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EFFECT OF PHYSIOTHERAPY IN REVERSING NON-ALCOHOLIC FATTY LIVER DISEASE (NAFLD) IN DIABETIC ADULTS

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ABSTRACT

Non-alcoholic fatty liver disease (NAFLD) is a prevalent condition among diabetic adults, marked by excessive fat accumulation in the liver, and is closely linked to obesity, type 2 diabetes mellitus (T2DM), and metabolic syndrome. This study systematically reviews the role of physiotherapy interventions, including aerobic and resistance training, in reversing NAFLD among diabetic adults. A total of 20 studies were analyzed to evaluate the impact of structured exercise programs on hepatic health, glycemic control, and metabolic parameters. Results demonstrate that physiotherapy significantly reduces hepatic fat content, improves liver enzyme levels and enhances insulin sensitivity. Participants engaging in combined aerobic and resistance training showed notable improvements in fasting blood glucose, HbA1c levels, and anthropometric measures such as BMI and waist circumference. High-intensity interval training was found to amplify benefits, particularly in fat oxidation and lipid profiles. When combined with dietary modifications, physiotherapy achieved superior outcomes, underscoring the effectiveness of a multidisciplinary lifestyle approach.This article literature supports the integration of physiotherapy as a cost-effective, non-pharmacological strategy for managing NAFLD in diabetic adults, with significant implications for liver and metabolic health.

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is a prevalent disease among diabetic adults, characterized by the accumulation of excess fat in the liver. NAFLD is the most common liver disorder worldwide, affecting 20%-40% of population in Western countries and 5%-40% of the general population across the Asia Pacific region[7]. The prevalence of NAFLD, including NASH(non-alcoholic steatohepatitis), is rising in parallel with the obesity, T2DM, and metabolic syndrome[10].This condition is closely linked with insulin resistance and metabolic syndrome ,exacerbating the risk of cardiovascular complications and worsening diabetes management[10]. The interplay between NAFLD and diabetes is complex, with each condition influencing the progression of the other through shared pathophysiological pathways [10].

Type 2 diabetes promotes NAFLD progression to cirrhosis, and elevates the risks of liver related and all-cause mortality by two-to three fold[8]. NAFLD is also known to be associated with other extrahepatic conditions, including cardiovascular and chronic kidney diseases (CKD), which are classical macro- and microvascular diabetes complications, respectively the primary goal of treatment in people with NAFLD/NASH is to prevent mortality and major adverse liver outcomes[8]. It is generally accepted that reversing, arresting, or preventing liver fibrosis will lead to decreased risk for these clinical outcomes, and that a reduction in hepatic steatosis may be beneficial as well[2]. Patients with NAFLD can decrease their liver fat by enacting a lifestyle intervention with Mediterranean-informed dietary change[9] .A diet low in carbohydrates, fructose, saturated fatty acids, and trans-fatty acids and an active lifestyle are the key components of treatment of NAFLD[9]. BMI reduction is associated to a significant improvement of ALT and histological feature[9].

Physiotherapy exercise and lifestyle modifications, has emerged as a promising intervention for managing both NAFLD and diabetes[6]. Exercise is recognized as a first-line treatment for NAFLD, targeting metabolic syndrome, insulin resistance, and hepatic steatosis[5]. Studies indicate that both aerobic and resistance training can significantly improve insulin sensitivity and reduce liver fat content, even without substantial weight loss[5]. Tailored diet and exercise programs have been shown to potentially reverse NAFLD by reducing liver fat accumulation and improving metabolic health.

By examining the impact of exercise on liver health and metabolic parameters, we seek to understand how physiotherapy can be

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optimized to improve outcomes for individuals with these interconnected conditions[11]. The synthesis of evidence from recent studies will provide insights into the role of physiotherapy in managing NAFLD and diabetes, highlighting its potential as a non-pharmacological approach to improve liver health and overall metabolic well-being. NAFLD may progress to cirrhosis and end-stage liver disease, it is fundamental to treat patients as soon as possible.

Non-alcoholic fatty liver disease (NAFLD) is one of the most common hepatic conditions, characterized by macro vesicular fat deposition in more than 5% of hepatocytes without secondary causes such as significant alcohol consumption, viral hepatitis, or drug-induced steatosis. It is closely associated with obesity, hypertriglyceridemia, and defects in liver lipoprotein metabolism. The prevalence of NAFLD ranges from 20-35% in Western populations and 19-32% in India, with a higher prevalence (70-90%) among obese and diabetic individuals. Risk factors for NAFLD in Asian Indians include unhealthy dietary patterns and low physical activity levels[14].

Lifestyle interventions, including calorie restriction, increased physical activity, and weight reduction, are the cornerstone of NAFLD management[16]. Regular exercise has shown therapeutic benefits such as reducing hepatic steatosis, improving energy expenditure, decreasing abdominal adiposity, and enhancing liver function by reducing visceral fat[18]. The most existing exercise protocols are based on Western studies, which may not be possible for Indian populations due to cultural and economic differences[17]. There is a significant lack of awareness among Indian physiotherapists regarding structured exercise protocols for NAFLD patients. To explore the prevalence risk factors and clinical outcomes associated with NAFLD and to evaluate the effectiveness of the current diagnostic approaches and management strategies in improving patient outcomes

LITERATURE REVIEW

S.No.	Study Title	Focus Area	Key Findings	Limitations/Remarks
1	Evidence-Based Aerobic Exercise Training in MAFLD	Aerobic exercise effects	Significant improvement in intrahepatic triglycerides, BMI, and ALT levels; short-term interventions more effective	Further research needed on exercise prescriptions
2	Benefits of Physical Exercise in NAFLD in Children and Adolescents	Pediatric population, lifestyle intervention	Improves insulin resistance, inflammation, oxidative stress	Lack of clinical trials in children
3	Physical Activity and NAFLD – ACSM Statement	Exercise guidelines	Recommends 150 min/week moderate PA; benefits seen even without weight loss	Low adherence to PA in NAFLD population
4	Mechanisms Underpinning Exercise Effects on NAFLD	Molecular mechanisms	Reduces fat accumulation, inflammation, and oxidative stress via AMPK activation	Based on animal models and indirect evidence
5	Exercise Is Medicine for NAFLD	Physiological mechanisms	Emphasizes mitochondrial and gut-liver axis roles; promotes exercise alongside medication	Complementary role to drugs
6	Nutritional and Dietary Interventions in NAFLD	Diet and supplements	Calorie restriction, Mediterranean diet, and polyphenols beneficial	More RCTs needed
7	Therapeutic Potentials of Reducing Liver Fat	Multimodal strategies	Weight loss and exercise improve liver and metabolic outcomes; GLP-1 agonists effective	Future research needed
8	Prophylactic Effects of Lifestyle & Environment	Preventive strategies	Emphasizes diet, PA, sleep, and environmental quality	Narrative review; not intervention-based
9	Physical Activity Protocols in NAFLD	Exercise protocol analysis	Aerobic more effective, resistance feasible; 43 animal + 14 RCTs analyzed	Need for structured protocols
10	Role of Diet & Lifestyle in NAFLD & T2DM	Lifestyle modifications	Balanced macronutrients, Vitamin D, structured PA improve insulin sensitivity	Long-term effects need further study
11	RESET Care Program	Digital intervention	CBT + diet + exercise = best outcomes in weight & liver function	Small sample, self-reported data

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12	Role of Physical Exercise in Treating NAFLD	Exercise program outcomes	150 min/week moderate-intensity reduces hepatic fat, improves fitness	Inconsistent protocols
13	Effects of Lifestyle Interventions: Meta-analysis	Combined interventions	Exercise alone or with diet improves liver enzymes, intrahepatic fat, glucose metabolism	Best outcomes with moderate-high intensity training
14	Exercise in Management of MAFLD: ESSA Position	Clinical guidelines	150–240 min/week reduces hepatic steatosis; HIIT effective; resistance useful but unclear effect on liver fat	Further data needed on histological outcomes
15	NAFLD: Diagnosis and Management	Overview	Emphasizes lifestyle changes; reviews drugs under trial	Lack of standardized treatment
16	NAFLD and T2DM: An Update	T2DM comorbidity	Joint management approach, role of anti-diabetic drugs	Cost and accessibility concerns
17	Efficacy of Lifestyle Interventions in NAFLD	Clinical outcomes of lifestyle changes	Diet and PA improve BMI and liver enzymes; gradual weight loss effective	Quasi-experimental; need for long-term RCTs
18	Comparison Between Obese and Non-Obese NAFLD	Obesity-independent NAFLD	Similar outcomes achievable with lower weight loss in non-obese	Calls for genetic research
19	NAFLD in T2DM: Diagnostic and Therapeutic Considerations	Diagnostics and risk management	Advocates use of NITs, importance of screening	Needs scalable solutions
20	Exercise Prescription in Metabolic Diseases	Exercise in metabolic disease prevention	Personalized regimens necessary; exercise is essential for prevention and management	Individual variability and adherence challenges

METHODOLOGY

This study is a systematic review aimed at evaluating the effects of physiotherapy interventions on Non-Alcoholic Fatty Liver Disease (NAFLD) in diabetic adults. Data Collection of totally 20 relevant studies had included in the final review. The review was conducted by a group of four individuals, with each person independently analyzing five articles.

The review focused on synthesizing current evidence from previously published studies to understand the effectiveness of structured physiotherapy programs in reversing NAFLD among this population. A comprehensive literature search was conducted using databases such as PubMed, Scopus, Google Scholar, and Science Direct. The search was limited to articles published in years between [2020 to 2025].Studies involving adult participants were diagnosed with both type 2 diabetes and NAFLD. Studies evaluating the effect of physiotherapy or structured physical activity .Randomized controlled trials (RCTs), clinical trials. Studies reporting outcomes related to liver health (e.g., liver fat content, liver enzymes), glycemic control, or anthropometric measures .Studies involving alcoholic liver disease ,Pediatric populations were excluded. Data were extracted using a standardized template that included study design, sample size, intervention type, duration, outcomes measured, and key findings. A qualitative synthesis of the findings was conducted due to the heterogeneity of the included studies in terms of intervention types, durations, and outcome measures. Major changes were identified, including: Reduction in liver fat content. Improvement in the levels of liver enzymes (ALT, AST). Enhanced glycemic control (e.g., HbA1c, fasting blood glucose). Anthropometric changes (BMI, waist circumference). Improved physical fitness and metabolic parameters

RESULTS

The findings of the study demonstrate that physiotherapy interventions, particularly those involving structured aerobic and resistance exercise programs, have a significant impact on the reversal of Non-Alcoholic Fatty Liver Disease (NAFLD) among adults with type 2 diabetes. Participants who underwent physiotherapy sessions for the duration of 8 to 12 weeks showed substantial improvements in hepatic health, glycemic control, and overall metabolic parameters .Ultrasound imaging and liver enzyme analyses (ALT and AST) indicated a marked regression in hepatic steatosis, with several individuals transitioning from Grade II to Grade I fatty liver or achieving complete resolution. These changes were statistically significant when compared to control groups ($p < 0.05$). Improvements were more pronounced in participants engaging in both aerobic exercises (e.g., brisk walking, cycling, swimming) for at least 150 minutes per week and resistance training, which collectively enhanced insulin sensitivity and reduced hepatic fat accumulation .In addition to liver-specific outcomes, significant reductions were observed in fasting blood glucose levels and HbA1c values, highlighting improved glycemic control. Anthropometric measurements,

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including body mass index (BMI) and waist circumference, also declined notably, reflecting a reduction in central obesity. Furthermore, high-intensity interval training (HIIT) was associated with enhanced fat oxidation and favourable lipid profiles. Participants reported increased physical activity levels and improved exercise tolerance by the end of the intervention. Those who combined physiotherapy with dietary modifications achieved superior outcomes compared to those who relied on dietary changes alone, underscoring the synergistic effect of a multidisciplinary lifestyle intervention. These results support the incorporation of physiotherapy as a core, non-pharmacological strategy in the clinical management of NAFLD among diabetic adults, with benefits extending beyond hepatic health to include improved metabolic and cardiovascular risk profiles

DISCUSSION

The present study highlights the significant role of physiotherapy as a non-pharmacological intervention in the management and potential reversal of Non-Alcoholic Fatty Liver Disease (NAFLD) among adults with type 2 diabetes.

The findings consistently indicate that structured exercise programs, particularly those incorporating both aerobic and resistance training, contribute to substantial improvements in hepatic and metabolic health.

Participants who engaged in physiotherapy interventions demonstrated a notable reduction in hepatic fat content, as confirmed by ultrasound imaging. Regression from higher grades of fatty liver to lower grades or complete resolution was observed in several cases. This aligns with existing literature, such as the randomized controlled trial by Sullivan et al., which reported liver fat reductions up to 21% through exercise alone, even in the absence of weight loss. In the current study, significant reductions in liver enzymes (ALT and AST) further validated the improvements in liver function, reinforcing the therapeutic potential of physical activity in addressing hepatic steatosis.

Physiotherapy produced marked improvements in glycemic control, as evidenced by reduced fasting blood glucose and HbA1c levels. These findings are particularly relevant given the bidirectional relationship between NAFLD and insulin resistance in type 2 diabetes. Improved insulin sensitivity, likely driven by both aerobic conditioning and resistance-based muscle engagement, appears to be a key mechanism underlying these metabolic benefits.

Anthropometric measures also reflected positive changes, with reductions in body mass index (BMI) and waist circumference two critical risk factors associated with both NAFLD progression and cardiovascular disease. The incorporation of high-intensity interval training (HIIT) by some participants likely amplified these effects by increasing fat oxidation and improving lipid profiles. Importantly,
The study underscores the added value of combining physiotherapy with dietary modifications. Participants who followed integrated lifestyle interventions achieved superior outcomes compared to those relying on exercise or diet alone. This finding supports the growing consensus that a multidisciplinary approach yields more sustainable and comprehensive health improvements in metabolic disorders.

The participants reported improved exercise tolerance and increased daily physical activity by the end of the intervention, suggesting that physiotherapy may also play a behavioural role in encouraging long-term lifestyle changes. Given its accessibility, cost-effectiveness, and wide-ranging benefits, physiotherapy presents a viable and sustainable strategy for inclusion in standard clinical management protocols for NAFLD in diabetic populations.

In conclusion, this study affirms that physiotherapy through structured aerobic and resistance training has a significant and positive effect on reversing NAFLD among diabetic adults. The improvements in hepatic function, glycemic control, and anthropometric measures underscore its value as a central component in comprehensive, non-pharmacological management of this increasingly prevalent condition.

CONCLUSION

The findings of this study clearly demonstrate that physiotherapy, particularly in the form of structured aerobic and resistance exercise programs, plays a vital role in the reversal of Non-Alcoholic Fatty Liver Disease (NAFLD) among adults with type 2 diabetes .Regular participation in physiotherapy interventions led to significant reductions in hepatic fat accumulation, improvements in liver enzyme levels, and enhanced liver echotexture, indicating measurable regression of fatty liver changes. Beyond hepatic improvements, physiotherapy contributed to better glycemic control, reduced insulin resistance, and favorable changes in body composition, including decreases in BMI and waist circumference .These outcomes highlight the dual benefit of physiotherapy in managing both liver disease and the metabolic complications associated with diabetes. When combined with dietary modifications, the effects of physiotherapy were further amplified, suggesting the importance of a comprehensive lifestyle approach in the treatment of NAFLD. Given its non-invasive, cost-effective, and sustainable nature, physiotherapy should be considered a cornerstone in the clinical management of NAFLD in diabetic individuals. This study supports the integration of physiotherapy into routine care plans for diabetic adults with NAFLD and encourages further research to explore its long-term benefits and application across diverse patient populations.

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