International Journal of Science and Healthcare Research
[Indexed, Peer-Reviewed Journal]
Vol. 10; Issue: 1; January-March 2025
Website: ijshr.com
ISSN: 2455-7587

Case Report

Combined Effect of 12-week High-Intensity Interval Training (HIIT), Strength Training and Dietary Modification on Metabolic Profile, Liver Function and Exercise Tolerance in Metabolic Dysfunction-Associated Fatty Liver Disease (MAFLD): A Case Report

Dr. Nayla Naurin Shaikh (PT)[1], Dr. Harda Shah (PT, PhD)[2]

[1]MPT Student (Transplantation rehabilitation), IKDRC ITS College of Physiotherapy, Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat, India,
[2]Senior lecturer (PhD), IKDRC ITS College of Physiotherapy, Civil Hospital Campus, Asarwa, Ahmedabad, Gujarat, India,
Gujarat University of Transplantation Sciences, Ahmedabad, India

Corresponding Author: Dr. Harda Shah

DOI: https://doi.org/10.52403/ijshr.20250135

ABSTRACT

BACKGROUND: MAFLD is characterized by hepatic fat accumulation and is strongly associated with obesity, insulin resistance, and dyslipidemia It is known as hepatic manifestation of metabolic syndrome which can progress to fibrosis, cirrhosis, and carcinoma. We report a case of 47 years old male with MAFLD, referred to the physiotherapy department for exercise intervention. On evaluation, we found central/abdominal obesity, dyslipidemia, diabetes-mellitus, abnormal liver function tests-(SGPT/SGOT), liver-elastography/fibro-scan suggest grade-III fatty liver, and reduced functional capacity.
PURPOSE: To study the combined effect of 12 weeks of HIIT, strength training, and dietary modification in MAFLD.
METHOD: Physiotherapy was implemented as [1] HIIT: Frequency-3days/week, Intensity- 75% to 85% HRmax/RPE-(15-17), Bouts/sessions-6bouts/session, each bout equal to 1min, Active recovery-(low intensity 40% HRmax/RPE<14), Work: Rest of (1:2) to (2:2) after 6weeks. [2] Strength training: Frequency- 3 days/week, Intensity- 65% of 10RM to 75% of 10RM after 6 weeks. Each session consists of 40-min. Dietary modification was done by a dietician.
RESULT: After 12 weeks of intervention, there is a significant improvement in fibro-scan (12.5 to 10kPa), liver function test (SGPT: 74U/L to 35U/L, SGOT: 40U/L to 28U/L), HbA1c (7.3% to 5.8%), dyslipidemia (S. Cholesterol: 193mg/dl to 147 mg/dl, S. Triglyceride: 254 mg/dl to 84 mg/dl, S.LDL: 111.60 mg/dl to 87.20 mg/dl, S.HDL: 34 mg/dl to 43 mg/dl, waist-circumference-103 cm to 94 cm, and physical and functional capacity.
CONCLUSION: According to our findings, combined HIIT, strength training and dietary modification are crucial pillars in the treatment of metabolic profile, liver function, and exercise tolerance in MAFLD.

Keywords: HIIT, strength training, MAFLD.

INTRODUCTION

MAFLD stands for Metabolic Associated Fatty Liver Disease. MAFLD is a global health concern, affecting approximately 25-30% of the adult population worldwide, with its prevalence rising in tandem with obesity and metabolic syndrome. [1,2]

It is a term that was introduced as an updated and more precise classification for fatty liver disease, replacing the older term NAFLD (Non-Alcoholic Fatty Liver Disease). MAFLD reflects a broader understanding of liver disease concerning metabolic conditions, including obesity, type 2 diabetes, dyslipidemia, and metabolic syndrome, and better emphasizes the underlying metabolic dysfunction rather than solely the absence of significant alcohol consumption. MAFLD is diagnosed when an individual has hepatic steatosis (fat accumulation in the liver) and at least one of the following three criteria: Overweight or obesity (defined by BMI ≥ 25 kg/m²), Type 2 diabetes or other metabolic disorders, Evidence of metabolic dysregulation (e.g., elevated blood pressure, dyslipidemia, insulin resistance).[1]

It is associated with significant morbidity and mortality due to its progression to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and hepatocellular carcinoma, as well as its link to cardiovascular disease and other metabolic comorbidities. Management of MAFLD primarily involves lifestyle changes, particularly weight loss, improved diet, and physical activity. Pharmacological treatments may also be used, especially for managing associated conditions like diabetes and dyslipidemia.[2]

CASE REPORT

We present a case of a 47-year-old male who was diagnosed with grade 1 fatty liver disease in 2023. To monitor the condition, the patient underwent regular laboratory investigations every three months, which included liver function tests (LFTs) and clinical follow-ups. During his routine follow-up in May 2024, the patient's laboratory results showed abnormalities in liver function tests (LFTs): Elevated AST/SGOT and ALT/SGPT levels, indicative of liver inflammation or damage. These findings raised concerns about disease progression and prompted further diagnostic evaluation to determine the extent of liver involvement. The consultant recommended the following tests including a Whole abdomen sonogram to assess liver structure. Elastography to measure liver stiffness. Fibro-scan to evaluate the degree of fibrosis or liver damage. The results from these advanced imaging tests revealed progression to grade 3 fatty liver disease. Medical management was started accordingly and advised for exercise and diet modification. The patient was referred to the Physiotherapy Department for Exercise-based interventions to complement dietary and medical management. On evaluation we found central/abdominal obesity (waist circumference - 103cm), dyslipidemia [(S, Cholesterol-193mg/dl), (S. Triglyceride-254mg/dl), (S. HDL Cholesterol-34mg/dl), (S. LDL Cholesterol-111.60mg/dl), (S. VLDL Cholesterol-50.80mg/dl), (CHO/HDL Ratio-5.3), (LDL/HDL Ratio-3.8),], diabetes-mellitus (HbA1c – 7.3%), abnormal liver function tests [(SGPT-74U/L) (SGOT-40U/L)], liver-elastography/fibro-scan (E-12.5kPa), and reduce functional capacity (distance-580m) which was assessed via shuttle walk test and strength was assessed via 10 RM.

A tailored physiotherapy program was implemented to improve overall physical fitness and target weight reduction, which are crucial in managing advanced fatty liver disease.

INTERVENTIONS

Physiotherapy was implemented as High-intensity interval training (HIIT) summarized in ***Table 1***, Strength training summarized in ***Table 2***, and dietary modification in ***Table 3***.

ADVISE – smoking cessation.

Table 1

HIGH-INTENSITY INTERVAL TRAINING		
1st week to 6th week		
Frequency		3 days/week
Intensity	High-intensity interval training	70% to 75% of HRmax or RPE (15-17)
	Low-intensity interval training	40% of HRmax or RPE (<14)
High intensity (bouts)/sessions		6 bouts/session. Each bout equals to (1min)
Low intensity (active recovery period)		The active recovery period is followed by each bout and the duration of the active recovery period is (3min).
Work rest regimen (W: R)		(1:3) 6 cycles
Type	High intensity	Jumping jacks and high knees
	Low intensity	spot marching
Duration		40 min/day (5 min – warm, 25 min – HIIT training, 10 min of stretching)
7th week to 12th week		
Intensity	High-intensity interval training	From 75% progressed to 85% of HRmax or RPE (15-17)
Work rest regimen (W: R)		From (1:3) progressed to (2:2)

Table 2

STRENGTH TRAINING			
1st week to 12th week			
Frequency	3 days/week, 12 reps×2sets		
Intensity	65% of 10RM up to 6 weeks then progressed to 75% of 10RM		
Form of training	Free weight (dumbbell, sandbags)		
Duration	40 min (5 min – warmup, 25 min – strength training, 10 min - stretching)		
EXERCISE	**LOAD**		**REPS/SETS**
	1st to 6th weeks	**7th to 12th week**	
Upper limb			
Shoulder press	65% of 10RM	75% of 10RM	12 reps×2sets
Shoulder lateral raise	65% of 10RM	75% of 10RM	12 reps×2sets
Bicep curl	65% of 10RM	75% of 10RM	12 reps×2sets
Triceps curl	65% of 10RM	75% of 10RM	12 reps×2sets
Lower limb			
Quadricep curl	65% of 10RM	75% of 10RM	12 reps×2sets
Hamstring curl	65% of 10RM	75% of 10RM	12 reps×2sets
Standing hip flexion	65% of 10RM	75% of 10RM	12 reps×2sets
Standing hip abduction	65% of 10RM	75% of 10RM	12 reps×2sets
Standing hip extension	65% of 10RM	75% of 10RM	12 reps×2sets

Table 3

The dietary modification includes a low-calorie diet, low-glycemic index food, low sugar, non-processed carbs, low saturated and trans-fats food and this dietary chart was monitored by a dietician.

Figure 1: HIIT Eg – High knees

Figure 2: Active recovery Eg – Spot marching

Figure 3: Strength training Eg – Hamstring curl

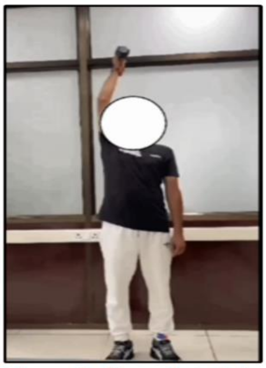

Figure 4: Strength training Eg – shoulder press

RESULT

After 12 weeks of intervention as shown in ***Table 4***

1. A significant Improvement is seen in metabolic markers, such as blood glucose, insulin sensitivity, and a more favorable lipid profile.
2. Reduction in liver fat as assessed by imaging.
3. Improvement in liver enzyme levels (ALT, AST) reflecting a reduction in liver inflammation.
4. Reduction in body weight and waist circumference.
5. Enhanced exercise tolerance, measured by improved aerobic fitness or increased endurance.

Table 4

			PRE	POST
Metabolic profile	HbA1c		7.3%	5.8%
	Cholesterol profile	S. Cholesterol	193 mg/dl	147 mg/dl
		S. Triglyceride	254 mg/dl	84 mg/dl
		S. HDL	34 mg/dl	43 mg/dl
		S. LDL	111.6 mg/dl	87.2 mg/dl
		S. VLDL	50.8 mg/dl	16.8 mg/dl
		Cholesterol/HDL	5.32	3.42
		LDL/HDL	3.8	2.03
Liver function	Fibro-scan		12.5kPa	10kPa
	SGPT		74 U/L	35 U/L
	SGOT		40 U/L	28 U/L
Exercise tolerance	Incremental shuttle walk test		580 m	830 m
Anthropometry/ other	Weight		63 kg	61.4 kg
	BMI		23.1 kg/m^2	22.6 kg/m^2
	WHR		1.07	0.98
	BCA	Skeletal muscle mass	25 kg	26.6 kg
		Body fat mass	16.8 kg	16 kg
		Percentage body fat	27 %	26 %

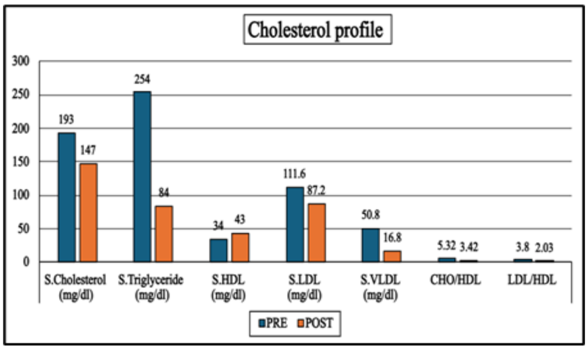

Figure 5: Graph illustrating the improvement in lipid profile

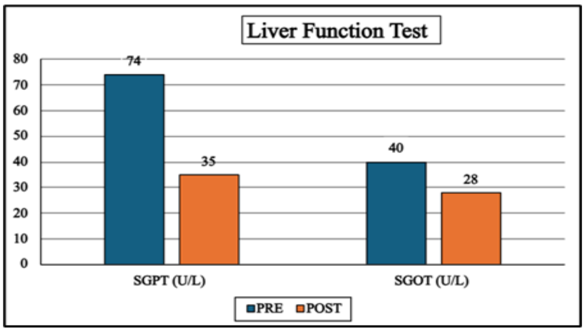

Figure 7: Graph illustrating the improvement in LFT

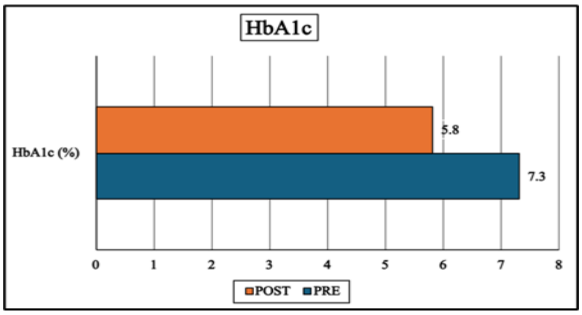

Figure 6: Graph illustrating the improvement in HbA1c

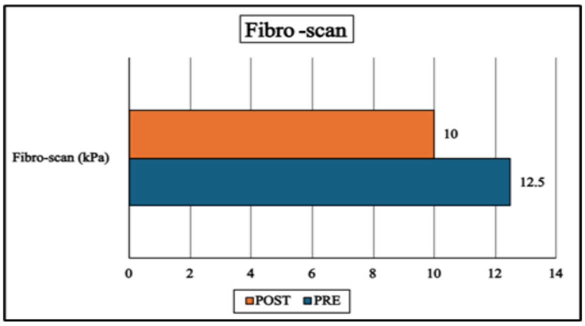

Figure 8: Graph illustrating the improvement in fibro-scan

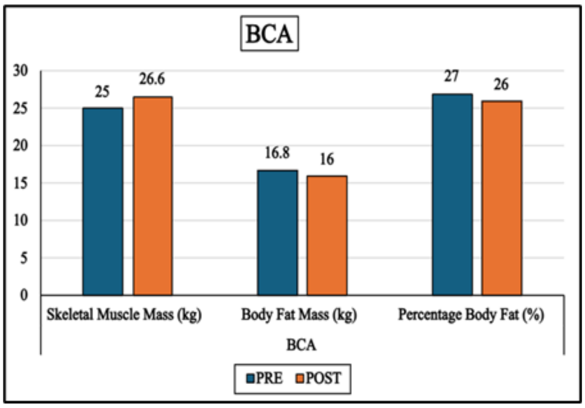

Figure 9: Graph illustrating the improvement in BCA

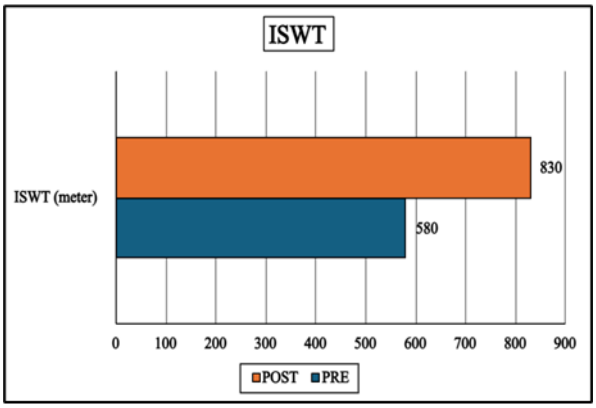

Figure 10: Graph illustrating the improvement in ISWT

Table 5: shows the improvement in strength				
Strength (10-RM)				
Right			**Left**	
Pre	**Post**	**Shoulder**	**Pre**	**Post**
5.5 kg	6 kg	Flexor	5.5 kg	6 kg
5 kg	6 kg	Abductor	5 kg	6 kg
		Elbow		
7.5 kg	8.5 kg	Flexor	7.5 kg	8.5 kg
4 kg	5 kg	Extensor	4 kg	5 kg
		Hip		
5 kg	5.5 kg	Abductor	5 kg	5.5 kg
		Knee		
10 kg	15 kg	Flexor	10 kg	15 kg
11 kg	13 kg	Extensor	11 kg	13 kg

DISCUSSION

HIIT promotes mitochondrial biogenesis, and β-oxidation in hepatocytes, reduces fat synthesis by downregulating lipogenic genes ultimately reducing hepatic lipid droplets and improves metabolic flexibility, making it an effective intervention for addressing the metabolic dysfunction commonly seen in MAFLD patients.[3] On the other hand, strength training increases muscle glucose uptake, which directly impacts liver fat accumulation and improves liver function by reducing the pro-inflammatory cytokines associated with fat deposition in the liver. [4]

This case report highlights the use of a combined approach involving HIIT, strength training, and diet modification. In this case, we have used 6 cycles of HIIT each cycle consists of 1 min of high-intensity interval training followed by 3 min of the active recovery period, the work rest regimen was (1:3). While the previous study by K Hallsworth et al,[7] incorporated HIIT as (2:3) work-rest regimen of 5 cycles and found significant improvement in intrahepatic lipid, liver function and body composition.

In this case, the patient showed significant improvements in both metabolic markers and liver function after completing the 12-week intervention. Specifically, liver function tests, and fibro-scan, which may reflect a decrease in hepatic fat content and inflammation. This result aligns with findings from studies like those by Xue and Zhang et al,[5] which demonstrated the role of HIIT in reducing hepatic steatosis and improving liver enzyme levels in individuals with MAFLD.

The improvements in the patient's metabolic profile, including reductions in glycated hemoglobin, better lipid profiles, and enhanced body composition, can be attributed to the combined effects of HIIT, strength training, and dietary modifications.

RCT by Charatcharoenwitthaya et al, [6] states that both aerobic and resistance exercises have been shown to improve insulin sensitivity and glucose uptake, which are particularly beneficial in managing MAFLD.

The improvements in exercise tolerance, as measured by physical performance, further support the efficacy of the intervention. Increased exercise capacity is critical not only for the management of MAFLD but also for reducing cardiovascular risk, as MAFLD is a significant risk factor for cardiovascular disease. [7]

In addition to exercise, dietary modifications play a crucial role in the management of MAFLD. According to Nseir W et al, [8] a balanced diet one that reduces refined carbohydrates while increasing the intake of fibre, healthy fats, and antioxidants is essential for supporting liver health and improving metabolic outcomes. In this case, dietary modifications contributed to the reduction in liver fat, as evidenced by improvements in the patient's lipid profile. The findings of this case are clinically relevant as they provide support for the use of combined HIIT, strength training, and dietary modification as a non-pharmacological approach to managing MAFLD. This approach not only addresses liver health but also targets the broader metabolic dysfunction underlying MAFLD, potentially reducing the risk of comorbidities such as type 2 diabetes and cardiovascular disease.

Limitation And Future Recommendations

While the combined approach of HIIT, strength training, and dietary modification is promising for improving metabolic health, liver function, and exercise tolerance in patients with MAFLD, there are several limitations, including a small sample size, short study duration, and lack of control groups. Future studies should address these limitations by using larger sample sizes, longer follow-up periods, objective monitoring tools, and more diverse populations. Long-term, well-designed randomized controlled trials (RCTs) are essential to confirm the efficacy of this intervention and its role in preventing disease progression in MAFLD.

CONCLUSION

This case demonstrates that a patient-centered multidisciplinary approach combining targeted exercise intervention (HIIT and strength training) along with dietary modification effectively addresses metabolic dysfunction, reverses liver damage, improves body composition, and improves exercise tolerance and can serve as a powerful tool in managing MAFLD patients.

Such a strategy is a viable non-pharmacological treatment option to improve patient outcomes, emphasizing the importance of a combined approach in managing advanced metabolic and liver disorders.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Eslam M, Newsome PN, Sarin SK, Anstee QM, Targher G, Romero-Gomez M, Zelber-Sagi S, Wong VW, Dufour JF, Schattenberg JM, Kawaguchi T. A new definition for metabolic dysfunction-associated fatty liver disease: An international expert consensus statement. Journal of hepatology. 2020 Jul 1;73(1):202-9.
2. Keating SE, Sabag A, Hallsworth K, Hickman IJ, Macdonald GA, Stine JG, George J, Johnson NA. Exercise in the management of metabolic-associated fatty liver disease (MAFLD) in adults: A position statement from exercise and sport science Australia. Sports Medicine. 2023 Dec;53(12):2347-71.
3. Kilpatrick MW, Jung ME, Little JP. High-intensity interval training: A review of physiological and psychological responses.

ACSM's Health & Fitness Journal. 2014 Sep 1;18(5):11-6.

4. Zelber-Sagi S, Buch A, Yeshua H, Vaisman N, Webb M, Harari G, Kis O, Fliss-Isakov N, Izkhakov E, Halpern Z, Santo E. Effect of resistance training on non-alcoholic fatty-liver disease a randomized-clinical trial. World journal of gastroenterology: WJG. 2014 Apr 21;20(15):4382.
5. Xue Y, Peng Y, Zhang L, Ba Y, Jin G, Liu G. Effect of different exercise modalities on nonalcoholic fatty liver disease: a systematic review and network meta-analysis. Scientific reports. 2024 Mar 14;14(1):6212.
6. Charatcharoenwitthaya P, Kuljiratitikal K, Aksornchanya O, Chaiyasoot K, Bandidniyamanon W, Charatcharoenwitthaya N. Moderate-intensity aerobic vs resistance exercise and dietary modification in patients with nonalcoholic fatty liver disease: a randomized clinical trial. Clinical and Translational Gastroenterology. 2021 Mar 1;12(3): e00316.
7. Hallsworth K, Thoma C, Hollingsworth KG, Cassidy S, Anstee QM, Day CP, Trenell MI. Modified high-intensity interval training reduces liver fat and improves cardiac function in non-alcoholic fatty liver disease: a randomized controlled trial. Clinical science. 2015 Dec 1;129(12):1097-105.
8. Nseir W, Hellou E, Assy N. Role of diet and lifestyle changes in nonalcoholic fatty liver disease. World journal of gastroenterology: WJG. 2014 Jul 28;20(28):9338.

How to cite this article: Nayla Naurin Shaikh, Harda Shah. Combined effect of 12-week high-intensity interval training (HIIT), strength training and dietary modification on metabolic profile, liver function and exercise tolerance in metabolic dysfunction-associated fatty liver disease (MAFLD): a case report. *International Journal of Science & Healthcare Research.* 2025; 10(1): 259-265. DOI: *https://doi.org/10.52403/ijshr.20250135*

******