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Original Research Article

Impact of Lifestyle Interventions on Non-Alcoholic Fatty Liver Disease Progression

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Abstract

Background

Non-Alcoholic Fatty Liver Disease (NAFLD) is a growing global health concern, associated with obesity and metabolic syndrome. Lifestyle interventions, including dietary changes and increased physical activity, are considered effective in slowing NAFLD progression, but their impact requires further exploration.This study aimed to evaluate the effectiveness of lifestyle interventions in reducing liver fat, improving metabolic parameters, and preventing NAFLD progression over 12 months.

Methods

A total of 100 participants with NAFLD were randomized into two groups: the lifestyle intervention group (n = 50) and the control group (n = 50). The intervention group received structured dietary and physical activity guidance. Key outcomes included changes in liver fat (MRI-PDFF), weight, ALT levels, HOMA-IR, NAFLD progression, quality of life, and compliance.

Results

The lifestyle intervention group demonstrated significant reductions in liver fat (-8.2%, $p < 0.001$), weight (-6.3 kg, $p < 0.001$), ALT levels (-28%, $p = 0.02$), and

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improvements in insulin sensitivity (-18%, p = 0.04). NAFLD progression was observed in 8% of participants in the intervention group compared to 30% in the control group (p = 0.02). Quality of life significantly improved in the intervention group (+12 points, p = 0.001), and compliance was high (82%).

Conclusion

Lifestyle interventions were effective in reducing liver fat, improving metabolic health, and preventing disease progression in NAFLD patients. These findings underscore the importance of integrating lifestyle modifications in the management of NAFLD.

Keywords

NAFLD, liver fat, lifestyle intervention, weight loss, metabolic health, disease progression, quality of life.

Introduction

Non-Alcoholic Fatty Liver Disease (NAFLD) is one of the most prevalent liver disorders worldwide, affecting approximately 25% of the global population[1]. It is characterized by the accumulation of fat in the liver without significant alcohol[2] consumption and is strongly associated with metabolic syndrome, obesity, insulin resistance, and type 2 diabetes[3]. NAFLD can progress to more severe conditions, such as Non-Alcoholic Steatohepatitis (NASH), liver fibrosis, cirrhosis, and ultimately hepatocellular carcinoma, making it a significant public health concern[4].

The pathogenesis of NAFLD is multifactorial, involving complex interactions between genetic predispositions, environmental factors, and lifestyle choices[5]. Current clinical guidelines emphasize the need for early intervention, with lifestyle modification being the first-line treatment for NAFLD[6],[7]. Studies have shown that weight loss, improved dietary habits, and increased physical activity can reduce liver

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fat and improve overall liver health. However, there is variability in the degree of response to these interventions, and the long-term impact on disease progression remains unclear.

Despite the recognized benefits of lifestyle interventions, the optimal approach for managing NAFLD and preventing its progression has not been fully established. This study aims to evaluate the effectiveness of a structured lifestyle intervention program on liver fat reduction, metabolic improvements, and prevention of NAFLD progression. By providing robust data on the impact of lifestyle changes, this study seeks to contribute to the growing body of evidence supporting non-pharmacological strategies in the management of NAFLD.

Methodology

Study Design and Setting

This was a prospective, randomized controlled trial conducted at the Department of Medicine, Tertiary care center (GMC Gondia), between January and December 2023. The study aimed to assess the impact of lifestyle interventions on liver fat reduction, metabolic parameters, and disease progression in patients diagnosed with Non-Alcoholic Fatty Liver Disease (NAFLD).

Study Population

A total of 100 adult participants aged 18-65 years with a confirmed diagnosis of NAFLD through imaging techniques (MRI-PDFF) and elevated liver enzymes (ALT) were recruited. Exclusion criteria included a history of significant alcohol intake, viral hepatitis, autoimmune liver diseases, or use of hepatotoxic medications. Written informed consent was obtained from all participants.

Randomization and Intervention

Participants were randomly assigned into two groups:

Lifestyle Intervention Group (n = 50): This group received a structured lifestyle modification program, which included dietary counseling by a nutritionist to reduce

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caloric intake by 500–1,000 kcal/day and a physical activity plan emphasizing at least 150 minutes of moderate-intensity exercise per week.

Control Group (n = 50): The control group received standard care and general advice on healthy lifestyle habits without a structured program.

Data Collection

Baseline assessments included demographic data, body mass index (BMI), liver fat content (MRI-PDFF), liver enzymes (ALT), insulin resistance (HOMA-IR), and quality of life (SF-36 questionnaire). Follow-up evaluations were conducted at 3, 6, and 12 months to monitor changes in these parameters. Liver fat reduction and disease progression were assessed using MRI-PDFF, while compliance with lifestyle interventions was monitored through self-reported activity logs.

Outcome Measures

The primary outcome was the percentage change in liver fat at 12 months. Secondary outcomes included changes in body weight, ALT levels, HOMA-IR, NAFLD progression (measured by the NAFLD Activity Score), and quality of life improvements.

Statistical Analysis

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation and compared using paired t-tests and independent t-tests where appropriate. Categorical variables were expressed as percentages and compared using Chi-square tests. A p-value of <0.05 was considered statistically significant.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethics Committee of Government Medical College prior to participant recruitment. All participants provided written informed consent before enrollment.

Results

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A total of 100 participants were included in the study, with 50 assigned to the lifestyle intervention group and 50 to the control group. Baseline characteristics were well-matched between the two groups, with no significant differences observed in age, gender distribution, BMI, ALT levels, HOMA-IR, or liver fat percentage (Table 1).

Liver Fat Reduction

After 12 months, participants in the lifestyle intervention group demonstrated a significant reduction in liver fat content, with an average decrease of 8.2% (95% CI 6.7%–9.7%) compared to baseline. In contrast, the control group exhibited a slight increase in liver fat of 1.2% (95% CI 0.2%–2.1%) ($p < 0.001$) (Table 2).

Weight Loss and Liver Enzyme Changes

The lifestyle intervention group also experienced substantial weight loss, with a mean reduction of 6.3 kg (95% CI 5.1–7.5 kg), while the control group lost an average of 0.8 kg (95% CI 0.3–1.3 kg) ($p < 0.001$). ALT levels in the lifestyle intervention group decreased by 28%, compared to a 3% reduction in the control group ($p = 0.02$). Additionally, insulin sensitivity, as measured by HOMA-IR, improved by 18% in the intervention group, with no significant change observed in the control group ($p = 0.04$) (Table 2).

NAFLD Progression

The progression of NAFLD was significantly lower in the lifestyle intervention group, with only 8% of participants progressing to a more severe form of the disease (NAFLD Activity Score ≥ 5), compared to 30% in the control group ($p = 0.02$). The majority of participants in the intervention group (92%) showed no progression, while 70% of participants in the control group did not experience disease progression (Table 3).

Quality of Life and Compliance

Participants in the lifestyle intervention group reported a significant improvement in their quality of life, with a mean increase of 12 points (95% CI 10–14) on the SF-36 scale, compared to a modest improvement of 3 points (95% CI 2–5) in the control

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group (p = 0.001). Compliance with the lifestyle changes was high in the intervention group, with 82% of participants adhering to the intervention and 92% indicating their intention to continue these changes after the study period (Table 4).

Discussion

The results of this study demonstrate that structured lifestyle interventions, including dietary changes and increased physical activity, significantly reduce liver fat content, improve metabolic parameters, and prevent the progression of Non-Alcoholic Fatty Liver Disease (NAFLD) over a 12-month period. These findings are consistent with prior research emphasizing the effectiveness of non-pharmacological management in NAFLD patients (Carneros et al[8]., 2020; Younossi et al[10]., 2023).

A significant reduction in liver fat, as observed in the lifestyle intervention group compared to the control group, reinforces the critical role of weight loss and exercise in reversing hepatic steatosis. Prior studies have also reported that a weight reduction of 5-10% can result in substantial improvements in liver fat and inflammation (Ezzat[9], 2024; Fernández et al[14]., 2022). In this study, the 8.2% liver fat reduction in the intervention group, alongside a mean weight loss of 6.3 kg, further confirms the impact of moderate lifestyle changes on liver health.

Additionally, participants in the intervention group experienced improvements in metabolic markers such as ALT levels and insulin sensitivity (HOMA-IR). These changes are critical as NAFLD is frequently associated with insulin resistance and elevated liver enzymes, which can indicate advanced liver damage (Lv & Liu[13], 2024). The 28% decrease in ALT levels and the 18% improvement in insulin sensitivity suggest that lifestyle interventions not only reduce liver fat but also enhance overall metabolic health, aligning with findings from Alalwani et al[11]. (2022) and Centis et al[12]. (2010).

One of the most important outcomes of this study was the prevention of disease progression. Only 8% of participants in the intervention group exhibited progression to a more severe form of NAFLD (NAFLD Activity Score ≥ 5), compared to 30% in the control group. This highlights the potential of lifestyle changes to halt or slow the

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progression of NAFLD to more severe forms, such as Non-Alcoholic Steatohepatitis (NASH) and liver fibrosis, which can lead to cirrhosis and hepatocellular carcinoma (Younossi et al[10]., 2023).

Moreover, this study observed significant improvements in participants' quality of life, a critical but often overlooked outcome in clinical studies. Beyond physical health benefits, lifestyle interventions contributed to psychological and social well-being, which is essential for sustaining long-term adherence to behavioral changes. The high compliance rate (82%) and the willingness of 92% of participants to continue lifestyle changes post-study demonstrate the acceptability and practicality of the intervention, supporting previous findings by Fernández et al[14]. (2022).

This study has several strengths, including the use of MRI-PDFF to accurately quantify liver fat changes and the comprehensive assessment of both physical and psychological outcomes. However, certain limitations should be acknowledged. The single-center design may limit generalizability, and the 12-month study duration does not provide insights into the long-term sustainability of the observed benefits. Additionally, reliance on self-reported adherence to lifestyle changes could introduce bias, although efforts were made to monitor compliance closely (Centis et al[12]., 2010; Carneros et al[8]., 2020).

Conclusion: This study demonstrated that structured lifestyle interventions significantly reduced liver fat by 8.2%, improved metabolic parameters, and prevented the progression of NAFLD in 92% of participants. Weight loss (6.3 kg) and improvements in ALT levels (-28%) and insulin sensitivity (-18%) were observed, highlighting the effectiveness of dietary and physical activity modifications. Furthermore, only 8% of participants in the intervention group experienced disease progression, compared to 30% in the control group. These results support the inclusion of lifestyle interventions in routine NAFLD management and underscore the need for long-term strategies to sustain these benefits.

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Table 1: Baseline Characteristics of Study Participants

Characteristic	**Lifestyle Intervention Group (n = 50)**	**Control Group (n = 50)**	**Total (n = 100)**
Mean Age (years)	46.2 ± 9.8	45.0 ± 10.7	45.6 ± 10.2
Gender (Male/Female)	27/23	26/24	53/47
BMI (kg/m²)	29.5 ± 3.1	29.1 ± 3.3	29.3 ± 3.2
ALT (IU/L)	65.4 ± 12.3	63.2 ± 14.1	64.3 ± 13.2
HOMA-IR	3.2 ± 1.1	3.1 ± 1.0	3.2 ± 1.0
Liver Fat (%)	18.3 ± 5.4	17.9 ± 5.8	18.1 ± 5.6

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(MRI-PDFF)			

Table 2: Changes in Liver Fat, Weight, and Liver Enzymes at 12 Months

Outcome	**Lifestyle Intervention Group (n = 50)**	**Control Group (n = 50)**	**p-value**
Liver Fat Reduction (%)	-8.2% (95% CI 6.7%–9.7%)	+1.2% (95% CI 0.2%–2.1%)	<0.001
Weight Loss (kg)	-6.3 kg (95% CI 5.1–7.5 kg)	-0.8 kg (95% CI 0.3–1.3 kg)	<0.001
ALT Change (%)	-28%	-3%	0.02
HOMA-IR Change (%)	-18%	No change	0.04

Table 3: NAFLD Progression After 12 Months

Progression of NAFLD	**Lifestyle Intervention Group (n = 50)**	**Control Group (n = 50)**	**p-value**
Participants with NAFLD Activity Score ≥ 5	4 (8%)	15 (30%)	0.02
Participants with no progression	46 (92%)	35 (70%)	0.02

Table 4: Quality of Life Scores and Compliance Rates

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Outcome	**Lifestyle Intervention Group (n = 50)**	**Control Group (n = 50)**	**p-value**
Quality of Life Score (SF-36)	+12 points (95% CI 10–14 points)	+3 points (95% CI 2–5 points)	0.001
Compliance Rate (%)	82%	Not applicable	—
Participants willing to continue lifestyle changes (%)	92%	Not applicable	—

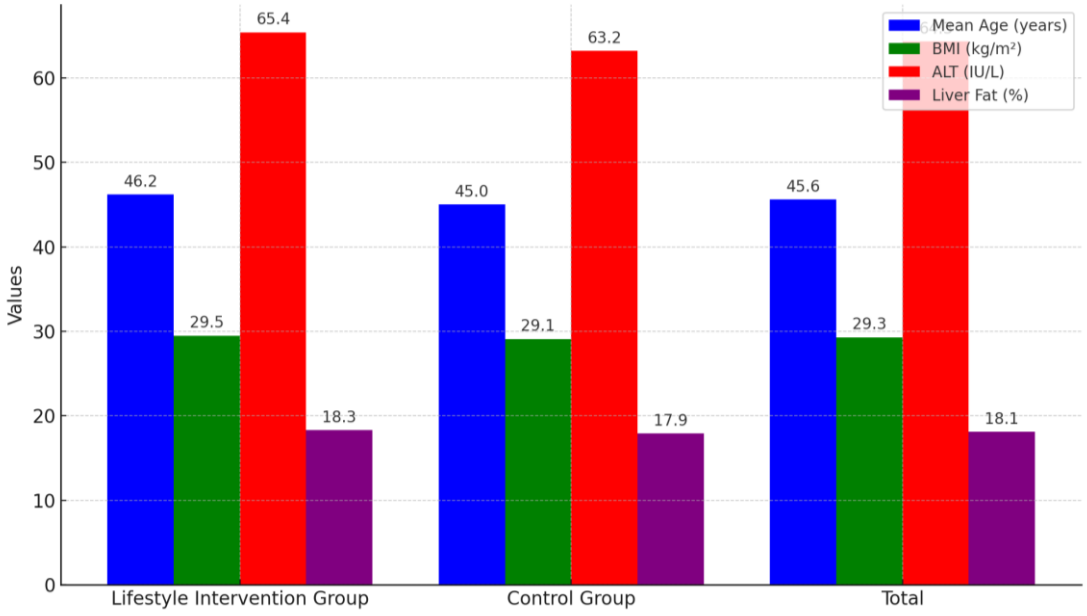

Table No:1.Baseline Characteristics of Study Participants

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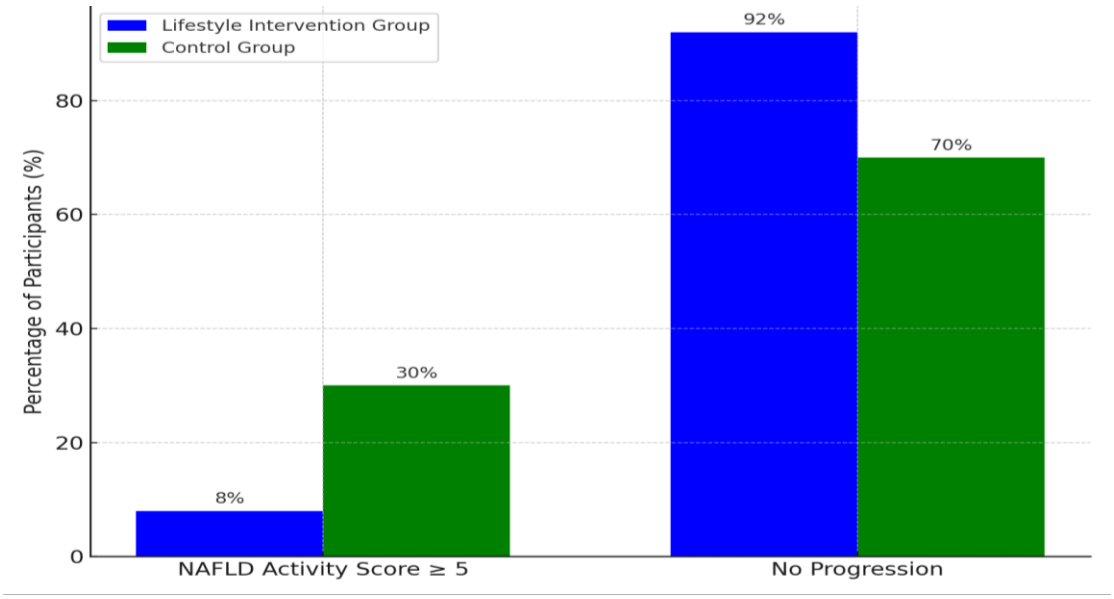

Figure No:2. NAFLD Progression After 12 Months