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The Effect of Resistance Training on Physical Performance in Obese Women after Bariatric Surgery

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ABSTRACT

Background: Bariatric surgery is one of the most common methods for weight loss. This study, explores the effects and differences of control and exercise on obese patients after surgery and observed the effects of a 4-week exercise program combined with standard postoperative treatment on the physical function and glycolipid metabolism of obese individuals following bariatric surgery.

Materials and Methods: Eight of the seventeen obese female individuals who satisfied the inclusion criteria were placed in the group of exercise, and nine were placed in the group of control. During four weeks, the exercise group got a 60-minute exercise intervention three times per week (training every other day). The Control group did not engage in any athletic activity. Before and after the intervention, data were gathered. Software SPSS26.0 was employed. Since the data had a normal distribution, the groups individually were compared using the independent sample T test, whereas the groups before and after the group were contrasted using the paired sample T test. Use a non-normal distribution with a nonparametric Mann-Whitney U test.

Findings: Weight, BMI, waist and neck circumferences, and hip circumferences in the exercise and control groups were substantially decreased ($P<0.01$) compared to the pre-test, as well as the waist-to-hip ratio (WHR) in the group of the exercise was statistically significantly reduced ($P<0.05$), while WHR in the Control group was not statistically different ($P>0.05$). The decrease in basal metabolic rate (BMR) was better in than in the Control group ($P<0.05$) in the exercise group. When compared to the pre-test, both groups' total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) levels considerably decreased ($P< 0.01$).

Conclusion: Both groups had improvements in the composition of the body; however, exercise had a more significant effect on subjects' WHR and TF, as well as delaying the loss of skeletal muscle and BMR, than the Control group did on subjects' WC decline.

Keywords: Exercise; Bariatric surgery; Obesity; physical function

INTRODUCTION

Between 1975 and 2016, the prevalence of overweight and obesity quadrupled worldwide (Nam et al., 2020). According to studies, obesity affects about 30% of the world's population, and its prevalence has considerably grown (Li et al., 2015). China, formerly thought to have one of the world's leanest populations, has experienced a sharp increase in overweight and obesity (Wang & Lobstein, 2006). In 2016, China's population of obese people quickly surpassed that of the United States to take the top spot globally. Studies have shown that as the obese population increases year by year, it further increases the economic burden on the medical system (Shen et al., 2012). From 2000 to 2025, the indirect loss caused by obesity in China accounted for 3.6%-8.7% of the gross national product (Zhang & Chaaban, 2013).There are several diseases associated with obesity, including: type 2 diabetes; high blood pressure; heart disease and stroke, sleep apnea and other breathing problems (Wilcox, 1998). Osteoarthritis, fatty liver disease; kidney disease; certain types of cancer, such as breast, colon, and prostate cancer, depression and anxiety disorders (Ilie et al., 2020). Infertility and menstrual irregularities in women (Hollmann et al., 1996). Obesity can also increase the risk of developing other health problems such as gallstones, gastroesophageal reflux disease (GERD), and skin infections (Neff et al., 2015).

Resistance training is a type of physical exercise that involves using weights or other forms of resistance to build strength and endurance. It typically involves exercises such as weightlifting, bodyweight exercises, and resistance band training. Obesity is generally defined as having a body mass index (BMI) of 30 or higher. BMI is calculated by dividing a person's weight in kilograms by their height in meters squared (Racette et al., 2005).

However, it's important to note that BMI is not always a perfect measure of health, as it doesn't take into account factors such as muscle mass and body composition. Bariatric surgery is a type of weight loss surgery that involves modifying the digestive system to limit the amount of food a person can eat and/or absorb. There are several different types of bariatric surgery, including gastric bypass, sleeve gastrectomy, and adjustable gastric banding (Freeman et al., 2014). These procedures are typically reserved for people who have severe obesity and have been unable to lose weight through other methods such as diet and exercise.

Obesity is a major health concern worldwide and can lead to various health problems such as cardiovascular diseases, diabetes, and musculoskeletal disorders(Montenegro, 2011). Bariatric surgery has been shown to be an effective treatment for obesity by reducing weight and improving metabolic and cardiovascular function. However, weight loss alone may not result in significant improvements in physical performance. Resistance training is a type of exercise that has been found to improve physical performance in various populations, including obese individuals. Therefore, this study aims to investigate the effect of resistance training on physical performance in obese women after bariatric surgery. In addition to measuring physical performance, blood pressure and heart rate variations are also important to monitor in this study. Obese individuals are at risk of developing hypertension and cardiovascular diseases, and bariatric surgery can have an impact on blood pressure regulation. By monitoring blood pressure and heart rate, we can evaluate any changes that may occur as a result of resistance training and assess the overall cardiovascular health of the participants (Genelhu et al., 2009).

This information can help to better understand the potential benefits of resistance training on both physical performance and cardiovascular health in this population. Millions of people worldwide are impacted by obesity, which is a major public health issue (Nguyen & Lau, 2012). Since bariatric surgery may result in considerable weight reduction and better health outcomes, it has become a more frequently used strategy for those with extreme obesity. Bariatric surgery, however, can potentially have unfavorable side effects, such as a loss of muscle mass and a decline in athletic ability.

Exercise, known as " resistance training," includes using weights or other types of resistance in order to increase physical function and build strength (Kraemer et al., 2002). In several groups, it has been demonstrated to be useful in enhancing physical performance and reducing muscle loss, but its effects on obese women following bariatric surgery are little known. It may be crucial for resistance training to understand how resistance training affects physical performance in obese women following bariatric surgery. Healthcare professionals can better support patients who have bariatric surgery and enhance their quality of life by discovering effective therapies to stop muscle loss and enhance physical function in this group. Overall, the impact of resistance training on physical performance in obese women following bariatric surgery is a significant field of research with the potential to guide resistance training and enhance the health outcomes of people who are fat.

MATERIALS AND METHODS

Research Design and Ethics

According to the procedure of the ethical committee of Beijing Sports University (approved by Beijing Sport University's Sports Science Experimental Ethics Committee, effective date: October 2020 to In October 2021, it will be implemented at the China-Japan Friendship Hospital and Beijing Sport University), the purpose of the research and potential risks and benefits were shared with the responsible person of the participants' families, permission was taken from him, and public awareness was also given. Any personal information about the participants in this study will be kept confidential. The Ethics Committee of Beijing Sports University re-evaluated the research proposals and ethical standards, and the Ethics Committee of Beijing Sports University took responsibility for the ethical results of the overall research and the well-being of the participants in this research. That this practice is considered appropriate for research. The approval number of this study is: 2020131H.

Documentation analysis

In this paper, through search websites such as CNKI, PubMed, Google scholar and other search sites. The research results related to bariatric surgery and exercise at home and abroad were consulted, which provided a theoretical basis for the later experimental research of this paper. Search terms: exercise, aerobic exercise, resistance training, glucose metabolism, lipid metabolism, glucose and lipid metabolism, insulin resistance, etc. Primary data in this study were collected through form and clinical examination. In terms of form, the researchers developed a special questionnaire to collect information from the participants about their physical activity and other relevant factors such as medical history, current medications, and lifestyle habits. The questionnaire will be administered by the researchers, and the responses will be recorded and entered into a database for analysis. A clinical examination refers to a physical assessment of participants performed by a trained health care professional. This includes measurements such as body weight, height, and waist circumference, as well as assessments of muscle strength, balance, and mobility. The results of these assessments were also recorded and included in the data set for analysis. Regarding the similarities and differences between the two groups, researchers are likely to compare various characteristics of the participants at baseline to ensure that they are comparable. For example, they may have looked at age, BMI, and other demographic factors. They will then compare the results between the two groups after the intervention to determine if there are any significant differences in physical activity, as well as other measures of interest such as quality of life, medication use, and health care use. The research results related to bariatric surgery and exercise at home and abroad were consulted (Table 1).

Table 1. Basic characteristics of subjects

Item	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
control group=9	30.44±5.10	166.89±4.31	95.96±13.37	34.42±4.33
exercise group=8	31.88±6.49	166.50±5.10	88.50±6.16	31.93±1.90
p-value	$P > 0.05$	$P > 0.05$	$P > 0.05$	$P > 0.05$

Stage of preparation prior to the experiment

Prior to the experiment's start, the subjects were screened for medical aspects, and the subjects with higher risk were excluded. The subjects were given action instructions and told to sign the informed consent form. At the same time, the body Baseline tests such as scores and blood indicators.

Exercise program

Blackburn and other specialist organizations in bariatric surgery advise patients to enhance their physical activity from preoperative to postoperative times, focusing on low- to moderate-intensity activities (Blackburn et al., 2009). The study's exercise intervention is as follows: Each workout session lasts 70 minutes and consists of a 5-minute pre-workout warm-up, 30 minutes of strength training, 30 minutes of aerobic training, and 5 minutes of stretching and relaxation. The exercise is conducted online, lasts for 4 weeks, three times per week, and subjects are required to practice every other day. Strength training is done at a 40% 1RM and 50% HRmax intensity. The 1RM during strength training is determined by having the subject warm up and attempting to lift a weight estimated by the tester for no more than 10 repetitions (Robergs & Landwehr, 2002). Do total attempts, resting 1-2 minutes between each attempt, then note the most repeats possible. 1RM = (0.33 ×number of repetitions) weight used + weight used is the outcome of the calculation (Rieckmann, 2011).

Analysis method

The data of obese women before and after 4 weeks were statistically processed using SPSS 26.0 statistical analysis program in this study. The mean and standard deviation (mean ±SD) are used to represent the test results for each topic index. The independent sample T test is used to compare groups when the experimental data are within the normal distribution. Instead, use the nonparametric Mann-Whitney U test. A paired-samples t-test was used to assess differences between before and after within groups. $P< 0.05$ was chosen as the significance threshold, and $P <0.01$ as the highly significant level.

Selection of topics

In this study, seventeen obese female individuals who had undergone bariatric surgery underwent a 4-week experimental intervention. 1. Assess any modifications in physical performance as well as the metabolism of glucose and lipids in the exercise group and the control group before and after the trial. 2. Examine the alterations and variations in each indicator between the exercise group and the control group. 3. To offer resources for creating scientifically sound and practical exercise regimens for those who have undergone weight-loss surgery.

RESULTS

Changes in body shape before and after exercise intervention

Weight, Body Mass Index(BMI), a measure of body fat based on height and weight, Neck Circumference, the measurement around the neck(NC), Waist Circumference, the measurement around the waist(WC), Hip Circumference, the measurement around the hips(HC), and Waist-to-Hip Ratio, a ratio of waist circumference to hip circumference(WHR), that is used as an indicator of health risks associated with excess abdominal fat, of control and exercise groups by paired-sample t-test The changes before and after the 4-week experiment are shown in Table 2. The data from the exercise group and the Control group were analyzed using SPSS.26, and the body weight, BMI, NC, WC, HC, and WHR all followed the normal distribution. The independent sample T test revealed no significant difference between the Control group and the exercise group in any of the six baseline variables of body weight, WHR, WC, NC, HC, and BMI (P>0.05). It can be seen from Table 2 that the weight loss before and after the exercise group was 9.95±2.53kg, and the weight loss before and after the group of Control was 10±2.31kg, both groups were statistically significant (P<0.01). Between the population and the standard control group, there was no difference in body weight (P>0.05).

Table 2. shows the difference in body composition between the two time periods

Norm	Pretest	Control group	Variation	Pretest	exercise group	Variation
Weight(kg)	95.96±13.37	85.96±12.80**	-10±2.31	88.50±6.16	78.55±6.54**	-3.71±1.06
BMI(kg/m^2)	34.42±4.33	30.84±4.28**	-3.57±0.75	31.93±1.90	28.34±2.21**	-2.19±0.92
NC (cm)	37.79±2.41	35.89±2.46**	-1.9±1.39	38.00±2.27	35.81±2.07**	-2.19±0.92
WC(cm)	109.28±13.94	100.61±13.39**	-8.67±4.9	101.63±3.34	92.38±4.03**	-9.25±5.82
HC (cm)	120.06±8.57	110.17±5.41**	-9.89±4.62	109.75±5.09	105.31±5.12**	-4.44±3.54#
WHR	0.91±0.08	0.91±0.09	0.00±0.04	0.93±0.06	0.88±0.04*	-9.25±5.82##

Note: *$p < 0.05$; **$p < 0.01$. BMI stands for Body Mass Index, which is a measure of body fat based on height and weight. NC stands for Neck Circumference, which is the measurement around the neck just below the Adam's apple. WC: Waist Circumference, the measurement around the waist HC: Hip Circumference, the measurement around the hips. HC stands for Hip Circumference, which is the measurement around the widest part of the hips. WHR stands for Waist-to-Hip Ratio, which is the ratio of the circumference of the waist to that of the hips. These measurements are commonly used in healthcare to assess a person's overall health and risk for certain diseases.

Blood pressure and heart rate variations before and after exercise intervention

Prior to and following the 4-week trial, paired T-tests were performed on the HR rest, SBP, and DBP of the group of Control and the exercise group. For the variation difference, see Table 3. It can be seen from Table 4. that the HR rest pre-test and post-test changes of the two groups of subjects are different, and the HR rest index of the group of Control has no significant change after 4 weeks (P>0.05), and the HR rest index has increased by 3.67 compared with the pre-test ±16.02 times/min, 4 weeks of exercise significantly decreased the HR rest index of the subjects (P<0.01).

Table 3. shows the variations in heart rate and blood pressure prior to and during the four-week intervention.

Norm	Pretest	Control group	Variation	Pretest	Exercise group	Variation
HRrest (min)	77.56±9.58	81.22±15.54	3.67±16.02	84.50±10.61	76.13±9.83**	-8.38±6.48
SBP (mmHg)	123.00±8.44	119.56±12.77	-3.44±12.91	131.50±11.60	123.75±7.74	-7.75±11.18
DBP (mmHg)	79.22±13.05	79.33±10.54	0.11±12.47	78.88±7.16	73.88±6.31	-5.00±6.44

Note: *$p < 0.05$; **$p < 0.01$. Variations are shown within groups. HR: Heart Rate, the number of heart beats per minute, SBP: Systolic Blood Pressure, the highest pressure exerted by the blood against the walls of arteries when the heart beats and DBP: Diastolic Blood Pressure, the lowest pressure exerted by the blood against the walls of arteries when the heart is at rest between beats.

Changes in exercise capacity before and after exercise intervention

The 6MWT, STS and ACT of the group of Control and the exercise group before and after the 4-week experiment were compared by paired T test See Table 4. The normal distribution test was carried out on the pretest data of the two groups through SPSS. The 6MWT, STS and ACT all conformed to the normal distribution. Statistical difference (P>0.05).

Table 4. Changes in exercise capacity before and after the four-week intervention.

Norm	Pretest	Control group	Variation	Pretest	Exercise group	Pretest
6MWT	501.11±42.27	524.67±30.00**	23.56±16.64	522.38±31.49	547.50±15.65**	25.13±16.61
STS	12.78±2.64	14.00±2.00**	1.22±0.97	12.25±1.67	14.13±0.99**	1.88±1.25
ACT	13.22±1.86	15.00±1.22**	1.78±1.39	13.88±1.55	15.00±1.07**	1.13±0.83

Note: *$p < 0.05$; **$p < 0.01$. 6MWT: Six-minute Waking Test, STS: Sit- To Stand, and ACT: Aram Coral Test.

Changes of glucose metabolism before and after exercise intervention

Through the paired T test, before and after the 4-week experiment, the differences in FBG, FINS, CP, HbA1c, Table 5 displays the HOMA-IR and ISI results for the exercise group and the control group. The normal distribution test of the two groups of pretest data was carried out by SPSS, and FBG, FINS and CP all conformed to the normal distribution. Through the independent sample T test, there was no difference between the group of Control and the exercise group in FBG, FINS and CP (P>0.05). HbA1c, HOMA-IR and ISI tests were non-normal, using non-parametric Mann-Whitney U test, there was no difference in the three indicators between the exercise group and the group of Control (p>0.05).

Table 5. Differences in the metabolism of glucose before and after four weeks of treatment

Norm	Pretest	Control group	Variation	Pretest	Exercise group	Pretest
FBG（mmol/L）	6.21±2.41	3.95±0.81**	-2.26±1.66	5.34±0.65	4.93±0.67	-0.41±0.49
FINS（ulU/ml）	22.46±12.06	8.20±6.91**	-14.27±10.12	20.33±8.31	7.86±3.00**	-12.47±9.68
CP（ng/ml）	3.63±0.84	1.92±1.15**	-1.71±0.94	3.33±0.64	2.08±0.49**	-1.25±0.93
HbA1c（%）	6.28±1.51	5.42±1.48**	-0.83±0.60	6.30±1.50	5.55±0.56	-0.75±0.97
HOMA-IR	6.39±4.70	1.61±1.62**	-4.81±3.42	4.81±1.89	1.78±0.86**	-3.03±2.18
ISI	0.01±0.01	0.09±0.11*	0.09±0.11	0.01±0.00	0.03±0.02*	0.02±0.02

Note: *$p < 0.05$; **$p < 0.01$. FBG: Fasting blood glucose, FINS: Fasting insulin, CP: Cerebral palsy, HbA1c: Glycated hemoglobin, HOMA-IR: Homeostatic model assessment of insulin resistance, and ISI: Insulin sensitivity index.

Changes of lipid metabolism before and after exercise intervention

Through the paired T test, the differences in TC, TG, HDL-C and LDL-C between the group of Control and the exercise group before and after the 4-week experimental intervention are shown in Table 6. Through the analysis of the data, TC and LDL-C conformed to the normal distribution, and the data were analyzed by independent sample T test, and there were differences in TC and LDL-C between the Control group and the exercise group (P<0.05). Exercise has been shown to have a significant impact on lipid metabolism, leading to improvements in lipid profiles and reducing the risk of cardiovascular disease. Here are some of the changes that occur (Haskell et al., 1994). 1. Increased lipolysis: Exercise stimulates lipolysis, which is the breakdown of stored fat into fatty acids that can be used for energy. 2. Increased oxidation of fatty acids: The fatty acids released during lipolysis are then transported to the mitochondria where they are oxidized to produce energy (Wolfe, 1998).

Table 6. Changes of lipid metabolism before and after four weeks of intervention

Norm	control group			exercise group		
	Pretest	Posttest	Variation within groups	Pretest	Posttest	Variation within groups
TC(mmol/L）	4.87±0.43	3.60±0.5**	-1.27±0.38	5.60±0.80a	4.30±0.74**	-1.30±0.87
TG(mmol/L）	1.58±1.11	0.99±0.37	-0.60±1.12	1.79±0.63	1.12±0.16*	-0.67±0.63
HDL-C(mmol/L）	0.96±0.21	0.64±0.11**	-0.32±0.13	0.98±0.22	1.02±0.25	0.03±0.16##
LDL-C(mmol/L）	3.03±0.43	2.06±0.40**	-0.97±0.20	3.66±0.69a	2.68±0.59**	-0.98±0.72

Note: A means P<0.05, which indicates that there was a difference between the two groups prior to the test; * means P<0.05, which indicates that the intervention was significant; ** means P<0.01, which indicates that the difference was highly significant; and # means P<0.05, which indicates that the two groups differed after the intervention. Significant change within the group; ## denotes P<0.01, indicating that the disparity between the two groups' increases is extremely significant; TC stands for Total Cholesterol, which is the sum of all types of cholesterol in the blood including low-density lipoprotein (LDL), high-density lipoprotein (HDL), and very-low-density lipoprotein (VLDL).TG stands for Triglycerides, which are a type of fat found in the blood. HDL-C stands for High-Density Lipoprotein Cholesterol. HDL is often referred to as "good" cholesterol because it helps remove excess cholesterol from the blood vessels and reduces the risk of heart disease. LDL-C stands for Low-Density Lipoprotein Cholesterol. LDL is often referred to as "bad" cholesterol because it can build up in the walls of arteries, leading to blockages that increase the risk of heart disease and stroke.

DISCUSSION

Exercise's effects on the physique

Exercise increases the body's extra energy consumption, which has been proven to be one of the more effective ways to improve body shape. In this study, 4 weeks of postoperative exercise was compared with postoperative routine management of the control group. Both groups effectively reduced and improved body weight, BMI, NC, WC, and HC indicators (Marcon et al., 2011). evaluated the changes in body weight and metabolic indicators of a group of obese patients undergoing bariatric surgery, and found that postoperative weight and BMI were significantly lower than those before surgery, metabolic parameters FBG decreased, TC, TG, LDL- The three indicators of C also decreased after the operation, and the value of HDL-C, which is beneficial to the body, showed an upward trend. According to some studies, postoperative weight changes typically begin with rapid weight loss in the first three months following bariatric surgery before slowing down and finally stabilizing. The primary cause of the initial rapid weight loss is reduced energy intake(King et al., 2012). (1) Via a 4-week workout program, the body index of obese female patients after weight loss after exercise was clarified. (2) Compared with obese female patients who do not participate in exercise after bariatric surgery, it is clear that exercise can improve the physical function and glucose and lipid metabolism of obese patients.

Exercise's effects on blood pressure and heart rate

The foundation of healthy blood pressure is a proper metabolism and blood flow. Both too high and too low blood pressure can have serious consequences for the body. In this study, after 4 weeks of experimental intervention, after four weeks after the pre-test, there was no significant change in the control group's HR ($P>0.05$), SBP, or DBP ($P>0.05$). Three months following bariatric surgery, 17 patients were assessed by (Marcon et al., 2011), who discovered that postoperative SBP was considerably lower than pre-bariatric surgery, whereas postoperative HR rest values were significantly lower than pre-bariatric surgery ($P<0.01$). There was no difference in DBP from pre-bariatric surgery ($P = 0.7$), nor was there a significant decrease ($P = 0.2$). Because of the shorter cycle period in this investigation, there was not a substantial drop in HR rest in the control group, and changes in SBP and DBP were mostly in line with the aforementioned experimental findings. After a 4-week exercise intervention, the HR rest in the exercise group in this research was considerably lower ($P< 0.01$).

Exercise's impact on exercise capacity

Obesity is strongly associated with impaired movement, lacking aerobic ability and having limited muscular power. According to this study, both the control groups and the exercise group's exercise capacity post-test values (6MWT, STS, and ACT) were considerably higher than they were pre-test. In a study by(Baillot et al., 2018), it was shown that physical activity can be significantly improved by bariatric surgery. (Hassannejad et al., 2017). showed that the improved exercise capacity after bariatric surgery may be related to postoperative weight loss and increased physical activity. At the same time(Marcon et al., 2011). believed that postoperative weight loss may reduce the burden on the body during activities, which may be an important factor in improving exercise capacity(Hassannejad et al., 2017). The idea that physical activity improves postoperative exercise capacity has also been confirmed by other researchers. A meta-analysis showed (King et al., 2012)that the 6MWT distance increased to 75 m in patients 3 to 6 months after surgery, and 6 to 12 m after surgery.

Comparing the Effects of Exercise and Bariatric Surgery on Glucose Metabolism Indicators

In this study, both the Control group and the exercise group had improved glucose metabolism indicators. Compared with the pretest, FBG ($P<0.01$), FINS ($P<0.01$), CP ($P<0.01$), HbA1c ($P<0.01$) and HOMA-IR ($P<0.01$) in the Control group were significantly decreased, and ISI ($P<0.05$) significantly improved. At the same time, in the exercise group, FINS ($P<0.01$), CP ($P<0.01$) and HOMA-IR ($P<0.01$) decreased significantly, and ISI($P<0.05$) significantly improved. There was no significant difference in FINS, CP, HbA1c, HOMA-IR and ISI between the two groups ($P>0.05$), while the Control group had an advantage in improving FBG indicators ($P<0.01$). A study showed that(Zakas et al., 2006), Indicators were gathered prior to surgery as well as 6, 12, and 24 months following surgery, and it was discovered that the combined exercise group of 60 patients who had undergone bariatric surgery performed better than the control group. Both the control group and the group of controls had considerably lower glucose metabolism scores. Between the exercise intervention group and the control group, there was no discernible difference in the effects of FBG, FINS, HbA1c, and HOMA-IR (P>0.05). Studies like Campos (King et al., 2012) and Lin (Rieckmann, 2011) found that bariatric surgery not only resulted in considerable weight reduction but also quickly enhanced FBG and ISI.

CONCLUSION

Both groups improved body composition; however, the Control group was more effective at lowering subjects' WC, while exercise was more effective at lowering subjects' WHR and TF, postponing the loss of skeletal muscle, and lowering BMR. The glucose and lipid metabolism in both groups improved, but the Control group had a stronger impact on lowering FBG levels. But exercise might be able to influence how stable FBG levels are. Exercise significantly increases HDL-C. At present, there are few domestic studies on exercise intervention after bariatric surgery, and the specific exercise program is not yet mature. This study clarified the feasibility of exercise for postoperative obese patients through exercise intervention after weight loss. Finding a scientifically sound and efficient workout program may also serve as a guide for patients' post-weight reduction surgery rehabilitation training, so as to achieve better postoperative training management. Secondly, the exercise intervention in this study adopts the method of online supervision and guidance, and conducts 4 weeks of "face-to-face" intervention training for postoperative patients to explore the effect and feasibility of online exercise. Finally, this study is also combined with resistance training to better respond to the slogan of "integration of sports and medicine".

CONFLICT OF INTEREST: The authors declared no conflicts of interest.

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