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Original Article

Effect of Exercise on Liver Fat and Lipid Profiles in Non-Alcoholic Fatty Liver Disease: A Hospital-Based Study

Shankar Ramchandwani[1], Santosh Kumar Pradhan[2], Jyotiranjan Mohapatra[3], Kaushik Parasar Patra[4]*

[1]Assistant Professor, Department of General Medicine, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Odisha, India
[2]Associate Professor, Department of Paediatrics, MKCG Medical College & Hospital, Berhampur, Odisha, India
[3]Assistant Professor, Department of General Surgery, Shri Jagannath Medical College & Hospital, Puri, Odisha, India
[4]Assistant Professor, Department of Paediatrics, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Odisha, India

***Address for Correspondence:** Dr. Kaushik Parasar Patra, Assistant Professor, Department of Paediatrics, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Odisha, India
E-mail: kppatra7@gmail.com

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ABSTRACT

Background: The most common cause of liver dysfunction globally is non-alcoholic fatty liver disease (NAFLD), which is becoming more common due to poor lifestyle choices, obesity, and metabolic syndrome. Although exercise and weight loss are advised therapies, the best course of therapy is yet unknown. The purpose of this study is to assess how an aerobic and resistance exercise program affects a patient with non-alcoholic fatty liver disease's body composition and lipid profiles.

Methods: A 31-year-old male with NAFLD and no previous exercise history participated in a 12-week exercise program. Blood samples were collected after a 12-hour fast to assess lipid profiles, and a liver ultrasound was performed to evaluate liver fat content. The exercise program combined aerobic and resistance training, progressively increasing in intensity.

Results: After the 12-week intervention, the patient showed significant improvements in body composition, including reduced weight (88.9 kg to 75.8 kg), BMI (30.01 to 26.03), body fat (48.1% to 24.2%), and waist-to-hip ratio (0.96 to 0.85). Blood lipid profiles improved with lower total cholesterol (229 mg/dl to 204 mg/dl), LDL (171 mg/dl to 140 mg/dl), and triglycerides (176 mg/dl to 101 mg/dl), while HDL increased (31 mg/dl to 45 mg/dl). Liver fat content decreased from grade II to grade I.

Conclusion: The exercise program led to significant improvements in both body composition and lipid profiles, providing evidence that aerobic and resistance exercises can be effective non-pharmacological treatments for NAFLD. Regular exercise may play a critical role in managing and reversing the progression of NAFLD, emphasizing the importance of lifestyle interventions in liver health.

Key-words: Exercise, Liver fat, Lipid profile, Aerobic and resistance training, Body composition, Metformin, Non-alcoholic fatty liver disease, Lifestyle changes

INTRODUCTION

An excessive accumulation of fat in the liver, namely triglycerides (TG) and very low-density lipoproteins (VLDL), is the hallmark of NAFLD, the leading cause of liver dysfunction globally [1,2].

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The condition affects 25–30% of persons in developed nations [2,5,6], and its prevalence is rising, mostly due to rising rates of obesity, metabolic syndrome, and unhealthy lipid profiles [7-9].

Poor eating choices have been intimately linked to the development of NAFLD, physical inactivity, and a sedentary lifestyle [10,11]. Although weight loss is frequently advised as a crucial intervention, a viable therapeutic strategy for NAFLD is still unknown despite the disease's increasing burden [1,12]. Among the treatment strategies, exercise (EX) has emerged as a promising approach, with evidence suggesting that it can

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significantly improve body weight, lipid profiles, and liver fat content [7]. EX serves as a non-pharmacological treatment that contributes to improving various aspects of physical fitness, offering both prevention and management of NAFLD [13,14].

The effects of exercise on lipid profiles, both quantitatively and qualitatively, are still not well understood, especially when it comes to liver fat levels. Exercise may reduce the amount of fat in the liver by lowering TG, VLDL, and apolipoprotein B-100 production rates, according to some research [3]. The best kind, level of intensity, and length of exercise to lower intrahepatic lipids (IHL) is still up for debate, even though exercise is essential in the treatment of NAFLD [13,15]. This study looks at how an aerobic and resistance training program affects blood lipid profiles and anthropometric measurements, with a particular emphasis on how it may help individuals with NAFLD lose liver fat.

MATERIALS AND METHODS

Research Design- An exploratory and descriptive case study design is used in this investigation. A 31-year-old man who had not exercised for at least two years was the participant. The participant gave written approval for the use of his data in this study, guaranteeing his identity and the privacy of any public material.

After an overnight fast of twelve hours, blood samples were drawn and processed in accordance with the guidelines set forth by the Brazilian Ministry of Health. Total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) were all measured as part of the analysis of the blood lipid profile using flow cytometry (6).

A skilled endocrinologist performed a liver ultrasound, which was scored at baseline and the end of the trial using a 0–3 scale (0=none, 1=mild, 2=moderate, 3=severe). These were the grades:

- ✓ **Mild-** Hepatic echogenicity somewhat increased whereas portal vein wall echoes were mostly preserved.
- ✓ **Moderate-** Diffuse aberrant bright echoes with a moderate loss of echoes from the portal vein walls, particularly from outlying branches.
- ✓ **Severe-** Significant reduction in beam penetration, loss of echoes from most of the portal vein walls, and extensive abnormal bright echoes (7,8). Hepatic fatty infiltration grade II (moderate) was identified on the first ultrasound. The individual was given a prescription for 500 mg of metformin to be taken twice a day after supper in response.

The study participant underwent twenty four-hour monitoring of blood pressure while walking. The findings showed that blood pressure remained normal over the observation period.

The individual was positioned on a vertical stem and a flat surface, and his height was measured using a stadiometer. Weight was measured to calculate body mass index (BMI). The participant's weight status was evaluated using this. The waist-to-hip ratio (WHR) was also computed. A measuring tape was positioned at the narrowest region of the waist while the subject stood with their abdomen relaxed to determine their waist circumference. The hip circumference was measured at the gluteal region's widest point.

Exercise Program- To obtain the intended results within the patient's physical limitations, a twelve-week workout program was created that considered both participant preferences and scientific considerations.

- ❖ **Weeks one through three:** The workout regimen was followed three times a week on days that were not consecutive, with a sixty-minute session each time. It consisted of weight training (8–12 repetitions, 3 sets for each exercise) after 25 minutes of aerobic activity on a treadmill. The exercises that were utilized were the latissimus pull-down, sitting chest press, cable triceps extension, biceps curl, leg press, adductor press, abductor press, and calf raise. The workout concluded with 10 minutes. Nearly 70% of the subject's maximum heart rate (HRmax) was attained throughout these sessions.
- ❖ **Weeks four through twelve:** The workout regimen was changed to be done five times a week for sixty minutes each time. The regimen included circuit resistance training (12–16 repetitions, 2 sets for each activity) following a quarter-hour cardiovascular workout on a stationary bike. The training cycle

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consisted of eleven exercises: seated chest press, biceps curl, cable triceps extension, shoulder press, leg press, leg extension, adductor press, abductor press, calf raise, abdominal press, and latissimus pull-down. Each practice ended with ten minutes of stretching. 85% of the participant's HRmax was reached during these sessions.

Statistical analysis- Descriptive statistics were used to analyze anthropometric measurements, blood lipid profiles, and blood pressure data. Continuous variables were expressed as mean ± SD, while categorical variables, such as hepatic ultrasound grades, were presented as frequencies. Data analysis was conducted using SPSS 27, with a significance level set at $p<0.05$.

RESULTS

The subject first reported gains in his physical fitness, mood, and quality of sleep, all of which had a favorable effect on his capacity to carry out daily tasks and jobs. The baseline liver ultrasonography revealed grade II (moderate) hepatic fatty infiltration. A follow-up ultrasound showed a decrease in hepatic fatty infiltration grade I (mild) following a 12-week workout regimen. Following the exercise regimen, the subject's liver ultrasonography revealed no vascular distribution abnormalities, neither liver lesions nor dilation of the intra- or extrahepatic bile ducts. This suggests that the clinical parameters were consistent with normal results based on the ultrasound data.

Following training, there was a substantial improvement in the subject's weight, BMI, conicity index, body fat percentage, waist-to-hip ratio (WHR), and waist circumference. and total cholesterol, LDL, VLDL, triglycerides, and hip circumferences. Moreover, HDL cholesterol levels increased. These results supported the idea that exercise might be a helpful treatment for the clinical symptoms of non-alcoholic fatty liver disease.

Table 1: Body composition results before and after the exercise intervention

Parameters	Before the Exercise	After the Exercise Program
Weight (kg)	88.9	75.8
BMI (kg/m²)	30.01	26.03
Conicity Index	1.49	1.29
Body Fat Percentage	48.1	24.2
WHR	0.96	0.85
Waist (cm)	98	82
Hip (cm)	102	96

Table 2: Blood lipid profile data before and after the exercise intervention are displayed

	Before the Exercise Program (mg/dl)	After the Exercise
Total	229	204
Cholesterol HDL	31	45
Cholesterol LDL	171	140
Cholesterol	36	21
Triglycerides	176	101

DISCUSSION

The exercise regimen used in this study was intended to assist the participants reverse the clinical condition they were presented with. A key component of altering the physiological state associated with NAFLD is changing one's lifestyle, especially losing weight, which can be accomplished by consistent exercise [1,13-18].

Moderate-intensity exercise has been identified by prior studies as one of the most successful non-pharmacological therapies for non-alcoholic fatty liver disease [2,19]. The benefits of moderate exercise probably result from its capacity to improve glucose absorption, especially when paired with a decrease in visceral fat. AMP-activated protein kinase is regulated, lipid levels are decreased, fasting insulin concentrations are decreased, muscle mRNA expression and circulating adiponectin are increased, and whole-body glucose absorption is enhanced [5,20]. Thus, patients who engage in fitness regimens typically gain weight.

The study advises 20 to 60 minutes of moderate-intensity exercise that targets large muscle groups at least five days a week to prevent weight gain. It is recommended to engage in moderate exercise for 150–250 minutes per week in order to get clinically meaningful weight loss [6,7]. These guidelines were followed by our workout regimen, which began with 180 minutes per week and escalated to 300 minutes starting in the fourth week. By the end of the 12-week program, the individual had shed about 12 kg.

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The regimen included both resistance and aerobic activities. Research indicates that the advantages of weight training alone may be comparable to those of aerobic training [8]. Therefore, consistent exercise has been demonstrated to lower the incidence of NAFLD, as supported by comparable results in another research [9]. In support of its use as a non-pharmacological therapy, certain studies have emphasized the significance of exercise for the management and prevention of NAFLD [10]. For example, Hallsworth *et al.* [11] conducted a 10-week fitness program in which participants rode stationary bicycles for an hour twice a week. However, this study found no significant decreases in body weight, waist circumference, hip circumference, WHR, lipid profile, or BMI, indicating the necessity for greater frequency or longer-duration exercise programs.

In a study by Finelli *et al.* [11] and Sullivan *et al.* [21] five times a week for 16 weeks, half an hour of aerobic exercise at 45–55% of VO2 peak was shown to reduce 10% of intrahepatic lipids (IHL). The lipid profile and body weight, however, were not significantly impacted. However, after engaging in moderate-to-intense physical activity, our participants' weight, body fat percentage, WHR, waist circumference, and hip circumference all dropped. Thus, higher-intensity exercise may lead to more substantial changes in body composition.

Hallsworth *et al.* [11] found that, although having no effect on body weight, waist circumference, hip circumference, WHR, or body fat %, three times a week for eight weeks, 45 minutes to an hour of strength training at 50–70% of a single repetition maximum decreased 13% of IHL. With a 40-minute session three times a week for three months, Chen *et al.* [6] also used resistance training to treat NAFLD patients, which resulted in a decrease in total cholesterol. Resistance training may be a good substitute for aerobic exercise for people who are physically unable or unmotivated to do so [7].

Similarly, following the exercise program, our participant's HDL levels rose while their total cholesterol, LDL, VLDL, and TG levels decreased. According to these results, moderate-to-high-intensity Exercise has been shown to improve blood lipids and body composition, both of which have a good influence on liver function [8,9]. For seven days in a row, Finelli *et al.* [10] had patients engage in aerobic activity for an hour at 80–85% of HRmax. However, there were no discernible changes in IHL, weight, or BMI between MRI scans taken before and after the program. The absence of noteworthy findings may be explained by the short research period. These results underline the necessity of regular exercise evaluations in the treatment of NAFLD and provide credence to the notion that exercise might be a therapeutic target for the illness [11,12]. In order to aid in weight loss, the participant in our research was taken 500 mg of Metformin every day after supper. Despite being often recommended for NAFLD, metformin's efficacy is constrained by adverse effects and low patient adherence [13]. According to another study, lifestyle changes might have advantages comparable to those of metformin, making exercise a suitable substitute therapy [14].

Metformin for the treatment of NAFLD was not supported by enough evidence, according to three Cochrane studies [15]. Interestingly, Palmer *et al*. [16] found that aerobic exercise alone improved fasting glucose levels and decreased liver triglyceride content more effectively than metformin. Furthermore, there was little additional advantage to taking Metformin together with aerobic activity, and Metformin seemed to reduce the rise in mitochondrial fat oxidation brought on by exercise. These findings imply that Metformin may hinder the hepatic mitochondrial adaptations and cardiorespiratory performance brought on by exercise, which may be lessened by combining Metformin medication with exercise [17,18].

In research by Sanchez-Muñoz *et al.* [19] a 12-week exercise program at moderate to high intensity for 300 minutes per week enhanced cardiorespiratory function and decreased liver fat, outperforming the Metformin group [20]. Except for metformin, this supports our hypothesis that exercise is a beneficial treatment for NAFLD.

Although there have been favorable reports of exercise therapies on an individual basis, these findings frequently have small sample sizes and lack the power to identify benefits for a liver function that are clinically important. Given the dearth of available treatments for NAFLD, exercise offers a practical and affordable solution [21,22]. To examine the effectiveness of aerobic, resistance, or combination exercise regimens for the treatment of NAFLD as well as to investigate the effects of exercise dosage (intensity, frequency, and volume), more extensive randomized controlled studies are

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required [13,22-24]. We hypothesise that people with NAFLD may benefit most from moderate-to-intense exercise that lasts 300 minutes or more per week.

CONCLUSIONS

Regular exercise is crucial for improving lipid profiles and liver function in people with NAFLD. Our findings demonstrated that resistance and aerobic exercise enhanced body composition and lipid profiles, which was beneficial for NAFLD patients. Because of their connection to cardiovascular disease and the decrease in lipid levels that lead to liver damage, these findings are significant. For the management and treatment of NAFLD, exercise might be a useful therapy.

CONTRIBUTION OF AUTHORS

Research concept- Shankar Ramchandwani, Jyotiranjan Mohapatra
Research design- Jyotiranjan Mohapatra, Kaushik Parasar Patra
Supervision- Santosh Kumar Pradhan
Materials- Jyotiranjan Mohapatra, Kaushik Parasar Patra
Data collection- Shankar Ramchandwani, Jyotiranjan Mohapatra
Data analysis and Interpretation- Santosh Kumar Pradhan
Literature search- Jyotiranjan Mohapatra, Kaushik Parasar Patra
Writing article- Shankar Ramchandwani, Jyotiranjan Mohapatra
Critical review- Santosh Kumar Pradhan
Article editing- Shankar Ramchandwani, Jyotiranjan Mohapatra
Final approval- Santosh Kumar Pradhan

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