Intradialytic Range of Motion Exercises Program: its Effect on Knowledge, Fatigue, and Blood Pressure among Hemodialysis Patients

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Abstract

Background: Dialysis is a lifesaving treatment for patients who diagnosed as kidney failure that considered as a physically stressful procedure where the majority of patients suffer from fatigue as uremic symptom after long period of dialysis sessions. **Aim of the study:** To evaluate effect of Intradialytic range of motion exercises program on knowledge, fatigue, and blood pressure among hemodialysis patients**. A quasi-experimental research design** (study & control) was utilized to achieve aim of this study. **Setting**: This study was conducted at Hemodialysis Unit at Benha University Hospital,Qalyubia, Governorate, Egypt. **Sample:** purposive sample of (80) adult patients undergoing hemodialysis were recruited in this study. **Three tools** were used to collect data which were Structured Interview Questionnaire, Fatigue assessment scale, Range of motion exercises Observational checklist. **Results:** showed that, there was high statistically significant difference in terms of high post know1edge scores of study group who were exposed to educational program than the control group. As well as, the post stable blood pressure scores of study group were improved than control group. In addition, study group exhibits low fatigue level post program implementation than control group. **Conclusion:** the study concluded that, intradialytic exercises program was effective in improving patient' knowledge, blood pressure stability, and reducing fatigue level among study group than control group .**The study recommended that,** Exercises schedule or planning should be involved in daily care based on patient's age and comorbidities under strict observation of staff . Further studies are more required to help in results generalization.

Key words: Blood pressure, Fatigue, Hemodialysis, Intradialytic range of motion exercises

Introduction:

Chronic kidney disease is recognized as an international health issue due to its rising prevalence and incidence. Patients need renal dialysis or a transplant to continue living once their kidneys quit functioning. The majority of patients receive hemodialysis or peritoneal dialysis to remove excess fluid from the blood and filter waste products. **(Kellum, et al., 2021).**

Fatigue is a subjective problem as the patient may experience tiredness, weakness, lack of energy, decreased cognitive function, memory loss, and poor attention, which prevents them from engaging in daily activities (**Brys, et al., 2019).** Lack of energy is a source of stress and frustration since patients have limited functional capability which impacts their ability to work, care for their families, and accomplish personal goals. Therefore, fatigue negatively affects their physical, cognitive, and social wellbeing and life satisfaction. 60–97% of hemodialysis patients experience it **(Metzger, et al., 2021).**

Physical inactivity is a significant factor to the worsening of physical status with adverse clinical outcomes that can be partially alleviated by engagement in regular exercises which is associated with a decreased mortality risk, enhanced quality of life, and reduced depressive symptoms and fatigue **(Parker, et al., 2021).**

Patients often have two or three hemodialysis sessions per week, lasting anywhere between two and four hours each. Since many patients maintain bed rest during hemodialysis sessions, Intradialytic exercise can be a potentially effective approach to improve their health status **(Lin et al., 2021).** Intradialytic exercises can improve the perfusion of muscle cells and increase blood flow to peripheral tissues, restoring the body's physiological and physical activities. Additionally, it promotes the transit of urea from the tissue to the vascular compartment, resulting in optimal dialysis efficacy and serum urea clearance. **(Wilund et al., 2021).**

Therefore, range of motion exercises should be performed for 15-20 min per day three times a week during dialysis session to enhance patient' activity without any cost or assuming extra time. In addition, exercise will be effective in reducing fatigue level, enhancing daily living activities performance, increasing dialysis adequacy and other clinically relevant outcomes involving blood pressure and cardiorespiratory fitness when compared to usual care **(Ferrari, et al., 2020).**

Assessing the patient's vascular access patency and measuring vital signs (heart rate, blood pressure, respiration rate, and temperature) every half an hour because BP variations can happen quickly are all part of the nursing role when caring for hemodialysis patients. Also, check patient's history for chronic illness or allergy, assess lab investigation findings , prepare necessary supplies and drugs , measuring intake and output, assessing for peripheral or central edema , determining the difference between previous dialysis weight and the existing pre-dialysis that reflects excess fluid removal, maintaining proper body alignment and position, monitoring the patient for episodes of nausea and vomiting while receiving dialysis session , observing vascular access for bleeding , and adhering to infection control measures (**Hermalia, et al., 2021).**

Significance of study

More than 750 million individuals worldwide were affected by kidney disease, and an estimated 2 million people had renal failure. 1.3% of them received peritoneal dialysis, whereas the majority of them (98.7%) underwent hemodialysis. According to data from **United States Renal Data System, 2021** this number was predicted to more than double in 2030 with increased demand for renal replacement therapy or kidney transplantation as end-stage renal illness has a number of negative effects on overall patient health and wellbeing with high morbidity and mortality rates and substantial management costs**. (Mohamed et al., 2020).**

In Egypt, the prevalence of chronic kidney diseases estimated 7.1 million individuals of total population that ranked as the fifth greatest cause of death from 2009 to 2021 **(Egypt Social Progress Indicators, 2021)**. In 2021, Studies showed that half of hemodialysis patients were aged ≥55 years and Hypertension considered as the most common complication 41%, followed by diabetes 14%, whereas glomerulonephritis ranked as primary diagnosis in 3% of patients undergoing dialysis **(Hassaballa et al., 2021).** According to report of **Benha University Hospital Statistical office (2020& 2021),** the number of patients who admitted to hemodialysis unit was 80 cases in 2020 while, the number increased into 100 cases in 2021 with increased demand for optimizing patient' health outcomes.

Patients typically have a negative attitude towards engaging in physical activity or exercise, with lack of interest of medical and nursing staff in this setting. They consequently have a high risk of developing cardiovascular problems due to dyslipidemia and elevated levels of inflammatory markers. In order to improve patient care, an organized intradialytic training program should be suggested **(Geelen et al., 2021).**

Aim of the study:

This study aimed to evaluate effect of intradialytic range of motion exercises program on knowledge, fatigue, and blood pressure among hemodialysis patients.

Research Hypotheses:

The following research hypotheses had formulated to achieve the aim of the study:

H.1 Patients who exposed to Intradialytic range of motion exercises program (study group) could be have a higher knowledge score than patients who don't exposed to Intradialytic range of motion exercises program (control group).

H.2 Patients who practice Intradialytic range of motion exercises program (study group) would experience more stable blood pressure than patients who don't practice Intradialytic range of motion exercises program (control group)

H.3 Patients who practice Intradialytic range of motion exercises program (study group) would experience low fatigue level than patients who don't practice Intradialytic range of motion exercises program (control group)

Subjects and method:

Research Design:

Quasi-experimental (study and control) was utilized to fulfill the aim of this study.

Setting: The study was conducted at Hemodialysis Unit at Benha University Hospital, Qalyubia, Governorate, Egypt.

Subjects: purposive sample of (80) adult patients undergoing hemodialysis were recruited in this study. Based on the census report of hemodialysis unit admissions from Benha University Hospital Census, 2021, the sample size of patients was determined utilizing **Solvin's formula** as:

$$n = \frac{N}{1+N(e)^2}$$

n= sample size
N= total population (100)
e= margin error (0.05)

Inclusion Criteria: Patients aged 20-60 years old, being under hemodialysis for more than 6 months, receiving hemodialysis sessions 3 times per week**,** patients who agree to participate in the study.

Exclusion criteria: patients with uncontrolled hypertension, any heart diseases or problems, fractured or paralyzed limbs, musculoskeletal disorders and unstable on dialysis.

Tools of data collection:

- **Tool 1: Structured Patients' interviewing questionnaire:**

It was developed by researchers after reviewing recent and related literature (**Kallenbach, 2020).** It wrote in the simple Arabic language to assess patients' knowledge regarding hemodialysis and intradialytic range of motion exercises consisting of four parts: **Part (1):** concerned with socio-demographic characteristics of the studied sample such as age, sex, marital status, level of education and occupation.

Part (2): concerned with patient' medical history involving:

- Past history which included data about previous smoking and family history, and comorbid disease.
- Present medical history including data regarding duration of hemodialysis, as body mass index, duration of dialysis, number of dialysis session per week, dialysis access, current chronic disease.

Part (3): encompassed patient's knowledge assessment. It designed after reviewing related literature including Multiple Choose Questions about renal failure, hemodialysis, complications of hemodialysis, types of intradialytic range of motion exercises, benefits, how the patient can start and perform exercises.

Scoring system:

The correct answer was scored one. While, incorrect answer was scored zero. These scores were summed up and converted into percent score. **The total level of patient's knowledge score was categorized as follows:**

- ≥ 70% of total score considered as good knowledge.
- 60 ≤ 70 % of total score considered as fair knowledge.
- < 60 % of total score considered as poor knowledge.

Part (4): Blood Pressure assessment through measuring patients' blood pressure by researchers using mercury sphygmomanometer

at pre and post periods of exercises program implementation.

Tool 2: Fatigue assessment scale (FAS): It was adopted from **(Hendricks et al., 2018)** which is self-reported questionnaire consisting of ten items with 5-point Likert response scale ranging from "1 = never to "5 = Always" Five items denote physical symptoms of fatigue and the other five denote psychological symptoms. Of these items, eight represents negative aspects during fatigue states (1, 2, 3, 5, 6, 7, 8, and 9). The remaining two items (4 and 10) are worded inversely and are given reverted scores reflecting energy states.

Scoring system:

Total scores can range from score of 10 to 50 that categorized as:

- less than 22 considered as normal fatigue level
- between 22 and 34 considered as low or mild fatigue level
- 35 or more considered as high fatigue level

Tool 3: Range Of Motion Exercises Observational Checklist

It used to investigate the patient's practice of range of motion exercises during dialysis session. It contained exercises related to 4 parts of the body (elbow, wrist, knee, and ankle). These exercises were done by the patients and checked by the researchers to decide whether or not they were effective.

Scoring system:

The correct practice was given one score and incorrect practice was given zero score. These scores were summed up and converted into percent score. **The total level of patient's practice score was categorized as follows:**

- $\geq$ 70% of total score considered good level of practice
- 60 $\leq$ 70 % of total score considered acceptable level of practice
- < 60 % of total score considered poor level of practice

Content validity and reliability

A panel of seven experts (5 professors from medical surgical nursing department, Benha University & 2 professors of physiotherapy and internal medicine, Benha University) revised the tools and reviewed the content for comprehensiveness, clarity and relevancy. Accordingly, modifications were done. The **Cronbach's alpha coefficient** was used to examine the proposed tools' reliability, and the results were (0.76, 0.80, and 0.74, respectively), suggesting good reliability.

Pilot study:

It was conducted on 10% of the studied subjects (8 patients) to test the applicability, clarity, feasibility of tool and to pinpoint obstacles that may be encountered during data collection and to determine the required time. Patients who participated in pilot study were excluded from the main study sample.

Ethical considerations

- The research approval was obtained from the ethical committee in the faculty of nursing before starting the study. Official permission to conduct the study was obtained from the responsible administration of the hospital and director of hemodialysis unit.
- After explaining the study's purpose to the study sample's willing participants, verbal consent t was obtained before inclusion.
- The researchers emphasized that the privacy and the confidentiality of all information would be secured by coding the data.
- Anonymity, privacy, rights, safety of the subjects would be assured from the beginning of the study.
- Each patient was informed that refusal to participate in the study or withdrawal would not neither entail any harmful effects nor affect their care.

Administrative design

An Approval to carry out this study was obtained from the dean of faculty of nursing and the director of hemodialysis unit at Benha university Hospital.

Preparatory phase

Tools of data collection had been developed through reviewing of related literature using textbooks, evidence-based articles, internet periodicals, and journals.

Supportive material: booklet was designed by the researchers using simple Arabic language and various illustrated pictures in order to facilitate hemodialysis patients understanding comprehend theoretical and practical parts.

Theoretical part comprehended: Definition of renal failure, causes of renal failure, definition of hemodialysis, Purpose of hemodialysis, methods of performing range of motion exercise, benefits of intradialytic range of motion exercises, Type of exercise should be performed.

The practical part involved a group of (wrist, elbow, knee, ankle) range of motion exercises and how to perform each one of them.

Field work:

Data were collected over a period of four months from the beginning of February, 2022to the end of May, 2022. The data collection done in three phases:

1-Assessment Phase:

Researchers visited hemodialysis units in the morning and afternoon shifts three days a week to gather study-related data once patients confirmed the study met the inclusion and exclusion criteria. Each patient was interviewing individually about 30 - 45minutes.In addition, patient' blood pressure and fatigue level measured using tool II & sphygmomanometer.

2- Planning and Implementation Phase

Patients who agreed to participate in the study and fulfilled the inclusion criteria were interviewed individually by the researchers. The patients were alternately split into two equal groups (40 patients for each group).Patients from the morning shift were chosen to be part of the study group, while patients from the afternoon shift were chosen to be part of the control group. Firstly, the researchers deal with the study group then control group (II) to avoid data overlap. At the beginning of the first session: Social characteristics of each patient were obtained and assess patients' blood pressure using tool one. Assess the patients fatigue level using tool two. The researcher thoroughly explained everything about these exercises (definition, benefits, precautions, and description of each exercise) for the study group. Following that, demonstration was done for every patient in the study group using tool three (Observational checklist). The following exercises were demonstrated by the researchers:

Elbow:

- Flexion : bend elbow so lower arm move toward its shoulder joint and hand is level with shoulder (20 times)
- Extension: straight elbow by lowering hand (20 times)

Wrist:

- Flexion :move palm toward inner aspect of forearm(20 times)
- Extension : move fingers and hand posterior to midline(20 times)
- Abduction : place hand with palm down and extend wrist laterally(20 times)
- Toward fifth finger (20 times)
- Adduction : : place hand with palm down and extend wrist medially toward thumb(20 times)

Knee:

- Flexion: bring heel back toward back of thing(20 times)
- Extension :return knee to the floor(20 times)

Ankle

- Dorsal flexion :move foot so toes are pointed upward(20 times)
- Planter flexion : move foot so toes are pointed downward(20 times)

The intradialytic exercises were done for 20 minutes, 3 times per week, during the first 2 hours of each dialysis session. Body parts that were connected to dialysis machine were excluded. At the beginning of the follow up session: The researcher refreshed the previous knowledge and then a redemonstration for the intradialytic exercises was done using tool three (Observational checklist). The patients' blood pressure assessed pre- and post-patient dialysis session and recorded .

3-Evaluation Phase

Evaluation of all patients of both groups was carried out twice;

Knowledge was evaluated pre program ,immediately post program and post two month , while as fatigue and blood pressure were evaluated post one month and post two of intradialytic range of motion exercises program . Blood pressure: Systolic and diastolic blood pressures were measured before and after hemodialysis session. Then, the mean of blood pressure measures was

estimated at the end of every month for every patient to be prepared for comparison A comparison was done between both groups to determine the effect of intradialytic exercises on fatigue and blood pressure among patients undergoing hemodialysis.

Statistical Design:

The collected data were tabulated and statistically analyzed using an IBM computer and Data analysis was performed using the SPSS software (version 25). For determining the normal distribution of quantitative variables was used to Kolmogorov-Smirnov test. Chi-square tests were used to compare nominal variables in the two groups and compare between different periods. Fisher's exact test was applied on smaller sample sizes, alternative to the chi-square test, when the frequency count is < 5 for more than 20% of cells. For comparing the mean scores in two groups were used to the independent t-test, Mann Whitney test for non-parametric quantitative data. Friedman test to compare between more than two periods or stages. spearman method was used to test correlation between numerical variables. P-value ≤ 0.05 was considered significant, and ≤ 0.001 was considered highly significant.

Results:

Table (1): Shows the distribution of studied patients regarding their sociodemographic characteristics, where there was no significant difference between both studied groups. Clarifying that (62.5% & 55.0%, respectively) had ≥ 50 years old with a mean age of (49.33±0.88 & 49.35±0.97) years, while (57.5% & 60.0%) of them were females, (85.0% & 70.0%) were married. In addition, (37.5% & 40.0%) of the studied patients were employed. Moreover, (35.0% &37.5%) of them were not reading and writing.

Table (2): Reveals the distribution of studied patients regarding their medical history, where there was no significant difference between both control and study groups. displaying that (80.0% & 85.0%, respectively) had no family history of renal failure, while (72.5% & 62.5%) of them were smoking, and (50.0% & 45.0%) were overweight. In addition, (52.5% & 47.5%) of the studied patients were undergoing hemodialysis since 1-<5 years for two times per week among (55.0% & 50.0%, respectively). Moreover, (65.0% &60.0%) of them were performing hemodialysis through graft and finally (57.5% & 52.5%) had comorbid diseases with (30.4% & 38.1%) of them had diabetes mellites.

Figure (1): illustrates that there was no significant statistical difference between control and study groups regarding incidence of hemodialysis complications (p value=$0.360^{n.s}$), where the highest incidence of complications was chest pain among (53.4% & 50.0%, respectively) followed by hypertension among (36.7% & 35.7%) of control and study groups.

Table (3): Displays that there was no significant statistical difference between control and study groups regarding their knowledge level about renal failure and intradialytic range of motion exercise preprogram, while there was a highly significant statistical difference between both groups regarding their knowledge during immediate and two months periods post program implementation.

Figure (2): illustrates that there was no significant statistical difference between control and study groups regarding their total knowledge level pre program (p value=0.196n.s), where 77.5% and 70.0%, respectively had Poor level. While there was a highly significant statistical difference between both groups regarding their total knowledge level (p value= <0.001**) during immediate post period, where control and study groups had good level among 0.5% and 75%, respectively, also highly significantly different during two months period post program, where, both groups had good level among 12.5% and 72.5%, respectively.

Table (4): Shows that there was a significant statistical difference between both immediate post and post two months periods among study group regarding their practice level about intradialytic range of motion exercise and pre program period

Figure (3): illustrates that 80.0% among study group had poor level of practice pre program period to reach to a agood level among (93.8% & 75%, respectively) during immediate post and two months post program implementation periods.

Table (5): Reveals the comparison between the mean score of blood pressure among the studied patients, where there were no significant difference between both groups during pre program period to be highly significantly different during one and two months periods post

program in term of more stable blood pressure among study group. Also there was a highly significant difference in systolic and diastolic scores within each group throughout measurement periods.

Table (6) :Reveals the comparison between the mean score of fatigue among the studied patients, where there were no significant difference between both control and study groups during pre program period to be highly significantly different during one and two months periods post program in term of lower fatigue score among study group. Also there was a highly significant difference in fatigue score within each group throughout measurement periods.

Table (7): shows correlation between studied variables among studied groups post two months of program implementation, it was noticed that there were a significant and negative correlation between total knowledge with blood pressure and fatigue, moreover it was positive and significant between blood pressure and fatigue levels among study group while not significant in control group.

Table 1. Distribution of both studied groups according to their demographic characteristics, control group (n=40), and study group (n= 40).

Patients' demographic data	Variables	Control group N=40		Study group N=40		X^2	P value
		No.	%	No.	%		
Age (year)	20-<30	3	7.5	2	5.0	1.280	0.734 n.s
	30-<40	5	12.5	5	12.5		
	40-<50	7	17.5	11	27.5		
	≥ 50	25	62.5	22	55.0		
	Mean ± SD	**49.33±0.88**		**49.35±0.97**		t= -0.120	0.905 n.s
Sex	Male	17	42.5	16	40.0	0.052	FEp
	Female	23	57.5	24	60.0		1.000 n.s
Marital status	Single	3	7.5	1	2.5	6.369	0.095 n.s
	Married	34	85.0	28	70.0		
	Widowed	2	5.0	9	22.5		
	Divorced	1	2.5	2	5.0		
Occupation	Not Working	15	37.5	13	32.5	0.252	0.969 n.s
	Employee	15	37.5	16	40.0		
	Retired	4	10.0	4	10.0		
	Free work	6	15.0	7	17.5		
Educational level	Can't read and write	14	35.0	15	37.5	0.211	0.976 n.s
	Read and write	9	22.5	8	20.0		
	Intermediate qualification	8	20.0	9	22.5		
	University qualification	9	22.5	8	20.0		

(n.s) Not Significant (P>0.05) FEp: p value for Fisher exact for chi square

Table 2. Distribution of both studied groups according to their medical history, control group (n=40), and study group (n= 40).

Medical history	Variables	Control group N=40		Study group N=40		X^2 test	P value
		No.	%	No.	%		
Family history of renal failure	Yes	8	20.0	6	15.0	0.346	FEP 0.770 n.s
	No	32	80.0	34	85.0		
History of smoking	Yes	29	72.5	25	62.5	0.912	FEP 0.474 n.s
	No	11	27.5	15	37.5		
Body Mass index	Underweight <18.5	4	10	4	10	1.008	0.089 n.s
	Normal weight (18.5–24.9)	13	32.5	14	35		
	Overweight (25–29.9)	20	50	18	45		
	Obesity (30 or greater)	3	10	4	10		
Duration of hemodialysis	<1 years	10	25	11	27.5	1.076	0.084 n.s
	1-<5 years	21	52.5	19	47.5		
	>5 years	9	22.5	10	25		
Number of dialysis session/ week	One time per week	15	37.5	16	40	0.676	0.713 n.s
	two times per week	22	55	20	50		
	three times per week	3	7.5	4	10		
Dialysis access	Fistula	12	30	13	32.5	0.976	0.126 n.s
	Graft	26	65	24	60		
	Central venous catheter	2	5	3	7.5		
Presence of comorbid disease	Yes	23	57.5	21	52.5	1.421	0.053 n.s
	No	17	42.5	19	47.5		
Chronic disease		n= 23		n= 21			
	Diabetes	7	30.4	8	38.1	1.322	0.062 n.s
	Chronic obstructive pulmonary disease	6	26.1	7	33.3		
	Peripheral vascular disease	6	26.1	4	19.1		
	Cerebrovascular disease	4	17.4	2	9.5		

(n.s) Not significant (p > 0.05) **FEp:** p value for Fisher exact for chi square

Figure (1): Distribution of both studied groups according to incidence of hemodialysis complications, control group (n=40), and study group (n= 40).

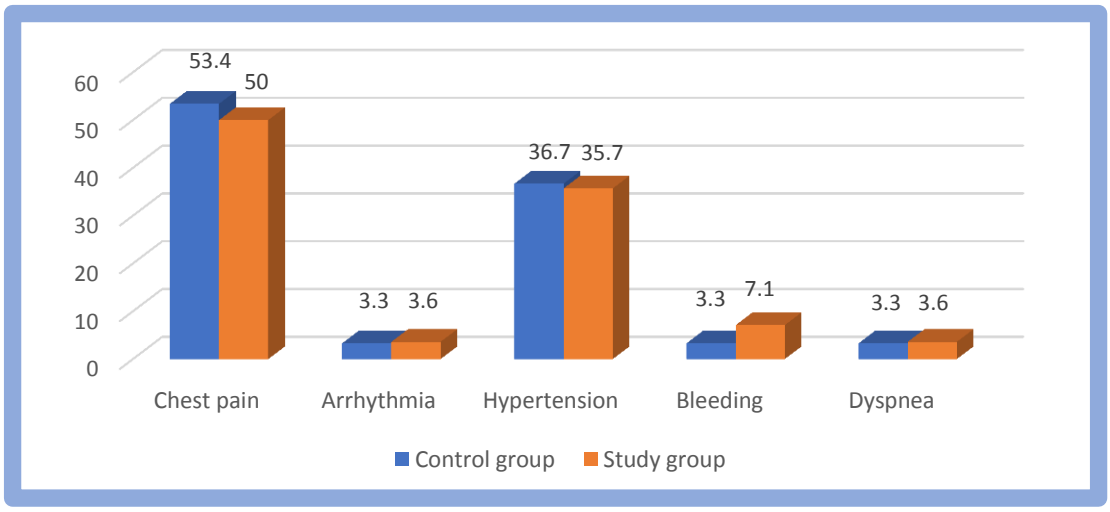


Table (3): Comparison of patients' knowledge about renal failure and intradialytic range of motion exercise pre, immediate post and post two months of program implementation, control group (n=40), and study group (n= 40).

Knowledge items	Response	Control group (n=40)						Study group (n=40)						X^2 test P value (1)	X^2 test P value (2)	X^2 test P value (3)
		(pre program)		immediate post program		(post two months of program)		(pre program)		immediate post program		(post two months of program)				
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Definition of renal failure	Correct	4	10.0	4	10.0	4	10.0	1	3.3	36	90.0	32	80.0	FE 1.07	38.40	29.69
	Incorrect	36	90.0	36	90.0	36	90.0	39	96.7	4	10.0	8	20.0	0.612 ns	<0.001**	<0.001**
Causes of renal failure	Correct	5	12.5	5	12.5	5	12.5	9	22.5	40	100.0	34	85.0	FE 1.385	62.222	42.076
	Incorrect	35	87.5	35	87.5	35	87.5	31	77.5	0	0.0	6	15.0	0.378 ns	<0.001**	<0.001**
Definition of hemodialysis	Correct	5	13.3	5	13.3	5	13.3	4	10.0	28	70.0	25	63.3	FE 0.162	19.81	15.86
	Incorrect	35	86.7	35	86.7	35	86.7	36	90.0	12	30.0	15	36.7	1.000 ns	<0.001**	<0.001**
Purpose of hemodialysis	Correct	5	13.3	5	13.3	5	13.3	4	10.0	40	100.0	36	90.0	FE 0.162	45.88	35.30
	Incorrect	35	86.7	35	86.7	35	86.7	36	90.0	0	0.0	4	10.0	1.000 ns	<0.001**	<0.001**
Methods of performing range of motion exercise	Correct	0	0.0	0	0.0	0	0.0	3	6.7	21	53.3	20	50.0	FE 2.06	21.81	20.00
	Incorrect	40	100.0	40	100.0	40	100.0	37	93.3	19	46.7	20	50.0	0.492 ns	<0.001**	<0.001**
benefits of intradialytic range of motion exercise	Correct	1	3.3	1	3.3	1	3.3	1	3.3	36	90.0	24	60.0	0.000	45.26	22.25
	Incorrect	39	96.7	39	96.7	39	96.7	39	96.7	4	10.0	16	40.0	1.000 ns	<0.001**	<0.001**
Possibility of performing the exercise at home	Correct	15	37.5	17	42.5	15	37.5	18	45.0	33	82.5	29	72.5	FE 2.464	13.653	9.899
	Incorrect	25	62.5	23	57.5	25	62.5	22	55.0	7	17.5	11	27.5	0.178 ns	<0.001**	0.002*
How to get start the exercise	Correct	5	13.3	5	13.3	5	13.3	1	3.3	40	100.0	29	73.3	FE 1.96	45.88	22.99
	Incorrect	35	86.7	35	86.7	35	86.7	39	96.7	0	0.0	11	26.7	0.353 ns	<0.001**	<0.001**
Type of exercise should be performed	Correct	8	20.0	9	22.5	11	27.5	4	10.0	38	95.0	38	95.0	FE 2.296	4.114	7.440
	Incorrect	32	80.0	31	77.5	29	72.5	36	90.0	2	5.0	2	5.0	0.225 ns	0.043*	0.006*
What can be done to make it more enjoyable and easier to do	Correct	7	17.5	9	22.5	8	20.0	9	22.5	26	65.0	30	75.0	FE 0.313	14.679	24.261
	Incorrect	33	82.5	31	77.5	32	80.0	31	77.5	14	35.0	10	25.0	0.781 ns	<0.001**	<0.001**

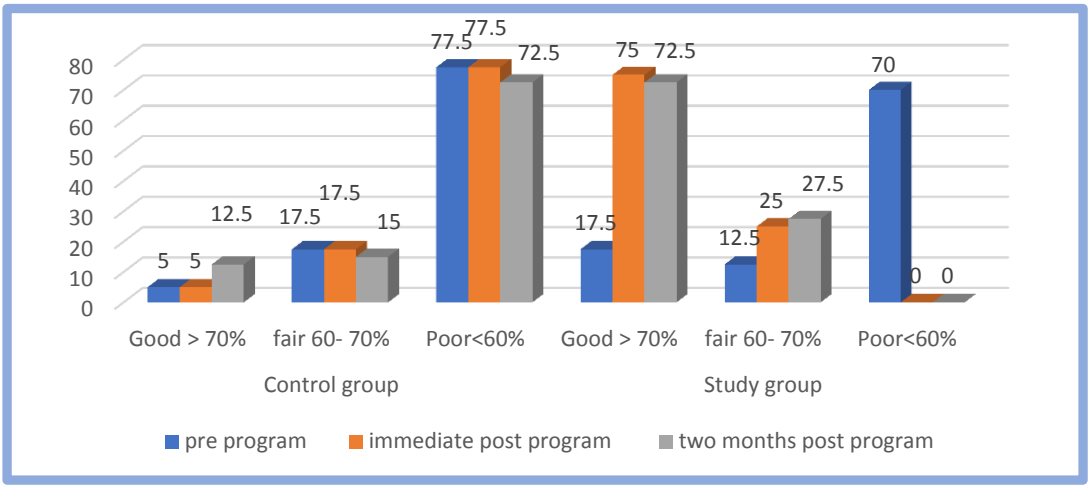
(FE) p value for Fisher exact for chi square Not significant ($p > 0.05$) (*) Statistically Significant at ≤0.05 ** Highly significant ($p \leq 0.001$)

(1) control group (pre program) vs study group (pre program)

(2) control groups (immediate post program) vs study groups (immediate post program)

(3) control groups (post 2 months of program) vs study groups (post 2 months of program)

Figure (2): Comparison between study and control groups related to total knowledge level about renal failure and intradialytic range of motion exercise pre, immediate post and post two months of program implementation, control group (n=40), and study group (n= 40).



(FE) p value for Fisher exact for chi square Not significant (p > 0.05) ** Highly significant (p ≤ 0.001)

(1) control group (pre program) vs study group (pre program)
(2) control groups (immediate post program) vs study groups (immediate post program)
(3) control groups (post 2 months of program) vs study groups (post 2 months of program)

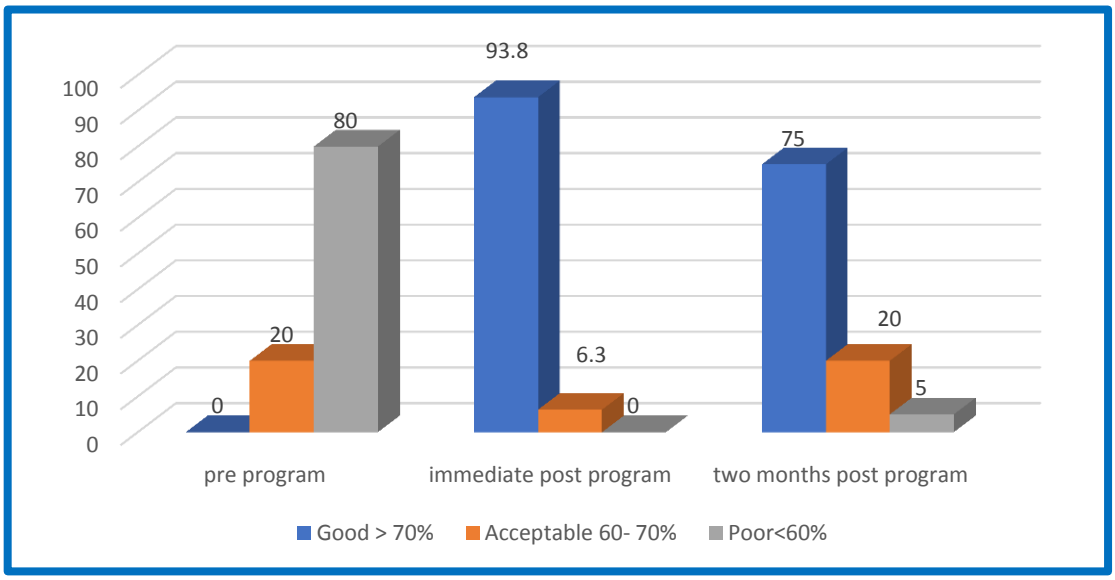
Table (4): Distribution of practice of intradialytic range of motion exercise among study group pre, immediate post and post two months of program implementation (n= 40).

Range of motion exercise	Response	Study group (n=40)						X^2 test P value (1)	X^2 test P value (2)
		(pre program)		immediate post program		(post two months of program)			
		No.	%	No.	%	No.	%		
Elbow (flexion)	Done correctly	6	15.0	32	80.0	29	72.5	84.71 <0.001**	76.17 <0.001**
	Done incorrectly	34	85.0	8	20.0	11	27.5		
Elbow (extension)	Done correctly	16	40.0	28	70.0	28	70.0	18.18 <0.001**	18.18 <0.001**
	Done incorrectly	24	60.0	12	30.0	12	30.0		
Wrist (flexion)	Done correctly	5	12.5	33	82.5	29	72.5	98.25 <0.001**	73.66 <0.001**
	Done incorrectly	35	87.5	7	17.5	11	27.5		
Wrist (extension)	Done correctly	14	35.0	35	87.5	35	87.5	55.87 <0.001**	55.87 <0.001**
	Done incorrectly	26	65.0	5	12.5	5	12.5		
Wrist (abduction)	Done correctly	20	50.0	39	97.5	37	92.5	58.27 <0.001**	44.09 <0.001**
	Done incorrectly	20	50.0	1	2.5	3	7.5		
Wrist (adduction)	Done correctly	18	45.0	32	80.0	37	92.5	26.13 <0.001**	52.51 <0.001**
	Done incorrectly	22	55.0	8	20.0	3	7.5		
Knee (flexion)	Done correctly	13	32.5	36	90.0	36	90.0	69.95 <0.001**	69.95 <0.001**
	Done incorrectly	27	67.5	4	10.0	4	10.0		
Knee (extension)	Done correctly	22	55.0	37	92.5	36	90.0	36.32 <0.001**	30.72 <0.001**
	Done incorrectly	18	45.0	3	7.5	4	10.0		
Ankle (dorsal flexion)	Done correctly	8	20.0	35	87.5	34	85.0	91.64 <0.001**	84.71 <0.001**
	Done incorrectly	32	80.0	5	12.5	6	15.0		
Ankle (planter flexion)	Done correctly	5	12.5	26	65.0	26	65.0	58.06 <0.001**	58.06 <0.001**
	Done incorrectly	35	87.5	14	35.0	14	35.0		

** Highly significant (p ≤ 0.001)

1. (pre program) vs (immediate post program) among Study group- 2. (pre program) vs (post 2 months of program) among Study group

Figure (3): Distribution of total practice level about intradialytic range of motion exercise among study group pre, immediate post and post two months of program implementation (n=40).



** Highly significant ($p \leq 0.001$)

(1) (pre program) vs (immediate post program) among Study group

(2) (pre program) vs (post 2 months of program) among Study group

Table (5). Comparison between the mean scores of blood pressure among the studied patients throughout pre, post one month and two months of program implementation, control group (n=40), and study group (n= 40).

Blood pressure		Studied groups		U-test p value
		Control group	Study group	
		$\bar{X} \pm SD$	$\bar{X} \pm SD$	
Pre program	Systolic pressure	159.63±3.47	158.37±3.99	716.500 0.271 n.s
	Diastolic pressure	99.75±2.76	96.00±6.32	438.000 <0.001**
One month post program	Systolic pressure	141.50±2.32	143.38±4.72	594.000 0.026*
	Diastolic pressure	90.13±0.79	86.50±4.69	487.500 <0.001**
Two months post program	Systolic pressure	142.00±2.95	138.88±4.73	536.000 0.003*
	Diastolic pressure	90.13±0.79	86.50±4.69	487.500 <0.001**
Fr –test P value	Systolic pressure	75.062 (<0.001**)	114.419 (<0.001**)	
	Diastolic pressure	76.000 (<0.001**)	53.388 (<0.001**)	

Fr: Friedman test U: Mann Whitney test Not significant (p > 0.05) (*) Statistically Significant at ≤0.05
**** Highly significant (p<0.001)**

Table (6). Comparison between the mean score of fatigue among the studied patients throughout pre, post one month and two months of program implementation, control group (n=40), and study group (n= 40).

Fatigue	Studied groups		U-test p value
	Control group	Study group	
	$\bar{X}$ ± SD	$\bar{X}$ ± SD	
Pre program	41.28±2.53	41.40± 2.49	779.000 0.836 n.s
One month post program	34.40±4.94	21.35±3.17	24.000 <0.001**
Two months post program	34.15±5.21	20.33±3.28	29.000 <0.001**
Fr test **P value**	115.274 <0.001**	116.889 <0.001**	

Fr: Friedman test U: Mann witney test Not significant (p > 0.05) ** Highly significant (p ≤ 0.001)

Table 7: Correlation between studied variables among the studied patients after two months of program implementation: study group (n= 40) & control group (n=40)

Variables	r-p		Total knowledge	Fatigue
Systolic Blood pressure	Study group	**r**	-0.788	0.635
		p	<0.001**	<0.001**
	Control group	**r**	-0.338	0.304
		p	0.033*	0.056n.s
Diastolic Blood pressure	Study group	**r**	-0.724	0.711
		p	<0.01**	<0.001**
	Control group	**r**	-0.670	0.128
		p	<0.001**	0.430 n.s
Fatigue	Study group	**r**	-0.904	-
		p	<0.001**	
	Control group	**r**	-0.952	-
		p	<0.001**	

Not significant (p > 0.05) (*) Statistically Significant at ≤0.05 ** highly significant (p ≤ 0.001)

Discussion

Chronic Kidney disease is a progressive and gradual loss of kidney function, which is commonly caused by diabetes and hypertension. End-stage renal disease is diagnosed when the glomerular filtration rate is less than 15 mL/min/1.73m2. Early management of chronic kidney disease patients and referral is a key component in order to preserve kidney function and delay complications **(Gołębiowski, et al., 2021).**

Hemodialysis is always a stressful condition to the patients who undergo the procedures of frequent dialysis. Numerous studies highlight the value of physical activity in dialysis patients because of their restricted mobility. Exercise increases muscle activity, which increases blood circulation, decreases fatigue levels, and maintains normal blood pressure. **(Alsuwaida, et al., 2020).**

Demographic characteristics of the studied patients. Regarding age: the current study revealed that, more than half of studied patients were over 50 years old and there was

no significant difference between both studied groups, this is in line with **Soliman (2019)**, who study about " Effect of intradialytic exercise on fatigue, electrolytes level and blood pressure in hemodialysis patients" and stated that more than three quarters of sample age ranged between 56-65 years with no significant differences in the experimental and control groups' age, gender, marital status, living conditions, education levels, or work status. This finding is also similar with **Mohamed et al., (2020)**, whose study about " Effect of Intradialytic Range of Motion Exercises on Dialysis Efficacy and Blood pressure among Patients Undergoing Hemodialysis", which reported that There were no statistically significant differences between both groups regarding social characteristics.

This finding is also in accordance with **Ramai &Diana (2021),** who found that the majority of study subject were above 50 years which stated in their study about " Impact of intradialytic exercise on fatigue, biochemical and physiological parameters in patients on maintenance hemodialysis " .

As regard to gender, the current study results revealed that more than half of studied patients in the study and control groups were females. This finding is agree with **Zhang & Rothenbacher (2019)**, who study about " Prevalence of chronic kidney disease in population-based studies: systematic review. "that more than half of studied patients were females.

This is incongruent with **United States Renal Data System, (2020),** who study about " Annual Data report: Epidemiology of kidney disease in the United States ", and reported that More than half of the studied patients in the study and control groups were males

Also the result of the current study disagree with **Christoforos, et al., (2020)** who study about " The Effect of Prolonged Intradialytic Exercise in Hemodialysis Efficiency Indices" and reported that the majority of the studied patients were male.

Concerning to marital status, the present study finding revealed that more than two third of studied patients study and control group were married .

This finding goes in the same line with **Zhang&Rothenbacher,(2019)**,who reported that the majority of the studied patients in the study and control groups were married**.**

In respect to the level of education, the result of the present study revealed that less than half of both study and control group were not reading and write.

This finding is agree with study by **Soliman (2019)**, who stated that fewer than half of studied patients were illiterate. Similarly, this result concur with study by **Ramai &Diana , (2021)** found that less than half of studied patients were not reading and write.

This finding conflicted with **Arazi , (2021),** who showed in their study about "Effects of different types of exercise on kidney diseases " that the majority of studied subjects were illiterate.

From the researcher point of view, this could be due to that most of the studied patients are live in rural area with less attention to education and decrease the level of health awareness.

As regard to occupation, the finding of the present study represented that less than half of studied patients were employed. This finding is in line with study by **Kouidi & Deligiannis, (2019)** titled " Effects of exercise training on noninvasive cardiac measures in patients undergoing long-term hemodialysis. " they reported that less than one third of patients were employed.

Also this finding goes in the same line with **Gaipov et al., (2020),** who study about " Epidemiology of dialysis-treated end-stage renal disease patients ", and reported that less than half of studied patients were employed.

From the researcher point of view, this might be because more than half of the patients who were investigated were female and the majority of them are unemployed.

Medical history of studied patients control group and study group.

Concerning patients' medical history;

There was no significant difference between both control and study groups. displaying that more than two third of studied patients had no family history of renal failure.

Regarding smoking: the finding of the present study, revealed that more than half of studied patients were smokers. this finding goes in the same line with **Mohamed et al., (2020)**, reported that more than half of studied patients were smokers.

This finding disagreed with **Tamilmozhi, et al., (2021**) who study about " A Quasi-Experimental Study to Evaluate the Effectiveness of Intradialytic Leg Exercise on Pain, Fatigue and Quality of life among Patients undergoing Hemodialysis' 'and reported that more than half of studied patients were nonsmokers.

In relation to studied patient's weight, the result of the current study displayed that near half of study group and half of control group were overweight. This finding is agree with **Chang, et al,. (2020)** in their study about "The effectiveness of intradialytic leg ergometry exercise for improving sedentary life style and fatigue among patients with chronic kidney disease" and reported that the majority of studied patients were overweight.

Concerning duration of hemodialysis : the finding of the present study, revealed that near half of study group and half of control group were undergoing hemodialysis since 1 <5 years and there was no significant difference between both control and study groups regarding years of Hemodialysis.

This result is in accordance with **Konstantinidou, et al., (2021)** who study about " Exercise training in patients with end-stage renal disease on hemodialysis: comparison of three rehabilitation programs " and reported that three quarter of studied patients were undergoing hemodialysis from one to five years. Additionally, this result is consistent with a study by **Ramai & Diana (2021),** which found that more than two thirds of the patients remained on maintenance hemodialysis for a period of one to five years.

This result disagree with **Soliman (2019)**, who stated that there were a significant change in the two groups regarding years of Hemodialysis where more than two third of control group on Hemodialysis from one to five year and less than half of experimental group on Hemodialysis from one to five years.

AS regard Presence of comorbid disease the present study shows that more than half of studied patients study and control group had comorbid disease and about one third of them had diabetes mellitus.

This finding is consistent with **Rhee,et al., (2020)**, who study about " Intradialytic exercise improved physical function and reduces intradialytic hypotension and in hemodialysis patients ", and reported that more than half of studied patients were diabetic. Additionally, **ELShemy, et al.,(2019)** study on the " Efficacy Of Exercise Program In Intra Hemodialysis On patients' Quality Of Life" which discovered that nearly half of the patients under study had diabetes mellitus, supported this finding.

This finding is inconsistent with **So Yon, et al., (2019)** who study about "Intradialytic exercise improves physical function and reduces intradialytic hypotension and depression in hemodialysis patients" reported that most of studied patients were hypertensive. Also this result supported by **Al.Rashei & Ghaleb (2019)** the who study about " Effectiveness of Intradialytic Leg Exercise on Dialysis Efficacy among Patients Undergoing Hemodialysis" which found that hypertension was the most prevalent comorbidity in both groups

In relation to incidence of hemodialysis complications the present study demonstrates that there was no significant statistical difference between control and study groups regarding incidence of hemodialysis complications, where the highest incidence of complications was chest pain among control

and study groups. This result in the line with **Christoforos, et al., (2020)** who study about " The Effect of Prolonged Intradialytic Exercise in Hemodialysis Efficiency Indices" and reported that the most common complications among hemodialysis patients was chest pain. On the other hand **Al.Rashei& Ghaleb (2019)** demonstrated that hypertension was the most common complication among hemodialysis patients.

Regarding to patients' knowledge the current study displays that there was no significant statistical difference between control and study groups regarding their knowledge level about renal failure and intradialytic range of motion exercise pre program, while there was a highly significant statistical difference between both groups regarding their knowledge during immediate and two months periods post program implementation. This result aligns with **Jung & Park (2020)**, who study about " Intradialytic exercise programs for hemodialysis patients " which demonstrates that there were highly statistically significant differences in knowledge levels between the experimental and control groups before and after the 8-week period. Also this result supported by **So Yon, et al., (2019)** who study about "Intradialytic exercise improves physical function and reduces intradialytic hypotension and depression in hemodialysis patients" and reported that there was a highly statistically significant changes in knowledge level pre and post program implementation among study and control group.

In relation to patients' practice of intradialytic range of motion exercise the present study shows that 80.0% among study group had poor level of practice pre program period to reach to a agood level among (93.8% & 75%, respectively) during immediate post and two months post program implementation periods.

This is agree with the results of the study **Bullani, et al., (2021)** titled " Effect of in-tradialytic resistance band exercise on physical function in patients on maintenance hemodialysis ", and stated that the total scores of patients in the first was about two thirds of the study group did poor exercises. While in the 2nd week, about half of study group did acceptable exercises and about more than half of them did good exercises. With highly significant difference ($p \leq 0.001$).

Regarding blood pressure among the studied patients throughout pre, post one month and two months of program implementation , the current study demonstrates that there were no significant differences between the two groups during the pre-program period but that there were throughout the one and two months following the program in terms of more stable blood pressure among study group. Additionally, there was a highly significant difference in systolic and diastolic scores within each group throughout measurement periods.

This result agree with **Dziubek., et al., (2020)** who study about " The Effects of Aquatic Exercises on Physical Fitness and Muscle Function in Dialysis Patients " They found that sessions of range-of-motion exercises held during hemodialysis were linked to improved hypertension control. After eight weeks of exercise, the experimental group's blood pressure results showed a highly significant improvement. This come in accordance with a results done by **Henrique, et al., (2021)** who stated in his study about " Aerobic Exercise Improves Physical capacity in Patients under Chronic Hemodialysis" that at the end of the exercise program, there was a statistically significant reduction in systolic and diastolic blood pressure, despite maintaining the same doses of antihypertensive drugs and the dry weight of patients. Also this result supported by **Smith, (2021) t**itled " Physiological benefits of exercise in pre-dialysis chronic kidney disease ", and showed that there was statistically significant difference between the study and control groups in the first month. Also, there was a high statistically significant difference between the study and control groups in the second month. Regarding diastolic blood pressure, the result of the current study showed that there was statistically significant difference between the study and control groups in the second month.

Reduction in the cardiac load because of favorable effects of exercise on the peripheral vascular resistance, sympathetic nervous system

activity and also possibly to the renin-angiotensin system according to **Deligiannis, et al., (2019).**

This result contradicts **Seong, (2021)** about "Acute intradialytic exercise and oxidative stress in hemodialysis patients." claim that there was no discernible difference between the study and control group in terms of physiological and biochemical indicators.

In relation to the mean score of fatigue among the studied patients, where there were no significant difference between both control and study groups during pre program period to be highly significantly different during one and two months periods post program in term of lower fatigue score among study group. Also there was a highly significant difference in fatigue score within each group throughout measurement periods.

This result agree with **Zhang & Rothenbacher (2019)**, who shows that the pretest mean score of fatigue in experimental group was 29.89 and post 8 week mean score of fatigue was 14.44 which was statistically significant. This shown that after completing eight weeks of doing intraadialytic range of motion exercises, the patients in the experimental group had experienced less fatigue. Between the experimental and control groups, there were statistically significant differences in the fatigue score before and after the eight-week period. Similarly, this result is agreement with **ELShemy, et al., (2019)** in their study about" Efficacy Of Exercise Program In Intra Hemodialysis On patients' Quality Of Life" and, found that the differences and improvement between pre and post three months exercise. This finding is also similar to **Tamilmozhi, et al., (2021**) who study about " A Quasi-Experimental Study to Evaluate the Effectiveness of Intradialytic Leg Exercise on Pain, Fatigue and Quality of life among Patients undergoing Hemodialysis" reported that intradialytic leg exercise was effective in reducing the level of fatigue in experimental group than the control group.

Also this finding is consistent with **Dziubek, et al., (2020)**, stated that the Intradialytic range of motion exercise showed a significant difference between study and control group at 1 and 3 months, showing that the intervention was successful. The average fatigue score of the intervention group has gradually decreased, indicating a statistically significant decline in fatigue in this group.

Conclusion

Based on the findings of the current study, it concluded that: Implementing Intradialytic Range of Motion Exercises Program was effective in improving knowledge, decreasing level of fatigue and maintaining stable blood pressure among study group than control group.

Recommendations

Based on results of the present study the following recommendations can be suggested:

- Exercise planning should be scheduled at optimal volume and intensity and be based on the patient's age and comorbidities.
- Patients should be motivated to participate in supervised exercises training programs
- Further studies are more required to help in results generalization.
- Range of motion exercises posters should be placed in dialysis units in Arabic versions.

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