Effect of Intradialytic Exercises on Muscle Cramps and Fatigue among Children Undergoing Hemodialysis

Yahia Mohamed Sayed[1], Shaima Shaban Mohamed[2], Nagwa Rizk Mohammed Abu-Elenen[3]

[1] Lecturer of Pediatric Nursing Faculty of Nursing, Minia University, Egypt.
[2]Assistant Professor of Pediatric Nursing Faculty of Nursing, Minia University, Egypt.
[3]Assistant Professor of Pediatric Nursing, Faculty of Nursing, Port-Said University, Port-Said, Egypt, Dean of Gouna Technical Nursing Institute, Hurghada, Red Sea, Egypt.

Corresponding author: Yahia Mohamed Sayed
Email: yehiamsayed@mu.edu.eg

Abstract

Background: Children undergoing hemodialysis often suffer from negative effects such as muscle cramps, arrhythmias, nausea, vomiting, low blood pressure, and fatigue. **Aim:** The current study aimed to evaluate the effect of intradialytic exercises on muscle cramps and fatigue among children undergoing hemodialysis. **Research design:** This research was conducted using one group (pre-posttest) quasi-experimental research design. **Setting:** This research was conducted in the pediatric hemodialysis units at Minia University Hospital for obstetric and pediatrics (MUHOP). **Sample:** A Convenience sample included all the available children (55) with end-stage renal disease undergoing hemodialysis. **Research tools:** There were two tools used. **Tool I:** A Structured interview questionnaire**. Part I:** Bio-demographic data of children. **Part II:** Multidimensional Fatigue Scale for the Pediatric Quality of Life Inventory. **Tool II:** Muscle cramps questionnaire. **Results**: The study findings indicated that nearly three quarters of the studied children experienced severe fatigue before intradialytic exercises, whereas most of them reported mild fatigue after these exercises, showing highly statistically significant differences. Conversely, more than half of children experienced severe muscle cramp pre-intradialytic exercises compared to None of them in post-intradialytic exercises. **Conclusion**: Intradialytic exercises had a positive effect on reducing fatigue level and muscle cramp severity among hemodialysis children with statistically significant differences between pre and post intradialytic exercises. **Recommendations**: Intradialytic exercises can be adapted as a standard practice for children receiving hemodialysis.

Key words: Children, Fatigue, Hemodialysis, Intradialytic exercises, Muscle cram

Introduction

A serious global health concern, Chronic Kidney Disease (CKD) has a high fatality rate, particularly in children. A reduced glomerular filtration rate (below 60 mL/min/1.73 m2) that lasts for at least three months or kidney damage, regardless of filtration rate (even if it surpasses 60 mL/min/1.73 m2), are the two hallmarks of chronic kidney disease **(Vaidya & Aeddula,2024).**

The causes of CKD in children differ by age; from birth to early teens, they typically involve hereditary or congenital conditions, while for ages 15-19, glomerulonephritis is the most frequent reason for CKD. Chronic kidney disease results in various health issues, including anemia, heart complications, bone deterioration, and mortality **(Ghatas et al., 2020)**.

Hemodialysis (HD), a laborious process that occurs two or three times a week for roughly three to five hours each day, is the most popular and extensively utilized renal replacement therapy for children with End-Stage Renal Disease (ESRD). Hemodialysis replaces the functions of the failing kidneys with an artificial kidney machine **(Kamal Eldin etal.,2024).** Despite its benefits, children undergoing hemodialysis often suffer negative effects on dialysis days, such as muscle cramps, arrhythmia, nausea, vomiting, post-dialysis hypotension, and fatigue. With the lengthening of dialysis sessions, patients encounter different levels of physical, cognitive, and psychological impairments, greatly affecting their quality of life **(Fang, etal.,2025).**

Muscle cramps are a frequent complication encountered by HD children and are characterized by abrupt, painful and involuntarily contraction of a muscle, especially in the lower extremities **(Anbu& Rathiga,2021).** They occur suddenly during and in between HD sessions and may last from few seconds to several minutes, cramps commonly affect the calf, feet, toes and thigh muscles**.** Between 25% to 80% of adolescents receiving hemodialysis experience muscle cramps, which are a typical cause for interrupting a hemodialysis session early **(Takahashi,2021).** The causes of these cramps including hypotension caused by removing excess fluid during HD. Likewise, electrolyte imbalance, hypo-perfusion, tissue hypoxia, hyponatremia, hypomagnesaemia and, alterations in plasma osmolality are the common causes **(El-Said etal.,2023)**.

Fatigue is a significant symptom faced by hemodialysis patients, often largely ignored by healthcare professionals. Fatigue is a term describing a complex, multifaceted symptom, marked by an intense feeling of exhaustion, low energy, and reduced ability for physical and mental tasks that rest does not alleviate, moreover, fatigue affects life quality, emotional health, and daily self-care activities **(Mohamed etal.,2024)**.

Recently, numerous researches have indicated the importance of intradialytic exercises to relieve muscles wasting and fatigue among hemodialysis children. Intradialytic exercise is one of the most common

non-pharmacological treatments used to control muscular cramps **(Shalaan etal.,2024)**. According to the current literatures, stretching a muscle can decrease and alleviate muscle cramps, as it reduces muscle protein loss and maintains muscle functions. Also, it reduces the circulation stasis, which promotes solute elimination, blood flow, and the strength of the muscle, as well as improving oxygen diffusion, which promotes aerobic capacity **(Wayan, 2021).**

Similarly previous study by **Hatef et al, (2021) 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.

Pediatric dialysis nurse serves as a caregiver and advisor during HD sessions, playing a crucial part in addressing both immediate and ongoing challenges faced by children with ESRF and their families. Consequently, nursing actions focus on both preventing and addressing HD complications like muscle cramps and fatigue, as well as educating children on non-pharmacological care. Non-pharmacological approaches effectively reduce muscle cramps and fatigue; therefore, nurses play a crucial role in helping children on HD recognize options that can alleviate and address these issues, as medication can be expensive and linked to side effects or other medication-related complications **(Sabry et al., 2023)**.

Significance of the study

It is presently estimated that there are 18.5 to 100 instances of chronic renal failure in every million children worldwide, a number that has gradually climbed over the past 20 years. Adolescent mortality rates range from 30% to 100% greater than the general populations. The necessity for specialist care is highlighted by the brief lifespan of an adolescent under the age of 14 who is reliant on dialysis. According to statistics, there are 264 cases of children getting dialysis overall, 225 cases of CRF per million children in Egypt, and an estimated 74 occurrences of ESRD per year (**El-Said et al., 2024)**.

Numerous studies examine the great advantages of physical exercises for children receiving dialysis, similarly, a prior study in Egypt by **Salama et al., 2022**, evaluated the effects of intradialytic exercise on the biochemical results, fatigue, and psychological distress of 50 hemodialysis children at the pediatric hemodialysis unit at Menoufia University Hospital in Shubin El-Koom City. The study found that intradialytic exercise had a positive effect on the biochemical findings, psychological distress, and fatigue of hemodialysis children.

In Egypt, while all hemodialysis children report experiencing fatigue, depression, and muscle cramps, there has been limited research conducted to alleviate their complaints. Intradialytic exercises have been recognized as essential in enhancing muscular tissue flexibility and overall health and well-being in

children receiving hemodialysis, by facilitating physiological processes such as the restoration of skeletal muscle. Therefore, this study was done to evaluate the effect of intradialytic exercises on muscle cramps and fatigue among children undergoing hemodialysis. The researchers sincerely hope that the findings from the current study will offer evidence-based guidelines that can effectively enhance both nursing practice and research within the field of nephrology nursing.

Aim of the study

The aim of the present research was to evaluate the effect of intradialytic exercises on muscle cramps and fatigue among children undergoing hemodialysis

Research hypotheses: -

H0: Intradialytic exercises have no effect on muscle cramps and fatigue among children undergoing hemodialysis.

H1: Children undergoing hemodialysis who will practice intradialytic exercises will have lower muscle cramps level than before application.

H2: Children undergoing hemodialysis who will practice intradialytic exercises will have lower fatigue level than before application.

Research design: -

This study was carried out using a quasi-experimental research approach with one group (pre-posttest). Although it includes manipulating the independent variable without randomly assigning participants to conditions or the order of conditions, this kind of experimental design is quite similar to a real experimental design **(Grove & Gray, 2018)**

Settings:

This study was conducted at Minia University Hospital for Obstetrics and Pediatrics (MUHOP) in the pediatric hemodialysis units. The hemodialysis facility included four rooms accommodating 16 beds.

Sample:

A Convenience sample including all the available children (55) having known as end-stage renal disease undergoing hemodialysis over a period of three months.

Data collection tools

To collect the necessary data, two tools were used: -

Tool I: A Structured interview questionnaire, which included the following Parts:

Part I: Bio-demographic data related to children:-It encompassed the child's age, gender, residence, frequency and duration of hemodialysis sessions, the times when cramps occur, the muscles involved, and the limitations of movement and activity brought on by cramps.

Part II: Multidimensional Fatigue Scale:

Multidimensional Fatigue Scale for the Pediatric Quality of Life Inventory was taken from **Varni et al. (1998)**. This scale evaluates fatigue in pediatric patients and comprises 18 items categorized into three primary domains: general fatigue, sleep and rest fatigue, and cognitive fatigue, with six items in each category. A 3-point Likert scale will be employed, where 0 signifies

that a problem is never present; 1 indicates that a problem occurs sometimes, and 2 denotes that a problem is almost always present.

Scoring system:

- Mild fatigue= 0–12 score
- Moderate fatigue = 3–24 score
- Severe fatigue = 25–36 score

Tool II: Muscle cramps questionnaire:

It was adopted from **Basemath (2014)** to measure the severity of muscle cramps during hemodialysis. It rates the degree of cramping from 0 to 13 and takes into account various factors of muscular cramps, including frequency, duration, temperature, discomfort, and pain intensity.

Muscle cramp scoring system: a score of zero means there are no cramps, a score between one and four points suggests mild cramps, a score between five and eight points shows moderate cramps, and a score between nine and thirteen points indicates severe cramps.

Ethical considerations

The research proposal had been given approval by Minia University's Faculty of Nursing's ethical committee with code number (REC202553). Prior to the pilot study and the actual research, formal approval and consent were secured from the Dean of the Faculty of Nursing and the director of the aforementioned hospital. Written permission was secured from the parents of children who agreed to take part in the study, following an explanation of the study's intent and nature; participants had the right to decline participation and/or withdraw from the study at any moment without reason, and no health risks were involved. Participants were guaranteed that all their information is strictly confidential, and anonymity was ensured by assigning numbers to each child instead of using names to safeguard their privacy.

Validity

The tools were provided to five specialists in the Pediatric field to evaluate the content validity, including 3 experts from the Faculty of Nursing at Minia University and 2 experts from the Faculty of Medicine at Minia University. Tools were reviewed for topic coverage, items sequencing, clearness, relevance, applicability, format and length. Minor changes had been done such as rephrasing of certain sentences based on the suggestions of experts.

Reliability

The reliability of the study instruments was assessed through Cronbach's alpha coefficient test, showing tool I and tool II were dependable with r=0.776 and r=0.81, respectively.

Pilot Study: Once ethical approval was obtained and access to the hospital was granted, a pilot study was performed involving 10% (5) of the participants to assess the study procedure and evaluate the effectiveness of the tools used in the research. The required adjustment was made, and the pilot was added to the study sample.

Data collection procedure

The researchers provided the parents and their children with a straight-forward explanation of the study's

aim and the contents of the sheet, assuring them of the procedure's safety and encouraging them to take part. All pertinent ethical factors evaluated to guarantee the privacy and confidentiality of the gathered data by obtaining written consent from the parents of children involved in the study, explaining that they have the right to refuse to continue participation and the interview took place in the dialysis units. The data was gathered over a period of three months from early June 2025 to late August.

Before application of intradialytic exercises):

The researchers collected demographic data, medical data, muscle cramps level and fatigue level from children.

During Intradialytic exercises application: -

Where intradialytic exercises applied for them. The researchers interviewed each child and his/ her parent and explained how to do the intradialytic exercises by performing it while the child and his/ her parent watched them, the child was asked to re-demonstrate it and to perform the intradialytic exercises in the same way at home every day, the researchers used demonstration and re-demonstration for teaching and also, video recorded about intradialytic exercises, brochures and posters were used as the teaching method. The researcher visited the hemodialysis units three days a week.

The researchers instructed the child to do intradialytic exercises in the following steps:

The exercise session began within the first two hours of starting the dialysis once the child was connected to the machine and all alarms were turned off. **Intradialytic exercises** consisted of flexibility exercises; range-of-motion, resistance and relaxation were performed three times per week for 20-minutes over one month. Participants were instructed to take a deep inhale through their noses, hold it for a little while, and then softly exhale after five deep breathing exercises at the start of each exercise session. The child then started the flexibility exercises, which involved smoothly extending their muscles for ten seconds until a slight tension was felt.

Following five repetitions of this exercise, the child completed the range-of-motion exercise on their own. This activity involved raising and lowering the arm's shoulder without a shunt, moving it side to side, and then bending and straightening the elbow and wrist from up to down and side to side while rotating in both clockwise and counterclockwise directions. Next, rotate clockwise and counterclockwise while bending and straightening the knee joints and moving the ankle joints up and down from side to side. The researchers then assisted the child in performing the resistance exercise by using the child's wrist and ankle to pull and push the researcher's hand. At the end of each session, relaxation techniques were used. The children were told to stay quiet, close their eyes, and take five deep breaths. The

body portions connected to the dialysis machine were not exercised in order to prevent the needle from disconnecting; instead, the remainder of the body was physically active. The posttest was taken from each child one month after starting to practice the intradialytic exercises in the form of measuring muscle cramps severity and fatigue level for children undergoing hemodialysis using tool I &II

Statistical Analysis

Version 28 of the statistical program SPSS (Statistical Package for Social Sciences) was used to enter and analyze data. Excel was used to produce graphics. The Wilcoxon test was used to compare two Means before and after intradialytic workouts, and the Friedman test was used to compare more than two means. The quantitative data were given as mean and standard deviation (X ±SD). Frequency distribution tables were used to display the qualitative data, together with counts and percentages (No. & %). The chi-squared ($\chi 2$) test was used to analyze it. For all tests considered significant, the significance level was set at a P value of less than 0.05.Furthermore, the association between the total tiredness scores and the total muscle cramp scores prior to and following the intradialytic exercise technique tests was evaluated using a Spearman correlation test.

Results:

Table (1): Proves that, regarding to the child's age 60% of them their age ranged between10-<14 yrs., concerning education the study results proves that 58.2% of the studied children were in primary school, on the other hand; regarding residence 69.1% of the studied children came from rural area and 81.8% of the them receiving hemodialysis for more than 3 yrs. Concerning number of sessions per week 87.3% of the studied children received three hemodialysis sessions per week.

Regarding the time and the site of the child's experiencing muscle cramp 87.3%, 78%, respectively of the studied children experience muscle cramp in the last hour of dialysis and in both legs. On the other hand, the calf muscle cramp was experienced in 76.4% of the studied children and the muscle cramp restrict activity in 90.9% of them.

Figure (1): Reveals that; regarding child's gender the study results proved that; 67.6% of the studied children were male and 32.4% were female.

Table (2): Clears that the statistically significant differences were found between pre and post intradialytic exercises intervention among hemodialysis children in every item on the muscular cramp scale, including the frequency, duration of muscle cramp, leg temperature, discomfort and pain, p. value at .001.

Figure (2): Proves that 54.5% of the studied children experienced severe muscle cramp pre-intradialytic exercises compared to no one in post intradialytic exercises. Moreover; 14.5% of children had mild cramp pre- intradialytic exercises compared to 69.1% post- intradialytic exercises**.**

Table (3): Clarifies that; there were a reduction in the total mean score of general fatigue, cognitive and sleep/rest fatigue and total mean score of multidimensional fatigue scale in which the mean scores were 4.54 ± 1.74, 3.12 ± 1.82, 2.25± 1.35and 9.94± 3.79 respectively post-intervention compared to 9.03± 3.40, 8.16± 2.78, 9.47± 3.24 and 26.67± 8.31 respectively pre-intervention with statistically significant differences p. value at0.001

Figure (3): Proves that;74.5% of the studied children had severe fatigue pre- intradialytic exercise compared to 81.8% of them had mild fatigue after intradialytic exercise with highly statistically significant differences P. value at 0.001.

Table (4): Shows that, there were no statistically significant difference between the child's demographic data and muscle cramp except for gender before application of intradialytic exercises, the statistically significant differences were found at P. value at 0.01. But for medical data of children the statistically significant differences were found between the time experiencing muscle cramp in pre and post intradialytic exercise P. value 0.01and 0.04 respectively and also, the statistically significant differences were found between location of muscle cramp at pre-intradialytic exercises P. value 0.001, and the affected muscles of cramp with muscle cramp score P. value at 0.008 and0.01 respectively at pre and post-intradialytic exercises.

Table (5): Proves that; the statistically significant relations were found between total fatigue level and child's age, educational level, duration of hemodialysis, frequency of hemodialysis per week and time of experiencing muscle cramp post-intradialytic exercise application P .value at 0.0001.

Table (6): There were statistically significant fair positive correlation between total fatigue level and muscle cramp scale score r=0.625 P. (0.001**) post intradialytic exercise intervention.

Table (1):-Percentage distribution of the studied children according to their bio-demographic characteristics (n =55)

Bio-demographic characteristics of the studied children	No.=55	
	No	%
Child age in years:		
6- <10	5	9.1
10- <14	33	60.0
>14	17	30.9
Mean + SD	**12 ± 2.24 Years**	
Child education		
Primary school	32	58.2
Preparatory school	16	29.1
Secondary school	7	12.7

Residence:		
Rural	38	69.1
Urban	17	30.9
Duration of hemodialysis:		
<1yrs	2	3.6
1 -< 3 yrs	8	14.5
More than 3 yrs	45	81.9
Frequency of hemodialysis per week:		
Once	3	5.5
Twice	4	7.3
Three times	48	87.2
Duration of hemodialysis per session:		
4 Hours	55	100.0
Time experiencing muscle cramp:		
Middle hour	7	12.7
Last hour	48	87.3
Location of muscle cramp:		
Right leg	8	14.5
Left leg	4	7.3
Both legs	43	78.2
Affected muscles:		
Calf	42	76.4
Hamstring	6	10.9
Soleus	7	12.7
Cramp could restrict activity:		
No	5	9.1
Yes	50	90.9

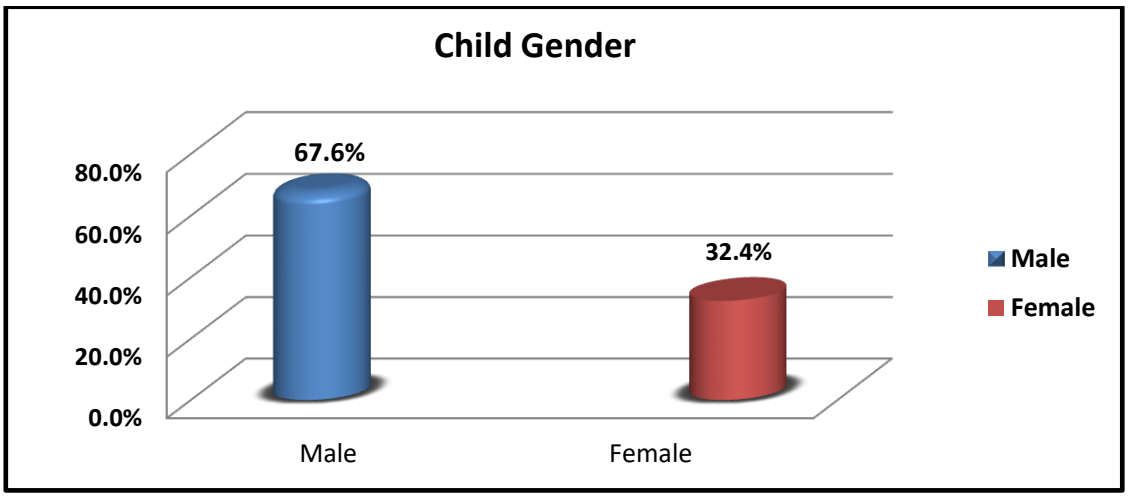

Figure (1): Percentage distribution of the studied children according to their gender (n = 55)

Table (2): Percentage Distribution of Muscle Cramps Scale items pre and post intradialytic exercises application among Children Undergoing hemodialysis (n = 55)

Muscle cramps scale items	Pre-intradialytic exercises application		Post-intradialytic exercises application		X^2	P-Value
	No	%	No	%		
Frequency of muscle cramps						
Not occur	7	12.7	40	72.7	52.64	**0.001****
Less than 3 times/hour	19	34.5	15	27.3		
More than 3 times/hour	29	52.8	0	0.0		
Muscle cramps duration						
Not occur	6	10.9	29	52.7	43.53	**0.001****
Less than 5 min	20	36.3	26	47.3		
More than 5 min	29	52.8	0	0.0		
Pain level						
No pain	3	5.5	38	69.1	67	**0.001****
Mild	15	27.3	17	30.9		
Moderate	31	56.4	0	0.0		
Severe	6	10.8	0	0.0		
Leg temperature						
Warm	5	9.1	43	78.2	55.6	**0.001****
Cold	38	69.1	12	21.8		
Calmmy	12	21.8	0	0.0		
Discomfort						
No	0	0.0	9	16.4	54.32	**0.001****
Perceptible	7	12.7	30	54.5		
Sensitive	17	30.9	16	29.1		
Painful	20	36.4	0	0.0		
Unbearable	11	20	0	0.0		

** =A highly statistically significant

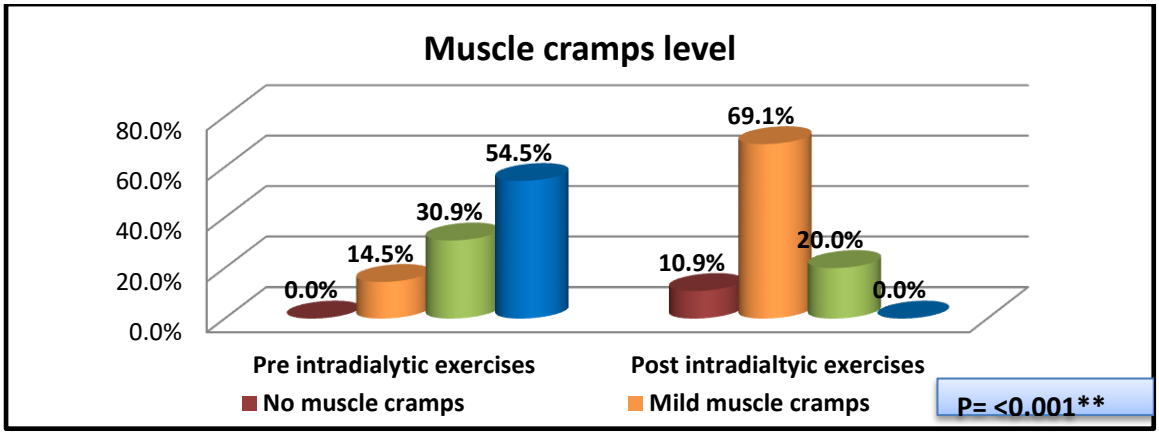

Figure (2): Total muscle cramps level pre and post intradialytic exercises application among children undergoing hemodialysis (n = 55)

Table (3): Total Mean score of Fatigue Scale domains pre and post intradialytic exercises application among children undergoing hemodialysis (n = 55)

Multidimensional Fatigue Scale domains	Pre intradialytic exercises	Post intradialytic exercises	P – value (Wilcoxon)
	Mean ± SD	Mean ± SD	
General Fatigue	9.03± 3.40	4.54 ± 1.74	<0.001** (8.71)
Sleep / Rest Fatigue	8.16± 2.78	3.12 ± 1.82	<0.001** (11.20)
Cognitive Fatigue	9.47± 3.24	2.25± 1.35	<0.001** (15.24)
Total score	26.67± 8.31	9.94± 3.79	<0.001** (13.57)

** =A highly statistically significant

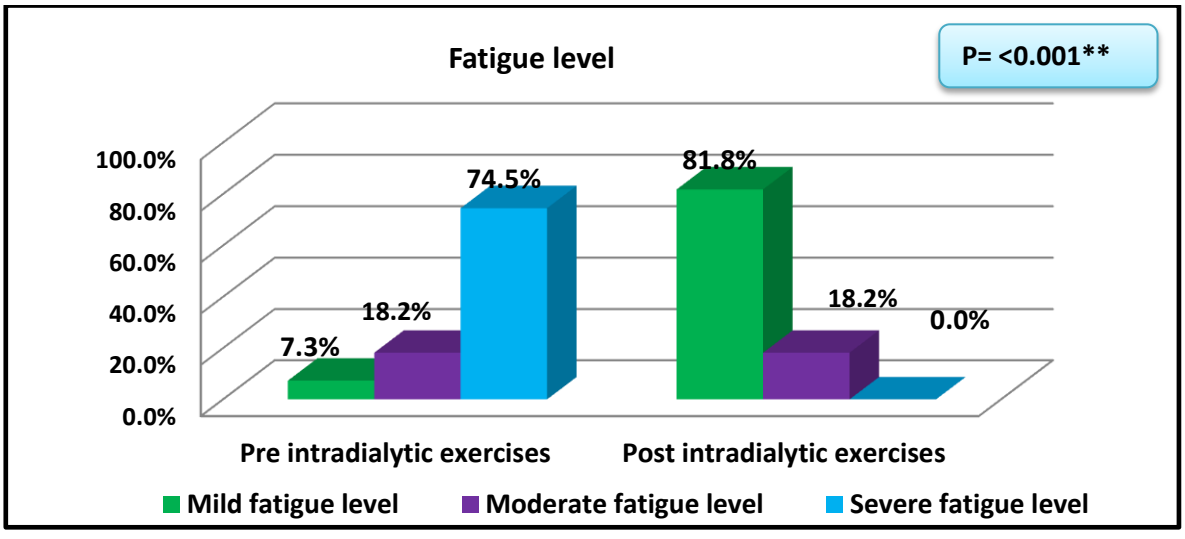

Figure (3) :Total fatigue level pre and post intradialytic exercises application among children undergoing hemodialysis (n = 55)

Table (4): Relation between the Bio-demographic characteristics of the studied children and Muscle Cramps Scale (n=55)

Bio-demographic characteristics	Pre-intradialytic exercises		Post -intradialytic exercises	
	Mean ±SD	Significance test	Mean ±SD	Significance test
Age (Years)				
6<10	7.6 ±1.9	Fri=0.16 P=0.84(NS)	1.0±0.0	Fri=0.20 P=0.64(NS)
10<14	8.3 ±2.8		2.12 ±1.6	
>14	8.1 ±2.4		3.5±1.8	
Gender				
Male	8.8 ±2.3	Mann-Whitney =2.41, **P=0.01***	2.4 ±1.9	Mann-Whitney =1.75, P=0.86(NS)
Female	6.9 ±2.6		2. 2 ±1.5	
Residence				
Rural	8.1 ±2.5	Mann-Whitney =0.27, P=0.78(NS)	2.1 ±1.8	Mann-Whitney =1.65, P=0.098(NS)
Urban	8.3 ±2.9		2. 9 ±1.5	
Educational level				
Primary school	8.5 ±2.9	Fri=1.34 P=0.32(NS)	2.1 ±1.7	Fri=1.08 P=0.29(NS)
Preparatory school	8.2 ±2.4		2. 8 ±1.8	
Secondary school	6.8 ±3.0		2. 4 ±1.8	
Duration of hemodialysis:				
<1	10.0±0.0	Fri =0.83 P=0.44) (NS)	1.0 ±0.0	Fri=3.1 P=0.07(NS)
1 -< 3	8.8 ±1.3		3. 2 ±2.18	
≥3	8.0 ±2.8		2. 3 ±1.7	
Frequency of hemodialysis per week:				
Once	8.6 ±2.5	Fri =0.39, P=0.67) (NS)	1.3±0.55	Fri=1.31 P=0.23(NS)
Twice	9.2 ±2.2		2.5±2.08	
Three times	8.1 ±2.6		2.4 ±1.8	
Time experiencing muscle cramp:				
Middle hour	6.0 ±3.1	Fri =6.30, **P=0.01***	1.0 ±0.0	**Fri=4.08 P=0.04***
Last hour	8.5 ±2.4		2. 6 ±1.8	
Location of muscle cramp:				
Right leg	5.1 ±1.7	Fri =8.5, P=**0.001****	1.0 ±0.0	Fri=0.23 P=0.63(NS)
Left leg	8.0 ±2.8		3.0 ±1.4	
Both legs	8.8 ±2.3		2. 6 ±1.8	
Affected muscles:				
Calf	8.6 ±2.4	Fri=5.30 **P=0.008****	2.7 ±1.7	**Fri=5.81 P=0.01***
Hamstring	5.1 ±2.6		1.6 ±1.6	
Soleus	8.8 ±2.3		1.0 ±1.4	
Cramp could restrict activity:				
No	6.8 ±1.6	Mann-Whitney =1.60, P=0.12(NS)	1.0 ±0.0	Mann-Whitney=1.80 P=0.08(NS)
Yes	8.3 ±2.6		2.5±1.80	

Fri- Friedman test , Mann-Whitney test

NS= Non statistically significant * =Statistically significant difference ** =A highly statistically significant

Table (5): Relation between the bio-demographic characteristics of the studied children and the total mean score of fatigue (n=55)

Socio-demographic characteristics	Pre-intradialytic exercises		Post-intradialytic exercises	
	Mean ±SD	Significance test	Mean ±SD	Significance test
Age (Years)				
6<10	28.0 ±4.18	Fri=0.16 P=0.85(NS)	8.6 ±3.04	**Fri=55 P=0.0001****
10<14	26.9 ±8.9		9.4 ±3.02	
>14	25.8 ±8.1		11.3±4.9	
Gender				
Male	26.9 ±7.1	Mann-Whitney=0.74 P=0.455(NS)	10.5±4.2	Mann-Whitney =1.77, P=0.07(NS)
Female	26.1 ±10.5		8.6 ±2.2	
Residence				
Rural	25.2 ±9.2	Mann-Whitney =2.16, **P=0.03**	10.5±4.0	Mann-Whitney =1.77, P=0.07(NS)
Urban	29.8 ±4.5		8.5 ±2.9	
Educational level				
Primary school	26.3 ±9.1	Fri=0.23 P=0.78(NS)	9.5 ±3.7	**Fri=51.04 P=0.0001****
Preparatory school	26.5 ±8.2		10.18±2.7	
Secondary school	28.7 ±3.4		11.1±5.8	
Duration of hemodialysis:				
<1	31.0 ±0.0	Fri =0.56, P=0.58(NS)	12.5±0.7	**Fri=54 P=0.0001****
1 -< 3	24.3 ±10.9		13.1±3.7	
≥3	26.8±7.9		9.2 ±3.5	
Frequency of hemodialysis per week:				
Once	29.0 ±3.0	Fri =1.83, P=0.31(NS)	8.3 ±2.5	**Fri=52 P=0.0001****
Twice	20.7 ±9.4		13.7±6.9	
Three times	27.0 ±3.0		9.7 ±3.4	
Time experiencing muscle cramp:				
Middle hour	27.1 ±5.2	Fri =0.025, P=0.87(NS)	8.8 ±4.2	**Fri=55 P=0.0001****
Last hour	26.6±8.7		10.1±3.7	
Location of muscle cramp:				
Right leg	28.8 ±4.5	Fri =1.41, P=0.25(NS)	8.3 ±4.4	Fri=1.77 P=0.18(NS)
Left leg	20.5 ±14.4		7.7 ±2.0	
Both legs	26.8±8.1		10.4±3.7	
Affected muscles:				
Calf	26.1±9.0	Fri=0.75 P=0.47(NS)	9.6 ±3.1	Fri=0.46 P=0.63(NS)
Hamstring	25.8 ±6.3		10.3±7.8	
Soleus	30.2 ±2.3		11.1±3.0	
Cramp could restrict activity:				
No	31.8 ±1.4	Mann-Whitney =1.95,**P=0.05***	10.2±3.0	Mann-Whitney=0.44 P=0.65(NS)
Yes	26.1±8.5		9.9 ±3.7	

Fri- Friedman test , Mann-Whitney test

NS= Non statistically significant * =Statistically significant difference ** =A highly statistically significant

Table (6): Correlation between total fatigue level and Muscle cramps Scale scores (n=55)

Fatigue Scale	Muscle cramps Scale	
	Pre – intervention	Post – intervention
Pre – intervention	0.056 (0.685)	
Post – intervention		0.625 (<0.001**)

**. Correlation is significant at the 0.01 level

Discussion

Regarding bio-demographic characteristics of children the present study findings clear that, concerning the child's age more than half of them, their age ranged between10-<14 yrs., and were in primary school. On the other hand, more than two thirds of the studied children came from rural area, the majority of them received hemodialysis for more than 3 yrs. and received three hemodialysis sessions per week.

Regarding age, the study result was agreed with the study done by **Ali & Mohamed (2023)** who studied the effect of intradialytic physical exercise on stress levels for children receiving hemodialysis they declared that half of the studied children their ages were 14-18 years. But the present study was contradicted with **Osman et al. (2023)** who assessed self-care program and its effect on the quality of life for children receiving hemodialysis, they documented that; two fifths of the studied children their ages were 12 years.

Current study results were congruent with **a** descriptive research design done by **Ali et al. (2024)** entitled assessment of stress and anxiety levels in hemodialysis children at Beni-Suef University Hospital's nephrology unit; they showed that; two third of the studied children their ages were 11-<15 years.

Regarding to the child's education, present study results were supported with the study by **Elfeshawy et al. (2024)**, they declared that two third of them attended primary schooling.

Regarding duration of hemodialysis, the present study results were congruent with the study done by **El-Said et al. (2023)** about intradialytic exercises program for nurses and its effect on cramping in the periphery of muscles and perfusion in children receiving hemodialysis, completed at the pediatric renal dialysis unit at Benha University Hospital stated that; more than half of the children were on hemodialysis for 3 years or longer, but the current study results were contradicted with the study done by **Mahmoud et al.(2022)** who studied non-pharmacological methods used to reduce discomfort and anxiety in children receiving dialysis carried out in the pediatric dialysis unit at Sohag University Hospital. They reported that half of the studied children received hemodialysis <2 yrs.

Regarding Frequency of hemodialysis per week, the study

results came in line with the study done by **Sayed et al. (2025)** about implementing an acupressure strategy to alleviate the effects of hemodialysis in children suffering from chronic kidney failure, conducted at the hemodialysis unit of Assiut University Children's Hospital, they reported that; three quarters of the children under study received hemodialysis three times per week. **Additionally,** the current study results were similar to the study done by **Abdelsamie et al. (2022)** they stated that; the majority of children received three dialysis sessions per week

Concerning gender of the studied children receiving hemodialysis, the current study findings revealed that; just more than two thirds of children under study were male. The study result was consistent with a randomized control trial conducted by **Mohamed et al. (2024),** who evaluate the effect of foot reflexology on sleep quality and fatigue for children in school-age undergoing hemodialysis, they reported that two-thirds of the children involved in the study were male. Also, the study results were consistent with a randomized control trial conducted by **Khalf-Allah et al. (2024)**, who assessed the stretching muscle and isometric exercises and their impact of on the quality of life for children undergoing continuous hemodialysis, they proved that; the majority of the children were male.

Regarding the time and the site, the child's experiencing muscle cramps the present study results proved that the majority and more than three quarters respectively of the studied children experienced muscle cramp in the last hour of dialysis and in both legs. On the other hand, regarding the affected muscle, the study results concluded that; more than three quarter of the studied children experienced calf muscle cramp and the muscle cramp restricted activity in most of them.

Regarding the time and the site, the child experiencing muscle cramp, current study results were congruent with the study by **Albadr et al. (2020)** their study investigated intradialytic hemodialysis exercises and their impact on leg cramps and fatigue, the researchers concluded that; a significant number of participants experienced muscle cramps during the final hour of hemodialysis, with more than half of patients reporting cramps in both legs.

Concerning the affected muscle and activity restriction by the muscle cramp, present study results were congruent with the Egyptian study by **El-Said et al. (2023)** proved that; muscle spasms were experienced in both legs in the majority of children, which included the calf muscles. Furthermore, the movement and activity were restricted in all children.

Regarding the **muscle cramps scale items,** the study results prove that statistically significant differences were found between pre and post intradialytic exercises application among hemodialysis children in all items of muscle cramp scale such as frequency and duration of muscle

cramp, pain level, temperature of the leg, and discomfort p. value at .001.

The present study findings were supported with the study by **El-Said, et al. (2023)** proved that there was a highly statistically significant difference between muscle cramps frequency and duration, level of pain, leg temperature and discomfort in the children under study before and after intradialytic exercises program implementation. Also, the study by **Al badr et al., (2020)** found that there was statistically significance difference as regard cramp questionnaire chart (frequency and duration of muscle cramps, leg temperature, level of pain and discomfort) pre and post intradialytic exercises application.

Regarding the total level of muscle cramps, the study results proved that more than half of children under the study experienced severe cramp pre-intradialytic exercises compared to no one in post intradialytic exercises. Moreover, minority of children had mild cramp pre intradialytic exercise compared to more than two thirds post-intradialytic exercises. The study results were consistent with **Jancy & Parimalas (2020)** concluded that ongoing intradialytic physical exercises can help prevent and diminish the muscle cramps occurrence during hemodialysis.

From the researchers' point of view intradialytic exercises can enhance muscle blood circulation that helps in reducing muscles cramps. Also, the study results ensure the role of the researchers' instructions which make children adhered to the exercises at home as the presence of the researchers in the unit and encouraging the children to re-demonstrate the exercises using videos and posters. ***The current study results accepted the first hypothesis***

Also; the study results were congruent with the study by **Abouelala& Khalil (2021)** who studied passive and active physical stretching exercises and their impact on managing cramped leg in patients receiving hemodialysis indicated that; over three-quarters and more than two- thirds of the patients examined who experienced severe muscle cramps prior to engaging in intradialytic exercises for the two examined groups, respectively. However, following the implementation of stretching exercises, more than half of the study group reported the absence of muscle cramps, in contrast to a minority of the control group with statistically significant differences p. value at (p= 0.001) between the study and control groups.

The study result also was in accordance with **Chandralekha & Mercy (2020) who** studied the effect of intradialytic stretching exercises on muscle cramps and fatigue indicated that there is a notable enhancement in the intensity of muscle cramps scores within the intervention group after intradialytic stretching exercises application.

Regarding the total mean score of fatigue, the study results proved that there was a reduction in the total mean score of cognitive fatigue, general fatigue, and sleep/rest fatigue

and total mean score of multidimensional fatigue scale in post-intradialytic exercises intervention group with statistically significant differences p. value at0.001.

The present study findings were supported with the Egyptian study by **Salama, et al.(2022)** whose study entitled the impact of intradialytic exercise on psychological distress, fatigue and biochemical results in children undergoing hemodialysis, Egyptian journal of health care, concluded that; the study group scored less mean scores of general fatigue, cognitive fatigue, and sleep/rest fatigue compared to control group after 4 weeks of intervention with highly statistically significant differences p. value 0.001.

Regarding the total level of fatigue among children, current study findings prove that; near three quarters of children under the study had severe fatigue pre- intradialytic exercises compared to the majority of them had mild fatigue after intradialytic exercises and the highly statistically significant differences were found at P. value at 0.001. **The current study results accepted the second hypothesis**

The current study findings were congruent with **Hamed and Abdel Aziz (2020)** who studied a randomized quasi-experimental study about the deep breathing exercise training and its impact on fatigue' level among patients undergoing hemodialysis, proved that; there were statistically significant differences in fatigue scores before and after the deep breathing exercise among regular hemodialysis patients in the study group.

From the researchers' perspectives, the children's eagerness and drive to combat fatigue, along with the guidance provided during follow-up calls to initially engage in light exercise for brief intervals and progressively extend the duration based on the children's tolerance, are likely contributing factors for the ongoing enhancements.

Regarding the relation between the children's bio-demographic data and total mean score of muscle cramp, the study findings cleared that, there were no statistically significant difference between the demographic data of child and muscle cramp except for gender before application of intradialytic exercise P. value at 0.01.But for medical data of children the statistically significant differences were found between the time experiencing muscle cramp in pre and post intradialytic exercise P. value at 0.01and 0.04 respectively and also, the statistically significant differences were found between location muscle affected muscle with cramp score P. value at 0.008 and0.01 respectively at pre and post-intradialytic exercise.

Present study results were contradicted with the study done by **Prageetha et al. (2023)** who studied the impact of intradialytic physical exercise on muscle cramps among patients receiving hemodialysis in a selected hospital at namakkal found that; there were no correlation between the demographic characteristics with the level of

muscle cramp at post-test among hemodialysis patients, also there were no association between the clinical data with the muscle cramps level of at post- test among hemodialysis patients.

The present study findings were congruent with **Kumari et al. (2024)** whose study entitled intradialytic stretching exercises: Its effect on lower limb muscular spasms in individuals undergoing routine hemodialysis revealed that; there was no significant association between the severity of muscle cramps and factors such as gender, age and the disease duration, or length of dialysis treatment in both the study and control groups. Furthermore, the same research identified a significant relationship between the intensity of muscle cramps in lower limb and the muscle cramps occurrence during daily activities, the experience of lower limb cramps while undergoing hemodialysis, the specific leg affected by the cramps, the extent to which cramps limited activities and movement, and the areas impacted by muscle cramps in the study and control groups P. value $p < 0.001$.

Concerning the relation between the children's demographic characteristics and fatigue the study results proved that the statistically significant association was found between the fatigue level and child's age, educational level, duration and, frequency of hemodialysis per week P .value at 0.001

Present study findings were congruent with the research done by **Alshammari et al. (2023) about** social support and its impact fatigue levels and sleep in patients undergoing hemodialysis in Saudi Arabia, they noted a significant correlation between the patients' age and their level of fatigue. Also, current study findings were congurent with the study done by **Ramadan et al. (2023)** about evaluation of fatigue and its determinants in children suffering from chronic renal disease stages III to V; found that an extended duration of hemodialysis correlates with an increased severity of fatigue experienced by pediatric CKD patients.

The present study results were disagreed with the study done by **Sułkowski et al. (2025) e**ntitled "fatigue in patients undergoing hemodialysis: a comparative study with healthy individuals they clarified that; male patients undergoing hemodialysis experienced higher levels of fatigue. In the same context, Hassen et al. (2024) demonstrated that; female hemodialysis patients exhibited severe fatigue scores compared to male.

Regarding correlation between total fatigue and muscle cramp level , current study findings proves that; there were statistically significant fair positive association between total fatigue and muscle cramp level r=0.625 P.(0.001) post-dialytic exercise intervention, these findings were consistent with the study by **Albadr et al.(2020)** cleared that; a positive association was found between the cramp questionnaire scale and the fatigue severity after two months of application of

intradialytic exercises. Also, the present study findings were consistent with the study by **Adhikary etal.(2022)** about the fatigue level and muscle cramps experienced by patients undergoing hemodialysis in a specific hospital, concluded that; very strong association was found between fatigue & muscle cramps.

Conclusion

Application of intradialytic exercises for children receiving hemodialysis was effective in reducing the total level of fatigue from near to three quarters of the studied children had severe fatigue pre-intradialytic exercise compared to the majority of them had mild fatigue after intradialytic exercises with highly statistically significant difference .Also, there was a reduction in the severity of muscle cramp from more than half of the children under study experienced severe cramp pre-intradialytic exercises compared to no one in post- intradialytic exercises. Also, statistically significant fair positive association was found between the total fatigue and muscle cramp level r= 0.625 (0.001) post-intradialytic exercise intervention.

Recommendations

- Nurses should be trained in the use of intradialytic exercises to lessen muscle cramps and fatigue during hemodialysis.
- The hemodialysis unit should be provided with booklets and brochures to convey the significance of intradialytic exercises for children.
- Intradialytic exercises should be adapted to be standard practice for the children receiving hemodialysis.
- The effects of intradialytic exercises on hemodialysis children's fatigue and muscle cramps should be further investigated by conducting comparable study with a bigger sample size and from other geographic locations.

References

Abdelsamie, E., Mansy, G., Khamis, G., Fathy, H. M., & Gaber, W. M. (2022). Effect of Acupressure on Thirst among Children Undergoing Hemodialysis. *Alexandria Scientific Nursing Journal*, *24*(1), 67-76.

Abouelala,F.,M.&Khalil,H.,K.,N.(2021). Effect of Passive and Active Stretching Exercises on Controlling Leg Cramps for Patients undergoing Hemodialysis. *Egyptian Journal of Health Care, 12*(1), 1549-1562.

Adhikary,T., Das,S., Ghosh,R, Deb,S., Agni,A., Saha,A., etal…(2022). A study to assess the level of fatigue & muscle cramp among the patients undergoing hemodialysis in a selected hospital, murshidabad International Journal of Interdisciplinary Research, 3(3)84-88.

Albadr, A. H., Azer, S. Z., Abd Elhamed, N., & Mostafa, N. M. (2020). Effect of intradialytic hemodialysis exercises on fatigue

and leg cramps. Assiut Scientific Nursing Journal, 8(20), 132-141.

Ali, A. B., & Mohamed, H. S. (2023). Effect of intradialytic physical exercise on stress level among hemodialysis children. Assiut Scientific Nursing Journal, 11(39), 28-37.

Alshammari, B., Alkubati, S. A., Pasay-An, E., Alrasheeday, A., Madkhali, N., Edison, J. S., ... & Alshammari, F. (2023). The influence of social support on sleep and fatigue level among patients receiving hemodialysis in Saudi Arabia: a cross-sectional correlational design. Frontiers in Psychology, 14, 1272500.

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

Basemath, S. (2014): Development and testing of Cramp questionnaire chart.

Chandralekha.C. Sa , & Mercy, (2020). Intradialytic Stretching Exercises on Fatigue and Muscle Cramps. *International Journal of Innovative Science and Research Technology, 5(11);* 947-52.

El-Said, R. R., Mohamed, A. H., & Abduallah, R. M. (2023). Effect of Intradialytic Exercises Program for Nurses on Peripheral Muscle Cramps and perfusion among Children Undergoing Hemodialysis. *Tanta Scientific Nursing Journal,* 31(4), 342-362

Elfeshawy, R., Mohamed Ahmed Ayed, M., Habib Sadek, E., Elsayed Bauomey Mohamed, E., & Abd-Elaziz Mohamed, E. (2024). Effectiveness of Eye Movement Exercise Application on Pain and Anxiety among Children undergoing Haemodialysis. *Egyptian Journal of Health Care, 15*(1), 2192-2211.

Fang, Y., Xiaoling, B., Huan, L., Yaping, G., Binying, Z., Man, W., ... & Xinyu, L. (2025). Effects of exercise dose based on the ACSM recommendations on depression in hemodialysis patients: a systematic review and meta-analysis of randomized controlled trials. *Frontiers in Physiology, 15,* 1513746.

Ghatas, A. A., Eldakhakhny, A. M., & Mohamed, B. M. (2020). Effect of Psychosocial Status of Children under Regular Hemodialysis on Their Quality Of Life. *Zagazig Nursing Journal, 16(*2), 29-45.

Grove, S. K., & Gray, J. R. (2018). Understanding Nursing Research E-Book: Building an Evidence-Based Practice.7th.ed. Elsevier Health Sciences.

Hamed. L, A., & Mohamed Abdel Aziz, T. (2020). Effect of Deep Breathing Exercise Training on Fatigue' Level among Maintenance Hemodialysis Patients: Randomized Quasi-experimental Study. *Egyptian Journal of Health Care*, 11(4), 634-644

Hassen, A. M., Zahran, A. M., Yassein, Y. S., Kasemy, Z. A.,

& El-ghorieb, A. S. (2024). Study of depression, anxiety and sleep quality as possible predictors of fatigue in regular hemodialysis patients. *Menoufia Medical Journal, 37*(1), 19

Hatef, M., Mousavinasab, N., Esmaeili, R., Kamali, M., Madani, Z., Spahbodi, F., & Shafipour, V. (2021). The Effects of Exercise Training on Physical Performance and Self-efficacy in Hemodialysis Patients: A Randomized Controlled Clinical Trial. *Iranian Journal of Nursing and Midwifery Research, 26*(1), 87.

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*(3), 1-6.

Kamal Eldin Ali, F., Sayed Abdelaziz, F., & Mohammed Elmawafie, S. (2024). Assessment of Anxiety and Stress Levels in Children Undergoing Hemodialysis. *Egyptian Journal of Health Care, 15*(1), 82-102.

Khalf-Allah, S. H., Ebrahim, H., Badawy, A., & Sayed, H. (2024). Effect of muscle stretching and isometric exercises on quality of life in children undergoing regular hemodialysis. *Pediatric Nephrology, 39*(11), 3289-3299.

Kumari, M. J., Kiruthika, S. R., Parameswaran, S., & Nisha, A. (2024). Effect of Intradialytic Stretching Exercises on Lower Limbs Muscle Cramps among Patients Undergoing Regular Haemodialysis. Nursing Journal of India, 115(2), 70-76.

Mahmoud, F., J., Mohamed Ahmed, S., Abdallah Mohammed, H., & Mohamed Ahmed Ayed, M. (2022). Non-pharmacological Strategies to Mitigate Pain and Anxiety among Children on Dialysis. *Egyptian Journal of Health Care, 13*(1), 1609-1625.

Mohamed, A. H., Shaban, M., Mohammed, H. H., Abobaker, R. M., Alsaqri, S. H., & Allam, R. A. E. M. (2024). The impact of foot reflexology on fatigue and sleep quality in school-aged children undergoing hemodialysis. *Journal of Integrative Nursing, 6*(2), 76-82.

Osman, D., Abusaad, F., Abu Salem, L. Y., & Gad, R. (2023). Effectiveness of Self-Care Program on the Health-Related Quality of Life for Children UndergoingHemodialysis. *Manso ura Nursing Journal, 10*(1), 1-10.

Prageetha,N.,Geetha,M.,Sumathi, M. (2023). A study to assess the effectiveness of intradialytic stretching exercise on muscle cramps among patients undergoing haemodialysis in a selected hospital at namakkal", ijnrd - *international journal of novel research and development (www.ijnrd.org), 4*(8) 194-c200,available :https://ijnrd.org/papers/ijnrd2304224.pdf

Ramadan, Y., Elkoofy, N., Sabry, S., Mansour, G., & El-Anwar, N. (2023). Fatigue assessment and its predictors in pediatric patients with chronic kidney disease stages III to V. *Egyptian Pediatric Association Gazette, 71*(1), 3.

Sabry Attia Hassan, A., Gad Soliman Ebrahem, G., Mustafa Abu Samra, O., & Atef Abed El-Magid Lawend, J. (2023). Effect of Nursing Intervention Using Reflexology Massage on Muscle Cramps and Fatigue among Adolescents Undergoing Hemodialysis. *Egyptian Journal of Health Care, 14*(1), 225-245

Salama, A., A Radwan, H., Ramzy Elfiky, E., & A Zayed, D. (2022). Effect of Intradialytic Exercise on Fatigue, Psychological Distress, and Biochemical Findings among Hemodialysis Children. Egyptian Journal of Health Care, 13(4), 1443-1457 https://doi.org/10.3390/sports10030042

Sayed, M. M., Ahmed, E. S., Mohamed, F. Z. M. Z., & Ali, A. B. (2025). Applying Acupressure Strategy to Mitigate Consequences of hemodialysis among Children with chronic renal failure. *Assiut Scientific Nursing Journal, 13*(48), 94-104**.**

Shalaan, K. F., Mohsen, M. M., & Elabbassy, A. A. (2024). Effect of Implementing Intradialytic Stretching Exercise on Reducing Muscle Cramps for Improving Quality of Life among Hemodialysis Patients. *Menoufia Nursing Journal, 9*(4), 191-215.

Sułkowski, L., Matyja, A., & Matyja, M. (2025). Fatigue in hemodialysis patients: a comparative analysis with healthy controls. *European Journal of Investigation in Health, Psychology and Education, 15*(2), 12.

Takahashi A. (2021). The pathophysiology of leg cramping during dialysis and the use of carnitine in its treatment. Physiological reports, 9(21), e15114.

Vaidya, S. R., & Aeddula, N. R. (2024). Chronic kidney disease. In StatPearls [Internet]. StatPearls Publishing.

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.

Wayan, D. (2021). Benefits of Intradialytic Exercise to Increase Muscle Strength, Prevent Muscle Mass Loss on Chronic Renal Failure Patients on Hemodialysis. *Jurnal keperawatan cikini, 2*(1).