

## The Effect of Foot Reflexology on Hemodialysis Patients' Leg Cramp at the Hemodialysis Unit: A Randomized Controlled Trial



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### ABSTRACT

**Background:** Leg cramps are one of the main stresses faced by hemodialysis patients, with a range of psychological and physical consequences. Foot reflexology can help hemodialysis patients relax, enhance their circulation, and feel better overall. **Aim:** Evaluate the effect of foot reflexology on hemodialysis patients' leg cramps. **Method:** The study employed a pretest-posttest randomized control trial, randomly selecting 51 patients from the intervention group and 51 from the control group from the Mit-Ghamr Hemodialysis Unit, affiliated with Mit-Gamer Urology and Nephrology Hospital. **Tools:** The investigators collected socio-demographic characteristics and assessed hemodialysis patients' health, leg cramp knowledge, and self-reported practices through four structured interview questionnaires and a scale. **Results:** declare no statistically significant difference between the hemodialysis patients in the intervention and control groups concerning the assessment of camp pain based on the Visual Analog Scale pre-intervention. At the same time, there was a statistically significant difference post-intervention ( $p < 0.001$ ). **Conclusion:** Reflexology foot massage significantly reduced the frequency, intensity, and length of leg cramps in hemodialysis patients in the intervention group compared to the control group. **Recommendation:** Implementing foot massage as a standard treatment in dialysis units can provide new opportunities and trends within the nursing profession.

**Keywords:** Hemodialysis, Leg Cramps, Nurse, Patients, Reflexology

### Introduction

One important medical intervention for patients with end-stage renal disease and renal failure is hemodialysis. Through this process, the body gets rid of excessive fluid and waste products from the blood. Across a semipermeable membrane, surplus water and waste are eliminated via diffusion and osmosis (Albadr, Azer, Abd Elhamed, & Mostafa, 2020).

According to Flythe et al. (2019), more than half of hemodialysis patients experience fatigue, cramps, and disturbed sleep. Patients claim that symptoms have a significant impact on their quality of life because they interfere with their capacity to maintain healthy social interactions, financial security, and general well-being.

Leg cramps affect 33 to 86% of patients receiving hemodialysis, making it one of the most common side effects (Takahashi, 2021).

Frequent muscle cramps during dialysis can have a variety of negative effects, including the early ending of hemodialysis sessions and noncompliance with prescribed treatment plans. These outcomes are thought to be major contributors to hypertension, chronic fluid overload, and cardiovascular disease (Mastnardo et al., 2016). Moreover, persistent cramping episodes

in the muscles lead to chronic pain, sleeplessness, and a decrease in the patient's social and physical activities (El-Deeb, Donia, Zeid, & Moursy, 2017).

One of the oldest known medical practices is reflexology. It is based on a scientific massage technique that originated in ancient China and Egypt. The fear of pharmaceutical side effects and the need to relieve symptoms are two potential causes of the rise in complementary and alternative medicine (CAM) use in healthcare settings (El-Deeb et al., 2017). To optimize quality of life and prevent additional difficulties, patients and their families must have extensive knowledge and experience about end-stage renal disease and its management through health education. Community health nurses must possess this knowledge to do their duties (Pagan & Pauly, 2017).

Indeed, leg cramps are a prevalent and distressing symptom among hemodialysis patients, significantly impacting their quality of life (Naz et al., 2024). While previous research has explored various interventions for managing leg cramps, the efficacy of foot reflexology in this population remains understudied. Existing literature primarily focuses on pharmacological and conventional therapies, with limited investigation into

complementary and alternative approaches such as reflexology. Consequently, there is a lack of evidence regarding the potential benefits of foot reflexology in alleviating leg cramps among hemodialysis patients. This research gap underscores the need for a randomized, controlled trial to evaluate the effectiveness of foot reflexology in addressing this significant clinical challenge.

#### **Aim of the Study**

This study aimed to evaluate the effect of foot reflexology on hemodialysis patients' leg cramps at the hemodialysis unit.

#### **Research Hypotheses**

- Reflexology released patients' leg cramps in the intervention group compared to the standard of care in the control group at the hemodialysis unit.
- Hemodialysis patients' knowledge related to leg cramps and reflexology in the intervention group improves after the intervention.
- Hemodialysis patients' self-reported practices related to leg cramps and reflexology in the intervention group improved after the intervention.

#### **Outcome Measures**

##### **Primary outcome**

The reduced frequency of leg cramps among hemodialysis patients was assessed using the Leg Cramps Intensity Scale.

##### **Secondary outcome**

The knowledge and self-reported practices of hemodialysis patients improved regarding leg cramps and reflexology.

#### **Method**

##### **Research Design**

This study used a pretest-posttest randomized control trial. The current study used the intervention and control groups to assess the effect of reflexology on hemodialysis patients' leg cramps versus standard care. This type of design is an empirical study used to evaluate the effect of an intervention on the target population with random assignment (Pattison, Gutwill, Auster, & Cannady, 2019).

##### **Setting**

This study was carried out at the Mit-Ghamer Hemodialysis Unit affiliated with Mit-Gamer Urology and Nephrology Hospital (MUNH). Nephrology and Urology Mit-Ghamr Hospital is one of the Egyptian Ministry of Health and Population's hospitals. Its capacity is 184

hemodialysis patients and 16 urology surgery patients. The hospital provides other services, such as nephrology surgeries and laparoscopy, and outpatient clinics for medicine, urology, and nephrology.

#### **Participants**

The study participants who met the following criteria were included: Hemodialysis patients who complained of leg cramps during hemodialysis received hemodialysis three times a week for at least six months later, fully conscious and oriented. Patients with open foot wounds, suspicious fractures, burns in legs, deep vein thrombosis in legs, and peripheral neuropathy were excluded from the study sample.

#### **Sample Size and Technique**

Calculating sample size for studying the effect of reflexology on patients with fatigue, pain, and cramps as a randomized control trial through DSS research.com sample size calculator software at 5%  $\alpha$  error (95.0% significance) and 20.0  $\beta$  error (80.0% power of the study), assuming the cramp severity score after applying reflexology in the intervention group is 1.10 (1.80). It is 2.30 (2.30) in the controls (Ozdemiret et al., 2013). The calculated sample size is 102, 51 in the intervention group, and an equal number in the control group. The fishbowl method was used to assign hemodialysis patients to intervention and control groups to ensure the matching of independent variables among the groups.

#### **Tools for Data Collection**

The investigators reviewed national and international literature, such as scientific articles and textbooks on the various aspects of hemodialysis, leg cramps, and reflexology, which served as guides for developing study tools I, II, IV, and V and adopting tool III from Cline et al. (1992).

**Tool I:** Hemodialysis patients' socio-demographic characteristics, including age, sex, marital status, residence, education level, occupation, and caregiver, were identified by a structured interview questionnaire.

**Tool II:** The health assessment for hemodialysis patients consisted of two parts: the first part collected past health history before renal failure, current health history, present urination problems, and current complications. The second part assessed leg cramps before and after the intervention. It included the following items related to the leg cramp: site of cramps, onset of cramps, number of cramp episodes, time of cramp episodes, days of cramp episodes, occurrence of cramp

episodes, duration of cramp episodes, and degree of cramp pain.

**Tool III:** The Visual Analog Scale [VAS] was adopted by Cline et al. (1992) to assess leg cramp intensity at the time of the cramps, before the intervention, and after the intervention. It is 10 cm a horizontal line, described by word descriptors at each end; on the left end side, no leg cramp at all, and on the right end, cramps as bad as they can be.

The VAS scoring values were allotted as (0) indicates no leg cramps, (1-3 cm) describes mild leg cramps (4-6 cm) shows moderate leg cramps, (7-9 cm) indicate severe leg cramps, and (10 cm) reveals very severe leg cramps.

**Tool IV:** Hemodialysis patients' knowledge of leg cramps and reflexology was assessed by a structured interview questionnaire developed based on Eldeeb et al. (2017). The questionnaire was classified into six categories and was composed of 27 closed-ended questions.

**Scoring system of hemodialysis patients' knowledge.** Zero was awarded for wrong and did not know and one mark for each correct response from 27 questions as follows: definition of cramp (2 items), causes of cramp (3 items), sites of cramp (3 items), forms of cramp (4 items), duration of cramp (3 items), and methods used to reduce cramp (reflexology) (12 items). The total score of hemodialysis *patients'* knowledge ranged from zero to 27 marks. According to the investigators' cut point, the knowledge levels were categorized into three levels:

- *Poor.* Score which is less than 50% of total scores (less than 13.5)
- *Fair.* Scores that are 50% to less than 75% of total scores (13.5 to less than 20)
- *Good.* Scores that are more than 75% of total scores (20 and more)

**Tool V:** Hemodialysis patients' self-reported practices to reduce leg cramps were assessed by using a structured interview questionnaire developed based on Song et al. (2018). It consisted of 12 closed-ended questions.

**Scoring system of hemodialysis patients' self-reported practices.** Zero was awarded for improper and not done, and one mark was given for each proper response from the 12 questions as follows: performance of exercise (1 item) Type of exercises (2 items), duration of exercises (2 items), frequency of exercises (2 items), massage site of the cramp (1 item), massage technique (4 items), the daily amount of water (1 item), the daily

amount of fluid (1 item), nutrients to reduce leg cramp (4 items), medications to reduce leg cramps (2 items), consultation (7 items), and acting in the occurrence of leg cramps (8 items). The total score of subjective practices ranged from zero to 35 marks. According to the investigators' cut point, the subjective practice levels were categorized into two levels:

- *Improper = less than 50% of total scores (less than 17)*
- *Proper = 50% of the total score and more (17 and more)*

**Tools' face and content validity were** tested by five experts in community health nursing, the Faculty of Nursing, Mansoura University. Also, **a pilot study** was carried out on a convenient sample of 10% (10) of hemodialysis patients in the previously mentioned setting to evaluate the clarity and relevancy of the tools, identify feasibility, and identify any problems associated with the implementation of the study. The required modifications were carried out. Participants in the pilot study were excluded from the main sample of the study to avoid bias.

A Cronbach's alpha tested the internal consistency of the tools. It was 0.88 for the VAS for leg cramps, 0.91 for the knowledge-structured interview questionnaire, and 0.89 for the self-reported practices-structured interview questionnaire. Those values indicate good reliability, according to Tavakol and Dennick (2011) and Vaske, Beaman, and Sponarski (2016).

#### **Phase I: Preparatory**

**Administrative process.** The vice dean of the postgraduate and researcher in the Faculty of Nursing submitted an official letter to the director of Mit-Ghamer Hospital to get approval to conduct the study. The investigators informed the director about the study's aim to gain his support and facilitate the study.

**Ethical Considerations.** The Mansoura University Faculty of Nursing's Research Ethics Committee approved the investigators. Participants gave their informed consent after being informed of the study's goal and given the assurance that their data would be handled with confidentiality and anonymity and used exclusively for research. Each participant also had the freedom to leave the study at any moment without explanation that would not affect the quality of care they received and had the right to ask any questions they might have had.

To overcome the ethical issue of depriving the control group of the benefits introduced to the intervention group after the evaluation phase of the study, the principal investigator supplemented the control group with printed material about leg cramps and reflexology.

### **Phase II: Data Collection**

The study covered the period from April 2023 to the end of September 2023. The principal investigator visited the hemodialysis unit at Nephrology and Urology Mit-Gamer Hospital six days per week (Saturday, Monday, Wednesday, Sunday, Tuesday, and Thursday).

The patients were selected from Mit-Gamer Urology and Nephrology Hospital. Each patient fulfilled the previously mentioned criteria selected from a total of 184 hemodialysis patients who accepted to participate in the study; his or her name was written on a piece of paper, and the required sample was selected from those pieces for both the intervention and control groups by using the simple random sample technique of a fishbowl. The control group received a standard of care related to leg cramps (which are intravenous fluids, either saline or glucose), while the intervention group received foot reflexology.

Preliminary assessment stage: before applying reflexology, the principal investigator assessed the following for both the intervention and control groups during a hemodialysis session: socio-demographic characteristics by using tool I; health assessment by using tool II; assessment of leg cramp intensity by using tool III (VAS); patients' knowledge about leg cramps and foot reflexology by using tool IV; and patients' self-reported practices to reduce leg cramps by using tool V.

### **Phase III: Planning phase**

Based on the findings of the preliminary assessment, the principal investigator developed intervention sessions for hemodialysis patients. The intervention sessions were carried out through four sessions, divided into three theoretical and one practical, as follows: first session (introduction session). The first intervention session was a preliminary session that included the principal investigator presenting herself and a brief introduction about the aim and schedule of the sessions.

Second session (nature of the leg cramp): it covered the items concerning the nature of the leg cramp, which included the following: definition of leg cramp, causes of leg cramps, signs and symptoms of foot leg cramp. Third session: the

principal investigator summarized the previous session to remind the patients. It covered the items concerning the nature of reflexology, which included the following: methods used to reduce leg cramps, the meaning of reflexology, and the benefits of foot reflexology.

Fourth session (practical session): the principal investigator summarized the previous session to remind the patients. It consisted of items concerning the technique of reflexology, which included the following: provide a comfortable, confidential environment for deep relaxation before and during reflexology sessions. The principal investigator advised patients to wear wide clothes since tight ones can obstruct circulation and to clean their feet with warm water and soap and dry them.

The principal investigator teaches patients to take deep breathing before the session immediately to minimize any tension or pain from the reflexology points and encourage healing by a free flow of energy in the whole body. The principal investigator kept her hands warm and clean and her nails short to save the patient from any injury. She asked the patient to be in the semi-setting position covered with a blanket or linen to promote privacy and relaxation to enhance the reflexology session with the patient's legs extended and uncrossed, so the patient sensed the flow of energy.

Firstly, for foot relaxation, the principal investigator applied primarily effleurage, shaking rotation, and stretching techniques at the start and end of reflexology sessions. This helped better circulation, enhanced relaxation to the feet, and made reflexology work easier and more benefit.

Secondly, the principal investigator massaged the outer edge of the foot with the fingers and the side of the thumb and turned it clockwise continuously without losing contact with the skin. The intensity of the pressure was weak at the beginning, then increased as the treatment progressed.

### **Phase IV: Implementation phase**

The intervention sessions covered theoretical and practical aspects related to leg cramps and foot reflexology. The principal investigator implemented four intervention sessions. The principal investigator observed every patient during hemodialysis sessions and when leg cramps occurred during them. The principle investigator interviewed patients individually in the hemodialysis unit. The intervention session started at 10 a.m. for the first

shift (morning shift) and at 2.30 p.m. for the second shift (afternoon shift). Each session lasted between 30 and 40 minutes for each patient to discuss the items. During each session, the researcher used simple words and different teaching methods such as brainstorming, discussion, and demonstration.

As well as teaching materials such as PowerPoint, brochures, and colored booklets, and ended each education session with a summary. The foot reflexology technique was performed immediately after the hemodialysis session for 30 minutes on both feet (fifteen minutes for every foot) to each of the reflex points in the feet, according to a map of foot reflexology massage. It was done three times per week (day after day) for four consecutive weeks. The total number of sessions was 12 for each patient.

**Phase V: Evaluation phase**

Evaluation was carried out for both the intervention and control groups immediately after conducting the intervention sessions as follows: leg cramp assessment by using tool I; second part, assessment of leg cramp intensity by using tool III (VAS); patients' knowledge about leg cramps and foot reflexology by using tool IV; and patients' self-reported practices to reduce leg cramps by using tool V.

**Statistical Analysis**

All statistical tests were conducted using SPSS (Standard for Statistical Product and Service Solutions) for Windows version 25.0 (SPSS, Chicago, IL). Continuous data were normally distributed and were expressed in mean standard deviation (SD). Categorical data were expressed in frequency and percentage. The Chi-square test was used for the comparison of variables with categorical data. Statistical significance was set at p

< 0.05, while high significance was set at p < 0.001.

**Results**

Table 1 shows no statistically significant differences between the hemodialysis patients in the intervention and control groups concerning their socio-demographic characteristics.

Table 2 indicates that there was no statistically significant difference related to the assessment of leg cramps in the hemodialysis patients in the intervention and control groups' pre-intervention. At the same time, there were statistically significant differences post-intervention in terms of suffering from leg cramps and the number and occurrence of cramp episodes.

Table 3 reveals no statistically significant difference between the hemodialysis patients in the intervention and control groups concerning the assessment of cramp pain based on the Visual Analog Scale pre-intervention. At the same time, there was a statistically significant difference post-intervention (p<0.001).

Table 4 shows no statistically significant difference related to the hemodialysis patients' knowledge about leg cramps in the intervention and control groups pre-intervention. At the same time, there was a statistically significant difference post-intervention (p<0.001) for total knowledge score levels.

Table 5 displays that there was no statistically significant difference related to the hemodialysis patients' self-reported practices about leg cramps in the intervention and control groups pre-intervention. At the same time, there was a statistically significant difference post-intervention (p 0.004) for total self-reported practice score levels.

**Table 1** The Socio-Demographic Characteristics of the Hemodialysis Patients in the Intervention and Control Groups

Item	Intervention (51)		Control (51)		Chi-Square	
	n	%	n	%	X <sup>2</sup>	P
<b>Age (Years)</b>						
< 35	7	13.7	11	21.6		
35 – <45	15	29.4	18	35.3		
45 – < 55	15	29.4	8	15.7		
≥55	14	27.5	14	27.5	3.292	0.349
<b>Sex</b>						
Male	34	66.7	41	80.4		
Female	17	33.3	10	19.6	2.468	0.116
<b>Marital status</b>						
Married	38	74.5	33	64.7		
Single / Divorced / Widow	13	25.5	18	35.3	1.159	0.282

<b>Residence</b>						
Rural	33	64.7	27	52.9		
Urban	18	35.3	24	47.1	1.457	0.227
<b>Level of education</b>						
Elementary	17	33.3	19	37.3		
Preparatory	17	33.3	16	31.4		
Secondary	11	21.6	10	19.6		
University or Postgraduate	6	11.8	6	11.8	0.189	0.979
<b>Occupation</b>						
Employee	21	41.2	15	29.4		
Don't work / Retired	24	47.1	31	60.8		
Student	6	11.8	5	9.8	1.982	0.371
<b>Care giver</b>						
Husband / Wife / Sons	39	76.5	33	64.7		
Father / Mother / Brothers	12	23.5	18	35.3	1.700	0.192

**Table 2** Assessment of Leg cramps in the Hemodialysis Patients in the intervention and Control Groups pre, and Post-Intervention

Item	Pre – Test						Post – Test					
	Intervention		Control		Chi-Square / Fisher's exact test		Intervention		Control		Chi-Square / Fisher's exact test	
	n	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
<b>Suffering from leg cramp</b>	51	100.0	51	100.0	0.000	1.000	21	41.2	39	76.5	13.114	<0.001**
<b>Site of cramps</b>							<b>(n=21)</b>		<b>(n=39)</b>			
Left leg	18	35.3	21	41.2			10	47.6	17	43.6		
Right leg	31	60.8	27	52.9			11	52.4	21	53.8		
Both legs	2	3.9	3	5.9	0.707	0.702	0	0.0	1	2.6	0.593	0.743
<b>Onset of cramp</b>							<b>(n=21)</b>		<b>(n=39)</b>			
Suddenly	30	58.8	32	62.7			15	71.4	24	61.5		
Gradually	21	41.2	19	37.3	0.165	0.685	6	28.6	15	38.5	0.587	0.444
<b>Number of cramps episodes</b>							<b>(n=21)</b>		<b>(n=39)</b>			
1 – 5 times daily	31	60.8	28	54.9			0	0.0	20	51.3		
1 – 5 times weekly	14	27.5	18	35.3			13	61.9	14	35.9		
1 – 5 times monthly	6	11.8	5	9.8	0.743	0.690	8	38.1	5	12.8	16.845	<0.001**

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**Table 2** Assessment of Leg Cramps in the Hemodialysis Patients in the Intervention and Control Groups Pre, and post-Intervention, Con

Item	Pre – Test						Post – Test					
	Intervention		Control		Chi-Square / Fisher's exact test		Intervention		Control		Chi-Square / Fisher's exact test	
	n	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
<b>Time of cramp episodes</b>							<b>(n=21)</b>		<b>(n=39)</b>			
In the morning	17	33.3	13	25.5	0.756	0.385	6	28.6	7	17.9	0.908	0.341
Afternoon	17	33.3	16	31.4	0.045	0.832	9	42.9	12	30.8	0.877	0.349
At the evening	12	23.5	13	25.5	0.053	0.818	4	19.0	10	25.6	0.332	0.565
At night	14	27.5	17	33.3	0.417	0.518	5	23.8	13	33.3	0.590	0.443
<b>Days of cramp episodes</b>							<b>(n=21)</b>		<b>(n=39)</b>			
Hemodialysis days	26	51.0	21	41.2			11	52.4	16	41.0		
Another hemodialysis days	7	13.7	3	5.9			3	14.3	2	5.1		
Both	18	35.3	27	52.9	3.932	0.140	7	33.3	21	53.8	2.996	0.224
<b>Occurrence of cramps episodes</b>							<b>(n=21)</b>		<b>(n=39)</b>			
Before hemodialysis	1	2.0	2	3.9	0.343	0.558	0	0.0	3	7.7	1.700	0.192
During hemodialysis	40	78.4	38	74.5	0.218	0.641	20	95.2	29	74.4	3.974	0.046*
After hemodialysis	18	35.3	21	41.2	0.374	0.541	1	4.8	17	43.6	9.799	0.002*
<b>Duration of cramps episodes</b>							<b>(n=21)</b>		<b>(n=39)</b>			
One minute	26	51.0	21	41.2	0.986	0.321	6	28.6	10	25.6	0.060	0.807
Two minutes	25	49.0	16	31.4	3.303	0.069	8	38.1	18	46.2	0.361	0.548
Five minutes	8	15.7	13	25.5	1.499	0.221	6	28.6	12	30.8	0.031	0.859

**Table 3** Assessment of Camp pain Based on Visual Analog Scale on the Hemodialysis Patients in the Intervention and Control groups pre, and Post-Intervention

Item	Pre – Test						Post – Test					
	Intervention		Control		Chi-Square / Fisher's exact test		Intervention		Control		Chi-Square / Fisher's exact test	
	N	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
<b>Degree of camp pain</b>												
No pain	0	0.0	0	0.0			30	58.8	12	23.5		
Mild	1	2.0	0	0.0			10	19.6	5	9.8		
Moderate	6	11.8	7	13.7			9	17.6	6	11.8		
Sever	10	19.6	14	27.5			2	3.9	7	13.7		
Very sever	34	66.7	30	58.8	1.994	0.574	0	0.0	21	41.2	33.758	<0.001**

**Table 4** The hemodialysis Patients' Knowledge About leg Cramps in the Intervention and Control Groups Pre, and Post-Intervention

Item	Pre – Test						Post – Test					
	Intervention		Control		Chi-Square		Intervention		Control		Chi-Square	
	n	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
Definition	11	22.0	9	18.0	0.250	0.617	37	74.0	13	26.0	23.040	<0.001**
Causes	6	12.0	7	14.0	0.088	0.766	33	66.0	11	22.0	19.642	<0.001**
Sites	8	16.0	10	20.0	0.271	0.602	35	70.0	13	26.0	19.391	<0.001**
Forms	11	22.0	6	12.0	1.771	0.183	34	68.0	10	20.0	23.376	<0.001**
Duration	8	16.0	4	8.0	1.515	0.218	40	80.0	12	24.0	31.410	<0.001**
Reduction methods	7	14.0	9	18.0	0.297	0.585	33	66.0	12	24.0	17.818	<0.001**
Total knowledge score levels	n	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
Poor	41	82.0	43	86.0			4	8.0	39	78.0		
Fair	5	10.0	4	8.0			10	20.0	7	14.0		
Good	4	8.0	3	6.0	0.301	0.860	36	72.0	4	8.0	54.617	<0.001**

**Table 5** The Hemodialysis Patients' Self-reported Practices About leg Cramps in the Intervention and Control Groups pre, and post-Intervention

Item	Pre – Test						Post – Test					
	Intervention		Control		Chi-Square		Intervention		Control		Chi-Square	
	n	%	n	%	X <sup>2</sup>	P	n	%	n	%	X <sup>2</sup>	P
<b>Committing to exercising</b>												
No	29	56.9	30	58.8			11	21.6	20	39.2		
Yes	22	43.1	21	41.2	0.040	0.841	40	78.4	31	60.8	3.754	0.053
<b>If yes</b>	(n=22)		(n=21)				(n=40)		(n=31)			
Type of exercise	19	86.4	15	71.4	1.448	0.228	38	95.0	24	77.4	4.877	0.027*
Duration of exercise	13	59.1	8	38.1	1.896	0.168	37	92.5	10	32.3	28.325	<0.001**
Schedule of exercise	16	72.7	17	81.0	0.407	0.523	39	97.5	20	64.5	13.529	<0.001**
<b>Massage site of the cramp</b>	29	56.9	27	52.9	0.158	0.690	43	84.3	30	58.8	8.142	0.004*
<b>Massage description</b>	29	56.9	23	45.1	1.412	0.234	46	90.2	25	49.0	20.437	<0.001**
<b>The daily amount of water</b>	23	45.1	18	35.3	1.019	0.312	41	80.4	22	43.1	14.986	<0.001**
<b>The daily amount of fluid</b>	22	43.1	28	54.9	1.412	0.234	41	80.4	30	58.8	5.607	0.017*
<b>Nutrients to reduce leg cramp</b>	20	39.2	25	49.0	0.994	0.318	40	78.4	28	54.9	6.352	0.011*
<b>Medications to reduce leg cramps</b>	26	51.0	27	52.9	0.039	0.842	44	86.3	29	56.9	10.840	<0.001**
<b>Consultations</b>	29	56.9	21	41.2	2.510	0.113	50	98.0	27	52.9	28.030	<0.001**
<b>Acting in the occurrence of leg cramps</b>	17	33.3	20	39.2	0.381	0.536	41	80.4	28	54.9	7.570	0.006*
<b>Total self-reported practices score level</b>	n	%							n	%	X <sup>2</sup>	P
Improper	27	52.9	28	54.9			8	15.7	21	41.2		
Proper	24	47.1	23	45.1	0.039	0.842	43	84.3	30	58.8	8.142	0.004*



## Discussion

One of the most common complications of hemodialysis is leg cramps, which occur at the end of the hemodialysis session or a little before. The exact cause of it is unknown. But lower blood pressure, hypernatremia, hypomagnesaemia, tissue hypoxia, reduced volume of fluid in the body, electrolyte disturbance, changes in plasma osmolality, and changes in extracellular fluid volume have all been effects of cramps. The main electrolytes that help the cells function normally and affect muscle cramps are potassium, sodium, and calcium (Punj, Enaam, Marquez, Atkinson, & Batlle, 2020).

There is no doubt that foot reflexology was used to preserve the energy flow smoothly, which also decreased feelings of exhaustion, pain, and muscle cramps. Reflexology massage is one technique that is used to reduce these symptoms, improve hemodialysis sufficiency, provide relaxation, induce intra-dialytic protein synthesis, increase oxygen consumption, and increase muscular strength and tissue nutrition (Shafaii, Payami, Amini, & Pahlevan, 2017).

The current study finds that there was no statistically significant difference between the hemodialysis patients in the intervention and control groups concerning their socio-demographic characteristics. These findings agree with the findings of El-Deeb et al. (2017), who studied the impact of foot massage with reflexology on leg cramps for patients' undergone hemodialysis at Alexandria Hospital and confirmed that there were no statistically significant differences in socio-demographic and clinical data between both groups (the intervention and control groups). These findings point out the extraneous factors that might confuse the impact of reflexology foot massage.

The results of the current study demonstrate that there was no statistically significant difference related to the assessment of leg cramps in hemodialysis patients in the intervention and control groups pre-intervention, but there was a statistically significant difference post-intervention in all items of leg cramps.

These results are in line with the findings of Elmetwaly et al. (2019), a study aimed at evaluating the reflexology foot massage effectiveness on leg cramps in hemodialysis patients. They mentioned that there was a highly statistically significant difference between all of the items on the muscle cramp scale score that evaluates the recurrence of reported muscle spasms

for hemodialysis patients during dialysis sessions after the use of a reflexology foot massage technique.

Concerning the degree of pain for hemodialysis patients, the findings of this study reveal that there was no statistically significant difference between the intervention and the control groups concerning cramp pain based on the VAS pre-intervention. These results are in agreement with the findings of Gite (2020), who assessed the impact of nursing interventions on muscle leg cramps for patients on hemodialysis in Indian hospitals, which revealed that the majority of their intervention group experienced severe leg cramp intensity before applying foot reflexology massage. In addition, Shady and Ali (2019) concluded that there was no statistically significant difference between the study and the control groups before the first reflexology foot massage session.

The present study findings reveal an improvement with a highly statistically significant difference in the degree of pain on the VAS among hemodialysis patients in the intervention group compared with the control group. These results are in line with those of Shahgholian et al. (2016), who studied the effects of two methods of reflexology and stretching exercises on the severity of restless leg syndrome among hemodialysis patients; they reported that hemodialysis patients who had nine sessions of 30-minute reflexology massage reported less foot pain and cramping.

As well, the Malekshahi, Aryamanesh, and Fallahi (2018) study aimed to evaluate the effectiveness of foot reflexology massage and Swedish massage on restless leg syndrome among hemodialysis patients; they illustrated the effective nursing massage for decreasing the intensity of muscle cramps (a 20-minute foot massage given before each hemodialysis session for 2 weeks, with a maximum of 6 massage sessions).

These results may corroborate the theory of reflexology, which holds that every foot contains 7,200 nerve endings that connect to the brain to initiate the proper response that releases tension from the muscles, promotes relaxation, and raises endorphin levels. Furthermore, the improvement in muscle spasms due to hemodialysis after receiving a reflexology massage can be explained by the zone reflexology theory. Because of this, energy flows via the ten invisible channels in the body, which start at the top of each toe and conclude at the tips. To restore balance to energy imbalances, one might use their thumbs or fingers to trigger reflex areas along these ten energy lines. Thus, pressing on leg

reflex points can help reduce cramping (Vimala, 2018).

The results of the current study demonstrate that there was no statistically significant difference related to the hemodialysis patients' knowledge about leg cramps in the intervention and control groups pre-intervention but there was a statistically significant difference post-intervention.

These results are in agreement with the findings of Abdel Monem et al. (2022), who studied the nursing interventions that influence Intradialytic weight and vascular access complications among hemodialysis patients at Shebin El-Kom Teaching Hospitals, which reveal that the patients in the study group had a higher level of knowledge than patients in the control group post-intervention.

In addition, these findings are consistent with Alikari et al. (2019) study of the effect of education on knowledge, adherence, and the quality of life among hemodialysis patients; they mentioned that the mean total knowledge score was highly improved in the study group post-intervention than in the control group.

Results of the current study demonstrate that there was no statistically significant difference related to the hemodialysis patients' self-reported practices about leg cramps in the intervention and control groups pre-intervention, but there was a statistically significant difference post-intervention.

These findings are consistent with the results of a study by Albadry et al. (2020) that studied the effect of intradialytic hemodialysis exercises on fatigue and leg cramps, which shows that the intradialytic stretching exercise is a simple and efficient technique for reducing and preventing muscle cramps among patients undergoing hemodialysis.

These results are consistent with Abouelala and Khalil (2021) results, who studied the effect of passive and active stretching exercises on controlling leg cramps for patients undergoing hemodialysis at Kafrelsheikh General Hospital. They confirmed that passive and active stretching exercises have a positive effect on decreasing the level of muscle cramp intensity among patients under hemodialysis, with statistically significant differences between the study and control groups.

Leg cramps are one of the most obvious and painful consequences of hemodialysis. Since reflexology foot massage is one of the simplest techniques that can assist hemodialysis patients, the investigators construct the intervention session to orient patients on the required knowledge and

technique of reflexology before performing the foot reflexology.

The investigators' intervention resulted in significant improvement in hemodialysis patients' leg cramps and their pain, knowledge, and subjective practice in the intervention group. This sheds light on the importance of empowering the role of the nurse as a health educator, care provider, and researcher to solve clinical issues.

### **Conclusion**

The investigators conclude that reflexology foot massage significantly reduced the frequency, intensity, and length of leg cramps in hemodialysis patients in the intervention group compared to the control group. In addition, there was no statistically significant difference related to the hemodialysis patients' knowledge and self-reported practices about leg cramps in the intervention and control groups pre-intervention, while there was a statistically significant difference post-intervention for total knowledge and self-reported practices score levels, respectively.

### **Recommendations**

- The implementation of foot massage as a standard treatment in dialysis units has the potential to provide new opportunities and trends within the nursing profession.
- To ensure that nursing practice with hemodialysis patients is backed by scientific study and has the potential to be used in other contexts, more research on reflexology foot massage is necessary.

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