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Assessment of Post-Liver Transplant Physical Fitness and Functional Performance

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ABSTRACT

Liver transplantation is a critical treatment option for individuals with end-stage liver disease and select hepatic malignancies. Although successful in restoring liver function, patients often face challenges in recovering physical fitness and functional performance levels after transplantation due to factors such as pre-transplant deconditioning, postoperative complications, and long-term immunosuppressive therapy. This study aimed to assess the physical fitness and functional performance of liver transplant patients compared to sedentary individuals to inform effective rehabilitation programs. A correlational study was conducted with 30 liver transplant patients and 30 age- and gender-matched sedentary individuals. Physical fitness was assessed through body dimensions (waist-hip ratio), aerobic capacity (six-minute walk test), flexibility (sit and reach test), and muscle strength (hand dynamometer). Functional performance was evaluated using the timed supine-to-stand and squat tests. Statistical analysis revealed that while the waist-hip ratio showed no significant difference ($p = 0.207$), liver transplant patients exhibited significantly lower performance in flexibility (41% reduction, $p = 0.00$), grip strength (25% reduction, $p = 0.00$), aerobic capacity (40% reduction, $p = 0.00$), squat test (49% reduction, $p = 0.00$), and timed supine to stand test (71% reduction, $p = 0.00$) compared to sedentary individuals. These findings underscore the need for tailored rehabilitation programs to enhance recovery and improve quality of life post-transplantation.

Keywords: Liver transplantation, physical fitness, functional performance

INTRODUCTION;

Liver transplantation is a vital therapeutic option for patients suffering from end-stage liver disease and certain hepatic malignancies. While the procedure itself is often successful in restoring liver function, patients frequently encounter significant challenges in regaining their pre-disease levels of physical fitness and functional performance post-transplantation. These challenges arise due to a combination of factors, including pre-transplant deconditioning, postoperative complications, and the long-term effects of immunosuppressive therapy 1.

Assessing physical fitness and functional performance after liver transplantation is crucial for developing effective rehabilitation programs and improving patient outcomes. Physical fitness encompasses several key components: cardiorespiratory endurance, muscular strength, flexibility, and balance, all of which can be adversely affected by both the underlying liver disease and the transplantation process 2. Functional performance refers to the ability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs), which are essential for maintaining independence 3.

Studies have demonstrated that targeted interventions can significantly enhance physical fitness and functional performance, leading to improved quality of life and reduced morbidity 4. A comprehensive assessment enables healthcare providers to tailor rehabilitation programs to meet individual patient needs, facilitating optimal recovery. This assessment also aids in monitoring recovery progress and identifying any limitations or complications that may require further medical attention 5.

The benefits of structured rehabilitation programs post-liver transplantation have been well documented. Early and continuous physical activity has been shown to improve cardiovascular fitness, muscle strength, and overall functional capacity 6. Furthermore, patients who engage in regular physical exercise tend to experience a lower incidence of post-operative complications and a faster return to normal activities 7.

MATERIAL AND METHODS;

Study Design and Setting

The study was conducted at Rajendra institute of medical sciences, Bariatu Ranchi Jharkhand, from Jan 2019 to Jan 2020, after receiving ethical clearance from the Institutional Review Board of Rajendra institute of medical sciences; Bariatu

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Ranchi Jharkhand, and A correlational study design was employed to evaluate the physical fitness and functional performance of liver transplant patients compared to sedentary individuals.

Participants

A total of 60 participants were recruited for the study. This included 30 liver transplant patients and 30 sedentary individuals. Participants were matched for age and gender and informed written consent was obtained from all individuals before participation.

- **Inclusion Criteria:**
  - Liver transplant patients aged 18 and above, who were more than one month post-transplant (31 days or more).
  - Sedentary individuals aged 18 and above.
- **Exclusion Criteria:**
  - Liver transplant patients with a history of chronic illness, cardiovascular disease, kidney disease, or those who have undergone multiple organ transplants.
  - Sedentary individuals engaging in physical activity more than two times a week or with a history of cardiovascular disease, kidney disease, or musculoskeletal disorders.

Data Collection

Data collection involved evaluating each participant using a series of physical fitness and functional performance tests. These assessments were conducted over 20 to 30 minutes per individual at five designated stations.

1. **Physical Fitness Tests:**
   - **Body Dimensions:** Measured using the Waist-Hip Ratio (WHR) to assess body composition.
   - **Aerobic Capacity:** Assessed using the Six-Minute Walk Test (6MWT) to measure cardiovascular endurance.
   - **Flexibility:** Evaluated using the Sit and Reach Test to measure hamstring flexibility.
   - **Muscle Strength:** Measured using a Hand Dynamometer to assess grip strength.
2. **Functional Performance Tests:**
   - **Supine to Stand Test:** Time taken for a participant to rise from a supine position to standing was recorded.
   - **Timed Squat Test:** Duration for which a participant could maintain a squat position was measured.

Procedure

Each participant was guided through the assessments sequentially at each of the five stations. The assessments were standardized to ensure consistency and accuracy. All data were recorded for subsequent analysis to compare physical fitness and functional performance between liver transplant patients and sedentary individuals.

Statistical Analysis;

After evaluating and compiling the data from both groups—liver transplant patients and sedentary individuals—the comparison between these groups was conducted using SPSS software version 21.

An unpaired t-test was administered to compare the means of the two groups across several measures: body composition (measured by waist-hip ratio), hand grip strength, hamstring flexibility, aerobic capacity (measured by the six-minute walk test), time taken to transition from supine to standing, and the timed squat test.

The level of significance for all statistical tests was set at 0.05.

Table no. 1 The demographic details of the participants of both groups

Profile	Liver Transplant	Patients Sedentary	Individuals Total
Gender			
Male	28	26	54
Female	2	4	6
Age Group			
18-40	4	3	7
41-60	25	26	51
61-80	1	1	2

This table organizes the demographic information, making it easy to compare the composition of both groups in terms of gender and age distribution.

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Table no. 2 The mean+ S.D. of physical fitness and functional performance

S. no.	Indicators	Liver Transplant Patients		Sedentary Individuals	
		Mean	S.D	Mean	S.D
Physical Fitness Indicators					
1	Waist-Hip Ratio	1.015	0.083	0.994	0.035
2	BMI	24.913	4.907	29.993	4.709
3	Sit and Reach Test (cm)	13.500	6.219	23.033	8.904
4	Right-Hand Grip Strength (kg)	20.100	4.278	26.900	5.486
5	Left-Hand Grip Strength (kg)	18.900	3.968	25.700	5.408
6	Six-Minute Walk Test (m)	224.867	90.635	466.233	68.210
7	VO2Max (L/min/kg)	10.726	2.719	17.857	2.151
Functional Performance Indicators					
8	Squat Test	14.933	4.540	29.267	5.988
9	Timed Supine to Stand Test (seconds)	7.849	3.789	2.607	1.132

This table displays the mean and standard deviation (S.D.) for each physical fitness and functional performance indicator, making comparing the results between liver transplant patients and sedentary individuals easy.

Data was recorded, and the means were compared using an unpaired t-test with a significance level of $p < 0.05$, comparing liver transplant patients to sedentary individuals after one month of transplantation. The analysis showed that the difference in waist-hip ratio between the two groups was only 2%, with a p-value of 0.207.

In contrast, liver transplant patients showed significantly lower performance than sedentary individuals in several areas: flexibility was reduced by 41% ($p = 0.00$), grip strength by 25% ($p = 0.00$), aerobic capacity by 40% ($p = 0.00$), squat test performance by 49% ($p = 0.00$), and timed supine to stand test performance by 71% ($p = 0.00$).

DISCUSSION

This study aimed to assess the physical fitness and functional performance of liver transplant patients compared to sedentary individuals. The results highlight significant differences in several physical fitness and functional performance indicators between the two groups, which have important implications for post-transplant rehabilitation strategies.

Physical Fitness Indicators

The analysis showed no significant difference in the waist-hip ratio between liver transplant patients and sedentary individuals ($p = 0.207$). This suggests that, although there are differences in other fitness indicators, body composition, as measured by the waist-hip ratio, may not be as severely impacted in the early post-transplant period.

However, liver transplant patients exhibited significantly lower performance in flexibility, grip strength, aerobic capacity, and endurance. Flexibility was reduced by 41% ($p = 0.00$), grip strength by 25% ($p = 0.00$), aerobic capacity by 40% ($p = 0.00$), and endurance (measured by the timed squat test) by 49% ($p = 0.00$). These findings align with previous research, which indicates that liver transplant patients often experience declines in muscle strength, flexibility, and aerobic capacity due to factors like reduced physical activity and prolonged recovery from surgery [1][2].

The reduced aerobic capacity and muscle strength observed in liver transplant patients can be attributed to several factors including prolonged bed rest and decreased physical activity levels during the recovery phase. The impact of immunosuppressive medications on muscle mass and strength also contributes to these reductions [3]. Similar findings

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have been documented in other studies, which reported diminished physical fitness and functional performance in liver transplant recipients compared to healthy controls [4][5].

Functional Performance Indicators

Functional performance measures, including the timed supine-to-stand test, demonstrated even more pronounced differences. Liver transplant patients had a 71% reduction in performance on this test ($p = 0.00$), highlighting significant challenges in regaining functional mobility and independence post-transplant. This reduction in functional performance is consistent with findings that liver transplant patients often experience reduced functional capacity and slower recovery of daily living skills [6][7].

The observed reductions in functional performance can be partially explained by the physical deconditioning that occurs during the pre-and post-transplant periods. The physical limitations imposed by the transplant procedure, coupled with postoperative complications and ongoing immunosuppressive therapy, contribute to difficulties in regaining functional performance [8][9]. Studies have also shown that tailored rehabilitation programs focusing on improving strength, flexibility, and aerobic capacity can help address these issues and improve overall functional outcomes [10][11].

Implications for Rehabilitation

The findings underscore the need for targeted rehabilitation programs that address the specific deficits observed in liver transplant patients. Incorporating exercises designed to improve flexibility, strength, and aerobic capacity can significantly enhance recovery and quality of life for these patients. Structured rehabilitation programs have been shown to reduce postoperative complications and accelerate the return to normal activities [12][13].

Conclusion

In summary, while liver transplantation successfully restores liver function, patients often face significant challenges in regaining physical fitness and functional performance. The significant differences observed in flexibility, grip strength, aerobic capacity, and functional performance between liver transplant patients and sedentary individuals highlight the need for comprehensive rehabilitation strategies. Future research should continue to explore effective rehabilitation interventions to support optimal recovery and improve long-term outcomes for liver transplant recipients.

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