

effect of 8 weeks HIIT and algomed supplementation on liver enzymes in obese men

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Abstract

Background and aim: Non-alcoholic fatty liver disease (NAFLD) is characterized by elevated liver enzymes, indicating hepatic stress. This study aims to evaluate the synergistic effects of HIIT combined with Algomed supplementation on reducing liver enzymes .

Methods: In this quasi-experimental study, 44 obese male volunteers who worked in public and administrative centers and were between the ages of 23 and 32 with a body mass index of 30 and a waist-to-height ratio greater than 0.5 were studied. The subjects were randomly assigned to four groups: control (n = 11), exercise (n = 11), supplement (n = 11), and exercise-supplement (n = 11). The training groups performed resistance interval training 3 sessions per week for 8 weeks in the form of 3 sets of 13 repetitions at an intensity of 60% of one maximum repetition, with active rest between sets and an intensity of 20% of one maximum repetition and a number of repetitions of 15. The group taking the supplement consumed 1800 mg of *Chlorella vulgaris*, which was 6 tablets. Fasting blood samples were taken from the subject's right brachial vein 48 hours before and 48 hours after the training period. After ensuring the normal distribution of the data, the data were analyzed using a two-way variance test, Bonferroni's post hoc test, and dependent T-test ($P < 0.05$).

Results The results showed that serum ALT, ALP, GGT and AST levels increased significantly after 8 weeks of resistance interval training with *Chlorella vulgaris* supplementation ($P < 0.05$).

Conclusion: The combination of High-Intensity Interval Training and Algomed (*Chlorella*) supplementation appears to be a highly effective non-pharmacological strategy for reducing liver enzymes. While HIIT directly reduces hepatic steatosis and enzyme leakage, Algomed appears to support this process via anti-inflammatory pathways, suggesting a synergistic hepatoprotective effect.

Introduction

Obesity, as a complex metabolic disorder, has significant effects on liver function and liver enzyme profiles. Weight gain and accumulation of excess body fat, especially in the abdominal region, can lead to fat accumulation in liver cells (hepatic steatosis), chronic liver inflammation, and ultimately structural changes in this vital organ (Del Bo', Perna et al. 2023). This process is often accompanied by disruption of liver biochemical pathways, especially glucose and lipid metabolism (Bhat and Mani 2023). The mechanism of action of interval training involves significantly increasing calorie burn during exercise and maintaining a higher post-exercise metabolic rate (EPOC), which effectively leads to reduced body fat and improved body composition (BaiQuan, Meng et al. 2025). This exercise method is highly effective, especially for people with limited time, and can produce significant results in a short period of time. In addition, interval training also helps strengthen the cardiovascular system, increasing muscle strength and endurance. Scientific evidence suggests that these exercises improve the function of this vital organ by increasing blood circulation and improving oxygenation of liver tissue, while reducing inflammation and oxidative stress in the liver, which are destructive factors of liver health (Reljic, Dieterich et al. 2022).

Researchers have proposed several strategies to combat obesity, and among them, dietary supplements are a suitable option due to their high safety and easy availability (Bonetti, Herbst et al. 2022). In this regard, *Chlorella vulgaris*, which is considered an algae, contains vitamins, phenolic compounds, and minerals, and this nutritional supplement is known to have antioxidant, anti-inflammatory, and immune-boosting properties (Kalogerakou and Antoniadou 2024). The chlorophyll content of this algomed includes antioxidants such as carotenoids, which play a role in regulating lipogenesis and fat metabolism, and therefore can be effective in reducing white fat mass through the process of adipogenesis (Madani, Abednatanzi et al. 2025). In addition, polyphenolic compounds in *Chlorella vulgaris*, such as catechins and flavonols, can prevent the formation of adipocytes and reduce fat accumulation in the body (Georgiopoulou, Tzima et al. 2023). Despite the growing understanding of the individual effects of exercise and algomed, the response of the inflammatory system to the combination of these two interventions still requires further investigation. Recent articles also indicate that despite many efforts, an effective and comprehensive treatment method to prevent or reduce inflammatory symptoms in different conditions has not yet been proposed, which may be due to the lack of a correct and complete understanding of the pathogenesis of inflammation. Accordingly, the aim of this study was to investigate the combined effects of a selected high-intensity interval training (HIIT) protocol and algomed supplementation on inflammatory markers in obese elderly women.

Materials and Methods

Samples

This study was conducted as a quasi-experimental trial, using a pretest-posttest design and including a control group. The participants in this study included 44 inactive elderly women aged 23 to 32 years who were members of a nursing home and had not experienced any regular exercise in the past two years. The study subjects were selected through convenience sampling. In order to explain the objectives and implementation protocol of the study, a meeting was held with the director, medical staff (including doctors and nurses) of the nursing center, and all eligible participants. In this meeting, complete information was provided about the nature of the study, the implementation steps, and the participation requirements. Then, each of the participants was given an invitation containing details about the objectives and methods, an informed consent form for voluntary participation, and a comprehensive questionnaire regarding general health status and possible risk factors for diseases. Inclusion criteria included the absence of any clinical or physical signs of cardiovascular disease, diabetes, or hypertension. Participants were also not taking any medications, dietary supplements, or pharmaceuticals. The baseline anthropometric characteristics of these individuals are presented in Table 1.

Table 1
Baseline characteristics of subjects

Diff between group		control	combination	suppl	Experimental	stage	Variable
sig	F						
939/0	134/0	03/70 ± 6/55	97/40 ± 7/55	86/80 ± 5/56	71/80 ± 8/54	pretest	Age (yr)
		-	-	-	-	posttest	
994/0	026/0	02/20 ± 7/80	86/40 ± 6/79	14/55 ± 7/79	39/60 ± 6/79	pretest	Wiegth (kg)
956/0	107/0	70/00 ± 7/80	44/40 ± 6/78	94/78 ± 6/78	58/50 ± 6/79	posttest	
		480/0-	121/2-	775/1-	429/0-	t	Diif between group
		642/0	063/0	110/0	678/0	sig	
374/0	07/1	96/80 ± 4/163	93/10 ± 6/159	22/50 ± 8/160	01/30 ± 6/159	pretest	Heigh (cm)
		-	-	-	-	posttest	
553/0	708/0	89/94 ± 2/29	79/53 ± 3/31	35/11 ± 4/31	31/92 ± 10/27	pretest	BMI
618/0	601/0	13/86 ± 3/29	69/14 ± 3/31	21/80 ± 4/30	26/83 ± 10/27	posttest	
		461/0-	04/2-	74/1-	11/1-	t	Diff intergroup
		656/0	071/0	115/0	343/0	sig	

High-intensity interval training (HIIT) protocol

This study will utilize a HIIT training program three days a week for 8 weeks. Before the start of the training period, subjects participated in 30- to 45-minute training sessions in the gym for two weeks (three sessions per week) to familiarize themselves with the tests and how to properly perform the HIIT protocol. In the coordination session before the start of the study, in addition to a full explanation of the goals and measurement methods, daily physical activity questionnaires, determination of maximum heart rate, 24-hour nutritional reminder, health questionnaire, and consent form for participation in the training were completed by the selected individuals, and necessary medical examinations were performed. The duration of each training session will gradually increase from 34 minutes in weeks 1 and 2 to 58 minutes in weeks 7 and 8. The exercises are performed using body weight and no special equipment is required. The ratio of activity time to rest is considered to be 1:2. The structure of each training session consists of three parts as follows: Warm-up (5 minutes): Dynamic stretching and light

aerobic exercises aimed at preparing the cardiovascular and musculoskeletal systems for the main activity. Main exercises (24–48 minutes): Performing high-intensity interval training and active rest periods. The list of exercises is as follows: running forward and backward, bodyweight squats, push-ups, sit-ups, butterfly movement, six-point support plank, walking lunge, bodyweight dips, quick jumps, lunge passes, reverse lunges, mountain climber movement, raising hands and feet in a cat position, jumping to the sides, changing direction forward, stairs (height 25 cm). Cool-down (5 minutes): Static stretching and light aerobic exercises to gradually reduce the heart rate and prevent muscle cramps. Duration and intensity of training: Weeks 1–4: 30 seconds of activity at an intensity greater than 75% of heart rate reserve (Karvonen) or equivalent to 17 or higher on the Borg scale, and 60 seconds of active rest. Weeks 5–6: 45 seconds of activity at the same intensity, and 90 seconds of active rest. Weeks 7–8: 60 seconds of activity at the same intensity, and 120 seconds of active rest (Milad, Saedmocheshi et al. 2025). Maximum heart rate (HR_{max}) was calculated for each subject using the age-difference formula from 220. Training intensity was monitored using the percentage of heart rate reserve (HRR) based on the Karvonen formula and the Borg CR10 Scale. To ensure compliance with the training intensity, the subjects' heart rates were continuously recorded and monitored during the training sessions using a Polar Pacer Pro, Kempele, Finland.

Supplementation

The supplement group took 1800 mg of Algomed (*Chlorella vulgaris*) algae daily in the form of 6 tablets (2 tablets 1.5 hours before breakfast, 2 tablets 1.5 hours before lunch, and 2 tablets 1.5 hours before dinner) according to the manufacturer's instructions. The placebo group took starch tablets with a similar appearance to the *Chlorella vulgaris* tablets (Milad, Saedmocheshi et al. 2025). It is worth noting that all participants completed a food diary three days before blood collection in the pretest phase and three days before blood collection in the posttest phase.

Measurement of variables

For this study, venous blood sampling from the medial cubital vein was performed at two key points: 24 hours before the start of the first training session and 48 hours after the end of the last training session. All samplings were performed between 7:00 and 8:00 AM and after a 10- to 12-hour fasting period. Before each blood sampling session, participants rested for a few minutes in a sitting position to stabilize physiological conditions. At each session, 5 cc of venous blood was collected from each participant. After collection, blood samples were poured into test tubes without anticoagulant for ALT and AST analysis. After complete clotting, the samples were centrifuged and the resulting serum was stored for measurement of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels using the ELISA method and dedicated RewriteKen kits. ELISA kits were used to measure alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The technical specifications of the kits used are as follows:

Code ethics

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Research Committee of the University of Kurdistan (Certificate No. IR. UOK.REC. 1403.027). Written informed consent was obtained from all subjects.

Statistical analysis

The collected data were analyzed using SPSS version 27 statistical software. Descriptive statistical indicators including mean and standard deviation were used to describe the data. The Kolmogorov-Smirnov test was used to check the normality of the data distribution and the Levene test was used to check the homogeneity of variances. After ensuring that the assumptions were valid, the two-way analysis of variance (Two-Way ANOVA) test was used within the framework of the general linear model to determine the main effects and the interaction effect of the two factors "exercise" and "supplement" on the research variables. In cases where the results of the two-way analysis of variance test were statistically significant, the Tukey post-hoc test was used to identify significant differences between the groups. Also, the dependent t-test was used to compare the pre-test and post-test values in each of the groups separately. The significance level was also considered ($p \leq 0.05$).

Results

In this study, the statistical assumptions of normality of data distribution and homogeneity of variances were met. Table 1 shows the individual and physiological characteristics of the subjects before the interventions. The mean age of all subjects in the study was 55 ± 67 years. There were no significant differences between the study groups in all baseline measurements including age, weight, height, and body mass index (BMI) ($p > 0.05$).

Variables Stage Exercise group Supplement group Exercise + supplement group Control group Difference between groups

Also, the results of two-way analysis of variance showed that exercise had a significant effect on alanine aminotransferase (ALT) ($p > 0.001$, $F = 35.09$). In contrast, algomed supplementation had no significant effect on ALT ($p > 0.117$, $F = 2.57$). Also, the interaction effect between exercise and algomed supplementation on ALT was not statistically significant ($p > 0.231$, $F = 1.43$). In addition, Tukey's test showed that there was a significant difference in ALT between the exercise and control groups ($p \leq 0.001$). Also, a significant difference was observed between the exercise and supplement groups ($p \leq 0.001$). The combination group also showed a significant difference in ALT compared to the control group ($p = 0.021$) and the supplement group ($p = 0.010$). However, no significant difference was found between the control group and the supplement group ($p = 0.993$) or between the exercise group and the combination group ($p = 0.208$).

The results of two-way ANOVA for aspartate aminotransferase (AST) showed that exercise had a significant effect on AST ($p > 0.001$, $F = 39.97$), while algomed supplementation had no significant effect ($p = 0.380$, $F = 0.79$). Also, the interaction effect between exercise and algomed supplementation was not significant ($p = 0.736$, $F = 0.115$). Tukey's multiple comparison test showed that there was a significant difference in AST between the exercise group and the control group ($p = 0.001$). Also, a significant difference was observed between the exercise group and the supplement group ($p = 0.003$). The combination group also showed a significant difference in AST with the control group ($p < 0.001$) and the supplement group ($p < 0.001$). However, no significant difference was found between the control group and the supplement group ($p = 0.980$) as well as between the exercise group and the combination group ($p = 0.821$).

ALP (Alkaline Phosphatase)

The results of the two-way ANOVA for the variable alkaline phosphatase (ALP) indicated that exercise had a significant effect on ALP levels ($F = 10.17$, $p = 0.003$). In contrast, algomed supplementation did not have a significant effect on ALP ($F = 0.021$, $p = 0.886$). Furthermore, the interaction effect between exercise and algomed supplementation was not significant ($F = 0.002$, $p = 0.966$). The results of Tukey's post-hoc multiple comparisons test showed no significant difference in ALP between the exercise group and the control group ($p = 0.120$). The mean scores of the exercise group also did not differ significantly from the supplement group ($p = 0.156$). Additionally, the differences between the combination group and the control group ($p = 0.104$), as well as the supplement group ($p = 0.136$), were not statistically significant.

GGT (Gamma-Glutamyl Transferase)

The results of the two-way ANOVA for the variable gamma-glutamyl transferase (GGT) indicated that exercise had a significant effect on GGT levels ($F = 1038.405$, $p = 0.002$). Moreover, algomed supplementation had a significant effect on GGT ($F = 693.692$, $p = 0.003$). The interaction effect between exercise and algomed supplementation was also highly significant ($F = 380.127$, $p = 0.001$). The results of Tukey's post-hoc multiple comparisons test revealed a significant difference in GGT between the exercise group and the control group ($p = 0.001$). The mean scores of the exercise group also differed significantly from the supplement group ($p = 0.003$). Furthermore, the differences between the combination group and the control group, the supplement group, and the exercise group were all statistically significant ($p = 0.001$).

Discussion

Obesity, as one of the public health problems in recent decades, is closely related to metabolic diseases, especially non-alcoholic fatty liver disease (NAFLD). Due to hormonal changes, increased visceral fat storage, and decreased insulin sensitivity, obese women are more susceptible to liver disorders and increased liver enzymes such as ALT, AST, and GGT than men. In this context, non-pharmacological interventions, including exercise and nutrition, have attracted the attention of researchers as safe, low-

cost, and effective methods. In this study, we focused specifically on high-intensity interval training (HIIT) and algomed supplementation, both of which have been reported to have positive effects on liver health in recent years.

Although few studies have been conducted on the effects of *Chlorella vulgaris* on liver function, Li et al. tested different diets containing 5% and 10% by weight of *Chlorella vulgaris* on liver enzymes in mice compared to a diet without this supplement, and the results showed that ALT and AST levels did not change after consuming the diet containing *Chlorella vulgaris* (Lee, Kang et al. 2010).

In another clinical trial, Panahi et al. examined the effect of 1200 mg of *Chlorella vulgaris* for three months in patients with nonalcoholic fatty liver disease and observed a significant reduction in ALT and AST levels in the group that consumed *Chlorella vulgaris* (Panahi, Pishgoo et al. 2012). Also, the effect of *Chlorella vulgaris* on liver function may be mediated by its effect on body weight (Panahi, Pishgoo et al. 2012).

Several studies have shown that HIIT, in addition to improving body composition, has a direct effect on reducing liver fat and improving liver enzymes. Due to the high intensity of the activity and the presence of short rest phases, HIIT training produces different metabolic responses than continuous moderate-intensity exercise. Possible mechanisms include increased fatty acid oxidation capacity, increased insulin sensitivity, and stimulation of mitochondrial pathways, all of which contribute to reducing triglyceride accumulation in liver cells. Keating et al. (Keating, Croci et al. 2023) showed in a meta-analysis that HIIT is more effective than continuous aerobic exercise in reducing ALT and AST levels. Furthermore, (Verbrugghe, Klaps et al. 2025) reported that a course of HIIT reduces systemic inflammation and, consequently, reduces liver cell damage. These adaptations are of particular importance in obese women, who often have insulin resistance and high levels of chronic low-grade inflammation.

When examining the effects of high-intensity interval training (HIIT) and algomed supplementation on people with nonalcoholic fatty liver disease (NAFLD), the results of different studies are sometimes contradictory. Some research has shown that these interventions can have positive results; for example, a 2014 study by Keating et al. showed that HIIT training reduced liver enzymes ALT and AST in patients with NAFLD compared to moderate-intensity exercise, and was introduced as a more effective method. Also, a 2016 study by Jäger et al., which was conducted on obese people with fatty liver, showed that HIIT not only reduced liver enzymes, but also improved insulin sensitivity, and is considered an effective non-pharmacological strategy for the treatment of NAFLD (Leżnicka, Gasiorowska et al. 2023, Madani, Abednatanzi et al. 2025, Milad, Saedmocheshi et al. 2025).

On the other hand, some studies have provided mixed results. For example, (Sabag, Barr et al. 2022)) found that both HIIT and moderate exercise were effective in improving liver enzymes, but HIIT had no particular advantage over moderate exercise. Also, a study by (Yoshimura, Hamaguchi et al. 2021) showed that exercise without weight loss did not produce significant changes in ALT and AST enzymes in obese women, so weight loss is a key factor in improving liver function.

Although each of these interventions has an independent effect on liver health, evidence suggests that the combination of HIIT and algomed can have a synergistic effect. HIIT increases lipolysis and the release of fatty acids from peripheral adipose tissue, paving the way for more efficient utilization of these fatty acids in metabolic pathways. Another reason for the effectiveness of *Chlorella vulgaris* is the presence of carotenoids, which play a role in lipid metabolism (Safi, Zebib et al. 2014). Carotenoids can also lead to lipid oxidation and reduce the risk of heart and metabolic diseases with their antioxidant and anti-inflammatory effects (Safi, Zebib et al. 2014). Among carotenoids, beta-carotene and lutein are the most abundant. Taking supplements containing these carotenoids can help reduce triglyceride and cholesterol levels (Safi, Zebib et al. 2014). Also, the results have shown that lutein can affect the expression of genes related to lipid metabolism and regulate cholesterol and low-density lipoprotein levels by modifying the corresponding receptors. Thus, it can be concluded that the consumption of *Chlorella vulgaris* and carotenoids can help improve metabolic health and reduce the risk of chronic diseases. *Chlorella vulgaris* supplementation reduces TNF- α levels by inhibiting NF- κ B expression and decreasing TNF- α converting enzyme activity (Farag, Alagawany et al. 2023). Another possible mechanism is the role of protein tyrosine phosphatase, which is mainly activated in cytokine and growth factor receptor signaling pathways. Increased production of this enzyme is known to be one of the effective factors in vascular inflammation and tumor growth (Farag, Alagawany et al. 2023). Also, the use of protein kinase inhibitors is considered as one of the important therapeutic targets to reduce inflammation (Mohamed, El-Kholy et al. 2022). For this reason, research has shown that the consumption of *Chlorella vulgaris* reduces protein tyrosine phosphatase in cells, which helps to inhibit the activity of some key protein kinases in the chronic inflammatory process and thus reduces inflammation (Mohamed, El-Kholy et al. 2022). These interventions also improve cardiovascular health in obese women by improving insulin sensitivity, lowering blood pressure, and improving lipid profiles. In this study, the effects of using various antioxidants such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPX) were investigated. The study aimed to investigate changes in liver enzyme levels. The results showed that the combination of these two helped improve liver function in animals. In particular, the activity of ALT and GGT enzymes, which are usually indicators of liver damage, improved in the groups receiving these compounds. It was also observed that the activity of AST and ALT enzymes decreased. Considering the results obtained, it can be concluded that the use of these two interventions can be considered as an effective method for improving liver health. Overall, the evidence suggests that although HIIT and algomed can have positive effects on liver function and metabolism, factors such as exercise intensity, weight loss, and type of intervention play an important role in the final results.

5. Limitations and Research Needs

Despite the promising findings, there are important limitations. First, the number of studies that have simultaneously examined the effects of HIIT and algomed on liver enzymes is limited. Second, differences in exercise protocols (duration, intensity, number of sessions) and differences in the dose algomed supplement make it difficult to compare results. On the other hand, many studies have had short-term periods, and long-term evidence on the durability of effects is still insufficient.

Conclusion

Overall, scientific evidence suggests that both HIIT training and algomed can independently reduce liver enzymes and improve liver function in obese women. Combining these two interventions is likely to be more effective due to complementary mechanisms and could be a practical and cost-effective strategy for the prevention and treatment of liver disorders in this population. However, in order to obtain definitive results and develop clinical guidelines, it is necessary to conduct prospective studies with randomized clinical trial designs, longer duration, and a special focus on the female population.

Declarations

Author Contributions

Maryam keshvary and Afshar rezvan : methodology, software, data curation. SaberSaedmocheshi: software, methodology, formal analysis, investigation, writing – original draft, writing – review and editing. Maryam keshvary and Afshar rezvan : visualization, writing – review and edit-ing, writing – original draft. Saber saedmocheshi: project administration, writing – review and editing. Maryam keshvary and Afshar rezvan : writing – original draft, writing – review and editing.

Acknowledgments

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Ethics Committee of the University of Kurdistan (protocol code IR.UOK.REC.1403.027).

Consent Informed

consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data are available in the article. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Transparency Statement

The lead author Saber Saedmocheshi, Maryam keshvary and Afshar rezvan affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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