Effect of Intradialytic Exercises Program for Nurses on Peripheral Muscle Cramps and perfusion among Children Undergoing Hemodialysis

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Background: Muscle cramps and impaired peripheral perfusion are the most common complications experienced by children undergoing hemodialysis. Intradialytic exercises are the best measures to reduce muscle cramps which occurring during hemodialysis to increase the cardiac output, enhancing perfusion and facilitating oxygen demand of the skeletal muscles. **Aim of the study** was to evaluate the effect of intradialytic exercises program for nurses on peripheral muscle cramps and peripheral perfusion among children undergoing hemodialysis. **Setting:** The study was conducted at Children Renal Dialysis Unit at Benha University Hospital. **Design:** A quasi-experimental design was used to conduct the study. **Subjects:** Sample (I) A convenient sample of (30) nurses was selected from the previously mentioned setting, Sample (2) A purposive sample of 36 children undergoing hemodialysis. **Tools of data collection:** Five tools were used; **Tool I**: Nurses characteristics and children bio-sociodemographic data included three parts: (1) The studied nurses' characteristics, (2**)** Studied children characteristics (3) Clinical data of children undergoing hemodialysis, **Tool II:** Knowledge assessment questionnaire, **Tool III**: Intradialytic exercises checklist, **Tool IV:** Muscle cramp questionnaire chart **Tool V**: Assessment checklist for clinical features of impaired peripheral perfusion. **Results:** There is a highly statistical significant difference between frequency and duration of muscle cramps, level of pain, leg temperature and discomfort pre and post- intradialytic exercises program implementation. There was high statistical significant difference between clinical features of impaired peripheral perfusion pre and post-intradialytic exercises program. **Conclusion:** The majority of the studied nurses had good level of knowledge and satisfactory level of practices post-intradialytic exercises program implementation compared to pre-intradialytic exercises program implementation **Recommendations:** Organizing continuous training programs for nurses to reinforce intradialytic exercises for hemodialysis children. Structured training program can be provided to children undergoing hemodialysis on active intradialytic exercises.

Keywords: Children , Hemodialysis, Intradialytic exercises, Muscle cramps , Nurses, , Peripheral perfusion.

Introduction

Chronic renal failure is marked by a reduction in glomerular filtration, changes in extracellular fluid volume, electrolyte and acid-base homeostasis, and retention of nitrogenous waste products from protein catabolism. It happens when renal function is lost completely or partially.**(1)**

The most severe type of chronic kidney disease is end-stage renal disease. It is a disorder that necessitates continuous hemodialysis as part of chronic kidney replacement therapy and is characterized by a very low glomerular filtration rate along with uremic symptoms or over hydration. **(2)**

Chronic renal failure early phases are asymptomatic, so it is unknown with certainty how frequently it affects children. The prevalence of CRF in children has steadily increased over the past 20 years, and it is currently estimated that there are 18.5 to 100 cases of CRF in every million children worldwide. The mortality rate among adolescents is 30% to 100% higher than that of the overall population. The short lifespan

of a dialysis-dependent adolescent under the age of 14 highlights the need for specialized care**.** According to reports, there are 225 CRF cases per million children in Egypt, 74 cases of ESRD are anticipated to occur annually ,and there are 264 cases of children receiving dialysis overall. **(3)**

The most common therapeutic intervention for children with end-stage renal disease is hemodialysis; it is considered one of the main renal replacement therapies in pediatric patients. Maintenance hemodialysis withdraw many of the toxins responsible for the uremic syndrome and prolongs survival. Although, hemodialysis is generally a safe procedure, danger complications frequently encountered including tiredness, fatigue, nausea, dizziness, hypotension, impaired peripheral perfusion and muscle cramps (1 & 4).

Children receiving hemodialysis most frequently experience muscle cramps. Unexpected, painful, and uncontrollable muscular contractions are known as muscle cramps, and they often affect the lower extremities. Between 25% to 80% of adolescents receiving hemodialysis experience muscle cramps, which are a typical cause for interrupting a hemodialysis session early. **(5)**

Muscle cramps and excruciating muscular twitches are typically how muscle cramps start. The typical locations for muscular cramps are the calf, feet, toes, thighs, and belly. Reduced fluid volume, hypotension, low sodium dialysis levels, an imbalance of fluid and electrolytes, tissue hypoxia and hypomagnesaemia, excessive filtration, and an increase in serum creatinine kinase are the causes of this condition. These variables cause muscle vasoconstriction, particularly in the arms and legs, which results in muscular hypoperfusion during dialysis**.** **(6)**

Hemodialysis-induced circulatory stress results in hypo-perfusion in some vascular beds. Hemodialysis changes physiology, affecting cardiovascular hemodynamics beyond anything else. Intradialytic hypotension brought on by these physiological disturbances may result in hypoxia and ischemic damage.**(7)**

Systematic hypo-perfusion, subclinical ischemia, and poor peripheral perfusion can result from a reduced cardiac output during hemodialysis.**(8)**Reduced arterial blood flow to the extremities is referred to as inadequate perfusion. Severe or persistent pain, numbness or tingling in the vicinity of the vascular access or in the extremity distal to it, as well as swelling, coldness, discoloration, or a prolonged capillary refill time, are indications of poor peripheral perfusion. As a result of the diminished blood flow to the extremities, any of these symptoms may indicate poor tissue perfusion.**(9)**

Nurses working in hemodialysis units should be trained on the use of exercises as one of the effective strategies to control or eliminate some of the dialysis complications .**(10)**Since cramps are a common complication for hemodialysis children that cause discomfort, proper interference with muscle cramps and preventing the occurrence as well has become an essential intervention of the nurses who are taking care of HD children**.** Dialysis nurses are in a unique position to help monitor and evaluate cramps and in management technique.**(6)**

Exercise during hemodialysis has attracted attention since it may counteract side effects from the treatment and increase the overall effectiveness of dialysis .**(11)**One of the defenses against the drop in blood flow and the ensuing muscle soreness and cramps is regular exercise .**(12)**

Intradialytic exercise (IDE) is defined as a training program for children undergoing hemodialysis that aims to improve their strength and endurance while also focusing on a variety of physiological and psychosocial aspects. Intradialytic exercise

can range from stretching to aerobic exercise to resistance training.[13,14]

Exercise training can enhance peripheral perfusion, blood pressure, muscle blood circulation, and physical labor capacity while reducing fatigue, uremic nephropathy, myopathy, and cramping in the muscles. As skeletal muscles' oxygen demands increase during intradialytic activities, cardiac output can increase fourfold, improving perfusion and lowering cardiac stunning .[15]

Intradialytic stretching exercise is the exercise performed actively or passively to the affected muscles at the end of second hour of hemodialysis session. Intradialytic stretching exercise improves muscle protein synthesis and breakdown which helps in reducing or preventing intradialytic muscle cramps. Moreover, stretching exercises reduce muscle pain and soreness, enhancing flexibility and elasticity as well as reducing injury risk.[16]

Intradialytic range of motion exercises (ROM) can be considered as a routine care while delivering hemodialysis as it performed 15 minutes/ day, three times a week during HD session. It is an activity carried out to make the body healthy, to improve health and to maintain physical health. Range of motion is vital for increasing the cardiac output, alveolar ventilation and joint mobilization.[14,17]

Significance of the study

Hemodialysis is one of the most important treatment modality for CKDs. It is an ongoing process with patients experiencing various complications like hypotension, muscle cramps, disequilibrium syndrome and nausea during the procedure. Muscle cramps are mostly seen complication who begin with very painful muscle twitches and hard movements. Calf muscle, feet, toes, thighs and abdomen are the usual sites for muscle cramps. Exercise is one of the most likely preventive steps to lower protein loss from muscles and maintain muscle function. Children exercise tolerance and quality of life are both improved by intradialytic exercise. ([6]

Regular physical activity has a variety of positive health effects for CKD patients, including physiological, psychological, and functional advantages. It increases toxin clearance by dialysis, exercise capacity, blood pressure control, lipid profile, haematocrit, glycaemic control, serum albumin, and nutritional summary; it decreases cardiovascular mortality, hypertensive medication use, inflammatory indicators, and prevents muscle atrophy .[18]

As skeletal muscles oxygen demands increase during intradialytic activities, cardiac output can increase fourfold, improving perfusion and lowering cardiac stunning.[8] Exercises also improve blood pressure, lipid profiles, and the effectiveness of dialysis, which are all cardiovascular risk factors .[14]

Nurses working in hemodialysis units should be trained on the use of exercises as one of the effective strategies to control or eliminate some of the dialysis complications.[8]

Therefore, this study is conducted to evaluate the effect of intradialytic exercises program for nurses on peripheral muscle cramps and perfusion among children undergoing hemodialysis.

Aim of the study

The aim of this study is to evaluate the effect of intradialytic exercises program for nurses on peripheral muscle cramps and perfusion among children undergoing hemodialysis through:

-Assessing nurses' knowledge and practices regarding intradialytic exercises

- Assessing level of peripheral muscle cramps and perfusion among children undergoing hemodialysis

- Designing program about intradialytic exercises for nurses working at hemodialysis unit based on pre-program assessment

- Appling and apprising the effect of the program on nurses'' knowledge and practices about intradialytic exercises
- Evaluating the effect of the improved nurses' knowledge and practices on the children undergoing hemodialysis peripheral muscle cramps and perfusion.

Research hypotheses

1-Nurses' knowledge and practices regarding intradialytic exercises for children undergoing hemodialysis are expected to be improved after intradialytic exercises program implementation.

2- Application of intradialytic exercises program are expected to reduce peripheral muscle cramps and improve peripheral perfusion among children undergoing hemodialysis

2. Subjects and method

Study Design

A quasi–experimental research design (pre/ post-test) was adopted to conduct the study.

Research Setting:

Benha University Hospital's Pediatric Nephrology Unit, this study was carried out. It had four rooms—two for renal diseases and two for dialysis (one for children with hepatitis and another for children without hepatitis) with 18 beds.

Subjects

The subjects consisted of two types of samples.

Sample (1) A convenient sample of nurses (30) in the previously mentioned setting.

Sample (2) A purposive sample of 36 children undergoing hemodialysis.

Inclusion criteria for children as the following: children from both genders, aged 6-18 years, performing regular hemodialysis for at least six months, alert, cooperative and willing to participate in the study. **Exclusion criteria**: children undergoing emergency and first HD, having femoral catheter, lower limb disability or any concurrent medical conditions that may contraindicate exercises.

Tools of data collection

Tool (I): Nurses characteristics and children bio-sociodemographic data:

The questionnaire that the researchers created after revised recent literature. There were three components:

Part 1 focused on the personal characteristics of the nurse under study, including age, gender, educational attainment, years of experience, and attendance at training sessions for care for children with HD.

Part (2) focused on personal characteristics of the children the age, gender, educational attainment, and residency of the children who were the subject of the study. **Part 3** The clinical data of children receiving hemodialysis, including the duration of the treatment, the frequency and duration of sessions, the times when cramps occur, the muscles involved, and the limitations on movement and activity brought on by cramps.

Tool (II): Knowledge assessment questionnaire

It was designated by the researchers based on recent literatures review **Murdeshwae and Anjum, (2021) [19], Cho, (2020) [20], Habas et al., (2019) [21] and Himmelfarb and Ikizler, (2019). [22]** It is composed of of (30) multiple choice questions covering main four items of nurses' knowledge regarding:

- Chronic kidney disease
- Hemodialysis
- Intradialytic muscles cramps
- Impaired peripheral perfusion
- Intradialytic exercises.

Nurses' knowledge scoring: Each item assigned a completely correct answer was scored (2), the incomplete correct answer was scored (1) and incorrect or don't know answer was scored (0). Total knowledge scores ranged from (0-60). In this respect,

the level of nurses' knowledge was categorized as the following:

- Poor knowledge (< 60%)
- Average knowledge (between 60% and 85%).
- Good knowledge in ≥85 %.

Tool (III): Checklist for intradialytic exercises: it consists of two parts

Part 1: Stretching exercises: It was adopted from **Lekha, (2016)**[23] to assess nurses' practices regarding intradialytic stretching exercises including:

- Ankle dorsiflexion
- Soleus stretching
- Gastrocnemius stretching
- Hamstring stretching
- Quadriceps stretching

Part 2: Range of motion exercises checklist: It was adapted from **Cobbett et al., (2020)** [24] **and Sorrentino and Remmert, (2017)** [25] to assess nurses' practices regarding intradialytic range of motion exercises It involved ROM exercises of upper extremities (shoulder, elbow, forearm, wrist and fingers) and ROM exercises of lower extremities (hip, knee, ankle, feet and toes).

Scoring system for nurses' practices

The score of each item of the previous tool was classified as the following: not done had score (0), incorrectly done had score (1) and correctly done had score (2). According to the nurses' actual practice, their level of practice was categorized as the following:

- Unsatisfactory (< 85%).
- Satisfactory (≥ 85%).

Tool (IV): Muscle cramps questionnaire chart: pre/ post-test.

It was adopted from **Basemath (2014)** [26] to estimate the severity of muscle cramps during hemodialysis. It includes different aspects of muscle cramps, such as frequency, duration, level of pain, temperature, and discomfort, and it was scored as having a level of cramps ranging from 0 to 13.

Interpretation of Score:

(0) No cramps

(1-4) mild cramps

(5-8) moderate cramps

(9-13) Severe cramps

Tool(V): Peripheral perfusion impairment observational checklist. It was adapted from **Priya (2016)** [27] to assess clinical features of peripheral perfusion impairment. It included six parameters such as peripheral pulse, capillary refill time, edema, temperature, pain, and skin color as the following:-

1-Peripheral pulse ranges from zero (0) (normal pulse) to (3) (none palpable peripheral pulse)

2-Capillary refill time (1-2s, 3s, 4s &>4s)

3- Presence of edema (no edema, (+1) a depression less than 2 mm that suddenly disappeared, (+2) a depression less than 2-4 mm that disappeared within 10-15 seconds, and (+3) a depression 4-6 mm dents will disappear after 10-15 seconds),

4-Temperature (warm, mild coldness, moderate coldness , sever coldness).

5- Pain (no pain, mild, moderate, severe)

6- Skin color (pink, pale, cyanotic/black, reddish).

The evaluation scheme for this tool was estimated as follows.

- (0 - 4) adequate peripheral perfusion,
- (5-9) slightly inadequate peripheral perfusion,
- (10 -14) inadequate peripheral perfusion
- (15 -18) severely inadequate peripheral perfusion

Tools validity and reliability

Three Pediatric Nursing Experts from the Nursing Faculty at Benha University assessed the instruments used for gathering data, evaluating their clarity, comprehensiveness, relevance, simplicity, and accuracy as well as their content

validity. Utilizing Cronbach's alpha, the internal consistency reliability of the validated tools was evaluated. The reliability values for knowledge evaluation questionnaire and assessment checklist for clinical features of peripheral perfusion impairment were 0.75 and 0.897, respectively.

Ethical considerations

The scientific research ethical committee of the nursing faculty at Benha University gave its official approval for the study to be carried out. Before beginning the practical work, a formal letter outlining the study's objectives was obtained from the Nursing Faculty dean to the hospital director to take approval to carry out the study and gather the required data. Participants were informed of their right to participate, decline, or withdraw at any time, and the researchers then obtained their consent. Anonymity and confidentiality of any acquired information were guaranteed.

Pilot Study

Ten percent of the total study sample underwent a pilot study to assess the research tool's applicability, clarity, relevance, feasibility, consistency of question order, and time commitment. Pilot study participants were incorporated into the study's overall sample because no changes were made.

Field work

The intradialytic exercises program was put into place through four phases including assessment, planning, implementation, and evaluation to accomplish the goal of the current study. The study was conducted over the course of six months, from the beginning of April 2023 to the end of September 2023 in accordance with the phases listed below:

Assessment phase

- During the assessment phase, interviews were conducted with nurses to collect baseline data.
- The researchers were allowed to collect data on three days per week (morning and afternoon shifts) using research tools in a research environment.
- After clarifying the purpose of the study, oral consent for participation was obtained from the nurses.
- A pre-test was conducted using the above tool to assess nursing staff's knowledge and practice of intradialytic exercises.
- The children were assessed regarding level of peripheral muscle cramps and perfusion using muscle cramps questionnaire & assessment checklist for clinical features of impaired perfusion.

- Pre-test results were analyzed to determine the actual knowledge and practice needs of nurses. Subsequently, general and specific goals for an on- intradialytic exercises program were established and implemented to meet the actual needs of nursing staff. This pre-test period lasted at four weeks.

Planning phase

This phase included analysis of pre-test results and determination of nurses' actual knowledge and practice needs regarding intradialytic exercises. Therefore, the program intervention (booklet) was designed by the researchers in plain Arabic and various illustrations to facilitate subject comprehension. General and specific goals for educational interventions were established and implemented to meet the actual needs of study participants. For educational interventions, a range teaching strategies were employed, including modified lectures, brainstorming, demonstrations and post-demonstrations, and group discussions. The right teaching materials, including audio-visual aids, were included to aid nurses in properly understanding the subject matter. This stage lasted about four weeks.

Implementation

There were seven sessions total, divided into three theoretical sessions and four practical sessions, to complete the intradialytic exercises program. Small groups of nurses attended lectures that lasted an average of 45 minutes for theoretical instruction and 60 minutes for practical sessions. Each group had about eight nurses in it. This stage lasted about 3 months .

The theoretical sessions include

- Chronic kidney disease
- Hemodialysis
- Intradialytic muscles cramps-
- Inadequate peripheral perfusion
- Intradialytic exercises

The practical sessions include

- Intradialytic stretching exercises including ankle dorsiflexion, soleus stretching, gastrocnemius stretching, hamstring stretching and quadriceps stretching.
- Intradialytic range of motion exercises of upper extremities (shoulder, elbow, forearm, wrist and fingers).
- Intradialytic range of motion exercises of lower extremities (hip, knee, ankle, feet and toes).

Evaluation phase

The evaluation was conducted immediately after the educational program using the same pretest tool. The data collection process was repeated to assess the effect of the program on nurses' knowledge and practice. Children were assessed for degree of peripheral muscle spasm and perfusion using the muscle cramp questionnaire and evaluation checklist for clinical features of Perfusion impairment after intra-dialys training. This phase lasted about 4 weeks. The entire field work took about six months

Administrative Design

A formal letter from the dean of the nursing Faculty at Benha University was submitted to Benha University Hospital's administrators to take written permission from the hospital to conduct the study.

Statistical design

Collected data were organized, tabulated, and statistically analyzed using the (SPSS) version 20 for Windows running on an IBM compatible computer. Data were presented using descriptive statistics in the continuous data. Qualitative variables were compared using the chi-square test. If the expected value was less than 5, Fisher's exact test was used instead. To examine how quantitative variables, relate to one another, Pearson correlation analysis was used. P-value of less than (0.05) established statistical significance, and p-value of less than (0.001) established high statistical significance form of numbers and percentages for qualitative variables and mean and standard deviation for quantitative variables. For comparisons between two groups, paired t-test were used to compare quantitative.

Results

Table (1) showed that more than half (53.3%) of the nurses under study were between the ages of 20 and 30 years with a mean age of 32.14 3.62 years .The majority of them (86.7%) were female, and more than two thirds (66.7%) had technical institute of nursing degrees. Less than half (43.3%) of the nurses in the study had five to ten years of experience. Additionally, it was discovered that the majority of the studied nurses (83.3%) did not attend training sessions on intradialytic exercises.

Table (2) shows that more than half (52.8%) of the children under the age of 12 were included in the study, with a mean age of 11.44±3.81 years and a more than half of them (55.6%) being female. This table showed that less than half (47.2%) of children were enrolled in primary level education. Additionally, about two thirds (66.7%) of children were from rural areas.

Table (3) clarifies that more than half (58.3%) of the children were on hemodialysis for 3 years or longer, and all (100%) were found to have had 3 weekly hemodialysis sessions, each session lasting 4 hours. It is also evident from this table that the majority of the studied children experienced muscle spasms in both legs and calf muscles during the last hour of hemodialysis (88.9%, 80.6%,72.2%, respectively). Furthermore, this table reflects that muscle spasms limited movement and activity in all children surveyed (100%).

Figure (1) shows that, 43.4% of the studied nurses scored average level of total knowledge pre-intradialytic exercises program. While, the majority of them (80.0%) had good level of total knowledge post-intradialytic exercises program, there was significant improvement in the nurses' total level of knowledge post-intradialytic exercises program as compared to pre- intradialytic exercises program (P-value <0.05).

Figure (2) this figure shows that, 80% of the nurses in this study had an unsatisfactory practice pre-intradialytic exercises program. Meanwhile, 83.3% of them had a satisfactory practice post-intradialytic exercises program. There was a highly statistically significant improvement in practice ratings from nurses after of the intradialytic exercise program**.**

Table (4) reveals that, less than two thirds (63.9%) of the studied children had intradialytic muscle cramps more than three times pre-intradialytic exercises program implementation. While, more than half (55.6%) of them had no muscle cramps post-program implementation. As regard, duration of muscle cramps, this table shows that, more than half (55.6%) of children suffered from muscle cramps for more than five minutes pre-program implementation. Whereas, more than two thirds (69.4%) of them had no muscle cramps post-program implementation. Also, this table illustrates that, more than half (52.8%) of studied children had moderate pain pre-intradialytic exercises implementation, while 63.9% of them had no pain post-program implementation. Also, it is obvious from this table that, more than half (55.6%) of children had cold leg pre-intradialytic exercises program, while, the majority (88.9%) had warm leg post-program implementation. Regarding discomfort, 72.2% of children were unbearable before intradialytic exercises. Whereas, more than two thirds (66.7%) of them were sensitive post-program implementation. Moreover, this table demonstrated that, there is a highly statistical significant difference between frequency and duration of muscle cramps, level of pain, leg temperature and discomfort pre and post-intradialytic exercises program implementation (P< 0.000).

Table (5) clarifies that 41.7 % of children in this study had severe muscle cramps pre intradialytic exercises program. While, less than two thirds (61.1%) of them had mild cramps post intradialytic exercises program intervention. There is a high significant difference in level of muscle cramps post-intradialytic exercises program (P< 0.000).

Table (6) shows highly statistically significant differences between the clinical features of perfusion injury (peripheral pulse, capillary filling, edema, body temperature, pain, skin color) pre and post the intradialytic exercise program. Indicates that there is a difference (P<0.000).

Figure (3) described that, more than (58.3%) of the children in this study suffered from inadequate perfusion pre intradialytic exercise. While, nearly half (47.2%) of them had adequate perfusion after intr-dialytic exercise application.There is a highly statistical significant difference in level of peripheral perfusion post-intradialytic exercises program (P< 0.000).

Table (7) reflectes that, there was a highly statistical significant positive correlation between nurses' total knowledge level and total practice level post intradialytic exercises program implementation.

Table (8) reflects that there was a statistically significant correlation between nurses' total practices level and muscles cramps post intradialytic exercises program implementation.

Table (9): reflects that, there was significant statistical correlation between nurses' total practices and the clinical features of perfusion impairment post intradialytic exercises program implementation..

Table (1): Distribution of studied nurses regarding their personal characteristics (n=30)

Items	No.	%
Age / years		
< 20	3	10.0
20 - <30	**16**	**53.3**
30- <40	7	23.4
≥40	4	13.3
Mean ±SD 32.14±3.62		
Sex		
Male	4	13.3
Female	**26**	**86.7**
Educational level		
Diploma of Nursing	6	20.0
Technical Institute of Nursing	**20**	**66.7**
Bachelor of Nursing Sciences	4	13.3
Years of experience		
<5	10	33.3
5- <10	**13**	**43.3**
≥10	7	23.3
Mean ±SD 7.31±2.43		
Attendance of training courses about intradialytic exercise	5	16.7
Yes	**25**	**83.3**
No		

Table (2): Distribution of the studied children regarding their characteristics (n=36).

Items	No.	%
Age		
6 < 12	**19**	**52.8**
12 ≥18	17	47.2
Mean ±SD	11.44±3.81	
Gender		
Male	16	44.4
Female	**20**	**55.6**
Educational level		
Illiterate	3	8.3
Primary	**17**	**47.2**
Preparatory	9	25.0
Secondary	7	19.5
Residence		
Rural	**24**	**66.7**
Urban	12	33.3

Table (3): Distribution of children for clinical data (n=36).

Items	No.	%
Hemodialysis duration / years		
<1	7	19.5
1 -< 3	8	22.2
≥ 3	**21**	**58.3**
Number of hemodialysis sessions per week		
One session	0	0.00
Two sessions	0	0.00
Three sessions	**36**	**100.0**
Duration of hemodialysis session.		
2 hours	0	0.00
4 hours	**36**	**100.0**
6 hours	0	0.00
Time of experiencing muscle cramps		
First hour	0	0.00
Middle hour	4	11.1
Last hour	**32**	**88.9**
Location of muscle cramps		
Right leg	5	13.9
Left leg	2	5.5
Both	**29**	**80.6**
Affected muscles		
Calf	**26**	**72.2**
Hamstring	5	13.9
Soleus	5	13.9
Muscle cramps restrict motion and activity		
Yes	**36**	**100.0**
No	0	0.00

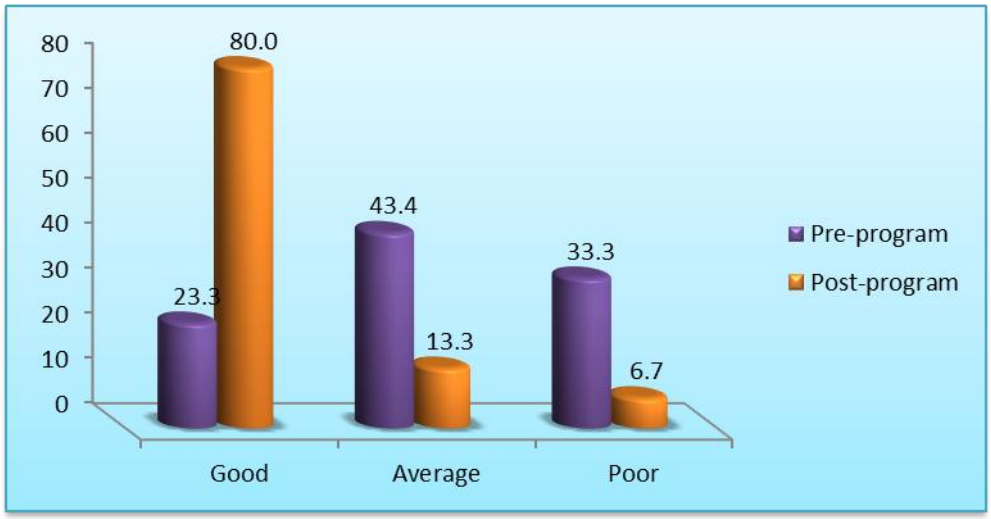

Figure (1): Percentage distribution of studied nurses regarding their total knowledge level (pre/post-intradialytic exercises program)(n=30).

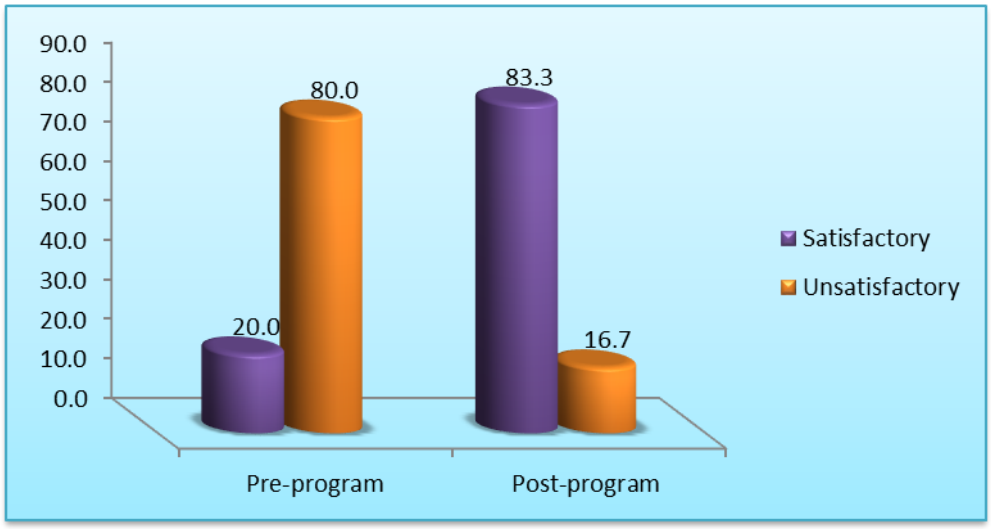

Figure (2): Percentage distribution of the studied nurses regarding their total practices level regarding interadialytic exercises(pre/post-intradialytic exercises program).

Table (4): Frequency distribution of the studied children regarding cramp questionnaire chart(pre/ post-intradialytic exercises program) (n=36).

Features of muscle cramps	Pre-intradialytic exercises program		Post-intradialytic exercises program		X^2	p-value
	No.	%	No.	%		
Frequency of muscle cramps						
Not occur	0	0.0	20	55.6	43.31	.000**
Less than 3 times/hour	13	36.1	16	44.4		
More than 3 times/hour	23	63.9	0	0.0		
Duration of muscle cramps						
Not occur	0	0.0	25	69.4	45.92	.000**
Less than 5 min	16	44.4	11	30.6		
More than 5 min	20	55.6	0	0.0		
Level of pain						
No pain	0	0.0	23	63.9	57.55	.000**
Mild	5	13.9	13	36.1		
Moderate	19	52.8	0	0.0		
Severe	12	33.3	0	0.0		
Leg temperature						
Warm	1	2.8	32	88.9	58.60	.000**
Cold	20	55.6	4	11.1		
Calmmy	15	41.7	0	0.0		
Discomfort						
No	0	0.0	0	0.0	72.00	.000**
Perceptible	0	0.0	12	33.3		
Sensitive	6	16.7	24	66.7		
Painful	4	11.1	0	0.0		
Unbearable	26	72.2	0	0.0		

Table (5): Percentage distribution of the studied children regarding level of muscle cramps (pre/ post-intradialytic exercises program) (n=36).

Level of muscle cramps	Pre-intradialytic exercises program (n=36)		Post-intradialytic exercises program (n=36)		X^2	P-value
No cramps	0	0.0	7	19.4	27.03	**.000****
Mild cramps	8	22.2	22	61.1		
Moderate cramps	13	36.1	5	13.9		
Severe cramps	15	41.7	2	5.6		

** A highly statistical significant difference

Table (6): Distribution of the studied children regarding clinical features of impaired peripheral perfusion (pre/ post-intradialytic exercises program (n=36)

Items	Pre-intradialytic exercises program		Post-intradialytic exercises program		X^2	p-value
	No.	%	No.	%		
Peripheral pulse						
-Normal pulse	0	0.0	11	30.6	45.08	.000*
-A slightly Diminished pulse than normal;	5	13.9	22	61.1		*
-detectable pulse	23	63.9	3	8.3		
-no palpable pulse;	8	22.2	0	0.0		
Capillary refill						
1-2 seconds	0	0.0	9	25.0	12.75	.005*
3 seconds	2	5.6	0	0.0		
4 seconds	24	66.7	22	61.1		
>4seconds	10	27.8	5	13.9		
Edema						
No edema	0	0.0	11	30.6	64.53	.000*
(+1) < 2 mm pitting	0	0.0	23	63.9		*
(+2) 2 to < 4 mm pitting	28	77.8	2	5.6		
(+3) 4 to < 6 mm pitting	8	22.2	0	0.0		
Leg-Temperature						
Warm	0	0.0	18	50.0	57.82	.000*
Mild coldness	0	0.0	14	38.9		*
Moderate coldness	25	69.4	2	5.6		
Sever coldness	11	30.6	2	5.6		
Pain						
No	0	0.0	7	19.4	64.50	.000*
Mild	0	0.0	27	75.5		*
Moderate	30	83.3	2	5.6		
Severe	6	16.7	0	0.0		
Color of skin						
Normal	0	0.0	14	38.9	36.77	.000*
Pale	9	25.0	19	52.8		*
Black	27	75.0	3	8.3		

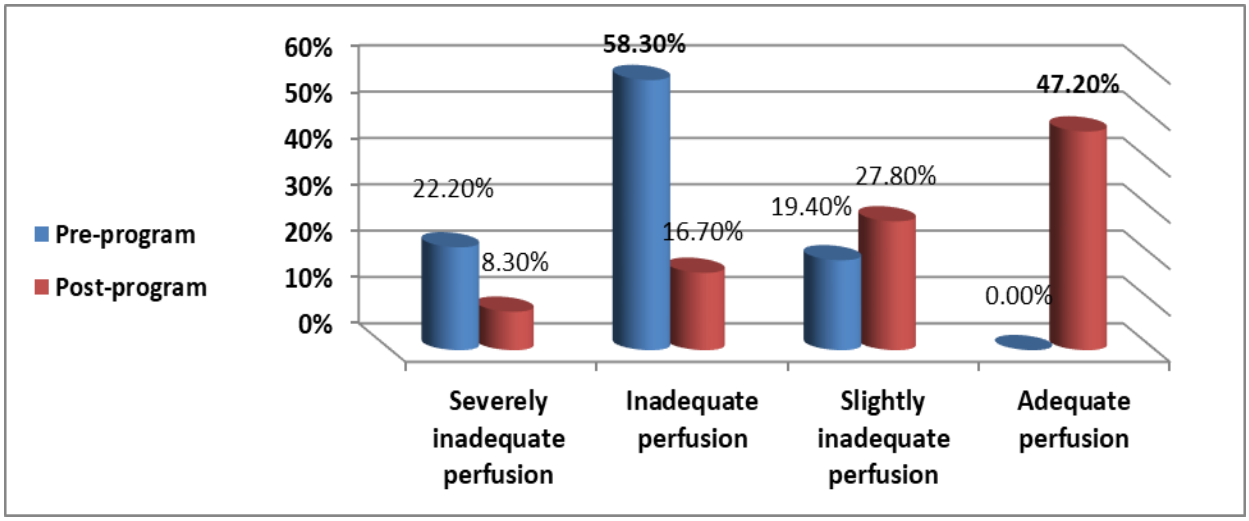

Figure (3): Percentage distribution of the studied children regarding total level of peripheral perfusion(pre/ post-intradialytic exercises program)(n=36).

Table (7): Correlation between total knowledge and total practices of the studied nurses pre/ post-intradialytic exercises program.

	Total knowledge			
	Pre-intradialytic exercises program		Post- intradialytic exercises program	
	R	p-value	r	p-value
Total practices	0.314	0.091	0.758	0.000**

** A highly statistical significant difference

Table (8): Correlation between total practices and muscle cramps pre and post intradialytic exercises program.

	Cramps			
	Pre- intradialytic exercises program		Post- intradialytic exercises program	
	R	p-value	R	p-value
Total practices	-.244	.193	.488	.013*

Table (9): Correlation between total practices and clinical features of impaired peripheral perfusion pre and post intradialytic exercises program.

	Clinical features of impaired perfusion			
	Pre- intradialytic exercises program		Post- intradialytic exercises program	
	R	p-value	R	p-value
Total practices	.097	.609	.370	.044*

Discussion

Muscle spasms known as involuntary muscle contractions with severe stretching pain, are most commonly associated with hemodialysis and begin with extremely painful muscle spasms that leave children nearly immobile. Muscle spasms usually end a dialysis session prematurely and can result in ineffective treatment. Some literature provides evidence that different sets of stretching during dialysis are a useful strategy for preventing and treating muscle spasms during hemodialysis **Yadav &. Lakhani (2022)** [28]**.** The aim of this study is to evaluate the effect of intradialytic exercises program for nurses on peripheral muscle cramps and perfusion among children undergoing hemodialysis.

Concerning the nurses' characteristics, the findings from the current study clarified that, more than half of the studied nurses were aged between 20-<30 years, with mean age 32.14±3.62 years and the majority of them were females. These findings are consistent with **Machaley et al**., **(2020)** [29] who studied"effect of implementing evidence based nursing guidelines on nurses' performance regarding care provided for children undergoing hemodialysis" and reported that more than half of the nurses in the study aged between 20 to 30 years and the majority of them were females.

The result of the current study demonstrated that more than two thirds of the studied nurses had technical institute of nursing. This finding was compatible with **Bayoumi and Mahdy, (2014)** [30] who investigated "impact of range of motion exercise program for hemodialysis nurses on quality of life for children with end-stage renal disease undergoing hemodialysis" and stated that 68.7% of the nurses graduated from technical institute of nursing.

As for the experience of the studied nurses, less than half of the nurses had five to 10 years of work experience. Regarding training participation, the majority of surveyed nurses did not participate in training on exercise during dialysis. These results are consistent with those of **Ibrahim et al. (2019).** [3] As a result, less than half of the nurses surveyed had five to ten years of experience, and almost two-thirds of them had prior training in caring for children undergoing hemodialysis. This finding is equally relevant to **Bayomi & Mahdy (2014)** [30], who stated that none of the nurses surveyed had been trained in performing exercises in a hemodialysis unit. This may be related to the understaffing and workload of the hemodialysis unit.

As regards children characteristics in this study the findings of the present study represented that more than half of the studied children were in the age group from 6<12years.This result was compatible with **Bahgat & Nada, (2019)** [31] who studied "effect of implementing exercise training program on dialysis efficacy and physical performance of children undergoing hemodialysis" and clarified that more than half children in their study aged 10-15 years. Moreover, the current study revealed that more than half of children were females and less than half of them enrolled in primary level of education. This finding was supported by **Ahmed et al., (2020)** [32] who carried out a study entitled "effect of nursing intervention program on self-esteem, body image and quality of life of children undergoing hemodialysis" and reported that more than half of children were females and less than half of them had primary education level. In contrast, these results disagree with **Bayoumi & Mahdy, (2014)** [30] they documented that nearly more than half of the children were males and enrolled in preparatory level.

According to the children residence area, this study illustrated that more than two

thirds of the children in this study were from rural areas**.** On the same scope this finding agreed with **Ahmed et al., (2020)** [32] who mentioned that more than two thirds of children were living in rural areas. This result goes in accordance with **Bahgat & Nada, (2019)** [31] who found that, the most of studied children from rural areas.

As regards clinical data of the studied children, the present study illustrated that more than half of the children were on hemodialysis for ≥ 3 years. These findings are consistent with **Ahmed et al., (2020)** [32] who mentioned that nearly half of studied children start renal dialysis for more than three years. Similarly, this study is on the same line with **Bayoumi & Mahdy, (2014)** [30] who demonstrated that more than half of children receive hemodialysis therapy for more than three years. The findings of the current study confirmed that, all children underwent three hemodialysis sessions per week. These results are on the same wavelength with **Al badry et al., (2020)** [14] who conducted study to evaluate "effect of intradialytic hemodialysis exercises on fatigue and leg cramps" and mentioned that vast majority of subjects receive three hemodialysis sessions per week.

The present study clears that, hemodialysis session of all children in this study last for four hours and the majority of them experience muscle cramps during the last hour of hemodialysis in both legs and in calf muscle. These results are compatible with **Ghaleb & Sharaf, (2020)** [16] they study "effects of nursing interventions on intradialytic muscle cramps among patients undergoing maintenance hemodialysis" and pointed out that all of patients underwent hemodialysis for four hours and the majority of them experienced muscle cramps in both legs, calf muscle and during the last hour of hemodialysis session. Moreover, this table reflected that, muscle cramps restrict motion and activity in all of studied children.

This result agrees with **Jancy & Parimalas, (2020)** [6] who study "the effect of intradialytic stretching exercises to reduce leg muscle cramps among patients undergoing hemodialysis" and concluded that 67% of subjects had restricted activities due to muscle cramps.

Regarding the nurses' total knowledge illustrated that, less than half of the studied nurses had average level of knowledge pre-intradialytic exercises program intervention. While, the majority of them scored good level of knowledge post-intradialytic exercises program, with significant improvement the program as compared with pre- program intervention. This may be due to the effective program that used simple language, pictures and preparation of educational program materials based on actual needs of nurses and children. These findings of the present study were supported by **Bayoumi & Mahdy, (2014)** [30] who found that there were highly statistically significant differences in relation to total nurses' knowledge during pre/post program implementation (P-value <0.001), where most of them had good knowledge and the minority of them had poor knowledge post program. Additionally, this result is in compliance with **Machaley et al., (2020)** [29] they reflected that, before implementing the guidelines they observed that, slightly less than two thirds of the nurses had good total knowledge scores and their total knowledge mean scores improved to 88.3% after implementing the guidelines with significant difference in the nurses 'total knowledge scores.

As regards nurses' total practice scores, the study findings showed that most of the studied nurses had unsatisfactory practice score regarding intradialytic exercises pre-intradialytic exercises program. However, the majority of them had a satisfactory practice score post-intradialytic exercises program. Moreover, there is a highly statistical significant improvement in nurses' practice score post- intradialytic exercises program (P< 0.000).These results go in the same wavelength with **Bayoumi & Mahdy, (2014)** [30] who stated that there were significant differences regarding total nurses' performance pre and post program implementation .

Concerning features of intradialytic muscle cramps, the present study clarifies that, there is a highly statistical significant difference between frequency and duration of muscle cramps, level of pain, leg temperature and discomfort among the studied children pre and post- intradialytic exercises program implementation . These results agree with **Ghaleb & Sharaf, (2020)** [16] who pointed out that, the nursing intervention were proved to be significant in reducing frequency and duration of muscle cramps and level of pain among the studied children (p<0.001).

Additionally, these findings are consistent with **Al badry et al., (2020)** [14] who found that, there was statistical significance difference as regard cramp questionnaire chart (frequency and duration of muscle cramps, level of pain, leg temperature and discomfort) pre and post implementation of intradialytic exercises.

Regarding the level of muscle cramps among children undergoing hemodialysis, the current study showed that two fifth of the studied children had severe muscle cramps pre- intradialytic exercises program. While, less than two thirds of them had mild cramps post intrdialytic exercises program. There is a highly statistical significant difference in level of muscle cramps post-intradialytic exercises program .These findings confirmed with **Bharti & Chavda, (2020)** [33] they studied "effectiveness of intradialytic stretching exercise on muscle cramps among patients undergoing hemodialysis" which reflected that, the intradialytic exercise was effective in reducing the muscle cramps score among hemodialysis patients.

This result supported by **Ghaleb & Sharaf, (2020)** [16] pointed that the used nursing intervention demonstrated statistically significant difference in the level of muscle cramps, as two thirds had moderate muscle cramps before applying the nursing intervention, compared to 58.1% and 41.9% who had no to mild cramps after intervention respectively. Moreover, **Jancy & Parimalas, (2020)** [6] concluded that continuous intradialytic exercises can prevent and reduce the level of muscle cramps during hemodialysis. From to researchers' point of view that exercise training can enhance muscle blood circulation that help in reducing muscles cramps.

The current study revealed that, there is a highly statistical significant difference between clinical features of impaired perfusion (peripheral pulse, capillary refill, Edema, temperature, pain and color of skin)pre and post-intradialytic exercises program implementation and more than half of the studied children suffered from inadequate perfusion before intradialytic exercise. While, nearly half of them had adequate perfusion after intrdialytic

exercises application. There is a highly statistical significant difference in level of peripheral perfusion post-intradialytic exercises program (P< 0.000). These results are supported by **McGuire et al., (2018)** [8] who pointed that, an increase in cardiac output achieved by intradialytic exercises would enhance perfusion. Also, these results agree with **Mohamed et al., (2020)** [14] who mentioned that, intradialytic exercises increased muscle blood flow and opened capillary surface area.

Regarding the correlation between nurses' overall knowledge and practice levels, survey results showed a positive correlation between nurses' overall knowledge levels and overall practice levels before and after the program. These results are inconsistent with those of **Ibrahim et al. (2019)** [3] reported that there was no statistically significant relationship between nurses' knowledge level and practice level ($p \geq 0.05$). Furthermore, **Machaly et al. (2020)** [29] found no association between total knowledge scores of surveyed nurses and total practice scores before and after implementation of evidence-based nursing guidelines.

Moreover, In this study, the correlation between overall practice and muscle cramps before and after implementing an intradialytic exercise program showed a positive correlation between overall practices scores and muscle cramps in nurses after implementing an intradialytic exercise program. This finding is corroborated by **Lakhwinder et al. (2019)** [34] they conducted a study entitled "Quasi-experimental study to evaluate the effect of stretching exercise during dialysis on muscle spasms in patients undergoing hemodialysis in selected hospitals in Jalandhar, Punjab". , found that stretching exercise during dialysis had a significant effect on muscle spasms in patients undergoing hemodialysis.

Regarding the correlation between overall practice before and after an intradialysis exercise program and clinical features of peripheral blood flow disorders. This study reflects a statistically significant correlation between nurses' practice total scores and clinical features of perfusion failure after using an intradialysis exercise program. This supported by Exercise training can enhance peripheral perfusion, blood pressure, muscle blood circulation, and physical labour capacity while reducing fatigue, uremic nephropathy, myopathy, and cramping in the muscles. As skeletal muscles' oxygen demands increase during intradialytic activities, cardiac output can increase fourfold, improving perfusion and lowering cardiac stunning **Hatef et al, (2021)** [15] who illustrated that exercise training can enhance peripheral perfusion, blood pressure, muscle blood circulation, while reducing fatigue, uremic nephropathy, myopathy, and cramping in the muscles. As skeletal muscles' oxygen demands increase during intradialytic activities, cardiac output can increase fourfold, improving perfusion and lowering cardiac stunning.

Conclusion

Based on the findings of the current study, it can be concluded that:

There was significant improvement in nurses' knowledge and practices regarding intadialytic exercise after program. Additionally there was a statistically significant correlation between overall nurses' practices level and muscle spasms following the intra-dialysis exercise program application. Also there was a statistically significant correlation between nurses'

practice total scores and clinical features of perfusion failure after intradialysis exercise program.

Recommendations

Considering the results of this study, the following recommendations can be suggested:

- Intradialytic exercises should be added as a routine procedure for children undergoing hemodialysis to promote comfort and decrease muscles spasm.
- Structured training program can be provided to children undergoing hemodialysis on active intradialytic exercises.
- Provision of health teaching programs and booklets for children receiving hemodialysis and their caregivers to disseminate the importance of intradialytic exercises.
- Organizing continuous training programs for hemodialysis nurses to encourage them applying intradialytic exercises for hemodialysis children.
- The study replication using a large sample for generalization of results is essential.

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