Effect of Passive and Active Stretching Exercises on Controlling Leg Cramps for Patients undergoing Hemodialysis

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Abstract

Background: One of the most prevalent physical symptoms among patients undergoing hemodialysis is muscle cramping. Active and passive stretching exercises may be helpful in alleviating leg muscles cramps for those patients. **Study aims to:** Evaluate the effect of practice passive and active stretching exercises on controlling muscle cramps for patients on hemodialysis. **Subjects and method:** Quasi experimental pretest-posttest research design was employed. **Setting:** It was conducted at hemodialysis unit at Kafrelsheikh general hospital, one of the hospitals of Ministry of health, Kafrelsheikh governorate, Egypt. **Subjects:** A purposive sample of 50 hemodialysis patients divided equally into study group who practice stretching exercises and control group who received ordinary hospital care. **Tools**: two tools were used. Tool (I) "Structured Interview questionnaire" It was created by the researchers to collect data about demographic and clinical data. Tool (II) "Muscle cramps questionnaire chart": it used to assess the intensity level of muscle cramp for patients on hemodialysis. **Results:** There was statistically significant reduced in the muscle cramps intensity level of the study group after practice stretching exercises (p= <0.001*). **Conclusion**: Active and passive stretching exercises have positive effect on reducing level of leg muscle cramps among hemodialysis patients. **Recommendation**: Enroll Intradialytic stretching exercises with routine nursing care for hemodialysis patients.

Keywords: Active and passive stretching exercises, Hemodialysis, Leg cramps.

Introduction

End stage renal disease (ESRD) is an irreversible progressive renal disease when kidney function is no longer enough to maintain life (GFR <15 mL/min/1.73m2). The prevalence (ESRD) is rising at an obvious rate, with more than two million persons globally suffering from the disease and over than 1.4 million persons undergoing Renal Replacement Treatment (RRT) **(Al-Sabbah, et al., 2019)**. This condition is especially severe in underdeveloped nations with limited health-care resources (**Lv, & Zhang 2019).** Hemodialysis (HD) is the most used technique of replacement of the renal system worldwide. This is a lengthy procedure that requires three to five hours every day, two or three times per week **(Qarni, et al., 2020; Park, & Jung, 2017).**

In Egypt, ESRD is one of the most serious health issues; the yearly incidence of ESRD is estimated to be about 74 per million, with a total prevalence of 264 per million people on hemodialysis. the most common causes of ESRD in Egypt include diabetic nephropathy hypertensive kidney disease, chronic glomerulonephritis, and obstructive uropathy. obstructed urinary uropathy **(El-Arbagy et al., 2016; Afifi 2008).**

Many complications like hypotension, muscular cramps, fatigue, and nausea can develop during hemodialysis session **(Isaac & Jacob, 2016).** Muscles cramps is a sudden involuntary muscle spasm that causes considerable pain and happens often in hemodialysis patients. Leg cramps most often affect the calf, foot, toe, and thigh muscles, but they can also affect the arms and hands, as well as the abdominal muscles. **(Salem & Elhadary, 2017).**

Whereas the precise cause of muscle cramps is unknown, there have been a number of frequent triggers identified, including, hypotension, dialysate composition, rapid ultrafiltration, hypovolemia and Interruptions in electrolyte and mineral metabolism, such as high levels of calcium and phosphorous in the

blood and low levels of sodium, potassium, and magnesium in HD patients **(Mastnardo, 2016); Ulu, & Ahsen, 2015).** Furthermore, therapeutic immobility for three to four hours, which causes progressive muscle wasting, poor blood supply, and reduced blood flow can lead to muscle fatigue and cramping **(Poornzaari, et al., 2019).**

Muscle cramps are the most prevalent problems for patients undergoing HD, affecting around 33 percent to 86 percent of patients and resulting in pain, insufficient dialysis time, and premature HD termination **(Lekha, 2016)**. The early termination of dialysis session may also result in decreased fluid removal, insufficient waste product clearance, fluid overload, hypertension, and an increased risk of death, it may impact a patient's choice to discontinue dialysis therapy in extreme circumstances **(Ghaleb, 2020).**

Nonpharmacological therapy is essential for reducing and treating muscular cramps as well as minimizing the harmful effects of pharmacotherapy. Stretching exercises and strengthening exercises are most often used nonpharmacological treatment in reducing muscle cramp **(Isaac, & Jacob, 2016).** Also **(Laxmipriya, & SA, 2020)** concluded that intradialytic stretching exercises was effective in preventing and reducing muscle spasms during hemodialysis. Leg stretching exercises performed during dialysis such as quadriceps knee strengthening exercises, hamstring stretch, and gluteal muscle strengthening exercises, increase muscular protein production and catabolism, which assists in the assessment of both strength and overall body function **(Punithavathi, 2016).**

Nurses are an integral member of the healthcare team responsible for providing care for patients on the dialysis apparatus. They also play a part in a variety of other activities as protecting, monitoring and training the patient and his family concerning complications of dialysis and how they can be prevented or reduced such as muscle cramps, inadequate ultrafiltration, hypotension, air emboli, and vomiting **(Isaac & Jacob, 2016).** Also **(Sasirekha, 2017)** added that, hemodialysis nurses are in unique position to assist in the monitoring, evaluation, and management techniques of patients with muscle cramps.

Significant of the Study

Muscular cramps can have serious consequences for individuals receiving HD, since they are the most common cause for a HD session to be terminated early **(Ghaleb, 2020)**. Evidence-based practice recommends that special attention is needed regarding the diagnosis and management of cramps in the muscles during the HD sessions to prevent premature termination of the HD procedure **(Lekha, 2016).** Most patients view these symptoms as having a tremendous influence on their quality of life due to interference with social relation and general wellbeing, this symptom relief may dramatically enhance patient-reported outcomes.

Furthermore, HD patients emphasize symptom management as an important topic of research and innovation, prioritizing symptoms over other health outcomes such as mortality and laboratory indicators **(Flythe, et al 2018; Cox, et al 2017)**. Also, patients' compliance on hemodialysis can be enhanced by controlling of muscle cramps **(Mohmadi, et al 2016).** Furthermore, stretching exercises are easily implemented by patients, and they have a benefit effect regarding muscle cramps when applied to the legs with no effect on dialysis interruption **(Aliasgharpour, et al., 2016)**. So, this study is conducted to determine the effect of intradialytic passive and active stretching exercise on muscle cramps among hemodialysis patients.

Study aim

- Evaluate the effect of practice intradialytic passive and active stretching exercises on controlling muscle cramps for patients on hemodialysis.

Research hypothesis

H1: The study group who practice passive and active stretching muscles exercises will have significantly lower level of muscle cramps intensity than the control group that got the ordinary HD unit care.

Subjects and Methods:

Research design:

The study used a quasi-experimental research design. A quasi-experimental study design is a prospective or retrospective study in which patients self-select or are randomly assigned to one of many treatment groups to examine the true effectiveness and safety of non-randomized therapies **(Maciejewski, 2019).**

Setting:

The study was conducted at hemodialysis unit at Kafrelsheikh general hospital, one of the hospitals of Ministry of health, Kafrelsheikh governorate, Egypt. This unit composed of 4 parts containing 42 hemodialysis machines, 7 of them are allotted for hepatitis C patients, 3 machines are allotted for hepatitis B patients in a separate room, and 2 machines for emergency dialysis. The type of all machines is Fresenius model 4008. The unit operates 3 shifts throughout the week except on Friday.

Subjects:

A purposive sample of 50 hemodialysis patients were included using the Epi info7 software, which was used to estimate sample size using the following data. The total population of selected hospital was 150 with an expected frequency of 50%, an acceptable error of 10%, a confidence coefficient of 95%.

The selected subjects based on the following criteria

- Willing to take part in the study
- The age is between 18 to 60 years, both genders.
- On regular hemodialysis for at least three months ago, two or three times each week.
- Have a history of muscle cramps during hemodialysis session.
- Hemodialysis patients with femoral catheter, intellectual or mentally retarded, have lower limb deformity, or who have hemodynamic instability in previous sessions were excluded.

Tool for Data collection:

Two tools were used for data collection:

Tool (I): "Structured Interview Questionnaire": It was constructed by the researchers to collect data about demographic and clinical data from the studied patients after reviewing the relevant references as **Sasirekha, (2017)**; **Isaac & Jacob, (2016),** which included two parts

Part (1): Demographic data as age, gender, educational level, area of residence and occupation

Part (2): Clinical data which collect data about past and present medical history which including the duration of the dialysis treatment, associated diseases, number of hours on dialysis, number of hemodialysis session per week, prescribed medications, weight in current session, mean blood pressure during hemodialysis, ultrafiltration rate, time of occurrence of muscle cramp during dialysis session, the affected part of muscle cramp, and the effect of muscle cramp on activity of daily living

Tool II: Muscle Cramps Questionnaire Chart: It was developed by **Morris, (2014).** Used to measure the intensity of muscular cramp for hemodialysis patients which includes 5 items namely frequency of muscle cramps, duration of muscle cramps, quality of muscle cramps, temperature and level of pain "Numerical Rating Scale". This tool includes total scores ranging from 0 to 13, with a 0-score indicating no cramps, 1-4 score indicating mild cramps, 5-8 score indicating moderate cramps, and 9-13 score indicating severe cramps.

Tool validity and reliability

- The content validity of the tools was determined by a jury of five professors in the specialty of medical surgical nursing who assessed the tools for clarity and competency, their modification was taken in consideration. The tool reliability for second tool was 0.775 by using Cronbach's Alpha test.

Pilot study

- A pilot study was implemented on 10% of the total sample (5 patients) to examine the clarity and relevance of the research method. No changes were made. Patients who took

part in the pilot were not included in the study.

For ethical considerations:

- Permission from the ethical committee to carry out this study was got from Faculty of Nursing, Damanhur University, Egypt.
- Each patient was knowledgeable about the purpose and benefits of the study, and then verbal consent was taken before data collection began. Strict confidentiality was ensured through the study process. The researchers told the participants that participation in the study is fully voluntary and that they can withdraw at any period.

Field Work

The study was carried out in the following three stages: Preparatory stage, implementation stage and evaluation stage which took about 3 months for data collection from the February till May 2020 in the evening and morning shift.

Data collection procedure:

Phase 1: Preparatory stage

- Official permission to conduct research was obtained from the authorized personal of Kafrelsheikh general hospital, Egypt.
- Tools of data collection and instruction booklet was developed after review of relevant literature, as **Salem, & Elhadary (2017); Sasirekha, (2017); Kishor, et al., (2016); Morris, (2014).**

Phase II: The implementation stage:

- During this phase, the enrolled patients are randomly divided into two equal arms (study and control groups) 25 patients per each.
- Consent to participate in the study had been obtained from the participant.
- Each patient in both study and control group interviewed personally in the dialysis unit prior to the start of dialysis session to collect essential data by using study tools. It took about 15-20 minutes (pretest).
- The contents of stretching exercises covered in two sessions.

In the first session

- Every patient of study group was interviewed personally to explain the causes of muscle cramps as well as the purpose, benefits, and steps of active and passive stretching exercises.

In the second session

- Before starting the stretching exercises, ask the hemodialysis patients to take slow deep breathing and exhale slowly during period of exercises.
- Inform the patients to stop performance of exercises if they have muscles or joints pain.
- All hemodialysis patients in the study group received the active and passive stretching exercises procedure by the researchers for about 20 minutes, two times per hemodialysis session. First time at the end of first hours and second time at the end of the second hours of dialysis session by using illustrated booklet, demonstration and redemonstrations.
- Stretching exercises consisted of ankle dorsiflexion, soleus stretching, gastrocnemius stretching, hamstring stretching, and quadriceps stretching.
- Each stretching exercise was performed five times.
- The researchers started with passive exercises followed by active exercises that the patients did themselves.
- Hemodialysis patients in the control group received only ordinary care.

The evaluation phase:

- The aim of this phase was to assess the effect of practice of active and passive stretching exercises on HD patients by using study tools after 4 weeks (posttest) by comparing the study and control group.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution.

Quantitative data were described using mean, standard deviation. Significance of the obtained results was judged at the 5% level.

- **Chi-square test used** for categorical variables, to compare between different groups**.**
- **Fisher's Exact or Monte Carlo correction, used for** correction for chi-square when more than 20% of the cells have expected count less than 5.
- **Student t-test,** for normally distributed quantitative variables, to compare between two studied groups.
- **Paired t-test,** for normally distributed quantitative variables, to compare between two periods.
- **Mann Whitney test,** for abnormally distributed quantitative variables, to compare between two studied groups.
- **Wilcoxon signed ranks test, f**or abnormally distributed quantitative variables, to compare between two periods**.**
- **McNemar and Marginal Homogeneity Test,** used to analyze the significance between the different stages.

Results

Table (1) Demonstrates that 76.0% and 68.0% of the study and control group were in the age group ranged from 50 – 60 years old respectively. Regarding to gender 56.0% and 60.0% were males in both the study and control group respectively. Referring to level of education 48.0% and 44.0% of the two groups respectively have diploma degree. As regards occupation, 40.0% and 36.0% of both study and control group were housewives respectively. There is no statistically significant difference between the two groups regarding demographic data.

Table (2) illustrates that 64.0% and 56.0% have had dialysis sessions for 5 years or less for both study and control group respectively, Also, (44.0%) of the study group and (24.0%) of the control group have history of diabetes mellitus. Regarding numbers of dialysis hours per session (60.0%, 52.0%) had three hours per session respectively. Also 80.0% and 76.0% of them experience hemodialysis sessions three times per week for the study and control group. As for use of prescribed medications this table shows that (40.0%) of the study group had IV iron supplementation and 28.0% in the control group had nifedipine tablets.

Table (3) Demonstrates that the difference between the two groups was statistically significant regarding systolic pressure post practice stretching exercises p value at (p= 0.009), in relation to ultrafiltration rate there was statistically significant difference among study group pre and post practice stretching exercises. On the contrary, there was no statistically significant difference between the study and control group regarding diastolic blood pressure, and weight in the current session.

Table (4) illustrates time of occurrence of muscles cramps during dialysis session, there was 60.0%, and 56.0% for both groups respectively had muscle cramps in the last hours and the muscle cramps of lower limb represent 72.0%, 80.0% for both groups respectively pre practice stretching exercises and reached to 44%, 68.0% for both groups respectively post practice stretching exercises. Referring to awaken during night due to muscles cramps this table shows that 56.0%, and 68.0% of the study and the control groups respectively awaken during night due to muscles cramps pre practice stretching exercise, compared to 24.0%, and 72.0% of the both groups after practice stretching exercise with statistically significant difference between two studied groups after practice stretching exercises

Table (5) shows that there was statistically significant difference between the two groups regarding the effect of muscle cramps on activity of daily living post practice stretching exercise as p value at p= <0.001*.

Table (6) clarifies that 76.0%, and 68.0% of studied patients had severe muscle cramps pre practice stretching exercises for both groups respectively, but after practice stretching exercises there was 52.0% of the study group compared to 4.0% of the control group had no muscle cramps with statistically significant improvement in the level of muscle cramps intensity of the study groups after practice stretching exercises p value at (p= $<0.001^{*}$).

Table (1): Comparison between the two studied groups according to demographic data (n=50).

Demographic data	Study (n=25)		Control (n=25)		Test of sig.	p
	No.	%	No.	%		
Age (years)						
<40	2	8.0	4	16.0	χ^2= 0.876	MCp= 0.908
40 – <50	4	16.0	4	16.0		
50 – 60	19	76.0	17	68.0		
Gender						
Male	14	56.0	15	60.0	χ^2= 0.082	0.774
Female	11	44.0	10	40.		
Marital status						
Single	2	8.0	2	8.0	χ^2= 0.841	MCp= 0.931
Married	16	64.0	15	60.0		
Widowed	4	16.0	6	24.0		
Divorced	3	12.0	2	8.0		
Level of education						
Illiterate	5	20.0	5	20.0	χ^2= 0.914	MCp= 1.000
Primary school	3	12.0	4	16.0		
Diploma	12	48.0	11	44.0		
Technical	1	4.0	1	4.0		
BSC	4	16.0	4	16.0		
Occupation						
Manual	4	16.0	8	32.0	χ^2= 2.124	MCp= 0.610
Professional	7	28.0	6	24.0		
Housewife	10	40.0	9	36.0		
Not working	4	16.0	2	8.0		
Area of residence						
Rural	15	60.0	15	60.0	χ^2= 0.0	1.000
Urban	10	40.0	10	40.0		

χ^2: Chi square test MC: Monte Carlo test p: value for comparing between the two studied groups

Table (2): Comparison between the two studied groups according to clinical data (n=50).

Part II: Clinical data	Study (n=25)		Control (n=25)		Test of sig.	p
	No.	%	No.	%		
Duration of dialysis treatment						
<5	16	64.0	14	56.0	χ^2=0.333	0.564
5–10	9	36.0	11	44.0		
Mean ± SD.	4.24 ± 2.26		3.96 ± 2.42		t=0.423	0.675
Associated diseases #						
Diabetes mellitus	11	44.0	6	24.0	χ^2=2.228	0.136
Hypertension	6	24.0	6	24.0	χ^2=0.0	1.000
Neurological disorder	1	4.0	2	8.0	χ^2=0.355	FEp=1.000
Others (Systemic lupus)	1	4.0	2	8.0	χ^2=0.355	FEp=1.000
Number of hours patient stay on dialysis machine in a day						
3 hours	15	60.0	13	52.0	χ^2=0.325	0.569
4 hours	10	40.0	12	48.0		
Mean ± SD	3.40 ± 0.50		3.48 ± 0.51		U=287.50	0.573
Number of hemodialysis session per week						
Twice	5	20.0	6	24.0	χ^2=0.117	0.733
3 times	20	80.0	19	76.0		
Mean ± SD.	2.80 ± 0.41		2.76 ± 0.44		U=300.0	0.735
Prescribed medications #						
IV iron supplementation	10	40.0	4	16.0	χ^2=3.571	0.059
Nifedipine	7	28.0	7	28.0	χ^2=0.00	1.000
Long acting B agonists	2	8.0	5	20.0	χ^2=1.495	FEp=0.417

χ^2: Chi square test FE: Fisher Exact t: independent t-test U: Mann Whitney test
 # Multiple responses

Table (3): Comparison between the two studied groups according to clinical data (n=50) "continue"

Part II: Clinical data	Study (n=25)		Control (n=25)		Test of sig.(p_1)	Test of sig.(p_2)
	Pre	Post	Pre	Post		
clinical data						
Weight in current session						
Mean ± SD.	77.24 ± 9.86	77.20 ± 9.68	78.24 ±12.84	78.48 ±12.59	t=0.309 (0.759)	t=0.403 (0.689)
t_1 (p_0)	**0.296 (0.770)**		**1.297 (0.207)**			
Mean blood pressure during hemodialysis Systolic						
Mean ± SD.	134.80±15.31	130.0±12.58	133.60±29.67	140.0±13.23	t=0.180 (0.858)	t=2.739* (0.009*)
t_1 (p_0)	**2.493* (0.020*)**		**1.131 (0.269)**			
Diastolic						
Mean ± SD.	80.80 ± 8.12	79.20 ± 7.02	78.60 ± 7.0	80.40 ± 7.35	U=288.0 (0.597)	U=277.50 (0.454)
Z (p_0)	**836 (0.403)**		**0.619 (0.536)**			
Ultrafiltration rate						
Mean ± SD.	224.0±109.09	198.0±96.26	240.0±100.0	234.0±87.46	U=283.50 (0.559)	U=236.0 (0.126)
Z (p_0)	**2.235* (0.025*)**		**1.089 (0.276)**			

t: Student t-test **U: Mann Whitney test** **t_1: Paired t-test** **Z: Wilcoxon signed ranks test**

p_0: p value for comparing between pre and post in each group

p_1: p value for comparing between the two studied groups in pre test

p_2: p value for comparing between the two studied groups in post test

*: Statistically significant at $p \leq 0.05$.

Table (4): Comparison between the two studied groups according to clinical data (n=50) "continue"

Part II: Clinical data	Study (n=25)				Control (n=25)				$\chi^2(p_1)$	$\chi^2(p_2)$
	Pre		Post		Pre		Post			
	No.	%	No.	%	No.	%	No.	%		
Time of occurrence of muscle cramp during dialysis session										
No	0	0.0	11	44.0	0	0.0	0	0.0		
First hour	4	16.0	0	0.0	2	8.0	3	12.0	0.0 (1.000)	14.558*
Middle hour	6	24.0	6	24.0	9	36.0	9	36.0		(0.001*)
Last hour	15	60.0	8	32.0	14	56.0	13	52.0		
$^{MH}p_0$	0.010*				0.180					
Site of muscle cramps										
No	0	0.0	11	44.0	0	0.0	0	0.0		
Lower limb	18	72.0	11	44.0	20	80.0	17	68.0	0.531	0.034
Neck	7	28.0	3	12.0	5	20.0	8	32.0	(^{FE}p=0.678)	(^{FE}p=1.000)
$^{MH}p_0$	0.004*				0.317					
Awaken during night due to muscle cramp										
No	11	44.0	19	76.0	8	32.0	7	28.0	0.764	11.538*
Yes	14	56.0	6	24.0	17	68.0	18	72.0	(0.382)	(0.001*)
$^{McN}p_0$	0.039*				1.000					
IF yes how many during the last week Mean ± SD.	1.50± 0.65		1.17± 0.41		1.47 ±0.62		1.44 ±0.62		U=116.50 (0.922)	U=41.50 (0.415)
Z (p_0)	**0.000 (1.000)**				**0.000 (1.000)**					

χ2: Chi square test **FE: Fisher's Exact** **McN: McNemar test**

MH: Marginal Homogeneity Test **U: Mann Whitney test**

p_0: p value for comparing between **pre** and **post in each group**

p_1: p value for comparing between the two studied groups in **pre** test

p_2: p value for comparing between the two studied groups in **post** test

*: Statistically significant at $p \leq 0.05$.

Table (5): Comparison between the two studied groups according to effect of muscle cramps on activity of daily living (n=50).

Part II: Clinical data	Study (n=25)				Control (n=25)				$\chi^2(p_1)$	$\chi^2(p_2)$
	Pre		Post		Pre		Post			
	No.	%	No.	%	No.	%	No.	%		
Effect of muscle cramps on activity of daily living	0	0.0	21	84.0	0	0.0	0	0.0	4.025 (^{MC}p=0.166)	43.409* (^{MC}p<0.001*)
No, not limited at all	2	8.0	1	4.0	5	20.0	5	20.0		
Yes, limited a little	10	40.0	3	12.0	9	36.0	8	32.0		
Yes, limited a lot										
Yes, muscle cramps stop me from doing this activity	13	52	0	0	11	44.0	12	48.0		
$^{MH}p_0$	<0.001*				0.317					

χ^2: **Chi square test** **McN: McNemar test** **MH: Marginal Homogeneity Test**
p_0: p value for comparing between **pre** and **post in each group**
p_1: p value for comparing between the two studied groups in **pre** test
p_2: p value for comparing between the two studied groups in **post** test
*: Statistically significant at $p \leq 0.05$.

Table (6): Comparison between the two studied groups according to level of muscles cramps (n=50).

Tool II: Muscle cramps questionnaire chart	Study (n=25)				Control (n=25)				Test of sig. (p_1)	Test of sig. (p_2)
	Pre		Post		Pre		Post			
	No.	%	No.	%	No.	%	No.	%		
No cramps (0)	0	0	13	52.0	0	0	1	4.0	χ^2= 0.397 (0.529)	χ^2= 27.899* (<0.001*)
Mild cramps (1-4)	0	0	7	28.0	0	0	2	8.0		
Moderate cramps (5–8)	6	24.0	3	12.0	8	32.0	4	16.0		
Severe cramps (9-13)	19	76.0	2	8.0	17	68.0	18	72.0		
Total score Mean ± SD.	9.20±1.47		5.56 ±2.16		8.72 ± 1.24		9.0±1.15		U=247.0 (0.175)	U=67.50* (<0.001*)
Z (p_0)	4.125*(<0.001*)				1.361(0.174)					

χ^2: **Chi square test** **U: Mann Whitney test** Z: **Wilcoxon signed ranks test**
p_0: p value for comparing between **pre** and **post in each group**
p_1: p value for comparing between the two studied groups in **pre** test
p_2: p value for comparing between the two studied groups in **post** test
*: Statistically significant at $p \leq 0.05$.

Discussion

Hemodialysis is the primary renal replacement treatment in Egypt **El-Zorkany, (2017).** Muscles cramps is a common symptom among HD patients, affecting around 61 percent of them **Almutary, et al., (2013)**. Intradialytic stretching exercises are active and passive stretching exercises performed on the leg muscles at the end of the second hour of hemodialysis. **Sheeba, (2015).** The findings of the current study show that practice of stretching exercises help to avoid and reduce muscle cramps for HD patients.

The current study illustrated that the three quarters of the study and two thirds control group belonging to the age group (50- 60 years old). This result is consistent with the findings of a research done by **Ahmed, et al., (2020)** jn Sharkia governorate Egypt they reported that, the largest proportion of ESRD patients on maintenance HD was between the ages of 50 and 59. Also, **Elavally et al, (2017)** who found in there study that 50% of the study group patients belonged to the age group of 51- 60 years. This finding is inconsistent with the results of **Sasirekha, (2017)** as that about one third of the hemodialysis subjects were between the age group of 41 to 50 years and 51 to 60 years in both the study and the control group. The finding of this current study may explain as the increasing age is associated with chronic disease as diabetes, hypertension, and cardiovascular diseases which consider as risk factors of ESKD.

Regarding to gender more than half 56% of the study group and about three fifths 60%

of control group were males. This finding agrees with **Albadry et al, (2020)** and **El-Ballat et al., (2019)** who concluded that more than half of patients in their studies were male. On the other hand, **Ghaleb, & Sharaf, (2020)** found that 58.1 percent of their study were female.

In relation to marital status this current study revealed that about three fifths of study group and control group were married. This result was in accordance with a study conducted by **Panchiri, et al., (2017)** and disagrees with **Soliman, (2015)** who indicated that the majority of the patients who were tested were married according to the findings.

As regard to level of education of HD patients; less than half 48% of study group, 44% of control group have diploma degree. These finding was in congruence with **Ghaleb, & Sharaf, (2020)** who stated that 41.9% of HD patients have diploma degree. This finding contradicts the findings of **Bayoumi, & Al Wakeel, (2015),** who claimed that half of the patients could read and write. The observed disparity in marital status and level of education findings between the current research and other studies might be attributed to sociological disparities across various areas in Egypt and small sample size in one hospital which affects the generalizability of the results.

The results of the current study found that there is no statistically significant difference between the two groups regarding demographic data which include age, gender, marital status, level of education, occupation, and area of residence. This result come in agree with **El-Deen, & Mohammed, (2019)** who stated that, in terms of demographic factors, there was no statistically significant difference between studied groups.

In reference to duration of dialysis treatment, the present study showed about two thirds of the study group and more than half of the control group have a history for hemodialysis for 5 years or less with mean 4.24 ± 2.26, and 3.96 ± 2.42 for both groups respectively. This result is in line with **Albadry et al, (2020)** who found in their study less than half of patients (48.3%) the duration of dialysis was from1 to 5 years. This finding was agreed with **Mohamed et al., (2007)** who declared the similar result. Furthermore, **Sasirekha, (2017)**, stated in her study that nearly half of the patients in the experimental group were on HD for more than three years, whereas more than one-third of the patients in the control group were on HD for four years or more.

Concerning to associated diseases, the present study found that, diabetes mellitus represents more than two fifths followed by less than quarter suffer from hypertension in the study group and as for the control group diabetes and hypertension represent less than one quarter. This finding comes in agreement with a study was conducted by **Hassanien et al., (2012),** who reported that the leading cause of ESKD was diabetes followed by glomerulonephritis and hypertension. On the contrary, two studies conducted in two governorates in Egypt; **El-Ballat, et al., (2019) and El-Zorkany, (2017),** whose study were conducted in Menoufia and Beheira governorate, they reported that the main known causes of ESRD was hypertension, followed by diabetic.

Regarding number of HD per week, the present study clarified that the majority of patients (98.3%) had three HD sessions per-week. Also, this study illustrated that mean of dialysis hours for study group were 3.40 ± 0.50 and control group was 3.48 ± 0.51. In this context, **Panchiri, et al., (2017)** showed that (60%) of patients experienced 4 hours HD session. In the same line **Algendy, & Bahgat, (2019)** mentioned that in their study, the vast majority of the studied groups receiving HD session for 4 hours and all of them on a schedule 3 times a week. The current finding is strongly agreed with **Ahmed, et al., (2010),** who mentioned the main HD schedule adopted in Egypt is 3 times per week.

This study demonstrated that there were statistically significant differences between study and control group regarding pre and post practice stretching exercises regarding mean systolic blood pressure during hemodialysis session p value at 0.009*, while there was decrease in mean average of diastolic blood pressure after practice stretching exercises among study group (80.80 ± 8.12, 79.20 ± 7.02) without significant differences in pre and post phases.

This result is in agreement with **Mohamed et al, (2020)** who showed in their study that the mean systolic and diastolic blood pressure measurement have been significantly decreased among the study group compared with the control group post practice of intradialytic exercises during study phases. in the **Miller et al, (2017)** which showed that intradialytic exercises were safe during HD and led to significant reductions in systolic and diastolic blood pressure readings.

This finding also came in agreement with two studies done by **Henrique, et al. (2010)**; **Reboredo, et al., (2010)** who stated that there was a statistically significant decrease in systolic blood pressure at the end of the exercise program. This finding may attribute to the positive effect of practice exercises as decrease peripheral vascular resistance, improve venous return and relaxant effect which in turn help to lower blood pressure.

As regarding to time of occurrence of muscle cramp during dialysis session, this study concluded that, there was less than two thirds for both groups had muscle cramps in the last hour and the muscle cramps of lower limb represent 72.0%, 80.0% for both groups respectively pre practice stretching exercises and reached to 44.0 %, 68.0 % for both groups respectively post practice stretching exercises. The current study's findings agreed with those **Chavda & Singh (2018); Lekha (2017)** and who indicated that intradialytic muscular cramps occurred in the last hour of the majority of study group patients, with the calf muscle of both legs being the most implicated. This might be explained by the fact that individuals with greater interdialytic fluid gain are subjected to fast removal of excess fluid, which causes hypotension and, as a result, muscular cramps. This results also is in agreement with **Elavally et al, (2017)** who showed that the intensity of muscle cramps was calculated for the third hour for study group.

This study illustrated that 56 % of study group and 68 % of control group wake during night due to muscle cramp pre practice stretching exercise but post stretching exercise 24 % of study and 72 % of control group awaken during night due to muscle cramp. This finding agrees with **Hallegraeff, et al., (2012)** who found that practice of stretching of the calf and hamstring muscles for six weeks, the incidence and severity of nocturnal leg cramps in studied subjects were dramatically decreased.

Regarding to the effect of muscle cramps on activity of daily living 84% of study group not limited at activity post stretching exercise compared with 48 % of the control group had muscle cramps that stop them from doing the activity. With statistically significant differences between both groups post practice stretching exercise where p <0.001*. In the same line a study by **Jancy, & Parimala, (2020)** who stated that restricted activity due to muscle cramps depicts that 67% of sample had restricted activities due to muscle cramps in HD patients.

Concerning level of muscle cramps, this study showed that nearly three quarters and two thirds for study and control group respectively had sever muscle cramps pre practice stretching exercises but after practice stretching exercises there was more than half of the study group compared to minority (4.0%) of the control group had no muscle cramps with statistically significant improvement in the level of muscle cramps intensity of the study groups after practice stretching exercises p value at <0.001*. This result is in line with **Elavally et al., (2017)** who identified that intradialytic stretching exercises intervention was effective in reducing the frequency, intensity and duration of muscle cramps among patients undergoing HD. Also, this result is in agreement with **Albadry et al., (2020)** who found there were statistical significance difference as regard total feature of muscle cramps pre and post implementation of intradialytic exercises.

This finding also is in agreement with another study by **Vimala, (2018),** who illustrated that the level of muscle cramps pre and post implementing the intradialytic stretching exercise. It showed that the majority of the studied patients who on HD had severe (86.67%) muscle cramps pre implementing the intradialytic stretching exercises. But after practice intradialytic stretching exercise (60%) of them had severe muscle cramps. In addition to (40%) had moderate muscle cramps with

significant improvement in the reduction of muscle cramps after the practice of intradialytic stretching exercises.

Similar finding was proven by many studies including **Jancy, & Parimala, (2020); Sasirekha, (2017); Lekha, et al., (2017)** who stated that there was a statistically significant difference in lowering the frequency of muscular cramps post practice stretching exercises. This result also is in accordance with **Chandralekha & Mercy, (2020)** who stated that there is significant improvement in severity of muscle cramps scores in the experimental group after practice intradialytic stretching exercises. Finally, the current findings proved that the research hypothesis which showed that, hemodialysis patients in the study group who practice passive and active stretching muscles exercises will have significantly lower level of muscle cramps intensity than the control group that got the ordinary HD unit care.

Conclusion:

The results of the current study revealed that active and passive stretching exercises have positive effect on reducing level of muscle cramps intensity among HD patients with statistically significant differences between study and control group. These exercises have advantages that they are safe and inexpensive nursing procedure.

Recommendations

The following suggestions are made based on the findings of the current study:

- Intradialytic stretching exercises should be combined with routine nursing care for hemodialysis patients.
- Future researches include replication of the present study on a large sample of HD patients to generalize the study's findings.
- Additional research is recommended to determine the effect of practice exercises on biochemical laboratory tests.

Conflict of interest

The researchers claim that there were no commercial or financial ties to the study that may be seen as a potential conflict of interest.

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