

# Effect of the Comprehensive Intervention of Exercise and Diet on Obese Patients

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**Summary.** *Objective:* This study aims to analyze the effect of comprehensive intervention of exercise and diet on the body weight of obese patients. *Methods:* Forty obese patients were selected as subjects. A comprehensive intervention method of exercise and diet for eight weeks was designed. The body indexes (body weight, body mass index (BMI), etc.) and blood indexes (fasting blood glucose, total cholesterol, etc.) were measured and compared before intervention and four and eight weeks after intervention. *Results:* There was no significant difference between male and female patients. Compared to before intervention, after eight weeks of intervention, the weight of patients decreased significantly ( $p < 0.05$ ), the BMI, waist to hip ratio (WHR), and percentage of body fat (PBF) significantly decreased ( $p < 0.05$ ), the fasting blood glucose decreased ( $p < 0.05$ ), the blood lipid level also significantly reduced, and the blood urea nitrogen had no significant change. *Conclusion:* The comprehensive intervention of exercise and diet has a significant effect on weight loss and fat reduction of obese patients, which is beneficial to improve the blood glucose and blood lipid levels of patients.

**Key words:** exercise, diet, obese patients, intervention, fasting blood glucose, lipid

## Introduction

With the development of society and economy, great changes have taken place in people's lifestyles. Overnutrition, a high-fat diet, and reduced physical activity have led to more and more chronic diseases. Obesity is a chronic disease (1), which has become an important health problem (2). According to the causes, obesity can be divided into simple obesity and secondary obesity. Secondary obesity is caused by diseases, while simple obesity is caused by lack of exercise and excessive nutrition (3), accounting for 95% of the obese population. Obesity is a predisposing factor of many chronic diseases, such as diabetes, hypertension, coronary heart disease, etc. (4, 5), which may shorten lifespan (6) and has negative impacts on the body and mind (7). With the increasing incidence rate of obesity (8), how to prevent and control it effectively has become

a very important problem. Intervention refers to carrying out planned and purposeful projects on subjects in a certain time and space to affect their cognition, behavior, and health. The comprehensive intervention of exercise and diet refers to the intervention of exercise and diet on the subject to make them develop the habit of a reasonable diet and proper exercise. The advantage of exercise is that it can improve body posture and body composition, reduce blood sugar and blood lipid, and improve aerobic metabolism. The intervention of exercise and diet has been studied in many fields of human health. Ngandu et al. (9) conducted a two-year multi-domain intervention on 2654 patients with cognitive impairment, including exercise intervention, diet intervention, cognitive intervention, etc. Through the long-term experiment, they found that the multi-domain intervention could maintain or improve the cognitive function of patients. Hui et al. (10) carried

out the exercise and diet intervention on 190 pregnant women and grouped them randomly into a control group (88 cases) and an intervention group (102 cases). The comparison found that the prevalence of excessive pregnancy weight gain of pregnant women decreased after two months of intervention ( $p < 0.01$ ). Mcpherson et al. (11) carried out the exercise and diet intervention on obese men for eight weeks and found that the intervention could normalize aberrant epigenetic signals in sperm and improve the metabolic health of female offspring. Murillo et al. (12) studied the effect of the exercise/diet intervention on the infrapatellar fat pad by taking 454 obese elderly patients with joint pain or arthritis as research subjects and found that the change of infrapatellar fat pad was very sensitive to the exercise/diet intervention and the changes of weight and constitution could effectively reduce the volume of the infrapatellar fat pad. Van et al. (13) studied the effects of exercise and nutrition interventions on the improvement of the quality of life of the elderly. After 52 weeks of interventions on 200 elderly people, they found that interventions were effective in improving or maintaining the physical function and quality of life of the elderly. Huang et al. (14) aimed at childhood obesity and intervened in early pregnancy. Through a 12-week experiment, they found that the intervention group lost weight and had a lower fetal bone index after the intervention of exercise and diet. Through an eight-week comprehensive intervention of exercise and diet, this paper studied the influence of the intervention on obese patients and analyzed the changes of body indexes and blood indexes of patients, aiming to understand the effect of the intervention on weight loss and fat reduction of obese patients.

## Materials and Methods

### *Research subject*

In this study, volunteers were recruited from the society. The requirements of the research subjects were having simple obesity, body mass index (BMI)  $\geq 24$  kg/m<sup>2</sup>, age between 18-45 years old, conscious, understanding the purpose and method of the experiment, signing informed consent, having no mental disease,

serious endocrine disease, cardiovascular and organ damage, or coagulation dysfunction, and not pregnant or lactating. Finally, 40 obese patients were selected, including 22 males and 18 females. There was no significant difference in general data.

### *Research methods*

The experiment lasted for eight weeks. In this period, the diet, exercise, and accommodation for the research subjects were unified. The detailed intervention method is as follows.

Exercise intervention method: The subjects exercised six days a week, twice a day, 9:00-11:00 in the morning and 15:00-17:00 in the afternoon. Before and after every time of exercise, 15 minutes of warm-up and relaxation were carried out. During the exercise, the subjects took appropriate rest and supplemented water in time. The sports items were mainly low-intensity, long-time, and interesting items, such as swimming, badminton, and aerobics. To keep subjects' interest in sports, the sports items were adjusted regularly. In the process of exercise, the researchers organized and mobilized the subjects to make sure that everyone could complete the corresponding exercise plan and achieve the corresponding amount of exercise. The exercise was carried out under the guidance of professionals to avoid sports injury.

Warm-up actions included: ① head movement: with two hands on the waist, the head nodded twice forward, backward, rightward, and leftward, and turned clockwise and anticlockwise two times; ② body rotation movement: the subject naturally separated two legs, clenched hands, bent elbows, lifted arms horizontally in front of the body, and turned left and right for 90°; ③ lunge stretching: the subject bent one leg in front and the other leg in the back and moved the center of gravity forward to form an action of lunge and then pressed the legs eight times, and the left side and right side were alternated; ④ wrist and ankle: the left leg kept straight, the right leg slightly bent, the toe pointed on the ground, the ankles rotated clockwise four circles, and the wrists rotated for four circles, and the left side and right side were alternated.

Relaxation actions included: ① neck relaxation: the subject naturally separated two legs, hands held the head with hands, pressed the head towards the left shoulder and right shoulder for 30 s, and raised the head for 30 s; ② shoulder relaxation: the subject naturally separated two legs, stretched the left arm rightwards, slightly bent the right arm, and pressed the left arm with the elbow for 30 s, and the left side and right side were alternated; ③ waist relaxation: the subject raised the head, lifted the chest, put the left hand on the waist, pressed the upper part of the body leftward for 30 s, and the left side and right side were alternated; ④ lower leg relaxation: the subject stood against the wall, raised the head and chest, pointed one heel on the ground, and leaned forward, and the left side and right side were alternated.

Diet intervention: The subject was asked to reduce the intake of animal fat and carbon water and increase the intake of fruits, vegetables and bean products. The proportion of energy provided by carbon water, fat, and protein was 55–65%, 10–15%, and 20–35%, respectively. The calorie ratio of breakfast, lunch, and dinner was about 3:4:3. The recipe formulated is shown in Table 1.

### Measurement index

(1) Physical indicators: before the experiment, four weeks after the experiment, and eight weeks after the experiment, the subjects received measurement under the condition of fasting and uniform clothing in the morning. The physical indicators included:

① Body weight (BW): the subject stood barefoot in the center of the scale and rested for a few seconds until the scale's reading became stable.

② body mass index (BMI):  $\text{weight/height}^2$

③ Waist to hip ratio (WHR): waist circumference/hip circumference. The human body stood naturally. A tape measure measured the waist circumference at the thinnest position of the waist and measured the hip circumference at the thickness position of the hip.

④ Percentage of body fat (PBF): a body composition analyzer was used for measurement. The subjects stood barefoot in the sensing area of the instrument and held the touch handle. The reading of the instrument was recorded after being stable.

(2) Blood index: before the experiment, four weeks after the experiment, and eight weeks after the

**Table 1.** The Recipe for Diet Intervention

	Breakfast	Lunch	Dinner	Fruits
Monday	Coarse cereal porridge, eggs, milk	Rice, tomato fried eggs, stir-fried Chinese cabbage	Millet porridge, spicy cucumbers, fried beef with green pepper	An apple
Tuesday	Apples, eggs, yogurt	Coarse cereal porridge, fried bean sprouts with leek, beef with green pepper	Millet porridge, broccoli with garlic, fried pork with green beans	A kiwi
Wednesday	Porridge, soymilk, steamed sweet potato	Rice, shredded potato with green pepper, fried lettuce	Coarse cereal porridge, fried cowpeas, stewed beef with potatoes	A banana
Thursday	Porridge, eggs, milk	Rice, fried leaf lettuce, bitter melon fried shredded meat	Millet porridge, stir-fried cowpea, hot and sour cabbage	A banana
Friday	Corn, eggs, milk	Rice, fried lettuce, boiled fish fillet	Coarse cereal porridge, dried bean curd with shredded meat, fried bean sprouts with leek	An apple
Saturday	Porridge, eggs, milk	Rice, fried cabbage, stewed spare ribs with lotus root	Millet porridge, dry fried string beans, fried pork with cauliflower	An orange
Sunday	Soymilk, eggs, corn	Rice, roast chicken with potato, fried celery with smoked bean curd	Coarse cereal porridge, fried Chinese cabbage, shredded pork with green pepper	A banana

experiment, the fasting venous blood was taken in the morning and sent to Linhe District People's Hospital for detection. The detailed indicators included:

① fasting blood glucose (FBG): 3.89 ~ 6.1 mmol/L as normal (a high-level indices hyperglycemia);

② total cholesterol (TC): 3 ~ 5.69 mmol/L as normal (a high level is not conducive to body health);

③ triglycerides (TG): 0.45 ~ 1.69 mmol/L as normal (a high level indicates a risk of cardiovascular disease);

④ high-density lipoprotein (HDL-C): 0.7 ~ 2.0 mmol/L as normal;

⑤ low-density lipoprotein (LDL-C): below 3.12 mmol/L as normal;

⑥ blood urea nitrogen (BUN): 2.86-7.14 mmol/L as normal (a change of value is related to renal function).

#### Statistical analysis

Data were input into Excel and processed by SPSS 19.0. The data were expressed by  $\bar{x} \pm sd$ . The data before and after the experiment were treated by the t-test.  $P < 0.05$  indicated that the difference had statistical significance.

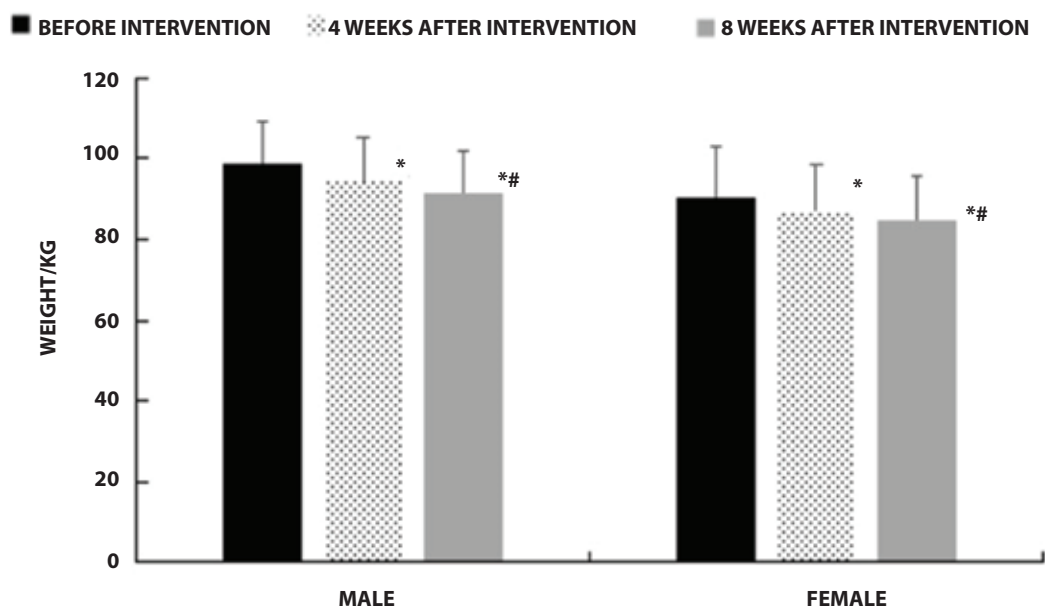
## Results

### Effect of intervention on physical indicators

The changes of BW before the intervention, four weeks after the intervention, and eight weeks after the intervention are shown in Figure 1.

It was seen from Figure 1 that the BW of male and female patients were  $98.76 \pm 10.49$  kg and  $90.33 \pm 12.67$  kg respectively before the intervention; after four weeks of intervention, the weight of male patients decreased to  $94.16 \pm 11.27$  kg, and the weight of female patients decreased to  $87.13 \pm 11.48$  kg ( $p < 0.05$  compared with before the intervention); after eight weeks of intervention, the body weights of male and female patients were  $91.33 \pm 10.68$  kg and  $84.54 \pm 11.37$  kg respectively ( $p < 0.05$  compared to before the intervention and four weeks after the intervention). The above results indicated that the BW of obese patients decreased significantly and there was no significant difference between male and female patients.

The changes in BMI, WHR, and PBF are shown in Table 2.



**Figure 1.** Weight changes in obese patients

\*: Compared with before the intervention,  $p < 0.05$

#: Compared with four weeks after the intervention,  $p < 0.05$

**Table 2.** Changes in BMI, WHR, and PBF in obese patients

		BMI (kg/m <sup>2</sup> )	WHR	PBF (%)
Male	Before the intervention	32.16±5.08	0.95±0.04	36.12±6.33
	Four weeks after the intervention	30.27±4.39*	0.93±0.05*	34.57±5.17*
	Eight weeks after the intervention	28.67±4.62*#	0.91±0.04*#	32.16±6.09*#
Female	Before the intervention	32.09±4.64	0.94±0.03	36.41±6.22
	Four weeks after the intervention	29.64±4.51*	0.92±0.05*	35.07±6.18*
	Eight weeks after the intervention	28.03±4.33*#	0.89±0.05#	32.39±6.49*#

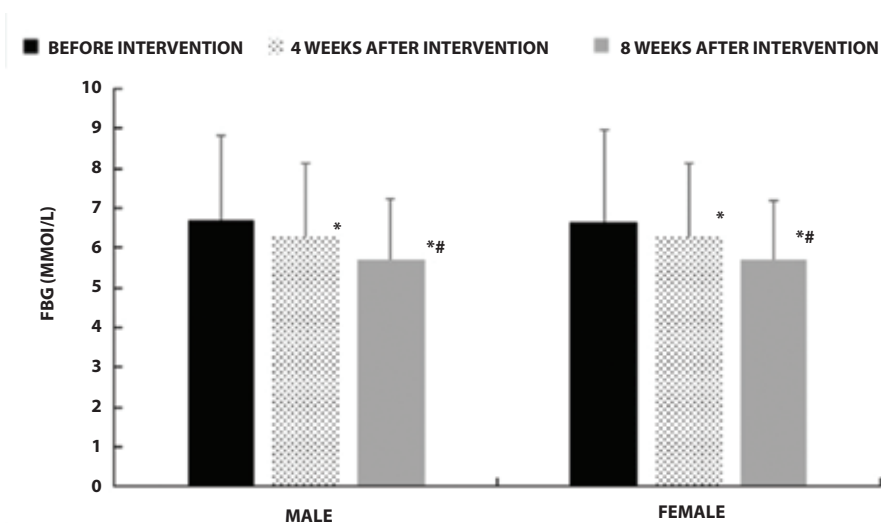
Note: \*: compared with before the intervention, p < 0.05; #: compared with four weeks after the intervention, p < 0.05.

It was seen from Table 2 that various values of patients significantly decreased, but there was no significant difference between male and female patients. First of all, the BMI values of obese patients all significantly decreased, and the differences were significant. Taking the male patients as an example, the BMI was 32.16 ± 5.08 kg/m<sup>2</sup> before the intervention, it decreased to 30.27 ± 4.39 kg/m<sup>2</sup> after four weeks of intervention (p < 0.05 compared with before the intervention), and it decreased to 28.67 ± 4.62 kg/m<sup>2</sup> after eight weeks of intervention (p < 0.05 compared with before the intervention and after four weeks). The WHR of the male patients was 0.95 ± 0.04 before the intervention, decreased to 0.93 ± 0.05 after four weeks of intervention (p < 0.05 compared to before the intervention), and decreased to 0.91±0.04 after eight

weeks of intervention (p < 0.05 compared to before the intervention and after four weeks). The PBF of the male patients was 36.12 ± 6.33% before the intervention, 34.57 ± 5.17% after four weeks of intervention, and 32.16 ± 6.09% after eight weeks of intervention (p < 0.05 compared to before the intervention and four weeks after the intervention). It was found from Table 2 that the comprehensive intervention method could significantly reduce the weight and fat proportion of patients.

*Effect of intervention on blood indicators*

The change in FBG before the intervention, four weeks after intervention, and eight weeks after intervention are shown in Figure 2.



**Figure 2.** FBG changes in obese patients  
 \*: p < 0.05 compared with before intervention  
 #: p < 0.05 compared with four weeks after intervention

It was seen from Figure 2 that the PBG of the male patients and female patients were  $6.68 \pm 2.12$  mmol/L and  $6.65 \pm 2.31$  mmol/L respectively before intervention; after four weeks of intervention, the FBG of the male patients decreased to  $6.25 \pm 1.86$  mmol/L, and the FBG of the female patients decreased to  $6.26 \pm 1.87$  mmol/L (both  $p < 0.05$  compared to before intervention); after eight weeks of intervention, the FBG of the male patients was  $5.71 \pm 1.54$  mmol/L, and the FBG of the female patients was  $5.73 \pm 1.45$  mmol/L, and there were significant differences compared with before intervention and four weeks after intervention. The above results demonstrated that the comprehensive intervention of exercise and diet had a positive role in controlling the blood glucose of obese patients.

The change in blood lipid in patients are shown in Table 3.

It was seen from Table 3 that the TC and TG of obese patients decreased significantly after the intervention. Before the intervention, the TC and TG of

male patients were  $4.96 \pm 1.21$  mmol/L and  $1.98 \pm 0.78$  mmol/L. After four weeks of intervention, the TC and TG decreased to  $4.76 \pm 0.98$  mmol/L and  $1.75 \pm 0.68$  mmol/L, respectively, and there were significant differences compared to before the intervention. After eight weeks of intervention, the TC and TG decreased to  $4.46 \pm 0.77$  mmol/L and  $1.46 \pm 0.75$  mmol/L, respectively, and there were significant differences compared with before the intervention and four weeks after the intervention ( $p < 0.05$ ). In addition, the difference in LDL-C before the intervention and four weeks after the intervention was significant ( $p < 0.05$ ), but the HDL-C had no significant change after the intervention ( $p > 0.05$ ). In conclusion, the blood lipid of the patients significantly improved after the intervention.

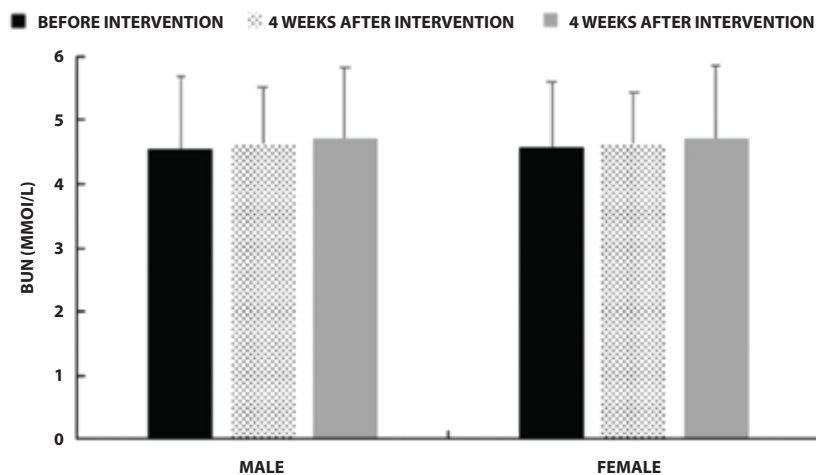
The change in BUN before the intervention, four weeks after the intervention, and eight weeks after the intervention are shown in Figure 3.

It was seen from Figure 3 that there was no significant change in BUN after the intervention.

**Table 3.** Changes in blood lipid in obese patients

		TC (mmol/L)	TG (mmol/L)	HDL-C (mmol/L)	LDL-C (mmol/L)
Male	Before intervention	$4.96 \pm 1.21$	$1.98 \pm 0.78$	$1.16 \pm 0.21$	$2.87 \pm 0.49$
	Four weeks after intervention	$4.76 \pm 0.98^*$	$1.75 \pm 0.68^*$	$1.17 \pm 0.32$	$2.72 \pm 0.51$
	Eight weeks after intervention	$4.46 \pm 0.77^{* \#}$	$1.46 \pm 0.75^{* \#}$	$1.18 \pm 0.22$	$2.63 \pm 0.48^*$
Female	Before intervention	$4.95 \pm 0.99$	$1.99 \pm 0.76$	$1.18 \pm 0.22$	$2.88 \pm 0.51$
	Four weeks after intervention	$4.78 \pm 0.97^*$	$1.74 \pm 0.65^*$	$1.19 \pm 0.21$	$2.71 \pm 0.48$
	Eight weeks after intervention	$4.45 \pm 0.75^{* \#}$	$1.45 \pm 0.73^{* \#}$	$1.21 \pm 0.22$	$2.62 \pm 0.46^*$

Note: \*:  $p < 0.05$  compared with before the intervention; #:  $p < 0.05$  compared with four weeks after the intervention.



**Figure 3.** BUN changes in obese patients

Taking the male patients as an example, the BUN was  $4.56 \pm 1.12$  mmol/L before the intervention,  $4.64 \pm 0.88$  mmol/L four weeks after the intervention ( $p > 0.05$  compared to before the intervention), and  $4.71 \pm 1.11$  mmol/L eight weeks after the intervention ( $p > 0.05$  compared to before the intervention and four weeks after the intervention). It indicated that the comprehensive intervention of exercise and diet did not affect the renal function of patients.

## Discussion

In general, the daily intake of energy and energy consumption is balanced, can maintain normal metabolism, and will not cause obesity. But if people eat many high-energy substances, sleep a lot, and exercise little, i.e., the intake is larger than the consumption, the energy will be surplus and stored in the human body in the form of fat. A high-fat and high-sugar diet will affect the fat consumption ability of the human body and is easy to cause obesity. Also, the metabolic capacity of the human body is inversely proportional to age. The basal metabolic rate of adults decreases. If the absorption of adults is still high, it is more likely to lead to obesity. Due to the increasing number of obese patients in the world (16), the treatment of obesity has become varied, including diet, exercise, medicine, and surgery (17, 18). However, the most scientific and reasonable way is exercise and diet control. Exercise can reduce body fat rate, waist circumference, and hip circumference to keep the body in better shape. It also has a positive effect on lowering blood sugar, blood fat, and blood pressure. It can also reduce the content of fatty acids and improve the activity of muscle aerobic metabolic enzymes, thus improving the metabolic capacity of the body.

In this study, 40 obese patients were given the comprehensive intervention of exercise and diet for eight weeks. First of all, in terms of the changes of body indicators, the BW, BMI, WHR, and PBF of the patients decreased, which showed that the basic body shape of the patients effectively improved under the comprehensive intervention. Obese patients have a higher incidence of diabetes and cardiovascular disease. For obese patients, due to the abnormal accumulation of fat and insulin resistance (19), blood glucose

and blood lipid levels will be abnormal, and appropriate weight loss will play a positive role in improving the glucose and lipid metabolism of patients. Exercise intervention can improve the metabolism of the human body and the utilization of blood glucose. Diet intervention can help to reduce blood glucose and blood lipid. Based on Figure 2 and Table 3, it was found that the blood glucose and blood lipid levels of the patients significantly reduced after eight weeks of comprehensive intervention, which showed that the comprehensive intervention was conducive to improving the blood glucose and lipid levels of obese patients. In addition, it was found from the change of BUN that eight weeks of intervention did not affect the renal function of patients.

This study intervened obese patients through exercise and diet control and verified the positive impact of exercise and diet intervention on the health of obese patients through experiments. This paper provided some suggestions for obese patients on how to treat obesity and improve their physical fitness in real life. However, the research time was relatively short, there was no long-term follow-up of patients, and the control of exercise and diet was not carried out in a completely closed situation. In future research, some improvements are needed.

## Conclusion

In this study, an eight-week comprehensive intervention method of exercise and diet was designed. Forty obese patients were taken for the experiment, and their physical and blood indicators were tested. After eight weeks of intervention, the conditions of the male patients are as follows.

- (1) The weight of the patients decreased from  $98.76 \pm 10.49$  kg to  $91.33 \pm 10.68$  kg ( $p < 0.05$ );
- (2) the BMI, WHR, and PBF of the patients significantly decreased compared with those before and four weeks after intervention ( $p < 0.05$ );
- (3) the FBG decreased from  $6.68 \pm 2.12$  mmol/L to  $5.71 \pm 1.54$  mmol/L;  $p < 0.05$  compared to before intervention and four weeks after intervention.
- (4) the levels of TC, TG, and LDL-C significantly decreased;  $p < 0.05$  compared to before intervention and four weeks after intervention.
- (5) the BUN had no significant change.

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