Golestan University of Medical Sciences

Jorjani Biomedicine Journal

Online ISSN: 2645-3509

Response of liver enzymes and serum indices to whey protein isolate and jogging after bariatric surgery in obesity women

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Abstract

Background: Regular physical activity helps maintain health and improves the performance of various body systems. It is also recommended for managing many diseases and disorders, even after surgery. In this regard, the use of supplements may effectively synergize these benefits and promote faster recovery and cell repair. This study investigated the response of liver enzymes and serum indices to whey protein and jogging after bariatric surgery in women.

Methods: The statistical population included all women aged 30 to 45 who underwent bariatric surgery. From this population, 30 individuals were selected as a statistical sample based on entry and exit criteria, using a simple random method without replacement. After providing necessary explanations, written consent was obtained from all participants. Before surgery, body composition assessment, fibroscan, and blood liver enzyme tests were performed. Following the surgery, the research sample participated in an 8-week jogging program and consumed Iso whey supplement. The training protocol was incremental, and the participants consumed 20 grams of Iso whey supplement twice daily, as a suspended solution in water, 30 minutes before and immediately after training. At the end of the research protocol, re-evaluations of body composition, fibroscan, and blood liver enzyme tests were conducted. To compare data, the mean, standard deviation, and Levine's test were used. Shapiro-Wilk test, dependent t-test, and analysis of variance with repeated measurements were employed to assess differences.

Results: The research showed that alanine aminotransferase and aspartate aminotransferase enzyme levels decreased significantly. In addition, bone density, calcium levels, and muscle mass increased, while fat percentage and liver fibrosis decreased (P-Value < 0.05).

Conclusion: Iso whey protein and jogging appear to have synergistic effects in stimulating growth, increasing muscle size and strength, and improving performance through protein building blocks and amino acids. These factors may also enhance the release of anabolic hormones. The decrease in liver enzymes was likely due to improved fat metabolism, increased energy and oxygen consumption, and enhanced cardiovascular activity.

Article History

Received: 13 July 2024
Received in revised form: 17 August 2024
Accepted: 23 September 2024
Published online: 25 September 2024
DOI: 10.29252/jorjanibiomedj.12.3.11

Keywords

Endurance training
Muscles
Whey proteins
Obesity
Enzymes

Article Type: Original Article

Highlights

What is current knowledge?

Post-surgical supplementation with whey protein and regular jogging further promotes liver health by improving metabolic markers and reducing inflammation, potentially leading to improved liver enzyme levels, as well as serum glucose and lipid indices.

What is new here?

The synergistic effects of these interventions in the context of bariatric surgery are well documented in this study and offer valuable insights into optimizing long-term outcomes in obese women following the procedure. This research has the potential to inform more targeted post-surgical rehabilitation strategies that integrate both nutritional interventions and physical activity, ultimately improving liver health and metabolic indices, including glucose levels, lipid profiles, and liver enzyme levels.

Introduction

With the increase in overweight among women, bariatric surgery has attracted significant attention as an effective treatment solution. While these surgeries are highly effective in weight loss, they require careful management during the recovery period and intelligent planning for the return to physical activity. Proper nutrition, especially adequate protein intake, along with well-planned initiation of physical activities such as running, plays a vital role in the success of treatment and rehabilitation. Studies show that combining a protein-rich diet with appropriate physical activity can significantly improve treatment outcomes. As a rich source of essential amino acids, Iso whey protein supplements play an important role in supporting recovery after bariatric surgery. This supplement may help maintain muscle mass, accelerate tissue repair, and boost the immune system. On the other hand, running, as a moderate aerobic activity, has significant potential to help stabilize weight and improve cardiovascular health. The combination of these two factors can greatly impact the quality of life for patients after surgery. However, the proper timing for starting physical activities and the appropriate amount of protein supplement consumption require careful scientific investigation and adjustment based on the individual conditions of each patient. Recent studies indicate that an integrated approach to nutrition and physical activity yields better results than focusing on each factor alone. Nevertheless, further research is necessary to accurately determine the optimal protocols in this area. Such studies can help provide more effective strategies to manage the postoperative period and improve treatment outcomes in women. In addition, a better understanding of this relationship could lead to the development of personalized plans for each patient, ultimately resulting in improved quality of life and greater treatment success.

The effect of physical activity on liver enzymes provides a complex and contradictory perspective on the response of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and other liver biomarkers. While several studies show the beneficial effects of moderate exercise in lowering liver enzymes and improving liver function through increased insulin sensitivity and reduced inflammation, other research has shown potential adverse effects, especially during intense or prolonged physical activity. These inconsistencies have sparked considerable debate in the scientific community, as researchers attempt to understand the mechanisms and underlying factors that contribute to these divergent results. The intensity, duration, and type of exercise, along with individual factors such as physical fitness level, nutritional status, and underlying health conditions, play an important role in determining the direction and extent of enzyme changes. The results of many studies have shown that the use of whey protein, especially in the post-exercise recovery phase, strengthens, increases volume, and regenerates muscle tissue (1).

Mousavi et al. reported the effect of sports activities on obesity and risk factors related to the reduction of liver and visceral fat and insulin resistance (2). Exercise is considered one of the main regulators of liver metabolism, as it increases beta-oxidation and decreases fat production. According to reports, changes in IL-6, TNF-α, AST, ALP, ALT, and adiponectin enzymes have also been observed (3). Liver function and sports performance in 30 male soccer players were investigated by Bari et al. (2023), and significant differences were found in alkaline phosphatase, AST/SGOT, total protein, ALT/SGPT, and albumin. Therefore, lifestyle management, diet, and exercise can have significant effects on clinical markers, including intrahepatic lipids, ALT and AST levels, and insulin resistance. However, the effects of different exercise methods yield conflicting results (4). In the research of Smart et al. (2016), aerobic exercise and combined exercise (Aerobic exercise + resistance exercise) did not improve liver enzymes (5).

A meta-analysis by Xiong et al. (2021) on liver patients showed that aerobic exercise led to a greater reduction in metabolic markers and improvements in liver function compared to resistance and intense exercises (6). In this regard, Zhu et al. (2021) observed in a meta-analysis that combined exercise training resulted in the most favorable changes in total cholesterol, ALT, and AST (7), which indicates the effects of exercise, even without the use of supplements. Healthy individuals who performed heavy weight lifting demonstrated increased AST and ALT levels in clinical liver tests, and the effect of muscle training on clinical parameters varied by gender and physical fitness level (8). Bariatric surgery often leads to changes in serum parameters, including lipid profiles and glucose levels, but the combined effects of whey protein supplementation and exercise on these parameters in obese patients have not been well established. Gender-specific responses to these interventions may affect changes in liver enzymes. Factors such as the type of surgery, baseline liver function, general health status, and adherence to postoperative recommendations vary significantly. Therefore, the most effective method of exercise to improve clinical markers has not yet been determined, and conflicting results exist regarding the effects of exercise on liver enzymes and their role in prevention and treatment (9). The liver mainly controls lipid and glucose metabolism, and fatty liver diseases are closely associated with obesity and diabetes. A combination of exercise and diet is one of the control methods for these conditions (10). Therefore, this research aimed to investigate the effects of Iso whey protein and jogging after bariatric surgery on the liver, based on fibroscans, muscle and bone changes, blood tests, and body composition analysis reports in 30- to 45-year-old women.

Iso whey protein is specifically chosen for women after bariatric surgery due to its rapid absorption and essential amino acids that aid in muscle repair and recovery. This type of protein is highly soluble and has excellent bioavailability, making it easier and faster for the body to absorb compared to other protein sources. After bariatric surgery, many patients face a decrease in nutrient absorption, and consuming Iso whey protein is an effective way to address these deficiencies. This supplement helps maintain muscle mass, prevent muscle breakdown, and ultimately improve physical condition and energy for daily activities. Jogging increases the heart rate, improves blood circulation, builds endurance, and effectively aids in weight loss by burning calories (11). This exercise does not put excessive pressure on the joints and also strengthens the muscles. Combining jogging with whey protein intake can have a synergistic effect in increasing the results of bariatric surgery, as both work together to increase muscle mass and improve cardiovascular health.

Methods

The statistical population of the research included all obese women who had undergone bariatric surgery and were in the age group of 30-45 years. The research sample was randomly selected, with personal consent, from individuals who referred to Sadr Medical Clinic, totaling 597 people. Obesity was determined according to World Health Organization guidelines, with a BMI between 30-35. After estimating the sample size and meeting the inclusion and exclusion criteria, the participants were selected using a random table (30 people). The inclusion criteria included not using any supplements or special medications in the past six months, no history of common chronic health problems or various diseases such as respiratory, metabolic, cardiovascular, kidney, and liver diseases, and not smoking. The exclusion criteria included unwillingness to continue participating in the research protocol and sports injuries.

The research sample consisted of individuals who went to Sadr Clinic intending to undergo bariatric surgery due to failure in weight control, lack of physical activity, childbirth, improper diet, and at least 30 kilograms of excess weight. Among the women referred to the clinic, the participants were included in this plan randomly and with their consent. After receiving the necessary explanations about the research and clinical trials, the participants completed a personal satisfaction form and a nutritional status questionnaire. Body composition was analyzed using a body analyzer, which measured and recorded weight, fat percentage, body soft tissue, the ratio of abdominal circumference to hip circumference, and BMI. The anthropometric characteristics of the participants were measured and recorded upon arrival before starting the protocol in a special room at the clinic. Height (Without shoes), weight, body mass index, lean mass, bone density, fat mass, and calcium level were measured. Heart rate and blood pressure were also measured at the beginning of the research protocol. A blood sample was then taken from the front vein of the subject's left arm while sitting, between 9 and 11 am. The samples were placed in heparin tubes and, after centrifugation, transferred to the laboratory department to measure ALT, AST, and other research variables. Liver stiffness and fibrosis were assessed and recorded before bariatric surgery during the pre-test phase. Fibroscan results were used to determine the degree of fibrosis and compare it with clinical standards of liver health.

The Karen brand in isolated form was used in this research for the consumption of the Iso whey protein supplement. The protein was in powdered form and was prepared as a suspended solution in water, with 20 grams consumed per serving on training days, 30 minutes before training and immediately after training (Vitamin 1402 site).

Exercise protocol

The training program consisted of 45 minutes of walking and light jogging at 60% of the maximum heart rate until the fifth week. From the sixth to the eighth week, the program was conducted at 70% of the maximum heart rate (Table 1).

Table 1. Exercise program protocol (Gaiini and Rajabi 1401: Edit 13)

Week / Specifications	1-2	3-4	5	6	7-8
Warming up and cooling down stretching exercises (Minutes)	7				
Distance (km)	2	2.4	2.8	3.2	3.6
Speed (km/h)	4.8	4.8	4.8	5.6	5.6
Percentage of maximum heart rate	60	60	60	70	70
Repetition per week	5				

Bariatric surgery was then performed on the subjects. Twenty-one days after the surgery and recovery period, the participants were prepared to engage in the protocol and began jogging according to the scheduled exercise program. The determined dose of whey protein was consumed as instructed. At the end of the eight weeks, all the previously mentioned measurements were repeated and recorded as a post-test.

For blood sampling, the arm of each subject was first tied with a tourniquet to make the vein more accessible and compressed. The skin area was then cleaned and disinfected. Using a sterile needle, 5 ml of blood was drawn directly from the vein into heparinized laboratory tubes with green lids to prevent blood clotting. After sampling, the tubes were gently inverted several times to mix the blood with heparin.

Blood sampling procedure

Hepatic enzymes were measured using spectrophotometric methods and commercial kits. These tests were performed with automatic analyzers and spectrophotometric techniques based on enzymatic reactions. For ALT and AST, the method involved measuring the rate of NADH oxidation, which is proportional to enzyme activity. The measurement process included sample preparation (Plasma or serum), reagent preparation, device calibration, analysis according to kit protocols, and result calculation. Quality control measures, including regular calibration, accuracy checks, and the use of control samples, were conducted in the equipped laboratory of Sadr Clinic by trained personnel following standard methods to ensure accurate and reliable results. Enzyme activities were reported in international units per liter (IU/L). The results were interpreted by considering the specific reference ranges of the laboratory and the patient's characteristics using modern automatic analyzers. Laboratory analysis of liver enzymes was performed with Roche Diagnostics (Switzerland) and Cobas series systems, which have a CV accuracy rate of <2% and the capability to process 200-300 tests per hour.

Fibro scan data

In FibroScan, ultrasound waves and a special technique called "transient elastography" are used to assess liver diseases such as viral hepatitis, non-alcoholic fatty liver disease, and liver cirrhosis. During a FibroScan, an ultrasound probe is placed on the skin of the patient's abdomen and sends low-intensity vibratory waves to the liver. These waves pass through liver tissues at varying speeds. By measuring the speed of the waves in the liver tissue, the device estimates liver stiffness. Increased stiffness indicates greater fibrosis (Scar tissue). The data obtained from the FibroScan were measured and presented in kilopascals (kPa). Each subject was instructed to lie on their back on the examination bed and raise their right hand to their head to ensure that the chest and abdomen on the right side were fully accessible and that the abdomen area was ready for the ultrasound probe. No anesthesia or sedation was required. The FibroScan device’s ultrasound probe sent gentle vibrations to the skin, using ultrasound waves to measure liver tissue stiffness and density. The device automatically analyzed the waves reflected from the liver and calculated stiffness in kilopascals (kPa). Liver stiffness values typically range between 7 and 12.5 kPa. An increase in this value indicates a higher likelihood of cirrhosis or advanced fibrosis. The FibroScan machine, manufactured by Echosens in France, utilizes Transient Elastography technology. Depending on the patient’s body structure, either an M probe or an XL probe was used. The results were displayed instantly and graphically on the touch-sensitive color screen.

Data analysis in the fibro scan device

The FibroScan machine uses the average of several measurements to measure liver stiffness and enhance final accuracy. Each time the device's probe sends ultrasound waves to the liver, it performs multiple precise measurements (Usually between 10 and 15), analyzes these values, and calculates their average as the final result. At the end of the process, key values are obtained, including the average stiffness of the liver (Measured in kilopascals), the dispersion of values (Interquartile Range or IQR), and the dispersion relative to the average (IQR/Median). The validity criterion is the IQR/Median ratio, which should be less than 30%. A lower ratio indicates stable measurements and high accuracy of the results.

Validation of the device's accuracy using invasive methods (Such as liver biopsy, the gold standard for diagnosing liver fibrosis) has shown that FibroScan has very high accuracy in diagnosing moderate to severe fibrosis and cirrhosis in 80% to 90% of cases.

The periodic stability and calibration of the device were conducted by expert technicians under the supervision of the manufacturing company or authorized representatives to ensure accurate results, with precise probe adjustments and testing of the ultrasound waves' accuracy. Parameters such as patient weight, abdominal fat, and age can affect the accuracy of FibroScan measurements. After scanning, the measured data were analyzed using ROC (Receiver Operating Characteristic) statistical methods. The FibroScan data were adjusted to global criteria, in which liver stiffness is classified in kilopascals into different fibrosis ranges (From F0 to F4). In general, the accuracy of the FibroScan device is very high, and it is of great interest due to its ability to provide repeatable and reliable results when examining the liver status of patients.

Statistical analysis

A paired t-test was used to compare the average results of two different conditions for the patient group (Changes in liver fibrosis, muscle mass, and fat) before and after the training period and whey protein consumption to determine any significant differences.

The Shapiro-Wilk test was used to check the normality of data distribution, as the default tests were the t-test and analysis of variance (ANOVA).

Analysis of variance with repeated measurements was used to compare the means in two groups, and Tukey's test identified differences between specific groups (SPSS, version 23, $p \leq 0.05$).

This research was calculated with a 95% Confidence Interval using the CI formula. Cohen's d was used to calculate the effect size, and the result indicated a large effect size for jogging exercise and whey protein, which is also clinically important.

In this protocol, there were no missing data, as all the subjects participated with personal interest in improving their health and physical condition. All subjects attended the test and training sessions and consumed whey protein according to the schedule. Questionnaires and tests were completed correctly by the participants, and no technical problems, such as device errors or data entry mistakes, were observed.

Results

All descriptive statistics of the dependent variables in the research were measured and recorded before bariatric surgery and after exercise and supplement consumption (Table 2).

Table 2. Descriptive statistics of the participants before and after the research protocol

Variable / Levels	Pre-Test	Post-Test
Height (cm)	165.93 ± 7	-
Weight (kg)	76.10 ± 9.89	60.39 ± 5.77
Body mass (kg)	60.39 ± 5.77	64.60 ± 9.83
BMI (kg/m^2)	34.68 ± 2.38	24.68 ± 2.38
WC (cm)	85.06 ± 5.81	81.70 ± 6.25
Resting heart rate (bpm)	79.71 ± 8.75	75.71 ± 4.75
Systolic blood pressure (mm/Hg)	115.14 ± 8.07	107.78 ± 3.33
Diastolic blood pressure (mm/Hg)	75.00 ± 3.98	75.00 ± 7.98
ALT (U/L)	38.20	19.70
AST (U/L)	35.30	29.30
Ca (mg/dl)	7.88	9.05
Bone (%)	10.98	11.14
Fat (%)	33.34	30.51
Muscle (kg)	17.71	18.79
Liver fibroses (KPa)	33-52	17-39

Comparing the averages of bone mass, muscle mass, and calcium showed an increase, while fat, fibrosis, and the liver enzymes ALT and AST decreased (Figure 1). The assumption of normality and homogeneity of variance for the research data was not significant. Using the dependent t-test, the research variables were examined to determine their relationships in a pairwise manner (Table 3).

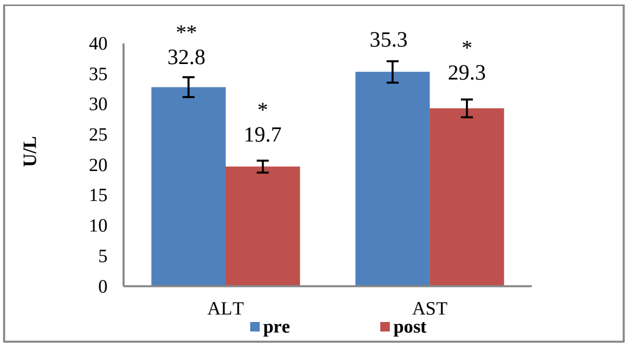

Figure 1. Comparison of changes in liver enzymes before and after bariatric surgery and jogging and consuming whey protein isolate

Table 3. The results and pairwise comparison of the scores of the dependent variables of the research in the subject

Variables	t	P-Value	Standard Error
Bone	8.484	0.000*	0.03
Fat	2.838	0.02*	0.06
Muscles	2.560	0.03*	0.15
ALT	4.195	0.002*	0.77
AST	1.286	0.23	0.547
Ca	- 0.170	0.56	0.28
Liver fibroses	0.231	0.02	0.26

* $P < 0.05$

According to the results, changes in bone weight, fat percentage, muscle weight, and ALT showed significant differences. To determine the extent of these changes and to check more precisely, the analysis of variance test with repeated measurements was used (Table 4).

Table 4. The results of the analysis of variance test with repeated measurements of the dependent variables of the research

Variables	P-Value	F
Bone	0.05*	679.89
Fat	0.01*	278.33
Muscles	0.04*	343.15
ALT	0.000*	233.36
AST	0.012*	217.30
Ca	0.001*	522.74
Liver fibroses	0.002*	213.12

* $P < 0.05$

To determine the extent of the changes and to check more precisely, the analysis of variance test with repeated measurements was used (Table 4). According to the results of the test, changes in bone weight, calcium, and muscle weight increased significantly, while fat percentage, AST, ALT, and fibrosis decreased significantly.

Discussion

The results of the research showed a significant increase in muscle volume, bone density, and calcium, and a significant decrease in the fat percentage of the subjects who engaged in jogging and consumed whey protein after bariatric surgery. The possible mechanism is that jogging exercise caused the consumption of extra fat to produce energy, increased the breathing rate, and enhanced oxygen consumption in the subjects' bodies. Furthermore, with the increased heart rate and breathing, fat metabolism is accelerated. Jogging exercise has been effective in strengthening muscles, developing physical fitness, maintaining the physiological balance of energy pathways, and increasing oxygen supply to fat tissues (12). After adapting to the activity, the heart rate slows down, and blood flow increases, which allows the liver to filter the blood more easily and return it to circulation (4). Jogging has induced a positive hypertrophic response in bones, muscles, joints, and calorie burning. These results align with the findings of Garofolini et al. (2019) (13). Petersen and colleagues (2021) obtained similar results (14). Tucker et al. (2016) stated that exercise and hunger increase catecholamine secretion (11), which, after being absorbed through beta-adrenergic receptors in fat cells, increases cAMP levels, activates PKA, and finally increases lipolysis (15,16). Pellegrin et al. (2020) reported that voluntary exercise capacity improved and mRNA expression of genes related to lipid metabolism was regulated in all exercise groups (17). However, Hartono et al. (2022) showed that protein consumption during recovery after an acute period of exercise simultaneously increased the rate of myofibrillar protein synthesis and improved muscle condition (1). Protein supplementation is designed as a nutritional strategy to optimize the adaptive response to exercise, improve muscle repair and regeneration, and increase adaptations related to strength and hypertrophy. Researchers have also considered the role of protein supplement timing (8). Iso whey protein, with a wide range of essential amino acids and nutrients, including the building blocks of contractile elements (Such as BCAAs), has been effective in stimulating growth, releasing anabolic hormones, and aiding weight reduction (18). Examining the blood calcium status showed significant increases in calcium in the post-test compared to the pre-test. Jogging and Iso whey protein increased renal tubular calcium reabsorption, osteoclast activity, and serum calcium levels. In this regard, stimulation of 5D hydroxylation in the kidney to vitamin D derivatives stimulates intestinal calcium absorption (19). The discrepancy with the results of other researchers may be due to differences in the exercise program, the type and amount of supplement consumed, or the organ (Femur) or research sample (Rat) studied (20).

The results of the research showed that liver enzymes ALT and AST decreased after bariatric surgery, jogging, and consumption of isoflavone protein (21,22). However, Katri et al. (2021) and Delicata et al. (2018) reported contradictory results (12,23). Sports activity itself acts as a stressor before metabolic, nervous, and hormonal adaptation, functioning as an anti-homeostasis mechanism that affects liver function. The decrease in hepatic blood flow and oxygen saturation during intense exercise increases the permeability of the liver membrane and, subsequently, liver enzymes (24). Factors such as the level of physical fitness, the type of training protocol, weight condition, excess fat, and the food consumed by the subjects are important. Recovery time, the effects of cell adaptation and DNA changes, lifestyle, and efforts to burn more calories should also be considered. This research underscores the growing emphasis on personalized post-obesity care, including tailored nutrition and exercise programs, and shows how protein supplements, including whey protein, combined with exercise programs, may help maintain musculoskeletal and metabolic health after surgery. Gender-related outcomes should also be considered in post-surgical interventions.

Conclusion

Jogging probably increased energy metabolism, fat utilization, and the levels of stress hormones and catecholamines. Therefore, the accumulation of fat in the liver and the secretion of liver enzymes decreased. In this regard, protein catabolism is halted by cortisol, blood sugar levels are maintained, and the use of fat sources as fuel increases. Epinephrine and norepinephrine are released from the terminals of the sympathetic system and affect fat loss. The metabolic, nervous, and hormonal adaptations caused by running likely contributed to the decrease in liver enzymes. The reduction of ALT and AST enzymes, which are involved in the Krebs cycle and the electron transport system, increases the capacity of muscle tissues to oxidize fat and carbohydrates, as well as the molecular and functional cellular adaptation of mitochondria (Number, size, and membrane surface area).

Acknowledgement

This article is the result of student theses. We sincerely appreciate all the obese women who had bariatric surgery at Sadr Medical Clinic and participated in this research, their sincere support, and the officials and professors of the university who cooperated in conducting the research and providing the necessary facilities.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors personally covered all associated costs of the study.

Ethical statement

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine at Islamic Azad University with the following specifications: IR.IAU.VARAMIN.REC.1402.048 and IRCT20171210037809N8.

Conflicts of interest

There are no conflicts of interest among the authors, and this research was conducted with the financial support of the authors.

Author contributions

FN and MM were responsible for the conceptualization, methodology, data analysis, and drafting of the manuscript. FN reviewed, edited, and provided critical feedback throughout the research process. Both authors read and approved the final manuscript.

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How to Cite:

Nameni F, Motevasseli M. Response of liver enzymes and serum indices to whey protein isolate and jogging after bariatric surgery in obesity women. *Jorjani Biomedicine Journal.* 2024;12(3):11-4.