

The Effects of Nursing Interventions on Intradialytic Muscle Cramps among Patients Undergoing Maintenance Hemodialysis.

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Abstract:

Background: Muscle cramps are the most prevalent intradialytic complication among patients on maintenance Hemodialysis. **Aim of the study:** Identify the effects of nursing interventions on intradialytic muscle cramps among patients undergoing maintenance Hemodialysis. **Setting:** This study was conducted at Hemodialysis Unit, Medical Research Institute Hospital, Alexandria University, Egypt. **Subjects:** The study subjects comprised a convenience sample of 43 adult male and female patients with intradialytic muscle cramps. **Tools:** Two tools were used. **Tool I.** Patients' Knowledge; Structured Interview Questionnaire: to assess patients' knowledge related to fluids and sodium restrictions as well as muscle cramps. **Tool II:** Cramp Questionnaire Chart: to assess the level of intradialytic muscle cramps before, during and after the application of nursing interventions. **Results:** More than half of the studied patients were females (58.1%), whose mean age was 43.35 ± 9.45 years. High statistically significant differences were found between patients' overall knowledge scores pre and post application of the nursing interventions ($p < 0.001^*$). The overall mean percent improvement score in muscle cramps' level after application of the nursing interventions was 81.62 ± 23.30. Statistically significant associations between patients' age, education and overall mean percent improvement score of intradialytic muscle cramps were noted after the application of the nursing interventions. **Conclusion:** Nursing interventions are proved to be significant in reducing the level of muscle cramps among the studied patients. **Recommendations:** Hemodialysis patients' education regarding fluid, sodium restrictions, and carrying out intradialytic leg stretching exercises are highly advocated to prevent intradialytic muscle cramps.

Key words: Nursing interventions, Intradialytic muscle cramp, Maintenance Hemodialysis.

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I. Introduction

End Stage Renal Disease (ESRD) has become a public health issue, as the number of patients requiring renal replacement therapy has been increased drastically worldwide^(1,2). In Egypt, like other developing countries, there is no recent data about the prevalence of ESRD; however, the estimated number of patients with ESRD almost doubled, from 18,000 in the year 2000 to 33,693 in 2009⁽³⁾. According to latest Egyptian Renal Registry in 2008, the prevalence of dialysis patients in Egypt has increased from 225 per million populations (pmp) in 1996 to 483 pmp in 2004. Ninety-eight percent of them are on maintenance Hemodialysis^(4,5).

Hemodialysis (HD) is one of the most effective treatment modalities that can sustain ESRD patients' life⁽⁶⁾. Although HD has resulted in longer survival of end-stage renal disease patients, they are confronted with numerous intradialytic complications^(6,7). These complications may result from the disease itself or the treatment process, which change patients' quality of life^(8,9). Intradialytic complications, in order of frequency, include hypotension, muscle cramps, nausea, vomiting, flushing of face, headache, increased pruritus, chest pain, fever, and chills⁽¹⁰⁾.

Muscle cramp is a widespread problem experienced by patients undergoing HD, as it affects about 61% of them⁽¹¹⁾. Muscle cramp is characterized by a sudden painful, involuntary contraction of the skeletal muscle that begins with fasciculations and is related to nerve conduction rather than the muscles themselves. The most commonly affected muscles are the gastrocnemius, triceps, quadriceps and the hamstrings muscles^(12,13).

Although the exact etiology of muscle cramps is incompletely understood, several common triggers have been identified including; the rapid removal of excess fluid and waste products associated with excessive interdialytic weight gain, electrolyte abnormalities, tissue hypoxia resulting from hypotension and vasoconstriction, dialysis prescription (blood flow rate and ultrafiltration), and dialysate composition^(10,14,15).

Intradialytic muscle cramp may have serious consequences on patients undergoing HD, as it represents the most common reason for early termination of HD session⁽¹¹⁾. Also, it may lead to reduction of fluid removal, inadequate clearance of waste products, fluid overload, hypertension, and increased mortality risk

^(11,15). Furthermore, muscle cramp negatively affects sleep and patients' quality of life. In severe cases, it may affect patient decisions to ultimately withdraw from dialysis treatment ⁽¹⁶⁾.

Therapeutic maneuvers to manage muscle cramps include: intravenous fluids, oral medications, warm compresses, stretching exercise, and adherence to prescribed diet ^(17,18). Several studies mentioned that alleviating, and preventing the occurrence of muscle cramps is a major responsibility of the nurse, through instructing the patient to avoid excessive interdialytic weight gain, and encouraging as well as assisting patients to carry out intradialytic stretching exercises ⁽¹⁹⁻²¹⁾.

Patients' adherence to diet and fluids regimens together with dialysis is the cornerstone of renal failure treatment ⁽²²⁻²⁴⁾. Adherence to diet and fluid instructions improves health, reduces treatment costs, risk of complications and improves quality of life ^(23,24). Patients' education about adherence to dietary plan, and fluid restrictions is one of the most important aspects of nursing care that can prevent or alleviate many dialysis-related complications ^(25,28). Hemodialysis nurses should educate their patients regarding adherence to their fluid, and diet restrictions to prevent or alleviate prolonged and painful cramps. Also, HD nurses should instruct their patients regarding muscle cramps causes, sites, and prevention ^(29,30).

Intradialytic stretching exercise is the exercise performed actively and passively to the affected muscles at the end of second hour of hemodialysis session ⁽³¹⁾. Intradialytic stretching exercises like quadriceps, knee strengthening exercise, hamstring exercise, and gluteal strengthening exercise will improve muscle protein synthesis and breakdown, which helps in reducing or preventing intradialytic muscle cramps ^(18,23). Other health benefits of stretching exercises include reduction of muscle pain, and soreness, enhancing flexibility, and elasticity as well as reducing injury risk. Stretching exercise can lower the build-up of lactic acid in the muscles and eliminate tightness and any chance of damage ⁽¹⁷⁾. Panchiri et al (2017) demonstrated that intradialytic stretching exercises had a significant effect on muscle cramps' reduction in their studied patients ⁽¹²⁾.

Patient education is one of the most important aspects of nursing care that can reduce mortality and complications from toxins among patients on maintenance HD ⁽²⁹⁾. Dietary counseling and education motivate patients to change and comply with dietary recommendations ⁽³⁰⁾. Improvement in patient's knowledge has frequently been described as a primary outcome in randomized clinical trials evaluating kidney disease patient education ⁽³²⁾. Patient education concerning fluid and sodium restrictions as well as stretching leg muscle exercises are the two nursing interventions that have proved to have many useful effects. So far, no studies have been carried out in Egypt to identify the effect of these nursing interventions on intradialytic muscle cramps among HD patients. Therefore, this study aimed to identify the effects of nursing interventions on intradialytic muscle cramps among patients undergoing maintenance hemodialysis.

Operational definitions:

- Nursing interventions: are health education aspects concerning fluids and sodium restriction, as well as leg stretching exercise
- Intradialytic stretching exercise: are exercises that carried out actively and passively to the affected muscles.

Aim of the study:

To identify the effects of nursing interventions on intradialytic muscle cramps among patients undergoing maintenance Hemodialysis.

Hypotheses:

1. Patients undergoing maintenance hemodialysis (HD) who receive nursing interventions will exhibit improvement of knowledge related to fluids, and sodium restrictions, as well as muscle cramps.
2. Patients undergoing maintenance hemodialysis (HD) who receive nursing interventions will exhibit improvement in intradialytic muscle cramps' severity, duration and frequency.

II. Material and Methods

Research Design: A quasi experimental pre-test/ post-test design was used.

Setting: This study was conducted at the Hemodialysis Unit, Medical Research Institute Hospital, Alexandria University, Egypt.

Subjects: The study subjects comprised a convenience sample of 43 patients complaining of intradialytic muscle cramps. Patients who were suffering from intradialytic muscle cramps in about 50% of their dialysis sessions were identified and included in the study.

The Epi info 7 program was used to estimate sample size using the following parameters:

- Population size= 120
- Expected frequency =50%.
- Maximum margin of error= 10%.

- Confidence coefficient =95%.
- Estimated sample size =40 patients.

Inclusion criteria: Study sample included male, and female ESRD patients, aged 20- 60 years old, alert and able to communicate verbally, on maintenance HD for at least six months, and receiving three HD sessions a week

Exclusion Criteria:

- Patients with skin sores, wounds, dermatitis, or edema of the lower extremities, with a known history of deep vein thrombosis (DVT) or peripheral vascular disease (PVD), or with a vascular access in a lower extremity, peripheral neuropathy, or liver disease.
- Patients who had already received nursing interventions related to intradialytic muscle cramps

Tools:

Tool I. Patients' Knowledge; Structured Interview Questionnaire: This sheet was developed by the researchers based on a review of the related literature, to assess patients' knowledge related to fluids and sodium restrictions, as well as muscle cramps⁽²⁵⁻²⁹⁾. It incorporated two parts:

Part A. Sociodemographic, and clinical data sheet: It included age, gender, diagnosis, education and occupation of the patient, associated diseases with ESRD, and duration of HD treatment.

Part B: Hemodialysis Patients' knowledge assessment sheet. This part incorporates three sections of open, and/or closed ended questions pertaining to:

- Fluid restrictions as; types of fluids allowed, the accepted amount of fluid gains between dialysis sessions, intradialytic complications of interdialytic fluid gain.
- Dietary sodium restrictions as; sources of sodium in diet, the exact amount of sodium needed/day, examples of salt substitute, and ways to decrease sodium in diet.
- Intradialytic muscle cramps as; definition, site, causes, and maneuvers to prevent or alleviate cramps.

- Responses to the above mentioned questions were noted as being: "correct/complete", "correct incomplete", and "don't know/wrong answer" using the following scoring system:

Two scores= correct/complete answer

One score = correct incomplete answer (equal to at least half of the true answer).

Zero = do not know /wrong answer

Scoring system

- Total scores of <50% were considered poor level of knowledge.
- Total scores of 50 <75% were considered fair level of knowledge
- Total scores of $\geq 75\%$ were considered good level of knowledge.

Tool II: Cramp Questionnaire Chart: The Cramp Questionnaire Chart was adapted from Morris (2014)⁽³²⁾ to assess the level of intradialytic muscle cramps before, during and after the application of the nursing interventions. It contains various features of muscle cramps such as frequency, duration of muscle cramps, and level of pain, which comprehensively scored as level of muscle cramps ranging from (0-12).

Scoring system:

- "No cramps" Zero score
- "Mild cramps" from one to less than 5 scores
- "Moderate cramps" from 5 to less than 9 scores
- "Severe cramps" from 9 - 12 scores

The Nursing interventions:

- A health education unit was developed by the researchers after extensive review of related literature⁽²⁵⁻²⁹⁾ to help HD patient to gain knowledge about:
 - Fluid restrictions, dietary sodium restrictions
 - Intradialytic muscle cramps' definition, site, causes, and maneuvers to prevent or alleviate cramps.
- Intradialytic leg stretching exercises: These exercises comprised of:
 - Ankle flexion and extension
 - Calf muscle stretching exercise
 - Hamstring stretching exercise
 - Active straight leg raising

II. Method

- Approval to carry out the study was obtained from the Ethical Committee of Nursing Research at the Faculty of Nursing, Alexandria University.
- Permission to carry out the study was obtained from the directors and the responsible authorities of the chosen setting after explaining the aim of the study.
- The study tools (I, II) were developed, and adapted by the researchers based on recent review of literature. Content validity of the study tools, were tested by five experts in the fields of Medical-Surgical Nursing, and Nephrology to assure the content validity, and clarity of items. Necessary modifications were introduced accordingly.
- A pilot study was conducted on 10% of the total sample to test the feasibility and applicability of the study tools. Modifications were done accordingly. Pilot study subjects were excluded from actual study.
- Reliability testing for the study tools were estimated to measure their internal consistency using the Cronbach's Alpha test for tool I ($r=0.724$), for tool II ($r=0.70$).

Phases of data collection

I: Assessment Phase:

Subjects were approached throughout their dialysis sessions and the purpose of the study was explained. All patients who met the inclusion criteria and agreed to participate in the study were interviewed individually. Initial assessment of the study participants' knowledge related to fluid restrictions, dietary sodium restrictions, and intradialytic muscle cramps was done in the first session using tool (I) through structured interviews while muscle cramps assessment was done using tool II.

II. Planning phase:

A health education unit was designed by the researchers based on assessment phase and recent review of literature. Two sessions were designed for each patient to cover knowledge related to fluid, sodium restrictions and practice of stretching leg exercises.

Teaching strategies used included: interactive lecture/ discussion, demonstrations and re-demonstration.

III. The Intervention Phase:

Health education items were covered in two teaching sessions, which were provided for each patient individually.

- Each session lasted 30 to 45 minutes.
- During the initial teaching session, information about fluid restrictions, and dietary sodium restrictions were provided. In the second session, muscle cramps' definition, site, causes, and stretching exercises demonstration, and practice were covered.
- Every study participant was supplied with a written Arabic leaflet as a reminder, and reference about instructions & exercises, and to motivate them for follow up.
- Practice of intradialytic leg stretching exercises continued for 8 sessions.

During HD sessions:

- Patients practiced intradialytic leg stretching exercises twice (in the third and fourth hour of HD session respectively), for 10 minutes each.
- Each stretching exercise was repeated 5 times.
- At the end of each session, instructions given related to fluid, and sodium restrictions were re-emphasized.

IV: Evaluation Phase:

- Evaluating the effects of the nursing interventions on muscle cramps was carried out during the 5th, and 10th HD sessions using tool II.
- Evaluation of patients' knowledge was done at the 10th session using part B from tool one.

Ethical considerations:

Verbal informed patients' consents to participate in the study were obtained after explaining the aim of the study. Anonymity, and privacy of the participants and confidentiality of the collected data were assured throughout the study. Patients also, were informed about their rights to withdraw from the study at any time.

Statistical analysis:

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

1 - Student t-test: for normally distributed quantitative variables, to compare between two studied groups

2 - F-test (ANOVA): for normally distributed quantitative variables, to compare between more than two groups, and Post Hoc test (Tukey) (LSD) for pairwise comparisons

3 - Paired t-test: for normally distributed quantitative variables, to compare between two periods

4 - Friedman test: for abnormally distributed quantitative variables, to compare between more than two periods or stages and Post Hoc Test (Dunn's) for pairwise comparisons

III. Results

Table (1): displays distribution of the studied patients according to their socio-demographic characteristics (n =43)

The table shows that the mean age of the studied patients was 43.35 ± 9.45 years, and 58.1% were females. The majority of the studied patients were married, from urban areas (81.4%, 95.3% respectively) and more than half (58.1%) were house wives. The majority of the studied patients were allocated between read & write and diploma graduate (44.2%, 41.9% respectively).

Table (1): Distribution of the studied patients according to their sociodemographic characteristics (n=43)

Socio-demographic Characteristics	No.	%
Age (years)		
20>30 years	2	4.7
30>40 years	17	39.5
40> 50 years	16	37.2
50-60 years	8	18.6
Min. – Max.	20.0 – 60.0	
Mean \pm SD.	43.35 \pm 9.45	
Gender		
Male	18	41.9
Female	25	58.1
Marital status		
Single	6	14.0
Married	35	81.4
Divorced	2	4.7
Level of education		
Illiterate	2	4.7
read and write	19	44.2
Diploma	18	41.9
Bachelor	4	9.3
Occupation		
Labor	8	18.6
Clerical	0	0.0
Housewife	25	58.1
Not working	10	23.3
Area of Residence		
Urban	41	95.3
Rural	2	4.7

Table (2): shows distribution of the studied patients according to their clinical data (n = 43)

More than half of the studied patients (58.1%) didn't have associated disease with ESRD, compared to 23.3% of them who suffered from hypertension. The majority of the studied patients (81.4%) were on maintenance HD for 5 years and more, all of them underwent HD for 4 hours. The majority of the studied patients experienced muscle cramps in both legs, calf muscle, and during the last hour of HD session, (86%, 95.3%, 90.7% respectively).

Table (2): Distribution of the studied patients according to their clinical data (n = 43)

Clinical Data	No.	%
Associated disease with ESRD		
None	25	58.1
Hypertension	10	23.3
Congestive heart Failure	6	14.0
Systemic lupus erythematosus	2	4.7
Duration of Hemodialysis treatment /years		
>1 year	0	0.0
1>5 years	8	18.6
\leq 5 years	35	81.4
Duration of Hemodialysis session/hours		
4 hours	43	100.0
6 hours	0	0.0

Time of intradialytic muscle cramps.		
First hour of dialysis session	0	0.0
Middle hours	4	9.3
Last hour	39	90.7
Location of muscle cramps		
Right leg	4	9.3
Left leg	2	4.7
Both	37	86.0
Muscles involved in cramps.		
Calf muscle	41	95.3
Hamstring	4	9.3
Soule	4	9.3

Table (3) displays differences of interdialytic weight gain of the studied patients pre and post application of the nursing interventions

The table shows that the mean interdialytic weight gain of the studied subjects was 3.15 ± 0.70 kg pre-interventions which decreased by the 5th session to 2.68 ± 0.75 , then increased slightly to 2.87 ± 0.73 . The table also shows that there are statistically significant differences between subjects' interdialytic weight gain pre and post interventions in both 5th and 10th sessions as $p_1 < 0.001^*$, $p_2 = 0.031^*$.

Table (3): Differences of interdialytic weight gain of the studied patients pre and post application of the nursing interventions

Interdialytic Weight Gain	Pre-interventions	Post Interventions		F	P
		5 th session	10 th session		
Min. – Max.	2.0 – 4.50	1.0 – 4.30	0.80 – 4.0	11.562*	<0.001*
Mean ± SD.	3.15 ± 0.70	2.68 ± 0.75	2.87 ± 0.73		
Sig. bet. periods.	$p_1 < 0.001^*$, $p_2 = 0.031^*$, $p_3 = 0.190$				

F: F test (ANOVA) with repeated measures, Sig. bet. periods were done using Post Hoc Test (adjusted Bonferroni)

p: p value for comparing between the studied periods

p1: p value for comparing between Pre interventions and 5th session

p2: p value for comparing between Pre interventions and 10th session

p3: p value for comparing between 5th and 10th

*: Statistically significant at $p \leq 0.05$

Table (4), Fig (1): displays differences in the studied patients' knowledge regarding fluid restrictions, dietary sodium restrictions, and muscle cramps pre, and post application of the nursing interventions (n = 43).

High statistically significant improvement in patients' knowledge related to fluids restrictions, dietary sodium restrictions, and intradialytic muscle cramps is observed in the total knowledge score after application of the nursing interventions, as ($t = 8.406^*$, 14.449^* , 6.445^* respectively). Additionally, the majority of patients (81.4%) had poor level of overall knowledge pre interventions, while all patients achieved good overall level of knowledge post interventions. High statistically significant differences were found between patients' overall knowledge pre and post interventions ($t = 23.991^*$ $p < 0.001^*$).

Table (4): Differences in the studied patients' knowledge regarding fluid restrictions, dietary sodium restrictions, and muscle cramps pre, and post application of the nursing interventions (n = 43)

Area of Patients' Knowledge	Pre-interventions		Post Interventions		Test of sig.	P
	No.	%	No.	%		
a) Fluid restrictions						
Poor	18	41.9	0	0.0	-	-
Fair	9	20.9	0	0.0		
Good	16	37.2	43	100.0		
Total score (Mean ± SD)	5.02 ± 3.88		10.0 ± 0.0		t =	<0.001*
% score (Mean ± SD)	50.23 ± 38.82		100.0 ± 0.0		8.406*	
b) Dietary sodium restrictions						
Poor	31	72.1	0	0.0	-	-
Fair	6	14.0	0	0.0		
Good	6	14.0	43	100.0		
Total score (Mean ± SD)	3.14 ± 3.11		10.0 ± 0.0		t =	<0.001*
% score (Mean ± SD)	31.40 ± 31.14		100.0 ± 0.0		14.449*	

c) Muscle cramps						
Poor	36	83.7	0	0.0		
Fair	5	11.6	0	0.0	-	-
Good	2	4.7	43	100.0		
Total score (Mean ± SD)	3.26±2.50		8.35±6.47		t=	<0.001*
% score (Mean ± SD)	11.95 ± 0.21		27.13±20.82		6.445*	
Overall level of patients' knowledge						
Poor	35	81.4	0	0.0		
Fair	8	18.6	0	0.0	-	-
Good	0	0.0	43	100.0		
Total score (Mean ± SD)	8.35±6.47		31.95± 0.21		t=	<0.001*
% score (Mean ± SD)	26.09±20.21		99.85 ± 0.67		23.991*	

Scoring system: poor <50% fair 50% - <75% good ≥75%

t: Paired t-test

p: p value for comparing between pre and post

*: Statistically significant at p ≤ 0.05

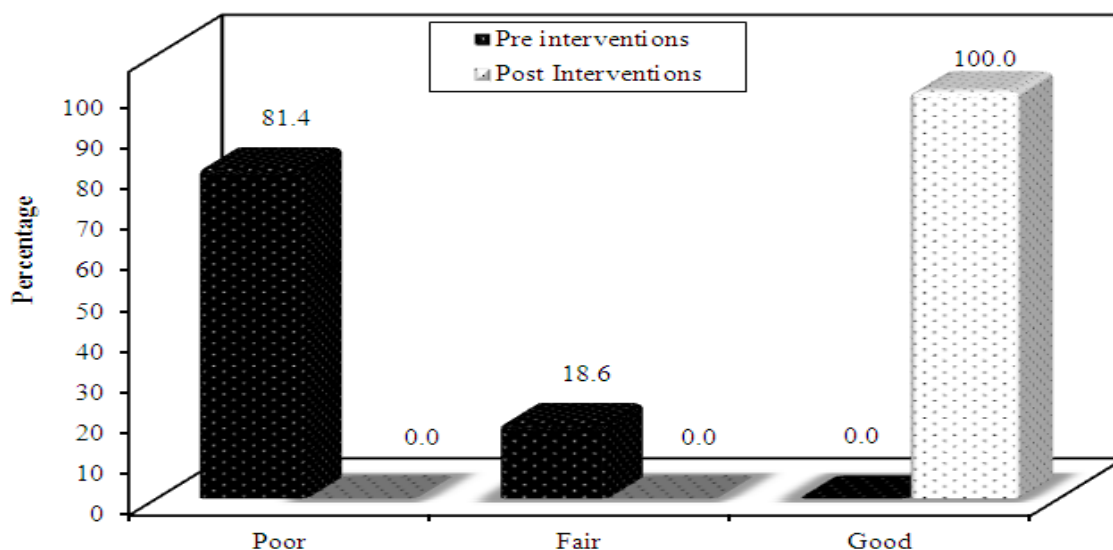


Figure (1): Frequency distribution of the studied patients according to their overall level of knowledge pre, and post interventions.

Table (5), Figures (2,3,4): display differences in the studied patients according to intradialytic muscle cramps' frequency, duration, and pain level pre and post interventions application (n=43).

The table shows that more than half of the studied patients (55.8%) had two to three times of muscle cramps pre interventions, whereas 58.1% of them had no cramps post interventions. Also, the nursing interventions were proved to be significant in reducing frequency of muscle cramps among the studied patients (Fr= 63.512*, p<0.001*).

The table also illustrates that nearly one third of the studied patients (32.6%) suffered from muscle cramps for two minutes duration pre interventions, which improved gradually to 58.1% with no cramps by the 10th session, and this shows statistically significant difference (71.042*, <0.001*). In addition, The table denotes that the majority of the studied patients had “moderate to severe pain” pre interventions (32.6%, 62.8% respectively), whereas the majority of them achieved “no to mild pain” post interventions (58.1%, 41.9% respectively), and these findings are highly significant (F=78.154*, p<0.001*)

Table (5): Differences in the studied patients according to intradialytic muscle cramps' frequency, duration, and pain level pre and post interventions application (n=43).

Clinical variable	Pre-interventions		Post interventions				Fr	p
	No.	%	5 th session		10 th session			
			No.	%	No.	%		
Frequency of muscle cramps								
None	0	0.0	6	14.0	25	58.1	63.512*	<0.001*
1 Time	17	39.5	29	67.4	18	41.9		
2 – 3 Times	24	55.8	8	18.6	0	0.0		
4 – 5 Times	2	4.7	0	0.0	0	0.0		
p₀			0.001*		<0.001*			
Duration of muscle cramps								
Nil	0	0.0	6	14.0	25	58.1	71.042*	<0.001*
1 minute	12	27.9	21	48.8	18	41.9		
2 minutes	14	32.6	16	37.2	0	0.0		
3 minutes	9	20.9	0	0.0	0	0.0		
4 minutes	8	18.6	0	0.0	0	0.0		
p₀			<0.001*		<0.001*			
Level of pain (VAS)								
No pain	0	0.0	6	14.0	25	58.1	78.154*	<0.001*
Mild Pain	0	0.0	15	34.9	18	41.9		
Moderate Pain	14	32.6	22	51.2	0	0.0		
Severe Pain	27	62.8	0	0.0	0	0.0		
Worst Possible pain	2	4.7	0	0.0	0	0.0		
p₀			<0.001*		<0.001*			

Fr: Friedman test, Sig. bet. periods was done using Post Hoc Test (Dunn's)

p: p value for comparing between different period

p₀: p value for comparing between pre and each other period

*: Statistically significant at $p \leq 0.05$

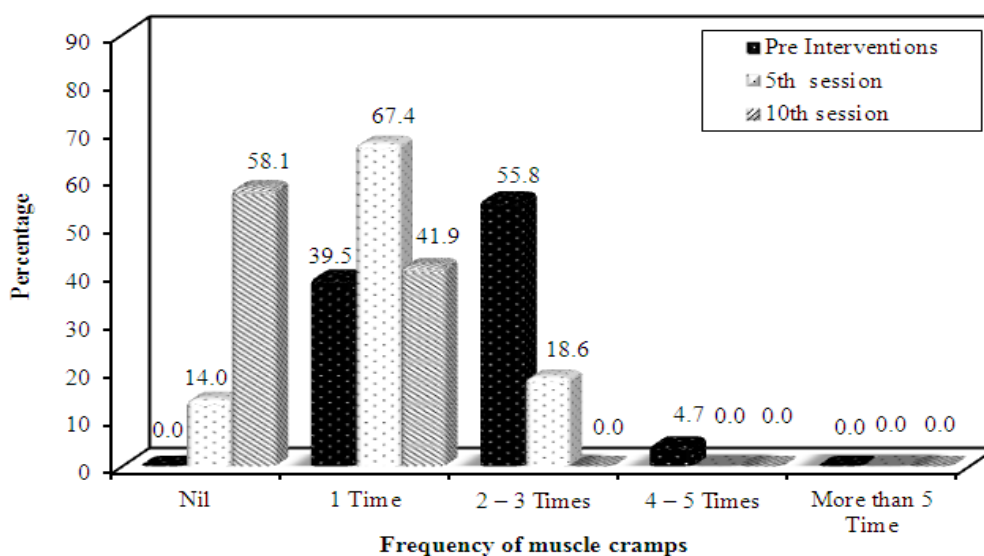


Figure (2): Differences in the studied patients according to muscle cramps' frequency pre and post interventions application (n=43).

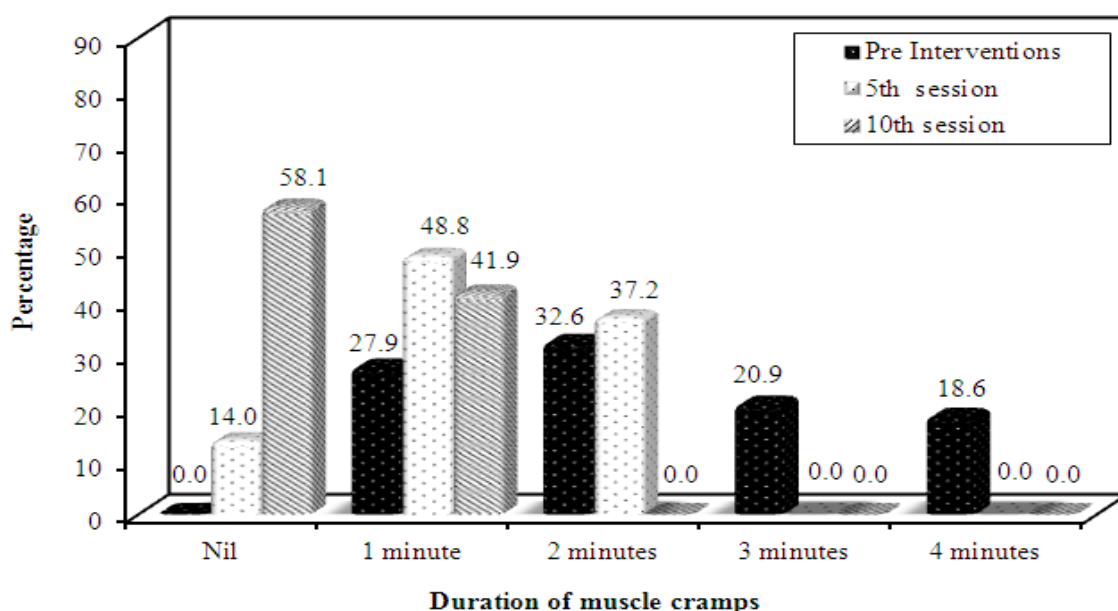


Figure (3): Differences in studied patients according to muscle cramps' duration pre and post interventions application (n=43).

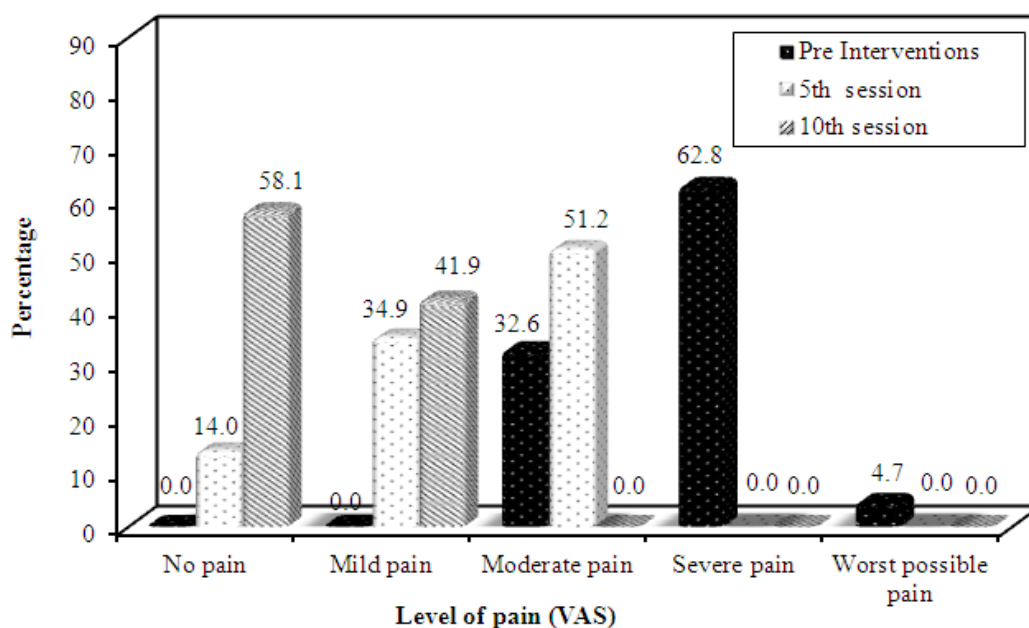


Figure (4): Differences in studied patients according to pain level related cramps pre and post interventions application (n=43).

Table (6), Fig (5): shows the effect of nursing interventions on overall level of muscle cramps among the studied patients (n=43).

The findings indicate that the used nursing interventions demonstrated statistically significant difference in the level of patients' muscle cramps (Fr 71.042*, p<0.001*), as two thirds of them (62.8%) had “moderate muscle cramps” before applying the nursing interventions, compared to 58.1%, and 41.9% respectively who had “no to mild cramps” after interventions. Furthermore, the table displays that the overall mean percent improvement score in muscle cramps' level after application of the nursing interventions, was 81.62 ± 23.30.

Table (6): The Effect of nursing interventions on overall level of muscle cramps among the studied patients (n=43).

Scoring System	Pre-interventions		Post Interventions				Fr	P
	No.	%	5 th session		10 th session			
			No.	%	No.	%		
No cramps	0	0.0	6	14.0	25	58.1	71.042*	<0.001*
Mild cramps	8	18.6	25	58.1	18	41.9		
Moderate cramps	27	62.8	12	27.9	0	0.0		
Severe cramps	8	18.6	0	0.0	0	0.0		
Overall mean % improvement score			81.62 ± 23.30					

Fr: Friedman test, Sig. bet. periods were done using Post Hoc Test (Dunn's)

p: p value for comparing between different period

p0: p value for comparing between pre and each other period

*: Statistically significant at $p \leq 0.05$

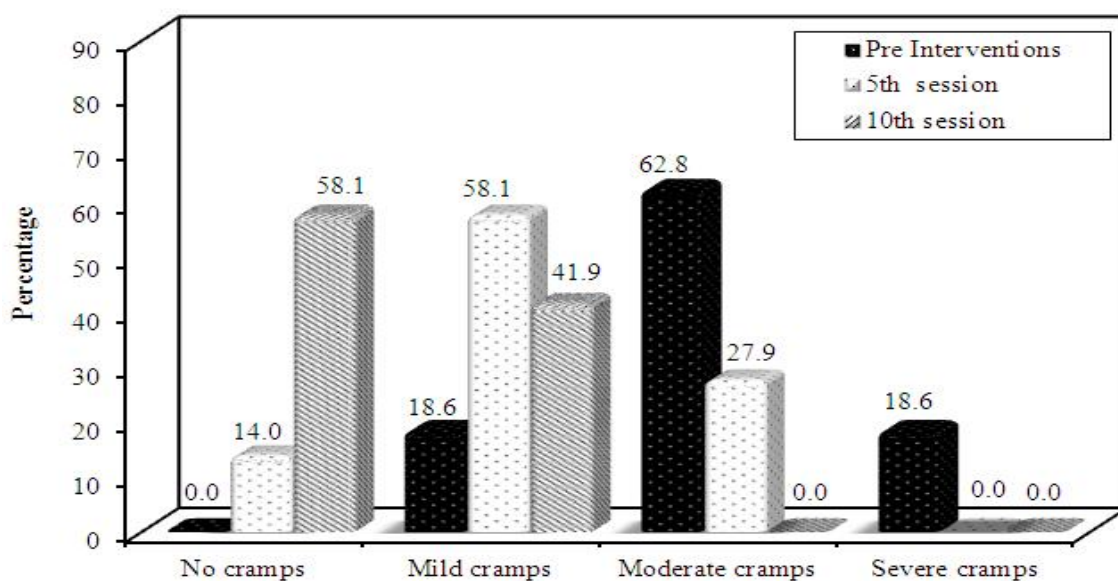


Figure (5): The Effect of nursing interventions on overall level of muscle cramps among the studied patients (n=43).

Table (7) represents relationships between socio-demographic characteristics of the studied patients and their overall mean percent improvement score of muscle cramps' level after application of the nursing interventions.

The table shows that there is a statistically significant association between patients' age and overall mean percent improvement score of intradialytic muscle cramps' level after application of the nursing interventions, where patients between 20-30 years showed the highest percent of improvement ($F = 6.930$, $p < 0.001^*$). Also, there is a statistically significant association between patients' level of education and overall mean percent improvement score in intradialytic muscle cramps' level, where patients with diploma degree achieved the highest percent improvement ($F = 3.173^*$, $p < 0.001^*$).

However, no significant difference is detected between patients' gender, marital status, or occupation, and percent of improvement in intradialytic muscle cramps' level.

Table (7) Relationships between socio-demographic characteristics of the studied patients and percent improvement in intradialytic muscle cramps after application of the nursing interventions.

Socio-demographic Characteristics	% improvement of muscle cramps		
	Mean ± SD	Test of sig.	P
Age (years)			
20>30 years	100.0 ± 0.0	F = 6.930*	0.001*
30>40 years	91.67 ± 15.52		
40> 50 years	64.14 ± 24.38		
50-60 years	90.63 ± 17.36		
Gender			
Male	78.11 ± 20.73	t = 0.835	0.409
Female	84.14 ± 25.10		
Marital status			
Single	73.21 ± 20.89	F = 1.018	0.370
Married	82.01 ± 23.96		
Divorced	100.0 ± 0.0		
Level of education			
Illiterate	62.50 ± 0.0	F = 3.173*	0.035*
Read and write	77.69 ± 22.10		
Diploma	92.13 ± 15.18		
Bachelor	62.50 ± 43.30		
Occupation			
Labor (Manual)	78.13 ± 23.86	F = 0.340	0.714
Housewife	84.14 ± 25.10		
Not working	78.10 ± 19.21		

t: Student t-test

F: F for ANOVA test

*: Statistically significant at $p \leq 0.05$

IV. Discussion

Intradialytic muscle cramp is a distressing problem for both patients and nurses in HD units, since it is a common reason for early termination of dialysis session^(33,34). This raises the urge to manage this problem safely. The current study displayed the effects of nursing interventions on reducing intradialytic muscle cramps' frequency, duration, and pain among patients on maintenance HD.

The findings of the present study revealed that the mean age of the studied patients was 43.35 ± 9.45 years. This finding is inconsistent with the results of Mastnardo et al (2016), as the mean age of their studied patients was 55 ± 15.7 years⁽¹⁵⁾. Also, the present study results showed that more than half of the studied patients were females, which contradicted the results of El-Ballat et al (2019) who reported that more than half of their patients were males⁽³⁵⁾. As regards marital status, Soliman's findings (2015) were in line with the findings of the present study as the majority of the studied patients were married⁽³⁶⁾. The noted difference between the findings of the present study and the other studies regarding age and gender could be due to social differences between different districts in Egypt.

As regards level of education, the present study showed that the studied patients were distributed almost equally among two categories read and write and secondary school. In this context, Sheeba (2015), who studied the effectiveness of muscle cramps on intradialytic muscle cramps among patients on maintenance HD, found that patients were distributed almost equally among two categories; primary and secondary school⁽³¹⁾. The present study findings also revealed that more than half of the studied patients were house wives, and the majority lived in urban areas. Soliman (2015) had similar findings, except for area of residence, as the majorities were from rural regions⁽³⁶⁾.

Regarding associated diseases with end stage renal disease, the findings of the present study reported that hypertension was the most common among the studied patients. In this context, several studies highlighted that hypertension was the main cause of end stage renal disease followed by diabetes mellitus in many Egyptian governorates^(5,35,37). In addition, the findings of the present study showed that the majority of the studied patients were under maintenance hemodialysis for at least five years, and all of them were receiving hemodialysis sessions for four hours. On the same line, Mohamed et al (2007) mentioned similar results⁽³⁸⁾.

Also, the majority of the studied patients experienced intradialytic muscle cramps in the calf muscle of both legs, and during the last hour of HD session. The findings of the present study were in agreement with Lekha (2017) and Chavada et al (2018) who reported that intradialytic muscle cramps occurred in the last hour among the majority of studied patients, where calf muscle of both legs was the most involved^(9,33). This could be explained by the fact that patients with increased interdialytic fluid gain are exposed to rapid removal of excess fluid that results in hypotension which triggers occurrence of muscle cramps.

Interdialytic weight gain (IDWG) is mainly the result of sodium and fluid intake between two consecutive dialysis sessions⁽³⁹⁾. The findings of the present study showed statistically significant reduction in the mean IDWG post interventions in both 5th and 10th HD sessions. Similarly, Baraz et al (2010) found significant reduction between hemodialysis sessions in their participants' interdialytic weight gain after providing health education program⁽⁴⁰⁾. Contrary to expectations, it was observed that the mean IDWG was reduced post interventions in the 5th session, and then increased slightly by the 10th session. This could be related to poor patients' self-monitoring, as reported by the majority of them as they didn't weigh themselves daily outside the dialysis unit. In this regard, Durose et al (2004) recommended that nurses should develop effective educational methods to motivate their patients to comply with dietary restrictions in order to maintain accepted IDWG between dialysis sessions⁽⁴¹⁾.

In addition, the outcomes of the present study revealed that the majority of the studied patients had poor overall level of knowledge related to fluid, and dietary sodium restrictions, as well as intradialytic muscle cramps before applying the nursing interventions. The current study findings are in accordance with those of Mohamed et al (2007) who reported that the majority of their participants had poor level of knowledge related to intradialytic muscle cramps⁽³⁷⁾. In a similar study, Saini, and Arora (2017), concluded that the majority of their participants initially had average knowledge concerning dietary management⁽⁴²⁾. Also, all of the studied patients achieved good overall level of knowledge after application of the nursing interventions with high statistically significant differences between pre, and post interventions. These findings were consistent with Ebrahimi et al (2016), and Ersan et al (2017) results which supported the positive effects of educational interventions on patients' knowledge^(43,44).

In relation to intradialytic muscle cramps' frequency, the findings of the present study showed different frequencies, where more than half of the studied patients reported intradialytic muscle cramps 2-3 times/ session pre interventions, while more than half of them reported that they became free from muscle cramps post nursing interventions. Also, the differences between pre, and post interventions were statistically significant. These findings were in line with Panchiri et al (2017) who illustrated that intradialytic leg stretching exercises showed a remarkable improvement in the frequency of muscle cramps among their subjects⁽¹²⁾. Similarly, Hallegraef et al (2013) emphasized the effect of stretching exercises in the prevention of muscle cramps during hemodialysis⁽⁴⁵⁾.

Regarding the duration of muscle cramps, it was observed that one third of the studied patients had reported 2 minutes duration pre intervention, which has been decreased to one minute in almost half of the studied patients in the 5th session, and progressed to no cramps among more than half of the studied patients by the 10th session. These improvements were statistically significant. In the same line, Divia (2016), who studied effectiveness of intradialytic stretching exercise on muscle cramps among patients undergoing hemodialysis, inferred that stretching exercise was found to be effective on reducing muscle cramps' duration among their participants⁽⁴⁶⁾.

Chavda and Singh (2018) reported that pain related to muscle cramps has been cited as the most commonly reported reason that may terminate hemodialysis sessions⁽³³⁾. The current study nursing interventions decreased pain experienced by the studied patients during the episodes of muscle cramps. More than half of the studied patients suffered from severe pain pre interventions which has been shifted to moderate by the 5th session then ranged between mild to no pain in the 10th session after the application of the nursing interventions where more than half of them reported no pain, and these differences were statistically significant.

The current study findings were consistent with Sasirekha (2018), who found that one quarter of their studied patients had severe muscle cramps before practicing stretching exercises, compared to the majority of them who had no muscle cramps post nursing interventions⁽⁴⁷⁾. Also, Moncy et al (2017), found that there was a significant reduction in the pain score after performing intra-dialytic stretching exercise among their experimental group on day one, three, and five⁽⁴⁸⁾.

Moreover, the results of the present study indicated that the applied nursing interventions have a remarkable effect on the level of patients' muscle cramps, as the majority of them had moderate cramps before applying the nursing interventions, while they had no to mild cramps respectively after interventions. Similarly, Lekha et al (2017) found a significant improvement in the level of muscle cramps after 6 days of application of intradialytic stretching exercises⁽⁹⁾.

On studying the relationships between patients' socio-demographics and their overall mean percent improvement score of intradialytic muscle cramps, the study findings showed high significant relationships between patient's age, and their overall mean percent improvement score, where patients between 20-30 years showed the highest percent of improvement. These findings were in line with those of Panchiri et al (2017), who revealed that there were significant relationships between age and both frequency and severity of muscle cramps⁽¹²⁾. Furthermore, a statistically significant association between patients' level of education and mean percent improvement score in intradialytic muscle cramps was found, where diploma holders achieved the highest percent improvement. However, Sasirekha (2018) found no significant associations between improvement in

intradialytic muscle cramps scores and selected demographic variables such as age, sex, education, occupation, and duration of Hemodialysis⁽⁴⁷⁾.

V. Conclusion

According to the findings of the present study, it can be concluded that nursing interventions, based on health education related to fluid, sodium restrictions, together with carrying out intradialytic stretching exercise, are proved to have significant effects on reducing the level of muscle cramps among the studied patients. High statistically significant differences were found between patients' overall knowledge pre and post application of the nursing interventions.

Recommendations

- Stretching exercises implemented by healthcare professionals for patients undergoing HD, are recommended to provide safe, comfortable, and adequate HD sessions.
- In- service training of nurses regarding interventions for muscle cramps in dialysis patient is advocated.
- Further studies are needed in other Egyptian Hemodialysis Units to support/ confirm the present study findings, and to improve the quality of nursing care in these settings.

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