseases in the world. Fruits are rich in various nutrients and bio-active compounds. So the author aims to discuss the roles of nutrients in fruits in the prevention and intervention of obesity based on the existing literature and related research. This paper discusses the preventive and therapeutic effects of dietary fiber, minerals, vitamins, and polyphenols in fruits on obesity and gives suggestions on the dietary combination of fruits to provide new ideas for obese people to prevent and improve obesity by improving the dietary combination of fruits. Through research, it has been found that these nutrients can reduce fat content and body weight by affecting digestion and absorption, fat metabolism, glucose metabolism, and improving intestinal flora, thereby preventing obesity.

Keywords: Obesity · Overweight · Fruits · Nutrients · Dietary Collocation

1 Introduction

Obesity is a chronic metabolic disease caused by genetic and environmental factors that refers to excessive total fat content and/or increased local fat content and abnormal distribution. Obesity is a major risk factor for several diseases, including cancer, coronary heart disease, diabetes, and fatty liver. It is also an important factor leading to the risk of death, and has become a global health problem. Over the past few decades, a large number of studies have been carried out at home and abroad on the pathogenesis, prevention, and treatment of obesity. Many studies have shown that obesity is related to poor lifestyles such as lack of sports, long-term intake of high-calorie foods, overeating, and social factors. Through research, Bouchard C et al. found that factors such as sedentary behavior and physical activity level are related to obesity [1], BA Swinburn et al. believed that due to the development of the global food system, economic development, and improvement in consumption, processed food became more delicious and attractive, and the food energy supply increased. People got more energy from food, resulting in an increase in the obesity rate [2].

At present, dietary intervention has become the basic means to prevent and intervene in obesity. Adjusting dietary structure is one of the important intervention methods. Fruits are rich in a variety of amino acids, dietary fiber, vitamins, minerals, flavonoids, polyphenols, and other nutrients and bio-active substances, and their energy is relatively low. Many of these nutrients have antioxidant, anti-aging, lowering blood lipid and blood pressure, lowering cholesterol, and other effects that can prevent cardiovascular and cerebrovascular diseases, prevent and treat certain cancers, prevent and treat diabetes and chronic complications, and have a positive effect on the prevention and intervention of obesity.

Based on the previous research results, this paper summarizes the prevention and intervention effects of dietary fiber, vitamins, minerals, flavonoids, and polyphenols in fruits on obesity and puts forward suggestions for fruits in dietary collocation, so as to provide a theoretical basis for the prevention and intervention of obesity in dietary fruit collocation, help obese people to prevent and improve obesity, and provide new ideas for researchers to develop special foods for obesity intervention.

2 Obesity and Obesity-Related Diseases

The World Health Organization defines overweight and obesity as abnormal or excessive fat accumulation that poses risks to health. Body mass index (BMI) is a simple index of height to weight that is commonly used to classify adults as overweight or obese. It is defined as a person's weight (in kilograms) divided by the square of height (kg/m^2) in meter. At present, BMI is mainly used to define overweight and obesity. The World Health Organization defines overweight as $25.0 \text{ kg}/\text{m}^2 \leq \text{BMI} < 30 \text{ kg}/\text{m}^2$, and obesity as $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$, while the Working Group on Obesity in China defines overweight as $24 \text{ kg}/\text{m}^2 \leq \text{BMI} < 28 \text{ kg}/\text{m}^2$, and obesity as $\text{BMI} \geq 28 \text{ kg}/\text{m}^2$. The fundamental cause of obesity is the imbalance of energy metabolism. When the calories consumed exceed the calories expended, excessive calories are converted into fat stored in the body. When the stored fat is too much, it will lead to obesity.

Obesity is not only a disease itself, but also a predisposing factor for many diseases. Due to the high content and abnormal distribution of total fat and/or local fat, the quality effect or direct metabolic effect of excessive adipose tissue occurs, resulting in obesity related to the occurrence of various chronic diseases, including various cardiovascular and cerebrovascular diseases, diabetes, respiratory diseases, obstructive sleep apnea, gallstones, osteoarthritis, and so on. Obesity has also been linked to a number of tumors and cancers, including colon cancer, liver cancer, gallbladder cancer, breast cancer, ovarian cancer, prostate cancer, and others. Moreover, obesity also affects mental health, which may cause adverse psychological problems and social consequences such as inferiority, depression, and anxiety. Studies have shown that vaccines are less effective for obese individuals, and obese people are more likely to suffer from COVID-19 [3].

Obesity has become a chronic disease prevalent worldwide, seriously endangering human health. Since 1975, the global prevalence of obesity has nearly tripled. In 2016, about 13% of adults were obese. According to the global burden of disease, more than 4 million people died each year as a result of being overweight or obese in 2017 [4]. This figure continues to rise in many countries and regions, exacerbating fears of obesity.

Obesity has become a chronic disease endemic worldwide, listed by the WHO as one of the top ten life-threatening diseases and the fifth risk factor affecting health. It not only seriously threatens public health, but also brings a heavy burden to the national economy and causes heavy economic pressure on society because of its high medical expenses.

There are many factors that cause obesity, among which genetics, central nervous system abnormalities, endocrine dysfunction, metabolism, nutrition, and other factors that are closely related to obesity. In addition to genetic factors, with the continuous development of society and the economy, the continuous improvement of urbanization, and the explosive rise of takeaway and taxi platforms, people's lifestyles and concepts of life, diet structure, and so on are constantly changing. Long-term consumption of high-energy and high-fat foods, long-term sedentary work, lack of exercise, and a series of other reasons may be an important factor in causing obesity.

3 The Roles of Nutrients in Fruits on Obesity

Fruits are rich in carbohydrates, fats, proteins, water, vitamins, minerals, dietary fiber, phenols, terpenoids, and other nutrients as well as bioactive substances that play an important role in maintaining health, resisting various diseases, antioxidation, and anti-aging. Among them, many nutrients have certain preventive and therapeutic effects on obesity. This paper mainly discusses the effects of dietary fiber, polyphenols, vitamins, and minerals in fruits on obesity prevention and treatment. These substances are rich in fruits and have prominent effects.

3.1 Effects of Dietary Fiber on Obesity

Dietary fiber (DF) is recognized as the seventh nutrient after protein, fat, sugar, vitamins, minerals, and water, which includes Soluble dietary fiber (SDF) and insoluble dietary fiber (IDF). Dietary fibre means carbohydrate polymers with ten or more monomeric units 2, which are not hydrolyzed by the endogenous enzymes in the small intestine of humans, according to the International Codex Committee [5].

Jujubes, pears, apples, citrus fruits, bananas, olives, and other fruits are rich in dietary fiber. Citrus fruits are a good source of dietary fiber. Citrus dietary fiber may help to prevent obesity by increasing satiety, decreasing food intake, regulating digestion, absorption, and metabolism, delaying fat absorption, and lowering energy consumption [6]. Apple pectin can regulate the intestinal flora of obese rats, protect intestinal barrier function, improve metabolism, and reduce weight. Jiang et al. found that the weight gain of diet-induced obese rats treated with pectin (HF-P group) was significantly lower than that of high-fat diet-induced obese rats (HF group) (207.38 ± 7.96 g vs. 283.63 ± 10.17 g, $p < 0.01$). When HF-P rats were compared with HF rats, their adipose tissue development was significantly inhibited. (epididymal adipose tissue: 17.90 ± 1.55 g vs. 23.44 ± 2.36 g, $p < 0.01$; subabdominal adipose tissue: 15.02 ± 1.44 g vs. 18.44 ± 2.36 g, $p < 0.01$) [7]. In addition, dietary fiber can affect the structure of intestinal flora to avoid obesity, and dietary fiber has less energy. It also prevents heart disease, improves constipation, lowers blood glucose, and prevents fatty liver. But the intake of dietary fiber is not the more the better. Excessive dietary fiber will hinder the absorption of protein and vitamins, causing bloating.

3.2 Effects of Fruit Polyphenols on Obesity

Plant polyphenols, also known as plant tannins, are the most diverse class of secondary metabolites in plants. They can be classified into flavonoids, phenolic acids, phenolic alcohols, stilbenes and lignans according to their structural characteristics such as phenolic rings. A large number of studies have proved that polyphenols in fruits have the effect of preventing and treating obesity. Gu et al. conducted an experimental study. The obese rats were fed a high-fat diet. After five weeks of intervention with grape seed procyanidin extract (GSPE), the liver weight (12.09 g vs. 14.40 g, $p < 0.05$) and white adipose tissue weight (1.30 g vs. 1.82 g, $0.05 < p < 0.10$) of the intervention group after the GSPE was dissolved in normal saline significantly decreased compared with those of the control group treated with normal saline, indicating that GSPE could significantly reduce the liver weight of obese rats, promote lipid metabolism in obese rats and inhibit fat deposition [8]. Polyphenols can also regulate the activity of metabolic enzymes to affect the metabolism of fat, reduce the digestion, absorption, and transport of fat, and promote its synthesis and decomposition. For example, apple polyphenols can inhibit the activity of pancreatic lipase in vitro, regulate fat metabolism in rats, lower blood lipids and prevent atherosclerosis [9, 10]. Lychee pulp polyphenols can regulate fat metabolism, inhibit dietary intake and reduce body weight in obese rats [11].

Polyphenols can also affect carbohydrate metabolism to prevent obesity. Polyphenols can inhibit glucose transport by inhibiting SGLT1 to reduce blood glucose spikes after glucose intake [12]. Sweet cherry anthocyanins (SWCN) can stimulate the insulin signaling pathway to inhibit gluconeogenesis, reduce blood glucose and insulin levels in obese mice, alleviate insulin resistance and glucose intolerance, and slow the occurrence of obesity. After Song et al. established an obese mouse model by feeding high-fat male C57BL/6J mice, the control group (HFD group) was fed with a high-fat diet and intragastrically administered with normal saline, and the treatment group (SWCN group) was fed with a high-fat diet and intragastrically administered. SWCN at a dose of 100 mg/kg. After 14 weeks, the body weight of the SWCN-treated group (37.13 ± 2.09 g) was significantly lower than that of the control group (16.76 ± 3.05 g). The glucose level and recovery speed of mice in the SWCN group were also significantly better than those in the HFD group. It shows that SWCN can reduce blood glucose and insulin levels in obese mice, thereby preventing the occurrence of obesity [13]. Besides, polyphenols may also prevent or reduce obesity by stimulating body heat production, accelerating energy consumption, affecting the proliferation, differentiation, and molecular expression of adipocytes, and regulating intestinal microflora [14].

3.3 Effects of Vitamins and Minerals in Fruits on Obesity

Vitamins and minerals are important nutrients that are indispensable to the human body. Fruits are rich in vitamins A, B, C, vitamin E, and other vitamins, as well as calcium, iron, zinc, magnesium, phosphorus, and other minerals. Since vitamin C is a cofactor necessary for carnitine production, lower concentrations of vitamin C may lead to reduced oxidation of fatty acids and may cause obesity [15]. Vitamin C can affect cholesterol metabolism, reduce triglyceride synthesis in liver cells, reduce body weight and blood lipids, and treat fatty liver. Many studies have shown that the lower the serum vitamin

D level, the higher the risk of developing metabolic syndrome (MS). The lack of vitamin D may lead to hypertension, diabetes, dyslipidemia, etc., and may increase the risk of obesity [16]. Vitamin E can affect the activity of enzymes involved in cholesterol catabolism, regulate blood lipids, and prevent obesity [17].

A number of minerals are inversely associated with obesity or its related diseases. Calcium is the most abundant mineral element in the human body, and studies have shown that dietary calcium is negatively correlated with body weight and body fat. Magnesium is an important cofactor for many enzymes and acts as a second messenger in the insulin response to signal and help improve glucose metabolism. Zinc is involved in the metabolism of carbohydrates and lipids. The serum zinc content of overweight and obese people is lower, and there is a significant correlation between cholesterol and triglycerides. It is a risk factor for obesity, diabetes, coronary heart disease, and other diseases [18]. Iron is an essential element for the formation of heme, and it is also the most abundant trace element in the human body. It affects the body's heat production function. When the iron content in the human body is maintained at a normal level, it is conducive to maintaining the normal metabolism of the body and has a positive effect on preventing obesity [17].

Some studies have shown that when the intake of iron, calcium, phosphorus, magnesium, and potassium is low, the BMI value is high. Although the difference is not obvious after adjusting the intake, the overall mineral intake of the body is not balanced. This nutritional status may contribute to obesity [19]. There are also studies showing that although mineral elements and vitamins cannot significantly reduce body weight and body fat content, they can effectively reduce the higher blood sugar and blood lipids in obese rats, improve hyperinsulinemia and hyperleptinemia, and improve the obese rats. The imbalance of material and energy metabolism helps prevent obesity [20].

So far, there are still some controversies about whether vitamins and minerals will affect and how obesity is reported. Different vitamins and minerals play different roles and have different effects on obesity. At the same time, for different age groups, there are also differences in the effects of different genders.

4 Dietary Suggestions for Fruits

More and more scientific studies have shown that a long-term unbalanced diet is closely related to obesity, cardiovascular disease, diabetes, and other chronic diseases and certain cancers, and a healthy and reasonable dietary pattern can prevent and intervene in these diseases and even cause all-cause death. Insufficient fruit intake accounted for 11.5% of the 12 dietary factors and factors associated with the estimated number of cardiometabolic deaths in 2010–12, second only to high sodium intake [21]. Studies have also shown that fruit intake is inversely related to BMI and weight change [22]. Because most fruits are rich in a variety of proteins, amino acids, vitamins, minerals, dietary fibers and a variety of nutritious active substances necessary for the human body, and have a lower fat content and fewer calories than other things. Therefore, whether it is a calorie restrict diet (CRD), low carbohydrate diet (LCD), intermittent energy restriction (IER), low glycemic index diet, dietary approaches to stop hypertension (DASH) or the Mediterranean-Style Dietary, all these dietary interventions to prevent and treat obesity are recommended to increase fruit consumption [23].

The reasonable dietary requirements in the dietary guidelines for Chinese residents suggest that the consumption of fruit is 200–350 g/d. The dietary guidelines for American residents recommend focusing on the intake of fruits (especially whole fruits), and the recommended daily intake of fruits for adults is 2 cup eq/day. In addition, most countries with recommended an intake of more than 300 g per day. Other countries without specific intakes, such as Mexico, Kenya and other countries, also recommend a large intake of fruit and vegetables. Although people's dietary patterns have improved in recent decades, for most people, the quality of their fruit diet is not ideal. In China, the urban population with a high per capita fruit consumption is only 55.7 g/d (reasonable dietary requirements are 200–350 g/d). In the United States, about 80% of American residents do not meet the recommended fruit consumption [24, 25]. All of these unbalanced dietary patterns increase the risk of obesity. We should pay attention to and make good use of a reasonable dietary pattern to maintain our health at all stages of lives.

For people who want to maintain their weight and prevent obesity, the best time for fruit intake is between meals or before meals. Because most fruits are low in fat, low in calories, and rich in dietary fiber, they not only reduce calorie intake but also enhance satiety and relieve hunger between meals, thereby reducing the amount of meals to prevent obesity.

In addition, with the rapid development of food processing technology, fruit juice drinks on the market appear in an endless stream, and many people choose to drink fruit juice drinks instead of eating fruits directly. Since most fruit juice drinks contain a lot of added sugar and other additives or preservatives, excessive intake of these drinks has no beneficial effect on health and obesity prevention. The recommended fruit group foods in the Dietary Guidelines for Americans include whole fruits and 100% pure fruit juices, and it is recommended that at least half of the fruit intake comes from whole fruits [25]. Whole fruit refers to the whole fruit in the form of fresh, canned, frozen, or dried. This fruit contains sufficient nutrients such as dietary fiber, vitamins, minerals, polyphenols and other antioxidants, and is a fruit juice beverage. Even 100% pure fruit juice cannot be replaced. Of course, increasing the intake of fruits is only part of a reasonable diet. For the prevention and intervention of overweight and obesity, age, a variety of factors such as region, race, physical condition, etc., all aspects of diet matching.

5 Discussion

This paper focuses on the prevention and intervention effects of nutrients in fruits on obesity, and gives reasonable dietary recommendations for fruits. In order to help obese and potentially obese people to alleviate obesity through fruit-based diets, and for the development of obesity-related obesity Special food offers special ideas. However, the effects of many fruits and their nutritional components on obesity are not independent, and their specific mechanisms of action remain to be further studied. In the prevention and treatment of obesity, in addition to a reasonable diet, it is also necessary to combine health education, appropriate exercise, behavioral and lifestyle interventions, and drug and surgical treatment if necessary. Obesity has become an important health problem at all ages, and the problem of obesity is highly concerning around the world.

6 Conclusion

Through investigation and research, this paper found that a variety of nutrients and bio-active components in fruits have both preventive and preventive effects on obesity. Dietary fiber can enhance satiety, improve metabolism, regulate intestinal flora, and reduce body weight. Polyphenols can affect fat metabolism by regulating enzyme activity and affecting carbohydrate metabolism. Vitamins can affect fatty acid and cholesterol metabolism, and regulate blood lipids. Minerals can participate in lipid metabolism and maintain the normal metabolism of the body. The current diet of most people is unreasonable, and the intake of fruit is seriously insufficient. A reasonable dietary pattern recommended by most countries recommends a daily intake of at least 300 g of fruit to maintain a normal healthy balance in the body.

This paper has some limitations. The nutrients in fruits are far more than these. The nutrients in different fruits are different, and their functions are also different. When eating fruit, these nutrients work at the same time, influencing each other to promote and maintain good health together. Due to these limitations, not all nutrients have been analyzed in this paper, and the functions of these nutrients have not been verified by specific experiments. In-depth research on their impact mechanisms needs to be conducted to provide more reasonable dietary patterns for obese patients or potentially obese people and help them improve their obesity status. Future research will explore more nutrients that play a positive role in the prevention of obesity and conduct in-depth research on their mechanisms.

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