

An overview of the negative effects of obesity on the body and its improvement through diet

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Abstract. Obesity is a major risk factor for chronic metabolic diseases and is strongly associated with premature death. The mechanisms linking obesity to the body's metabolic disorders include dyslipidemia, hyperglycemia, hyperinsulinemia, and hypertension. In addition, several recent studies have suggested that six types of diets (including low calorie, low carbohydrate, low fat, and high protein diets, plant-based diet, and low carbohydrate ketogenic diet) could significantly affect weight change, with each diet having its advantages and disadvantages.

Keywords: Obesity; Diet; Metabolic diseases; Weight loss.

1. Introduction

The Global Diseases Report published by the WHO states that globally in 2015, there were approximately 107.7 million children and 603.7 million adults who were obese, with an overall prevalence of obesity of 5.0% and 12.0%, respectively (The GBD 2015 Obesity Collaborators, 2017). The European Region Obesity Report 2022 shows that nearly two-thirds of adults and one-third of children in the WHO European Region are overweight or obese, and rates are still rising and tend to be youthful (Ogden et al., 2014). Being overweight and obese are not only important risk factors for many chronic diseases, such as diabetes and cardiovascular disease but are also strongly associated with an increased risk of death and show a trend of rejuvenation (Moriarty-Kelsey and Daniels, 2010).

Obesity has become a serious social problem. Given the enormous health risks of obesity, successful and safe weight loss methods are of wide interest. Current treatments for obesity include medication, exercise, diet, and more. However, medication may not only cause other diseases in the body but also have a high risk of rebound. Exercise and diet are therefore still the basic treatment strategies for weight loss. However, there is already evidence that diet changes weight loss more than physical activity (Barlow and the Expert Committee, 2007). However, different dietary patterns also have different effects on weight loss. In this study, we will review the health risks of obesity and the five common diets for weight loss promotion to provide reference material to researchers in the future.

2. Obesity-related diseases

Researchers define obesity by body mass index (BMI), which is strongly associated with disease risk. Overweight is a BMI above 25, and obesity is defined as a BMI at or above 30 (the Vasorisk group et al., 2012). The risk of mortality increases when BMI increases from 25. In addition, the waist-to-hip ratio is one of the most important indicators of the correlation between obesity and disease. When the waist-to-hip ratio exceeds the standard, it is considered abdominal obesity (Pimenta et al., 2016). On a physical level, abdominal obesity causes the expansion of visceral adipose tissue or visceral fat accumulation in and around the internal organs of the body, which leads to many metabolic diseases. In addition, visceral adipose tissue secretes more proinflammatory cytokines and prothrombotic factors than subcutaneous adipose tissue contributing to chronic low-grade inflammation.

2.1 Dislipidemia

Free fatty acids are released by the visceral adipose tissue of abdominally obese individuals and converted to triglycerides in the liver and exported as very low-density lipoproteins (VLDLs) into the blood. In addition, cholesterol ester protein in the blood acts as VLDL and high-density lipoproteins

(HDL), leading to fewer high-density lipoproteins (HDL-C) and greater amounts of small dense low-density lipoprotein (LDL), which lead to the development of atherosclerosis in the blood.

2.2 Hyperglycemia

Metabolic abnormalities can occur when the liver is unable to process all fatty acids. The fatty acids that cannot be absorbed can turn the liver into a fatty liver, which is what causes its sensitivity to circulate insulin to decrease. When insulin resistance occurs, the fatty liver begins to secrete more glucose, contributing to high blood glucose levels. Moreover, excess nonesterified fatty acids (NEFAs) in the blood are taken up by skeletal muscle, which can become insulin resistant as NEFAs accumulate. Furthermore, fatty acids compete with glucose uptake by skeletal tissue. When excess fatty acids are absorbed by skeletal muscle, glucose uptake is reduced, leading to hyperglycemia.

2.3 Hyperinsulinemia

In obese people, excessive storage of fat brings about an intensification of fat degradation, and a large number of free fatty acids produced by lipolysis enter the liver and peripheral tissues, resulting in liver sugar utilization and glycogen heterogeneity disorders (Bray, 2004). At the same time, the liver takes less insulin, increasing the concentration of circulating insulin, which in turn leads to a decrease in the expression of insulin collection, resulting in insulin resistance. Furthermore, in an environment of high free fatty acids, the activity of the cellular insulin receptor complex kinase is inhibited, thereby inhibiting the expression of insulin receptor substrates and their activity, resulting in insulin resistance. Obese people have decreased sensitivity to insulin, and increased compensatory secretion of the pancreas can also lead to hyperinsulinemia (Zhijuan, Zhang and Zhiyu, Huang, 2001).

2.4 Hypertension

As mentioned above, adipose tissue is capable of secreting a variety of adipokines, which in turn are involved in metabolic syndrome. The body's endocrine leptin releases nitric oxide through the activation of vascular endothelial cells, which in turn leads to vasodilation. In obese individuals with chronic hyperleptinemia, leptin resistance occurs at the hypothalamic and renal levels, the natriuretic effect of leptin in the body is lost, and leptin-induced nitric oxide release is reduced, leading to an increase in blood pressure (Derakhshan, 2004).

3. Dietary treatment of obesity

Dietary weight reduction focuses on limiting the number of calories provided by the diet while supplying sufficient amounts of various nutrients, such as essential amino acids, vitamins, and minerals. In addition, the amount of energy consumed is less than the amount of energy expended, thus achieving weight loss.

3.1 Low-calorie diet (LCD)

Compared to VLCDs, the energy intake of this diet is relatively high, ranging from 800 kcal to 1500 kcal. This diet increases the dietary fiber and low-sugar dietary components to increase satiety and lower postprandial blood glucose levels.

Gugliucci et al. (Gugliucci et al., 2009) found an average 6.3% reduction in BMI and an 11.9% reduction in triglycerides in subjects studied over two months, indicating that this diet was able to rapidly reduce body weight while improving triglyceride levels.

3.2 Low-carbohydrate diet

The proportion of carbohydrates in the diet needs to be less than 30%, with vegetables, fruit, and whole grains as the main sources of carbohydrates. Moller et al. (Moller and Krogh-Madsen, 2008) compared low-carb and low-fat diets and found that subjects lost more weight on average over a year. Those on the low-carbohydrate diet had a TC/HDL-C of 20%, which was 8% higher than that of the

low-fat group, significantly increasing HDL-C levels. However, the rate of urinary ketosis was found to be higher in the low carbohydrate group over two years. Both diets lowered blood pressure and were not significantly different.

3.3 Low-fat fat diet

As one of the six major nutrients, fat is energy dense, and low satiety produces a large amount of heat and is easily consumed in excess, so people should also strictly control their fat intake in a normal diet, which should account for 20% of total calories. Some studies note that for every 1% reduction in fat intake, 0.37 kg of body weight can be lost; a 10% reduction can lead to a 4.4 kg loss.

Bahadori et al. (Bahadori et al., 2005) experimented with subjects on a low-fat diet for six months and found a weight loss of approximately 8.9 kg, with a 15% reduction in adipose tissue and a 5% reduction in other tissues. The results suggested that a low-fat diet could significantly reduce the body's adipose tissue and lower total cholesterol and LDL-C.

3.4 High protein diet

In recent years, two popular protein diets are the high-protein diet, which means that protein accounts for more than 20% of the energy supply of the dietary structure, and the traditional standard protein diet, which means that the protein energy supply ratio is between 12% and 15%. Xu et al. (Dafeng, Xu et al., 2020). found that a high-protein diet not only led to significant weight loss in obese people compared to a standard protein diet but also improved blood lipids.

Traditionally, a high-protein diet is thought to increase the amount of dietary protein, reduce the proportion of carbohydrates and increase satiety, thereby reducing energy intake. However, Magkos et al. (Magkos et al., 2021) appropriately increased the protein intake of one group of experimenters in two groups of VLCDs by controlling the nutrient intake percentage. The changes in body weight and basal metabolism did not differ significantly between the two groups. The high protein group lost 11.5 kg, and the other group lost 13.2 kg, thus showing that consuming more protein under the VLCD diet does not enhance weight loss in the short term, but may have negative effects due to more energy intake. However, the experiment was short-lived, and it is not yet possible to judge whether prolonged adherence to a high-protein diet is beneficial for weight loss.

3.5 Plant-based diet

Epidemiological studies have shown that adherence to a healthy plant-based diet can improve the risk of obesity and its associated cardiovascular disease (Turner-McGrievy et al., 2017). A plant-based diet is not the same as vegetarianism. A plant-based diet is based on the consumption of plant-based ingredients such as fruits, vegetables, legumes, nuts, and whole grains, with a small amount of lean meat and low-fat dairy products. Wang et al. (Wang et al., 2015) demonstrated that a vegetarian diet was effective in reducing total cholesterol, LDL cholesterol, HDL cholesterol, and non-HDL cholesterol concentrations in the blood. In addition, Heianza et al. (Heianza et al., 2021) found that a plant-based diet also reduced the risk of myocardial infarction and showed significant improvements in obesity-related cardiometabolic disease.

3.6 Low-carbon hydrate ketogenic diet

The ketogenic diet, which requires people to consume less than 50 g of carbohydrates per day, was first used to treat epilepsy (Tucker, 1975). It has since been studied and found to induce nutritional ketosis by lowering insulin levels and promoting lipid metabolism, which in turn leads to weight loss (Gardos and Cole, 1976). Amari et al. (Al Aamri et al., 2022) found that low-carb ketogenic diets were more significant than low-calorie fat diets in terms of weight loss. Additionally, the LCKD was effective in reducing visceral fat.

4. Conclusion

In addition to genetic factors and pathological factors, the main cause of obesity is energy overload in the body, so the key to weight loss is to reduce energy intake while increasing energy expenditure, ensuring that the body is in a negative energy balance. Obesity is unhealthy and can also lead to many potential diseases. We should find a healthy way to lose weight and keep fit. Most weight loss diets are effective in the short term but also hurt the body. Weight loss is a long-term process, and more experimental support is needed to find a diet that is safe, nutritionally adequate, nonrebounding, avoids secondary damage to the body, and thus prevents the development of metabolic disease.

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