



*Full Length Research Paper*

# The effects of exercise on the body composition and lipid profile in a subject with non-alcoholic fatty liver disease

Luci Alves Cerqueira<sup>1</sup>, Moacir Pereira Junior<sup>2</sup>, José Roberto Lazarini Junior<sup>3</sup>,  
Fabio Henrique Ornellas<sup>\*4</sup>

<sup>1</sup>Trainee Gym – Health and Movement, Salvador Avenue, 320A, Vitória da Conquista – BA / Brazil.

<sup>2</sup>Physical Education Professional, Doralice Ramos de Pinho Street, 262 – São José – SC / Brazil

<sup>3</sup>Body and Action Gym, Luiz Boiteux Piazza Avenue, 6198, Florianopolis – SC / Brazil.

<sup>\*4</sup>School of Arts, Sciences and Humanities, Arlindo Bettio Avenue 100, Building A1 – Room 204E, University of Sao Paulo, São Paulo – SP / Brazil.

\*Corresponding author's e-mail: [fabioornellas@uol.com.br](mailto:fabioornellas@uol.com.br)

## ABSTRACT

**Non-alcoholic fatty liver disease is the most common cause of liver dysfunction worldwide. To describe the importance of a 12-week exercise program for a patient diagnosed with non-alcoholic fatty liver disease. This is a case study characterized as exploratory and descriptive. A 29-year-old male subject who had not undergone any physical activity for at least the past two years was invited to participate in the study. Through the assessment of anthropometric measurements and other laboratory exams, the medical report of upper abdominal ultrasound diagnosed hepatic fatty infiltration grade II (moderate). The subject practiced 12 weeks of aerobic and resistance exercises, three times a week for the first three weeks and five times a week from the fourth week on. The subject reduced his total body weight, body mass index, conicity index, body fat percentage, waist-hip ratio, waist circumference, hip circumference, total cholesterol, triglycerides, low-density lipoprotein, very low-density lipoprotein and suffered an increase in high density lipoprotein. Conclusions: It can be seen that the aerobic exercise combined with resistance training is an important non-pharmacological treatment for patients with non-alcoholic fatty liver disease.**

**Keywords:** NAFLD. Lifestyle Intervention. Aerobic Exercise. Resistance Exercise. Body Composition. Lipid Profile.

## INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is the most common cause of liver dysfunction worldwide (Mavrogiannaki and Migdali, 2013; Attar and Thiel, 2013) and is associated with excessive fat accumulation in the liver, especially the very low-density lipoprotein (VLDL) and triglycerides (TG) (Sullivan et al., 2012; Wilkins et al., 2013).

The prevalence of NAFLD in developed countries is

estimated at around 25-30% (Attar and Thiel, 2013; Ratziu et al., 2010; Sullivan et al., 2012) and has increased as more patients develop obesity, metabolic syndrome and an unfavorable lipid profile (Xiao et al., 2013; Wilkins et al., 2013; Attar and Thiel, 2013).

A sedentary lifestyle, physical inactivity and poor dietary habits are the main factors associated with NAFLD (Fan and Cao, 2013; Bradford et al., 2014). In

this approach, the treatment for NAFLD is not well established, although weight loss is strongly recommended (Mavrogiannaki and Migdali, 2013; Bhatia et al., 2012).

Therefore, exercise (EX) in the treatment of NAFLD is effective as it reduces body weight and more specifically, lipid profile and fat levels in the liver (Xiao et al., 2013). EX is a practical tool to prevent NAFLD and acts as a non-pharmacological treatment, while contributing to the improvement and maintenance of one or more components of the patient's physical fitness levels (Finelli e Tarantino, 2012, Zalber-Sagi et al., 2014).

There is still not enough evidence of the benefits of EX on the quantitative and qualitative levels of lipid profile. The hypothesis is that the results due to EX would decrease the levels of fat in the liver, particularly the relation between VLDL and TG and secretion rates of apolipoprotein B-100 (Sullivan et al., 2012). Although EX is fundamental for treating NAFLD, the relation between the type, intensity and volume of EX required to reduce the levels of IHL is still an obscure point in literature (Finelli and Tarantino, 2012; Keating et al., 2012).

Thus, this purpose of this study is to describe the importance of an aerobic and resistance exercise program on anthropometric measures and blood profile, aiming to reduce fat in the liver of a patient suffering from NAFLD.

## MATERIALS AND METHODS

This case study is characterized as exploratory and descriptive. The test subject was a 29-year-old male who had not undergone any physical exercise for the past two years at least. The participant signed a consent form for the required information outlined in this study, which ensures his anonymity and the complete confidentiality of the information published here.

### Blood Samples

Blood samples were obtained after an overnight fasting period of at least 12 hours and were analyzed and performed through the Protocol standards of the Ministry of Health of Brazil. Flow cytometry was used to measure and analyze the serum lipid profile: total cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein and very low-density lipoprotein.

### Liver ultrasound

Liver ultrasound was performed by an expert endo-

crinologist and graded on a scale of 0 to 3 (0: none; 1: mild; 2: moderate and 3: severe) at baseline and at study end. Mild was recognized by slight increase in liver echogenicity and relative preservation of echoes from the walls of the portal vein. Moderate was recognized by moderate loss of echoes from the walls of the portal vein, particularly from the peripheral branches, and moderate diffuse abnormally bright echoes. Severe was recognized by a greater reduction in beam penetration, loss of echoes from most of the portal vein wall, and extensive abnormally bright echoes (Palmer and Schaffner, 1990; Saverymuttu et al., 1986).

The upper abdominal ultrasound medical report diagnosed hepatic fatty infiltration grade II (moderate). Faced with this clinical condition, the medication that was prescribed for treatment was: Metformin 500mg, two tablets at night, after dinner.

### Ambulatory blood pressure monitoring

The subject performed Ambulatory Blood Pressure Monitoring for 24 hours and the results showed normal blood pressure values.

### Anthropometric and body composition evaluation

A *Caumaq* stadiometer was used to measure the subject's height by placing him on a flat surface and aligning with the vertical stem. To evaluate his weight, the patient remained in a standing position on a *2FW Glass Lot 0108* digital scale produced by *Accumed PROD MED HOSP LTDA*.

The assessment of body composition was achieved according to the evaluation standards recommended through tests, measurements and the subject's evaluation in physical education and sports. The body mass index (BMI) was obtained using the formula  $BMI = \text{total body weight divided by height squared}$  ( $BMI = \text{kg/m}^2$ ), used to diagnose overweight and obesity. The waist and hip ratio (WHR) was also determined, and for waist circumference, the subject remained in a standing position with a relaxed abdomen as a measuring tape was positioned on the horizontal plane, at the narrowest part of the waist. For the hip measurement, the tape was positioned on the horizontal plane from the point of greatest circumference of the gluteal region.

### Exercise Program

A 12-week exercise program was prepared bringing together scientific principles and the subject's preferences and interests, organized in a way for the goal to be duly achieved in a systematic manner and within the patient's possibilities.

During the first three weeks, the exercise program was performed three times a week on non-consecutive days, in which each session lasted 60 minutes. The program consisted of 25 minutes of aerobic exercise on a treadmill, followed by resistance exercises with 8-12 repetitions and three sets of each exercise. Eight exercises were included (latissimus pull down, seated chest press, cable triceps extension, biceps curl, leg press, adductor press, abductor press, calf raise). At the end of the session, there were 10 minutes of stretching. Approximately 70% of the maximum heart rate ( $HR_{max}$ ) was achieved during the session.

From the fourth week until the twelfth week, the program was performed five times a week and each session lasted 60 minutes. The program consisted of 25 minutes of aerobic exercise on a stationary bicycle followed by resistance exercise in the form of circuit training, with 12-16 repetitions and two sets of each exercise. Eleven exercises were included (latissimus pull down, seated chest press, cable triceps extension, biceps curl, shoulder press, leg press, extension leg, adductor press, abductor press, calf raise, abdominal press). At the end of the session, there were 10 minutes of stretching. Approximately 85% of the maximum heart rate ( $HR_{max}$ ) was achieved during the session.

## RESULTS

Initially, the subject reported an improvement in his quality of sleep, in his physical fitness levels, as well as feeling a better mood to work and to perform his daily activities. The result of the liver ultrasound diagnosed hepatic fatty infiltration grade II (moderate). After 12 weeks of the exercise program, the exam was repeated and verified hepatic fatty infiltration grade I (mild).

At the end of the exercise program, the liver ultrasound showed that the subject's vascular distributions were normal, and there was no dilatation of the intra- and extrahepatic bile ducts, nor were there lesions on the liver. Therefore, the exam demonstrates compliance with the parameters of normality, based on clinical examinations.

After the 12-week exercise program, the subject underwent a new evaluation and it was revealed that he had reduced weight, BMI, conicity index, body fat percentage, WHR, waist and hip circumferences, total cholesterol, triglycerides, LDL, VLDL and increased HDL. These results reinforced what was expected of the practice of exercise as a way to reverse NALFD's clinical condition.

Table 1 shows the results of body composition before and after interventions with the exercise

program.

Table 2 shows the results of the blood lipid profile before and after interventions with exercise program.

## DISCUSSION

An exercise program that could assist in reversing the clinical condition presented by the subject was adopted in this study. Thus, the crucial point in the search for an improvement of the physiological condition related to NAFLD is a lifestyle change aimed at weight loss, through the execution of EX regularly (Adams e Angulo, 2006).

Studies show that the moderate intensity EX remains one of the best non-pharmacological treatments for NAFLD (Keating et al., 2012; Martin-Rodriguez et al., 2013; Finelli and Tarantino, 2012).

This is probably due the fact that moderate EX improves glucose uptake; when associated with reduction on visceral fat, it improved whole-body glucose uptake, regulated AMP-activated protein kinase, decreased lipid profile, decreased fasting insulin concentrations and increased circulating adiponectin and mRNA expression in the muscle. Therefore, a patient that follows an EX program will ultimately lose weight (Finelli et al., 2012).

For this to occur, the literature recommends a total of 20-60 minutes of moderate intensity EX using large muscle groups for at least five days a week. The moderate intensity EX should be upgraded to 150-250 minutes a week for preventing weight gain, or more than 250 minutes a week for clinically significant weight loss (Finelli e Tarantino, 2012; Donelli et al., 2009).

Our program used these recommendations. We started with 180 minutes a week, and from the fourth week on, 300 minutes at week. At the end of the program, the subject had lost a total of 12,5 kg in 12 weeks. We chose both aerobic and resistance exercises because literature shows that resistance exercises alone can have similar results to those of aerobic exercises (Hallsworth et al., 2011). Thus, there seems to have an association between the practice of exercise on a regular basis and reducing the occurrence of NAFLD (Bae et al., 2012).

Some studies suggest a significant clinical implication for the prevention and progression of disease in NAFLD patients and support the use of EX as an effective non-pharmacological treatment (Fealy et al., 2012).

According to this, Chen et al., (2008) had his subjects undergo a 10-week EX program, two times a week, 60 minutes per session on stationary bicycle and showed no significant reduction in BMI, body weight, waist circumference, hip circumference and WHR. In addition, this study showed an insignificant reduction in lipid profile.

**Table 1.** Body composition before and after the 12-week exercise program.

	Before the exercise program	After the exercise program
Weight (kg)	87,2	74,7
BMI (kg/m <sup>2</sup> )	29,47	25,25
Conicity Index	1,51	1,32
Body fat percentage	47,4	23,5
WHR	0,97	0,84
Waist (cm)	99	80
Hip (cm)	102	95

Legend: KG: kilogram; BMI: body mass index; WHR: Waist-Hip Ratio; kg/m<sup>2</sup>: kilogram per square meter.

**Table 2.** Blood lipids before and after the 12-week exercise program.

	Before the exercise program	After the exercise program
Total Cholesterol	235 mg/dl	203 mg/dl
Cholesterol HDL	32 mg/dl	44 mg/dl
Cholesterol LDL	168 mg/dl	139 mg/dl
Cholesterol VLDL	35 mg/dl	20 mg/dl
Triglycerides	175 mg/dl	100 mg/dl

Legend: HDL: high-density lipoprotein; LDL: low-density lipoprotein; VLDL: very low-density lipoprotein; mg/dl: milligram per deciliter.

As Cheen et al., (2008), Sullivan et al. (2012) showed that 30–60 of aerobic exercise at 45-55% of  $VO_2$  peak, five times a week for 16 weeks is able to reduce 10% of IHL, but not body weight and lipid profile. Our patient reduced all variables of body composition, but the subject performed at a moderate-high intensity and this can improve the variables of body composition such as BMI, weight, body fat percentage, WHR, waist and hip circumferences.

Hallsworth et al. (2011) showed that 45–60 minutes of resistance exercise at 50-70% of a single repetition at most, three times a week for eight weeks is able to reduce 13% of IHL, but not weight, waist circumference, hip circumference, WHR and body fat percentage. Similar to Hallsworth et al. (2011), Zelber-Sagi et al. (2014) utilized resistance exercises as treatment for patients with NAFLD. The program consisted of 40 minutes, three times a week for three months and showed reduction in total cholesterol. For those patients who may have physical limitations or low motivation for performing aerobic EX, resistance EX can be an alternative option (Zelber-Sagi et al., 2014).

Corroborating with Zelber-Sagi et al. (2014), our patient reduced his total cholesterol after the exercise program. In addition, the patient reduced LDL, VLDL, TG and increased HDL. Our findings suggest that moderate-high intensity exercise can be more

beneficial to change body composition and blood lipids. This shows the efficiency of the exercise directly into liver function (Hallsworth et al., 2011).

Fealy et al. (2012) had his patients undergo 60 minutes of aerobic EX at 80%–85% of their  $HR_{max}$  for seven consecutive days. MRI scans were performed on all participants before and after the program and these showed no change in IHL before the intervention. Weight and BMI did not significantly change. This study was very short lived, which may explain the limited changes (Bradford et al., 2014). The findings confirm a role for EX as a therapeutic target and suggest that assessment of EX levels and EX prescription should be routine in NAFLD (Keating et al., 2012; Xiao et al., 2013).

In our study, the subject was prescribed 1g a day of Metformin after dinner to help reduce weight. Metformin is used as a pharmacological treatment in NAFLD, however the adherence is low because of its side effects (Sanchez-Muñoz et al., 2013). In patients with NAFLD, targeted lifestyle interventions are at least as beneficial as Metformin (Malinowski et al., 2013).

Three Cochrane reviews found insufficient evidence to support the use of Metformin for the treatment of NAFLD (Wilkins et al., 2013). In fact, Linden et al. (2014) concluded that aerobic EX alone lowered liver triglyceride content and high fasting glucose levels more than the sole use of Metformin. Surprisingly, combining Metformin

and aerobic EX training offered little added benefit to these outcomes, and in fact, Metformin blunted exercise-induced increases in complete mitochondrial palmitate oxidation. These findings suggest that Metformin potentially impairs exercise-induced hepatic mitochondrial adaptations and cardiorespiratory functions (Linden et al., 2014). Thus, it seems that the cardiorespiratory negative side effects brought on by Metformin therapy may be counterbalanced with the combination of an EX program (Cadeddu et al., 2014).

Sanchez-Muñoz et al. (2013) prescribed a 12-week EX program of 300 minutes a week at a moderate to vigorous intensity, like our intervention. The authors concluded that EX modified the liver fat content and improved cardiorespiratory more than the Metformin group. Based on this information, we hypothesized that EX is an important and beneficial choice therapy in NAFLD, regardless of Metformin.

Individual reports of EX interventions often have low sample sizes and insufficient power to detect clinically meaningful hepatic benefits. Given the paucity of current treatment options, exercise provides a valid, low-cost therapy for disorders characterized by NAFLD (Keating et al., 2012).

There is a need for randomized controlled trials which aim at elucidating the relative importance of exercise doses like intensity, frequency and volume, and to examine if the relative potency of aerobic, resistance or combined EX is better for NAFLD. We study the possibility that moderate-high intensity and 300 minutes or more of EX a week is more beneficial to people with NAFLD.

## LIMITATIONS

This study is a case study. We did not control the subject's diet and we did not have access to more specific exams related to NAFLD.

## CONCLUSION

Regular EX is crucial to the reduction of irregular lipid profile, promoting normal liver function. Our study showed that aerobic and resistance exercises promoted improvements in body composition and lipid profile. These findings are important in the sense that this data is related to cardiovascular disease and the reduction of lipid levels with lipid accumulation in the liver that can cause liver dysfunction. Aerobic and resistance exercises are important tools in the treatment of patients who present NAFLD.

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