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Effect and Mechanism of Aerobic Exercise on Prevention and Control of Adult Obesity in Young Rats

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Abstract: Adult obesity is a common problem at this stage, leading to the emergence of many obesity diseases, seriously jeopardized life and health. The purpose of this study was to explore the role and mechanism of aerobic exercise in the prevention and control of obesity in adulthood. In this paper, the development trend and measures of obesity in adulthood are described in detail. Then, the influencing factors of obesity in adulthood are analyzed from the perspectives of energy metabolism and exercise factors. Then, with the help of the experimental model of young rats, the specific role of aerobic exercise in the prevention and control of obesity in adulthood and the related mechanisms were explored and analyzed. The rate of obesity in adulthood was reduced by about 24 percent, the rate of obesity in adulthood was reduced by about 25 percent, and the rate of obesity recovery was increased by about 26 percent, when compared with the data without aerobic exercise. Overall, sustained aerobic exercise over a long period of time may protect against obesity in adulthood.

1. Introduction

At this stage, obesity has gradually become a universal problem in the world. Statistics show that in recent years, the proportion of obese adults in the world has been increasing year by year. Studies have shown that obesity in adulthood is related to diet and habits in childhood, especially inappropriate dietary characteristics. Therefore, a long period of exercise in childhood can achieve effective regulation of human metabolic activities to a certain extent, so as to minimize the possibility of obesity in adulthood. In addition, obesity in adulthood tends to lead to a variety of common diseases, which cannot guarantee the quality of life and physical health of obese people. Based on this, it is of great significance to conduct an in-depth study on the specific role and mechanism of prevention and control of obesity in adulthood.

With the change of people's lifestyle, obesity in adulthood has become a worldwide health problem. Scholars at home and abroad have conducted a series of studies on it and obtained relevant research results [1]. In literature [2], the author studied the specific causes of obesity in adulthood

from the perspectives of genes, lifestyle and environment. The results showed that the causes of obesity in adulthood were various, among which lifestyle was the most important external factor. In literature [3], the author analyzed the harmful effects of obesity in adulthood with the help of a rat exercise model, and the results showed that obesity in adulthood has a much higher incidence of diseases than normal weight. In literature [4], the author focused on the specific effect of environmental changes on human internal genes on obesity in adulthood. The research results showed that genetic changes caused by environment would, to some extent, increase the probability of obesity in adulthood. In literature [5], the author investigated the development of adult obesity worldwide in recent years by means of data investigation and big data analysis, and proposed specific strategies to prevent adult obesity on this basis.

To explore the aerobic exercise on the prevention and control of adulthood a specific role of obesity and its related mechanism, promote effective prevention [6] obesity in adulthood, this article first to the development trend of obesity in adulthood and measures in detail, and then from two angles of the energy metabolism and movement factors analyzed the influencing factors of the obesity in adulthood; Then, with the help of young rats, the experimental model was established to explore and analyze the specific role of aerobic exercise in preventing and controlling obesity in adulthood and related mechanisms [7]. The study in this paper not only provides a relatively sufficient experimental theoretical basis for the effective prevention and control of obesity in adulthood, but also lays a theoretical foundation for subsequent studies in related aspects [8].

2. Conceptual Theory

2.1. Trends and Measures of Obesity in Adulthood

At this stage, overweight and obesity have become a common public health problem in the world. BMI>25kg/m2 was defined as overweight, and a BMI of > of 30kg/m2 was defined as obese [9]. Previously, obesity had a high incidence in developed countries, and it still has a high incidence in developing countries. Obesity will promote the emergence of various types of diseases, and the common diseases caused by obesity include hypertension, diabetes and heart disease [10]. In recent years, the global trend of adult obesity has become increasingly serious, and the problem of childhood obesity has become increasingly prominent [11]. Statistics show that more than half the population in developed countries is obese. Almost one in three adults meets the so-called obesity criteria. According to the specific overweight and obesity criteria set by the world health organization in 2019, there are 1.6 billion obese adults in the world [12]. In recent years, obesity has become a common problem in developing countries. Influenced by the unhealthy lifestyle such as overnutrition and insufficient exercise, obesity has become an inevitable development trend. At the same time, due to the decline of children's activities, the number of obesity in the youth is also increasing. At this stage of the statistics, in the developing countries, about 235 million people are obese. According to the results of the big data analysis, the mortality rate of related diseases, especially cardiovascular diseases, increased by 127% in developing countries due to obesity. According to the statistics of China in 2016, there are about 263 million obese adults, among which the urban population accounts for 53.4% of the total obese adults in China. Some scholars have investigated the obesity situation in rural areas, and the results show that the proportion of obesity in rural men and women is relatively high in adulthood. According to the survey data of China, it is suggested that the specific criteria of overweight and obesity in China should be set at 24 and 28 based on the physiological characteristics of Chinese people. Based on this standard, more people in China will be included in the overweight and obesity population.

Worldwide, human morbidity, mortality and quality of life are one of the important factors affecting the occurrence of various types of obesity diseases, which consume a huge amount of

medical resources. Obesity diseases, such as diabetes and metabolic syndrome, are also on the rise in developing countries, and sound policies and programmes are needed to combat the disease. Theoretically speaking, reducing energy intake and promoting energy expenditure can cure and prevent obesity to some extent. Exercise is recognized as the most effective and healthy way to combat obesity in adulthood. There is no doubt that the abundance of food and the decline of physical activity are the main causes of obesity in China. Not only that, but genes are also a factor to be considered in the emergence of obesity-related diseases. Therefore, these factors should be taken into full consideration in the development of strategies for obesity.

2.2. Influencing Factors of Adult Obesity

(1)Energy metabolism factors

The reason that fat produces basically is because the energy that the body takes in is far bigger than the energy that the body can metabolize, redundant energy accumulates in body body for a long time easy cause fat. Thus, energy metabolism is a key factor in the formation of obesity in adulthood. The regulation of human energy metabolism is realized through the hypothalamus, and the storage of energy in the body is adipose tissue. The above two parts are also important joints in the process of forming programmed mechanism during human growth and development. A large number of genes that regulate energy metabolism exist in the hypothalamus and adipose tissue. They effectively maintain the overall balance of body functions from the synthesis and decomposition of metabolism, and some specific genes may also play a crucial role in the process of regulating energy metabolism. At present, many studies have begun to explore the key parts and related genes that regulate energy metabolism from the perspective of programming. At present, the most important energy regulation system is the hypothalamus, which is involved in the regulation of energy by multiple nuclear groups. The melanosin and NPY systems in the hypothalamus are the two main components to ensure the smooth functioning of hypothalamic mediation. The melanin system consists of POMC neurons, melanotropin and melanocorticoid receptors. This system can effectively control appetite and promote metabolism. The NPY system consists of NPY neurons, AgRP, and NPY receptors, which increase appetite and metabolism. The existing research data prove that the hypothalamus neuron plays an important role in the balance of energy, which, together with other ligands, plays a role in the formation of obesity. Moreover, POMC neurons in the hypothalamus are also important target cells in Leptin, which can effectively connect the energy stored in the central and peripheral tissues together. In the regulation of food intake of neurons can also for other similar functions of neuropeptide secretion, and with a variety of types of energy signal to produce a connection, and then realize the whole body ingestion, body weight and the specific regulation of energy balance, making its weight always stay in a stable condition.

(2) Sports factors

Adipose tissue is the most important part to store energy of the body, which is also a key endocrine organ. Multiple types of cytokines are secreted from this tissue. Such cells can effectively regulate local and overall energy and maintain a relatively balanced state. At the same time, the energy consumption of exercise mainly relies on the decomposition of triglycerides inside fat cells to achieve the specific supply of fatty acid energy. Therefore, exercise can promote the continuous decrease of specific fat content inside fat cells to a large extent. When fat is decomposed, the specific expression and secretion of most adipocytokines in the table will be affected, and to some extent, the proliferation and differentiation activities of some adipocytes will also be affected. In particular, aerobic exercise promoted the body weight and the body fat content to continuously reduce, but also promoted the effective improvement of various symptoms caused by obesity, which was mainly caused by the transformation of fat cytokines. In addition, adipose tissue not only

provides sufficient energy supply for body exercise, but also promotes the recovery of energy after body exercise. The research results of many scholars show that when the body is in the state of obesity and overweight, the content of Adiponectin in human blood will be reduced to some extent. However, after exercise, the content of Adiponectin in human blood will also be solicited due to the decrease of body weight.

3. Aerobic Exercise Training Experiment of Young Rats

(1) Experimental materials and methods

The young rats involved in the experiment in this paper were all SD pure rats of clean grade, which were provided by the animal experiment center. The young rats were all 3 weeks old, and these young rats were male rats that had just weaned. A total of 24 rats were involved in the experiment. The diet of the rats was a mixture of normal tap water and standard rats. The rats involved in the experiment were all in a state of free feeding, and the animal feed provider was the animal experiment center providing the rats. The humidity in the environment of the experimental rats was 50% ±5%, and the temperature was basically 23±2℃. Natural light was used in the room. Specific experimental scheme consists of two parts: first, the growth cycle for 3 weeks of young rats were divided into control group and exercise group, each group, there were 12 rats in the control group in C, C group rats not aerobic exercise, exercise group rats expressed in E, E group of rats, an aerobic exercise on a daily basis, experimental period of 9 weeks; Second, after the end of the first part of the experiment, the growth cycle of the rats was 12 weeks. Then, rats in group C were randomly divided into adult control group and adult obesity group, with 6 rats in each group, respectively represented by CC group and DIO group. Rats in group E were randomly divided into adult high-fat group and adult obesity exercise group, with 6 rats in each group, respectively represented by EH and EHE. Rats in DIO, EH and EHE groups were given high-fat diet.

(2) Acquisition of original data

In order to ensure the accuracy and scientificity of the experimental data to the maximum extent and provide sufficient data support for the aerobic exercise of the young rats in this paper, the author logged on the relevant data websites such as wanfang and zhiwang, and made statistics on the experimental data of the existing research data in this aspect at the present stage. The author collected a total of 27 pieces of research data in this field and statistically sorted out these data to form the original data of the experiment in this paper, which provided important data support for the experiment in this paper.

(3) Sports scheme design

Growth period is 3 weeks rats of the early stage of the concrete exercise plan arrangement as follows, the first 30 minutes of aerobic exercise, will increase the time of aerobic exercise for 15 minutes a week, every time when the aerobic exercise training volume reaches 60 minutes later, after training to add five minutes per week, at the end of the first part of the experimental rats in 9 weeks aerobic exercise time to reach 90 minutes at a time. Do aerobic exercise once a day and five times a week for 12 weeks. The water in the plastic bucket was 50cm high. The swimming activity area of each rat was 200cm2. In order to ensure the continuous aerobic exercise of the rats, the temperature of the swimming water was controlled at 35±1℃ during the experiment.

(4) Proportion of high fat feed

The specific formula of high fat feed is as follows. For every 100 grams of high fat feed, there are 20 grams of lard, 74 grams of basic feed, 4 grams of salt and 2 grams of cholesterol. The specific percentage of calories from the various nutrients in the high-fat feed was as follows: 46 percent fat, 34 percent carbohydrate, and 20 percent protein.

(5) Experimental materials

Before the use of the mouse material, fast and prohibit water for 8h, and stop the aerobic exercise training for 48h. Sodium pentobarbital (0.5%) was anesthetized by intraperitoneal injection, and blood was collected at the heart site. Serum was then prepared and stored at 20 degrees Celsius. Another part of the rats in each group were given normal saline for cardiac management, followed by perfusion with 4% paraformaldehyde, and then the fat pad around the kidney was removed, and the formaldehyde fixator was transferred to the dead weight and stored at a temperature of 4 ℃ for later use.

(6) Serum index test

Cholesterol was tested by glucose oxidase method, total serum cholesterol and triglycerides were tested by COD - PAD method, and then automated tests were conducted under the support of automatic biochemical analyzer. Insulin was tested by competitive radioimmunoassay (ria) using a kit purchased from China atomic energy science center. The specific conditions of Leptin and Adiponectin in serum were tested by the method of EUSA. The specific instrument was the WeUscan MK2 enzyme marker.

(7) Calculation and detection of other indicators

Harvest from the rat epididymal fat pads and renal week fat pad, and put it in the weighing electronic scale, and with the help of related formula for calculation, the percentage of fat in mice fat ratio calculation of epididymal fat pad and renal weeks fat pad weight sum divided by the total weight of rats itself, and then multiplied by one hundred percent. In addition, with the help of relevant software, the specific number of fat cells in rats and the relevant data of each type were detected and quantitatively analyzed.

(8) Statistical analysis of data

During the experiment, the data in the experiment were recorded accurately, and the data were sorted out after the experiment. The data generated in the experiment were expressed as mean ± standard deviation, and the results of cell number were compared by means of chi-square test. The significance level was set by means of variance trobosi for other types of indicators in different groups. The experimental data were statistically analyzed with SPSS statistical analysis software.

4. Discussion on the Effect and Mechanism of Aerobic Exercise in Young Rats on Prevention and Control of Obesity in Adults

4.1. Experimental Results

(1) Visceral fat pad weight and fat body ratio of rats at different growth stages

There was no statistical difference in body weight between rats in group C and group E at the beginning of the experiment. After aerobic exercise for 9 weeks, the body weight of rats in group E at 12 weeks of growth cycle was significantly lower than that in group C, and the difference was statistically significant. The specific results are shown in table 1. Rats aged 12 weeks in group C were randomly divided into CC group and DIO group. There was no significant statistical difference in body weight between the two groups. Rats in group E were randomly divided into EH group and EHE group.

Table 1. Comparison of body weight, fat pad weight and fat body ratio of rats in each group

Group	Weight(g)	Fat pad weight(g)	Fat body than(%)
CC	581.00±67.29	21.16±7.10	3.51±1.00
DIO	641.33±65.03	29.62±5.89	4.60±0.47
EH	555.18±66.87	7.63±2.75	1.61±0.59
EHE	464.77±41.82	5.78±3.63	1.20±0.65
*Data were derived from the results of the experimental analysis			

The data in table 1 showed that when the young rats grew to 24 weeks old, the weight of rats in the DIO group was statistically significant to that of rats in the CC group and the EH group. The overall weight of rats in the DIO group was higher than that of rats in the CC group, and the weight of rats in the EHE group was also higher than that of rats in the CC group. The fat pad weight of rats in DIO group was significantly higher than that in CC group and EH group, and the fat pad weight of rats in DIO group was also higher than that in CC group, and much higher than that in EH group.

(2)Serum index detection

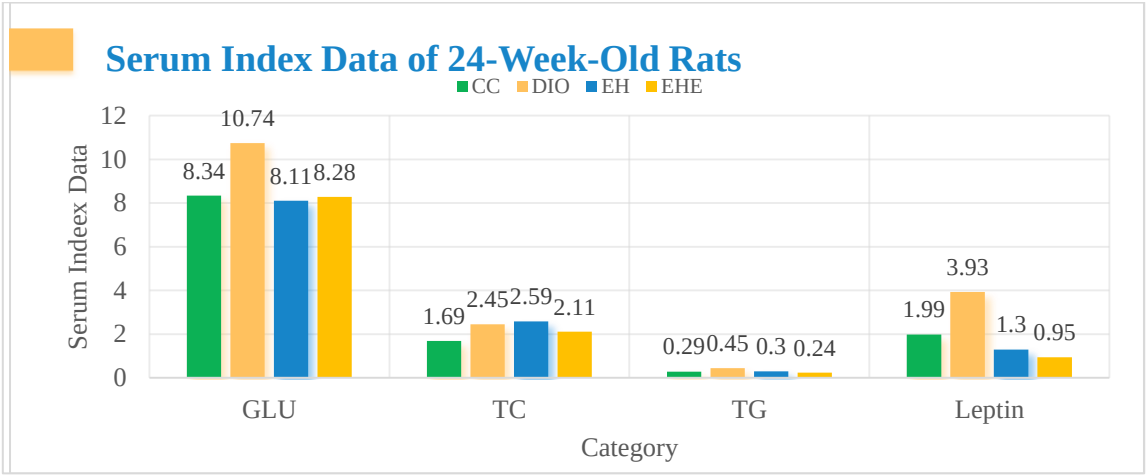

Figure 1. 24 weeks old rat serum index data

Figure 1 is the adolescent stage of rat growth to 24 weeks of age when the index detection in the serum of each group of rats with acute specific data, data we can see from the table, the adolescent stage of rat growth to 24 weeks of age, GLU, TC in DIO group rats with CC group has obvious statistical significance between the data, its overall value is higher than the CC group, TG and Leptin with CC group values also has a certain difference, both values are higher than CC group.

(3)The expression of Leptin and Adiponectin genes in adipose tissue

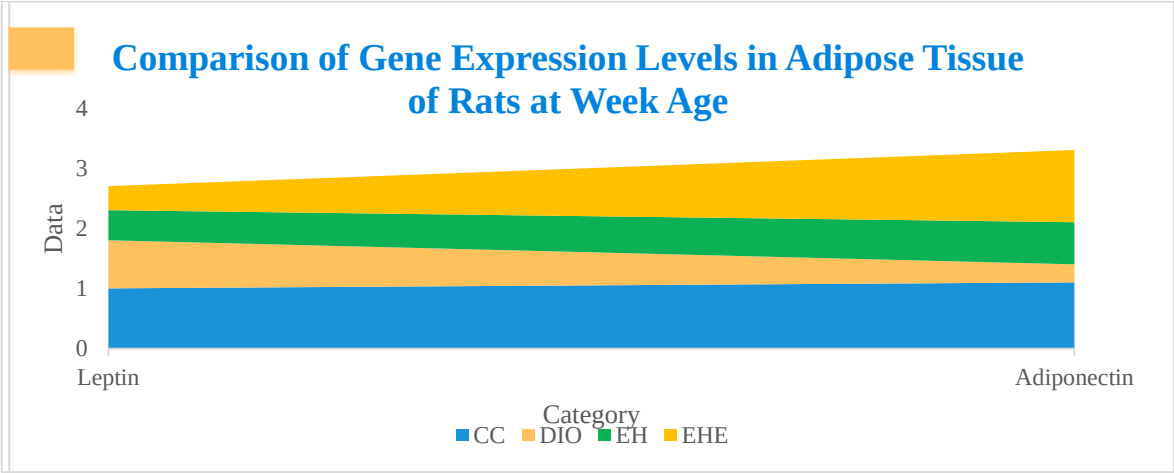

Figure 2. 4 comparison of gene expression levels in adipose tissue of rats at week of age

Figure 2 for growing rats for 24 weeks, different groups of genes specific differences in the level of gene expression, data to be able to see from the table, the total fat tissue specific expression of Leptin and Adiponectin level and CC group rats the expression level of no statistical difference, but EH group of adipose tissue of rats gene expression level was obviously lower than the DIO group.

Adiponectin in adipose tissue showed significant statistical significance between CC, DIO and EH groups, among which the expression level of DIO group was lower than that of CC group and EH group.

(4) Gene expression in rat hypothalamus tissue

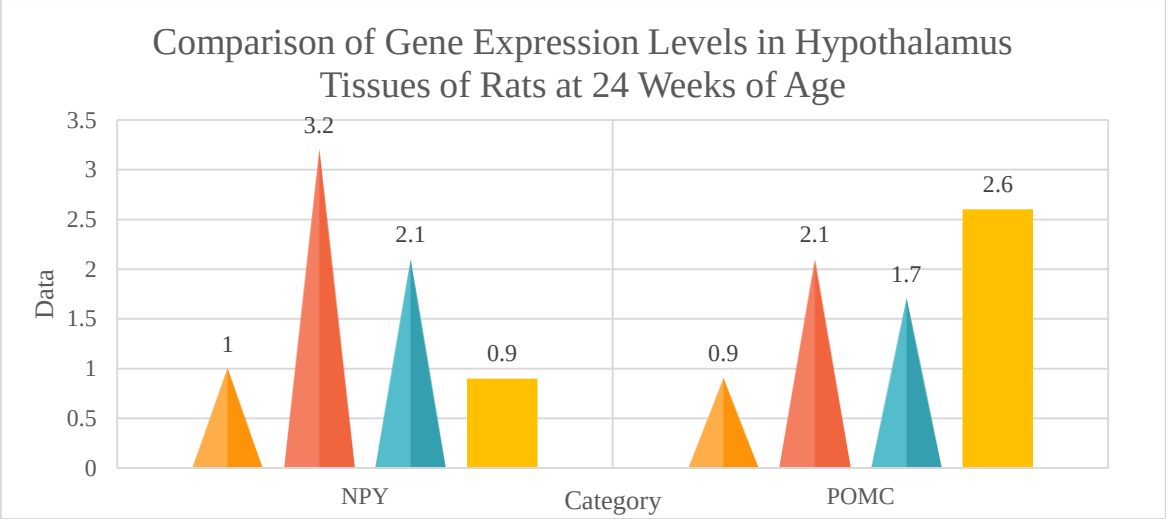

Figure 3. Comparison of gene expression levels in hypothalamus tissues of rats at 24 weeks of age

Figure 3 is the adolescent stage growth of rats to 24 weeks of age, different groups in the rat hypothalamus tissue specific gene expression level more, we can see from the data in figure 4, 24 weeks in DIO group rats, NPY in the organization of the thalamus and POMC specific expression level and CC expression level of statistical significance between groups of rats, are better than high level of the expression of the CC group of rats, and EH group rats and DIO rats no statistical differences between; The NPY value of rats in EH group was higher than that of EHE group, and its POMC value was lower than that of EHE group.

4.2. Discussion

At 3 weeks of age, the young rats were deprived of breastfeeding and allowed to feed freely. Moreover, the reproductive ability of the rats with the growth period of 12 weeks is already available, which can be used as an important standard to measure whether the rats enter adulthood, so as to be used in the study of various types of adult diseases. The intake of a large amount of high-calorie food is the main cause of obesity in adulthood. The obesity model of rats in the above experiment was established mainly through the induction of high-fat diet. Long-term consumption of high-fat diet will cause a certain degree of metabolic disorder in rats. Rats fed a high-fat diet were able to meet the basic criteria for obesity at around 8 weeks. After consuming high-fat diet, the adult rats in the experiment were tested for their body weight, body fat content, serum and other indicators. The test results showed that the obese rats would have a series of problems such as disordered metabolism.

In this study, after 9 weeks of aerobic exercise, the young rats were treated with high-fat diet for 12 weeks of induced obesity. The overall body weight and body fat levels of rats under normal aerobic exercise were lower than those of obese rats. In this paper, GLU, TC, TG and other indicators in the blood of rats in different groups were detected, and the specific changes of fat number were observed with the help of relevant equipment. Finally, it can be found that long-term aerobic exercise in young rats can effectively prevent the occurrence of obesity in adulthood. Moreover, rats that had been doing aerobic exercise for a long time were still able to keep the

specific fat content in the body at a lower level even when they were induced to become obese by high-fat diet. Existing studies have shown that the metabolism of the body will be re-programmed after birth, and obesity and metabolic disorders in adulthood are part of the reason for this phenomenon. In addition, the mechanism study of relevant scholars found that the low-protein diet given to young rats could change more than 300 specific genes in the adult liver. Based on the expression and secretion of fat cells, Leptin and Adiponectin, two important fat cell genes, were eventually produced. Leptin's main function is to suppress appetite, promote the specific regulation of energy metabolism, accelerate the decomposition of fat, and promote weight loss to a certain extent. Based of obesity based on high fat feedstuff, the process of its formation needs certain, according to the energy intake and body fat content and weight based on its development stages, which can be roughly divided into early, middle and late three phases, high-fat induced obesity rats in the middle-late stage of Leptin resistance can be formed, the substance in the body content in the blood will be a lot of ascension, but do not have normal adjustment. In this study, the specific levels of Leptin in the blood of rats in the obesity group of China were significantly higher than those in the control group, suggesting Leptin resistance in rats in the obesity group. Moreover, Leptin plays an important role in the formation of pregnant mice, which is also closely related to the formation of obesity in adulthood. In the present study, there was no significant change in gene expression in the adipose tissue of obese rats induced by high fat compared with rats reared normally. However, the expression level of this gene was higher than that of rats who were given aerobic training for a long period of time, and the expression level of Adiponectin in adipose tissue was lower than that of other groups. Adiponectin can promote the continuous increase of energy consumption and cause certain oxidation of skeletal muscle and liver. Many existing studies have shown that Adiponectin in the blood circulation is not enough to have a significant impact on obesity and insulin resistance. No change in Adiponectin in blood was observed in this study.

Adiponectin can activate related proliferators under the action of activated receptors, and the activated receptors can participate in the specific proliferation and differentiation activities of adipocytes under the action of related signal transfer pathways. In the experiments in this paper, the expression level of the adipose tissue contained in the adipose tissue of rats in each group was also consistent with the changes in the specific number of adipose cells. Based on the specific changes of Leptin and Adiponectin in adipose tissue, it can be seen that these two fat factors play an important role in the prevention of obesity in adulthood. Studies by most scholars showed that aerobic exercise could not affect Adiponectin in the blood, and there was no significant change in Adiponectin expression in specific fat cells before and after aerobic exercise. In the experiment in this paper, after regular aerobic exercise, young rats entered adulthood. Even if they continued aerobic exercise based on a high-fat diet, Leptin and Adiponectin contained in their body fat tissues did not show significant changes. Further research on this phenomenon is needed. In the experiment in this paper, the expression of NPY and POMC in the hypothalamus of obese mice fed with high-fat feed was improved to a certain extent. It is generally believed that the promotion of NPY in the hypothalamus of the rat can promote the improvement of energy storage quantity in the body, and the formation of POMC expression can hinder the development of obesity in adulthood to some extent. Obesity was induced in young rats with a growth cycle of 4 weeks. No expression of POMC appeared until the 8th week, and its expression level would decline until the 19th week. At the present stage, other studies have shown that short-term high-fat stimulation can also promote the continuous improvement of the overall excitability of POMC neurons to a certain extent. In this experiment, the improvement of POMC should be a transient performance in the process of energy balance in the hypothalamus of obese rats in the early stage. In the early stage of the study, scholars also found that aerobic exercise in pregnant rats promoted the expression level of POMC in the hypothalamus of lactating baby rats to a certain extent, but the overall expression level of NPY did

not change. Compared with obese rats, long-term aerobic training of swimming rats showed no change in the specific expression of NPY and POMC in the hypothalamus of rats undergoing aerobic exercise. In the summary of the experiments in this paper, the content of body fat in obese rats induced by high fat in the young age was kept at a low level after aerobic exercise for a long time, and there was no obvious close relationship between this phenomenon and the change of gene expression in the hypothalamus. Exercise can reduce the expression level of NPY in the hypothalamus of rats to a certain extent, indicating that aerobic exercise can promote the specific transformation of energy metabolism with the help of the reduction of the level of NPY system. In addition, many existing studies have shown that after 6 weeks of continuous aerobic exercise, the specific expression level of NPY in the blood of adult rats did not change, but the protein content in the NPY system inside the hypothalamus decreased.

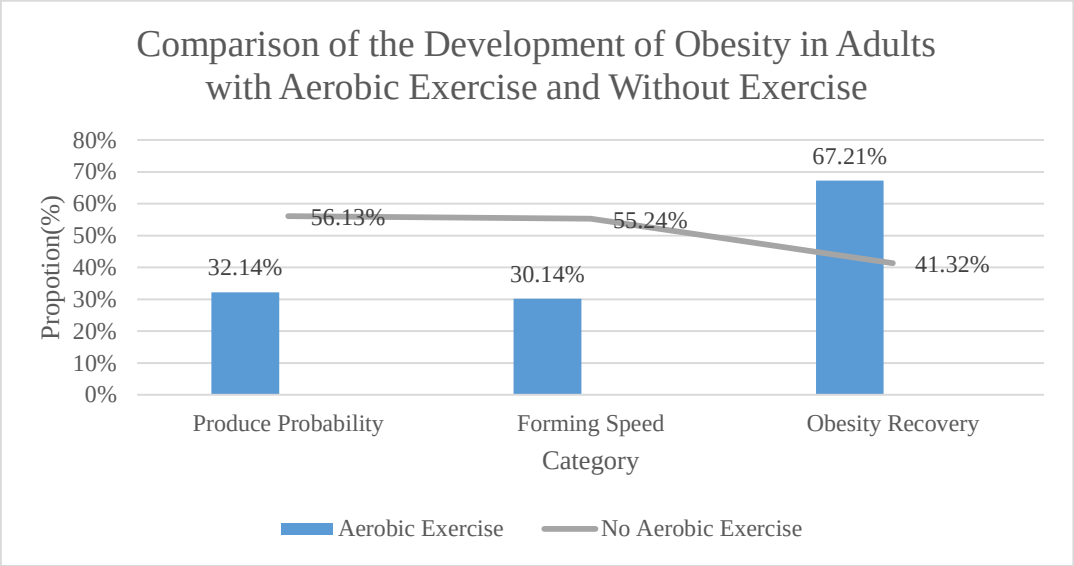

Figure 4. Comparison of the development of obesity in adults with aerobic exercise and without exercise

Figure 4 is under the aerobic exercise and obesity in adulthood movement condition compares the concrete development, from the data in the graph we can see, compared with the data of aerobic exercise, aerobic exercise appears under the probability of obesity in adulthood fell by about 24%, the formation of adulthood obesity rate fell by 25%, recovery rate of obesity increased by 26%. To sum up, long-term continuous aerobic exercise can prevent the occurrence probability of obesity in adulthood to a certain extent, and its prevention mechanism is realized through the regulation of various gene expression levels in adipose tissue.

5. Conclusion

With the help of aerobic exercise training experiment in young rats, the effect and mechanism of aerobic exercise in young rats on prevention and control of obesity in adulthood were studied in this paper. This study not only provides a theoretical basis for the prevention of obesity in adulthood, but also lays a foundation for the development of related studies. This paper draws the following conclusions through research:

(1) Long-term sustained aerobic exercise can prevent the occurrence of obesity in adulthood to a certain extent;

(2) The prevention mechanism of adult obesity is realized through the regulation of various gene expression levels in adipose tissue.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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