Effect of Deep Breathing Exercise Training on Fatigue' Level among Maintenance Hemodialysis Patients: Randomized Quasi-experimental Study

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Abstract

Background: End-stage renal failure is one of the widespread diseases requiring hemodialysis renal replacement therapy. However; patients on maintenance hemodialysis usually suffer from fatigue. A recent growing interest is directed at applying non-pharmacological alongside traditional methods for managing such chronic complaints. Therefore, this study **aimed** to evaluate the effect of deep breathing exercise training on level of fatigue among maintenance hemodialysis patients. **Materials and Method:** This study is a randomized quasi-experimental design with parallel groups. One hundred hemodialysis patients participated in the study. They were admitted to the Hemodialysis Department of Alexandria Main University Hospital. The patients were randomly and equally assigned to either the control group or the intervention group (n=50 each). Fatigue was measured in both groups; before and four weeks after nursing intervention using Fatigue Assessment Scale (FAS). **Results:** Prior to deep breathing exercises, the total mean percent score of fatigue in the intervention group was 66.30±12.19 compared to 62.80±13.12 in the controls. After four weeks of performing the exercise; the mean score was dramatically decreased to 26.25±5.47 in the intervention group compared to 61.40±11.06 in the control. Additionally, a statistically significant difference within the intervention group was declared before and after the intervention (P<0.001). **Conclusion:** Performing deep breathing exercises for twenty minutes, twice per day for a full month; can reduce maintenance hemodialysis patients' fatigue level.

Keywords: Breathing Exercises, Chronic Renal Failure, Maintenance Dialysis, Fatigue, Fatigue Assessment Scale, Nursing intervention.
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Introduction:

Chronic Renal Failure (CRF) turned to be an epidemiological global disease, denoting a serious threat to overall health. End-stage Renal Failure (ESRF) is a dramatic end of renal failure associated with lowered glomerular filtration rate; posing the urge for artificial replacement therapy. Approximately 5.1 million ESRF patients worldwide; rely on renal replacement therapy for better survival, that is either peritoneal dialysis, hemodialysis, or kidney transplantation, and this number is expected to double in the next decade **(Lew et al., 2016)**. Hemodialysis is the most common invasive and complex form of renal replacement therapy. In Egypt, the number of hemodialysis' patients in Egyptian governmental health care service units was estimated to be risen from 23500 to 26000 between 2016 and 2017, with a male to female ratio of 2:1. However, the number of hemodialysis patients is in unceasing increase **(Megahed et al., 2020)**.

Nevertheless, the rapid improvement in hemodialysis techniques have recently contributed to an increase in the survival of CRF patients, on the other hand resulting in a variety of physical and mental complications, which may contribute to a decline in patients' quality of life (QOL) **(Trillini et al., 2017)**.

Fatigue is one of the most explicated adverse effects among hemodialysis patients and the frequently recorded nursing diagnosis among CRF patients. Nevertheless, hemodialysis patients' fatigue may relate to multi factors, of which; dietary insufficiency and adverse pharmacological effects. Meanwhile, hemodialysis patients' fatigue

affects negatively their QOL; complaining from physical inactivity, social loneliness, loss of job, depressed mood, impaired sleep quality, feeling pain, and generally being un-well **(Picariello et al., 2017)**.

The treatment of fatigue in addition to other hemodialysis' complaints requires the integration of both non-pharmacological and pharmacological interventions. However, pharmacological management is costly and associated with various harmful side effects. Therefore, Fatigue nursing management necessitates pursuing alternative non-pharmacological management methods. Researchers' attention recently is directed toward practicing alternative, complementary, and adverse effect-free therapies in treating physical adverse disorders of illness. The alternative therapy includes aerobic exercise, massage, yoga, progressive muscle relaxation, reflexology, and deep breathing exercise. These alternative non-pharmacological interventions are extremely inexpensive, available, and without adverse effects **(Amini et al., 2016)**.

Remarkably; deep breathing and aerobic exercise have proven regulation in almost all of body systems' physiological activities. Accordingly, breathing deeply and slowly results in increased O2 transport to vital body organs besides intensifying the energy production process. Furthermore, it enhances muscle relaxation, improves cardiovascular function, corrects anemia, decreases insulin resistance, lowers cholesterol level, and consequently have a positive effect on reducing fatigue **(Zargarzadeh & Shirazi, 2014)**.

The efficiency of alternative and non-pharmacological methods has been asserted in a variety of chronic diseases, of which cardiac pain, cancer, and multiple sclerosis **(Ghorbani et al., 2019; Hassan et al., 2020).** Even so, these alternative methods, if investigated, could become beneficial in reducing fatigue associated with hemodialysis.

Based on a thorough, extensive, and in-depth review of the literature, it was revealed that; researches on the effect of deep breathing on hemodialysis fatigue are limited. Consequently, more nursing researches on CRF patients applying new non-pharmacological techniques and specific methodologies are required.

Aim of Study:

To evaluate the effect of deep breathing exercise training on fatigue' level among maintenance hemodialysis patients**.**

Research Hypothesis:

1. Patients with fatigue who have received deep breathing exercise training would have less fatigue than those who have not received the training.
2. Patients with fatigue who have received deep breathing exercise training would have a statistically significant difference before and after deep breathing exercise.

Materials and Method

Materials

Study design: A randomized quasi-experimental research design was utilized to fulfill the aim of the study.

Setting: This study was conducted in Hemodialysis Department at the Alexandria Main University Hospital, Egypt.

Subjects: The study subject comprised a convenience sample of 100 patients, attending the pre-mentioned health setting and meeting the following **inclusion criteria:**

- Adult ranging from 20- 60 years old of both genders.
- On maintenance hemodialysis for at least 6 months and more.
- Not currently diagnosed with Chronic Fatigue Syndrome (CFS).
- Free from mental illness, neuromuscular disorders, and serious lung problems and able to implement the interventional exercise.

Sample size calculation: Epi info -7 programs was used to estimate the sample size using the following parameters: Population size =300, Expected frequency =50%, Maximum error = (5%), Confidence coefficient =95%, estimated

sample size =100 (Figure 1: CONSORT flow diagram of the study).

The study subjects were randomly, equally, and sequentially divided into two equal groups of 50 patients each as follows:

- **The Control group' participants** received only routine hemodialysis department care.
- **The intervention group** to whom the deep breathing exercise training was implemented, in addition to their routine prescribed medication. Those patients were instructed to perform the taught deep breathing exercise throughout and in each scheduled hemodialysis session, in addition, twenty minutes/twice daily for 4 consecutive weeks.

Tools: Based on an extensive review of related literature; two tools were utilized in this study for data collection.

Tool I*: "Patients' Socio-demographic and Clinical Data Structured Questionnaire".* This tool included questions related to the socio-demographic characteristics of the studied patients (age, gender, level of education, occupation, and marital status), and the clinical data questions (onset and causes of the kidney disease, duration of the hemodialysis treatment, number and duration of each hemodialysis session, as well as information related to adherence to medication).

Tool II*: "Fatigue Assessment Scale (FAS)":* The FAS Arabic version was utilized; it was developed by **The World Association for Sarcoidosis and Other Granulomatous Disorders [WASOG] (2012), to assess both groups'** participants' perceived fatigue**; as baseline data and one month thereafter.** However; the instruction of the FAS was directed at how a person usually feels without measuring emotional stability or depression. The FAS consists of ten questions; the first five questions were measuring physical fatigue; while the remaining five were to assess participants' mental fatigue.

Scoring system of FAS: Each item of this scale was scored on a **Five-point Likert scale**; one point = never, two = sometimes, three = regularly, four = often, and five= always. The total FAS score ranged from 10 to 50; a **total score** < 22 indicates "Non-fatigue"; a score ≥ 22-<35 indicates "Fatigue" and a score of ≥35-50 indicates "Extremely fatigue".

The total score for each fatigue item was calculated by summing scores given for each item, and then was converted into a mean percent score. The lower FAS mean and standard deviation scores reflect a lower level of fatigue; while the total mean and standard deviation score 50 denotes the highest fatigue level.

Method

1- Approval of the Ethical Research Committee, Faculty of Nursing, Alexandria University was obtained. Moreover, official permission from the Faculty of Nursing, Alexandria University was directed to the study setting's responsible authorities to obtain their permission to conduct the study after explaining the study aim.

2- The study tool I was tested for content validity by 5 experts in Medical-Surgical Nursing to assure the content validity, clarity of items, comprehensiveness, appropriate, and necessary modifications were done. However, tool II reliability was (0.90) as identified by the WASOG using the Cronbach Alpha reliability test.

3- A pilot study was conducted on ten patients (10% of patients fulfilling the inclusion criteria); to test the tool I clarity, feasibility, and applicability. The necessary modification was done accordingly. The pilot sample was excluded from the study subjects.

4- **Randomization:** The researchers coded all the one hundred adult participants and used odd numbers in the intervention group, while the even numbers were used for the control group. Consequently, allocated patients were randomly assigned into two equal groups: control and intervention groups. Data were collected from the

control group first; considering tools anonymity.

5- In order to address the effect of deep breathing exercise training on fatigue level during hemodialysis' session; data were collected as follows:

a. Prior hemodialysis*:*

a. 1. Both groups' participants' socio-demographic and clinical data were collected just once using tool I.

a. 2. An initial fatigue assessment was performed as well; for both groups using a tool II.

a.3. Afterward, each patient in the intervention group was interviewed individually in an educational session 30 minutes prior to the hemodialysis and was oriented about the aim of the deep breathing exercise, that is to: increase the amount of air passing to the lung; to proliferate more nourishment to the brain, intended for minimizing hemodialysis fatigue.

a. 4. Thereafter, the researchers trained the intervention group participants about "How to perform the procedure" and "How long to perform".

a. 5. Patients were instructed to close their eyes and relax their muscles as possible during the technique. At the end of the educational session, each patient re-demonstrated the deep breathing exercise repetitively five times to ensure its correctness.

a. 6. Each patient in the intervention group received an educational pamphlet with pictures representing the benefits and steps of deep breathing exercise procedure.

b. During hemodialysis:

The Intervention group patients were supervised regarding deep breathing exercises procedure implementation during the session in the following steps according to, **Chopra, 2020 and Ünver et al., 2018**:

b. 1. Sit or lay down comfortably according to personal preference without crossing arms or legs.

b. 2. Place palm of one hand on the abdomen, below the ribcage. Place the second hand on the middle of the chest.

b. 3. Imagine that the stomach is a balloon that inflates. So; breathe in deeply through nostrils and let first resting a hand on the abdomen raised by the stomach. Try to move the abdomen on inhalation/exhalation, not shoulders.

b. 4. Breathe out slowly through pursed lips as whistling; to deflate the balloon. Gently push the palm on the stomach inwards, helping to press out the breathing.

c. *Post-hemodialysis*:

c. 1. The intervention group participants were asked to perform this deep breathing exercise at home for twenty minutes, at least twice daily for four consecutive weeks.

c. 2. Also, they were requested to record each breathing exercise session's date and time on a printed follow-up sheet; with the assistance of the family, if the participant is illiterate.

c. 3. The researchers reviewed these follow-up sheets prior to each dialysis session weekly for the four weeks.

c. 4. In the last scheduled hemodialysis session, at the end of the fourth week, the researchers assessed fatigue levels in both groups using tool II.

c.5. Then the effect of deep breathing exercise training on fatigue level experienced during maintenance hemodialysis was determined by comparing the total FAS mean and standard deviations scores prior to and after four weeks of implementing the exercise intervention. This study was conducted from February to August 2020, where each patient was interviewed individually in a separate room for both: study tools' assessment;

besides breathing exercise training. Each session took approximately 30 minutes; including the FAS filling which didn't exceed 3 minutes.

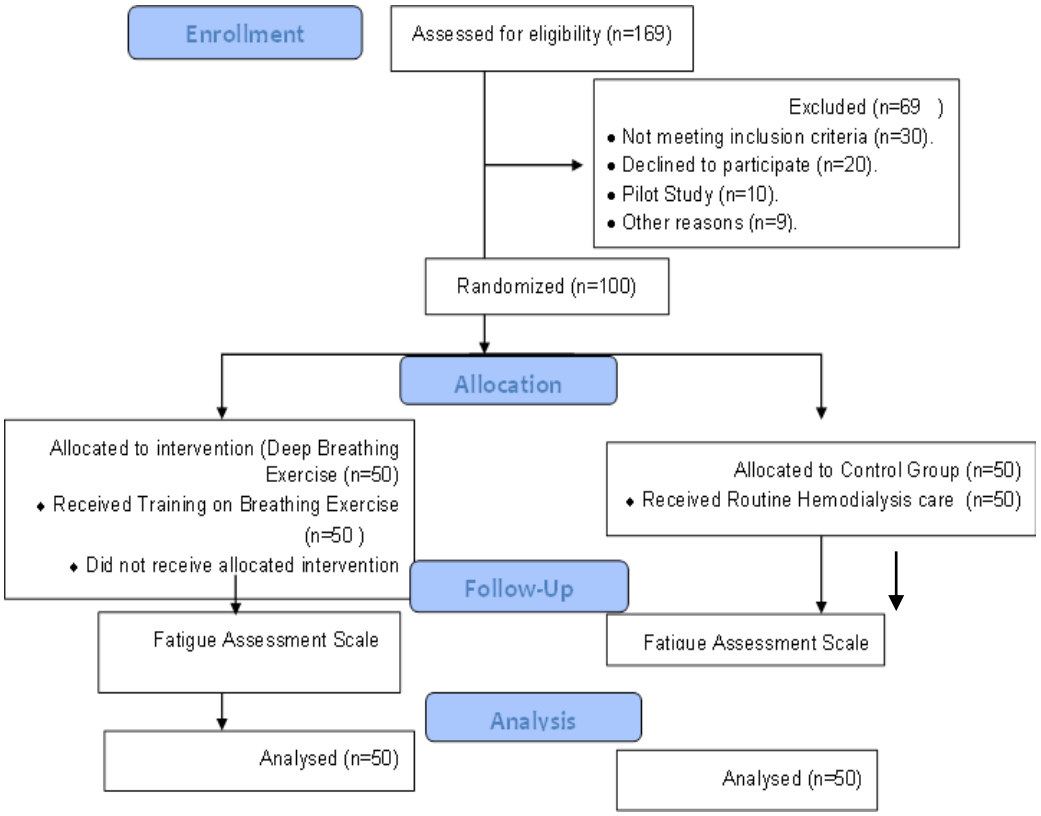
6- **Ethical considerations:**

Participants' written informed consent was obtained after an explanation of the study's purpose. Their voluntary participation and the right of withdrawal at any time ensued. Confidentiality of data and patients' privacy was ascertained.

7- **Statistical analysis of the data**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation. The significance of the obtained results was judged at the 5% level. Comparisons between groups for categorical variables were assessed using. Comparisons between groups for categorical variables were assessed using the Chi-square test for categorical variables, to compare between different groups. Monte Carlo correction, Correction for chi-square when more than 20% of the cells have expected count less than Student t-test: designed for normally distributed quantitative variables, to compare between two studied groups. Paired t-test: for normally distributed quantitative variables, to compare between two periods. In addition to F-test (ANOVA): for normally distributed quantitative variables, to compare between more than two groups.

Fig 1. Consort Flow Diagram of Study.



Results

Table 1 shows no statistically significant difference between the control and intervention group concerning socio-demographic and baseline data. Obviously, nearly half of the control (48%) and intervention groups (58%) age ranged from 50-60 years. Moreover, more than half of the control and study groups were male representing 62% and 60%; respectively. Furthermore, more than two-thirds of both controls (72%) and study groups (70%) were married. The results cleared nearly half of the participants that can read and write were representing 48% and 42%, in the control and study groups, respectively. Additionally, the majority of the studied patients, 88.0% and 86.0% in the control and intervention groups respectively were living with their families. Finally, (54%) of the controls, and (50%) in the intervention group were employees.

As regards clinical data, nearly equal percentages 38.0%, 40.0%, 40.0, and 44.0% respectively of the control and study groups, reported their cause of renal failure that was hypertension and diabetes mellitus. Furthermore, more than two-thirds of the control and intervention group had three hemodialysis sessions/ week representing 62% and 66%; respectively. Also, less than half of the control and intervention groups; 46 % and 44% had hemodialysis for 3 hours/ session. Equally, the majority of patients (88%, 86%) were adhering to medications. While more than two-thirds of both groups felt well with hemodialysis treatment representing 68% and 72%.

Table 2 shows that; the mean total percent fatigue analog scale score was higher in the intervention group before breathing exercise, compared to the control group without statistical significance (p=0.170). Moreover, the results of the marginal homogeneity test indicated a statistically significant difference regarding fatigue score before and after deep breathing exercise in the intervention group (P0<0.001) compared with (0.083) in the control group. Noticeably, the parentage of the extreme fatigue among the intervention group was high before breathing exercise (64.0%), and decreased to (0.0%) after one month of performing deep breathing exercise. However, after implementing the deep breathing exercise intervention, the mean total percent fatigue score was statistically lower in the intervention group compared to the control group (P=0.001).

Regarding the aspects of the fatigue analog scale (FAS), **table 3** shows that the mean **total physical question** percent scores were statistically significantly lower within the intervention group before and after breathing exercise (P_0=0. 001), compared to (0.028) in the control group. Moreover, a statistically significant difference was observed in the intervention group after breathing exercise compared to the control group (P_2=0001). Concerning **the mental question** of the (FAS), the results indicated that the total mental questions' mean percent scores were statistically significantly lower within the intervention group after breathing exercise (P_0<.0001) compared to (0.322) in the control group. However, a statistically significant difference was declared in the total FAS mean percent score after implementing deep breathing exercise intervention, between both groups (P_2<.0001)**.**

Table (1): Socio-demographic and clinical data of the studied groups before breathing exercise

Parameters		Control group (n =50)		Intervention group (n =50)		χ^2	P-value
		No.	%	No.	%		
Socio-demographic							
Age	18<30 years	1	2.0	6	12.0	6.365	^{MC}p= 0.092
	30<40 years	5	10.0	3	6.0		
	40<50 years	20	40.0	12	24.0		
	50-60 years	24	**48.0**	29	**58.0**		
Gender	Male	31	**62.0**	30	**60.0**	0.372	0.542
	Female	19	38.0	20	40.0		
Marital status	Single	3	6.0	4	8.0	2.055	^{MC}p= 0.624
	Married	36	**72.0**	35	**70.0**		
	Divorce	0	0.0	2	4.0		
	Widow	11	22.0	9	18.0		
Education	Illiterate	8	16.0	14	28.0	3.381	^{MC}p= 0.346
	Read and write	24	**48.0**	21	**42.0**		
	Secondary education	2	4.0	4	8.0		
	University education.	16	32.0	11	22.0		
Living condition	With family	44	**88.0**	43	**86.0**	0.088	0.766
	Alone	6	12.0	7	14.0		
Occupation	Does not work	10	20.0	12	24.0	0.878	0.831
	Employee	27	**54.0**	25	**50.0**		
	Retired	6	12.0	8	16.0		
	Housewife	7	14.0	5	10.0		
II. Medical History							
Cause of renal failure*	Hypertension	19	38.0	20	40.0	0.042	0.838
	Diabetes mellitus	20	**40.0**	22	**44.0**	0.164	0.685
	Medications	11	22.0	8	16.0	0.585	0.444
Onset of disease	<1 year	13	26.0	12	24.0	0.704	0.703
	1 - 5 years	20	40.0	17	34.0		
	> 5years	17	34.0	21	42.0		
Starting hemodialysis	<1 year	14	28.0	16	32.0	0.437	0.804
	1-3 years	18	36.0	16	32.0		
	3- > 5 years	18	36.0	18	36.0		
Hemodialysis sessions/ week	Two	19	38.0	17	34.0	0.174	0.677
	Three	31	**62.0**	33	**66.0**		
Hemodialysis hours/ session	One	0	0.0	3	6.0	2.790	^{MC}p= 0.485
	Two	8	16.0	8	16.0		
	Three	19	38.0	17	34.0		
	> 3 hours	23	**46.0**	22	**44.0**		
Medication Adherence	Yes	44	**88.0**	43	**86.0**	0.088	0.766
	No	6	12.0	7	14.0		
Do you feel better with hemodialysis treatment	Yes	34	**68.0**	36	**72.0**	0.190	0.663
	Sometimes	16	32.0	14	28.0		

Data presented in frequency and percent. χ^2: Chi square test MC: Monte Carlo
p: p value for comparing between the studied groups. *: More than one answer

Table (2): Comparison of the studied groups' Fatigue Analog Scale score before and after breathing exercise training

FAS score		Control group (n=50) No.	%	Intervention group (n=50) No.	%	χ^2	P-value
Before intervention	Non-fatigued (<22)	0	0.0	0	0.0	0.378	0.539
	Fatigued (22-<35)	21	42.0	18	36.0		
	Extremely fatigued (≥35)	29	58.0	32	**64.0**		
	Total mean percent score	62.80 ± 13.12		66.30 ± 12.19		1.382	**0.170**
After intervention	Non-fatigued (<22)	0	0.0	34	68.0	61.600*	**<0.001***
	Fatigued (22-<35)	24	48.0	16	32.0		
	Extremely fatigued (≥35)	26	52.0	0	**0.0**		
	p_0	**0.083**		**<0.001***		t-test	
	Total mean percent score	61.40 ± 11.06		26.25 ± 5.47		20.150*	**<0.001***

Data presented in Frequency, Percent, mean, and standard deviation. χ^2: **Chi square test**

p_0: p value for **Marginal Homogeneity Test** for comparing between **before** and **after in each group**

*: Statistically significant at $p \leq 0.05$. **Fatigue Analog Scale (FAS)**

Table (3): Comparison between the studied groups according to Fatigue Analogue Scale items mean and standard deviation % score before and after breathing exercise training

Fatigue analogue scale items	Control group (n=50) Initial assessment	After one month	tp (p_0)	Breathing exercise group (n=50) Initial assessment	After intervention	tp (p_0)	t_1 (p_1)	t_2 (p_2)
Total Physical questions mean ± SD%	63.50 ± 12.75	61.80 ± 12.28	2.265* (**0.028***)	**70.90 ± 15.61**	30.10 ± 7.18	17.467* (**<0.001***)	2.597* (0.011*)	15.760* **(<0.001*)**
Total Mental questions mean ± SD%	62.10 ± 15.52	61.0 ± 12.98	1.000 (**0.322**)	**61.70 ± 11.68**	22.40 ± 7.77	20.225* (**<0.001***)	0.146 (0.885)	18.044* (<0.001*)
Total FAS mean ± SD%	62.80 ± 13.12	61.40 ± 11.06	1.911 (0.062)	66.30 ± 12.19	26.25 ± 5.47	21.670* (<0.001*)	1.382 (0.170)	20.150* (<0.001*)

Data presented in mean and standard deviation percent. **t: Student t-test** **tp: Paired t-test**
p_0: p value for comparing between **before** and **after in each group**
p_1: p value for comparing between the studied groups in **before** period
p_2: p value for comparing between the studied groups in **after** period
*: Statistically significant at $p \leq 0.05$

Discussion

The present study was designed to evaluate the effectiveness of deep breathing exercise training on fatigue level among maintenance hemodialysis patients.

The current study's results showed no statistically significant difference between the control and intervention group concerning socio-demographic and baseline data. This means that patients in both groups have the same characteristics, being distributed in a homogeneous manner, and were properly randomized.

Hence numerous studies reported that the majority of ESRF patients on hemodialysis complain of dramatic reduction in performing their daily living activities secondary to fatigue. In accordance, the current study results showed that; performing breathing exercises deeply and slowly for twenty minutes at least twice daily significantly decreased the total mean percent fatigue score in the intervention group compared to the controls. This result supports the study hypothesis; pointing out a significant

difference between the control and intervention group in fatigue levels after practicing breathing deeply and pursing it slowly. This may be explained by the fact that; physiologically, breathing slowly and deeply stimulates the parasympathetic nervous to release noradrenaline, which slows the heart rate, maximizes lung expansion, and relaxes the muscles. Furthermore, deep breathing increases oxygen intake and get rid of excess carbon dioxide, enhancing the body to yield energy and reduce fatigue level. This finding is consistent with **(Sutinah & Azhari, 2020)** who verified a significant reduction in the experimental group's fatigue level compared to the control one after performing deep breathing exercise. However, this research was a nonequivalent quantitative quasi-experimental design with a small sample size (76 subjects) and a lower significance (P=0.043) than the current result ($p<0.001$). In accordance with the present results, a previous study has demonstrated that performing the Benson technique for four consecutive weeks, which is a different technique from our present research; but uses breathing exercises, could increase daily living activities of hemodialysis patients **(Heshmati et al., 2020)**. The result of the current research is in contrary to **(Sadeghimoghaddam et al., 2019)** who found that; deep breathing techniques cannot improve hemodialysis patients' quality of life together with fatigue level. This inconsistency could be attributed to the use of the different procedures or sampling techniques.

One interesting finding of the current research is that; most of the participants in the control and intervention groups were complaining from extreme fatigue before the deep breathing exercise. This finding is consistent with that of **(Mohamed, 2014)** who reported that, most of the hemodialysis patients in Egypt complain of fatigue.

Noticeably, the mental and physical sides of the fatigue assessment scale (FAS) of the intervention group were significantly lowered after performing deep breathing exercise compared to the control group ($p<0.001$). This result supports the idea that; breathing slowly and deeply improves mood, increases muscle power, reduce stress and fatigue level. This result also agrees with a systematic meta-analysis by **(Song et al., 2018)**, who noted that; exercise training reduces the severity of depression, mental and physical fatigue, and restless leg syndrome. Furthermore, a randomized controlled research trail conducted on kidney disease patients in **India** reported that, both fatigue's physical and mental health composite mean scores on CRF patients' Quality of Life (QoL) were 43.92±6.57, 44.16±7.74 respectively in the intervention group, after breathing exercise training with statistically improvement compared to pre intervention. Moreover this study concluded that; CRF patients' QoL was improved by deep breathing **(Kharbteng et al., 2020).** These results additional to **(Picariello et al., 2016)** who reported a solid correlation between the mental and physical fatigue amongst United Kingdom hemodialysis patients. However, this explains that fatigue is a biological warning of health risks, and the sense of fatigue has numerous adverse effects on the emotional, cognitive, and physical dimensions of patients' lives. Therefore, the researchers believe that deep breathing exercises are valuable and effective when practiced by CRF patients on maintenance hemodialysis routinely and sustainably being a habitual pattern of life. One of the implications of these findings is that; educating hemodialysis patients about the importance of deep breathing and relaxation could help them feel less fatigue level and more muscles relaxation.

Limitation of the study:

Despite the fact that our study used a small adult sample, the results were representative and statistically significant. Secondly, Lack of previous research studies on the scope of our research related to "assessing CRF patients fatigue using FAS".

Conclusion:

The current study's findings suggest that; practicing deep breathing exercises for twenty minutes twice a day as a lifestyle could reduce the level of fatigue in patients on maintenance hemodialysis.

Recommendations:

Further studies are required to assess the longer-term impact of breathing exercises as a

non-pharmacological, available, and applicable intervention on the hemodialysis patients' fatigue and QoL.

Acknowledgments:

First and foremost, the researchers would like to thank each of the participants in this study for their acceptance to participate and their families in this work and to comply with the instructions. Finally, the researchers also would like to thank the nurses in the hemodialysis unit being very assistive.

Conflicts of interest:

Regarding this study, the authors declared that they had no conflicts of interest.

Reference

Amini, E., Goudarzi, I., Masoudi, R., Ahmadi, A., & Momeni, A. (2016). Effect of progressive muscle relaxation and aerobic exercise on anxiety, sleep quality, and fatigue in patients with chronic renal failure undergoing hemodialysis. *International Journal of Pharmaceutical and Clinical Research, 8*(12), 1634-1639.

Chopra M. (2020). *Deep Breathing Exercises for Healthy Lungs: Effective Exercises to Fight Respiratory Ailments* India: Fitsutra Wellness Pvt Ltd

Ghorbani, A., Hajizadeh, F., Sheykhi, M. R., & Asl, A. M. P. (2019). The Effects of Deep-Breathing Exercises on Postoperative Sleep Duration and Quality in Patients Undergoing Coronary Artery Bypass Graft (CABG): a Randomized Clinical Trial. *Journal of caring sciences, 8*(4), 219.

Hassan, H. E., Mokabel, F. M., & AL_Radwan, N. A. (2019). Effect of massage therapy on the mood and pain of post cardiac catheterization patients. *American Journal of Nursing Research, 7*(3), 392-399.

Heshmati Far, N., Salari, M., Rakhshani, M. H., Borzoee, F., & Sahebkar, M. (2020). The effects of Benson relaxation technique on activities of daily living in hemodialysis patients; A single-blind, randomized, parallel-group, controlled trial study. *Complement Ther Clin Pract, 39*, 101133. doi:10.1016/j.ctcp.2020.101133

Kharbteng, L., Monaliza, V. K., Kaur, S., & Ghai, S. (2020). Effectiveness of a breathing training program on quality of life in patients with predialysis chronic kidney disease: A randomized controlled trial. *Indian Journal of Palliative Care, 26*(3), 271.

Lew, Q., Jafar, T., Koh, H., Jin, A., Chow, K., Yuan, J., & Koh, W. (2016). Red meat intake and risk of ESRD [published online ahead of print July 14, 2016]. *J Am Soc Nephrol*.

Megahed, A. F., Abdelhady, M. M. T., El Kannishy, G., & Sayed-Ahmed, N. (2020). Gender-Related Differences and Mortality Predictors among Egyptian Hemodialysis Patients: A Multi-Center Prospective Observational Study. *The Asian Journal of Medicine and Health, 18*(10), 118-130.

Mohamed, S. (2014). The effectiveness of an educational intervention on fatigue in hemodialysis patients: a randomized controlled trial. *J Nurs Health Sci, 3*(4), 40-50.

Picariello, F., Moss-Morris, R., Macdougall, I. C., & Chilcot, J. (2016). Measuring fatigue in haemodialysis patients: The factor structure of the Chalder Fatigue Questionnaire (CFQ). *J Psychosom Res, 84*, 81-83. doi:10.1016/j.jpsychores.2016.03.124

Picariello, F., Moss-Morris, R., Macdougall, I. C., & Chilcot, J. (2017). The role of psychological factors in fatigue among end-stage kidney disease patients: a critical review. *Clinical kidney journal, 10*(1), 79-88.

Rejeh, N., Tadrisi, S. D., Yazdani, S., Saatchi, K., & Vaismoradi, M. (2020). The Effect of Hand Reflexology Massage on Pain and Fatigue in Patients after Coronary Angiography: A Randomized Controlled Clinical Trial. *Nursing research and practice, 2020*, 8386167-8386167. doi:10.1155/2020/8386167

Sadeghimoghaddam, S., Alavi, M., Mehrabi, T., & Bankpoor-Fard, A. (2019). The Effect of Two Methods of Relaxation and Prayer Therapy on Anxiety and Hope in Patients with Coronary Artery Disease: A Quasi-Experimental Study. *Iranian journal of nursing and midwifery research, 24*(2), 102-107. doi:10.4103/ijnmr.IJNMR_60_18

Song, Y.-Y., Hu, R.-j., Diao, Y.-s., Chen, L., & Jiang, X.-L. (2018). Effects of exercise training on restless legs syndrome, depression, sleep quality, and fatigue among hemodialysis patients: a systematic review and meta-analysis. *Journal of pain and symptom management, 55*(4), 1184-1195.

Sutinah, S., & Azhari, R. (2020). The effects of relaxation breathing on fatigue in patients with chronic kidney disease undergoing hemodialysis. *Malahayati International Journal of Nursing and Health Science, 3*(1), 15-21.

The World Association for Sarcoidosis and Other Granulomatous Disorders (WASOG), 2012. Fatigue Assessment Scale (FAS) Arabic version. Available at: https://wasog.org/educational-material/fatigue-assessment-scale.html

Trillini, M., Perico, N., & Remuzzi, G. (2017). Epidemiology of end-stage renal failure: the burden of kidney diseases to global health *Kidney Transplantation, Bioengineering and Regeneration* (pp. 5-11): Elsevier.

Ünver, S., Kıvanç, G., & Alptekin, H. M. (2018). Deep breathing exercise education receiving and performing status of patients undergoing abdominal surgery. *International journal of health sciences, 12*(4), 35.

Zargarzadeh, M., & Shirazi, M. (2014). The effect of progressive muscle relaxation method on test anxiety in nursing students. *Iranian journal of nursing and midwifery research, 19*(6), 607.