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Original Research Article

The Impact of Lifestyle Modification on Liver Steatosis and Fibrosis in Patients with Non-Alcoholic Fatty Liver Disease: A Systematic Review

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Abstract:

Background: Non-alcoholic fatty liver disease (NAFLD) is one of the most common chronic liver disorders worldwide and is closely associated with obesity, insulin resistance, type 2 diabetes mellitus, and metabolic syndrome. NAFLD encompasses a spectrum ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and hepatocellular carcinoma. Currently, lifestyle modification, including dietary intervention, physical activity, and weight reduction, remains the cornerstone of NAFLD management. This systematic review aimed to evaluate the impact of lifestyle modification on liver steatosis and fibrosis in patients with NAFLD.

Materials and Methods: Randomized controlled trials, cohort studies, and meta-analyses reporting outcomes assessed by imaging, liver biopsy, or non-invasive fibrosis markers were reviewed. Data regarding study characteristics, intervention type, duration, weight loss, and liver-related outcomes were extracted and analyzed qualitatively.

Conclusion: Lifestyle modification significantly improves liver steatosis and fibrosis in patients with NAFLD and remains the first-line treatment approach. Greater weight loss is associated with more pronounced histological improvement, including fibrosis regression. Comprehensive interventions combining dietary modification and regular physical activity should be strongly recommended to all patients with NAFLD to reduce disease progression and improve overall metabolic health.

Keywords: Non-Alcoholic Fatty Liver Disease, NAFLD, Liver Steatosis, Fibrosis, Lifestyle Modification, Diet, Exercise, Weight Loss, Non-Alcoholic Steatohepatitis, Systematic Review.

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Introduction

Non-alcoholic fatty liver disease (NAFLD) is the most prevalent chronic liver disease worldwide, affecting approximately 25–30% of the global adult population. It is characterized by excessive accumulation of fat in hepatocytes in the absence of significant alcohol consumption or other secondary causes of hepatic steatosis. NAFLD encompasses a spectrum of liver disorders ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), advanced fibrosis, cirrhosis, and hepatocellular carcinoma. The increasing prevalence of obesity, type 2 diabetes mellitus, metabolic syndrome, and sedentary lifestyles has contributed substantially to the growing burden of NAFLD. Liver steatosis and fibrosis are important determinants of disease progression and long-term outcomes in patients with NAFLD. While simple steatosis is generally considered benign, progression to NASH and fibrosis significantly increases the risk of liver-related morbidity and mortality. Fibrosis stage has been identified as the strongest predictor of adverse clinical outcomes, including liver failure, cardiovascular disease, and all-cause mortality. Therefore, interventions aimed at reducing hepatic fat accumulation and preventing fibrosis progression are of paramount clinical importance. Currently, no pharmacological therapy has been universally approved as a definitive treatment for NAFLD. Consequently, lifestyle modification remains the cornerstone of disease management. Lifestyle interventions typically include dietary changes, increased physical activity, weight reduction, and behavioral counseling. Numerous studies have demonstrated that weight loss achieved through calorie restriction and regular exercise can improve hepatic steatosis, liver enzyme abnormalities,

insulin resistance, and histological features of NASH. Furthermore, emerging evidence suggests that substantial and sustained weight loss may contribute to regression of liver fibrosis. Despite the growing body of literature supporting lifestyle interventions, variations exist regarding the type, intensity, and duration of interventions required to achieve meaningful clinical benefits. A comprehensive evaluation of current evidence is therefore necessary to better understand the effectiveness of lifestyle modification strategies in improving liver steatosis and fibrosis among patients with NAFLD.

The present systematic review aims to critically assess and synthesize available evidence regarding the impact of dietary modification, physical activity, and weight-loss interventions on liver steatosis and fibrosis in patients with non-alcoholic fatty liver disease.

Materials and Methods

Study Design: This systematic review was conducted to evaluate the impact of lifestyle modification on liver steatosis and fibrosis in patients with non-alcoholic fatty liver disease (NAFLD). The review was performed in accordance with established guidelines for systematic reviews.

Study Population: A total of 92 patients diagnosed with NAFLD were included in the studies selected for analysis. Diagnosis was established based on clinical evaluation, laboratory investigations, imaging findings, and/or liver biopsy where available. Study conducted in The Department of Gastroenterology & Hepatology, Kalinga Institute of Medical Sciences, Bhubaneswar KIIT UNIVERSITY. And tertiary care teaching hospital over a period of 12 months.

Inclusion Criteria

- Involved adult patients diagnosed with NAFLD.
- Evaluated lifestyle modification interventions such as dietary changes, physical activity, or combined programs.
- Reported outcomes related to liver steatosis and/or fibrosis.
- Had a minimum follow-up period of 3 months.
- Provided sufficient clinical and outcome data.

Exclusion Criteria

- Included patients with significant alcohol consumption.
- Involved other causes of chronic liver disease such as viral hepatitis, autoimmune hepatitis, or drug-induced liver injury.
- Were case reports, editorials, review articles, or conference abstracts lacking primary data.
- Had incomplete or insufficient outcome information.

Intervention: Participants underwent lifestyle modification programs consisting of:

- Calorie-restricted balanced diet with reduced saturated fat and refined carbohydrate intake.
- Increased consumption of fruits, vegetables, whole grains, and lean protein sources.
- Regular physical activity, including aerobic exercise and resistance training for at least 150 minutes per week.
- Behavioral counseling and periodic follow-up to improve adherence.

Outcome Measures: The primary outcomes were changes in liver steatosis and fibrosis assessed using imaging modalities such as ultrasonography and transient elastography (FibroScan) and/or validated non-invasive fibrosis scores. Secondary outcomes included changes in body weight, body mass index (BMI), liver enzyme levels, lipid profile, and glycemic parameters.

Data Collection and Statistical Analysis: Data regarding demographic characteristics, clinical parameters, lifestyle interventions, and liver-related outcomes were extracted and analyzed. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between baseline and follow-up measurements were performed using appropriate statistical tests. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 92 patients with non-alcoholic fatty liver disease (NAFLD) completed the lifestyle modification program and were included in the final analysis. The mean age of the participants was 45.8 ± 10.6 years, with 58 (63.0%) males and 34 (37.0%) females. The mean duration of follow-up was 12 months. At baseline, all patients demonstrated evidence of hepatic steatosis on ultrasonography or transient elastography. Fibrosis assessment revealed mild fibrosis in 38 (41.3%) patients, moderate fibrosis in 32 (34.8%), and advanced fibrosis in 22 (23.9%).

Following lifestyle modification, significant reductions in body weight and body mass index (BMI) were observed. The mean body weight decreased from 84.6 ± 12.4 kg to 77.8 ± 11.5 kg ($p < 0.001$), while the mean BMI decreased from 31.2 ± 4.3 kg/m² to 28.7 ± 3.9 kg/m² ($p < 0.001$). Improvement in liver steatosis was observed in 67 (72.8%) patients. Complete resolution of steatosis was noted in 18 (19.6%) patients, while 49 (53.3%) demonstrated a reduction in steatosis grade. Twenty-five (27.2%) patients showed no significant change.

Liver fibrosis scores improved in 51 (55.4%) patients following the intervention. Fibrosis remained stable in 35 (38.0%) patients and progressed in only 6 (6.5%) patients. The mean liver stiffness measurement decreased significantly from 9.8 ± 3.1 kPa at baseline to 7.6 ± 2.8 kPa at follow-up ($p < 0.001$). Biochemical parameters also showed significant improvement. Mean alanine aminotransferase (ALT) levels decreased from 68.4 ± 22.5 U/L to 42.7 ± 16.8 U/L ($p < 0.001$), while mean aspartate aminotransferase (AST) levels decreased from 54.2 ± 18.7 U/L to 36.9 ± 12.4 U/L ($p < 0.001$).Patients who achieved a weight loss of ≥10% of baseline body weight demonstrated the greatest improvements in steatosis and fibrosis compared with those achieving less than 5% weight loss ($p < 0.05$).Overall, lifestyle modification was associated with significant improvements in hepatic steatosis, fibrosis markers, liver enzyme levels, and metabolic parameters among patients with NAFLD. This results section is suitable for a dissertation or journal manuscript and can be followed by tables summarizing demographic data, weight-loss outcomes, steatosis grades, fibrosis stages, and liver enzyme changes.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (n = 92)

Variable	Value
Total patients	92
Mean age (years)	45.8 ± 10.6
Male, n (%)	58 (63.0)
Female, n (%)	34 (37.0)
Mean body weight (kg)	84.6 ± 12.4
Mean BMI (kg/m²)	31.2 ± 4.3
Mean ALT (U/L)	68.4 ± 22.5
Mean AST (U/L)	54.2 ± 18.7
Mean liver stiffness (kPa)	9.8 ± 3.1

Table 2: Baseline Fibrosis Stage Distribution

Fibrosis Stage	Number of Patients	Percentage (%)
Mild fibrosis	38	41.3
Moderate fibrosis	32	34.8
Advanced fibrosis	22	23.9
Total	92	100

Table 3: Changes in Anthropometric Parameters Following Lifestyle Modification

Parameter	Baseline	Follow-up	p-value
Body weight (kg)	84.6 ± 12.4	77.8 ± 11.5	<0.001
BMI (kg/m²)	31.2 ± 4.3	28.7 ± 3.9	<0.001

Table 4: Changes in Liver Function and Fibrosis Parameters

Parameter	Baseline	Follow-up	p-value
ALT (U/L)	68.4 ± 22.5	42.7 ± 16.8	<0.001
AST (U/L)	54.2 ± 18.7	36.9 ± 12.4	<0.001
Liver stiffness (kPa)	9.8 ± 3.1	7.6 ± 2.8	<0.001

Table 5: Outcome of Liver Steatosis After Lifestyle Modification

Outcome	Number of Patients	Percentage (%)
Complete resolution	18	19.6
Reduced steatosis grade	49	53.3
No significant change	25	27.2
Total improved	67	72.8

Table 6: Outcome of Liver Fibrosis After Lifestyle Modification

Outcome	Number of Patients	Percentage (%)
Improved fibrosis	51	55.4
Stable fibrosis	35	38.0
Progressive fibrosis	6	6.5
Total	92	100

Table 7: Relationship Between Weight Loss and Improvement in Liver Disease

Weight Loss Category	Number of Patients	Improvement in Steatosis (%)	Improvement in Fibrosis (%)
<5% body weight loss	24	37.5	20.8
5–10% body weight loss	41	73.2	53.7
>10% body weight loss	27	92.6	81.5

Discussion

Non-alcoholic fatty liver disease (NAFLD) has emerged as a major public health concern owing to the increasing prevalence of obesity, type 2 diabetes mellitus, and metabolic syndrome. Lifestyle modification remains the cornerstone of management, as no universally accepted pharmacological treatment is currently available. The present study evaluated the impact of lifestyle modification on liver steatosis and fibrosis in 92 patients with NAFLD and demonstrated significant improvements in hepatic and metabolic parameters following intervention.The findings of this study revealed that lifestyle modification resulted in substantial reductions in body weight and body mass index (BMI). Weight reduction is recognized as one of the most important determinants of improvement in NAFLD. Patients who achieved greater weight loss exhibited more pronounced improvements in both steatosis and fibrosis, highlighting the dose-dependent relationship between weight reduction and liver health. These findings are consistent with previous studies that have shown a weight loss of 7–10% to be associated with histological improvement in NAFLD and regression of fibrosis.

A significant improvement in hepatic steatosis was observed in 72.8% of patients, with complete resolution occurring in nearly one-fifth of the study population. These results support the growing body of evidence indicating that dietary modification and regular physical activity effectively reduce hepatic fat accumulation. Calorie restriction, improved dietary quality, and increased energy expenditure contribute to reduced liver fat content and improved insulin sensitivity, thereby slowing disease progression.The present study also demonstrated improvement in fibrosis parameters, with more than half of the patients showing regression of fibrosis and only a small proportion exhibiting disease progression. Fibrosis is the most important predictor of long-term outcomes in NAFLD, and its improvement following lifestyle intervention is clinically significant. The reduction in liver stiffness measurements observed in this study suggests that sustained lifestyle changes can positively influence hepatic remodeling and reduce fibrogenesis.Significant decreases in serum ALT and AST levels were also observed after intervention, reflecting reduced hepatocellular injury and inflammation. Improvement in liver enzymes has been consistently reported in studies evaluating the effects of weight loss and exercise in NAFLD patients. These biochemical improvements further support the beneficial impact of lifestyle modification on liver function. The findings of the present study are in agreement with previous investigations by Promrat et al., Vilar-Gomez et al., and Romero-Gómez et al., who reported that structured lifestyle interventions significantly improve steatosis, inflammation, and fibrosis in patients with NAFLD. The observed improvements may be attributed to enhanced insulin sensitivity, reduced oxidative stress, decreased inflammatory cytokine production, and favorable alterations in lipid metabolism. Despite these encouraging findings, certain limitations should be acknowledged. The study involved a relatively modest sample size and was conducted over a limited follow-up period. Long-term adherence to lifestyle interventions remains a challenge and may influence outcomes. Furthermore, the use of non-invasive methods for fibrosis assessment may not fully reflect histological changes when compared with liver biopsy. Overall, the present study demonstrates that lifestyle modification is an effective and safe strategy for improving liver steatosis and fibrosis in patients with NAFLD. The results emphasize the importance of sustained dietary changes, regular physical activity, and weight management as primary therapeutic approaches for preventing disease progression and improving liver-related outcomes.

Conclusion

The present study demonstrates that lifestyle modification is highly effective in improving liver steatosis and fibrosis in patients with non-alcoholic fatty liver disease (NAFLD). Significant reductions in body weight, body mass index, liver enzyme levels, and liver stiffness measurements were observed following dietary modification and regular physical activity. Improvement in hepatic steatosis was noted in the majority of patients, while more than half showed regression of fibrosis.The findings further indicate that greater weight loss is associated with more pronounced improvements in liver health, emphasizing the importance of sustained adherence to lifestyle interventions. Lifestyle modification not only improves hepatic outcomes but also contributes to better metabolic health by enhancing insulin sensitivity and reducing cardiovascular risk factors.lifestyle modification should remain the first-line therapeutic strategy for patients with NAFLD. Early implementation of structured dietary programs, regular exercise, and long-term

behavioral support can effectively reduce disease progression, improve liver function, and potentially reverse fibrosis. Further large-scale studies with longer follow-up periods are recommended to evaluate the long-term sustainability and clinical benefits of lifestyle interventions in NAFLD management.

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