Evaluation the Impact of Aerobics on Sleeping Disorders: A Case Study of Patients with Chronic Liver Disease

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Abstract- **To evaluate the effect of aerobic exercise on sleep disturbances in patients with chronic liver disease through an experimental study. An intervention group and a control group formed by randomly assigning sixty patients with chronic liver disease and sleep problems to each. Participating in moderate-intensity aerobic exercise for 30 minutes five times weekly under supervision is what the intervention group does for 8 weeks. Supplemental exercise treatments are not administered to the control group; they only receive standard medical care. To measure the primary outcome, which is the "quality of sleep, the Pittsburgh Sleep Quality Index (PSQI)" used. Evaluations of sleep latency, duration, and efficiency on the "Pittsburgh Sleep Quality Index (PSQI), daytime sleepiness on the Epworth Sleepiness Scale (ESS), and weariness on the Fatigue Severity Scale (FSS)-" are part of the secondary outcomes. After the intervention, both groups have evaluations to determine their progress. When analysing data within groups, paired t-tests using SPSS. The research predicts that the aerobic exercise group exhibit a significant improvement in sleep quality relative to the control group, as shown by decreased PSQI scores. Furthermore, a decrease in daily drowsiness and tiredness levels is anticipated among individuals in the intervention group. These results underscore the effectiveness of aerobic exercise as a non-pharmacological approach to alleviating sleep disruptions in people with chronic liver disease. The findings are expected to facilitate the integration of aerobic exercise into holistic treatment strategies, enhancing sleep quality and overall health in this demographic.**

Keywords**: Aerobic exercise, Chronic liver disease, Liver function, Pittsburgh Sleep Quality Index (PSQI), Quality of life, Sleep disturbance.**

I. INTRODUCTION

Chronic liver disease (CLD) is a worldwide health issue, impacting millions and resulting in considerable morbidity and death [1, 2]. Chronic liver disease (CLD) includes a range of progressive hepatic disorders, such as "cirrhosis, non-alcoholic fatty liver disease (NAFLD), and hepatitis", marked by ongoing inflammation, fibrosis, and hepatic impairment. These problems not only compromise liver function but also influence many systemic systems, resulting in consequences such as tiredness, metabolic abnormalities, and sleep difficulties. Sleep problems are notably debilitating but often underdiagnosed and poorly treated in individuals with chronic liver disease (CLD) [3-5]. Sleep disorders, such as inadequate sleep quality, insomnia, and excessive daytime somnolence, are seen in 60–80% of patients with chronic liver disease (CLD), markedly diminishing their quality of life and accelerating disease progression. Comprehending effective, non-pharmacological strategies for addressing sleep problems in this demographic is essential.Sleep difficulties in chronic liver disease are multifaceted, arising from both physiological and psychological causes. Hepatic disease may interfere with the body's circadian rhythms by modifying melatonin synthesis, a hormone essential for sleep control. Moreover, systemic inflammation, elevated ammonia levels, and hepatic encephalopathy exacerbate sleep disturbances. Psychosocial stress, anxiety, and sadness, prevalent among CLD patients, contribute to sleep disruptions. If neglected, inadequate sleep quality intensifies tiredness, diminishes physical and mental well-being, and may aggravate liver disease [6-8].

Existing therapeutic modalities, including sedative-hypnotic agents, often face constraints due to adverse effects and possible hepatotoxicity, highlighting the need for new, safer strategies. Aerobic exercise has been recognized as an effective non-pharmacological approach to enhance sleep quality [9, 10]. Consistent aerobic exercise is recognized for its beneficial effects on circadian rhythms, alleviation of anxiety, and improvement of general physical health, making it a viable intervention for sleep disruptions in chronic liver disease patients. Exercise enhances relaxation, prolongs deep sleep duration, and augments sleep efficiency. Furthermore, it enhances liver function, reduces inflammation, and improves metabolic health, all of which may indirectly facilitate better sleep [11,12]. Although data indicates that exercise improves sleep in both healthy people and those with chronic disorders such as diabetes or cardiovascular diseases, there is a paucity of research examining its impact on sleep disruptions especially in patients with chronic liver disease (CLD).Aerobic exercise has further advantages for chronic liver disease patients beyond enhancement of sleep quality. It helps mitigate liver-related problems such as sarcopenia, insulin resistance, and tiredness, prevalent in this demographic. Moreover, participating in regular exercise may enhance well-being and empowerment, alleviating the psychological strain associated with chronic disease [13, 14].

Patients with chronic liver disease often encounter obstacles to physical activity, such as weariness and physical deconditioning, requiring planned and supervised exercise programs customized to their capabilities. This experimental investigation aims to fill the information gap by examining the impact of aerobic exercise on sleep disruptions in people with chronic liver disease (CLD). This study seeks to emphasize the efficacy of lifestyle alterations in tackling the many issues encountered by CLD patients, hence enhancing clinical results and quality of life.

II.REVIEW OF THE LITERATURE

Gupta et al., (2022) investigated how aerobic and resistance exercise affected the quality of sleep and Quality of Life (QoL) of older adults who were having sleep problems. ANOVA with post hoc analysis was carried out using SPSS software version 16.0 for repeated evaluations. Although there was no discernible difference between the groups, analysis showed a substantial rise in PSQI ratings within each group. The resistance training group exhibited improved sleep duration, decreased sleep onset latency, and higher sleep efficiency, according to post hoc analysis. In all areas, subsequent quality of life assessments revealed no discernible differences between the groups, with the exception of domain, social contacts, where the aerobic exercise group showed improvement. Exercise, both aerobic and resistance, enhances quality of life and sleep [15].

Ibrahim and Abdelbasset (2020) conducted research to ascertain the significance of physical activity in the treatment of “non-alcoholic fatty liver disease”. An aerobic exercise training regimen for people with NAFLD mostly depends on the muscles for the oxygen required for energy production. The key criterion for determining the intensity of the main activity is the maximum increase in heart rate (max. HR), metabolic equivalent (MET), heart rate recovery (HRR), or oxygen uptake (VO2 Max). Walking, jogging, cycling on an ergometer, general conditioning, cycling gloves, exercise. Flight preparation reduces liver fat by 43%, and other studies indicate that weight loss leads to significant reductions in body weight. Nonetheless, the pulse, volume, and power for fat loss remain ambiguous [16].

Altaye et al., (2019) investigated the effects of a 16-week high-impact practice program on alterations in plasma thyroid hormone levels during cognitive impairment in youth. A cohort of 36 young individuals with academic disabilities was selected to participate in the study using the optimal model. The activity regimen included 45-75 hours of forceful exercise and four months of moderate to intense physical activity. The exercises are completed in three weekly sessions, each lasting 30 to 45 minutes. 10 minutes of warm-up, 15-30 minutes of high-intensity activity, and 5 minutes of relaxation. Plasma concentrations of triiodothyronine (T3) and tetraiodothyronine (T4), together with plasma levels of thyroid hormones, are assessed after four months of aerobic exercise. Four months post-mediation, significant alterations in the plasma concentrations of thyroid hormones and thyroid-stimulating hormone were seen in the high-intensity exercise group [17].

According to Wang et al., (2019), aerobic exercise lowers triglycerides in people with cardiovascular

disease by focusing on apolipoprotein C3. In the treatment of patients with coronary heart disease (CHD), the high-impact practice has been suggested as an efficient intervention that has a good impact on plasma lipids. Apolipoprotein C3 (ApoC3) has a substantial correlation with coronary heart disease (CHD) and is connected to hypertriglyceridemia. Thirty-eight coronary artery disease patients were randomized to either the exercise group (19 patients) or the control group (19 patients). The two assemblies acquired the necessary medications for CHD. The non-sports group settled down, whereas the activity group engaged in moderate-intensity, high-impact exercise for an extended duration. Lipid levels and Apocyte 3 levels were assessed immediately and again after two months. Following about two months of preparation, the levels of Triglyceride and Apocyte 3 were significantly reduced compared to baseline measurements [18].

Van et al., (2018) evaluated the effects of physical activity on fatty liver. Obesity is contributing to "non-alcoholic fatty liver disease (NAFLD)", a chronic liver ailment. Similarly, NAFLD immunisation, particularly non-alcoholic steatohepatitis (NASH), is a new source of advanced-stage liver disease and hepatocyte damage. Exercise has been linked to the improvement of fatty liver disease, indicating that physical exercise may decrease hepatic fat formation. This survey provides evidence of the benefits of practice in NFLD and NASH. Numerous medical studies have shown that both robust and moderating medications reduce liver fat together. Clinical and rehabilitative assessments indicate that exercise affects fatty liver in various manners. Insulin resistance diminishes surplus fatty acids and facilitates glucose utilization for free fatty acid production in the liver [19].

Moghadam et al., (2015) conducted research with 21 inactive, healthy women aged 60 to 70 years, selected using purposive sampling, to investigate the effects of aerobic exercise on patients with elevated CRP levels. The individuals were categorized into two groups: con-10 and exp-21. The exercise routine spanned 8 weeks, including three sessions each week, with each session lasting 40 to 60 minutes. Adjust exercise intensity according to the patient's goal heart rate. The biological parameters were used for baseline and post-training enhancement. Paired and independent tests were used for results and analysis. The results indicated substantial improvements in weight, BMI, uric acid, and CRP. However, with aerobic activity, patients would enhance their biochemical and anthropometric profiles [20].

III.NEED FOR THE STUDY

Chronic liver disease (CLD) is a significant global health concern, often linked to pronounced sleep disturbances that diminish quality of life, hasten disease progression, and hinder effective treatment. Sleep disturbances in individuals with chronic liver illness result from complex pathophysiological connections, including altered hepatic metabolism, systemic inflammation, disrupted circadian rhythms, and psychological stress. Conventional treatments for sleep problems, including pharmacological methods, often encounter limitations owing to potential side effects, drug interactions, and restricted long-term efficacy. Aerobic exercise, recognized for its systemic anti-inflammatory effects and its role in improving physical and psychological well-being, is a non-pharmacological intervention that may alleviate sleep disturbances in patients with CLD [22]. Physical exercise enhances sleep quality by regulating the "hypothalamic-pituitary-adrenal (HPA) axis", promoting melatonin synthesis, and improving overall physical and mental health. Despite its acknowledged benefits, scientific research into the specific effects of aerobic exercise on sleep characteristics in individuals with chronic liver disease is limited. By assessing the impact of an organised aerobic exercise program on sleep latency, quality, and total sleep architecture in individuals with chronic liver disease (CLD), this experimental research seeks to close this gap. The study seeks to elucidate the therapeutic advantages of aerobic exercise as an economical, non-invasive, and sustainable approach to improve sleep quality and overall life satisfaction in this vulnerable population.

IV.CHALLENGES OF THE STUDY

The research titled "Effect of Aerobic Exercise on Sleep Disturbance in Patients with Chronic Liver Disease" encounters several hurdles, mostly due to the multifaceted character of the ailment and the intrinsic complications involved in assessing sleep and exercise effects. A significant problem is the variety of chronic liver disease (CLD) patients, which includes diverse etiologies, stages of liver failure, and co-morbidities that may affect the response to aerobic exercise and

sleep quality. Furthermore, compliance with the recommended exercise plan is a significant challenge owing to the weariness and diminished physical ability often encountered by CLD patients. The precise and dependable evaluation of sleep disturbances is an additional challenge, since subjective instruments such as sleep diaries or questionnaires may be vulnerable to patient bias, and objective methods like polysomnography or actigraphy need sophisticated resources and include logistical complexities. Regulating extrinsic variables influencing sleep, such pharmaceutical use, psychological stress, and lifestyle practices, is extremely difficult, since they might obscure the outcomes. Furthermore, establishing the ideal intensity, duration, and frequency of aerobic exercise for this particular demographic requires meticulous evaluation to mitigate possible hazards, including symptom worsening or exercise-induced consequences. Recruiting and keeping volunteers throughout the study's length poses challenges owing to the disease's chronic nature and the need for frequent hospital visits. Ensuring sufficient statistical power despite small sample sizes and possible dropout rates is essential for drawing meaningful results. These issues highlight the need for thorough preparation and strong research design.

V. AIMS

To evaluate the effect of aerobic exercise on sleep disturbances in patients with chronic liver disease through an experimental study.

VI. RESEARCH OBJECTIVE

- To assess the effect of aerobic exercise on sleep quality in individuals with chronic liver disease.
- To evaluate the changes in the intensity of sleep disruptions after the implementation of a systematic aerobic exercise program.
- To ascertain the correlation between aerobic exercise and overall physical health in individuals with chronic liver disease.
- To evaluate pre- and post-intervention results using standardized sleep assessment instruments in patients receiving aerobic exercise treatment.

VII. HYPOTHESIS

➢ Null Hypothesis (N0)

- N01: Aerobic exercise does not significantly affect sleep quality in patients with CLD.
- N02: A systematic aerobic exercise program does not significantly alleviate the intensity of sleep disruptions in patients with CLD.
- N03: No substantial correlation exists between aerobic exercise and overall physical well-being in patients with CLD.
- N04: No substantial difference exists in pre- and post-intervention outcomes as assessed by standardized sleep evaluation instruments in patients receiving aerobic exercise treatment.

➢ Alternative Hypothesis (NA)

- NA1: Aerobic exercise significantly improves sleep quality in patients with CLD.
- NA2: A systematic aerobic exercise program markedly alleviates the intensity of sleep disruptions in patients with CLD.
- NA3: Aerobic exercise is favorably correlated with enhancements in overall physical health in patients with CLD.
- NA4: A significant difference is shown between pre- and post-intervention sleep assessment ratings, indicating improved outcomes after aerobic exercise therapy in patients with CLD.

The rationale for the research "Effect of Aerobic Exercise on Sleep Disturbance in Patients with Chronic Liver Disease: An Experimental Study" emanates from the increasing recognition of sleep disturbances as a critical and inadequately addressed concern in individuals with chronic liver disease (CLD). Chronic liver disease, which includes disorders like cirrhosis and hepatitis, often results in problems such as sleep disruptions, adversely affecting the patient's overall health and quality of life. These disruptions are associated with heightened morbidity, tiredness, and cognitive impairment, adversely impacting both physical and psychological health. Although a connection between liver illness and sleep disruption is recognized, the impact of physical activity, especially aerobic exercise, in alleviating sleep difficulties in this patient demographic is little investigated. Aerobic exercise has demonstrated positive effects on sleep quality and duration in healthy individuals, and it is proposed to enhance circadian rhythms, diminish anxiety, and foster relaxation—all of which may contribute to mitigating sleep disturbances. Furthermore,

improvements in cardiovascular health, hepatic function, and metabolic equilibrium resulting from exercise may also facilitate improved sleep quality. This research seeks to investigate the precise effects of aerobic exercise on sleep patterns in individuals with chronic liver disease, assessing how consistent physical activity may function as a non-pharmacological intervention for sleep disruptions in this at-risk population. The study aims to establish a definitive, evidence-based link between aerobic exercise and sleep quality through an experimental design, thereby aiding in the formulation of more effective, comprehensive treatment strategies that incorporate lifestyle modifications for the management of chronic liver disease and enhancement of patients' quality of life.

VIII. METHODOLOGY

The research used a "randomised controlled trial (RCT) design" to assess the impact of aerobic exercise on sleep disturbances in individuals with chronic liver disease (CLD). Participants randomly allocated to either an intervention group (aerobic exercise program) or a control group (standard care without organised exercise).

The study was conducted at a tertiary care hospital or liver clinic. A total of 60 participants enrolled, with 30 participants in each group. Sample size estimation is based on a power analysis to detect a significant difference in sleep quality scores between the groups.

8.1 PARTICIPANT'S CRITERIA

- Inclusion
  - Adults aged 30–65 years diagnosed with chronic liver disease (e.g., cirrhosis or hepatitis).
  - Self-reported or clinically diagnosed sleep disturbances.
  - Ability to participate in moderate aerobic exercise.
- Exclusion criteria
  - Patients with advanced hepatic encephalopathy or severe comorbidities.
  - Use of medications specifically targeting sleep disturbances during the study.

8.2 Ethical consideration

Both the institutional ethics committee and the research protocol authorized. Every participant's written informed permission sought. Any negative outcomes from the workouts tracked and dealt with right away.

8.3 Sample Collection

The intervention group participate in a structured aerobic exercise program, conducted "3 times per week for 12 weeks". Sessions include 30–45 minutes of moderate-intensity aerobic activities (e.g., walking, cycling, or treadmill exercise) under supervision. Intensity monitored using heart rate and perceived exertion scales. The control group receive standard medical care without structured exercise. Data collected through questionnaires, clinical assessments, and laboratory tests. Patients recruited from liver clinics and gastroenterology outpatient departments. Written informed consent obtained before enrollment. Participants complete demographic and clinical questionnaires. Baseline PSQI, ESS, and FSS scores recorded. Liver function tests and anthropometric data collected.

8.4 Data Analysis

The intervention group attend supervised aerobic exercise sessions, with adherence monitored through attendance logs and heart rate tracking. Regular activities and medical attention provided to the control group. The primary outcome sleep quality as determined by the "Pittsburgh Sleep Quality Index (PSQI)". Changes in liver function tests, the Fatigue Severity Scale, and the SF-36 questionnaire's measure of quality of life are examples of secondary outcomes. Assessments conducted at baseline, six, and twelve weeks. After 12 weeks, the PSQI, ESS, and FSS were reassessed in both groups. Changes in sleep quality and other outcomes compared between groups. The intervention group participate in a supervised aerobic exercise program involving brisk walking or cycling for 30 minutes per session, five times per week, at a moderate intensity (50–70% of maximum heart rate) over a duration of 12 weeks. In contrast, the control group receives usual care, which includes standard medical advice without any additional physical activity interventions.

Schedule for Aerobic Exercise				
Exercise Module	Week	Duration	Frequency	Intensity
	1- 2	30 minutes	Five days per week	

Stretching, Walking, Brisk Walking, Jogging and Rhythmic	3 - 4	45 minutes	Five days per week	Low to Moderate (Progressive)
	5 - 12	60 minutes or more	Five days per week	

The primary outcome sleep quality measured using the "Pittsburgh Sleep Quality Index (PSQI)". Secondary outcomes include assessments of "sleep latency, duration, and efficiency; daytime sleepiness, evaluated using the Epworth Sleepiness Scale (ESS); and fatigue levels, measured with the Fatigue Severity Scale (FSS)" [21].

Outcome	Tool/Questionnaire	Parameters Assessed	Scoring/Details
Primary Outcome	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality, Sleep duration, delay in sleep	Scores for the 19 items range from 0 to 21. Poorer sleep quality is indicated by higher scores.
Secondary Outcomes			
Daytime sleepiness	Epworth Sleepiness Scale (ESS)	Tendency to fall asleep in various situations	Scores for the 8 items range from 0 to 24. Higher scores indicate more daytime sleepiness.
Weariness/Fatigue	Fatigue Severity Scale (FSS)	Impact of fatigue on daily functioning	Nine items, with scores ranging from 9 to 63. Elevated scores indicate increased intensity of fatigue.

Descriptive statistics include demographic and clinical data. Paired t-tests tests assess pre- and post-intervention scores within groups. Independent t-tests assess group differences. A p-value below 0.05 is considered statistically significant.

IX. CONCLUSION

It is hypothesized that aerobic exercise significantly improves sleep quality and reduces sleep disturbances in patients with CLD, offering a non-pharmacological approach to managing this condition. This research aims to provide evidence for incorporating aerobic exercise into holistic management strategies for patients with chronic liver disease.

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