

Effects of Diet and Exercise on Weight and Complications of Overweight/Obesity

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Abstract. With the change of the diet structure of Chinese residents, the incidence of overweight and obesity has increased year by year in recent years, and it is closely related to the occurrence and development of a variety of systemic diseases and has become the main influencing factor endangering the health of residents. In addition, obesity in China also has an obvious tendency to develop at a younger age. Obesity is caused by the imbalance between energy intake and expenditure. When the human body takes in too much energy and consumes too little, it will result in abnormal or excessive accumulation of fat, forming obesity. A number of studies have shown that diet combined with exercise intervention is effective, consumes calories and reduces excess fat, so as to control weight as soon as possible, relieve symptoms, improve metabolic level and improve quality of life. At the same time, it is necessary to combine health education mode to effectively improve patients' self-management level, and help patients correctly understand the disease and master self-management skills. And guide patients to carry out effective self-management.

Keywords: Overweight, obesity, diet, exercise.

1. Introduction

In the current social background, people's dietary structure has undergone significant changes, and the situation of overweight and obesity has shown a rapid growth trend on a global scale. The World Health Organization (WHO) reports that more than 350 million people worldwide are diagnosed with obesity, and obesity is also associated with many chronic diseases, such as type 2 diabetes, cardiovascular disease and so on.

How to control your weight within a healthy range has become a hot topic in all walks of life. At present, there are three mainstream weight loss methods on the market, drug weight loss, exercise weight loss and diet weight loss. In the process of using drugs to lose weight, the wrong choice of drugs or improper eating methods may cause serious harm to the body. Under the premise of ensuring good health, losing weight through exercise and diet has become a better choice. At present, the medical community generally believes that reducing body weight by 5% to 10% can improve various obesity-related cardiovascular diseases and complications [1]. Changing diet structure and increasing exercise are regarded as the core means to reduce weight, such as aerobic exercise, resistance training and other exercises, coupled with improving the diet pattern of low carbohydrate, low fat, high protein and high dietary fiber; These integrated strategies can lead to increased energy consumption and improved health.

Therefore, in-depth exploration of the advantages and challenges of diet combined with exercise as a comprehensive intervention strategy for weight control and complication management in obese and overweight people is a topic that we need to focus on. While there are not much research on the influence of the combination of diet and exercise on the human body, so this paper aims to reveal the synergistic effect of diet and exercise through scientific theoretical analysis and practical cases, and explore its potential advantages in improving obesity-related complications.

2. Overweight/Obesity and the Complications

2.1. Prevalence Rate

In the past decade, the prevalence of obesity and overweight has been on the rise globally. According to estimates by the WHO, in 2022, 2.5 billion adults in the global population will be overweight or obese, accounting for 40% of the total, of which 900 million will be obese, accounting for about 17% of the adult obesity. 160 million adolescents and children aged 5 to 19 are obese, while more than 400 million are overweight [2]. According to the latest "2023 Global Obesity Map" released by the World Obesity Association, by 2035, the world will be overweight or obese by more than 4 billion people, accounting for 51% of the global population [3]. According to the data of the National Health and Health Commission, the aging problem in China is gradually becoming serious. By the end of 2021, the population of the special population, the elderly people over 60 years old who are obese, will reach nearly 270 million, accounting for 19% of the total population. There are also more than 200 million people aged 65, accounting for 14% of the total population [4]. In 2023, the population of obese or overweight elderly people over 60 years old is expected to exceed 400 million, accounting for more than 31% of the total population [5].

2.2. Clinical Features/ Hazardous Complications

The two main methods used to determine the diagnosis of obesity and overweight are reference Body mass index (BMI) and Waist circumference (WC). The WHO considers overweight to be $25\text{kg/m}^2 < \text{BMI} < 30\text{kg/m}^2$, while obesity is defined as $\text{BMI} > 30\text{kg/m}^2$. The International diabetes federation (IDF) defines central obesity as $\text{WC} > 90\text{cm}$ for men and $\text{WC} > 80\text{cm}$ for women. According to the actual situation of the population in China, $24\text{kg/m}^2 < \text{BMI} < 28\text{kg/m}^2$ is explained as overweight, obesity is $\text{BMI} > 28\text{kg/m}^2$, and the value of main obesity is $\text{WC} > 90\text{cm}$ for men and $\text{WC} > 85\text{cm}$ for women [2]. According to obese and overweight people, their common body shape is abdominal obesity, which is called "apple shape".

The WHO defines obesity and overweight as storing up a host of chronic diseases, like high blood pressure, diabetes, stroke, unhealthy cholesterol levels and more. Type 2 diabetes is a chronic metabolic disease that is an important risk factor for obesity, mainly due to resistance between high blood sugar levels and insulin, which accelerates the progression of the disease [6]. The number of diabetic patients in China is about 1.0% ~ 11.7% [7]. The risk of diabetes comorbidity (HDC) in the overweight or obese group was 1.6 and 3.40 times higher than that in the normal BMI group, and the risk of HDC in the waist circumference (WC) group was 2.7 times higher than that in the normal WC group [8]. Obesity and overweight are also more likely to cause sleep disorders, arthritis, intestinal inflammation and systemic inflammation etc. According to research, children who sleep less than 9 hours a day will increase the risk of obesity, which is between two and three times more than that of normal children. Lack of sleep may lead to changes in the levels of leptin, growth hormone and other hormones in the body, which will lead to hunger and food intake, and increase the risk of obesity. Therefore, maintaining good sleep habits can help reduce the risk of obesity [2]. In addition, studies on the risk of cardiovascular and metabolic diseases have shown that non-alcoholic liver disease is an important factor in metabolic syndrome and cardiovascular disease, so pancreatic fat deposition is a potential factor in insulin resistance and has major implications for the prevention of diabetes [9]. In addition, obesity is closely related to cardiovascular diseases such as coronary heart disease, hypertension, etc., and it is also involved in promoting inflammatory response, oxidative stress, insulin response, etc [10]. In terms of mental and mental health, obesity is also associated with negative depression such as depression, self-perception, anxiety and other psychological disorders. Along with social psychological problems, mental depression and work stress, people will consume sugar to obtain satisfaction and reduce their psychological stress further increase obesity [2]. Overweight and obese people are also connected with an increased incidence of many types of cancer, significantly increasing the risk of cancer [4].

3. Intervention of Diet and Exercise in Overweight/Obese Population

3.1. Regular Diet Combined with Exercise

If the body's nutrients are not up to standard, it may not meet the requirements of body metabolism, especially protein, trace elements, vitamins, etc., and even lead to disease. So people need to comply with scientific weight loss, with scientific diet control. Diet control needs to master three points: control total calorie intake, reduce fat intake, intake of essential nutrients. The first is to control your total calorie intake, such as keeping track of your daily food intake and weight. Many scientists say that if you use 85-90% of the calculated energy, you can lose 1-2 kilograms in a week. The second is to lower your daily fat intake. Protein is very important in our body, in order to ensure the daily quality of protein supplement, meat is a must intake. Controlling diet also requires a reasonable intake of nutrients in proportion and total. No more than 100 grams of staple food per meal, 250 grams of vegetables, fruits and milk each. The third is to maintain the quality of the daily supplement of nutrients. Use meal management software to find out which nutrients are over or under-consumed each day [11]. On the basis of a reasonable and scientific low-energy diet, it is also necessary to combine regular light to moderate aerobic exercise, such as fast walking, walking, climbing, jogging and so on. Walking requirements are at least 7,000 to 10,000 steps per day, and other exercise requirements are at least 30 minutes per day. According to the test, 1-2 times a day aerobic, energy negative balance reached 750kcal, you can lose 0.7 kg per week [11]. Timely supplementation of protein after exercise contributes to muscle synthesis, can help overweight and obese people reduce body fat, and can promote energy metabolism and decomposition of fat [12].

The selected subjects were 18 obese patients (5 males and 13 females) who had been treated in the nutrition consultation clinic. By measuring BMI, 11 of them were overweight (25.0-29.9kg/m²), 4 were Grade 1 obese (30.0-35.0), and Grade 2 and 3 obese (35.0-40.0). In this study, 70% to 90% of the required energy was used, protein accounted for 17%, fat accounted for 25% of the total energy, and carbohydrates accounted for 58%. Patients can make their own food every week, but according to the parameters given by the medical staff, they also need to exercise moderately. After one year, all patients had significantly reduced body weight and body fat content ($P<0.05$). 10 of the patients managed to reach the standard BMI (18.5-24.9), while the other eight did not reach the standard weight, but the health risks were reduced like all patients are not more likely to get cancer and T2DM, another 13 patients had nearly normal body fat, significantly lower BMI than before ($P<0.05$), and no patients felt uncomfortable symptoms in the course of weight loss, liver and kidney function compared with before treatment had no significant changes [13].

3.2. Intermittent Fasting Combined with Exercise

In recent years, intermittent fasting (IF) has been widely sought after as a weight loss method by the public. IF is a dietary strategy that alternates between eating and fasting periods [6]. IF is divided into three main categories: alternate day fasting (24h forbidden food and 24h free diet exchange), 5:2 intermittent fasting (that is, fasting two days a week) and daily time-restricted eating (that is, fasting at a specified time in the day, commonly 16h a day). Glucose and fatty acids are the main sources of energy for cells. Fat is stored in adipose tissue as triglycerides. During fasting, the body breaks down triglycerides into fatty acids and glycerol, which are used for energy. And then, the liver converts the fatty acids into ketones. During feeding, blood levels of ketone bodies in humans are low. Within 8-12h of starting the fast, blood levels of ketone bodies show an upward trend, reaching levels of 2-5mM within 24 hours. Ketone bodies are powerful signaling molecules that have a huge impact on cell and organ function [14].

In one study, a total of 16 non-obese subjects fasted for 22 days every other day. These subjects lost 2.5% of their body weight, 4% of their initial fat mass, and 57% of their fasting insulin levels [15]. In another one-year observational study, 1,422 participants participated in a fasting program of 4-21 days with a daily calorie intake of 200-250 kcal. And accompanied by a light physical exercise program. After the end of the fasting period, the body weight and BMI of the subjects decreased

significantly, the blood glucose and blood lipid indexes also showed a decreasing trend, and the ketone body level increased significantly [16]. In another trial, 78 obese subjects ($BMI \geq 30$) were randomly assigned to 14:10 (14:10 time restricted eating beginning after dinner, a "fasting snack" at hour 12, and ending with breakfast 14 h later) or 12:12 in one of the groups and prescribed a diet and exercise program for an 8-week randomized controlled clinical trial. Finally, those in the 14:10 and 12:10 groups lost 8.5% and 7.1% of their body weight, respectively. At the same time, the fasting blood glucose was significantly lower in both groups of subjects who received the intervention [17]. All showed that IF was effective in reducing body weight, fasting insulin levels, blood sugar and lipid levels.

At the same time, it is worth noting the effect of intermittent fasting on athletic performance, and intermittent fasting can provide improvements in physical function. In the early stage, time-limited fasting is unfavorable to the performance of anaerobic exercise, because the body needs a fuel adaptation period, while the later period will be improved because of the physiological adaptation of the body [18]. One study examined the effects of IF on muscle and anaerobic performance in 14 women. Studies have shown that high-intensity interval training during fasting can reduce body fat, maintain muscle mass and improve anaerobic exercise performance [19]. Therefore, exercise training or protein intake during intermittent fasting can reduce weight, improve or increase muscle mass, strength and function, and enhance athletic performance. [18]

However, intermittent fasting has significant drawbacks. First, there is a lack of carbohydrate and energy supply during intermittent fasting, so many people who first switch to intermittent fasting feel hungry, irritable and unfocused. But these symptoms usually go away about a month after they start. Secondly, it is difficult to implement exactly in medical treatment. People have become so accustomed to eating three meals a day and a few snacks that patients and doctors rarely consider this mode of treatment [20].

3.3. Caloric Restriction Combined with Exercise

Caloric restriction is one of the intervention methods to lose weight and maintain body health, which is defined as reducing the intake of calories in the case of ensuring that the organism does not suffer from malnutrition, but giving the body the necessary nutrients such as protein, essential amino acids and trace elements, so that the body energy consumption is greater than the intake, so as to achieve the purpose of weight loss, also known as dietary restriction.

A randomized, parallel, controlled trial included 29 overweight and obese undergraduate students who were randomly divided into four groups: caloric restriction group, jump rope group, combination group and control group. The trial lasted for eight weeks. After intervention, compared with the control group, the body fat percentage and fat mass index of caloric restriction and combined exercise groups were decreased, while the systolic blood pressure and diastolic blood pressure of combined caloric restriction group were higher than those of control group (all $P < 0.05$). Compared with baseline, fat mass index in the caloric restriction group decreased, and body weight, BMI, and fat mass index in the combined group decreased (all $P < 0.05$), indicating that caloric restriction combined exercise can also reduce body weight, lower blood pressure, and improve cardiovascular and metabolic indicators such as glucose and lipid metabolism and inflammation in healthy young and middle-aged people [21].

A randomized controlled trial to explore dietary weight loss and exercise intervention effects on the quality of life in overweight/obese postmenopausal women. As a result, the combined diet + exercise group improved 4 aspects of HRQOL (physical functioning, role-physical, vitality, and mental health), and stress ($p < 0.05$), combination of caloric restriction and aerobic exercise resulted in a positive percentage, strongly suggesting it will be better to do it at the same time, rather than doing caloric restriction or aerobic exercise alone [22].

During the diet and exercise intervention, the implementation of the patient can be tracked and managed, which can not only understand the improvement of the patient's obesity symptoms and the effect of the intervention program in real time, but also play a certain supervisory role, so that the

patient can maintain good eating habits and exercise habits in daily life. However, in practice, people also face the influence of complex factors, such as individual differences, psychological barriers, social environment, etc., but diet and exercise interventions do not play a uniform role for all people.

4. Conclusion

In summary, obesity and overweight have become serious health problems, which may lead to a variety of complications, such as type 2 diabetes, sleep deprivation, and an increased risk of cardiovascular and metabolic diseases. In terms of psychological and mental health, obesity is also associated with negative depressive psychology (such as depression), self-perception, and psychological disorders such as anxiety.

Diet combined with exercise is the key to solving this problem. Specific case studies and clinical research on dietary and exercise interventions have provided ample evidence that this approach is highly effective in managing weight and improving outcomes for overweight and obese individuals. However, whether these diets will work for all populations has yet to be determined. The current diet experiments are basically short-term, and the selection of subjects is also limited. Moreover, the causes of metabolic problems are diverse, and it is not possible to rely on diet and exercise alone to improve obesity or health status.

Therefore, future interventions should place greater emphasis on individualization, sustainability and feasibility, also, multi-disciplinary, multi-center, large-scale, high-quality RCT research is needed to obtain different data and integrate analysis utilizing technology and collaboration among multidisciplinary teams to provide more precise and effective health management solutions.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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