

Effect of Nursing Intervention Using Reflexology Massage on Muscle Cramps and Fatigue among Adolescents Undergoing Hemodialysis

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Abstract

The most popular form of treatment for end-stage renal illness is hemodialysis. Hemodialysis frequently causes muscle cramps and exhaustion, which negatively impact adolescents' activities, relationships, and treatment tolerance. This study aimed to evaluate the effect of nursing intervention using reflexology massage on muscle cramps and fatigue among adolescents undergoing hemodialysis. It employed a quasi-experimental design. The study was conducted at Mansoura University Children's Hospital and New General Mansoura Hospital on a purposive sample of 48 adolescents on maintenance hemodialysis. A structured questionnaire sheet, cramps questionnaire and visual analog scale and pediatric quality of life inventory-multidimensional fatigue scale were used to collect data. Significant differences were found in muscle cramps and fatigue levels between pretest and post-test ($p=0.000$ for each). The use of reflexology massage for adolescents undergoing hemodialysis had a positive effect on muscle cramps and fatigue levels. There is a need for courses that give nurses the opportunity to become certified in reflexology, and reflexology massage should be used as the evidence-base for nursing practice with children receiving hemodialysis.

Key words: Adolescents, Fatigue, Hemodialysis, Muscle cramps, Reflexology massage.

Introduction

Chronic renal failure (CRF) is becoming recognized as a general medical problem with a dismal prognosis on a global scale. It is a serious disorder that decreases the quality of life, increases health care costs and imposes a heavy economic burden on communities. CRF is referred to as "an irreversible loss of kidney function that can progress to end-stage renal failure (ESRF), it develops due to multifactorial etiologies over a period

of a few years". In this disorder, the kidneys are unable to carry out metabolic tasks and maintain fluid and electrolyte balance in this illness (Dhudum & Bhore, 2020; Jancy & Parimala, 2020; Vaidya & Aeddula, 2020).

The precise incidence of CRF in children is unknown because its early stages are asymptomatic. In the past two decades, the incidence of CRF in children has progressively increased, while globally the estimated prevalence of CRF

in children is 18.5 -100 per million children. Adolescents have a mortality rate of 30%-150% greater than the general population. An adolescent on dialysis under the age of 14 years has only 20 years left to live, indicating the necessity for specialist care (**Al Shahawy, El-Gamasy, Seleem, Mawlana & El Sharkaway, 2020; Raj, Patel & Ramachandran, 2017**).

According to the statistical record of Mansoura University Children's Hospital 340 children from age 2 to 18 years were undergoing maintenance dialysis in 2018. This number increased to 360 in 2019 and to 397 in 2020 (**Unpublished Statistical Records from Mansoura University Children Hospital, 2018, 2019 and 2020**). On the contrary, the statistical record of Mansoura New General Hospital in 2018; reported 80 hospitalized children; who were undergoing hemodialysis (HD), which increased to 115 in 2019 and to 150 in 2020 (**Unpublished Statistical Records from Mansoura International Hospital, 2018, 2019 and 2020**).

HD is the treatment of choice which may be selected to supplement the function of the kidneys and the most prevalent renal replacement therapy for ESRF. Although it sustains the life of adolescents, it disrupts their normal lifestyle. During HD sessions, adolescents experience physical problems such as hypotension, fatigue, nausea, vomiting, muscle cramps, and headache. Additionally, they have psychological issues including stress, anxiety and depression, which have a severe impact on their daily lives (**Amini, Goudarzi, Masoudi, Ahmadi & Momeni, 2016**;

Shahgholian, Jazi, Karimian & Valiani, 2016).

Adolescents undergoing HD often experience muscle cramps that is defined as involuntary muscle contractions that last for a long time. It is a painful and unpleasant symptom that causes individuals to be uncomfortable, which shortened the dialysis session, affecting their sleep and health-related quality of life. Approximately 33%-86% of children experience muscle cramps during HD sessions, which is a common reason for the early termination of dialysis sessions. Noncompliance with the prescribed HD treatment that results from recurrent muscle cramps during HD sessions leads to fluid overload, hypertension and cardiovascular disease (**El-Deeb, Shadia, Montasser & Moursy, 2017, El-Nagar, Lawend & El-Belgahy (2020)**).

The next most prevalent symptom of HD is fatigue, that is a subjective feeling of weakness, loss of energy, exhaustion, and malaise. This disorder lowers one's sense of wellbeing and has a various consequence on the physical, emotional, and cognitive aspects of the adolescent life. Children with HD frequently experience fatigue, which can range in prevalence from 60% to 97%. Untreated weariness may cause a person to become more dependent on others, become weak, and experience a loss of bodily and psychological comfort, which can result in despair and social isolation. (**Shady & Ali, 2019; Souza, Kummer, Cardoso, & Lage, 2019**).

The dialysis nurse acts as a care provider and consultant during HD

sessions and plays a significant role in the management of immediate and long-term problems of adolescents with ESRF and their families. Thus, nursing interventions are directed not only toward preventing or managing complications of HD, such as muscle cramps and fatigue, but also teaching adolescents about non-pharmacological care. Non-pharmacological methods are effective in relieving muscle cramps and fatigue levels; hence, the nurse has an important role in assisting adolescents undergoing HD to identify solutions that would help alleviate and resolve these problems because pharmacological treatments are costly and are associated with adverse effects or other drug-related problems (Aliasgharpour, Abbasi, Pedram Razi, & Kazemnezhad, 2016; Pagan & Pauly, 2017).

Complementary and alternative medicine (CAM) usage has increased. It refers to healthcare procedures and products that are employed mostly outside the traditional healthcare system. Reflexology massage is the most common CAM modality. Pressure and massage are used to reflex sites on the palm and/or foot during a reflexology massage. It acts as a little mirror, reflecting all body organs. The mechanism of reflexology massage is unknown; however, the nerve impulse theory, the gate control theory of pain, and increased endorphin release for pain control are some theories on how it work, improved lymph flow, immune system stimulation, and blood circulation. Furthermore, enhanced blood flow aids in the removal of toxins from the body (Bender, 2017; Sharifi, Navidian, Jahantigh & Shamsoddini, 2018).

No research on the impact of reflexology massage on the symptoms described by adolescents receiving HD have been conducted in Egypt, despite the fact that the practice has grown in popularity among nurses and that it is supported by the literature review. Therefore, the purpose of this study was to evaluate the effect of reflexology massage on muscle cramps and fatigue among adolescents undergoing HD. Hopefully, this intervention will help alleviate some of the negative physical and psychological symptoms associated with renal failure and its therapeutic options (Küçükkeleşçe & Karaca, 2017).

Significance of the study

Strong data indicates that fatigue and muscle cramps have a significant impact on the quality of life and overall health of adolescents experiencing HD. Their everyday functioning, relationships with family and friends, and treatment tolerance are all impacted by these issues in addition to their sense of wellbeing. Orthopedics, neuroscience, and palliative care are among the nursing disciplines where reflexology massage has been widely used. However, there is a dearth of scientific proof to back up the efficacy and safety of many CAM treatments. Additionally, the results of numerous studies point to the beneficial and outstanding effects of reflexology massage in a variety of conditions, including exhaustion, pain, migraine, constipation, hypertension, renal disorders, digestive issues, chronic obstructive pulmonary disease, muscle cramps, and depression (Abd-Elmonem, Al-Tohamy,

Galal & Abd-Elhalim, 2019; Timothy & Robert, 2017).

Muscle cramps and fatigue are common among children undergoing HD that occurs in 35% - 80% of those children thus, the dialysis nurse should be aware of these problems and provide appropriate care using reflexology massage for the management of these symptoms (Beladi, Zeraati, Moradi & Mousavi, 2015; Hothi, Laskin, & Geary, 2016). For these reasons, there was an urgent need to conduct this study to evaluate the effect of nursing intervention using reflexology massage on muscle cramps and fatigue among adolescents undergoing HD.

Aim of the study

Thus, this study aimed to evaluate the effect of nursing intervention using reflexology massage on muscle cramps and fatigue among adolescents undergoing HD.

Research hypotheses:

1. The implementation of reflexology massage among adolescents undergoing HD may be associated with significant improvements in muscle cramps than pre-implementation.
2. The implementation of reflexology massage among adolescents undergoing HD associated with significant improvements in fatigue level than pre-implementation.

Subjects and Methods

Research design: A quasi-experimental design carried out using a single group, pre-post comparison without a control group.

Settings: This research was carried out in the Pediatric hemodialysis unit affiliated to Mansoura University Children's Hospital (MUCH) and Hemodialysis unit of New General Mansoura Hospital (NGMH).

Subjects: A purposive sample of 48 adolescents who consent to participate in the study and who are undergoing HD in previously mentioned settings and who match the following inclusion criteria

1. Conscious - oriented adolescents.
2. Aged 12-18 years
3. Both sexes
4. Free from any physical disability

Tools of data collection:

Data were collected using the following tools:

Tool I: Structured questionnaire (pretest):

The questionnaire was designed by the researcher following a thorough assessment of the relevant literature to gather necessary information. It was written in simple Arabic language to suit the understanding level of adolescents. It comprised of two parts:

Part 1: Included the characteristics of the study participants, such as age, sex, residence, and level of education.

Part 2: Collects clinical data of the study participants, such as past and present medical history such as duration

of renal failure, family history of renal disease, duration of HD treatment number of HD sessions per week, duration of HD session per hour, and health problems that occur during or immediately after the end of the HD session.

Tool II: Cramps questionnaire and visual analog scale (pretest and post-test):

Part 1: Cramps questionnaire: It was adapted from (Basemath, 2014). It is a self-reported tool designed to determine the severity of muscle cramps during, before and after HD. This tool was translated from English to Arabic. The assessment features of muscle cramps consisted of five questions, which included the frequency of cramps, duration of cramps, degree of pain, temperature, and discomfort.

Scoring system:

- Question 1. The score ranged from 0 to 2: 0 cramps do not occur; 1, cramps occur less than 3 times /hour; 2, cramps occur more than 3 times /hour.
- Question 2. The score ranged from 0 to 2, 0, cramps do not occur; 1, cramps last for <5 min; 2, cramps last for >5 min.
- Question 3. The score ranged from 0 to 3: 0, no pain; 1, mild; 2, moderate; 3, severe.
- Question 4. The score ranged from 0 to 3 regarding the temperature of the leg: 0, warm; 1, cold; 2, cold and clammy.
- Question 5. The score ranged from 0 to 4: 0, no cramps; 1, mild; 2, moderate; 3, severe; 4, unbearable.

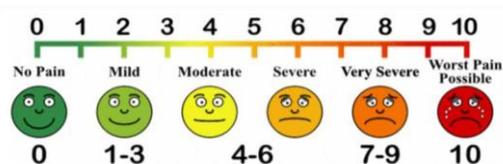
Score interpretation:

- 0 points: no cramps
- 1–4 points: mild cramps
- 5–8 points: moderate cramps
- 9–13 points: severe cramps

Part 2: Visual analog scale. This is used to determine the pain intensity (pretest and posttest). It was adopted from Price et al., (1983).

Score interpretation

- 0: no pain
- 1–3: mild pain
- 4–6: moderate pain
- 7–10: severe pain



Tool III: Pediatric Quality of Life Inventory–Multidimensional Fatigue Scale (pretest and post-test)

The pediatric fatigue scale was adopted from Varni et al. (1998). It was used to assess fatigue in pediatrics. It consisted of 18 items divided into three main items, namely, general fatigue, sleep and rest fatigue, and cognitive fatigue. Each category has six items. A 5-point Likert scale was used. On this scale, 0 indicates that there is never a problem; 1, there is nearly never a problem; 2, sometimes there is a problem; 3, there is often a problem; and 4, there is almost always a problem. This tool was translated from English to Arabic.

Score interpretation

- 0–35 points: mild fatigue
- 35–54 points: moderate fatigue
- 55–72 points: severe fatigue

Validity: The content validity of the tools used for data collection was determined by five experts in the field of pediatric nursing. The tools were modified according to these expert suggestions.

Reliability: The internal consistency of the study tools was tested by using Cronbach's alpha coefficient test. Tools I, II, and III were reliable with $r = 0.976$, $r=0.776$, and $r = 0.81$, respectively.

Ethical considerations: The Mansoura University Faculty of Nursing's Research Ethics Committee granted ethical approval for the study, which was carried out. After outlining the purpose of the study, each adolescent's caregiver gave their oral consent. The ability to leave the study at any moment was made clear to participants. Data confidentiality and anonymity were guaranteed.

Pilot study: A pilot study was conducted on 10% of the total subjects (five adolescents undergoing HD) to demonstrate the feasibility and applicability of the tools. The participants of the pilot study were included among the study total sample because no significant modifications were required in the study tools.

Field work: Data collection was extended for 6 months from February 1, 2021, to the end of July 2021. The researchers started by introducing themselves to the adolescents undergoing HD and giving them a brief overview of the study's purpose and scope. The framework of the study was conducted in four phases as follows:

1) Assessment phase

- Each participant was interviewed individually before applying the intervention
- (reflexology massage) to collect the characteristics of the study participants using tool (I) part (1) and clinical data using study tool (I) part (2).
- Levels of muscle cramps and pain during HD were assessed before the intervention using study tool (II).
- The fatigue level during HD was assessed before the intervention using study tool (III).
- The pretest was accomplished from the first week of February 2021 till its end.

2) Planning phase

- The researcher planned for applying reflexology massage to 48 adolescents for over 6 months.
- The researchers classified the participants into four groups. Each group contained 12 participants. In this phase, 12 sessions of reflexology massage were planned by the researchers with 3 sessions per week for 4 weeks.

3) Implementation phase

- The researcher has certified to practice reflexology after finishing a 32-hour theoretical and practical course. Reflexology education was provided to the participants before to their enrollment in the trial.
- Because every study participant had an arm fistula, foot reflexology was used. A 30 minute reflexology massage treatment was performed, with 15 minutes of pressure on the left foot and

an additional 15 minutes on the right foot.

- The researcher visited the HD unit at NGMH on Saturday, Monday, and Wednesday per week in the first 5 months of data collection and in the HD unit at MUCH in the last month on Sunday, Tuesday, and Thursday.
- The researcher started reflexology massage after assessment, which lasted for 4 weeks for each group.
- Each group was composed of 12 participants.
- The participants received three sessions of reflexology massage per week.
- The researcher met these 12 participants 3 days per week, with six taken in the afternoon shift and 6 in the night shift.

Study intervention:

The foot reflexology technique was conducted at four time points, as shown below:

Preparation time

- The researcher explained reflexology massage in simple terms to the participants before any treatment and told them that this process involves someone gently pressing different spots on their feet.
- The researcher reassured the participants that reflexology massage is a safe technique.
- The researcher demonstrated reflexology on a doll to improve participants' understanding, as they responded better to a visual

demonstration of reflexology massage than to a verbal explanation.

- The researcher provided the participants time answer any questions they have about reflexology massage because it is natural for first-timers to have questions about it. They asked questions to the participants, who listened to them patiently. The researcher answered each question thoughtfully and understandably.
- The participants were asked to get rid of his/her socks (if any).
- The researcher examined the participant's legs for any wounds, pain, and allergy.
- The participants were put in semi-Fowler's position. A pillow was placed under the participant's leg to support it.
- The researcher sat in front of the participant's leg in a rather relaxed and comfortable position.
- The participant's feet were cleansed using a warm cloth and wiped with alcohol.

Warm-Up time

- Pre-reflexology foot massage was performed and the entire foot was squeezed for 3 min by the following technique:
 - ❖ **Traction:** With the palm and fingers of one hand, the researcher massaged the area from the lower thigh to the ankle, sole, back, and toes. The foot was held firmly, and the researcher pulled it gently and gradually toward him/her, and the foot was held for 10–15 s and then

released. This technique was repeated several times.

- ❖ **Ankle rotation:** While one hand supported the heel, the ankle was repeatedly rotated.
- ❖ **Toe joint rotation:** Each toe was rotated several times while the foot was supported by one hand.
- For a smoother massage, 3–5 drops of baby oil were applied at room temperature.
- Foot massage started on the left foot first because this corresponds to the location of the heart and stimulates the circulating blood.

Mini-reflexology session

Reflexology massage was performed with special attention to the following nine important foot reflex areas:

- **Diaphragm reflex areas:** These are involved in respiration and run along the crease right below the ball of the foot.
- **Solar plexus reflex areas** (relaxation point): These are situated underneath the balls of the feet near the midline. This point, which interacts with the entire neurological system, has the power to greatly reduce tension and anxiety.
- **Thyroid reflex area:** This can be found beneath the large toes' necks. It begins between the big and second toes and turns into the diaphragm line as it descends the ball.
- **Brain reflex area:** This is located at the top of each toe.
- **Pituitary reflex area:** This is located in the middle of the big toe. This is controlled by the pituitary gland and can benefit body activities such as metabolism.
- **Adrenals and pancreas reflex areas:** These are located half-way between the diaphragm line and the waistline, just above the kidney.
- **Heart and lung reflex areas:** These are located below the chest of the foot, between the shoulder line and the diaphragm line. The heart reflex region controls blood flow and enhances cardiac performance. The lung reflex region controls breathing, oxygen levels, and maintains an open chest and lungs.

Step 1: Reflexology for the diaphragm and solar plexus reflex areas using the thumb walking technique for 2 min.

- The goal of the thumb-walking technique was to apply constant, steady pressure to the foot surface.
- The basic movement in the thumb-walking technique was the bending and unbending of the first thumb joint, below the researcher's thumbnail. It aimed to move the thumb across the skin in small "bites" and to create a feeling of constant and steady pressure.
 - ❖ The left hand was used to hold the toes back. The researcher started with the diaphragm reflex area.
 - ❖ The thumb was repositioned on the solar plexus reflex area. The same technique was used as before.

Step 2: Thyroid reflex area: Massage this area with the thumb by walking up, down, and across this area. The working thumb was rested under the neck of the big toes for about 1 min.

Step 3: Brain reflex area: The working thumb was rested just above the brain reflex area at the top of each toe. The researcher hooked in with the thumb and pulled back across the reflex area, which was repeated for approximately 1 min.

Step 4: Reflexology for the pituitary gland reflex area: The big toe was held with the holding hand. The working thumb was rested just above the pituitary gland reflex area. The researcher hooked in with the thumb and pulled back across the reflex area, which was repeated for approximately 1 min.

Step 5: Adrenals and pancreas reflex areas: The working thumb was rested under the ball of the foot, and pressure was applied for 2 min.

Step 6: Heart and lung reflex area. Massage with thumb by walking up, down, and across this area. The working thumb was rested on the chest of the foot for approximately 2 min.

Finishing time: (approximately 3 min)

- The feet were massaged by the same technique used in the warm-up phase, and the thumb was then placed on the solar plexus reflex area of each foot to induce relaxation and relieve anxiety and stress.

4) Evaluation phase

The final step of the data collection was to evaluate muscle cramps and fatigue levels using the same assessment

tools (tools II and III) at the end of the 3rd, 6th, 9th, and 12th sessions of foot reflexology massage and compared with the pretest levels. Pre- and post-test findings were compared to determine the effect of the training sessions on achieving outcomes, which included decreasing muscle cramps and fatigue levels for adolescents undergoing HD.

Statistical design

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 26, SPSS Inc. Chicago, IL, USA). The categorical variables were represented as frequency and percentage. The parametric continuous variables were represented as mean, standard deviation, and the non-parametric were represented as median and interquartile range (IQR). The Wilcoxon Signed Ranks Test was used to compare the differences between two non-parametric continuous variables (pre & post). The Marginal Homogeneity Test was conducted to compare the differences between categorical variables (more than two categories pre & post). Mann-Whitney U test was used to test the difference between two unrelated groups on the same non-parametric continuous variables whereas kruskal-wallis test was used to test the difference between more than two unrelated groups on the same non-parametric continuous variables. Chi-square test was conducted to test the association between two categorical variables. Spearman correlation coefficient test was conducted to test the association between two non-parametric continuous variables. Statistically significant was considered as ($p\text{-value} \leq 0.01 \ \& \ 0.05$).

Results

Table (1) illustrates that more than half of the study participants were 15–18 years old, with a mean age of 14.35 ± 1.76 years, and more than half of them were boys and were rural residents (56.3% for each). Moreover, more than half of the participants were undergoing HD for >5 years, and their sessions take 3 h each time (58.3% for each).

Figure (1) shows that less than two-thirds (60.4%) of the study participants reported a positive family history of renal failure.

Table (2) illustrates that 12.5% of the study participants complained of hypotension during HD sessions, whereas the majority (87.5%) complained of hypotension after HD sessions, and muscle cramps were the most common complain during HD sessions (100%). This table also represents that more than one-third (37.5%) complained of nausea during HD sessions compared with less than two-thirds (62.5%) who experienced nausea after HD sessions. Moreover, more than half of the study participants complained of vomiting and fatigue after HD sessions (56.3% and 62.5%, respectively).

Figure (2) presents that the majority of the study participants (93.8%) experienced severe muscle cramps before reflexology massage, whereas none of them (0.0%) experienced severe muscle cramps after 12 sessions of reflexology massage.

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experienced severe muscle cramps after 12 sessions of reflexology massage.

Figure (3) portrays that the majority of the study participants (85.4%) experienced severe pain before reflexology massage, whereas none of them (0.0%) experienced pain after 12 sessions of reflexology massage.

Figure (4) shows that the majority of the study participants (87.5%) experienced severe fatigue before reflexology massage, whereas the majority of the study participants (95.8%) experienced mild fatigue after the intervention.

Table (3) demonstrates that all study participants aged 12–14 years, girls, and those in primary schools experienced severe muscle cramps before reflexology massage (100.0% for each), whereas none of them (0.0% for each) had severe muscle cramps after 12 sessions of reflexology massage. Furthermore, a significant difference was found between cramp levels and duration of renal failure before and after reflexology massage sessions ($p=0.004$).

Table (4) reveals that the majority of the study participants aged 15–18 years, boys, and those in primary schools experienced severe pain before reflexology massage (88.5%, 89.3%, and 100.0%, respectively), whereas none of them (0.0% for each) suffered from severe pain after 12 sessions of reflexology massage. No significant association was noted between the pain levels of the study participants and their demographic characteristics before and after reflexology massage.

Table (5) demonstrates that the majority of the study participants aged 15–18 years, boys, and those in primary schools suffer from severe fatigue before reflexology massage (88.5%, 92.9%, and 100.0%, respectively), whereas none of them (0.0% for each) suffer from severe fatigue after reflexology massage. Moreover, no significant association was found between the fatigue levels of the study participants and their demographic characteristics before and after 12 sessions of reflexology massage.

Table (6) shows no significant differences between the fatigue severity scale and cramp questionnaire scale before the study intervention ($p = 0.194$). Meanwhile, a positive linear correlation ($r = 342^{**}$) was noted between the fatigue severity scale and cramp questionnaire scale after the implementation of the study intervention, showing a highly significant difference ($p = 0.01$).

Table (1): Percentage distributions of demographic characteristics and clinical data of the study participants (No = 48)

Demographic characteristics	No.	%
Age in years:		
12 – 14 Yrs	22	45.8
15 - 18Yrs	26	54.2
Mean \pm SD =	14.35 \pm 1.76	
Gender:		
Boy	27	56.3
Girl	21	43.7
Residence		
Rural	27	56.3
Urban	21	43.7
Educational level		
Primary	2	4.2
Preparatory	20	41.7
Secondary	26	54.2
Duration of renal failure		
< 5 years	18	37.5
6-10 years	27	56.3
>10 years	3	6.3
Mean \pm SD	6.25 \pm 2.96	
Duration of treatment with hemodialysis		
< 1 year	1	2.1
1-5 years	19	39.6
>5 years	28	58.3
Number of hemodialysis session per week		
3 times/ week	44	91.7
4 times/ week	4	8.3
Duration of hemodialysis session per hour		
2 hours	18	37.5
3 hours	28	58.3
4 hours	2	4.2

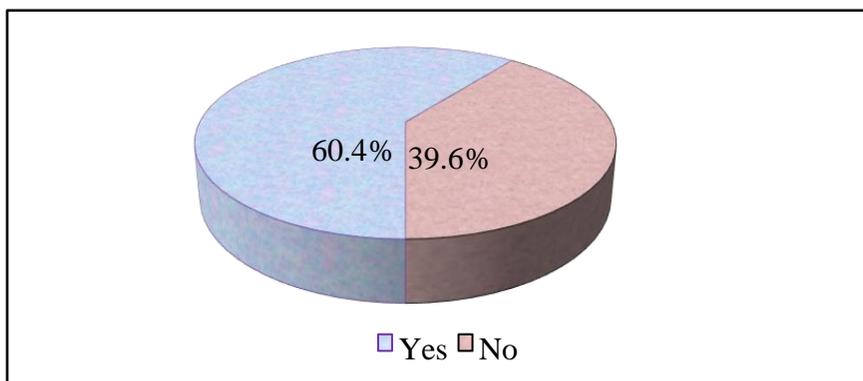


Figure (1): Family history of renal disease among the study participants

Table (2): Percentage distribution of common complaints of study participants during and immediately after hemodialysis session

	Complaints during HD session		Complaints immediately after HD session	
	No.	%	No.	%
Hypotension	6	12.5	42	87.5
Muscle cramps	48	100.0	0	0.0
Dizziness	2	4.2	18	37.5
Flushed face	10	20.8	3	6.3
Nausea	18	37.5	30	62.5
Vomiting	21	43.8	27	56.3
Fatigue	40	83.3	30	62.5

More than one answer

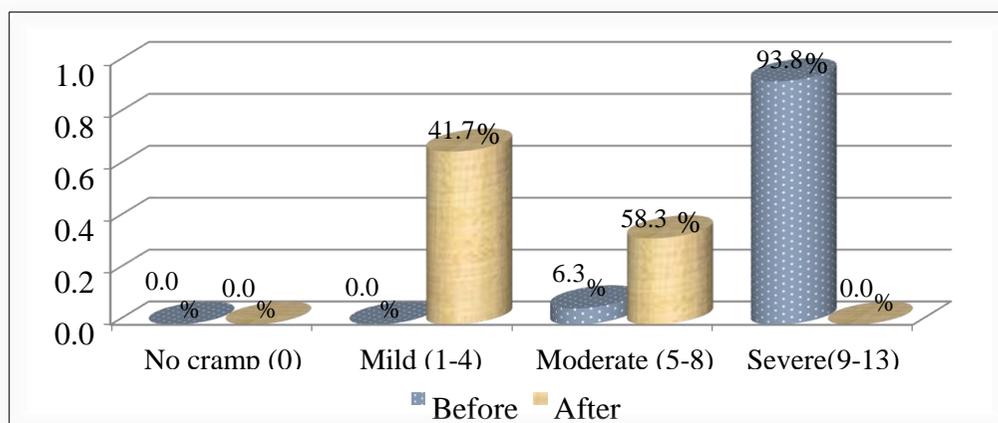


Figure (2): Cramp levels before and after 12 sessions of reflexology massage among the study participants

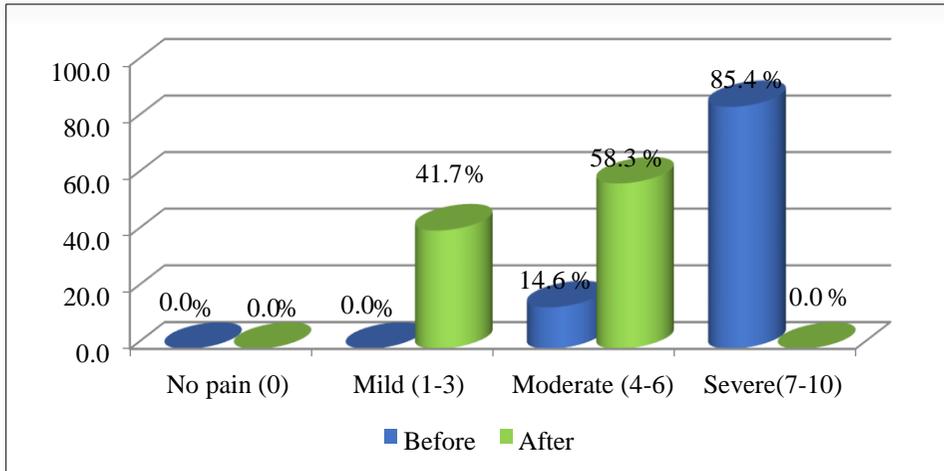


Figure (3): Pain levels among the studied adolescents before and after applying of twelve reflexology massage sessions

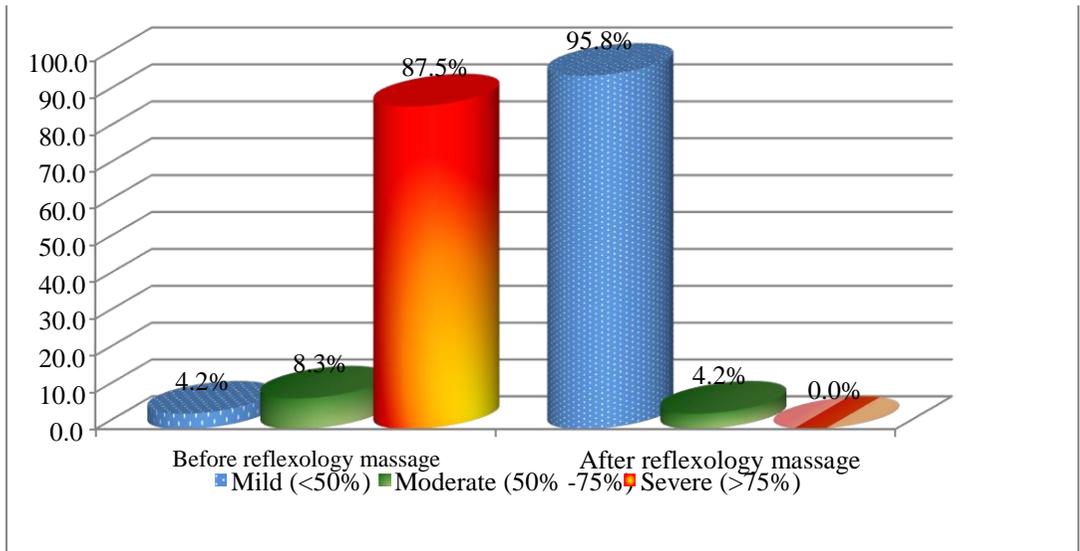


Figure (4): Percentage distribution of fatigue levels among the study participants before and after 12 sessions of reflexology massage.

Table (3): Relationship between demographic characteristics, clinical data of the study participants, and cramp levels before and after 12 sessions of reflexology massage.

	Cramps level before reflexology massage				Cramps level after 12 reflexology massage sessions			
	Moderate		Sever		Mild		Moderate	
	N	%	N	%	N	%	N	%
Age in years								
12-14 year	0	0.0	22	100.0	17	77.3	5	22.7
15-18 year	3	11.5	23	88.5	15	57.7	11	42.3
χ^2 or FE/ p-value	FE/ 0.24				2.05/0.22			
Gender								
Boy	3	10.7	25	89.3	19	67.9	9	32.1
Girl	0	0.0	20	100.0	13	65.0	7	35.0
χ^2 or FE/ p-value	FE/ 0.26				0.04/0.84			
Educational level								
Primary school	0	0.0	2	100.0	2	100	0	0.0
Preparatory school	0	0.0	20	100.0	15	75.0	5	25.0
Secondary school	3	11.5	23	88.5	15	57.7	11	42.3
χ^2 or FE/ p-value	FE/ 0.34				FE/ 0.35			
Duration of renal failure								
≤ 5 years	3	16.7	15	83.3	16	88.9	2	11.1
6-10 years	0	0.0	27	100.0	16	59.3	11	40.7
>10 years	0	0.0	3	100.0	0	0.0	3	100.0
χ^2 or FE/ p-value	FE/0.08				FE/ 0.004**			

FE: Fisher Exact / * (P) Significant ($p < 0.05$) / ** (P) Highly significant ($p < 0.01$)

Table (4): Demographic characteristics and clinical data of the study participants in relation to their pain levels before and after 12 sessions of reflexology massage

	Pain intensity levels before reflexology massage				Pain intensity levels after 12 reflexology massage sessions			
	Moderate		Severe		Mild		Moderate	
	No.	%	No.	%	No.	%	No.	%
Age in years								
▪ 12-14	0	0.0	22	100.0	11	50.0	11	50.0
▪ 15-18	3	11.5	23	88.5	9	34.6	17	65.4
χ^2 or FE/ p-value	FE/0.24				1.16/0.28			
Gender								
▪ Boy	3	10.7	25	89.3	11	39.3	17	60.7
▪ Girl	0	0.0	20	100.0	9	45.0	11	55.0
χ^2 or FE/ p-value	FE/ 0.25				0.15/0.69			
Level of education								
▪ Primary	0	0.0	2	100.0	2	100.0	0	0.0
▪ Preparatory	0	0.0	20	100.0	9	45.0	11	55.0
▪ Secondary education	3	11.5	23	88.5	9	34.6	17	65.4
χ^2 or FE/ p-value	FE/ 0.34				FE/ 0.24			
Duration of renal failure								
1-5 years	3	16.7	15	83.3	12	66.7	6	33.3
6-10 years	0	0.0	27	100.0	8	29.6	19	70.4
>10 years	0	0.0	3	100.0	0	0.0	3	100.0
χ^2 or FE/ p-value	FE/ 0.08				FE/0.01**			

FE: Fisher Exact

Table (5): Relationship between demographic characteristics and clinical data of the study participants and their fatigue levels before and after 12 sessions of reflexology massage

		Fatigue levels before reflexology massage						Fatigue levels after 12 reflexology massage sessions			
		Mild		Moderate		Severe		Mild		Moderate	
		No.	%	No.	%	No.	%	No.	%	No.	%
Age in years											
▪ 12-14 year		0	0.0	3	13.6	19	86.4	21	95.5	1	4.5
▪ 15-18 year		2	7.7	1	3.8	23	88.5	25	96.2	1	3.8
χ^2 or FE/ p-value		FE/ 0.28						FE/ 1.00			
Gender											
▪ Boy		1	3.6	1	3.6	26	92.9	27	96.4	1	3.6
▪ Girl		1	5.0	3	15.0	16	80.0	19	95.0	1	5.0
χ^2 or FE/ p-value		FE/ 0.42						FE/ 1.00			
Educational stage											
▪ Primary school		0	0.0	0	0.0	2	100.0	2	100.0	0	0.0
▪ Preparatory school		0	0.0	3	15.0	17	85.0	19	95.0	1	5.0
▪ Secondary school		2	7.7	1	3.8	23	88.5	25	96.2	1	3.8
χ^2 or FE/ p-value		FE/ 0.45						FE/ 1.00			
Duration of renal Failure											
\leq years		0	0.0	2	11.1	16	88.9	17	94.4	1	5.6
6-10 years		1	3.7	2	7.4	24	88.9	26	96.3	1	3.7
>10 years		1	33.3	0	0.0	2	66.7	3	100.0	0	0.0
χ^2 or FE/ p-value		FE/ 0.27						FE/ 1.00			

FE: Fisher Exact / * (P) Significant ($p < 0.05$) / ** (P) Highly significant ($p < 0.01$)

Table (6): Correlation between fatigue and cramps among the study participants before and after 12 sessions of reflexology massage.

	Total cramp scores	
	r	P
Total fatigue scores before reflexology massage	0.191	0.194
Total fatigue scores after reflexology massage	342**	0.01**

Note. r: Spearman's rank $r < 0.3$ weak correlation $r < 0.3-0.5$ moderate correlation $r > 0.5$ strong correlation * (P) Significant ($p < 0.05$) ** (P) Highly significant ($p < 0.01$)

Discussion

Adolescents with HD commonly experience muscle cramps and weariness due to the buildup of waste products in the body, changes in blood pressure, anemia, prolonged sitting during HD therapy, and psychosocial factors (Chanchlani et al., 2020). These adolescents can be helped by pediatric dialysis nurses by including them as much as possible in their healthcare decision-making, educating them about all available treatment options, and emphasizing self-care (El-Nagar et al., 2020; Machaly, Bahgat, Hassan & Kafli, 2020).

By unclogging any blocked energy pathways in the body, reflexology massage helps to maintain the flow of energy while also reducing feelings of weariness, cramping, pain, and exhaustion. By promoting the flow of energy throughout the body, reflexology massage is one method used to reduce these typical symptoms, provide relaxation, and enhance HD sufficiency, intradialytic protein synthesis, muscular strength, peak oxygen consumption, and nutritional status of the tissues (Sharifi et al., 2018; Shahgholian et al., 2016). Therefore, this study was carried out to evaluate the effect of reflexology massage, a nursing intervention, on muscle cramps and fatigue among adolescents undergoing HD.

Regarding the characteristics of the study participants, the result of this study revealed that more than half of the study participants were 15–18 years old, and more than half of them were in the secondary level of education (Table 1). These results agreed with those of Sadik and Abd–El Salam, (2018) in their study entitled “Effect of Using Meditation Techniques for Children with Chronic Kidney Disease on Hemodialysis Therapy.” They reported that more than half of the study

participants were between 15 and 18 years old. Moreover, more than half of the adolescents were rural residents. This finding was in line with those of Ahmed, Sayed and Elaasar (2020), who conducted the study “Effect of Nursing Intervention Program on self esteem, Body Image and Quality of Life of Children undergoing Hemodialysis.” They reported that more than two-thirds of the study participants came from rural areas. From the researcher’s point of view, the result could be due to the inclusion of children living in rural areas in Egypt who are at high risk of CRF development and factors such as poor socioeconomic status, water pollution, and lack of adequate healthcare. Also, in the same table, more than half of them were in the secondary level of education. This result did not agree with those of Hassan and Khalafallha, (2019), who reported that the majority of the study participants were in the preparatory school level. Furthermore, in the same table, the majority of the study participants received three dialysis sessions per week, and the duration of each dialysis session was 3 h in more than half of them. These findings were in agreement with those of Sadik and Abd–El Salam, (2018) and Ebrahim, Ahmed, Hammad & Eid, (2019) who found that most of the study participants had three HD sessions per week, and more than half of them had dialysis for 3 h each session.

Finally, this study revealed that nearly two-thirds of the study participants had a positive family history of renal failure (Figure 1). This finding contradicted with El-Nagar et al. (2020) who conducted the study “Empowering Mothers Caring for their Children with Chronic Kidney Disease through Engagement and Education.” They found that more than half of the studied children had a negative family history of

chronic kidney disease. This is because family history has a significant effect on the development of end-stage renal disease.

According to the findings of this study, the majority of the study participants experienced various problems, such as fatigue, nausea, and vomiting before HD sessions. In addition, the incidence of muscle cramps and hypotension increased during HD sessions, whereas hypotension, muscle cramps, flushed face, nausea, and vomiting decreased after HD sessions (**Table 2**). This could be explained in the light of fact that HD sessions alleviate children's common complaints before and during the session, improving their health, preventing complications, and sustaining the life of adolescents.

The findings of this study also revealed that the majority of the study participants experienced severe muscle cramps before reflexology massage, whereas none of them experienced severe cramps after 12 sessions of reflexology massage, with a highly significant improvement (**Figure 2**). These results are in line with those of **Ozdemir and Ovayolu, (2018)**, who reported that patients on HD getting reflexology massage experienced a reduction in the severity of muscle cramping **Shahgholian et al. (2016)**. Also found that patients on HD who had nine 30-minute reflexology treatments reported less foot pain and cramping. A 20-minute foot massage given before each HD treatment for two weeks, with a maximum of six massages, was also assessed by **Malekshahi, Aryamanesh and Fallahi (2018)**, who discovered that it was an effective nursing intervention for reducing the severity of muscle cramps. These results may support the reflexology idea, according to which each foot has 7,200 nerve endings, which communicate with the brain and trigger the right reaction to relieve muscle

tension, encourage relaxation, and boost endorphin levels. In addition, zone reflexology theory helps explain how HD-related muscle spasms improved following a reflexology massage. As a result, energy moves continuously through the body's ten invisible channels, which run from the top to the bottom of each toe and end in the tips. Reflex sites along these 10 energy routes can be stimulated with the thumbs or fingers to balance energy where there was previously an imbalance. Leg reflex spots can therefore be pressed to ease cramps (**Karamisefat, Cheraghi, Soltanian & Hasan, 2021; Vimala, 2018**).

Regarding the level of pain, this study revealed that the majority of the study participants had severe pain before reflexology massage, whereas nearly half of them experienced mild pain after 12 sessions of reflexology massage (**Figure 3**). These results agree with those of **Lekha, (2016)**, who reported that the majority of the study participants had severe pain before reflexology foot massage and two-thirds of them had mild pain after the intervention.

This study also revealed significant improvement in fatigue intensity after sessions 6–12 of reflexology foot massage (**Figure 4**). This may be attributed to the cumulative effects of reflexology message, in which noticeable improvements are seen only after 3–5 sessions. This finding study is consistent with those of **Mohamed et al. (2021)** who studied the “Effect of Foot Reflexology on Hemodialysis School Age Children on Fatigue and Sleep Quality.” They reported a significant improvement in fatigue intensity in the studied children after 12 sessions of foot reflexology.

As regards the relationship between the demographic characteristics of the study

participants and cramp levels before and after 12 sessions of reflexology massage. The current results revealed no significant association between cramp levels of the study participants, their demographic characteristics, and clinical data before and after 12 sessions of reflexology massage, except in relation to the duration of renal failure after the implementation of the study intervention (**Table 3**). Similarly, **Gite, (2020)** conducted the study entitled “A Study to Assess the Effect of Selected Nursing Interventions on Leg Cramps for Patients Undergoing Hemodialysis in Selected Hospitals” and found that in both the experimental and control groups of patients on HD, no significant correlation was found with demographic variables such as age (years), sex, education, habitat, disease duration, dialysis therapy duration, and source of information regarding renal failure.

This study present found a significantly positive association between the pain levels and duration of renal failure after the implementation of the study intervention (**Table 4**). This may be due to complications of uremia and underlying comorbid illnesses and may be related to the procedure and frequent exposure to insertion of vascular access. This finding was consistent with those of **Sadigova, Ozkurt, and Yalcin, (2020)** who reported a significant positive relationship between pain level and longer dialysis duration due to renal failure.

Furthermore, the findings exhibited no significant association between the fatigue levels of the study participants and their clinical data before and after reflexology massage (**Table 6**). This finding was contrary to those of **Mohamed, Farouk, and Mahmoud, (2021)** who revealed a positive significant association between fatigue level

and duration of HD. This can be explained by the fact that fatigue is a major problem in patients with HD, and a range of circumstances are associated with fatigue, such as the concentration of toxic materials in the bloodstream, blood pressure changes, anemia, and HD regardless of the clinical data of the adolescents.

Finally, this study revealed a positive linear correlation between the fatigue severity scale and the cramp questionnaire scale after the implementation of the study intervention, showing a highly significant difference (**Table 7**). The possible interpretation of this is that muscle cramps may be a prime cause of fatigue. This finding agrees with those of **Albadry, Azer, Elhamed, and Mostafa, (2020)** who studied the “Effect of Intradialytic Hemodialysis Exercises on Fatigue and Leg cramps” and mentioned a positive correlation between the fatigue severity scale and the cramp questionnaire scale after 2 months of intradialytic exercise.

Conclusion

Based on the findings of this study, the use of reflexology massage for adolescents undergoing HD had positive effects on muscle cramps and fatigue levels.

Recommendations

- ❖ Training programs on reflexology massage and workshops should be conducted periodically and regularly for dialysis nurses to raise their awareness about the benefits of reflexology massage.
- ❖ Health education programs for children undergoing HD and their caregivers should include information about using complementary therapies in addition to medical care, especially reflexology and its application.

Declaration of conflicting interests

The author emphasised that they had no known financial conflicts of interest or close personal ties that would have appeared to affect the research presented in this study.

References

- Abd-Elmonem, A.M., Al-Tohamy, A.M., Galal, R. E., & Abd-Elhalim, F.A. (2019).** Effects of progressive resistance exercises on quality of life and functional capacity in pediatric adolescents with chronic kidney disease: a randomized trial. *Journal of musculoskeletal & neuronal interactions*, 19 (2), 187.
- Ahmed, F.M., Sayed, F.S. & Elaasar, H.N. (2020).** Effect of Nursing Intervention Program on Self-Esteem, Body Image and Quality of Life of Children undergoing Hemodialysis. Al Shahawy, A. K., El-Gamasy, M. A., Seleem, M. A. E., Mawlana, W., & El Sharkaway, A. H. (2020). Assessment of cognitive functions and adaptive behavior in children with end-stage renal disease on regular hemodialysis. *Saudi Journal of Kidney Diseases and Transplantation*, 31(2), 395.
- Albadr, A., Azer, S., Abd Elhamed, N., Mostafa, N. (2020).** Effect of Intradialytic Hemodialysis Exercises on Fatigue and Leg cramps. *Assiut Scientific Nursing Journal*, 8(20), 131-140. doi: 10.21608/asnj.2020.80746
- Aliasgharpour, M., Abbasi, Z., Pedram Razi, S. & Kazemnezhad, A. (2016).** The effect of stretching exercises on severity of restless legs syndrome in patients on hemodialysis. *Asian J Sports Med*, 7, 31001.
- Amini, E., Goudarzi, I., Masoudi, R., Ahmadi, A. & Momeni, A. (2016).** Effect of progressive muscle relaxation and aerobic exercise on anxiety, sleep quality, and fatigue in patients with chronic renal failure undergoing hemodialysis. *Int J Pharm Clin Res*, 8, 1634:1639.
- Basemath, S. (2014):** Development and testing of Cramp questionnaire chart.
- Beladi Mousavi, S.S., Zeraati, A., Moradi, S. & Mousavi, M.B. (2017).** The effect of gabapentin on muscle cramps during hemodialysis: A double-blind clinical trial. *Saudi journal of kidney diseases and transplantation: an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia*, 26(6), 1142-1148.
- Bender, V. (2017).** What are the benefits of reflexology? Retrieved 10 Jan 2021 from: http://www.vscentials.com/Reflexology_Benefits.
- Chanchlani, R., Young, C., Farooq, A., Sangar, S., Sethi, S. & Raina, R. (2020).** SAT-232 hemodialysis in children and adolescents: a systematic review. *Kidney International Reports*, 5(3), S99.
- Dhudum, B. & Bhole, N. (2020).** Intradialytic Stretching Exercises on Muscle Cramps: A Systematic Review. *Journal of Critical Reviews*. 7. Doi: 4390-4398. 10.31838/jcr.07. 15.586.
- Ebrahim, G.G.S., Ahmed, G.E.N., Hammad, A. & Eid, R. (2019).** Applying Cryotherapy and Balloon Inflation Technique to Reduce Pain of Arteriovenous Fistula Cannulation among Children Undergoing Hemodialysis. *International journal of Nursing Didactics*, 9(5), 29-35.
- El-Deeb, H., Shadia, D., Montasser, Z., & Moursy, A. (2017).** Effect of Reflexology

- Foot Massage on Leg Cramps for Patients on Hemodialysis. *IOSR Journal of Nursing and Health Science*, 06, 45:61. Doi: 10.9790/1959-0602074561.
- El-Nagar, S., Lawend, J. & El-Belgahy, A., (2020):** "Empowering Mothers Caring for their Children with Chronic Kidney Disease through Engagement and Education", *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 9(4): 12-19.
- Gite, T. (2020).** A Study to Assess the Effect of Selected Nursing Interventions on Leg Cramps for Patients Undergoing Hemodialysis in Selected Hospitals. *International Journal of Health Sciences and Research*, 10(7), 2249-9571
- Hassan, E.A. & Khalafallah, H.D. (2019).** Self-Care Activities of Adolescents Undergoing Hemodialysis. *IOSR Journal of Nursing and Health Science*, 8, (5), 7-16.
- Hothi, D.K., Laskin, B. & Geary, D.F. (2016).** Pediatric Hemodialysis Prescription, Complications, and Future Directions. In *Pediatric Kidney Disease* (pp. 1725-1765). Springer, Berlin, Heidelberg.
- Jancy, P.O. & Parimala, S. (2020).** Assess the Effect of Intradialytic Stretching Exercises to Reduce Leg Muscle Cramps among Patients Undergoing Hemodialysis in Selected Dialysis Unit of Ernakulum District. *International Journal of Nephrology and Kidney Failure*, 6. Doi: 10.16966/2380-5498.198.
- Karamisefat, M., Cheraghi, F., Soltanian, A. & Hasan, T. (2021).** The Effect of Foot Massage on Pain of Preschoolers Undergoing Venipuncture: A clinical Trial. *Evidence Based Care*, 10(4), 49-58.
- Küçükkelepçe, D. & Karaca, T. (2017).** Examination of Nurses' Theses on Reflexology Practice in Turkey. *International Journal of Advanced Research*, 5, 1681:1685. Doi: 10.21474/IJAR01/5230.
- Lekha, J. (2016).** Effectiveness of intradialytic stretching exercises on prevention and reduction of muscle cramps among patients undergoing Hemodialysis. *Journal of Basic and Clinical Renal Science*. 24(5), 10-84.
- Machaly, E., Bahgat, R., Hassan, H. & Kafil, R.H. (2020).** Effect of implementing evidence based nursing guidelines on nurses' performance about care provided for children undergoing hemodialysis. *Journal of Nursing and Health Sciences*, 9(3), 21-28.
- Malekshahi, F., Aryamanesh, F. & Fallahi, S. (2018).** The effect of Foot Reflexology and Swedish massage on Sleep quality and Restless leg syndrome among Patients undergoing hemodialysis. *Sleep and Hypnosis*, 20(4), 91-95.
- Mohamed, H., Farouk Abolwafa, N. & Mahmoud Ahmed, S. (2021).** Effect of Foot Reflexology on Hemodialysis School Age Children on Fatigue and Sleep Quality. *Egyptian Journal of Health Care*, 12(2), 431-447.
- Özdemir, G., Ovayolu, N. & Ovayolu, Ö. (2018).** The effect of reflexology applied on haemodialysis patients with fatigue, pain and cramps. *International Journal of Nursing Practice*, 19 (3), 265-273.
- Pagan, J. & Pauly, M. (2017).** Access to conventional medical care and the use of complementary and alternative medicine. *Health Affairs Journal*, 24, 255-262.

- Raj, V.M.S., Patel, D.R. & Ramachandran, L. (2017).** Chronic kidney disease and sports participation by children and adolescents. *Translational pediatrics*, 6(3), 207.
- Sadigova, E., Ozkurt, S. & Yalcin, A.U. (2020).** Pain Assessment in Hemodialysis Patients. *Cureus*, 12(2), e6903. <https://doi.org/10.7759/cureus.6903>.
- Sadik, B.R.A. & Abd-El Salam, A. A. (2018).** Effect of Using Meditation Techniques for Children with Chronic Kidney Disease on Hemodialysis Therapy. *International Journal of Novel Research in Healthcare and Nursing*, 5, (3), 1-13.
- Shady, R.H.A. & Ali, H.M.A. (2019).** Effect of Reflexology Foot Massage on Fatigue level for Adolescents Undergoing Hemodialysis. *International Journal of Nursing*, 6(1), 151-170.
- Shahgholian, N., Jazi, S.K., Karimian, J. & Valiani, M. (2016).** The effects of two methods of reflexology and stretching exercises on the severity of restless leg syndrome among hemodialysis patients. *Iran J Nurs Midwifery Res*, 21, 219:224.
- Sharifi, S., Navidian, A., Jahantigh, M., & Shamsoddini Lori, A. (2018).** Investigating the Impact of Foot Reflexology on Severity of Fatigue in Patients Undergoing Hemodialysis: A Clinical Trial Study. *Med Surg Nurs J*, 7(1), 81634.
- Souza, T.T., Kummer, A. M., Cardoso, A.A., & Lage, C.R. (2019).** Impacts of Chronic Kidney Disease on occupational performance of children and adolescents on hemodialysis. *Cadernos Brasileiros de Terapia Ocupacional*, 27(1), 72-80.
- Timothy, M. & Robert, B. (2017).** Muscle cramps. *International Journal of Clinical Practice*, 32, 43:42
- Vaidya, S.R. & Aeddula, N.R. (2020).** Chronic Renal Failure. [Updated 2020 Dec 1]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Retrived from: <https://www.ncbi.nlm.nih.gov/books/NBK535404>.
- Varni, J., Katz, E., Seid, M., Quiggins, D., Friedman-Bender, A. and Castro, C. (1998).** The Pediatric Cancer Quality of Life Inventory (PCQL), I: instrument development, descriptive statistics, and cross-informant variance. *J Behav Med.*; 21:197 – 204.
- Vimala, A. (2018).** Effectiveness of Intradialytic Stretching Exercises on Reduction of Muscle Cramps among patients undergoing Hemodialysis. *Journal of Critical Reviews*, 7(15), 43-90.