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Effect of Leg Strength Exercises on Fatigue Level in Patients Undergoing Hemodialysis: A Clinical Trial

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ABSTRACT

Background: Hemodialysis serves as a main treatment method for these patients. It results in several complications like fatigue and decreased activities of daily living. Legs strength exercises are an effective method to minimize fatigue and for improving activities of daily living. **Method:** A purposive (non-probability) sample consists of 137 patients selected from patients with CKD who are undergoing HD and were treated at Imam Al-Hussein in Habib Ibn Mudaher center and hemodialysis wards of Imam Al-Hassan Al-Mujtaba Teaching Hospital in Holy Kerbala. The data were collected through interview using two scales that are socio-demographic and clinical data Questionnaire and Functional Assessment of Chronic Illness Therapy (FACIT) Fatigue Scale (Version 4) and The data were analyzed and interpreted using of the application of Statistical Package for Social Sciences (SPSS) version 26.0. **Result:** the study group showed a significant reduction in fatigue, with mean scores dropping from 39.60 (SD = 6.702) pre-test to 3.33 (SD = 2.832) post-test, Conversely, the control group's showed no improvement, with the mean fatigue score increasing slightly from 40.95 (SD = 4.386) in the pre-test to 41.84 (SD = 3.031) in the post-test. **Conclusion:** legs strength exercises were beneficial in decreasing fatigue level in patients undergoing hemodialysis.

Keywords: Leg Strengrth Exercises, Hemodialysis, Fatigue

Introduction

End stage renal disease is an irreversible and progressive reduction in kidney function in which

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the body's ability to mentain metabolic, electrolyte, and fluid balance diminishes, leading to azotemia or uremia [1]. Finally, the glomerular filtration rate became less than 60 ml/min/1.73 m2 [2]. Chronic kidney disease (CKD) is a worldwide medical concern as it not only deteriorations the quality of life but acts as a burden on the healthcare system because of its expenses [3]. Hemodialysis is a long-term therapy providing to patients suffering from end-stage chronic kidney failure [4]. Patients face challenges in role alterations, life involvement, and performance activities of daily living (ADLs), which are important skills like eating, bathing, and mobility crucial for self-care and independence [5]. HD sessions for patients with CKD must be two to three times a week, lasting three to four hours each. Consequently, their level of physical activity (PA) and physical tolerance are 35% lesser than those of healthy persons. The majority of patients approximately 47.4% have little time for exercise besides have grown sedentary instead [6]. PA are movements of the body caused by skeletal muscle contraction that raises energy expenditure over baseline level [7][8]. Fatigue is common in patient undergoing hemodialysis, with a prevalence proportion ranging from 60-97% [9][10]. Also, higher levels of fatigue are frequently connected with sleep quality, depression, anxiety and poor quality of life, potentially raising the risks of initial hospitalization and mortality among patients undergoing HD [11]. Moreover, it is important to evaluate and monitor the level of PA of all patients receiving HD, particularly on the day of treatment, because they typically experince a variety of difficulties connected with their sedentary lifestyles. To avoid complications from HD and live a healthy and well-being life, patients should improve their daily activities and self-care habits [12]. Little levels of physical activity (PA) are common in patients with renal failure receiving chronic hemodialysis treatment. Hence, this is linked to significantly higher rates of morbidity and mortality [13]. Thus, increasing physical activities through regular exercises might be a key method for enhancing outcomes for HD patients [14]. Therefore, all adults should engage in regular physical activities, and the research support the idea that any physical activity is better than none at all. The adult guidelines encompass strong recommendations for weekly quantities of aerobic and muscles strengthening physical exercises that are supported by general moderate certainty evidence [15].

Objective of the study

1. To assess level of fatigue in patients undergoing hemodialysis.
2. To investigate the effect of legs strength exercises on fatigue level in patients undergoing hemodialysis.

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Methodology

The study was carried out on 137 patients undergoing hemodialysis from (December 21th, 2024, and February 20th, 2025). The G*power calculator was employed to determine the sample size for multiple regression by computing the overall number of participants [16]. The study was performed at Imam Al-Hussein Habib Ibn-Mudaher Al-Asadi Center and hemodialysis wards of Imam Al-Hassan Al-Mujtaba hospital in Holy Kerbala. A total of 90 samples were chosen through purposive sampling technique, including 45 samples for both control and experimental groups that met specified criteria.

The selection criteria were designed as follow: inclusion criteria (patient have stable cardiac profiles, patients who are regular for HD sessions, and patients age from 18 to 60 year old) and exclusion criteria (patients who having femoral access to HD and patients have physical disability and orthopedic problems). The researcher uses an instruments consist two parts socio-demographic characteristic and clinical data and Functional Assessment of Chronic Illness Therapy (FACIT) Fatigue Scale (Version 4) to measure the problem statement include:PartI: Socio-demographic characteristic and clinical data: It is concerned with participants socio-demographic and clinical data that include (age, sex, educational level, occupational status, duration of dialysis therapy, number of weekly sessions, preexisting chronic illnesses, and medications of chronic illnesses). Part II: Functional Assessment of Chronic Illness Therapy (FACIT) Fatigue Scale (Version 4): Arabic version was used and translation was done by [17]. The scale consist of (13) items, each items address aspects of fatigue. Moreover, responses are given 5-point on a Likert scale: 0 = Not at all. 1 = A little bit, 2 = Somewhat, 3= Quite a bit, and 4= Very much. Except items seven and eight which are reversed score. A score range from 0 to 52 with a score of less than 30 indicate sever fatigue. Also, the greater scores indicate a higher the quality of life.

The intervention was carried out after the researcher reviewed related references and previous studies [18][19][20]. The intervention aimed to reduced fatigue level among patients undergoing HD, by utilizing a mini bicycle. Informed written and verbal consent was obtained from each sample involved in the study. on day zero, participants' socio-demographic data, clinical data, and fatigue level were assessed as a pretest before begining the intradialytic leg strength exercises. The intervention began for the intervention group on the first day of the 4th week. The exercises last for 25 minutes, allocated as follows: patients' feet are positioned on pedals and rotated in cycles as though riding a bike for

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about 10 minutes and take 5 minutes rest, then another 10 minutes began on pedals and rotated in cycles as though riding a bike. This occurs during the first 2 hours of HD for the 4th week of each session. Post-test evaluations were obtained after completion of exercises program. The data were analyzed and interpreted through use of the application of Statistical Package for Social Sciences (SPSS), version 26.0.

The results

Table (1) presents a descriptive analysis of patients undergoing hemodialysis; the findings reveal that average age in the intervention group was 41.7±11.5 years, while in the control group it was 43±11.6 years. The highest percentage of age group seen with age group "30 – 39 year" among 32.5% in the experimental group while in control group seen with age group of "30-39 years" and "40-49 years" with percentage of 25.6% for each age group. The variance test shows no significant difference based on age between study and control groups (Λ= .124, P= .726).The sex of patients refers to males in the intervention group (82.5%), and females in the control group (51.2%). The variance test shows high significant difference based on sex between study and control groups (Λ= 30.550, P= .001.(The marital status indicates that more of patients are married in study group 75% and control group 69.85. The variance test illustrations no significant difference based on marital status between study and control groups (Λ= .190, P= .664). The level of education reveals that highest percentage seen with "primary school graduate" among patients in the study group (37.5%) and control group (34.9%). The variance test shows no significant difference based on level of education between study and control groups (Λ= .685, P= .410). The occupational status displays that 25% of participants in the experimental group are jobless, while 20% are employees and 20% are housewives. In the control group, more than half of patients are housewives (55.8%). The variance test shows no significant difference based on occupation between study and control groups (Λ= 3.405, P= .069).

Table 1: Distribution of Patients according to their Socio-demographic Characteristics

No.	Characteristics	Study group		Control group		Variance test
		f	%	f	%	
1	**Age (year)** > 20	1	2.5	1	2.3	Λ= .124

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		20 – 29	4	10	5	11.6	P= .726 Sig= N.S
		30 – 39	13	32.5	11	25.6	
		40 – 49	11	27.5	11	25.6	
		50 – 59	7	17.5	12	27.9	
		60 +	4	10	3	7	
		Total	***40***	***100***	***43***	***100***	
		M ± SD	***41.7 ± 11.5***		***43 ± 11.6***		
2	**Sex**	Male	33	82.5	21	48.8	Λ= 30.550 P= .001 **Sig= H.S**
		Female	7	17.5	22	51.2	
		Total	***40***	***100***	***43***	***100***	
3	**Marital status**	Unmarried	7	17.5	6	14	Λ= .190 P= .664 Sig= N.S
		Married	30	75	30	69.8	
		Widowed/er	0	0	5	11.6	
		Divorced	3	7.5	2	4.7	
		Total	***40***	***100***	***43***	***100***	
4	**Level of education**	Doesn't read and write	4	10	15	34.9	Λ= .685 P= .410 Sig= N.S
		Read and write	2	5	4	9.3	
		Primary	15	37.5	15	34.9	
		Intermediate	11	27.5	6	14	
		Secondary	6	15	2	4.7	
		Diploma	1	2.5	0	0	
		Bachelor +	1	2.5	1	2.3	
		Total	***40***	***100***	***43***	***100***	
5	**Occupation**	Jobless	10	25	6	14	Λ= 3.405 P= .069 Sig= N.S
		Worker	7	17.5	0	0	
		Farmer	0	0	0	0	
		Employee	8	20	11	25.5	
		Retired	6	15	2	4.7	
		Housewife	8	20	24	55.8	
		Student	1	2.5	0	0	
		Total	***40***	***100***	***43***	***100***	

No: Number, f: Frequency, %: Percentage, Λ= Levene's Test, P: Probability value, Sig: Significance, N.S: Not significant, S: Significant, H.S: High significant

Table 2: Distribution of Patients according to their clinical data

No.	Characteristic	Study group	Control group	Variance test

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			f	%	f	%	
1	**Hemodialysis duration (Years)**	> 1	8	20	5	11.6	Λ= .206 P= .651 Sig= N.S
		1 – 3	12	30	17	39.5	
		4 – 6	13	32.5	12	27.9	
		< 6	7	17.5	9	20.9	
		Total	***40***	***100***	***43***	***100***	
2	**Number of hemodialysis per week**	2	12	30	19	44.2	Λ= 6.053 P= .186 Sig= N.S
		3	28	70	24	55.8	
		Total	***40***	***100***	***43***	***100***	
3	**preexisting chronic diseases**	No	10	25	13	30.2	Λ= .452 P= .504 Sig= N.S
		Yes	30	75	30	69.8	
		Total	***40***	***100***	***43***	***100***	
4	**Medication of chronic diseases**	None	10	25	12	27.9	Λ= 3.308 P= .073 Sig= N.S
		Amlodipine	20	50	14	32.6	
		Amlodipine + Carvedilol	2	5	0	0	
		Amlodipine + Insulin	3	7.5	11	25.6	
		Insulin + Warfarin	1	2.5	0	0	
		Bisoprolol	1	2.5	2	4.7	
		Bisoprolol + Kadomet	1	2.5	0	0	
		Amlodipine + Insulin + Isosorbide	1	2.5	0	0	
		Carvedilol + Nifedepine	1	2.5	0	0	
		Insulin	0	0	3	7	
		Amlodipine + Januvia	0	0	1	2.3	
		Total	***40***	***100***	***43***	***100***	

No: Number, f: Frequency, %: Percentage, Λ= Levene's Test, P: Probability value, Sig: Significance, N.S: Not significant, S: Significant, H.S: High significant

Table (2) displays the clinical characteristics of patients; the findings indicate that 32.5% of patients in the study group undergone hemodialysis for "4-6 years" while in the control group, 39.5% have period of "1-3 years". The variance test shows no significant difference based on hemodialysis duration between study and control groups (Λ= .206, P= .651).The number of session refers to 3 sessions among 70% of patients in the study group and 50% in the control group. The variance test shows no significant difference based on number of session between study and control groups (Λ= 6.053, P= .186). Regarding comorbid diseases, 75% of participants in the study group and 69.8% in control group reported history of comorbid diseases. The variance test shows no significant difference

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based on comorbid diseases between study and control groups (Λ= .452, P= .504). The medications of chronic diseases are varies in both group; the highly frequent reported medication is "Amlodipine" in both group; study (50%) and control (32.6%).

Table 3: Overall assessment of fatigue among patients in the experimental and control groups

Fatigue	Experimental Group								Control Group							
	Pre-test				Post-test				Pre-test				Post-test			
	f	%	M	SD	f	%	M	SD	f	%	M	SD	f	%	M	SD
Mild	1	2.5	39.60	6.702	40	100	3.33	2.832	0	0	40.95	4.386	0	0	41.84	3.031
Moderate	4	10			0	0			4	9.3			0	0		
Severe	35	87.5			0	0			39	90.7			43	100		
Total	***40***	***100***			***40***	***100***			***43***	***100***			***43***	***100***		

f: Frequency, %: Percentage, M: Mean of total score, SD Standard deviation
Mild= 0 – 17.33, Moderate= 17.34 – 34.66, Severe= 34.67 – 52

Table (3) highlights a significant reduction in fatigue in the intervention group, where the mean score dropped from 39.60 (SD = 6.702) in the pre-test to 3.33 (SD = 2.832) in the post-test, with 100% of patients reporting only mild fatigue after the intervention. In dissimilarity, the control group exhibited no improvement, with the mean fatigue score increasing slightly from 40.95 (SD = 4.386) in the pre-test to 41.84 (SD = 3.031) in the post-test, and 100% of patients continuing to experience severe fatigue. These results underscore the effectiveness of the intervention in significantly alleviating fatigue among hemodialysis patients.

Table 4: Significant Differences in Fatigue Score for Patients in the Study Group (Leg Exercise Intervention) and Control Group (Without Intervention)

Fatigue	Study Group (N=40)						Control Group (N=43)					
	M.	SD	Mean Rank	Z	p-value	Sig.	M.	SD	Mean Rank	Z	p-value	Sig.
Pre-test	39.60	6.702	20.50	-5.516	.001	**H.S**	40.95	4.386	.00	-5.727	.070	**N.S**
Post-test	3.32	2.832	.00				41.84	3.031	22.00			

M: Mean, SD: Standard Deviation, Z: Z-score (Wilcoxon Signed Rank), p: Probability, Sig.: Significance, HS: High Significant, N.S: Not Significant

Table (4) presents significant differences in fatigue scores for patients in the study group (leg

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exercise intervention) and the control group (without intervention). For the pre-test, the study group had a mean score of 39.60 (SD = 6.702), with a mean rank of 20.50, resulting in a Z-value of -5.516 and a p-value of .001, indicating a highly significant difference. In contrast, the control group had a pre-test mean score of 40.95 (SD = 4.386), with a mean rank of 22.00, yielding a Z-value of -5.727 and a p-value of .070, which is not statistically significant. For the post-test, the study group showed a significant reduction in fatigue, with a mean score of 3.32 (SD = 2.832), while the control group exhibited a post-test mean score of 41.84 (SD = 3.031), demonstrating the effectiveness of the leg exercise intervention in reducing fatigue among patients.

Discussion

The findings revealed that the average age in the study group 41.7±11.5 year and in the control group refers to 43±11.6. This findings align with explanatory randomized control study design, a sample of 114 adult with mean of age 48.58 ± 10.427 for the study group, and 48.75±7.742 for the control group [(21)]. Regarding sex, a higher proportion of males notes in the study group (82.5%) compared to the control group, where females consisted (51.2%). This difference was statistically significant. The researcher opinion is the higher percentage of males could be linked to gender based differences in healthcare access and disease progression patterns, where men may experience faster deterioration of kidney function observed almost worldwide [(22)]. This finding consistent with a quasi-experimental study was using convenient sampling along with randomization of days, conducted at a tertiary care hospital, New Delhi, India. Who reported that male 81% and female 19% [(23)]. Similarty, Elsayed, et al., [(24)] who revealed that results of the study males constituted two thirds of the studied subjects. As for marital status, indicates that more of patients are married in both groups study 75% and control group 69.85%. These findings are supported by a cross-sectional study consisted from 135 patients undergoing dialysis. who reported that majority of participants were married 69.62% [(25)]. The current study is backed by Albadr, et al., [(26)] who utilized in this study pre-posttest. It was found that majority of patients were married. In terms of education level, the highest percentage in both groups primary school graduate (37.5% in the intervention group and 34.9% in control group). This finding align with previous study who noted that a majority (56.96%) of patients receiving dialysis having primary education [(25)]. The occupational status illustrations that 25% of patients in the study group are unemployed, while 20% are employees and 20% are housewives. These findings are in agreement with previous research who stated that largest proportion of participants, 62.5%, were

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unemployed among patients receiving HD [5]. Likeness, Albadr et al., [26] who mentioned in the study as concerns occupation of the participants that two-third of the patients did not work. In the control group, more than half of patients are housewives (55.8%). This findings consistent with the previous study conducted at the Aswan University Hospital's dialysis unit. Who that more than one-third of participants were housewives whereas only 18% of the respondents were working [27].

The clinical characteristics of respondents in the table (2) shown. The findings indicate that 32.5% of patients in the study group undergoing HD for 4-6 years. This finding are supported by previous study conducted a quasi-experimental design that included 50 elderly patients, that reported more than two-fifths of their elderly participants had been on HD for over four years [28]. Whereas 39.5% of respondents in the control group had a dialysis history of 1-3 years. This finding align with the study conducted in Turkey at two dialysis centers, this study was a cross sectional descriptive carried out on 126 participants. Who stated that 41.3% of their participants had CKD disease for 2 to 5 years [29]. Regarding the number of HD sessions per week, 70% of the intervention group and 50% of the control group had three sessions weekly. This finding support with the study conducted in three state hospitals universe involved of 113 participants who received dialysis. Who stated that most respondents 90.7% received dialysis 3 times a week [30]. Likeness, the previous study who showed that practically all patients undergoing dialysis three times weekly [31]. Regarding preexisting chronic diseases, 75% of the study group and 69.8% of the control group reported history of preexisting chronic diseases. This result consistent with previous study who identified 67.09% hypertension and 27.75% diabetes as the most comorbidity among patients undergoing dialysis [25]. Similarity, the study conducted in Taiwan in total 120 participants, 49.2% had comorbidities that were common [6]. The study conducted in Turkey at two dialysis centers, to evaluated the symptoms occurring in patients receiving HD and the effects of the symptoms on activities of daily living. This a cross-sectional descriptive study performed on 126 participants. The participants had chronic diseases 86.5% of the (Diabetes, hypertension, heart failure, COPD, coronary artery disease and others) other than CKD [29]. Concerning the medications of chronic diseases, Amlodipine was the most frequently reported drug among both groups 50%. This finding is corroborated by a cross-sectional study, the conducted in CKD patients attending the nephrology outpatient department. The study registered 300 (150 dialysis and 150 nondialysis) adult patients with CKD. Who noted that antihypertensive medications, particularly Amlodipine, were the most commonly prescribed drugs among patients

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with CKD [32]. Likeness, the previous study who further emphasized the role of Amlodipine in improving dialysis efficiency and cardiovascular outcomes [33].

The study group showed a significant decrease in fatigue among patients, with the mean score dropped from 39.60 (SD = 6.702) in the pre-test to 3.33 (SD = 2.832) in the post-test, with 100% of patients reporting only mild fatigue after the intervention. In dissimilarity, the control group presented no improvement, with the mean fatigue score increasing slightly from 40.95 (SD = 4.386) in the pre-test to 41.84 (SD = 3.031) in the post-test, and 100% of patients continuing to experience severe fatigue. This finding consistent with the study, who reported the mean fatigue index in resistance and aerobic exercise groups was significantly lower than the control group ($p = 0.001$). These data suggested that exercise training can be an effective non-pharmacological technique for reducing fatigue in individuals receiving HD [34]. Similarity, the study conducted at tertiary care hospitals used a quasi-experimental design and selected 58 respondents The study result revealed that the the intervention group a lower mean post test of fatigue score (26.86±8.228) compared to control group (32.40±8.726). The differences was statistically significant at the $p<0.05$ level [18]. A quasi-experimental study was conducted at a tertiary care hospital, New Delhi, India, using convenient sampling along with randomization of days. An experimental study of 64 CKD patients The study found that statistically significant difference between the mean fatigue score of control and study group ($P = 0.001$). The mean fatigue scores of control group decreased from 20.40 ± 5.7 to 19.18 ± 5.01 while that of the experimental group decreased from 18.09 ± 9.9 to 13.09 ± 4.86 which was also statistically significant ($P = 0.02$, $P = 0.001$) [23].

The study presents significant differences in fatigue scores for patients in the study group (leg exercise intervention) and the control group (without intervention). For the pre-test, the study group had a mean score of 39.60 (SD = 6.702), with a mean rank of 20.50, resulting in a Z-value of -5.516 and a p-value of .001, indicating a highly significant difference. In contrast, the control group had a pre-test mean score of 40.95 (SD = 4.386), with a mean rank of 22.00, yielding a Z-value of -5.727 and a p-value of .070, which is not statistically significant. For the post-test, the study group showed a significant reduction in fatigue, with a mean score of 3.32 (SD = 2.832), while the control group exhibited a post-test mean score of 41.84 (SD = 3.031), demonstrating the effectiveness of the leg exercise intervention in reducing fatigue among patients. This finding agree with the study conducted at Erode, quasi experimental non-equivalent pre-test and post-test control group design. Purposive

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sampling technique was used to choice 60 sample. The study results revealed that performing intradialytic leg exercises was beneficial and there was significant decrease in pain, fatigue and improvement in the quality of life among patients undergoing hemodialysis in study group [20]. This finding supported by the study was a randomized controlled clinical trial, the participants in the intervention group exercised on mini-bikes for 20 min twice a week for 3 months. The experimental group experienced significantly lower total fatigue scores than the control group in the third month ($P = 0.001$) and one month after the intervention ($P < 0.001$) [35].

Conclusion: legs strength exercises can be used effectively as a non-invasive non-pharmacological intervention for 25 minutes each sessions for 4th weeks to reduce fatigue level in patients receiving hemodialysis.

Recommendations:

1. Nurses and healthcare personnel working with patients undergoing hemodialysis require obtain specialized training to plan, implement, and monitor safe and effective intradialytic exercises programs.
2. Create strategies to improve patient adherence to exercise programs, such as motivational counseling, peer support groups, and integrating exercises into dialysis sessions to boost engagement.
3. A basic booklet with guidelines for legs strength exercises programs should be available in all units to be distributed to newly admitted patients receiving hemodialysis.

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