The Effect of Practicing Leg Ergometric Exercises on Fatigue Level among Patients Undergoing Haemodialysis

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Abstract

Background: Ergometric exercises are regarded as a straightforward physical activity that is both safe and beneficial in clinical practice among patients receiving dialysis. Ergometric exercise aids in boosting daily activity levels and reducing levels of fatigue. **This study aimed to** determine the effect of applying leg ergometric exercise on fatigue level among patients undergoing hemodialysis. **Method: Design:** This study used a quasi-experimental research design (study and control group). **Setting**: The study was carried out at the hemodialysis unit at National Medical Institute in Damanhour, El-Behera Governorate, Egypt. **Subjects**: The sample was selected by convenient sampling technique of 100 patients undergoing hemodialysis who were hospitalized in the previously selected settings and were randomly divided into two groups: control and study;50 patients in each group. **Tools:** Two tools were used. Tool I: Patient's Assessment Sheet and Tool II: Modified FACIT (Functional Assessment of Chronic Illness Therapy) were used to collect data. **Results**: There were statistically significant differences between the study and the control groups pre & post-leg exercises implementation($P<0.001$) and a reduction was found in total fatigue severity level among the studied patients in the study group post-leg exercises implementation. **Conclusion**: The present study concluded that leg ergometric exercise was particularly successful at lowering patients' levels of fatigue while they were receiving hemodialysis. Leg ergometric exercise is useful to hemodialysis patients and is considered safe, practical, and effective. **Recommendations**: The study recommended that Leg ergometric exercise programs should be implemented continuously and regularly for hemodialysis patients

Keywords: Fatigue level, Leg Ergometric Exercise, Patients undergoing hemodialysis**.**

Introduction:

Chronic kidney disease (CKD) is one of the main factors contributing to worldwide morbidity and death. With a death toll of 3.16 million, CKD was one of the top ten risks linked with the greatest number of fatalities globally in the 2019 Global Burden of Disease research (Luyckx et al., 2019). According to data from basic health research, the percentage of people with CKD increased by 19.1% between 2013 and 2018 (Kementerian et al., 2018). A wide-ranging and developing medical ailment is CKD (Kementerian et al., 2020). The illness gradually progresses to a life-threatening condition known as end-stage renal disease (ESRD) when kidney function continues to deteriorate. Renal replacement therapy is necessary for ESRD patients to live (Zhang et al., 2020 Elshahat et al., 2020).

The three primary forms of renal replacement therapy are hemodialysis (HD), continuous ambulatory peritoneal dialysis, and kidney transplantation (Rivara & Mehrotra, 2019). HD is the most popular form carried out in Indonesia. Because the kidneys are unable to carry out these tasks, HD is utilized to remove fluids and waste items from the body, such as nitrogen and other harmful compounds (Wright, 2019). HD uses three mechanisms—diffusion, osmosis, and ultrafiltration—to remove impurities from the blood that the body does not require.9 HD is a kidney replacement therapy; it does not treat renal disease. It cannot function better than healthy kidneys after optimization (Evangelidis et al., 2017).

Since diffusion, osmosis, and ultrafiltration procedures are insufficient, patients who have undergone standard HD may still develop symptoms (Raja & Seyoum, 2020). According

to Alvarez et al. (2020), weariness is the most prevalent symptom encountered by HD patients (62%), followed by cramps (44%), and hypotension (42%). According to the data, pain (64%) is the second most common complaint, coming in second place to weariness (87%). Chronic tiredness symptoms have a negative impact on ESRD patients, for example, by lowering productivity, sleep quality, and quality of life (Cervantes et al., 2018).

Patients with ESRD continue to have complex and unidentified physical weariness. However, physical exhaustion is typically accompanied by the body's energy system being disrupted, mitochondrial malfunction, and inadequate physical exercise, which causes muscle atrophy and reduced muscle strength. These symptoms are linked to prolonged bed rest during each phase of HD and a sense of weakness that causes patients to engage in less physical activity, which leads to muscular atrophy (Shemy et al., 2016).

When patients with end-stage renal disease are diagnosed with hemodialysis, weariness is one of their most prevalent and frequent complaints, and its recording is viewed negatively. Ergometric exercise is regarded as a straightforward physical activity that is both safe and beneficial in clinical practice among patients receiving dialysis. Ergometric exercise aids in boosting daily activity levels and reducing levels of fatigue (Maria, 2018).

In patients receiving HD, interventions are required to lessen tiredness, enhance energy metabolism, lessen the severity of protracted bed rest, and reduce muscular atrophy. It is advised to exercise to reduce weariness. Studies on how intradialytic exercise affects tiredness symptoms in CKD patients receiving HD have not adequately outlined the patterns of exercise effectiveness. To reduce fatigue, a variety of intradialytic exercises have been used. Additionally, there are huge variations in how often people exercise, ranging from four sessions to eight months. It is necessary to conduct additional research on the types of fatigue treated so that the efficiency of intradialytic exercise against each form of weariness can be characterized. To find patterns of intradialytic exercise that effectively reduce fatigue symptoms, the exercise length and timing must also be evaluated. Studies of intradialytic exercise (Pu et al., 2019) and tiredness in HD patients (Yuan et al., 2018) are two examples of studies that have undertaken systematic literature reviews and meta-analyses to determine the benefit of exercise in patients receiving HD.

Significance of the study:

Hemodialysis patients can carry out their everyday tasks, such as housework, and maintain as much independence as possible by exercising. Due to a lack of knowledge about how exercise affects dialysis patients, the problems are still present in dialysis patients but are becoming more frequent and dependent. Patients are not exposed to an exercise regimen during HD or at home, despite the health advantages of exercise. Exercises are important since CKD patients have much lower levels of physical activity than healthy people. Additionally, the best predictor of death among ESRD patients has been noted to be low aerobic capacity, a biological fitness metric that can be increased by exercise (Grover et al., 2022).

The relevance of monitoring and recommending exercise regimens for patients with CKD should be increased. Exercise compliance is a crucial requirement for effective exercise programs for musculoskeletal problems. Therefore, exercise enhances functional capacity, lessens fatigue, and may enhance the quality of life. Physical activity should be viewed as a crucial part of treatment at all stages of the disease because the advantages of exercise may also apply to CKD patients. Patients with CKD can benefit from and feel safe participating in an exercise regimen that includes a supervised, at-home training phase (Gregg et al., 2021)**.**

Research studies include the advantages of exercise for hemodialysis patients. The autonomic nervous system is activated and blood vessels in active skeletal muscles vasodilate during exercise (Paluchamy & Vaidhyanathan, 2018). Therefore, the study was conducted to determine the effect of applying leg ergometric exercise on fatigue level samong patients undergoing hemodialysis.

Operational definition:

The term "leg ergometry exercise" refers to warm-up, stretching, leg ergometer biking, knee and ankle flexion, and extension in addition to strengthening exercises for the quadriceps and glute muscles.

Aim of the study:

The study aims to determine the effect of practicing leg ergometric exercises on fatigue levels among patients undergoing hemodialysis.

Research hypothesis:

- Hemodialysis patients who practice leg ergometric exercise exhibit significant improvement in the level of fatigue than those who do not.

Subjects and Method:

Research design:

This study used a quasi-experimental research design (study and control group)

Setting:

The study was carried out at the hemodialysis unit affiliated to National Medical Institute in Damanhour, El-Behera Governorate, Egypt. This setting was selected because it serves the most populated region and high prevalence of patients.

Subjects:

A convenience sample of 100 patients on chronic hemodialysis was selected settings from the previously mentioned according to the following inclusion criteria :

- Adult aged 21> 60 years
- Scheduled for hemodialysis session three times per week for at least 6 months.
- Communicated effectively.
- Free from (heart diseases, uncontrolled hypertension, unstable angina, musculoskeletal disorders, amputation at any limb)
- Accepted to participate in the study.

The exclusion criteria include:

- Patients having femoral access to hemodialysis
- Patients who are irregular for hemodialysis

- By using the equal allocation method, the selected subjects were randomly assigned to either the control (50) or the study group (50).

Tools of the study:

Two tools were used for data collection in this study:

Tool (I): Patient's Assessment Sheet: was developed by the researchers after reviewing pertinent literature (Anne, 2018; Joyce, 2020; & Grover et al., 2022). It consisted of two parts as follows:

- **Part 1: Patient's demographic data**: It included items related to the demographic variables such as age, gender, occupation, residence, and educational status.

- **Part 2: Patient's clinical data**: This part was developed to assess health status past and present history as the number of hemodialysis sessions per week, duration of illness, access type, and associated illness.

Tool (II): Modified FACIT (Functional Assessment of Chronic Illness Therapy) scale

The Functional Assessment of Chronic Illness Therapy – Fatigue Scale (FACIT-Fatigue) is a 13-item measure that assesses self-reported fatigue and its impact on daily activities and function. The FACIT Fatigue Scale is a short, easy-to-administer tool that measures an individual's level of fatigue during their usual daily activities over the past week. The level of fatigue is measured on a four-point Likert scale (4 = not at all fatigued to 0 = very much fatigued) (Webster et al., 2003). In a 2007 study, the FACIT Fatigue Scale was found to have high internal validity (Cronbach's alpha = 0.96) and high test-retest reliability (ICC = 0.95) (Chandran et al., 2007).

Scoring system:

To score the FACIT fatigue, all items are summed to create a single fatigue score with a range from 0 to 52. Items are reverse-scored when appropriate to provide a scale in which higher scores represent better functioning or less fatigue. The following are the score categories:

- A score less than 30 was considered "low fatigue."
- A score of more than 30 was considered as "severe fatigue."

Method:

- The study was submitted for the approval of the ethical committee of the research.
- The researchers looked through both recent and older material that was available, including books, journals, periodicals, and internet searches. The researchers initiated data collection by firstly collecting demographic and clinical data.

Preparatory phase

Using books, articles, periodicals, and magazines, a survey of recent, historical, local, and international related literature on the many aspects of the problems was conducted.

● **Tools' validity and reliability**:

- The study tools were arranged either constructed by the researchers (tool I) or adapted (tool II).
- The developed tools were observed for content validity by five experts (two from the academic Nephrology field and three from the medical-surgical nursing field) who examined the tools for clarity, relevance, and thoroughness before they were produced in their final configuration and dependability tested.
- The tool I was tested for its reliability by measuring the internal consistency of items using Cronbach's alpha coefficient. The value was (r=0.72).

Ethical Consideration:

The director of the hemodialysis unit and the ethics committee of the nursing faculty both gave their approval. Subjects provided oral consent after being informed about the study's purpose and receiving an explanation of it. Each subject's privacy and confidentiality are guaranteed by encrypting all data and safeguarding the collected data.

Administrative process:

- Official permission to carry out the study was obtained from the head of the urology department and head of the hemodialysis unit and the hospital directors at the selected settings, after an explanation of the aim of the study .

A pilot study

- In a group of ten patients (10%), a pilot study was conducted to test the clarity, feasibility, and applicability of the study tools. No changes were made to the evaluation sheet, which means the ten patients chosen for the pilot study were included in the main trial. It has also supplied an estimate of the time needed to complete the tools.

Implementation phase

- Data were collected by the researchers during the period from the beginning of March 2022 to the end of September 2022; data were gathered at the National Medical Institute in Damanhour dialysis unit. Participants were chosen based on the necessary criteria after receiving official approval from the nursing faculty and the unit administrator.
- Each patient with chronic kidney disease receiving hemodialysis gave the researcher their oral consent before the researcher started collecting data. The study's objectives were conveyed to the patients before they participated in the interview process, which was used to complete the tools. For all patients, the study was conducted during morning and afternoon shifts.
- Each patient in the study and control group was interviewed individually to collect the baseline patient data using the tool I (**Patient's Assessment Sheet**) and tool II (**The modified FACIT scale**). This interview took about 25 to 30 minutes.
- After evaluating the patients using Tools I and II, the researcher spoke to the study group and demonstrated the value of leg ergometric exercise. At the beginning of each dialysis session, all patients received verbal encouragement and motivation regarding the exercise program, which included warm-up, stretching, leg ergometer biking, knee flexion, and extension in addition to ankle and foot exercises (Dorsiflexion, Plantarflexion, Eversion, Inversion).

- A 40-minute exercise program was broken down into 5 minutes of exercise performed before the session and 35 minutes of exercise performed during the hemodialysis session.
- The researcher gave the leg ergometric exercise to every subject. Discussion, handouts, posters, demonstrations, and demonstrations are among the common teaching techniques used. sessions of the teaching program.
- Four theoretical sessions, each lasting roughly 20 minutes, were used to complete the implemented leg ergometric training program. Anatomy and physiology of the urinary system, renal failure, hemodialysis, fatigue, and leg pain are among the topics covered in the first session. The researcher then introduced herself to the patients and explained the purpose of the meeting before orienting them to the leg ergometric exercise program.
- **Second session**: This session's contents include range-of-motion exercises including the hip, knee, ankle, and foot range of motion. It began with a synopsis of what had been covered in the first session. A recap of the session's discussion and patient responses marked its conclusion. Numerous patients cooperated, expressed interest in a particular subject, and requested that the program continue.
- **Third session**: This session's objectives are summarized, and the exercises covered include soleus stretching, gastrocnemius stretching, hamstring stretching, and quadriceps stretching. It also includes leg ergometric exercises that involve knee flexion, and extension in addition to ankle and foot exercises (Dorsiflexion, Plantarflexion, Eversion, Inversion). A recap of the session's discussion and patient responses marked its conclusion.
- **The fourth session** began with a recap of the previous sessions' topics. The day's goals and topics are a hamstring set and hip abductor and adductor exercises. The session was summarized, and the patients provided input by talking about it and asking questions. The researcher provided each patient with a written pamphlet with illustrated photos of leg ergometric exercises as well as spoken instructions.
- **Control group** Patients Regular nursing care was provided to the control group; demographic and clinical information was gathered from the chosen participants, and the modified FACIT scale was used to gauge the severity of fatigue. In the study group, there was no ergometric leg exercise.

Evaluation phase

- The assessment phase, which comes at the end of the proposal instruction program, involves the researcher evaluating the patient one month after they've started doing leg ergometric exercises using tool II.
- Comparison between the study and control groups was carried out using appropriate statistical analysis to evaluate the effect of leg ergometric exercise on patients on hemodialysis.

Statistical analysis

Data was gathered, coded on an Excel sheet, and then analyzed in accordance with the study's goals. The study used inferential (Chi-square, paired t-test, and unpaired t-test) statistics in addition to descriptive (mean & SD) data. There was a 0.05 level of significance. By using the Chi-square test, the homogeneity of both groups was evaluated. The pre-and post-levels of fatigue in the study and control groups were evaluated using the paired t-test and the unpaired t-test, respectively. The outcome was displayed in tables and graphs. SSP (statistical package v 2.8) and SPSS 16.0 were used to analyze all of the data.

Results

Table (1): portrays that the mean age of the patients was 47.77± 10.56 in the study group compared to 44.89± 13.78 in the control group. As regard age 62% of the study group were aged (40-60 yrs.) compared to 60% in the control group. In terms of gender, males constituted (60% and 58%) respectively the study and control groups of the patient population. As regards educational level two-fifths of the patients (48%) in the study group compared to (54%) in the control group were preparatory education and 68% of the patients in the study group compared to 70 % in the

control group were not working. Finally, it was found that 70% of the studied patients in the study group compared to 74 % were from urban areas.

Table (2): Illustrated that (46% and 44%) of patients respectively in the study group and control group their duration of dialysis was 1-5 years. In terms of sessions per week, (98% and 96%) of patients respectively in the study group and control group attended three sessions of hemodialysis each week. Additionally, this table listed that the majority of patients (86% and 44%) of patients respectively in the study group and control group had prior medical experience.

Figure (1): Reveals that almost all (98%) of the studied patients in the study group had AV Fistula as access for hemodialysis compared to 90% of the patient in the control group.

Table (3): illustrates that fatigue score was reduced in the study group post-exercise implementation than in pre-exercise implementation with a highly statistically significant difference at p=(0.00).

Table 4 shows, It shows that leg ergometric exercise was effective in reducing the level of fatigue in study group patients undergoing hemodialysis which was significant at $p \leq 0.05$.

Figure (2): Concerning the level of fatigue, the majority of the studied patients in the study and the control groups had severe fatigue pre-exercise implementation. But post-exercise implementation, the majority of them had less fatigue severity level of less than 30. Additionally, it mentions that there were statistically significant differences found in total fatigue severity level for the studied patients in the study and the control groups' pre & post-leg exercises implementation. Also, in the study group fatigue level was decreased compared to the control group fatigue level.

Table (1): Demographic characteristics of the studied patients (n=100).

Demographic characteristics	**Study group**		**Control group**	
Variables	**N**	**%**	**N**	**%**
Age group				
- 21 - > 40 yrs.	19	38.0	20	40
- 40- > 60 yrs.	31	62.0	30	60
Mean age	47.77± 10.56		44.89± 13.78	
Sex				
- Male	30	60.0	29	58.0
- Female	20	40.0	21	42.0
Education level				
-Illiterate	15	30.0	13	26.0
-Write and Read	5	10.0	6	12.0
-Preparatory education	24	48.0	27	54.0
-Secondary education	2	4.0	3	6.0
-University	4	8.0	1	2.0
Occupation				
-Work	16	32.0	15	30.0
-Not work	34	68.0	35	70.0
Residence	35	70.0	37	74.0
Urban	15	30.0	13	26.0
Rural				

Table (2): Percentage distributions of clinical data of the studied patients (N= 100)

Medical data	Study group		Control group	
	N	%		
1-Numbers of hemodialysis per week				
-Twice	1	2.0	2	4.0
-Third	49	98.0	48	96.0
2-Duration of renal failure				
- > 1 yr.	6	12.0	5	10.0
-1-5 yrs.	23	46.0	22	44.0
-More than 5 yrs.	21	42.0	23	46.0
Associated illness				
Yes	43	86.0	44	88.0
No	7	14.0	6	12.0

Figure (1): Distribution of the studied patients in the study and control group according to their access type

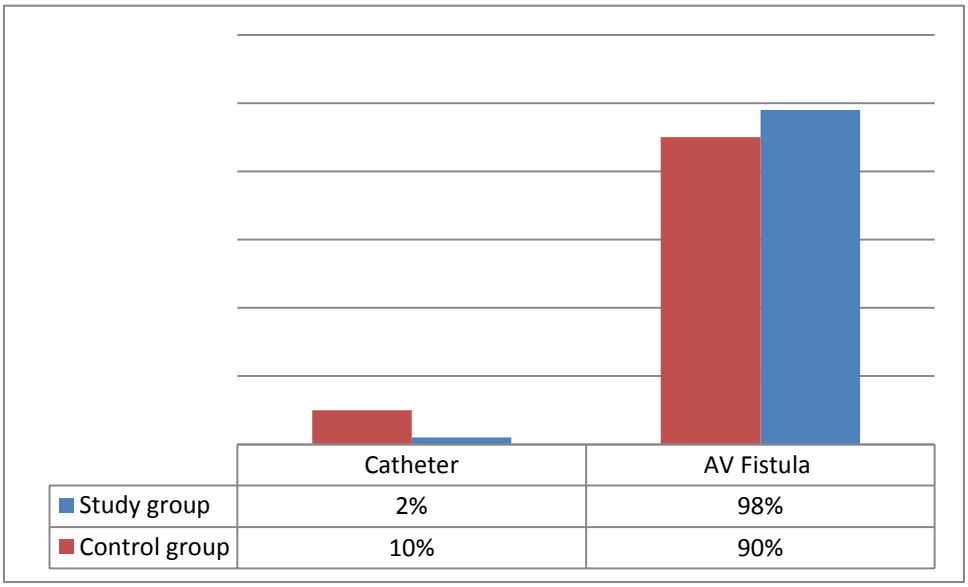

Table (3): Comparison of fatigue scores among the studied patients in the study and control groups pre and post-exercise implementation (N=100)

Fatigue Score	Pre-test	Post-test	Paired t/p value
	Mean ±SD	Mean± SD	
Study group	31.55±4.73	25.18±2.43	t=8.89 p=0.00*
Control group	33.67±5.38	35.55±6.56	t=0.94 p=0.35NS

P: Independent samples t-test * P < 0.05 (significant)

Table (4): Comparison of mean scores on the post-test level of fatigue among patients undergoing hemodialysis pre and post-exercise in the study and control group (n=100)

Items	Study Group		Control Group		"t" test value
	Mean	SD	Mean	SD	
Pre	23.56	7.56	28.23	6.67	4.43*
Post	20.79	3.78	31.24	5.34	5.87*

*Significant at p≤0.05

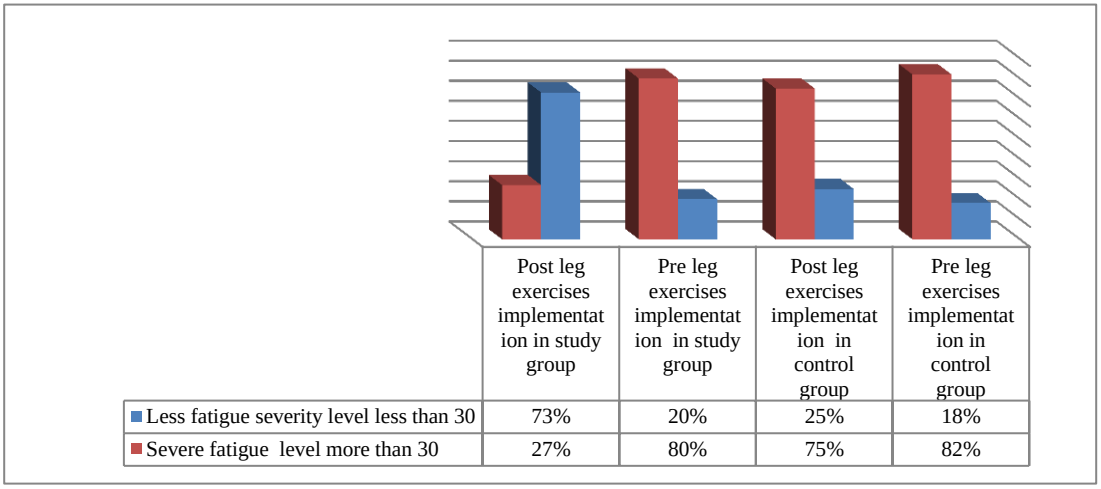

Figure (2): Total fatigue severity level for studied patients in the study and the control groups pre & post leg exercises implementation (n= 100)

Discussion:

Hemodialysis patients have a variety of symptoms, which vary significantly in terms of both the frequency and severity with which have an impact on the individuals. Symptoms have a strong correlation with weariness **(Nordqvist, 2017)**. According to **(Rashdi S. and Ghaleb 2017**), one of the most common side effects of hemodialysis patients is fatigue, which impairs their ability to do physical tasks. Ergometric leg exercise can enhance solute removal, the effectiveness of hemodialysis, intra-dialytic protein synthesis, muscular strength, peak oxygen consumption, nutritional status, and quality of life **(Merline et al., 2018).** So, the researchers implement this study to determine the effect of applying leg ergometric exercise on fatigue level s among patients undergoing hemodialysis.

More than two-fifths of the patients were found to be in the forty to fifty-year age range, according to the demographic characteristics of the patients. The current study is backed by **Ibrahim & Mokhtar, (2018**), who conducted a study to evaluate the benefits of leg exercise for hemodialysis patients in the Aswan University Hospital's dialysis unit. They looked at how it affected fatigue levels and daily activities. The majority of patients were 40–50 years old, according to the findings. Regarding gender, this finding that three-fifths of the patients under study were men contrasts with that of **Bahgat et al., (2016**), who claimed that more than half of the patients were female.

According to the current study's findings, more than half of the patients had just received preparatory schooling. This finding contradicts the findings of **(Bayoumi & Al Wakeel, 2015)**, who claimed that half of the patients could read and write. Regarding patient occupation, the current study noted that three-quarters of patients were unemployed, which is similar to the finding from **(Bayoumi & Alwakeel, 2015)**, who noted that the majority of patients were unemployed. The current study's findings on the frequency of hemodialysis per week showed that practically all patients underwent dialysis three times per week. This finding contradicts the findings of **(Elavally et al., 2017)**, who claimed that a fifth of patients underwent dialysis three times per week.

Regarding the duration of dialysis, this study showed that more than three-quarters of patients

were treated for one to five years. This finding contrasts with that of **(Lekha et al., 2017),** who claimed that three-quarters of patients had hemodialysis for more than four years.

The results of this study show that leg ergometric exercises significantly reduced the level of fatigue among the study group's patients. From the researchers' points of view, it reflected the positive effects of ergometric exercise on fatigue levels among patients undergoing hemodialysis. **Jose et al. (2014)** found similar findings in their study, "Effectiveness of leg exercise on fatigue and activities of daily living among patients undergoing hemodialysis," which found that the study group's patients experienced a significant change in their level of fatigue compared to the patients in the control group.

Chang et al. (2020) conducted another study to assess the impact of intradialytic leg ergometry exercise on reducing fatigue and increasing daily physical activity levels in individuals with chronic kidney disease. According to the study's findings, the experimental group was much less fatigued than the control group.

In a similar line, **(Tamilmozhi et al. 2021)** discovered that a leg exercise program was successful in lowering fatigue and enhancing the quality of life in hemodialysis patients. The findings are consistent with those of a study by **(Monera et al. 2016)**, which used pre-post tests on 60 participants and found that an exercise program during hemodialysis enhanced patients' quality of life and decreased fatigue. This study also suggested that hemodialysis should be used to create an exercise program for people with renal failure.

A simplified physical exercise program may be thought of as a safe and effective clinical nursing modality in patients with end-stage renal disease receiving hemodialysis, according to another study's findings by **(Soliman 2015)**. This study found that after 8 weeks of a range-of-motion exercise program, patients' levels of fatigue in the experimental group significantly decreased.

Before beginning leg exercises, the majority of patients reported being severely fatigued. From the researchers' points of view, it demonstrated how critical it is to give hemodialysis patients access to this exercise. This outcome is consistent with **(Salem and Elhadary, 2017)**, who observed that two-thirds of patients had mild pain following leg-stretching activities. From the perspective of the researchers, it demonstrated the benefits of applying this exercise for patients receiving hemodialysis.

Conclusion

From the results of the current study, it can conclude that hemodialysis patients who practice Leg ergometric exercises exhibit significant improvement in levels of fatigue than those who don't practice them.

Recommendations

The following recommendations can be suggested based on the results of the current study:

- A simple manual of guidelines for leg ergometric exercise programs should be available in all units to be provided to newly admitted patients undergoing hemodialysis.
- Leg ergometric exercise programs should be implemented continuously and regularly for hemodialysis patients.
- Administrators should plan and implement periodic patient teaching programs about leg ergometric exercise as one of the hospital policies, and procedures.
- The study should be repeated with a large sample size in a different environment to confirm and generalize the findings.

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