Effect of Progressive Muscle Relaxation on Fatigue and Sleep Quality in Children Undergoing Hemodialysis

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Abstract

Background: *Fatigue and poor sleep quality are more common in children undergoing hemodialysis (HD) than in other healthy children. The management of fatigue and sleep disorders using chemical drugs is mainly costly and associated with medication's side effects, it is necessary to seek out appropriate complementary alternative treatments such as progressive muscle relaxation (PMR).* ***Objective:****To investigate the effect of progressive muscle relaxation on fatigue and sleep quality in children undergoing hemodialysis.* ***Setting:*** *The study was carried out at Smouha Children's University Hospital (SCUH) in Alexandria, Egypt.* ***Subjects:*** *A convenient sample of 30 children having an end-stage renal disease (ESRD) undergoing HD who fulfill the following criteria was included: their age ranged from7-15 years old, undergoing HD for at least six months and free from other diseases such as neurological diseases, cerebrovascular accident or mental illness.* ***Tools:*** *three tools were used:"socio-demographic, physiological parameters and medical history of children undergoing hemodialysis structured interview schedule","Pediatric Quality of Life Inventory (PedsQL) Multidimensional Fatigue Scale" and "Pittsburgh Sleep Quality Index (PSQI) Scale".* ***Results:*** *the result of the current study revealed that, 46.7% of the studied children were aged from 10-12 years.The study showed that the mean percentage score of the overall Pediatric Quality of Life Inventory Multidimensional Fatigue Scale was higher after the application of PMR (84.35 ± 5.80%) which indicate less fatigue, compared with the mean score before (65.09 ± 9.01%) and the difference between before and after was statistically significant (p= <0.001*). Moreover, the mean percentage score of the overall Pittsburgh Sleep Quality Index Scale was lower after application of PMR (14.60 ± 6.49%) which indicate better sleep quality, compared with 30.63 ± 9.98% before application of this technique and the difference between before and after was statistically significant (p= <0.001*).* ***Conclusion:*** *progressive muscle relaxation has significantly decrease fatigue and improve sleep quality* among children undergoing hemodialysis. **Recommendations:** Establishment of hospital administration policies and protocol for non-pharmacological management particularly PMR are recommended to reduce fatigue and improve sleep quality.

Keywords: Progressive Muscle Relaxation, Fatigue, Sleep Quality, Hemodialysis, Children.

Introduction

Chronic kidney disease (CKD) is a major public health problem worldwide. It refers to a condition related to irreversible kidney damage that can gradually progress to ESRD (Alexander et al., 2020). Worldwide, more than 30 in every 100.000 children are suffering from CKD each year and the rate increases with age (Naritata et al., 2017).

Hemodialysis is the most common type of renal replacement therapy used for children

with ESRD. Children undergoing HD may face some physical complications such as headache, vomiting, muscle cramps, fatigue, insomnia and psychomotor problems (Sou'ub et al., 2018).

The fatigue commonly occurs in patients with stage five-CKD due to the uremia, HD itself and other co-morbid conditions. Prescribed drugs and their adverse effects, nutritional deficiencies, and physiological changes, particularly abnormal urea and hemoglobin levels are all co-morbidities that affect children with CKD (Artom et al., 2014). Poor sleep quality in children undergoing HD results from uremic and non-uremic factors such as metabolic factors, low production of melatonin and circadian rhythm disruption. The hemodialysis procedure itself may be a factor that leads to poor sleep quality and has a negative impact on quality of life and health status (Sayed & Younis, 2016).

Several complementary alternative therapies have proven to be effective in dealing with the fatigue and poor sleep quality such as progressive muscle relaxation (PMR). Progressive muscle relaxation includes voluntary continuous, systematic stretching and relaxation of various muscle groups. It is used to control stress and anxiety. Moreover, relieve insomnia, reduce symptoms of certain types of chronic pain, enhance the ability to cope and improve quality of life. It is based upon the simple practice of tensing one muscle group at a time followed by a relaxation phase with the release of the tension (Tsai et al., 2021).

Pediatric nephrology nurses play a critical role in empowering children undergoing HD to properly manage their disease and maximize the benefit of progressive muscle relaxation. They also have multi-dimensional roles in a strategic position to assess dialysis-related fatigue and poor sleep quality and develop strategies for managing their effects (Healthwise, 2020).

Aim of the Study

This study aims to investigate the effect of progressive muscle relaxation on fatigue and sleep quality in children undergoing hemodialysis

Research hypotheses

- Children undergoing hemodialysis who are subjected to progressive muscle relaxation exhibit less fatigue symptoms than those who do not.
- Children undergoing hemodialysis who subjected to progressive muscle relaxation exhibit better sleep quality than those who do not.

Materials and Method

Materials

Design: A quasi-experimental one-group pre-test- post-test research design was employed.

Settings: The study was conducted at the hemodialysis unit at SCUH in Alexandria. Egypt. The hemodialysis unit consists of two rooms with a capacity of 12 beds.

Subjects: A convenient sample of 30 children having ESRD undergoing HD who fulfill the following criteria was included: their age ranged from7-15 years old, undergoing HD for at least six months and free from other diseases such as neurological diseases, cerebrovascular accident or mental illness. The study sample was estimated based on Epi Info program which is used to estimate the sample size using the following parameters: total sample size within 3 months =33, expected frequency = 50%, acceptance error = 10%, confidence coefficient = 95%, current study sample size = 30.

Tools: In order to collect the necessary data for the study three tools were used:

Tool I: Socio-demographic, Physiological Parameters and Medical History of Children Undergoing Hemodialysis Structured Interview Schedule: This tool was developed by the researcher after reviewing related literature (Sayed &

Younis, 2016; Murtadho et al., 2019). This tool was used to assess socio-demographic, physiological parameters and medical data of children undergoing HD. **It consists of three parts:**

Part 1: Socio-demographic Data: Child's age, gender, educational level, residence and mother's/ child's phone number.

Part 2: Physiological parameters: Child's vital signs and oxygen saturation.

Part 3: Medical History: children's data about their disease and family medical history.

Tool II: Pediatric Quality of Life Inventory (PedsQL) Multidimensional Fatigue Scale: This tool was developed initially by Smets et al. (1995) and translated into Arabic Version by Haggag and Soliman (1997) and the researcher used the translated version to assess fatigue for the subject .

The scale comprises 18 items and 3 subscales: General Fatigue, Sleep/Rest Fatigue and Cognitive Fatigue.

The format, instructions, Likert response scale and scoring method are identical to the PedsQL 4.0 Generic Core Scales, with higher scores indicating a better health-related quality of life (lower fatigue symptoms). A five-point Likert scale was used to evaluate the responses in which (zero= never a problem; one = almost never a problem; two= sometimes a problem; three= often a problem; four= almost always a problem).

Items are reverse-scored and linearly transformed to a 0–100 scale as following: (0 = 100-76, 1 = 75-51, 2 = 50-26, 3 = 25-1, 4 = 0).

Tool III: Pittsburgh Sleep Quality Index (PSQI) Scale: This tool was developed initially by Buysse et al. (1989) and translated into Arabic Version by Suleiman et al. (2010) and the researcher used the translated version to assess sleep quality for the subject .

Nineteen individual items generate seven "component" scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction.

Each item is weighted on a 0–3 interval scale. In all cases, a score of "0" indicates no difficulty, "1" some difficulty, "2" difficulty, while a score of "3" indicates severe difficulty.

The sum of scores for these seven components yields one global score, with a range of 0 to 21 points, "0" indicating no difficulty and "21" indicating severe difficulties in all areas.

Reliability of the tools was tested using Cronbach's Alpha test. The reliability coefficient was 0.827 for tool I, 0.90 for tool II and 0.81 for tool III.

A pilot study was carried out on 10% of the study sample to test the clarity and applicability of the research tools.

The study was conducted as following: Each child and his/ her parent were interviewed individually, contracted and informed about the aim of the study to obtain informed consent.

A structured interview schedule using **Tool I** was used. The child's fatigue was assessed by the PedsQL Multidimensional Fatigue Scale using **tool II**. The child's sleep quality was assessed by PSQI Scale using **tool III**.

Tool I was used before the interval of PMR and the data about the physiological parameters of the child was recorded at the end of data collection. Tool II and III were used before the interval of PMR and at the end of data collection.

Progressive muscle relaxation was performed every day for 10 minutes for three weeks. The researcher interviewed each child and

his/ her parent and explained how to do the PMR by performing it while the child and his/ her parent were watching. Then the child was asked to redemonstrate it .

Initially, PMR was applied during the first two hours of the HD session under the supervision of the researcher. Then, the child was asked to perform the PMR in the same way at home every day using the video recorded about PMR for three weeks respectively and the researcher followed the application of the technique twice per week (Gok Metin et al., 2019).

•**The researcher has instructed the child to PMR in the following steps**:

Find a comfortable position without interruption. She/ he may sit up or lie down and keep her/ his eyes closed.

Begin with a deep breathing exercise.

Tense muscles of the face: Wrinkle the forehead, frown the nose, close the eyes very tightly and purse the lips. Hold for 5 seconds. Then, slowly release the hold and relax while counting to 10 (10 seconds).

Tense muscles of the neck and shoulders: shrug the shoulders up toward his/ her ears and hold for 5 seconds and slowly release the hold and relax while accounting to 10 (10 seconds)

Tense muscles of the forearms, hands and biceps: slowly draw both hands into fists. Move on to the biceps by drawing the forearm up towards the shoulder, slowly bend the elbow by using a strong 5 seconds contraction. Then, slowly release the hold and relax while counting to 10 (10 seconds).

Tense muscles of the abdomen: suck and hold the abdomen for 5 seconds. Then, slowly release the hold and relax while counting to 10 (10 seconds).

Tense muscles of the buttocks: pull them together, hold for 5 seconds. Then, slowly release the hold and relax while counting to 10 (10 seconds).

Tense muscles of the legs: Slowly increase the tension in quadriceps and calves over 5 seconds. Squeeze the muscles as hard as he/she can and then slowly release the hold and relax while counting to 10 (10 seconds).

Tense muscles of the feet: Slowly increase the tension in his/ her feet and toes. Tighten the muscles as much as he/ she can. Then, slowly release the hold and relax while counting to 10 (10 seconds).

Breathe in relaxation and breathe out tension.

Data was collected by the researchers during the period from July 2021 to October 2021.

Ethical considerations:

Approval from the Research Ethics Committee of the Faculty of Nursing at Alexandria University was obtained.

Written informed consent was obtained from every child's parent after explaining the aim of the study, the voluntary participation of the children and the right to withdraw children at any time.

Parents were ascertained about the confidentiality of their children's data and children's privacy was considered.

Statistical Analysis

The collected data were organized, tabulated and statically analyzed using the statistical package for social studies (SPSS) Version 25.0. Qualitative data were described using numbers and percentages. **Shapiro-Wilk test** was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Finally, analysis and interpretation of data were conducted. P-values of 0.05 or less were considered statistically significant. The tests used for data analysis were

Wilcoxon signed ranks test for abnormally distributed quantitative variables and to compare between two periods, **Cronbach's Alpha test** for assessing reliability statistics and the **Pearson coefficient** to correlate between two normally distributed quantitative variables.

Results

Table 1 presents socio-demographic data of the children undergoing hemodialysis and effect of progressive muscle relaxation on the participating children's physiological parameters. It was found that, 46.7% of participating children aged 10 to 12 years. The mean age of them was 10.87 ± 1.69 years. According to the residents, it was revealed that two-thirds of participating children were from rural areas (66.7 %). Regarding blood pressure, the mean participating children's systolic blood pressure before PMR was 109.80 ± 21.58 mm Hg, compared to 115.20 ± 16.02 mm Hg after the application the PMR and the difference between before and after was statistically insignificant (p= 0.100). The mean diastolic blood pressure of them before and after application of PMR was 79.87 ± 16.03 mm Hg and 80.47 ± 11.03 mm Hg respectively and the difference between before and after was statistically insignificant (p= 0.755). In addition, the mean children's oxygen saturation before and after application of PMR was 98.60 ± 1.57% and 98.93 ± 1.05% respectively and the difference between before and after was statistically insignificant (p= 0.275).

Table 2 points up the effect of progressive muscle relaxation on fatigue using the overall Pediatric Quality of Life Inventory Multidimensional Fatigue Scale among Participating Children Undergoing Hemodialysis. It was found that the mean percentage score of the overall fatigue scale was higher after the application of PMR (84.35 ± 5.80%) which indicates less fatigue, compared with 65.09 ± 9.01% before the application of this technique and the difference between before and after PMR was statistically significant (p= <0.001*).

Table 3 reveals the effect of progressive muscle relaxation on sleep quality using the overall Pittsburgh Sleep Quality Index Scale among participating children undergoing hemodialysis. It was found that the mean percentage score of the overall Pittsburgh Sleep Quality Index Scale was lower after the application of PMR (14.60 ± 6.49%) which indicates better sleep quality, compared with 30.63 ± 9.98% before application of such technique and the difference between before and after was statistically significant (p= <0.001*).

Table 4 shows the correlation between participating children's score averages obtained from the overall Pediatric Quality Of Life Inventory Multidimensional Fatigue Scale and the overall Pittsburgh Sleep Quality Index Scale after the application of PMR. The table revealed a positive, statistically significant correlation between fatigue and sleep quality before and after application of PMR (p= 0.009* and <0.022*) respectively.

Discussion

Fatigue and poor sleep quality are more common in children undergoing HD than in other healthy children and affect children's quality of life. Management of fatigue and poor sleep quality through using medical treatment are mainly expensive and are combined with side effects. So, it is important to seek out suitable complementary alternative treatments such as PMR (Mohammadpour, 2014). Progressive muscle relaxation is cheap, convenient and easily applied by the patients themselves; it has no side effects and it is a conscious technique in which the patient does not sleep. Kılıç and Parlar Kılıç 2021 reported that PMR represents an effective therapeutic intervention approach to reduce fatigue and improve sleep quality.

The researcher used information technology to motivate participating children through calling the child and/ or his/ her parent and/ or constituting WhatsApp groups, to follow up application of PMR and increase competition among them to do PMR daily. Furthermore, some of the participating children were competing with each other and some were competing with their brothers or sisters to perform PMR.

The children's age also from influencing factors of increased effect of PMR on fatigue and improved sleep quality among children undergoing HD. The present study findings revealed that 46.7% of participants' children were aged from 10-12 years. This age of participating children facilitates data collection through easy-to-understand this technique and following the instructions and present motivation to do that like a play.

The main findings of the current study revealed presence of a significant decrease in the overall PedsQL Multidimensional Fatigue Scale and its subscales such as the general fatigue subscale, sleep/ rest fatigue and cognitive fatigue subscale after the application of PMR. Moreover, when patients' pre-test/ post-test score averages were compared, the results reflect a significant effect of PMR on fatigue for participating children. Children undergoing HD suffer from physiological and mental stressors for a long time and experience lifestyle changes. Furthermore, HD is a stressful process and is followed by various psychological and social issues that predispose children to mental disorders.

Progressive muscle relaxation affects HD adequacy regarding its influence on children's stress and fatigue (Biabani et al., 2019). Also, practicing PMR activates the human body's reaction, which leads to relaxation. This relaxation response results in reduced sympathetic nervous system responsivity to counteract the activity of epinephrine or cortisol and opposes the stress response (Tsitsi et al., 2017).

These findings are reinforced by several studies such as Mohammadpour (2014) who conducted a study about the effect of PMR on fatigue in patients undergoing HD. They revealed that there was a significant difference in the level of fatigue after the application of PMR.

The current study showed that there was a statistically significant difference in the global PSQI Scale and its subscales such as subjective sleep quality, sleep latency, sleep duration, sleep disorder and daytime dysfunction after the application of PMR. Since all participating children had no difficulty in habitual sleep efficiency and also did not use any sleep medications, no statistical operations were performed. Furthermore, when patients' pre-test/ post-test score averages were compared, the results reflected a moderate effect of PMR on the improvement of sleep quality for participating children.

These findings are justified by effect of the applied PMR on reducing fatigue, anxiety and stress among children undergoing HD. Moreover, some chemical changes associated with PMR such as reduced adrenal hormones level may improve sleep quality. In addition, PMR helps in the management of stress, reduces psychological stress, enhances subjective well-being and consequently may improve sleep quality.

These findings are supported by several studies such as Amini et al. (2016), who conducted a study about the effect of PMR and aerobic exercise on anxiety, sleep quality and fatigue in patients with chronic renal failure undergoing HD. They reported that the mean total score for sleep quality after the PMR was significantly lower than that before it. In addition, the scores for dimensions of sleep quality except for taking hypnotic drugs were significantly lower before the PMR than after it

The correlation between sleep disorders and fatigue is strong and children with stage five-CKD associated with increased fatigue

and poor sleep quality. This study showed presence of positive correlation between fatigue and sleep quality. This finding is justified by children receiving HD experiencing debilitating psychological symptoms from the exhausting chronic HD treatment that negatively impacts their mental and physical health. Also about two third of children are from rural areas and are impacted by traveling to receive HD sessions about three to four times per week. This factor leads to fatigue and poor sleep quality among these children.

This finding is similar to Al Naamani et al. (2021) who conducted a study about fatigue, anxiety, depression and sleep quality in patients undergoing HD in Oman. They reported that participants with poor sleep were 3.8 times more likely to experience fatigue.

The current study revealed that there was statistically insignificant difference before and after application of PMR for systolic and diastolic blood pressure and oxygen saturation. These findings are justified by PMR blunt sympathetic arousal by training the individual to reduce oxygen requirements, achieved by the repetitive release of muscle tension combined with the slowing of respiration. These findings are consistent with Tsitsi et al. (2017) and Sheu et al. (2003).

Conclusion

Progressive muscle relaxation has significantly decrease fatigue and improve sleep quality among children undergoing hemodialysis.

Recommendations

Establishment of hospital administration policies and protocol for non-pharmacological management particularly PMR are recommended to reduce fatigue and improve sleep quality.

A multi-center research proposal should be conducted on larger study samples in this area.

Table (1): Socio-demographic data of patient and effect of progressive muscle relaxation on physiological parameters of participating children undergoing hemodialysis (n = 30)

Socio-demographic Data	No.	%
Age (years)		
<10 years	10	33.3
10 – 12 years	14	46.7
≥13 years	6	20.0
Min. – Max.	8.50 – 14.0	
Mean ± SD.	10.87 ± 1.69	
Median	11.0	
Residence		
Rural	20	66.7
Urban	10	33.3

Physiological Parameters	Before	After	P
Blood pressure (mm Hg)			
Systolic Blood pressure			
Min. – Max.	84.0 – 160.0	90.0 – 159.0	
Mean ± SD.	109.80 ± 21.58	115.20 ± 16.02	0.100
Median	105.0	110.0	
Diastolic Blood pressure			
Min. – Max.	59.0 – 117.0	65.0 – 105.0	
Mean ± SD.	79.87 ± 16.03	80.47 ± 11.03	0.755
Median	81.0	80.0	
Oxygen saturation (100%)			
Min. – Max.	95.0 – 100.0	97.0 – 100.0	
Mean ± SD.	98.60 ± 1.57	98.93 ± 1.05	0.275
Median	99.0	99.0	

SD: **Standard deviation** P: p value for comparing between **Pre-test** and **Post-test**

*: Statistically significant at $p \leq 0.05$

Table (2): Effect of the progressive muscle relaxation technique on overall PedsQL Multidimensional Fatigue Scale among participating children undergoing hemodialysis (n = 30)

Overall Pediatric Quality Of Life Inventory Multidimensional Fatigue Scale	Before	After	P
Total score			
Min. – Max.	950.0 – 1525.0	1325.0 – 1700.0	
Mean ± SD.	1171.7 ± 162.12	1518.3 ± 104.41	
Median	1150.0	1525.0	
% Score			<0.001*
Min. – Max.	52.78 – 84.72	73.61 – 94.44	
Mean ± SD.	65.09 ± 9.01	84.35 ± 5.80	
Median	63.89	84.72	

SD: Standard deviation
P: p value for comparing between Pre-test and Post-test
*: Statistically significant at $p \leq 0.05$

Table (3): Effect of the progressive muscle relaxation technique on overall Pittsburgh Sleep Quality Index Scale among participating children undergoing hemodialysis (n = 30)

Overall Pittsburgh Sleep Quality Index Scale	Before	After	P
Total score	**(0–21)**		
Min. – Max.	2.0 – 11.0	1.0 – 6.0	
Mean ± SD.	6.43 ± 2.10	3.07 ± 1.36	
Median	7.0	3.0	
% Score			<0.001*
Min. – Max.	9.52 – 52.38	4.76 – 28.57	
Mean ± SD.	30.63 ± 9.98	14.60 ± 6.49	
Median	33.33	14.29	

SD: Standard deviation
P: p value for comparing between Pre-test and Post-test
*: Statistically significant at $p \leq 0.05$

Table (4): Correlation between fatigue and sleep quality before and after application of progressive muscle relaxation (n = 30)

	Correlation between fatigue and sleep quality before and after application of progressive muscle relaxation	
	R	**P**
Before	0.471 *	0.009 *
After	0.415 *	0.022 *

SD: Standard deviation
P: p value for comparing between Pre-test and Post-test
*: Statistically significant at $p \leq 0.05$

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