

Effect of Deep Breathing Exercise on Stress among Haemodialysis Patients: A Pre-experimental One-group Pretest Post-test Design

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ABSTRACT

Introduction: Patients undergoing haemodialysis often experience stress which can affect their appearance and body's functioning. Deep breathing exercise plays an important role in alleviating stress and enhancing quality of life.

Aim: To assess the efficacy of deep breathing exercise on stress among haemodialysis patients.

Materials and Methods: This pre-experimental one-group pretest post-test design was conducted among 50 haemodialysis patients from May 2021 to July 2021, at the GCS Medical College Hospital and Research Centre, Ahmedabad, Gujarat, India. Participants were selected through purposive sampling from selected hospitals. Stress was assessed using the standard Perceived Stress Scale (PSS-10). The specific breathing technique used in the study was Structured Deep Diaphragmatic Breathing Exercise. Participants were instructed to perform slow, controlled nasal inhalation with abdominal

(diaphragmatic) expansion, followed by slow oral exhalation maintaining an inhalation-exhalation ratio of 1:2. The breathing rate was maintained at approximately 14-16 breaths per minute. Each session lasted 10 minutes, resulting in approximately 140-160 breathing cycles (repetitions) per session. Descriptive and inferential statistics were used for data analysis. The paired t-test was applied to compare pretest and post-test stress scores.

Results: In the pretest, 38 (76%) of patients had high stress and 12 (24%) had moderate stress. Following the intervention, 47 (94%) of patients had low stress and 3 (6%) had moderate stress. The mean pretest stress score was 29.0 ± 2.9 , which reduced to 9.9 ± 2.8 in the post-test. The reduction in stress level was statistically highly significant ($t=37.4$, $df=49$, $p\text{-value}<0.001$).

Conclusion: This indicates that the stress among haemodialysis patients improved remarkably after deep breathing exercises. Incorporating this technique into routine dialysis care may improve the psychological wellbeing of patients.

Keywords: Deep breathing exercise, Haemodialysis, Perceived stress, Nursing intervention, Non-pharmacological therapy

INTRODUCTION

The kidneys play a crucial role in maintaining fluid, electrolyte, and metabolic homeostasis by removing waste products from the bloodstream. The kidneys purify about 200 litres of blood every day and produce about two litres of urine. The waste products are generated from normal metabolic processes including the breakdown of active tissues, ingested foods, and other substances. Kidney diseases are silent killers which largely affect the quality of life [1]. Chronic Kidney Disease (CKD), also known as chronic renal disease, is the progressive loss in renal function over a period of months or years. CKD is a widespread medical condition that is progressive in nature [2]. CKD is characterised by the presence of kidney damage or an estimated Glomerular Filtration Rate (eGFR) of less than 60 mL/min/1.73 m², persisting for three months or more [3]. The CKD is identified by a blood test for creatinine. Higher levels of creatinine indicate a lower GFR and as a result a decreased capability of the kidneys to excrete waste products. In addition, serum creatinine indicates renal impairment at a relatively late stage-renal function is decreased by up to 50% before a rise in serum creatinine is observed [4].

Creatinine levels may be normal in the early stages of CKD and the condition is discovered if urine analysis shows proteinuria or haematuria. To fully investigate the underlying cause of kidney damage, various forms of medical imaging, blood tests and often renal biopsy are employed to find out if there are reversible cause for the kidney malfunction. Recent professional guidelines classify the severity of CKD in five stages, with stage 1 being the mildest and

usually causing few symptoms and stage 5 being a severe illness with poor life expectancy if untreated.

The five CKD stages (G1–G5), further divided into six GFR categories with G3 split into G3a and G3b, are described below [3]:

G1: GFR 90 mL/min/1.73 m² and above with evidence of kidney disease, such as haematuria or proteinuria

G2: GFR 60 to 89 mL/min/1.73 m²

G3a: GFR 45 to 59 mL/min/1.73 m²

G3b: GFR 30 to 44 mL/min/1.73 m²

G4: GFR 15 to 29 mL/min/1.73 m²

G5: GFR less than 15 mL/min/1.73 m² or treatment by dialysis

Haemodialysis patients experience a range of symptoms such as stress, fatigue, insomnia, loss of blood, nausea, etc with considerable variation in the frequency of symptoms experienced and in the severity with which the symptoms affect individuals. Patients who receive haemodialysis experience multiple symptoms that lead to limitations in everyday physical and mental activities as well as social restrictions, which can affect their psychological wellbeing and their quality of life [5,6]. While dialysis is necessary to ensure appropriate filtering, each session can be psychologically and physically exhausting if the treatment times extend past patients ability limits [7].

The number of people receiving renal replacement therapy exceeds 2.5 million and is projected to double to 5.4 million by 2030 [8]. Exercise and pranayam are known to improve mental and physical functioning and to improve quality of life. There are different exercise

therapies and asanas like deep breathing exercises, strengthening exercises, anulom vilom pranayam to improve the physical and mental functioning of the patient. Deep-breathing techniques can produce energy and reduce or even overcome fatigue in haemodialysis patients, thereby improving their quality of life [9,10]. According to a study deep-breathing techniques can reduce oxidative stress, increase cellular energy and the elasticity of blood vessels, and improve circulation to all tissues [11].

The aim of the study was to assess the efficacy of deep breathing exercise on stress among haemodialysis patient.

Objectives:

- To assess the pretest level of stress among haemodialysis patients.
- To assess the post-test level of stress among haemodialysis patients after deep breathing exercise.
- To evaluate the efficacy of deep breathing exercise on stress among haemodialysis patients.
- To find out association between pretest score with selected demographic variable of stress among haemodialysis patients.

Hypotheses

Null hypothesis: Deep breathing exercise did not reduce the stress among haemodialysis patients effectively.

Alternative hypothesis: Deep breathing exercises reduced the stress among haemodialysis patients effectively.

MATERIALS AND METHODS

This pre-experimental one-group pretest post-test design was conducted at the GCS Medical College Hospital and Research Centre, Ahmedabad, Gujarat, India and the duration of the study was from May 2021 to July 2021. The ethics committee at the GCS Medical College, Hospital and Research Centre approved this study (IEC Number: No.GCSMC/EC/Research project/ APPROVE/2021/300). Informed consent was taken from all participants of the study.

Sample size selection: A non probability purposive sampling technique was used to select 50 haemodialysis patients who met the inclusion criteria and were available during the period of data collection.

Inclusion criteria: Patients undergoing maintenance haemodialysis for $\geq$ three months, aged above 18 years, including both male and female participants, able to understand instructions and participate in the exercise were included in the study.

Exclusion criteria: Patients with severe psychiatric diagnosis, severe respiratory disorders and ICU patients were excluded from the study.

Research tools: A questionnaire was devised for the purpose of data collection.

It was divided into two parts:

- Section A gathers demographic data such as age, gender, marital status, educational status, family monthly income, and occupation;
- Section B includes tools to assess the effect of deep breathing exercise on stress level. This section contains a standard PSS-10 [12] to evaluate changes in stress levels.

Scoring for PSS

- Scores ranging from 0-13 would be considered low stress.
- Scores ranging from 14-26 would be considered moderate stress.
- Scores ranging from 27-40 would be considered high perceived stress.

Data collection involves administering the pretest using the standard tool to assess level of stress, followed by the implementation of the deep breathing exercise. After the intervention, a post-test was conducted to measure the outcomes.

Deep Breathing Exercise Regimen

A total of 24 sessions were conducted for each of the participants and duration of each session was 10 minutes. The sessions were conducted thrice a week for each participant and were carried out for two months. As the start date of each participant was different, the total study took three months for completion. All the participants received a proper training with demonstration by the investigator. There was no home based component for these exercises in order to avoid bias and all the sessions were fully supervised by the investigator and were performed in the dialysis unit of the GCS hospital.

The specific breathing technique used in the study was structured deep diaphragmatic breathing exercise. Participants were instructed to perform slow, controlled nasal inhalation with abdominal (diaphragmatic) expansion, followed by slow oral exhalation maintaining an inhalation-exhalation ratio of 1:2. The breathing rate was maintained at approximately 14-16 breaths per minute. Each session lasted 10 minutes, resulting in approximately 140-160 breathing cycles (repetitions) per session.

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics (mean, standard deviation, mean difference) were presented for continuous variables. Inferential statistics (paired t-test, Fisher's exact test) were used to test the significance of the changes in level of stress before and after the intervention. The level of significance was set at p-value <0.05 .

RESULTS

Demographic data is presented in [Table/Fig-1]. About 16 (32%) of them had age above 48 years with a significant gender disparity as 27 (54%) were females. Regarding marital status, a majority were married 39 (78%). About educational status 8 (16%) of them were uneducated, 18 (36%) of them had secondary education, 5 (10%) of them had higher secondary education, 15 (30%) of them had graduation and 4 (8%) of them were postgraduate.

[Table/Fig-2] indicates the pretest and post level of stress before and after deep breathing exercise among haemodialysis patients.

Demographic variable (N=50)	n (%)
Age (years)	
18-28	6 (12)
29-38	14 (28)
39-48	14 (28)
Above 48	16 (32)
Gender	
Male	23 (46)
Female	27 (54)
Marital status	
Married	39 (78)
Unmarried	11 (22)
Educational status	
Uneducated	8 (16)
Secondary	18 (36)
Higher secondary	5 (10)
Graduate	15 (30)
Postgraduate and above	4 (8)

Family monthly income	
Rs. 20,001 to 40,000	1 (2)
Rs. 40,001 to Rs.60,000	24 (48)
Above Rs.60,000	25 (50)
Occupation	
Self-employed	25 (50)
Employed	25 (50)

[Table/Fig-1]: Demographic details.

Stress	Pretest	Post-test
Low (score 0-13)	0	47 (94%)
Moderate (score 14-26)	12 (24%)	3 (6%)
High (score 27-40)	38 (76%)	0

[Table/Fig-2]: Level of stress among haemodialysis patients before and after intervention (N=50).

After deep breathing exercise, 47 (94%) of the haemodialysis patients had low stress and 3 (6%) of them had moderate stress. This indicates that the stress among haemodialysis patients improved remarkably after deep breathing exercises as more patients had low stress after the intervention and no patients had high levels of stress.

[Table/Fig-3] demonstrates the effect of deep breathing exercise on stress among haemodialysis patients. Mean stress score of 29.0 ± 2.9 which reduced to 9.9 ± 2.8 in post-test. Stress among haemodialysis reduced significantly after deep breathing exercises.

	Mean $\pm$ SD	T	df	p-value
Pretest	29.0 ± 2.9	37.4	49	< 0.001
Post-test	9.9 ± 2.8			

[Table/Fig-3]: Effect of deep breathing exercise on stress among haemodialysis patients (N=50).
Test applied: Paired t-test; Level of significance <0.05

[Table/Fig-4] depicts association of stress among haemodialysis patients with selected demographic variables. None of the demographic variables had a significant association with stress among haemodialysis patients.

Demographic variable		Stress		p-value
		High	Moderate	
Age (years)	18-28	5	1	0.292
	29-38	8	6	
	39-48	11	3	
	Above 48	14	2	
Gender	Male	17	6	1.000
	Female	21	6	
Marital status	Married	28	11	0.257
	Unmarried	10	1	
Educational status	Uneducated	7	1	0.874
	Secondary	14	4	
	Higher secondary	3	2	
	Graduate	11	4	
	Postgraduate and above	3	1	
Family monthly income	Rs. 20,001 to 40,000	0	1	0.192
	Rs. 40,001 to Rs.60,000	20	4	
	Above Rs.60,000	18	7	
Occupation	Self-employed	20	5	0.742
	Employed	18	7	

[Table/Fig-4]: Association of stress with selected demographic variables among haemodialysis patients (N=50).
Test applied: Fisher's exact test; Level of significance <0.05

DISCUSSION

The present study evaluated the effectiveness of deep breathing exercise on stress among patients undergoing haemodialysis. The results showed a statistically highly significant reduction in perceived stress scores from high stress to predominantly low stress levels. These findings confirm that a simple, low-cost, nurse-led, non pharmacological intervention can produce substantial psychological benefits in this population.

Possible reasons for such a drastic reduction in stress levels could be this intervention of deep breathing exercise was performed during the haemodialysis period. In this period the patients are already under stress and anxious and hence this makes them more prone to relaxation especially techniques like deep breathing can have a profound effect. Most participants had high baseline stress, allowing greater measurable improvement. Also, the exercise was simple and cost-free, which increases engagement.

The findings of the present study are consistent with several randomised controlled trials and quasi-experimental studies that evaluated relaxation or breathing-based interventions in haemodialysis patients.

A randomised controlled trial reported that Benson's relaxation technique significantly reduced stress, anxiety, and pain perception among haemodialysis patients compared with the control group [13]. The present study's findings are also consistent with Heshmatifar N et al., which highlight the beneficial effects of breathing exercise which reduce stress among haemodialysis patients [14].

A systematic review of randomised controlled trials also concluded that relaxation therapy produces a statistically significant reduction in anxiety and psychological distress, although it emphasised the need for more high-quality multicentre trials [15]. Similarly, research showed significant reductions in stress, anxiety, and depression following relaxation therapy, supporting the role of mind-body interventions in improving psychological outcomes in this population [16]. A more recent quasi-experimental randomised study evaluating deep-breathing exercise in maintenance haemodialysis patients also demonstrated a significant reduction in stress levels after the intervention, reinforcing the effectiveness of breathing-based techniques as a nursing intervention [17]. A study from the Indian background (Mhaske N et al.,) also concluded that deep breathing exercises were effective in reducing stress among CKD clients undergoing haemodialysis and can be recommended as a complementary therapy in nephrology care settings [18]. Also, the present study's examination of the association of stress among haemodialysis patients with selected demographic variables outcomes revealed that there are no significant associations; suggesting the benefits of deep breathing exercises are universally applicable across diverse patient backgrounds. This lack of demographic influence underscores the potential of deep breathing exercise interventions to universally reduce the level of stress of haemodialysis patients, independent of individual differences. Despite the strong findings, comparison with randomised controlled trials suggests the need for, larger multicentre studies, long-term follow-up and comparison with other relaxation techniques.

Limitation(s)

The sample size was relatively small ($n = 50$) and selected using a non probability purposive sampling technique, which limits the generalisability of the findings to the wider population of haemodialysis patients. The study was conducted in selected hospitals in a single geographical area, which may not represent patients from different clinical settings, cultural backgrounds, or healthcare systems. The duration of the intervention was limited to eight weeks, and long-term follow-up was not carried out; hence, the sustainability of the stress reduction effect could not be determined. There was no control group involved in the study and without a comparison group that did not receive the intervention, the true effect of the

deep breathing exercise cannot be isolated and the improvement in stress scores may have been influenced by other factors.

CONCLUSION(S)

In conclusion, the findings of the present study demonstrate that deep breathing exercise is highly effective in reducing stress among patients undergoing haemodialysis, as evidenced by the statistically significant improvement in PSS following the intervention. The absence of a significant association between stress reduction and selected demographic variables indicates that the benefits of deep breathing exercise are consistent across different patient characteristics. This suggests that the intervention can be effectively implemented irrespective of age, gender, educational status, or occupation. These findings advocate for the widespread implementation of deep breathing exercise as an effective practice to improve the overall level of stress for haemodialysis patients.

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