

## Effect of Moist Heat Application on Leg Muscle Cramp for Patients Undergoing Hemodialysis

Eman Adel Abohashima<sup>1</sup>, Esraa Hamdy Hassan<sup>2</sup>, Sheren Elsayed Shrief<sup>3</sup>

1. Clinical instructor at Nasser Nursing School

2. Lecturer of Medical Surgical, Faculty of Nursing - Beni-Suef University

3. Assistant Professor of Medical Surgical, Faculty of Nursing - Beni-Suef University

### ABSTRACT

**Background:** Leg muscle cramp that occur during hemodialysis result in shortening of treatment or reduction of fluid removal which lead to inadequate clearance of waste products which significantly increase mortality risk. **The aim of the study:** was to evaluate the effect of moist heat application on leg muscle cramp for patients undergoing hemodialysis. **Research design:** A quasi-experimental design was used. **Settings:** this study was conducted in the hemodialysis unit at Beni-Suef University Hospital and General Nasser Hospital. **Subjects:** A purposive sample of (60) patients who admitted to the hemodialysis unit with leg muscle cramps were included. **Data collection Tools:** three tools were used for data collection. **Tool I:** Patient structured interview sheet, **Tool II:** the cramp questionnaire chart and **Tool III:** The Pain Numeric Rating Scale. **Results:** The study findings revealed that there was statistically significant difference was found between study and control groups with higher reduction in the total mean score of pain from  $6.78 \pm 1.6$  to  $2.34 \pm 0.9$  among the study group who received moist heat application. **Conclusion:** this study concluded that moist heat application was an effective nursing measure in reducing the pain intensity of leg muscle cramp for patients undergoing hemodialysis. **Recommendations:** the study recommended that: Continuing education for nurses must be provided to improve their knowledge and practice regarding non-pharmacological methods such as moist heat application and its effect on reducing the pain intensity of leg muscle cramp for patients undergoing the hemodialysis.

**Keywords:** Hemodialysis, Leg muscle Cramps, Moist Heat application

## INTRODUCTION

The kidneys are essential for maintaining the body's water and electrolyte levels, as well as its acid-base balance. They also filter out metabolic waste, toxins, and medications, which are eliminated through urine. (*Kallenbach, 2020*).

The Chronic kidney disease (CKD) refers to the gradual decline in kidney function, which eventually leads to the necessity for renal replacement therapy, such as dialysis or transplantation. (**National Kidney Foundation, 2023**).

The medical management of the CKD includes the renal replacement therapy (RRT) as dialysis or transplantation (*Hashmi, Benjamin & Lappin, 2023*).

The Hemodialysis is a procedure that involves extracting blood from the body and passing it through an artificial kidney, which helps to eliminate harmful waste and excess water temporarily. (*Ma et al., 2020*). The Intra-dialytic complications are estimated to occur in 20-30% among hemodialysis treatment session. These complications include hypertension, hypotension, muscle cramps, chest pain, hemolysis, air embolism, nausea and vomiting (*Habas et al., 2021*).

The leg muscle cramp is an abrupt, involuntary contraction of a skeletal muscle that is painful. While it is temporary and not harmful, it can cause considerable discomfort and restrict movement in the affected muscle.

Typically, a cramp resolves on its own within a few seconds to minutes. It occurs in 33%-86% of patients that undergo hemodialysis (*Varghese et al., 2020*).

The leg muscle cramps pain cause severe discomfort, patient have leg swelling, redness or skin changes and muscle weakness (*American Academy of Orthopaedic Surgeons, 2022*).

To manage leg muscle cramp combination of pharmacological and non-pharmacological interventions may be used. (**Herguedas, 2021**).

Complementary methods are supportive approaches utilized alongside conventional medical treatments. As it safe and effective. It include meditation, nutrition, physical activity, acupuncture, yoga, guided imagery, reflexology, and massage (*Badakhsh et al., 2021*). In addition to relieve muscle cramp, decrease tiredness and improve flexibility and circulation (*National Institutes of Health, 2021*). It includes meditation, cold and hot application, acupuncture, yoga, guided imagery, reflexology, and massage (*Kisling et al, 2021*).

The heat application is one of the non-pharmacological methods that are used to relieve the muscle cramps. It is effective to reduce nerve sensitivity, enhance blood circulation, and boost tissue metabolism. (*Freiwald et al, 2021*). It may be dry heat application or moist heat application. The dry

heat application includes heating pads while, the moist heat application includes steamed towels, moist heating packs, or hot baths (Cameron, & Monroe, (2021).

The moist heat application is used to control pain, improve healing, relax muscles and increase range of motion (Balakrishnan et al, 2020).It plays an essential role in stretching soft tissues that help to release tension. It causes vasodilation that increases the supply of oxygen and nutrients to the affected muscle (Sayeed, Haque,Ali ,2024).

The nurses in the dialysis unit have an important role in monitoring, supporting and educating the patient. They should have a base of knowledge and practice regarding the use of dialysis machine efficiently, identification, intervention and prevention of hemodialysis complications (Kallenbach, 2020).

The nurses should determine the appropriate non-pharmacological pain relief methods. They should have sufficient knowledge and practice of their action and effects to assess the risks and benefits for the particular patient (Tsegaye et al, 2023). Encouraging the patient to regularly evaluate the therapy's effectiveness by utilizing standard pain assessment methods. (Kevin et al, 2023).

The nurse should evaluate patient's pain levels to determine the effectiveness of the heat therapy. Documentation the type of

heat applied, duration, patient responses, adverse reactions or complications that occur during the procedure. (Zhou et al., 2021).

#### **Significance of the study:**

Hemodialysis (HD) is the most prevalent type of kidney replacement therapy globally, representing roughly 69% of all such treatments and 89% of all dialysis procedures. In the past sixty years since HD was introduced, there have been significant improvements in dialysis technology and patient access to this therapy, especially in high-income nations. However, the availability, accessibility, costs, and outcomes of HD vary greatly across different regions, and overall, there are still high rates of diminished quality of life, morbidity, and mortality. (Bello, 2022)

According to world day kidney (2023), it is estimated about 850 million patient worldwide suffer from kidney disease and 2.4 million cases deaths annually all over the world (Keskar, 2023).

According to the Egyptian Society of Kidney Diseases and Transplantation, the proportion of those in need of dialysis reaches 650 patients per million, which is more than double the global rate. Annually, the number of deaths resulting from kidney diseases reaches approximately 20,433 patients (Hasaballa, Elwakill & Elsharkawy, 2022).

According to the statistic office of Beni-Suef University Hospital, the total number of hemodialysis patients weekly are 50 patients in 2023 and there is 35-45% of the patient suffer from leg cramps during hemodialysis.

According to the statistic office of General Nasser Hospital, the total number of hemodialysis patients weekly are 82 patients in 2023 and there is 25- 40% of the patient suffer from leg cramps during hemodialysis.

#### **SUBJECTS AND METHODS**

##### **Aim of the study:**

The present study sought to assess the impact of applying moist heat on leg muscle cramps in

patients receiving hemodialysis through:

- 1- Determining the effect of moist heat application on leg muscle cramp among patients undergoing hemodialysis.
- 2- Monitoring the effect of moist heat application on pain intensity among patients undergoing hemodialysis.

**Research hypotheses:**

The group that received moist heat therapy is expected to have a lower average score for leg muscle cramps compared to the control group that received standard hospital care.

the group treated with moist heat therapy is anticipated to report a lower average pain intensity score in comparison to the control group that received standard hospital care.**Operational definitions:**

**Moist heat application:**

- It is a noninvasive technique will be performed by the researcher through applying warm rubber bottle (35 to 37.5°C) wrapped by warm moist towel for 15 minutes on the calf muscle.

**Muscle cramp:**

- It is involuntary, painful and localized contraction of muscle group, last from a few seconds to minutes.

**Research Design:**

A quasi-experimental research design (study group & control group) was utilized to achieve the aim of this study.

**Setting:**

The study was conducted in the

hemodialysis unit at Beni-Suef University Hospital that was composed of 4 rooms &28 beds and General Nasser Hospital that was composed of 12 rooms & 61 beds.

**Subjects:**

This study was conducted on

$$n = \frac{N \times (1-p)}{[N-1 \times (d^2 \div z^2)] + (1-p)}$$

n = sample size, N = population, z =1.96, d = 0.05, p = 0.50

This study was conducted on, a purposive sample consisting of 60 adult patients from both genders, who admitted to the above mentioned setting and were randomly divided into two equal groups, with each group consisting of 30 participants (n=30) for both the study and control groups.

The patient were enrolled in the study according to the following criteria (Patients are above 18 years of age, alert and they are receiving hemodialysis session from two to three times per week at least for the last three months , they have experience calf muscle or thigh muscle cramp during hemodialysis session and also they are willing to participate.)

Exclusion criteria: The patients who are not willing to participate, altered hemodynamics, patients with femoral catheter and with surgery or any lower limb deformity

**Tools of data collection:**

To achieve the aim of the study the following tools were used to collect data:

**Tool I): Patient structured interview sheet: (Appendix I)**

It was adopted from (*George & Merkus, 2022*). It was used to collect the baseline characteristics and the medical data of the studied patients. It included two parts the following:

- **Part 1:** It was concerned with the demographic characteristics of the studied patients as age, gender, marital status, educational level and residence
- **Part 2:** It was concerned with the medical data of the studied patients as presence of chronic disease, type of chronic disease, medication history, duration of hemodialysis session, numbers of hemodialysis sessions per week, duration of treatment when the patient experience the leg muscle cramp during hemodialysis session and location of leg muscle cramp.

**Tool II): The cramp questionnaire sheet: (Appendix II)**

It was adopted from (*Morris, 2014, El-Deen & Mohammed, 2019*). It was used to assess the level of muscle cramps during hemodialysis. It consisted of 5 questions as the frequency of leg muscle cramp, the

duration of leg muscle cramp, the pain intensity, temperature and discomfort.

**Scoring system:**

The total score varied between 0 and 13, where a score of 0 indicates no cramps, scores from 1 to 4 reflect mild cramps, scores from 5 to 8 represent moderate cramps, and scores from 9 to 13 indicate severe cramps. **Tool III): Pain Numeric Rating Scale (PNRS): (appendix II)**

It was adapted from (*Mahmoud, Abed El Aziz & Ibrahim, 2022*) and used to assess quality and intensity of the patients' pain. The scale was modified by the researcher after reviewing relevant literatures .It consisted of a single 11 items pain numeric rating scale, they were graded as no pain, mild pain, moderate pain and sever pain .

**Scoring system:**

The scoring of pain numeric rating scale

No pain = 0	Mild pain
= 1- 3	Moderate pain = 4-6
Severe pain =7-10	

The pain scored from zero to ten where (0) indicates no pain and (10) indicate sever pain

**Administrative design:**

the required authorization was secured from the directors of BeniSuef University Hospital and General Nasser Hospital. Additionally, a letter was provided by the Faculty of

Nursing, outlining the purpose of the study to secure permission for data collection.

#### **Ethical consideration:**

The ethical considerations in the study encompassed several aspects: the researcher explained the study's purpose to the participating patients; assured that their data would be kept confidential and used solely for research purposes; and informed patients of their rights to participate or withdraw from the study at any time without needing to provide a reason.

#### **Preparatory phase:**

- This involved a review of relevant literature and theoretical knowledge on various aspects of the study by utilizing books, articles, the internet, periodicals, and magazines to create tools for data collection.

-Meetings and discussions were held by the researcher and patients to explain the aim, nature of the study and took their approval to participate in the study prior to any data collection. Required modifications were done.

#### **Tool validity and reliability (appendix VI):**

**Content validity:**The tools were revised for content validity by a jury of five assistant professors expertise in medical surgical nursing department. The tools were reviewed for clarity, relevance, simplicity, comprehensiveness and applicability. Minor modifications were done as required

**Testing reliability:** of the developed tools was done statistically through cronbach's alpha that was (0.72) fo **tool III**.

#### **Pilot study:**

It was carried out on 10% of patients (6 patients) of the total number of patients beings studied to assess applicability, clarity and efficiency of the tools .No modification was done, so the patients who shared in the pilot study were included in the sample.

#### **Field of work:**

Data collection took place over a six-month period, starting in August 2023 and concluding at the end of January 2024. The researcher explained the purpose and nature of the study to the participating patients and obtained their verbal consent to join the study before any data was collected. The data collection included the following phases:

#### **Assessment phase:**

-An official permission was obtained from the director of Beni-suef University Hospital in which the study was conducted.

-The researcher was conducting interviews with patients to explain the aim of the study and take their approval to participate in it prior to data collection

-Eligible patients were randomly assigned into two equal groups the study group and control group 30 for each the study group receive moist heat application program.

-Data collection was carried out from the beginning of August 2023 to the end of January 2024).

-The researcher attended to the HD units 3

day per week in the morning & afternoon shifts.

-The study group was informed during interviews that the heat moist applications become new best buddy and are a highly safe non-pharmacological technique to alleviate the leg muscle cramp.

### **Planning and implementation phase:**

-The baseline data were collected from the patients' records including demographic characteristics and the medical related data from both groups and medical record through using **tool I** and It was about 10 and 20 minutes.

-The control group was given the hospital routine care of the hemodialysis unit and follow up by using **tool II and III** without moist heat application intervention.

- Study group patient receive moist heat application when reported muscle cramp, while control group patients were under routine care.

### **Moist heat application protocol includes:**

-Hemodynamic parameters were measured pre and post intervention and documented

-Assessment the skin for any existing condition that might be aggravated by heat

-Assess patient's pain level using **tool III**

- The temperature of the warm water was assessed using a water thermometer, with readings ranging from 35 to 37.5°C.

-The researcher applied moist heat application warm rubber bottle wrapped in a

warm, moist towel was applied to the leg muscle cramp for 15 minutes.

-During application it is important to monitor the skin every 5-10 minutes for redness, blistering, or change in the skin integrity

-These interventions repeated each time the patient reported leg muscle cramp during the hemodialysis session for 2 weeks.

### **3- Evaluation phase:**

-The followed up was done for two weeks to evaluate the effect of moist heat application on leg muscle cramp for patients undergoing HD.

### **Statistical Analysis:**

#### **Descriptive statistics**

The data were summarized using three methods: 1) the arithmetic mean to represent the average and central tendency of observations for each variable; 2) the standard deviation to indicate the dispersion of results around the mean; and 3) the percentage of observations for each variable analyzed. Other statistical tests such as T test correlation coefficient were calculated between demographic data, numerical pain scale and muscle cramps. Moreover, cronbach's alpha test was used to test reliability of the tool.

#### **Level of significance**

For all statistical tests done the threshold of significance was fixed at the 5 % level (P-value):

-P-value > 0.05 indicated non – significant result.

-P-value < 0.001 indicated highly significant result.

-P-value < 0.05 indicated a significant result.

## RESULTS

### Part I: Demographic characteristics and medical data of the studied patients.

**Table (1):** Percentage distribution for the study and control groups according to their demographic characteristics (n=30 for each group).

Items	Study (n=30)		Control (n=30)		X <sup>2</sup>	p
	No.	%	No.	%		
<b>Age</b>						
• 18 < 30	3	10.0	3	10.0	0.09	0.76
• 30 < 40	6	20.0	5	16.7		
• 40 < 40	6	20.0	3	10.0		
• 50 < 60	9	30.0	9	30.0		
• < 60	6	20.0	10	33.3		
	<b>Mean ± SD 47.8±14.1</b>		<b>Mean ± SD 51.2±16.0</b>		T=0.873	0.386
<b>Gender</b>						
• Male	10	33.3	9	30.0	0.07	0.78
• Female	20	66.7	21	70.0		
<b>Marital status</b>						
• Single	5	16.7	3	10.0	2.5	0.45
• Married	22	73.3	20	66.7		
• Divorced	1	3.3	1	3.3		
• Widow	2	6.7	6	20.0		
<b>Educational level</b>						
• Illiterate	12	40.0	15	50.0	4.0	0.26
• Primary education	10	33.3	5	16.7		
• Technical institute	8	26.7	8	26.7		
• Bachelor degree	0	0.0	2	6.7		
<b>Residence</b>						
• Rural	22	73.3	18	60.0	1.2	0.27
• Urban	8	26.7	12	40.0		

*SD: stander deviation      X<sup>2</sup>: chi square test*

*P: p value for comparing between the studied groups*

*\*patient can choose more than one answer      Non-significant at p value > 0.05*

**Table (1)** shows that 30% of study group their age ranged between 50 < 60 with mean age of 47.8±14.1 years and 33.3% of control group their age more than 60 with the mean age of 51.2±16.0 years. In addition to 66.7 % & 70% respectively of the study and control groups were female. Regarding the marital status 73.3% & 66.7 % respectively of



the study and control groups were married. Regarding the educational level 40% & 50% respectively of the study and control groups were illiterate. 37.3% &60% respectively of the study and control groups were from rural.

**Table (2):** Percentage distribution for the study and control groups according to their medical data (n=30 for each group):

Items	Study (n=30)		Control (n=30)		X <sup>2</sup>	p
	No.	%	No.	%		
<b>Presence of chronic diseases</b>					5.2	0.02*
• No	0	0.0	2	6.7		
• Yes	30	100%	28	93.3%		
<b>Type of disease*</b>						
Hypertension	6	20.0	17	56.7	5.26	0.022*
Heart diseases	19	63.3	11	36.7	2.13	0.144
Tumors	2	6.7	0	0.0	2.00	0.157
Blood diseases	2	6.7	0	0.0	2.00	0.157
GIT diseases	13	43.3	3	10.0	6.25	0.012*
Respiratory diseases	7	23.3	10	33.3	0.53	0.467
Muscle disease	2	6.7	4	13.3	0.67	0.414
Neurological diseases	6	20.0	5	16.7	0.09	0.763
Infection diseases	10	33.3	2	6.7	5.33	0.021*
<b>Medication history</b>					0.73	0.39
Pain killers	13	43.3	9	30.0	0.73	0.394
Anti-histamine	6	20.0	5	16.7	0.09	0.763
Anti-inflammatory	9	30.0	10	33.3	0.05	0.819
Anti-clotting	10	33.3	7	23.3	0.53	0.467
Anti- biotic	8	26.7	7	23.3	0.07	0.796
Hypertension medications	15	50.0	8	26.7	2.13	0.144
Other	29	96.7	23	76.7	0.69	0.405

X<sup>2</sup>: chi square test      P: p value for comparing between the studied groups

\*patient can choose more than one answer      Non-significant at p value > 0.05

*\*Significant at p value > 0.05*

**(Cont.,) Table (2):** Percentage distribution for the study and control groups according to their medical data (n=30 for each group):

Items	Study (n=30)		Control (n=30)		X <sup>2</sup>	p
	No.	%	No.	%		
<b>1- Duration of session (hours)</b>					2.0	0.36
• One	0	0.0	0	0.0		
• two	0	0.0	1	3.3		
• Three	1	3.3	0	0.0		
• Four	29	96.7	29	96.7		
<b>2- Number of sessions weekly</b>					0.0	1.0
• Two	0	0.0	0	0.0		
• Three	30	100.0	30	100.0		
<b>3- Duration of treatment (years)</b>					1.1	0.55
• < 1	1	3.3	0	0.0		
• 1 < 5	13	43.3	15	50.0		
• > 5	16	53.3	15	50.0		

**X<sup>2</sup>:** chi square test      **P:** p value for comparing between the studied groups

*\*patient can choose more than one answer      Non-significant at p value > 0.05*

**Table (2)** shows that 100% & 93.3% respectively of the study and control groups had chronic disease. 63.3% & 36.75% of the study and control groups had hypertension. 50% of the study group took hypertension medications. 33% respectively of the control group took anti-inflammatory medications. Regarding the duration of session 96.7% of both groups take 4 hour sessions three times /week. Regarding the duration of treatment 53.3% &50% respectively of the study and control groups had more than 5 years of treatment.

**Table (3):** Percentage distribution for the study and control group according to the site of leg muscle cramps (n=30 for each group):

Items	Study (n=30)		Control (n=30)		X <sup>2</sup>	p
	No.	%	No.	%		
<b>4- Leg muscle cramps occurs during</b>					0.09	0.75
• Early hours of session	0	0.0	0	0.0		
• Mid-session	6	20.0	7	23.3		
• Last hour of session	24	80.0	23	76.7		
<b>5- Site of leg muscle cramps</b>					0.96	0.61
• Right leg	7	23.3	7	23.3		
• Left leg	8	26.7	5	16.7		
• Both legs	15	50.0	18	60.0		
<b>6- Name of leg muscle in which cramps occurs</b>					0.0	1.0
• Cords	0	0.0	0	0.0		
• Leg muscle	22	73.3	22	73.3		
• Solyos	8	26.7	8	26.7		

X<sup>2</sup>: chi square test      P: p value for comparing between the studied groups

\*patient can choose more than one answer      Non-significant at p value > 0.05

**Table (3)** illustrates that 80% &76.7% respectively of the study and control groups had leg muscle cramps in the last hours of the sessions. Regarding the site of the leg muscle cramp 50% &60% respectively of the study and control groups had leg muscle cramp in both legs. 73.3% of both groups had leg muscle cramp in leg muscle.

**Part (II): Muscle cramps of studied patients**

**Table (4):** Percentage distribution for the study and control groups according to their description of the leg muscle cramps (n=30 for each group):

Items	Study (n=30)		Control (n=30)		X <sup>2</sup>	p
	No.	%	No.	%		
<b>Frequency of cramps</b>						
None	2	6.7	0	0.0	2.8	0.24
< 3/hour	23	76.7	27	90.0		
> 3/hour	5	16.7	3	10.0		
<b>Duration of cramps</b>						
None	2	6.7	0	0.0	3.8	0.14
3-5 minutes	17	56.7	13	43.3		
> 5 minutes	11	36.7	17	56.7		
<b>3-Leg temperature</b>						
Warm	20	66.7	22	73.3	0.31	0.57
Cold	10	33.3	8	26.7		
<b>4-Degree of inconvenience</b>						
None	0	0.0	0	0.0	5.2	0.07
Felt	6	20.0	1	3.3		
Painful	11	36.7	9	30.0		
Unbearable	13	43.3	20	66.7		

X<sup>2</sup>: chi square test P: p value for comparing between the studied groups

\*patient can choose more than one answer Non-significant at p value > 0.05

Table (4) reveals that the frequency of cramp in the study and control groups were 76.7% & 90% respectively that less than 3/hour. 56.7% of the study group their cramps last for 3-5 minutes while 56.7% of control group lasts more than 5 minutes. Regarding the leg temperature 66.7% & 73.3% respectively of the study and control groups had warm leg. Finally for Degree of inconvenience, it was Unbearable for 43.3% & 66.7% respectively of study group and control group.

**Part (IV): Pain level of study and control groups pre and post**

**Table (5):** Comparison between pain scores among study and control groups pre and post intervention (n=30 for each group):

Items	Study				X <sup>2</sup>	p	Control				X <sup>2</sup>	p
	Pre		Post				Pre		Post			
	No.	%	No.	%			No.	%	No.	%		
<b>No pain</b>	0	0.0	6	20.0	49.3	0.0001**	0	0.0	0	0.0	2.6	0.25
<b>Mild pain</b>	3	10.0	24	80.0			1	3.3	0	0.0		
<b>Moderate pain</b>	8	26.7	0	0.0			9	30.0	5	16.7		
<b>Severe pain</b>	19	63.3	0	0.0			20	66.7	25	83.3		

X<sup>2</sup>: chi square test P: p value for comparing between the studied groups

*Non-significant at p value > 0.05    \*\*highly statistically significant at p value<0.0001*

**Table (5)** reveals that there is a highly significant difference between pre and post pain levels in study group as 63.3% had severe pain level pre intervention that improved to 80% had mild pain post intervention. On the other hand, the control group 66.7% had severe pain level pre intervention that becomes 83.3% post intervention.

**Figure (1):** Differences between the pain scores for the study and control groups pre and post intervention (N= 30 for each group).

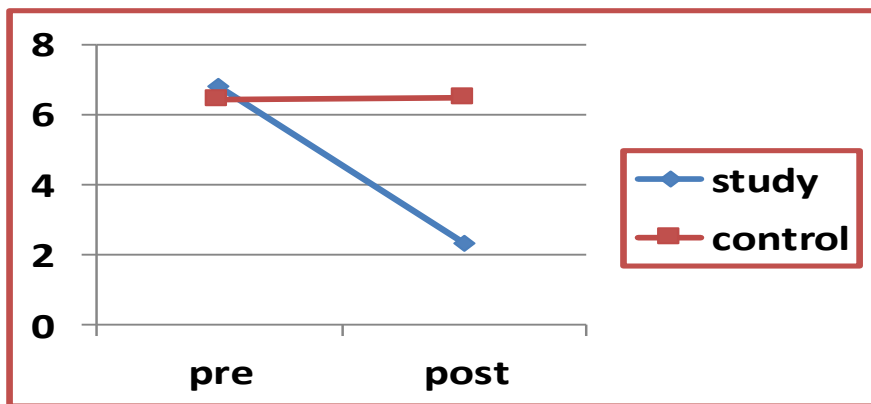


Figure (1) illustrates that there was a meaningful reduction in pain intensity score for the study group post intervention compared to pre intervention. And there was no reduction in pain intensity score for the control group between pre and post intervention.

**Table (6):** Comparison of the total mean score of the numerical pain scale for the study and control groups' pre and post intervention (n=30 for each group):

Items	Study		Control		t	p
	Mean	SD	Mean	SD		
<b>Pre-intervention</b>	3.5	0.68	3.6	0.55	0.62	0.53
<b>Post-intervention</b>	1.8	0.4	3.8	0.37	20.1	0.0001**

*P: p value for comparing between the studied groups    T: student test*

*Non-significant at p value > 0.0    \*\*highly statistically significant at p-value<0.001*

**Table (6)** reveals that there was high statistically significant difference between pain intensity scores pre and post intervention of the study group ( $P \leq 0.001$ ). While, there was no significant reduction in pain intensity scores pre and post intervention of the control group. ( $P > 0.05$ )

**Part (IV): Relation between demographic characteristics, pain intensity and muscle cramp.**

**Table (7):** Relation between the demographic characteristics and the numerical pain scale of study and control groups (n=30 for each group):

Items	r	p
Age	-0.12	0.32
Gender	-0.05	0.69
Marital status	-0.09	0.45
Education	0.32	0.01*
Residence	0.03	0.79

*P: p value for comparing between the studied groups*

*R: Pearson correlation coefficient*

*Non-significant at p value > 0.05      \*significant at p-value<0.05*

**Table (7)** shows there statistical significant association was found between educational level and numerical pain scale as p-value<0.05.

**Table (8):** Relation between the numerical pain scale and the leg muscle cramps of study and control groups (n=30 for each group):

Items	r	p
Frequency of cramps	0.25	0.04*
Duration of cramps	0.45	0.0001**
Leg temperature	0.04	0.74
Degree of inconvenience	0.84	0.0001**

*P: p value for comparing between the studied groups*

*R: Pearson correlation coefficient*

*Non-significant at p value > 0.05      \*significant at p-value<0.05*

*\*\*highly statistically significant at p-value<0.001*

**Table (8)** illustrate there high statistical significant association was found between duration of cramps, degree of inconvenience and numerical pain scale as at p-value <0.0001.and there was statistical significant association between frequency of cramps and numerical pain scale as at p-value <0.05.

### Discussion

The HD is a process of purifying the blood through fluid removal. The side effects caused by removing too much fluid or removing fluid too rapidly. The complication of the HD includes hypotension, fatigue, chest pains, muscle cramps, nausea and headaches. These can occur during the treatment and can last post treatment (*Armiyati et al., 2021*).

The muscle cramp occurs anywhere in the body, but common in calf muscles, feet, toes, thigh and abdomen. It is managed with normal saline infusion, simple calf massages, and cold and heat application and even by temporarily stopping the ultrafiltration till cramps go off (*Vati, 2021*).

Heat therapy works to improve the circulation to a particular area due to increased temperature which can relieve discomfort and increase muscle flexibility. Also, it can relax muscles and heal damaged tissue (*Sayeed et al., 2024*).

The role of hemodialysis nurse is vital in the acute care and management of patient. The nurse must have a set of knowledge about signs and symptoms, diagnosis, complications and treatment of patient with the HD to manage the patient effectively. In addition to a wide base of skills to enhance the patient health outcome (*Abdel Monem et al., 2022*).

The discussion of the current study result presented as the following: **Part I:** Demographic data of studied patients. **Part II:** Medical data of studied patients. **Part III:** Muscle cramps of the studied patients. **Part IV:** Pain level. **Part V:** Correlation between demographic data, pain level and muscle cramp of both groups post intervention

#### **Part (1): Demographic characteristics of the studied patients**

The current study result showed that, there is no significant difference between demographic data in study and control groups where as for the age, less than one third of study group and control group were in the age group 50-59 respectively. According to the researchers view this may be due to the increasing age is associated with chronic disease as diabetes, hypertension, and cardiovascular diseases which consider as risk factors of ESRD. This supported with *Shahriari et al. (2021)* who conducted a study about "The Effect of Foot Reflexology Massage on Pruritus in Hemodialysis Patients" and revealed that

more than two-fifths of the participants aged 50 years and older. This was agreed with *Xu et al., (2023)*, who conducted a study about "Knowledge, Attitude, and Practice of Patients Receiving Maintenance Hemodialysis Regarding Hemodialysis and Its Complications: A Single-Center ", who stated the same result.

The findings of the present study revealed that, two thirds of study group and less than three quarters of control group were females. This result was disagreed with *ELmetwaly et al., (2023)* who conducted a study about "Reflexology: Golden Foot Massage on Leg Cramps for Hemodialysis Patients " and reported that more than half of them were males. And this result was contrasted with *Gunes, Basks&Kasimoglu,(2020)* , who conducted a study about "Evaluation of Self-Care Agency and Perceived Social Support in Patients Undergoing Hemodialysis" and found that more than half of studied hemodialysis patients were males.

Concerning to the marital status, the current study result showed that, less than three quarters of study group and two thirds of control group was married. This result was supported with *Dawood, (2020)*: who conducted a study about "Patient's Knowledge Regarding Hemodialysis Therapy at Imam Hussein Medical City in Holly Karbala Governorate" and reported that 66.0% highly percentage of the studied

patients were married. And this result was in accordance with *Xu et al., (2023)* who showed that the majority of the studied patients were married.

Regarding the educational level, the present study revealed that, two fifths of study group and half of control group was illiterate. From the researcher point of view it may be related to increase the age of patients and lack of attention to importance of education in the past. This result was contrasted with *Hamza, Elmaghawry & Haseneb (2022)* , who conducted a study about "Effect of Educational Program for Hemodialysis Patients Regarding Their Knowledge and Practice about Self Care Behaviour" and reported that two fifths of the studied patients had Secondary level of education. And disagree with *Kim & Kim, (2019)* who conducted a study about "Influence of Uncertainty, Depression, and Social Support on Self-Care Compliance in Hemodialysis Patients" and proved that the highest percentage had secondary school.

Concerning to the residence, the findings of the present study revealed that less than three quarters of study group and less than two thirds of control group was from urban area. This result finding was in the same line with *Mahjubian , Baharamine & Kamali. (2018)* who conducted a study about "The Effects of Group Discussion Based Education on the Promotion of Self-Management Behaviors in Hemodialysis



Patients" and reported that the majority of studied patients were living in urban area. While this result was disagree with *Elsedawy et al. , (2023)*: who conducted a study about "Effect of Intra-Dialytic Stretching Exercises on Muscle Cramps among Elderly Patients Undergoing Hemodialysis", who stated the same results.

### **Part (II): Medical data of studied patients**

The result of the present study revealed that the majority of patients in the both groups have chronic disease. According to the researcher point of view this may be due to chronic diseases is considered one of the risk factors of renal failure. This result was contrasted with *Anbu & Rathiga, (2021)* who conducted a study about "Effectiveness of Intradialytic Stretching Exercises on Muscle Cramps among Patients Undergoing hemodialysis in a Selected Tertiary Care Hospital Kancheepuram District, Tamil Nadu, India", who found the same results.

Concerning the medication history, this study revealed that half of study group and more than one quarter of control group take hypertension medication while more than two fifths of study group and control group take pain killers respectively. According to the researcher point of view this could be related to low socioeconomic status, don't follow healthy diet or lifestyle. This result was supported with *Rodrigues & Costeira, (2024)* who conducted a study about " Pain Assessment in Patients during

Hemodialysis Treatment: Quality Improvement Project" and reported that about one third of the studied patients take pain killer. While, contrasted with *Abouelala & Khalil (2021)* who conducted a study about "Effect of Passive and Active Stretching Exercises on Controlling Leg Cramps for Patients undergoing Hemodialysis" and showed that more than three quarters of the study group and less than two thirds of control group take medication.

The findings of the current study revealed that the majority of both groups take four hours sessions three times per week. In addition to more than half of study group and half of control group had more than five years of treatment. This result in the same line with *Algendy & Bahgat, (2019)* who conducted a study about "Effect of Muscles Stretching Exercises on Severity of Restless Legs Syndrome of Adult Patients Undergoing Hemodialysis" and mentioned that in their study, the majority of the studied groups receiving HD session for 4 hours and all of them on a schedule 3 times a week. And *Abouelala & Khalil (2021)* who revealed the same results.

### **Part (III): Muscle cramps of studied patients**

The result of the present study revealed that, most of study group and more than three quarters of control group, muscle cramps occurs during last hour of session and

for half of study group and less than two thirds of control group, it happens in both legs and for less than three quarters of both groups it happens in leg muscle. From the researcher point of view this may be due to fast removal of excess fluid, delayed response from the body to fluid volume changes and sedentary position for a long time. This was agreed with *Salah El-Deen & Mohammed, (2019)*; who conducted a study about: "Effect of Moist Heat Versus Cold Therapy on Leg Muscle Cramp among Patients on Hemodialysis" who stated the same results. This was disagreed with *Anbu & Rathiga, (2021)* showed that one tenth of control and less than two fifths of study group had cramp in both legs. Also contraindicated with *Elsedawy et al. (2023)*, who revealed that less than two thirds of study group and more than half of control group muscle compulsions happened during last hour of session.

As for duration of session and number of weekly sessions, the majority of both groups take 4 hour sessions three times/week. This result depend on progress of renal failure and toxin concentration.

This result in the same line with *Algendy & Bahgat, (2019)* in a study entitled "Effect of Muscles Stretching Exercises on Severity of Restless Legs Syndrome of Adult Patients Undergoing Hemodialysis" and mentioned that the vast majority of the studied groups receiving HD session for 4

hours and all of them on a schedule 3 times a week.

As for duration of treatment, more than half of study group and half of control group had 5+ years of treatment. This result may be due to low level of awareness and follow up that effect on diagnosis and detect diseases. This result was supported with *Badakhsh et al., (2021)* revealed that less than two thirds of study group and more than half of control group had +5 years of treatment.

Also, most of study group and more than three quarters of control group, muscle compulsions happens during last hour of session and for half of study group and less than two thirds of control group, it happens in both legs and for less than three quarters of both groups it happens in leg muscle.

According to the researcher point of view 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 result was supported with *Salah El-Deen & Mohammed, (2019)* in a study entitled "Effect of moist heat versus cold therapy on leg muscle cramp among patients on hemodialysis: randomized control trial and reported that around two fifths of the studied groups had muscle cramp for 2 times per week in both legs. Additionally, there was no statistically significant differences

among the three study groups regarding the characteristics of the hemodialysis induced leg cramp. While disagreed with *Anbu & Rathiga, (2021)* showed that one tenth of control and less than two fifths of study group had cramp in both legs. Also contraindicated with *Dawood, (2020)*: showed that less than two thirds of study group and more than half of control group muscle compulsions happened during last hour of session.

As for the duration of compulsions, more than half of the study group and more than two fifths of the control group had 3-5 minutes compulsions while more than one third of study group and more than half of control group had >5 minutes compulsions. From the researcher point of view this result may be due to successfulness of moist heat application on decrease duration of compulsions.

This result was agreed with *Salah El-Deen & Mohammed, (2019)* who reported that about two fifths of control group had 3-5 minutes compulsions.

As for leg temperature, two thirds of study group and less than three quarters of control group had warm leg while one third of study group and more than one quarter of control group had cold leg. This result was agreed with *Vimala, (2018)* showed that most of the studied control group had warm leg.

Finally for degree of inconvenience, it was painful for more than one third of study group and less than one third of control group while it was unbearable for more than two fifths of study group and two thirds of the control group. The researchers reported that relaxation of muscles and reduction of pain intensity level may contribute to decrease mean muscle cramp intensity scores. In general, it is known that applying warm water particularly to legs and feet provide sense of comfort, relaxation and relief pain as well as, decrease leg muscle spasm or tension.

This result was supported with *Albadr et al. (2020)* who showed that before implementation vast majority of patients were severe cramps. While after intervention more than half of patients were moderate cramps. And this similar to *Vimala, (2018)* in a study entitled "Effectiveness of Intradialytic Stretching Exercises on Reduction of Muscle Cramps Among Patients Undergoing Haemodialysis at Sundaram Hospital Trichy" and reported that before implementation majority of patients were had sever cramps post implementation two fifths of patients were had moderate cramps.

#### **Part (IV): Pain level**

Regarding to pain level of the study group pre and post, the present study result showed that there is a significant difference between pre and post pain levels in study

group where more than one quarter of them had moderate pain level and less than two thirds of them had severe pain level pre intervention while most of them had mild pain and one fifth of them had no pain post intervention. This result explained that moist heat application effective to reduce level of patient's pain.

This result was supported with *Vimala, (2018)* who reported that there is a statistically significant relation between pre and post pain levels. And in accordance with *Poornazari, Roshanzadeh, Mohammadi(2019)* in a study entitled (Effect of isotonic exercise on the frequency of muscle cramps in hemodialysis patients: a clinical trial) and confirmed that administering the isotonic exercise program for hemodialysis patients can help prevent and decrease the number of muscle cramps and the severity of pain associated with this condition. While this result was disagreed with *Badakhsh et al., (2021)* who reported that there was no statistically significant difference among the three study groups in the pre intervention time in relation to pain intensity score

As regard to pain level of control group pre and post, these current study result revealed that there is no significant difference between pre and post pain levels in control group where less than one third of them had moderate pain level and two thirds of them had severe pain level pre intervention while

less than one fifth of them had moderate pain and most of them had severe pain post intervention. This result reflect patients' needs to nursing intervention to reduce level of pain

This result was supported with *Mastnardo et al. (2019)* who applied study entitled (Intradialytic Massage for Leg Cramps among Hemodialysis Patients: a Pilot Randomized Controlled Trial) and reported highly percentage of control group had severe pain. While this result was disagreed with *Albadr et al. (2020)* who reported that there were statistical significance differences level of pain pre and post intervention, the majority of them had pain level from 7-10 pre intervention while, less than two thirds of them had pain level from 4-6 post intervention.

As regard to comparison between pain level of both groups post intervention, the current study result revealed that there is a significant difference between post pain levels in both groups where most of them had mild pain and one fifth of them had no pain in study group while less than one fifth of them had moderate pain and most of them had severe pain in control group.

The researches may explain this finding that warm water produce relaxation to muscle as well as overall body and this relaxation may contribute to pain reduction.

This result in the same line with *Mastnardo, Lewis, Hall, (2019)* who

reported Intradialytic massage appears to be an effective way to decrease pain level due to muscle cramping. While this result was disagreed with *Rodrigues & Costeira, (2024)* who showed that about half of the studied patients had pain during HD treatment. And *ELmetwaly et al. (2023)* who showed that there was highly a statistically significant relation between level of pain levels pre and post intervention, about half of the studied patients had severe pain pre intervention, while more than two fifths of them hadn't pain post intervention.

### CONCLUSION

Based on the findings of the current study, it could be concluded that there was a statistical significant difference in the mean score of pain intensity for the study group before and after receiving the moist heat application with mean score ( $6.78 \pm 1.6$  &  $2.34 \pm 0.9$ ) respectively.

### Recommendations

Based on the previous findings of the present study, the following recommendations can be suggested.

1. All patients undergoing moist heat application should receive adequate knowledge and skills regarding effect of moist heat application on leg muscle cramp and pain through booklet, posters that lead to positive outcome.
2. Raise the awareness of patients about how to apply cold moist heat application

to reduce the pain that result from hemodialysis.

3. An orientation program should be prepared to help the newly appointment nurses to revise, acquire and develop their knowledge and practice regarding effect of moist heat application in reducing the pain intensity of the leg muscle cramp for patient undergoing hemodialysis .Continuous in-service training programs for refreshing and updating the nurses' knowledge and practice regarding effect of moist heat application on leg muscle cramp and pain associated with hemodialysis.
4. The importance of establishing booklet guideline for nurses regarding effect of moist heat application on leg muscle cramp and pain associated with hemodialysis.
5. Replication of the study on a larger probability sample is required from different setting, as well as different geographical areas in Egypt to raise the efficiency of nurses' performance regarding effect of moist heat application on leg muscle cramp and pain associated with hemodialysis.

### REFERENCES

- Abdel Monem, R., Abdullah, W., Atallah, H. & Henedy, W. (2022):* Effect of Nursing Intervention on Controlling Interdialytic

Weight and Vascular Access Complications among Patients Undergoing Hemodialysis. *Menoufia Nursing Journal*, 7(2), Pp. 351-366. **Available at:** <https://menj.journals.ekb.eg/article>

**Albadr, A., Azer, S., Abd elhamed, E. & Mostafa, N. (2020):** Effect of intradialytic hemodialysis exercises on fatigue and leg cramps. *Assiut Scientific Nursing Journal*: 8(20):Pp. 131-141.

**Available at:** [https://asnj.journals.ekb.eg/article\\_80746.html](https://asnj.journals.ekb.eg/article_80746.html)

**Algendy, A. & Bahgat, Z. (2019):** Effect of Muscles Stretching Exercises on Severity of Restless Legs Syndrome of Adult Patients Undergoing Hemodialysis. *Journal of Health, Medicine and Nursing*. (10).Pp.68

**Available at:**<https://core.ac.uk/download/pdf/270187834.pdf>

**American Academy of Orthopaedic Surgeons (2022):** Musclegcramp **Available at:** <https://orthoinfo.aaos.org/en/diseases-conditions/>

Muscle-cramps. Accessed Nov. 2, 2022.

**Anbu, K. & Rathiga, A. (2021):** Effectiveness of Intradialytic Stretching Exercises on Muscle Cramps among Patients Undergoing Haemodialysis in a Selected Tertiary Care Hospital Kancheepuram District, Tamil Nadu, India. *Journal of Pharmaceutical Research International*, 33

(57) Pp. 235-248.**Available at:** <https://journaljpri.com/index.php/JPRI/article/view/4771>

**Armiyati, Y., Hadisaputro, S., Chasani, S. & Sujianto, U. (2021):** High ultrafiltration increasing intradialytic blood pressure on hemodialysis patients. *South East Asia Nursing Research*, 3(1), Pp. 8-15.**Available at:** <https://jurnal.unimus.ac.id/index.php/SEANR/article/view/7291>

**Abouelala, m. & Khalil, k.mohamed, a.el gammal, a. (2021):** Effect of Passive and Active Stretching Exercises on Controlling Leg Cramps for Patients undergoing Hemodialysis. *Egyptian Journal of Health Care*, 12(1), pp.1549-1562.**Available at:**

[https://ejhc.journals.ekb.eg/article\\_231286.html](https://ejhc.journals.ekb.eg/article_231286.html)

**Badakhsh M, Dastras M, Sarchahi Z, Doostkami M, Mir A& Bouya S. (2021).**Complementary and alternative medicine therapies and COVID-19: a systematic review. Review on Environmental Health. 36(3).Pp.443450.**Available at:**<https://pubmed.ncbi.nlm.nih.gov/33838089/>

**Balakrishnan, P., Kumar, S, Chippala, P. & Hegde, C. (2020):** An in vivo electromyographic evaluation of pain relief using different therapies in masticatory myalgia patients. *Journal of the Korean Association of Oral and Maxillofacial Surgeons*, 46(5): Pp.321-327.

**Available at:**

<https://pubmed.ncbi.nlm.nih.gov/33122456/>

**Cameron, M., & Monroe, L. (2021).** "Physical Agents in Rehabilitation: An Evidence-Based Approach to Practice." Elsevier.

**Dawood, H. (2020):** Assessment of Patient's Knowledge Regarding Hemodialysis Therapy at Imam Hussein Medical City in Holly Karbala Governorate. *Indian Journal of Forensic Medicine & Toxicology*, 14(3).Pp868-875.**Available at:**

<https://medicopublication.com/index.php/ijfmt/article/view>

**ELmetwaly, A., Abdelkhalek, W. , Ibrahim, A. & Mohamed, E. (2023):** Reflexology: Golden Foot Massage on Leg Cramps for Hemodialysis Patients. *International Egyptian Journal of Nursing Sciences and Research*, 4(1). Pp.200-217.**Available at:**

[https://ejnsr.journals.ekb.eg/article\\_309986.html](https://ejnsr.journals.ekb.eg/article_309986.html)

**Elsedawy, A., Mohsen, M., El-Saidy, T. & Shehata, H. (2023):** Effect of intradialytic stretching exercises on muscle cramps among elderly patients undergoing hemodialysis. *Menoufia Nursing Journal*, 8(1).Pp. 1-11. **Available at:** [https://menj.journals.ekb.eg/article\\_284020.html](https://menj.journals.ekb.eg/article_284020.html)

**El-Deen, D. & Mohammed, H. (2019).** Effect of Moist Heat versus Cold Therapy

on Leg Muscle Cramp among Patients on Hemodialysis. - *Journal of Health Sciences and Nursing*: 4 (29). **Available at:** [https://scholar.cu.edu.eg/sites/default/files/dalia\\_elsedawy/files/effect\\_of\\_moist\\_heat\\_versus\\_cold\\_therapy\\_on\\_leg\\_muscle\\_cramp\\_among\\_patients\\_on\\_hemodialysisfinal\\_research\\_mnshwr.pdf](https://scholar.cu.edu.eg/sites/default/files/dalia_elsedawy/files/effect_of_moist_heat_versus_cold_therapy_on_leg_muscle_cramp_among_patients_on_hemodialysisfinal_research_mnshwr.pdf)

**Freiwald J, Magni A, Fanlo-Mazas P, Paulino E, Sequeira de Medeiros L, Moretti B, Schleip R, Solarino G(2021).** A Role for Superficial Heat Therapy in the Management of Non-Specific, Mild-to-Moderate Low Back Pain in Current Clinical Practice: A Narrative Review. *Life (Basel)*. 2; 11(8):780. doi: 10.3390/life11080780. PMID: 34440524; PMCID: PMC8401625.

**Gunes, D., Baskan, S. & Kasimoglu, N. (2020):** Evaluation of Self-Care Agency and Perceived Social Support in Patients Undergoing Hemodialysis. *International Journal of Caring Sciences*, 13(1) Pp.250-257.**Available at:**

[https://internationaljournalofcaringsciences.org/docs/29\\_atalikoglu\\_original\\_13\\_1.pdf](https://internationaljournalofcaringsciences.org/docs/29_atalikoglu_original_13_1.pdf)

**George, T. & Merkus, J. (2022).** Structured Interview | Definition, Guide & Examples. Scribbr. **Available at:** <https://www.scribbr.com/methodology/structured-interview/>

**Hamza,o., El maghawry,a.,& Hasanen ,s.(2022)** Effect Of Educational Program

For Hemodialysis Patients Regarding Their Knowledge And Practice About Self Care Behaviour. Assiut Scientific Nursing Journal, 10(28).Pp1-13 **Available at:** <https://www.researchgate.net/publication>

**Habas, E., Habas, A., Elgamal, M., Shraim, B., Moursi, M., Ibrahim, A.&Elzouki, A. (2021):** Common complications of Hemodialysis: A clinical review. *Ibnosina Journal of Medicine and Biomedical Sciences*, 13(04), Pp.161-172.

**Available at :** <https://d-nb.info/1269896806/34>

**Hashmi, M., Benjamin, O., & Lappin, S., (2023).** End-Stage Renal Disease .Stat Pears Publishing Journal.44(1).Pp1-30

**Available at**  
[:https://www.ncbi.nlm.nih.gov/books/](https://www.ncbi.nlm.nih.gov/books/)

**Hasaballa, M., Elwakill, H., Elsharkawy, M., (2022).** Egyptian Renal Data System (ERDS) 2020: An Annual Report of End-Stage Kidney Disease Patients on Regular Hemodialysis. *Journal of the Egyptian society of nephrology and transplantation* 22 (1) Pp. 1-28. **Available at**  
[:https://www.jesnt.eg.net/article.asp](https://www.jesnt.eg.net/article.asp)

**Herguedas, A. (2021).** Non-Pharmacological Interventions in Preventive, Rehabilitative and Restorative Medicine. IntechOpen. doi:10.5772/intechopen.94187

**Kallenbach, J., (2020).** Review of Hemodialysis for Nurses and Dialysis Personnel-E-Book: Review of

Hemodialysis for Nurses and Dialysis Personnel-E-Book.united state10 th ED .pp 1-3

**Kevin, B., Bill, M., Erik, S., Dennis, C., Wendy, L., David, S.,(20 22 )** A practical guide to recognize, assess, treat and evaluate (RATE) primary care patients with chronic pain.135(3) , Pp244-253**Available at:**<https://www.tandfonline.com/doi/citedby/10.1080/00325481.2021.2017201?scroll=top&needAccess=true>

**Kim, B. & Kim, J. (2019).** Influence of Uncertainty, Depression, And Social Support On Self-Care Compliance In Hemodialysis Patients. *TherClin Risk Manag.*; 15(6).Pp.1243-1251 **available at :**  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6815211/>

**Kisling, I., Claus, B., Stahlschmidt, L. & Wager, J. (2021).** The efficacy of an educational movie to improve A randomized controlled trial.15 (7).Pp.1612-1621.

**Available at**  
[:https://pubmed.ncbi.nlm.nih.gov/33949051/](https://pubmed.ncbi.nlm.nih.gov/33949051/)

**Keskar, V. (2023).** Understanding the Benefits and Challenges of Dialysis for Chronic Kidney Disease - WorldKidney Day**Available at:**2023<https://www.ndtv.com/health/world-kidney-day-2023->



understanding-the-benefits-and-challenges-of-dialysis-for-chronic-kidney-disease-3845776

**Ma, Y., Diao, B., Zhu, J., Liang, W., Liu, L. & Wang, H. (2020).** Novel Coronavirus Disease in Hemodialysis (HD) Patients: Report from one HD center in Wuhan, China. *MedRxiv*. **Available at:** <https://www.medrxiv.org/content/10.1101/2020.02.24.20027201v2>

**Mahjubian, A., Bahraminejad, N. & Kamali, K. (2018):** The Effects of Group Discussion Based Education on the Promotion of Self-Management Behaviors in Hemodialysis Patients. *Journal Caring Sciences.*, 7(4).Pp 225-232. **Available at:**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6311626/>

**Mahmoud, H., Abed El-Aaziz, S., & Ibrahim, M. (2022).** Effect of Cold Application on Intramuscular Injection Pain among Patients with Fractures. *Egyptian Nursing Journal*, 19 (1).Pp36-46. **Avialable at:** [https://scholar.cu.edu.eg/sites/default/files/mishmisha\\_ibrahim/files/egyptnurs..](https://scholar.cu.edu.eg/sites/default/files/mishmisha_ibrahim/files/egyptnurs..)

**Mastnardo D, Lewis J, Hall K.(2019).** Intradialytic Massage for Leg Cramps Among Hemodialysis Patients: a Pilot Randomized Controlled Trial. *International Journal of Therapeutic Massage & Bodywork*. 9(2).Pp3-8.

**available at:** <https://europepmc.org/article/MED/27257445>

**Morris, B. (2014).** Effect of Intradialytic Stretching Exercise on Muscle Cramps among Patients undergoing hemodialysis. *Tamil Nadu Nurses and Midwives Council Journal of Medical and Surgical Nursing*, 2(8).Pp 8-11. **Available at:**

[https://menj.journals.ekb.eg/article\\_284020\\_d6ce4b24361344445613641e6815d9cf.pdf](https://menj.journals.ekb.eg/article_284020_d6ce4b24361344445613641e6815d9cf.pdf)

**National Institutes of Health (2021):** National Center for Complementary and Integrative Health. Are You Considering a Complementary Health Approach? **Available at:** <https://www.nccih.nih.gov/health/are-you-considering-a-complementary-health-approach>

**National Kidney Foundation. Chronic Kidney Disease (CKD) (2023):** Symptoms and Causes. **Available at:** (<https://www.kidney.org/atoz/content/about-chronic-kidney-disease>).

**Poornzaari,M., Roshanzadeh,m., Mohammadi,s,(2019).** Effect of Isotonic Exercise on the Frequency of Muscle . *Medical-Surgical Nursing Journal*.8(1).Pp12-15 **Available at:** <https://www.researchgate.net/publication>

**Rodrigues, R. & Costeira, C. (2024).** Pain Assessment in Patients during Hemodialysis Treatment:Quality Improvement Project. *Nursing Reports*, 14(2),Pp. 1370-1387. **Available at:**

<https://pubmed.ncbi.nlm.nih.gov/38921713/>

**Salah El-Deen, D. & Mohammed, H. (2019):**

Effect of moist heat versus cold therapy on leg muscle cramp among patients on hemodialysis: randomized control trial IJRDO. *Journal of Health Sciences And Nursing*, 4(2) Pp.23-46 **Available at:** [https://scholar.cu.edu.eg/?q=dalia\\_elsedawy/publications/effect-moist-heat-versus-cold-therapy-leg-muscle-cramp-among-patients-he](https://scholar.cu.edu.eg/?q=dalia_elsedawy/publications/effect-moist-heat-versus-cold-therapy-leg-muscle-cramp-among-patients-he)

**Sayeed, A., Haque, M. & Ali, A. (2024).** Heat

Therapy: Concept, Mechanism and Application in Unani Medicine. *Current Traditional Medicine*, 10(3), Pp. 84-89. **Available at:** <https://www.researchgate.net/publication/370344699>

**Shahriari, A., Sarani, H., Sheikh, S. &**

**Arbabisarjou, A. (2021).** The effect of foot reflexology massage on pruritus in hemodialysis patients. *Journal of Education and Health Promotion*, 10(81). Pp20-59. **Available at:** <https://pubmed.ncbi.nlm.nih.gov/34084828/>

**Tsegaye, D., Yazew, A., Gedfaw, M., Yilak, G.,**

**& Yalew, Z. M. (2023).** *Non-Pharmacological Pain Management Practice and Associated Factors Among Nurses Working at Comprehensive Specialized Hospitals.* *SAGE open nursing*, 9, 23779608231158979.

**Available at:**

<https://doi.org/10.1177/23779608231158979>

**Varghese, A., Lacson E., Sontrop, J.,**

**Acedillo, R. , Al-Jaishi, A., Anderson, S. & Dialysate Magnesium (Dial-Mag) Investigators. (2020):** A higher concentration of dialysate magnesium to reduce the frequency of muscle cramps: a narrative review. *Canadian Journal of Kidney Health and Disease*.4(2)Pp.431-441 **Available at:** <https://pubmed.ncbi.nlm.nih.gov/33149925/>

**Vati, J. (2021).** Effectiveness of intradialytic

leg stretching exercises to reduce muscle cramps among patients undergoing hemodialysis. *managers Journal on Nursing*, 11(4). Pp16-24 **Available at:** <https://www.proquest.com/openview>

**Vimala, A. (2018).** Effectiveness of

Intradialytic Stretching Exercises on Reduction of Muscle Cramps Among Patients Undergoing Haemodialysis at Sundaram Hospital Trichy, EPRA International Journal of Research and Development 8(9). Pp1-4.

**Available at**

[:https://www.semanticscholar.org](https://www.semanticscholar.org)

**Xu, F., Zhuang, B., Wang, Z., Wu, H., Hui,**

**X., Peng, H., & Ye, H. (2023).** Knowledge, attitude, and practice of patients receiving maintenance hemodialysis regarding hemodialysis and its complications: a

single-center, cross-sectional study in Nanjing. *BMC nephrology*, 24(1), p275.

*Available at*  
:https://www.ncbi.nlm.nih.gov/pmc/articles

*Zhou, Y., Cui, L., You, X., Jiang, Z., Qu, W., Liu, P., & Cui, Y. (2021).* Effects of repeated and continuous dry heat treatments on the physicochemical and structural properties of quinoa starch. *Food Hydrocolloids*, 0268-005X, (113). Pp 106532 .**Available at:**  
<https://plu.mx/plum/a/?doi=10.1016/j.foodhyd.2020.106532&theme=plum-sciencedirect-theme&hideUsage=true>