The Effect Of Slow Deep Breathing On Fatigue In Chronic Kidney Disease Patients Undergoing Hemodialysis

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Abstract

Objective: This study aims to explore the impact of slow deep breathing on fatigue in patients with chronic kidney disease receiving hemodialysis.
Method: This quasi-experimental study employed a pretest-posttest control group design involving 44 participants selected through purposive sampling. Participants included individuals diagnosed with chronic kidney disease undergoing hemodialysis and experiencing fatigue. The FACIT-Fatigue instrument was used for data collection, and both dependent and independent t-tests were applied for statistical analysis.
Results: Findings revealed a significant reduction in fatigue scores in the intervention group following the slow deep breathing intervention, with a mean difference of 6.86 and a p-value of 0.000. In comparison, the control group showed a mean difference of 1.91 and a p-value of 0.000.
Conclusion: These results demonstrate the effectiveness of slow deep breathing in reducing fatigue among chronic kidney disease patients undergoing hemodialysis. Slow deep breathing is recommended as a complementary intervention for managing fatigue in this population.

Keywords: Chronic Kidney Disease, Fatigue, Hemodialysis, Slow Deep Breathing

INTRODUCTION

Globally, the prevalence of CKD increased from 13.9% in 2013–2016 to 14.0% in 2017–2020 (Bello et al., 2022). In Indonesia, CKD affects 0.38% of the population, translating to approximately 739,208 individuals (Basic Health Research, 2018). The Indonesian Renal Registry (2018) reported 66,433 new CKD cases requiring hemodialysis and 132,142 active hemodialysis patients. In West Java alone, 131,846 patients underwent hemodialysis in 2018, with 130,931 cases reported in Bandung City by 2020. As of 2023, medical records from a private hospital in Bandung recorded 115 patients undergoing routine hemodialysis.

Chronic kidney disease (CKD) is characterized by kidney failure persisting for three months or longer, with a reduction in kidney function by 78–85% or a glomerular filtration rate below 60 ml/min/1.73 m^2, regardless of the presence of structural kidney abnormalities. CKD is a progressive, irreversible condition that impairs the body's ability to regulate metabolism, fluids, and electrolyte balance, often leading to uremia (Siregar, 2020). CKD has various etiologies, including glomerulonephritis, diabetes, hypertension, nephropathy, and hereditary conditions. Symptoms include fatigue, nausea, vomiting, pruritus, peripheral edema, insomnia, and anemia (Levy et al., 2009). Treatment options include hemodialysis, peritoneal dialysis, and kidney transplantation. Hemodialysis is a high-tech therapy designed to remove metabolic waste and toxins through a semipermeable membrane, involving diffusion, osmosis, and ultrafiltration processes. Despite its benefits, hemodialysis can lead to complications such as hypertension, cardiovascular disease, and fatigue (Judith, 2012).

Fatigue in hemodialysis patients is multifactorial, influenced by uremia, anemia, malnutrition, depression, and physical inactivity. Uremia impairs energy production and protein metabolism, exacerbating fatigue (Brunner & Suddarth, 2001). Additionally, reduced erythropoietin production in CKD disrupts red blood cell formation, contributing to anemia and fatigue. Other contributing factors include inadequate iron intake, repeated phlebotomies, and gastrointestinal bleeding (Pernefri, 2011). Fatigue significantly impacts daily activities, social interactions, and quality of life, with a prevalence ranging from 60–97% among long-term dialysis patients. Hemodialysis sessions lasting 4–5 hours, performed 2–3 times weekly, can further exacerbate fatigue, particularly in patients with anemia and poor nutritional status (Septiwi, 2013).

Fatigue management in patients with chronic conditions, such as chronic kidney disease (CKD), requires a comprehensive approach that incorporates both pharmacological and non-pharmacological strategies. Pharmacological treatments typically aim to correct underlying physiological deficiencies contributing to fatigue, and may include the administration of erythropoietin to manage anemia, L-carnitine to support energy metabolism, and iron supplementation to address iron deficiency—each of which plays a critical role in enhancing oxygen transport and cellular function (Singh et al., 2006). While these interventions can be effective, they may also be associated with side effects, cost burdens, and limited applicability in certain patient populations, which highlights the importance of complementary, non-invasive therapies.

Non-pharmacological interventions have gained increasing attention for their potential to alleviate fatigue while promoting holistic well-being. These approaches include yoga, music therapy, guided relaxation, aromatherapy, and physical activity programs—all of which aim to reduce stress, enhance mood, and improve physiological function (Rezaei et al., 2016; Gok Metin & Ozdemir, 2016). Among these, one particularly promising technique is slow deep breathing therapy, which involves controlled, diaphragmatic breathing performed in a relaxed state, typically with the eyes closed to facilitate focus and mindfulness. As described by Brunner and Suddarth (2002), this rhythmic breathing technique encourages full lung expansion and optimal ventilation, stimulating the parasympathetic nervous system and promoting a state of physiological calm.

Physiologically, slow deep breathing enhances the expansion of respiratory muscles, increases alveolar ventilation, and stimulates surfactant production. These effects reduce alveolar surface tension, improve lung compliance, and ultimately enhance oxygen exchange efficiency and circulatory dynamics. Improved oxygen delivery contributes to better energy metabolism at the cellular level, which can play a significant role in reducing the sensation of fatigue, particularly in patients undergoing hemodialysis, who often experience reduced physical stamina and chronic exhaustion (Destanta et al., 2019). Additionally, by activating relaxation responses, this technique may also mitigate sympathetic overactivity and associated stress responses, further contributing to improved subjective energy levels.

Given the physiological and psychological benefits of slow deep breathing, its application as a non-pharmacological intervention in managing fatigue among CKD patients is both theoretically grounded and practically feasible. This study, therefore, seeks to examine the effect of slow deep breathing exercises on fatigue levels in individuals with CKD receiving regular hemodialysis treatment. Utilizing a quasi-experimental research design, the investigation aims to provide empirical evidence on the effectiveness of this intervention and to support its integration into routine nursing care. By evaluating both the clinical outcomes and practical implications, the study aspires to contribute to a growing body of literature advocating for evidence-based, low-cost, and patient-centered approaches to symptom management in chronic disease populations.

METHODS

Study Design

This quasi-experimental study employed a pretest-posttest design with a control group to evaluate the effect of slow deep breathing on fatigue in patients with chronic kidney disease undergoing hemodialysis. The intervention involved five cycles of slow deep breathing, each lasting five minutes, and was administered exclusively to the intervention group, while the control group continued with their routine activities during hemodialysis. The intervention was carried out over four weeks in January 2024.

Population

The study population comprised all chronic kidney disease patients undergoing hemodialysis in the dialysis unit, totaling 115 individuals. From this population, a sample of 44 respondents undergoing scheduled hemodialysis was selected using a purposive sampling technique. Inclusion criteria included patients diagnosed with chronic kidney disease who were undergoing regular hemodialysis and experiencing fatigue.

Data Collection

Data collection instruments included the SPO Slow Deep Breathing protocol and the FACIT-Fatigue (version 4) questionnaire, which was adapted into Indonesian and validated by Jhonson P. Sihombing in 2016. The validity of the FACIT-Fatigue scale was confirmed through Pearson correlation values ranging from 0.331 to 0.636 (exceeding the threshold of 0.279), while reliability was verified with a Cronbach's alpha of 0.646 (above the acceptable value of 0.6). The FACIT-Fatigue scale consists of 13 items rated on a Likert scale, yielding scores between 0 and 52. Higher scores indicate better quality of life, whereas scores below 30 denote severe fatigue.

Data Analysis

The study commenced with a detailed explanation of the research objectives and the collection of informed consent from participants. To analyze the results, a frequency distribution test was conducted for demographic data, hemodialysis duration, and hemoglobin concentration. The dependent t-test was used to compare mean fatigue levels before and after the intervention within groups, and the independent t-test assessed the effect of slow deep breathing on fatigue between the intervention and control groups.

RESULTS

The results of 44 respondents were distributed into 22 respondents in the intervention group and 22 respondents in the control group as follows:

Table 1. Frequency distribution of respondents in chronic kidney disease patients undergoing hemodialysis

Characteristics	Total (n=44) F(%)	Intervention n=44 (%)	Control n=44 (%)
Age (years)			
Mean ±SD	51.32±11.853	53.36±10.790	49.27±12.747
Min-Max	28-85	32-85	28-75
Gender			
Male	20 (45.5)	9 (40.9)	11 (50.0)
Female	24 (54.5)	13 (59.1)	11 (50.0)
Education			
Junior High School	1 (2.3)	1 (4.5)	

High Junior School	9 (20.5)	6 (27.3)	3 (13.6)
High School	11(25.0)	2(9.1)	9(40.9)
University	23(52.3)	13(59.1)	10(45.5)
Employment			
Civil servant	8 (18.2)	2 (9.1)	6 (27.3)
Self-employed	11 (25)	5 (22.7)	6 (27.3)
Private employee	7 (15.9)	2 (9.1)	5 (22.7)
Housewife	12 (27.3)	9 (40.9)	3 (13.6)
Not working	6 (13.6)	4 (18.2)	2 (9.1)
Duration of HD			
Mean ±SD	5.89±3.512	6.09±3.463	5.68±3.630
Min-Max	1-16	1-16	1-13
<1 years	3 (9.1)	2 (13.6)	1 (4.5)
1-3 years	11 (25)	4 (22.7)	6 (27.3)
>3 years	29 (65.9)	14 (63.6)	15 (68.2)
Hemoglobin level			
Mean ±SD	9.207±1.5125	9.050±1.7509	9.364±1.2519
Min-Max	6.6-13.8	6.6-13.8	6.9-12.1

Based on table 1, it is known that the average age of patients undergoing hemodialysis therapy is 51.32 with the youngest age of 28 years and the oldest age of 85 years. For the gender of female respondents more than male respondents, namely 24 people (54.5%). Based on the level of education, almost half of the patients were college students, namely 23 people (52.3%). For employment, most patients are still working, namely as civil servants as many as 8 people (18.2%), self-employed as many as 11 people (25%), private employees as many as 7 people. The average length of time undergoing hemodialysis is 5.89 years with a minimum value of 1 year and a maximum of 16 years. Patients who experience fatigue have mostly undergone hemodialysis for> 3 years, namely 29 people (65.9%). For the average value of hemoglobin levels is 9.207gr/dl with a minimum hemoglobin level of 6.6 gr/dl while the maximum is 13.8gr/dl.

Table 2. Distribution of mean pre-post fatigue levels in chronic kidney disease patients undergoing hemodialysis

	Total(n=44) *Mean*±**(SD)**	**Intervention**		**Control**	
		Mean ±**(SD)**	**Min-Max**	*Mean* ±**(SD)**	**Min-Max**
Fatigue					
Pre-test	28.89±6.449	28.05±7.442	12-40	29.73±5.320	19-41
Post-test	33.27±5.332	34.91±5.051	25-44	31.64±5.206	21-42

Based on table 2, it is known that the intervention group's pretest-posttest fatique level average value is (28.05) - (34.91). While the pretest-posttest average value of the control group's fatique level (29.73)-(31.64).

Table 3. Mean difference in fatigue levels of chronic kidney disease patients undergoing hemodialysis before and after the intervention group and control group (n=44)

Variabel		**Mean**	***Mean Difference***	**95%CI**	**t**	**P-value**
Intervention	Pretest	28.05	6.86	24.75-31.34	17.677	0.000
	Posttest	34.91		32.67-37.15	32.415	
Control	Pretest	29.73	1.91	27.37-32.09	26.209	0.000
	Posttest	31.64		29.33-33.94	28.505	

Based on table 3, it is known that the pretest-posttest average fatigue level in the intervention group is (28.05-34.91) there is a difference in the average value of 6.86 with a p-value of 0.000 (<0.05). So it can be concluded that there is a difference in the average pretest- posttest fatigue level of the intervention group. While the average value of the pretest-posttest fatigue level in the control group is (29.73-31.64) there is a difference in the average value of 1.91 and a p-value of 0.000 (<0.05). So it can be concluded that there is a difference in the average pretest-posttest fatigue level of the control group. But the increase in scores in the intervention group was higher than the control group.

Table 4 Mean difference in fatigue levels of chronic kidney disease patients undergoing hemodialysis after the intervention in the intervention group and control group

	Grup	N	*Mean*	*Mean* **Difference**	**95 % CI**	P value
Post Test	Intervensi	22	34.91	3.27	0.152-6.394	0.040
	Kontrol	22	31.64			

Based on table 4, it is known that the mean difference value is 3.27, which shows that there is a difference between the mean values of the intervention group and the control group with a p-value of 0.040 (<0.05). Based on these results, it can be concluded that there is an effect of slow deep breathing on fatigue in chronic kidney disease patients undergoing hemodialysis.

DISCUSSION

The evaluation of fatigue levels before and after the intervention within the intervention group, using a dependent test, revealed a mean score ranging from 28.05 to 34.91, with a mean difference of 6.86. In comparison, the control group exhibited a mean score between 29.73 and 31.64, with a mean difference of 1.91. In patients with chronic kidney disease undergoing hemodialysis, erythropoietin production is disrupted due to reduced kidney function. This disturbance impairs the erythropoiesis process, or the formation of red blood cells, leading to anemia. Consequently, the reduced number of erythrocytes compromises the transport of oxygen and nutrients throughout the body, resulting in fatigue and diminished activity tolerance (Septiwi, 2013).

Fatigue is characterized by an overwhelming sense of tiredness and a lack of energy to perform daily activities. Chronic kidney disease patients on hemodialysis frequently report symptoms such as fatigue, weakness, and low energy levels (Kring & Cranel, 2015). An effective intervention for mitigating fatigue in such patients is slow deep breathing exercises. This technique enhances oxygen intake, ensuring it is distributed throughout the body to generate energy and alleviate fatigue. Moreover, slow deep breathing is brief and can be practiced before, during, or after hemodialysis sessions (Stanley, 2011). Performing one to five cycles of slow deep breathing, particularly five cycles, has been shown to improve oxygen perfusion to peripheral tissues, thereby reducing fatigue (Black & Hawks, 2014).

The findings of this study classified the fatigue scores as severe, as indicated by an average score below 30 (Sihombing et al., 2016). Both the intervention and control groups experienced reductions in fatigue levels post-intervention, with average scores exceeding 30 after the intervention. An increase in fatigue scores corresponds to an improved quality of life (Cella, 1987). Similar results were observed in a study by Devi Listiana, where fatigue scores decreased from 26.35 to 33.88 following breathing exercise interventions, as assessed by the FACIT Fatigue questionnaire in hemodialysis patients (Listiana et al., 2023). The independent t-test results demonstrated a significant effect, with a mean post-intervention score of 34.91 in the intervention group ($p = 0.040$) compared to 29.64 in the control group. The mean difference between the groups was 3.27 ($p = 0.04$), confirming the impact of slow deep breathing exercises on reducing fatigue in chronic kidney disease patients undergoing hemodialysis.

The implementation of slow deep breathing exercises involved five cycles lasting 15 minutes during hemodialysis sessions. This aligns with physiological theories that suggest slow deep breathing as a relaxation technique enhances oxygen uptake and delivery to tissues, subsequently reducing fatigue (Brunner & Suddarth, 2002). This exercise focuses on expanding the respiratory muscles, particularly the diaphragm. During inspiration, increased alveolar ventilation occurs due to enhanced inspiratory volume and capacity, which stretches the alveolar walls. This stretching stimulates the production of type II alveolar surfactant, reducing alveolar tension and improving lung compliance. Effective inspiration is further supported by increased intra-alveolar volume, which opens Kohn's pores in the alveolar walls, facilitating collateral ventilation.

Optimizing inspiratory volume and capacity improves gas exchange efficiency at the alveolar-capillary interface. Gas transfer and exchange are influenced by the surface area of the alveoli; expanding this area enhances the exchange of oxygen (O_2) and carbon dioxide (CO_2) with pulmonary capillaries, improving oxygenation in systemic circulation. The resultant oxygen increase supports metabolic processes, generating energy and reducing fatigue (Sukma Destanta et al., 2019).

These findings align with a study by Uswatun Hasanah in 2021, which demonstrated the effectiveness of slow deep breathing exercises in reducing fatigue levels among hemodialysis patients (Hasanah et al., 2021). Similarly, research by Dzunijar Djamaludin in 2019 highlighted the significant impact of breathing exercises on fatigue reduction in this population. Regular practice of such exercises can improve overall health and alleviate fatigue (Djamaludin et al., 2021). Hamed's 2020 study further corroborated these results, showing that breathing exercise interventions during hemodialysis sessions effectively reduced fatigue levels in patients (Hamed et al., 2020).

CONCLUSION

The findings of this study provide robust evidence that slow deep breathing exercises significantly reduce fatigue among patients with chronic kidney disease (CKD) undergoing hemodialysis. The statistical analysis yielded a p-value of 0.04, which is below the conventional threshold of 0.05, indicating a statistically significant effect of the intervention. These results align with prior research emphasizing the effectiveness of relaxation techniques, such as deep breathing, in managing fatigue and enhancing psychological well-being in patients with chronic conditions (Yücel, Güner, & Erdoğan, 2020; Hamed & Abdel Aziz, 2020).

Fatigue remains one of the most frequently reported and debilitating symptoms among individuals receiving hemodialysis, often interfering with physical function, emotional stability, and overall quality of life (Tsai et al., 2015). While pharmacological approaches are commonly used, they may not be sufficient or appropriate for all patients, particularly due to potential side effects. This underscores the importance of integrating non-pharmacological strategies such as slow deep breathing, which is easy to administer, low-cost, and does not require specialized equipment or intensive training.

The physiological mechanism behind slow deep breathing is linked to increased parasympathetic activity and reduced sympathetic arousal, promoting relaxation, improved oxygenation, and ultimately reducing the perception of fatigue (Sari et al., 2024). When implemented as part of routine care, this technique not only alleviates physical symptoms but also enhances patients' sense of control and participation in their own care, contributing to holistic well-being.

However, while the short-term benefits are promising, further research is needed to investigate the long-term effects of this intervention, optimal frequency and duration, and its adaptability across diverse clinical populations and care environments. Future studies should also explore patients' perspectives on the feasibility, acceptability, and sustained use of breathing exercises to ensure their successful integration into standard clinical practice.

In conclusion, this study supports the integration of slow deep breathing as a complementary intervention for fatigue management in hemodialysis patients. Its simplicity, accessibility, and therapeutic potential make it a valuable tool in enhancing the quality of life in this vulnerable population.

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Conflict of Interest

The authors declare no conflict of interest related to the conduct or publication of this research.

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