Egyptian Journal of Occupational Medicine, 2016; 40 (1) : 71-82

EFFECT OF HIGH INTENSITY INTERVAL TRAINING VERSUS RESISTANCE TRAINING ON QUALITY OF LIFE AND FUNCTIONAL CAPACITY ON PATIENTS WITH FATTY LIVER DISEASES (PART II)

By

[1]Badr NM, [2]El Batanony MM , [3]Attia DI, 1El-Sayed SH, [4]Ali HM

[1] Department for Cardiovascular / Respiratory Disorder and Geriatrics, Faculty of Physical Therapy,

[2]Department of Occupational and Environmental Medicine ,Cairo University,

[3] Department of Tropical Medicine Faculty of Medicine , Beny Sueif University and

[4] Department of Fitness and Rehabilitation Unit, Cairo University Hospitals.

Abstract

Introduction: Obesity and physical inactivity are independent risk factors for the development of nonalcoholic fatty liver disease (NAFLD). **Aim of Work:** To assess the effect of high intensity interval training compared to resistance training on blood lipid and hepatic enzyme concentration in women in fatty liver disease patients. **Materials and Methods:** Twenty one female patients with fatty liver disease were assigned to supervise high intensity interval training or resistance training for eight weeks, paired t test was used for statistical comparison. **Results:** The results showed that both types of exercise improved blood lipid significantly and observed improvement in hepatic enzyme, but there was no significant difference between the groups after treatment. **Conclusion:** So, it can be concluded that both high intensity exercise training and resisted exercise training are appropriate in fatty liver disease patient.

Key words: Fatty liver disease, High intensity interval training, Resistance training, blood lipid ,hepatic enzymes.

Introduction

Non-alcoholic fatty liver disease (NAFLD) represents a spectrum from asymptomatic steatosis to potentially life-threatening non-alcoholic steatohepatitis, with an overall prevalence of NAFLD in western countries of 20-30% (Harrison and Day, 2007) Patients with simple steatosis have a relatively benign 'liver' prognosis with a 1-2% risk of developing clinical evidence of cirrhosis over 15 to 20 years. Patients with non-alcoholic steatohepatitis and fibrosis can progress to cirrhosis at a rate of approximately 12% over 8 year (Day, 2006). Once cirrhosis develops, patients are at a high risk of developing hepatic decompensation and of dying from a liver-related cause. To date, weight loss is the only confirmed therapy for the treatment of NAFLD, and lifestyle interventions remain the cornerstone of management. (Harrison and Day, 2007).Thiozolidine therapy has shown promise in providing a temporary reduction in liver fat (Ravikumar et al., 2008; Bajaj et al.,2004), although progressive weight gain, side effects and cost have prevented them from being used in routine care. Lifestyle interventions have been shown to reduce markers of liver lipid and metabolic control (Kantartzis et al., 2008, St George et al., 2009, Promrat et al., 2010) in addition to reducing intrahepatic lipid (IHL) (Goodpaster et al., 2003, Oza et al., 2009, Shah et al., 2009, Finucane et al., 2010). However, weight loss is difficult to achieve and sustain. Physical activity and exercise in NAFLD management could potentially be effective in decreasing IHL. Cross-sectional studies have shown that higher levels of physical activity are associated with lower levels of IHL (Perseghin et al., 2007, Zelber-Sagi et al., 2008).

Aim of Work: To assess the effect of high intensity interval training compared to resistance training on blood lipid and hepatic enzyme concentration in fatty liver disease patients.

Materials and Methods

- Place and duration of study: The study was carried in the Fitness and Rehabilitation Unit, Kasr Al-Aini Hospital, Cairo University.

- Study sample: Twenty one fatty liver female patients from Kasr EL Aini

out clinic between May 2012 to January 2015- were enrolled in the study.

- Inclusion Criteria were: (a) Age is from 40-55 years old. (b) Diagnosed as chronic liver diseases patient by sonography. (c) A written informed consent from the patients to participate in the study. (d) All patients under medical control.

-Exclusion Criteria were: if they had cardiovascular disease, physical disability, musculoskeletal disease, renal or hormonal diseases, smokers and pregnant women.

- Study methods: Patients' baseline characteristics, including body weight, body mass index(BMI), were collected .Then, we divided the patients into either high intensity interval training or resistive training program .The subjects were divided into two equal groups: the first group (A) received aerobic exercise training; the second group (B) received resisted exercise training three times a week for eight weeks.

Chemical analysis

A blood sample after fasting for 18 h was taken from each patient for: (a) Measuring of alanine and aspartate aminotransferase (ALT & AST). (b) Measuring of triglycerides (TG), high-density lipoproteins (HDL), low-density lipoproteins (LDL) and cholesterol (CHOL).

Exercise training

The high-intensity interval training (HIIT) group carried out a 7 min warm-up period at an intensity corresponding to 65–75% of HRmax (Maximum Heart rate will determined as (MHR=220 – age) (Robergs and Landwehr, 2002), before uphill treadmill walking for 4 intervals of 4 min at 85–90% of HRmaxk with 3 minutes active recovery at 65–75% of HRmax, in between, and a 3 min cool-down period (Tjonna et al.,2009). All patients were exercising using a heart rate monitoring device (fingertip oximeter), and the speed & the inclination of the treadmill were continually adjusted to ensure that all patients were exercising at the desired heart rate range.

The total duration was 20-38 minute and frequency was 3 times / week (day after day). If they experience any chest pain or breathing difficulties during the

HIIT workout, cool down immediately done. If the heart rate does not drop back down to about 70% of the max during recovery intervals, we may need to shorten the work intervals and/or lengthen the recovery intervals.

Resistive exercises included the following: The program consisted of eight exercises: biceps curl; calf raise; triceps press; chest press; seated hamstrings curl; shoulder press; leg extension and lateral pull down. Each session lasted between 45 and 60 min and consisted of a 10 min warm-up at approximately 60% maximum heart rate on a cycle ergometer, and followed by resistance exercise done as a circuit, ending with a repeat of the warm-up described. The one repetition maximum was measure at baseline and following the intervention. Initially, participants do two circuits using 50% of their one repetition maximum, progressing to three circuits, using a minimum 70% of their one repetition maximum by week seven. Participants will encouraged to increase the resistance used each week when possible.

Statistical analysis

All mean values obtained before and after three months in both groups were compared using the paired ‘‘t’’ test. An independent ‘‘t’’ test was used for the comparison between the two groups ($P < 0.05$).

Consent:

Authors declare that a verbal consent was taken from the studied group before making the study.

Ethical approval

The Ethical Committee of Faculty of Physical Therapy approved the study protocol.

Results

Table (1) Baseline subjects characteristics

Variables	Group A	Group B	P-value
Age (Years)	46.33±4.96	45.55±4.43	0.693
Height (cm)	161.58±8.07	157.45±3.50	0.133
BW (Kg)	105.92 ±13.91	107.91 ±13.98	0.736
BMI (Kg/m^2)	40.53 ±4.06	43.51 ±5.36	0.145
Serum Cholesterol (mg/dl)	234.08 ±26.91	217.36 ±32.08	0.189
Serum TG (mg/dl)	176.17 ±47.61	185.55 ±73.59	0.718
Serum LDL(mg/dl)	172.00 ±47.34	142.22 ±27.60	0.083
AST (U/ml)	40.25 ±34.52	36.27 ±14.47	0.727
ALT (U/ml)	36.92 ±22.13	40.00 ±16.84	0.713

All data are expressed as means & standard deviations. Paired t-test, ($P \leq 0.05$) was used. BW= Body weight, BMI= Body mass index, TG= Triglycerides, LDL= low density lipoproteins, AST= aspartate aminotransferase, ALT = alanine aminotransferase .

Table (1) shows that there is no significant difference in the demographic , clinical data and chemical analysis between high intensity interval training and resistive training program.

Table (2) Mean value and significance in group A before and after treatment.

Variable	Group A			
	Pre	Post	P-Value	% of change
BW (Kg)	105.92 ±13.91	91.83 ±10.15	0.0001*	↓13.30%
BMI (Kg/m^2)	40.52 ±4.06	35.38 ±3.28	0.0001*	↓12.71%
Serum Cholesterol(mg/dl)	234.08 ±26.91	181.58 ±22.11	0.0001*	↓22.21%
Serum TG (mg/dl)	176.17 ±47.61	134.92 ±27.26	0.002*	↓23.42%
Serum LDL (mg/dl)	172.00 ±47.34	129.08 ±25.99	0.0001*	↓24.95%
AST (U/ml)	40.25 ±34.52	29.00 ±10.25	0.219	↓27.95%
ALT (U/ml)	36.92 ±22.13	28.08 ±12.17	0.127	↓23.94%

All data are expressed as means & standard deviations. Paired t-test, ($P \leq 0.05$) was used. BW= Body weight, BMI=Body mass index, TG= Triglycerides, LDL= low density lipoproteins, AST= aspartate aminotransferase, ALT = alanine aminotransferase

*: Significant.

Table (2) shows statistically significant decrease in blood lipids, weight and BMI, while the decrease in liver enzymes is not significant in high intensity interval training group.

The study involved twenty one fatty liver female patients with aged from 40 to 55 years. The subjects were divided into two groups: the first group received high intensity interval training. (n=12), the second group (B) received resisted exercise training (n= 9) three times a week for eight weeks in order to compare the effect of HITT and resisted exercise on in fatty liver patients.

Table (3) Mean value and significance in group B before and after treatment

Variable	Group B			
	Pre	Post	P-Value	% of change
BW (Kg)	107.91 ±13.98	99.18 ±12.6	0.001*	↓8.09 %
BMI (Kg/m²)	43.51 ±5.36	40.01 ±5.00	0.0001*	↓8.04%
Serum Cholesterol (mg/dl)	217.36 ±32.08	195.73 ±23.45	0.003*	↓9.96%
Serum TG (mg/dl)	185.55 ±73.59	154.09 ±52.92	0.004*	↓16.95%
Serum LDL (mg/dl)	142.22 ±27.60	128.82 ±24.66	0.024*	↓9.42%
AST (U/ml)	36.27 ±14.47	31.55 ±7.80	0.141	↓13.01%
ALT (U/ml)	40.00 ±16.84	33.91 ±10.09	0.136	↓15.22%

All data are expressed as means & standard deviations. Paired t-test, ($P \leq 0.05$) was used. BW= Body weight, BMI=Body mass index, TG= Triglycerides, LDL= low density lipoproteins, AST= aspartate aminotransferase, ALT = alanine aminotransferase

*: Significant.

Table (3) shows that there is a statistically significant difference in all the parameters before and after resisted exercise training except for AST and ALT.

Table (4) Mean value and significance between group A and B.

Variable	Group A(Post)	Group B(Post)	P-value
BW (Kg)	91.83 ±10.15	99.18 ±12.6	0.137
BMI (Kg/m²)	35.38 ±3.28	40.01 ±5.00	0.015*
Serum Cholesterol (mg/dl)	181.58 ±22.11	195.73 ±23.45	0.152
Serum TG (mg/dl)	134.92 ±27.26	154.09 ±52.92	0.281
Serum LDL (mg/dl)	129.08 ±25.99	128.82 ±24.66	0.980
AST (U/ml)	29.00 ±10.25	31.55 ±7.80	0.513
ALT (U/ml)	28.08 ±12.17	33.91 ±10.09	0.228

All data are expressed as means & standard deviations. Paired t-test, ($P \leq 0.05$) was used. BW= Body weight, BMI= Body mass index, TG= Triglycerides, LDL= low density lipoproteins, AST= aspartate aminotransferase, ALT = alanine aminotransferase

*: Significant.

Table (4) shows that there is no significant difference between the groups after training. However; the HIIT group seemed to have better percent of change.

Discussion

There has been only limited research on the effects of exercise as the sole intervention intrahepatic lipid in individuals with fatty liver diseases. The aim of this study was to compare changes in body weight, body mass index, ALT, AST, s. LDL, and cholesterol after high intensity interval training and resistance exercise training in fatty liver patients. The mean values of BW, BMI, ALT, AST, s. LDL, and cholesterol were significantly decreased in both group A and group B. Also, there was no significant difference between the groups after treatment. While the percent of change in HIIT group was better than it in resistance group.

Resistance exercise provides an alternative to aerobic exercise; it improves muscular strength, muscle mass and metabolic control, safely and effectively, in vulnerable populations independent of weight loss (Larose et al., 2010). It places less of a demand on the cardiorespiratory system and may therefore be accessible to more patients (Gordon et al., 2009) To date, only two studies have reported the effect of exercise alone on liver health in adults with NAFLD, both having used aerobic exercise, but only one reported a direct measure of IHL. A 4-week aerobic exercise intervention showed a similar absolute reduction in IHL as seen during the present study.

The aerobic exercise brought about a reduction in IHL from 8.6% to 6.8% (Johnson et al., 2009). A 12-week intervention reported a 47% (47 U/l) and 48% (30 U/l) reduction in ALT and AST, respectively (Sreenivasa-Baba et al., 2006). However, these biomarkers can be elevated in the absence of excess liver fat and within the normal range in the presence of elevated liver fat, making them poor indicators for IHL. (Mofrad et al., 2003, Szczepaniak et al., 2005, Fracanzani et al., 2008)

Hallsworth et al., was the first to monitor habitual physical activity alongside exercise therapy. Their data suggest that changes in physical activity habits and the brief aerobic warm up accompanying resistance exercise contributed to the change in IHL only to a small extent. Although the changes in IHL following exercise therapy are significant, the absolute change independently of visceral fat (Hallsworth et al., 2011).

van der Heijden et al. reported improvements in HOMA-IR (homeostatic model assessment to quantify insulin resistance) in obese adolescents as a result of 12 weeks of continuous aerobic exercise, even without weight loss (van der Heijden et al., 2010). Meanwhile, as in our study, Johnson et al. did not observe any improvement in HOMA-IR as a result of continuous aerobic exercise (Johnson et al., 2009). Katsukawa reported in a systematic review (in Japanese) that, regarding improvements in HOMA-IR in an intervention trial, decreases in visceral fat were dose-dependently associated with improvements in HOMA-IR, and that a decrease in visceral fat of 20—30% and weight loss of 7—10% are required to achieve improvements in metabolic parameters (Katsukawa et al., 2009).

Yoshimura et al., showed that a 12-week continuous aerobic exercise program may contribute to improvements in intrahepatic fat, liver function and atherosclerosis related factors. Visceral fat and weight decreased by 16.7±15.0% and 3.4±2.7%, respectively (Yoshimura et al., 2011).

Conclusion:

In fatty liver disease patients high intensity interval training and resisted exercise training are both appropriate for improving blood lipid and hepatic enzymes but HIIT exercise showed better result in lowering blood lipid and liver enzymes than resisted exercise training.

Conflict of interest:

Authors have declared that no conflict of interests exists.

References

1. Bajaj M, Suraamornkul S and Pratipanawatr T (2003): Pioglitazone reduces hepatic fat content and augments splanchnic glucose uptake in patients with type 2 diabetes. Diabetes 2003; 52:1364-70.
2. Day CP (2006): Non-alcoholic fatty liver disease: current concepts and management strategies. Clin Med; 6:19-25.
3. Finucane F, Sharp S and Purslow L (2010): The effects of aerobic exercise on metabolic risk, insulin sensitivity and intrahepatic lipid in healthy older people from the Hertfordshire Cohort Study: a randomised controlled trial. Diabetologia ; 53:624-31.
4. Fracanzani AL, Valenti L and Bugianesi E (2008): Risk of severe liver disease in nonalcoholic fatty liver disease with normal aminotransferase levels: a role for insulin resistance and diabetes. Hepatology; 48:792-8.
5. Goodpaster BH, Katsiaras A and Kelley DE (2003): Enhanced fat oxidation through physical activity is associated with improvements in insulin sensitivity in obesity. Diabetes; 52:2191-7.

6. Gordon BA, Benson AC and Bird SR (2009): Resistance training improves metabolic health in type 2 diabetes: a systematic review. Diabetes Res Clin Pract; 83:157-75.
7. Hallsworth K, Fattakhova G, Hollingsworth KG, Thomas C, Moore S, Taylor R,
8. Day CP and Trenell MI (2011): Resistance exercise reduces liver fat and its mediators in non-alcoholic fatty liver disease independent of weight loss. Gut; 60(9):1278-83.
9. Harrison SA and Day CP (2007): Benefits of lifestyle modification in NAFLD. Gut; 56:1760-9
10. Johnson NA, Sachinwalla T, Walton DW, Smith K, Armstrong A and Thompson MW (2009): Aerobic exercise training reduces hepatic and visceral lipids in obese individuals without weight loss. Hepatology; 50:1105-12.
11. Kantartzis K, Thamer C and Peter A (2008): High cardio-respiratory fitness is an independent predictor of the reduction in liver fat during a lifestyle intervention in non-alcoholic fatty liver disease. Gut; 58:1281-8.
12. Katsukawa F (2009): Improvement of metabolic indices associated with decreases in visceral fat in an intervention trial. J Jpn Soc Study Obes; Pp162-9.
13. Larose J, Sigal RJ and Boule NG (2010): Effect of exercise training on physical fitness in type II diabetes mellitus. Med Sci Sports Exerc; 42:1439-47.
14. Mofrad P, Contos MJ and Haque M (2003): Clinical and histologic spectrum of nonalcoholic fatty liver disease associated with normal ALT values. Hepatology; 37:1286-92.
15. Oza N, Eguchi Y and Mizuta T (2009): A pilot trial of body weight reduction for nonalcoholic fatty liver disease with a home-based lifestyle modification intervention delivered in collaboration with interdisciplinary medical staff. J Gastroenterol; 44:1203-8.
16. Perseghin G, Lattuada G and De Cobelli F (2007): Habitual physical activity is associated with intrahepatic fat content in humans. Diabetes Care; 30:683-8.
17. Promrat K, Kleiner DE and Niemeier H (2010): Randomized controlled trial testing the effects of weight loss on nonalcoholic steatohepatitis. Hepatology; 51:121-9.
18. Ravikumar B, Gerrard J and Dalla Man C (2008): Pioglitazone decreases fasting and postprandial endogenous glucose production in proportion to decrease in hepatic triglyceride content. Diabetes; 57:2288-95.
19. Robergs RA and Landwehr R (2002): The surprising history of the ''HRmax=220-age'' equation. J Exerc Physiol Online; 5(2):1–10.
20. Shah K, Stufflebam A and Hilton TN (2009): Diet and exercise interventions reduce intrahepatic fat content and improve insulin sensitivity in obese older adults. Obesity; 17:162-8.
21. Sreenivasa-Baba C, Alexander G and Kalyani B (2006): Effect of exercise and dietary modification on serum aminotransferase levels in patients with nonalcoholic steatohepatitis. J Gastroenterol Hepatol; 21:191-8.
22. St George A, Bauman A and Johnston A (2009): Independent effects of physical activity in patients with nonalcoholic fatty liver disease. Hematology; 50:68-76.
23. Szczepaniak LS, Nurenberg P and Leonard D (2005): Magnetic resonance spectroscopy to measure hepatic triglyceride content: prevalence of hepatic steatosis in the general population. Am J Physiol Endocrinol Metab ; 288:E462-8.
24. Tjonna AE, Stolen TO and Bye A (2009): Aerobic interval training reduces cardiovascular risk factors more than a multi-treatment approach in overweight adolescents. Clin Sci.; 116:317–26.
25. Van der Heijden G, Wang Z, Chu Z, Sauer P, Haymond M and Rodriguez L (2010): A 12-

week aerobic exercise program reduces hepatic fat accumulation and insulin resistance in obese, Hispanic adolescents. Obesity (Silver Spring); 18:384-90.

26. Yoshimura E, Kumahara H, Tobina T, Ayabe M, Matono S, Anzai K, Higaki Y, Kiyonaga A and Tanaka H(2011): A 12-week aerobic exercise program without energy restriction improves intra-hepatic fat, liver function and atherosclerosis-related factorsObesity Research & Clinical Practice ; 5, 249-257
27. Zelber-Sagi S, Nitzan-Kaluski D and Goldsmith R (2008): Role of leisure-time physical activity in nonalcoholic fatty liver disease: a population-based study. Hepatology ; 48:1791-8.