

Impact of Range of Motion Exercise Program for Hemodialysis Nurses on Quality of Life for Children with End-stage Renal Disease undergoing Hemodialysis Therapy

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Abstract:

Health-related quality of life is a useful and important clinical measure in children with end-stage renal disease for monitoring their well-being; the hemodialysis (HD) nurse has an effective role in achieving this approach. Aim of this study was to evaluate the impact of range of motion exercise program for hemodialysis nurses on quality of life for children with end-stage renal disease undergoing hemodialysis therapy. The study utilized a quasi-experimental design. It was conducted at Adult and Pediatric Hemodialysis Units in Benha University Hospital. The sample included 32 nurses working at the previously mentioned settings and 34 children undergoing HD therapy. Data were collected through the following tools; the first tool a structured interviewing questionnaire tool for nurses which included: nurses' characteristics, assessment of nurses' knowledge regarding HD and range of motion (ROM) exercise, nurses' attitude toward application of ROM exercise program. The second tool was an observational checklist to assess nurses' performance regarding ROM exercise for children undergoing HD. The third tool involved: a) children's characteristics, b) Pediatric Quality of Life Inventory™ Version 4.0 scale. The study results concluded that, there were improvements in total mean scores of nurses' knowledge, performance and attitude after program implementation toward ROM exercise. As well as, there were statistically significant differences between the mean scores of children's QOL before and after implementation of ROM exercise program. The study recommended the integration of ROM exercise program in the routine care of children undergoing hemodialysis therapy.

Key words: End-stage renal disease, children, HD, QOL, range of motion exercise, nurses' role

Introduction:

End-stage renal disease (ESRD), the final stage of chronic kidney disease, is an incurable condition in which both kidneys function at <15%. Approximately 7,330 of pediatric patients, ages 0 to 18 years, are affected ⁽¹⁾. It is a devastating cause of morbidity and mortality in the pediatric population. Common etiologies for ESRD in this age group include congenital renal hypoplasia/dysplasia or obstructive uropathy, such as posterior urethral valves ⁽²⁾. However, in Egypt there is no regional registry collecting data on end-stage renal disease and its outcome ⁽³⁾.

End-stage renal disease (ESRD) presents substantial challenges to children's well-being, imposing deleterious effects on daily functioning both for the child and the family. It contributes to numerous sequelae in children including; growth retardation, cognitive delay, poor cardiovascular health, decreased exercise capacity, and decreased quality of life ^(4, 5). Fortunately, the treatment options for those children have increased or have become more effective such as center hemodialysis, home hemodialysis, peritoneal dialysis, and transplantation ^(6,7). Although transplant remains the treatment of choice to maximize survival, growth and development, 75% of children with ESRD require treatment

with dialysis prior to receive a kidney transplant ^(8,9).

Monitoring functional status and subjective state of well-being as it relates to health called health-related quality of life (HRQOL); it is of particular importance in children with ESRD. Levels of physical activity among hemodialysis children are low. Increased physical activity in this population has been associated with improved health-related quality of life and survival ^(10, 11). Although exercise can be a particularly daunting prospect for patients with end-stage renal disease but it improves their blood pressure control, cardiac function, lipid profiles and overall feelings of well-being as well as their quality of life. The key to maximize the benefits of exercise is to follow a well-designed program that accommodates patient's specific needs and abilities ⁽¹²⁾.

Range of motion (ROM) exercises are ones in which a nurse or patient move each joint through as full a range as is possible without causing pain and they are initiated as soon as the patient's condition permits ^(13, 14). However, range of motion exercise is a term which commonly used to refer to the movement of a joint from full flexion to full extension and aimed at improving movement of a specific joint which improve

patient' quality of life. This motion is influenced by several structures: configuration of bone surfaces within the joint, joint capsule, ligaments, tendons and muscles acting on the joint ⁽¹⁵⁾.

The positive effects of range of motion exercise reported in the general population may be highly relevant for ESRD patients. In addition to potentially reducing cardiovascular risk, exercise can improve physical functioning. The resulting improvements in physical functioning have the potential to improve quality of life in children with kidney disease, and to alleviate their feelings of being abnormal and isolated-even leading to better long-term outcomes, as it results in entrance of higher amounts of uremic toxins into vascular compartment by increasing muscle blood flow ^(16,17,18).

Nurses and dialysis staff are in an excellent position to encourage sustained physical activity via application of exercises program, as well as have the opportunity to act as health educator for dialysis patients. However, nursing care for the child with ESRD should be geared toward assessing, monitoring, and treatment of acute complications related to the disease process and improving their quality of life ⁽¹⁹⁾.

Significance of the Study:

Range of motion exercise program was considered a neglected aspect in pediatric HD unit and researches in Egypt generally and Benha city specifically although its importance, as good physical fitness is a prerequisite for promoting quality of life and can prolong survival of children with ESRD undergoing hemodialysis therapy. In addition, children do not have enough time to exercise as they dialyzed three times per week. So, the current study designed range of motion exercise program to be applied by the HD nurses for children with ESRD in order to improve their quality of life.

Aim of the Study:

The aim of the current study was to evaluate the effect of range of motion exercise program for hemodialysis nurses on quality of life of children with end-stage renal disease undergoing hemodialysis therapy, through the following objectives;

- Assessing level of nurses' knowledge, performance and attitude regarding range of motion exercises
- Assessing QOL of children with ESRD undergoing hemodialysis therapy
- Designing range of motion exercise program for hemodialysis nurses
- Implementing and evaluating the impact of range of motion exercise program on

QOL of children with ESRD undergoing hemodialysis therapy

Research Hypotheses:

1. Hemodialysis nurses' knowledge, performance and attitude mean scores toward application of range of motion exercises for children under hemodialysis therapy will be higher after receiving the program.
2. Quality of life mean scores of children with ESRD will be higher after implementation of range of motion exercise program by HD nurses than before.

Materials and Method

1. Materials

Research Design:

The current study utilized a quasi-experimental research design.

Setting:

The study was conducted at Pediatric and Adult Hemodialysis Units in Benha University Hospital, Benha city.

Sample:

A convenient sample of nurses (32) from the previously mentioned settings (all nurses "19" working at Pediatric Hemodialysis Unit and 13 nurse working at Adult Hemodialysis Unit) and 34 children with ESRD who met the following criteria;

- Children aged between 6-18 years.

- Children on a maintenance hemodialysis (HD) therapy for at least six months.
- Children who hadn't restricted activities such as; neurological disorders, handicapped, children with malignancies, etc.
- Children who will be able to participate in exercise program at least twice a week.

Ethical Consideration:

All nurses and children with ESRD were informed about the aim, tools and duration of the study. Verbal agreement was taken before data collection. The researchers informed all participants that the data will be strictly confidential and will not be used without their prior consent. Participants informed about their rights to withdraw from the study at any time without giving any reason.

Tools of Data Collection:

Three tools were developed for data collection.

Tool one: Data collection interview questionnaire sheet for nurses, it was developed by the researchers and contained three parts:

- a. **Part (I):** Nurses' socio-demographic characteristics. It contained age, level of education, job, years of experience in HD unit and attendance of training programs about range of motion exercise for

children undergoing hemodialysis therapy.

b. Part (II): Nurses' knowledge about; (1)- hemodialysis (15 items such as; definition, indications, complications, care provided for children under hemodialysis, etc.), (2)- knowledge about range of motion exercise (24 items such as; definition, types, time required for exercise, benefits of ROM exercise during hemodialysis, complications of ROM exercise during hemodialysis, warning signs of ROM exercise, role of the nurse, etc).

c. Part (III): Nurses' attitude toward application of ROM exercise in hemodialysis unit, it was composed from 22 items covering the following areas: before starting the procedure (10 items), during procedure (10 items), and after procedure (2 items).

Scoring system: For knowledge; complete correct answer=3, incomplete correct answer =2, and the wrong answer or the not known answer= 1, with a total score of 45 for HD and 72 for ROM exercise. Then nurses' responses were classified into three categories; poor <50%, average 50 > 75% and good knowledge $\geq 75\%$. Regarding nurses' attitude; the scores was distributed as the following; 5= strongly agree, 4= agree, 3= uncertain, 2= disagree and strongly disagree=1. Then the

scores of all items were summed-up and divided as the following: 0->37 negative attitude, 37->73 uncertain attitude, and 73- ≥ 110 was considered positive attitude.

Tool two: Observational checklist to evaluate nurses' performance during children's ROM exercise procedure. It was adopted from *DeLaune & Ladner, (2012)*⁽²⁰⁾ and translated into Arabic language. It was involved 31 items related to; preparation steps before starting ROM exercise session (4 items), warming up steps (6 items), main part about muscle stretching and strengthening (17 items) and the final part which included steps of relaxation (4 items).

Scoring system: As regards nurses' performance; 2= completely done, 1= incomplete done and the not done step= zero, with a total score of 62.

Tool three: a structured interview questionnaire sheet. It was developed by the researchers and involved the following;

a: Characteristics of children with ESRD under hemodialysis therapy, it was composed of 4 items about; age, gender, educational status and duration of hemodialysis.

b: Pediatric Quality of Life Inventory Version 4.0 (PedsQL 4.0) adapted from *Varni et al., (1999)*⁽²¹⁾, it was a modular instrument designed to measure health-related quality of life and disease-specific symptoms in children and adolescents aged 2-18 years and it

contained 30 items related to all domains. The scale encompasses the essential domains for pediatric HRQOL assessment: physical domain (8 items), emotional domain (5 items), social domain (5 items), school domain (5 items), well-being (6) items, and a global perception of overall health status (1 item). It was modified by the researchers by adding items from fatigue scale which was developed by *Chalder et al., (1993)*⁽²²⁾. The following items were be added; 4 items to physical domain which included "I need rest for long period of time, I feel disequilibrium, I've problem to start things and I feel weak" and 1 item to emotional domain "I lost interest in the things that I used to do". However, the scale was composed of 35 items and it takes approximately 10 minutes to be filled in.

Scoring system: A 5-point response scale is utilized: 0 = almost always a problem; 1 = often a problem; 2 = sometimes a problem; 3 = almost never a problem and 4 = never a problem) and the highest scores indicated better HRQOL.

Method

Written permission:

An official permission to conduct the current study was obtained from chairmen of the previous mentioned settings after simple explanation about the nature of the study.

Validity and reliability of study tools:

Data collection tools were revised by a panel

of five experts in the field of pediatric nursing, medical-surgical nursing, pediatric medicine and rheumatology and rehabilitation to test their content validity. Necessary modifications of the tools were done according to the panel of judgment on clarity of sentences and sequence of items. Regarding reliability, the reliability coefficients' alpha between questions was 0.6.

Pilot Study

The pilot study was done on 10% of HD nurses and children with ESRD under hemodialysis therapy to test the clarity of tools and the time required for data collection. Unclear items were clarified and the logic sequence of items followed.

Range of Motion Exercise Program:

The program was constructed by the researchers for HD nurses after reviewing all available literature concerning the topic of the study and based on their level of knowledge and performance toward ROM exercise for children with ESRD during hemodialysis therapy.

Data Collection Procedure

The first phase: The pre-program implementation data were collected from HD nurses and children after about one hour from the beginning of HD session and stability of children's health status to prevent work interruption. Each nurse was asked to fill the data collection tools individually (according

to their work place) to assure obtaining the unique awareness of every nurse, while data about children filled by the researchers. The time needed for each studied nurse ranged between 20-30 minutes and about 10 minutes for each child, this phase was done through four days/week and took about two weeks.

The second phase: The ROM exercise program, based on results of the first phase, was conducted by the researchers for HD nurses through eight sessions for four weeks as two sessions per week; each session lasted 35-50 minutes. The session included 2-4 nurses, between dialysis procedure, involved theoretical and practical part using lecture and discussion, illustrated booklet, video tape, role model, demonstration and re-demonstration for ROM procedure.

The third phase: implementation of ROM exercise program was conducted on children with ESRD by HD nurses through three sessions per day for two days per week for twelve weeks for each child. The session lasted 50-minutes or based on the child's condition, it was started by 10-minutes of warm-up period, 35 minutes of main part and ended with 5 minutes of relaxation exercises. The program was applied on children after the first hour of hemodialysis procedure. The arm with a-v shunt is relaxed and not activated during the exercise. ROM exercise started slowly and the intensity, number of

repetitions and exercise duration is gradually increased according to individual needs of each child. Shorter exercises were preferred at the early stages of intervention and children were informed to wear comfortable clothes. A maximum of five children participated in the program at the same dialysis session due to organizational reasons; vital signs of children were examined before and during exercise at least once. Implementation of the program was consulted with the assigned pediatrician and sometimes professor from rheumatology and rehabilitation

department. The researchers instructed HD nurses to stop program implementation when the child complains from; cramps, muscle pain or any other abnormal feelings.

The fourth phase: Evaluation of the impact of ROM exercise program on nurses' knowledge, attitude and performance (on children) was done immediately after sessions' completion for comparing changes by using the same pre-test tools. Meanwhile, the researchers evaluated children's quality of life by using the PedsQL 4.0 tool after twelve weeks from the program implementation or when each child took part in at least 20 sessions with no break longer than 3 weeks. The data collection started from March to December 2013.

Statistical design:

The collected data were categorized,

tabulated, and analyzed using the Statistical Package for Social Studies (SPSS), version (16). Numerical data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage and chi-square was used. Comparison of means was performed using paired t-test and analysis of variance (F-test), pearson correlation was used and level of significance was $P < 0.05$.

Results:

In relation to children's characteristics table (1) revealed that the mean age of them was 13.3 ± 3.4 years. Moreover, more than half (55.9%) of the studied children were males and enrolled in preparatory level. The same table reflected that mean score duration of hemodialysis therapy was 2.23 ± 0.88 years.

Concerning socio-demographic characteristics of the studied nurses, table (2) revealed that 62.5% of nurses their ages were more than 30 years with mean age 31.7 ± 9.1 year. Meanwhile, 68.7% of nurses were graduated from technical

institute of nursing and worked as bedside nurse, while half of them (50%) had from one to less than five years of experience in hemodialysis unit and all of them (100%) hadn't attended any training courses about ROM exercise in HD unit.

Regarding to quality of life of children with ESRD under hemodialysis therapy, table (3) proved that there were statistically significant

differences between physical, emotional, social, well-being functioning and global perception of overall health status in pre and post implementation of the ROM exercise program, ($P = 0.000, 0.000, 0.000, 0.038, 0.000, 0.000$ & 0.011 , respectively).

Table (4) represents a comparison of mean scores between children's QOL and their socio-demographic characteristics pre and post program implementation. It was clear that there were highly statistically significant differences in relation to children's education ($F = 18.185, P < 0.001$) and duration of hemodialysis ($F = 15.852, P < 0.001$). Meanwhile, the same table reflected that there was no statistically significant difference between children's QOL and their gender ($P > 0.05$).

Table (5) revealed that there was statistically significant difference between nurses' knowledge about HD during pre and post program implementation ($P < 0.05$), as 40.6% of the studied nurses had good knowledge pre program implementation while more than two thirds of them (71.9%) had good knowledge post program implementation. In relation to nurses' knowledge about ROM exercise, this table showed that there was no statistically significant difference during pre and post program implementation ($P = 0.160$). However, there were highly statistically significant differences in relation to total

nurses' knowledge during pre/post program implementation ($P<0.001$), where most of them (84.4%) had good knowledge and the minority of them (6.2%) had poor knowledge. Table (6) reflected distribution of nurses' performance regarding ROM exercise during hemodialysis session pre and post program implementation; it was clear that there were highly statistically significant differences related to preparation steps before starting exercise session, warming up steps for exercise session, main part (muscle stretching & strengthening) and final part (relaxation) ($P<0.001$). However, there were statistically significant differences regarding total nurses' performance pre and post program implementation ($P=0.032$).

Regarding to nurses' attitude toward application of range of motion exercise program for children with ESRD, it was evident from figure (1) that only 14.8% of the studied nurses had positive attitude pre program implementation which was improved post program implementation (66.7%). Meanwhile, about three quarters (74.1%) of nurses had negative attitude toward application of range of motion exercise procedure pre program implementation which was improved post program implementation to be 7.4% only of them.

Table (7) showed correlation between nurses' knowledge, performance and attitude in

relation to children's QOL, it was revealed that there were a highly statistically significant correlation between them pre and post program implementation ($r=0.866, 0.927, 0.758$ pre program implementation respectively; $r=0.754, 0.662, 0.438$ post program implementation respectively; $P<0.001$).

The current study results revealed that there were highly statistically positive correlation between nurses' knowledge, performance and attitude and their age, level of education and years of experience ($P<0.001$).

Table (1): Percentage Distribution of Children undergoing Hemodialysis Therapy regarding their Characteristics

Characteristics	(n=34)	
	No.	%
Age (in years):		
▪ 6 -<12	11	32.4
▪ 12 -≤ 18	23	67.6
Mean ± SD	13.3 ± 3.4	
Gender:		
▪ Male	19	55.9
▪ Female	15	44.1
Education:		
▪ Primary school	7	20.6
▪ Preparatory school	19	55.9
▪ Secondary school	8	23.5
Duration of hemodialysis therapy:		
▪ One year	10	29.4
▪ Two years	6	17.7
▪ Three years & more	18	52.9
Mean ± SD	2.23 ± 0.88 years	

Table (2): Percentage Distribution of the Studied Nurses regarding their Socio-demographic Characteristics

Characteristics	(n=32)	
	No.	%
Nurses' age(in years)		
▪ < 20	7	21.9
▪ 20-< 30	5	15.6
▪ ≥30	20	62.5
Mean± SD	31.7 ± 9.1	
Level of education:		
▪ Diploma nurse	8	25.0
▪ Technical institute of nursing	22	68.7
▪ Bachelor degree of nursing	2	6.3
Nursing job:		
▪ Bedside nurse	22	68.7
▪ Nurse supervisor	4	12.5
▪ Head nurse	6	18.8
Years of experience in heamodialysis unit:		
▪ <1 year	9	28.1
▪ 1-<5 years	16	50.0
▪ ≥ 5years	7	21.9
Mean± SD	1.92 ± 0.72	
Training courses about ROM exercise:		
▪ No	32	100.0

Table (3): Total Mean Scores of Children's QOL during Pre/Post Program Implementation

Items	(n=34)		t-value	P-Value
	Pre-implementation	Post-implementation		
	Mean ± SD	Mean ± SD		
Physical functioning	14.64± 3.67	19.91±6.37	4.17	0.000**
Emotional functioning	8.00 ± 4.17	17.32 ± 4.32	22.571	0.000**
Social functioning	5.79 ± 1.49	11.02 ± 2.12	11.75	0.000**
School functioning	8.59 ±1.67	11.05 ± 7.04	2.158	0.038**
Well-being	12.32 ± 5.45	18.41 ± 3.83	5.32	0.000**
Global perception of overall health status	1.64 ± 1.04	2.91 ± 0.67	5.96	0.000**
Total mean score of QOL	77.97 ± 4.14	86.47 ± 18.41	2.62	0.011*

*P<0.05----- statistically significant

**P<0.001 ---- highly statistically significant

Table (4): Total Mean Scores of Children's QOL during Pre/Post Program Implementation and their Socio-demographic Characteristics

Items	(n=34)		Test of significance	P-value
	Pre-implementation on Children's QOL	Post-implementation on Children's QOL		
	Mean±SD	Mean±SD		
Gender:				
• Male	75.15±16.24	78.21±3.44	t=1.91	>0.05
• Female	77.66±5.01	100.80±8.16		
Educational level:				
• Primary	57.42±4.27	79.00±.00	F=18.185	<0.001*
• Preparatory	76.57±5.04	89.00±9.54		
• Secondary	80.37±1.59	105.87±7.64		
Duration of hemodialysis:				
• 1 year	61.70±8.45	79.00±.00	F=15.852	<0.001*
• 2 years	79.00±.00	87.16±4.99		
• 3 years & more	77.05±5.60	100.00±7.64		

*P<0.001----- highly statistically significant

Table (5): Distribution of the Studied Nurses' Knowledge regarding Hemodialysis and ROM Exercise during Pre/Post Program Implementation

Items	(n=32)												t	P-value
	Pre- Implementation						Post- Implementation							
	good		average		poor		good		average		poor			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Knowledge about HD	13	40.6	9	28.1	10	31.3	23	71.9	6	8.8	3	9.3	14.64	0.005*
Knowledge about ROM exercise	2	6.2	16	50.0	14	20.8	23	71.9	7	21.9	2	6.2	6.57	0.160
Total nurses' knowledge	20	62.5	5	15.6	7	21.9	27	84.4	3	9.4	2	6.2	21.16	0.000**

*P<0.05 ---- statistically significant

**P<0.001---- highly statistically significant

Table (6): Distribution of the Studied Nurses' Performance regarding ROM Exercise Pre/Post Program Implementation

Items	(n=32)				X ²	P-value
	Pre-test		Post-test			
	No.	%	No.	%		
Preparation steps before starting exercise session:	0	0.0	23	71.8	43.81	0.000**
▪ Completely done	6	18.7	9	28.1		
▪ Incompletely done	26	81.3	0	0.0		
Warming up steps for exercise session:	3	9.3	23	71.9	33.33	0.000**
▪ Completely done	4	12.5	5	15.6		
▪ Incompletely done	25	78.2	4	12.5		
Main part (muscle stretching & strengthening):	0	0.0	21	65.6	30.64	0.000**
▪ Completely done	10	31.2	7	21.9		
▪ Incompletely done	22	68.8	4	12.5		
Final part (relaxation):	0	0.0	27	84.4	46.00	0.000**
▪ Completely done	8	25.0	5	15.6		
▪ Incompletely done	24	75.0	0	0.0		
Total nurses' performance	3	9.3	18	56.3	10.56	0.032*
▪ Completely done	8	25.0	9	28.1		
▪ Incompletely done	21	65.7	5	15.6		

*P<0.05 ---- statistically significant

**P<0.001---- highly statistically significant

Fig. (1): Distribution of the Studied Nurses' Attitude toward Application of ROM Exercise for Children undergoing Hemodialysis Therapy (n=32)

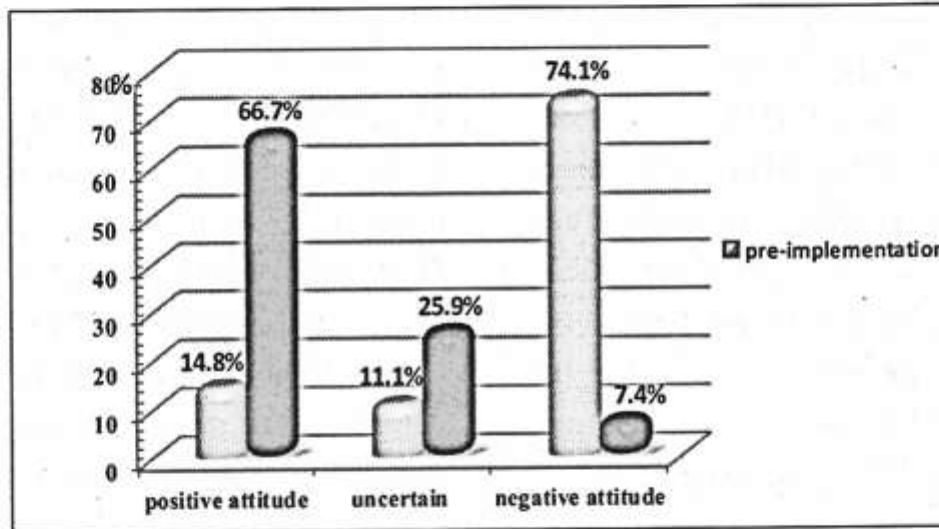


Table (7): Relation between Nurses' Knowledge, Performance and Attitude with children's QOL

Items	Pre-Implementation Children's QOL		Post-Implementation Children's QOL	
	R	P	r	p
Nurses' knowledge	0.866	.000	0.754	.000*
Nurses' performance	0.927	.000	0.662	.000*
Nurses' attitude	0.785	.000	0.438	.000*

*P<0.001----highly statistically significant

Discussion:

The hemodialysis (HD) nurse has a pivotal role in managing the care of patients with ESRD. Under general supervision of the attending physicians of the patient care manager, the nurse provides ongoing care to most dialysis patients, coordinating care delivered by other members of the healthcare team, teaching patients and families, and facilitating patient's satisfaction. The HD nurse should possess specialized knowledge and clinical skills necessary to provide expert care and consultation for a wide variety of adult and pediatric dialysis patients and their families⁽¹⁹⁾. So, the aim of the current study was to evaluate the impact of range of motion exercise program for hemodialysis nurses on quality of life for children with end-stage renal disease undergoing hemodialysis therapy.

Concerning children's characteristics, the current study results revealed that their mean age was 13.3 ± 3.4 years and more than half of them were males. This finding was supported by *Kul et al., (2013)*⁽¹¹⁾ who investigated "quality of life in children and adolescents with chronic kidney disease: comparative study between different disease stages and treatment modalities" and they found that the mean age of cases was 12.6 ± 2.2 years and 60% of them were male while 40% were female.

As regards characteristics of the studied nurses, the results of the current study revealed that their mean age was 31.7 ± 9.1 years, the highest percentage of them work as a bedside nurse and about half had from one to less than five years of experience in hemodialysis unit. In this regard *Mostafa (2009)*⁽²³⁾ in the study carried out about "improve the quality of nurses' performance to provide client satisfaction in kidney dialysis" revealed that the age group of the studied nurses was between 25- < 30 years and most of them had diploma degree and work as staff nurse. In addition, the current study result was agreed with *Keyser, (2011)*⁽²⁴⁾ in the study done about nephrology nurses' job satisfaction in chronic hemodialysis outpatient and reported that 6.1% of RNs were employed as a patient care technician prior to become a nephrology nurse, 55.6% flagged their position as staff nurse and 93.9% have 3-6 years of previous patient care technician experience in HD field. However, *Health Resources and Services Administration [HRSA], (2010)*⁽²⁵⁾ reported that the median age of renal nurses (RNs) was 46 years old, 95 RNs (66%) reported previous experience of 0-10 years; while 28 RNs (19.4%) reported previous experience of 11-20 years; and 21 RNs (14.6%) reported previous experience of 21 years or more.

The present study showed that, children's QOL mean scores before program implementation were low related to all QOL domains (physical, emotional, social, school, well-being, and a global perception of overall health status). The current study finding was agreed with *Abd El-Tawab, (2010)*⁽²⁶⁾ who studied factors affecting quality of life for adolescents undergoing hemodialysis and found that most of children undergoing hemodialysis had poor scores regarding to their quality of life. On contrary, *Mahmoud (2008)*⁽²⁷⁾ who investigated "needs assessment of children undergoing hemodialysis therapy" revealed that more than two thirds of children hadn't problems when dealing with their family members regarding social domain which reflects that not all QOL domains were poor.

However, the present study demonstrates that there was a statistically significant improvement in QOL for children with ESRD undergoing hemodialysis therapy after implementation of ROM exercise program. This improvement may be due to the direct beneficial effects of range of motion exercise children's QOL. The finding supported by *Storer, (2013)*⁽²⁸⁾ who emphasized that exercise training in patients with advanced chronic kidney disease (CKD) and undergoing hemodialysis therapy demonstrated benefits with regard to improve

physical performance, reduce risk of adverse events, and improve quality of life, so it should be a priority in the usual care of patients and should be considered part of routine therapy. As well, the finding of this study supported by *Sakkas et al., (2008)*⁽²⁹⁾ who studied intradialytic aerobic exercise training and they found an improving pattern for quality of life during 8 weeks of exercise among patients suffering from chronic hemodialysis. In this regard *Makhlough et al., (2012)*⁽³⁰⁾ proved in the study done about "effect of intradialytic aerobic exercise on serum electrolytes levels in hemodialysis patients" that aerobic exercise during hemodialysis improves the general health status for patients and their quality of life. The finding contradicted with the study carried out by *Mortazavi et al., (2013)*⁽³¹⁾ about "aerobic exercise improves signs of restless leg syndrome in end stage renal disease patients suffering chronic hemodialysis" and they mentioned that there is no a significant impact of aerobic exercise on quality of life between chronic hemodialysis patients and those in control group.

The current study results reflected that the mean total scores of nurses' knowledge regarding hemodialysis and ROM exercise before program implementation was low. This may be due to absence of training program in this field. This result agreed with the study

done by **Mohammed, (2012)** ⁽³²⁾ who "assessment of nurses' knowledge and practice about hepatitis C virus infection in children under hemodialysis" and found that more than two thirds of the studied nurses had poor knowledge about hemodialysis.

However, the finding of the current study proved that there was an improvement in the mean total scores of nurses' knowledge after program implementation and there was a highly statistically significant difference with children's QOL. These findings reflected the positive effect of the program in acquiring nurses with knowledge which in turn affects their performance. These results supported by **Altmann, (2008)** ⁽³³⁾ who stated in study about "nurses' attitudes towards continuing formal education: a comparison by level of education and geography" that quality health care is a priority. So, nurses need the scope and depth of knowledge, skills and judgment attained through continuing education courses in order to provide optimal quality care to complex patients. In the same line **Murray, (2013)** ⁽³⁴⁾ who stressed that improving participation in continuing education activities among long-term care nurses will expectantly lead to improve quality of care and patient's outcomes.

Regarding to nurses' performance, the results of the current study revealed that there were highly statistically significant differences

between all steps of range of motion exercise procedure pre and after program implementation. This may be due to the fact that the program makes refreshment in nurses' knowledge, which in turn led to improvement in their performance. This finding goes in line with **Mohamed, (2009)** ⁽³⁵⁾ who reported in the study done about "nursing role toward patients undergoing liver biopsy: A suggested training program" that nurses who had poor levels of knowledge and/or skills before the exposure to a training program underwent a significant improvement after the implementing of the program but this improvement usually decreased by time. This result also was agreed with **Abd-Alla, (2010)** ⁽³⁶⁾ who documented that the in-services training program has a beneficial effect in improving the nurse's knowledge and skills. **Batrof & Mansour (2012)** ⁽³⁷⁾ mentioned that continuing education for nurses is required to maintain competence in practice. **Friese et al., (2012)** ⁽³⁸⁾ added that continuing education must result in practice change to be effective and integration of knowledge occurs when information is combined with performance.

The current study results reflected that two thirds of the studied nurses have positive attitude toward application of ROM exercise program for children under hemodialysis after program implementation. This may be due to

most of nurses are becoming oriented about the importance and effect of ROM exercise on improving children's quality of life which in turn reflects their keenness on the general health status of children. Altmann (2008)⁽³³⁾ and Hayajneh, (2009)⁽³⁹⁾ mentioned that the nature of nurses' attitudes toward continuing education have an impact on their participation in continuing education. A positive attitude enhances nurses' professional growth, self-development as well as improves patients' quality of life. This was asserted by the finding of the current study that there was a highly statistically significant difference between nurses' attitude and children's QOL.

Apparently, the present study findings proved that there were positive correlations between nurses' knowledge, performance and attitude in relation to their age, level of education and years of experience. This result was in agreement with Ahmed & Jalel, (2011)⁽⁴⁰⁾ who reported a statistically significant correlation between nurse's performance scores and their level of education. Recently, the study carried out by Ragab et al., (2013)⁽⁴¹⁾ about "effect of designed training program on nurse's performance regarding care of patient with blood borne Viral Hepatitis at Assiut University Hospital" and clarified that age and years of nurses' experience were positively correlated with total knowledge and

practice scores through immediate post three and nine months post implementing of the training program.

Conclusion

The present study concluded that, there were an improvement in nurses' knowledge, performance and attitude in relation to range of motion exercise after implementation of the program, which in turn caused significant improvement in QOL for children with end stage renal disease undergoing hemodialysis therapy.

Recommendations

Based on the results of the current study, the following recommendations were reached: continuous training and encouragement for HD nurses to apply ROM exercise for hemodialysis children. Replication of this study on different settings should be done to be able to generalize its benefits. Provision of health education programs, handouts and booklets for children and their caregivers to disseminate importance of ROM exercise for their health and integration of ROM exercise program in the routine care of children undergoing hemodialysis therapy.

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