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Effect of Relaxation Techniques on Fatigue and Pain in Hemodialysis Patients: A Quasi-Experimental Study

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ABSTRACT

Background: Fatigue and pain are common and distressing symptoms among patients undergoing hemodialysis, negatively affecting their daily functioning and quality of life. Non-pharmacological interventions, such as relaxation techniques, may offer a safe and effective approach to managing these symptoms. ***Purpose***: To evaluate the effect of relaxation techniques on fatigue and pain levels among patients undergoing hemodialysis. ***Methods***: A quasi-experimental study with a two-group design was conducted on 80 patients undergoing hemodialysis, who were assigned to either an experimental group or a control group (40 patients in each group). The experimental group received a structured relaxation program during hemodialysis sessions, while the control group received routine care only. Fatigue and pain were assessed before and after the intervention using standardized measurement tools. Data was analyzed using non-parametric statistical tests (Mann–Whitney U test and Wilcoxon signed-rank test). This study was a quasi-experimental nursing intervention conducted within routine clinical care and was not pre-registered in a clinical trial registry. ***Results***: The experimental group demonstrated a statistically significant reduction in fatigue compared with the control group ($p<0.001$). Within-group analysis revealed significant reductions in both fatigue and pain following the relaxation intervention. ***Conclusion***: Relaxation techniques were associated with a statistically significant reduction in fatigue and pain and may serve as a beneficial adjunctive intervention for patients undergoing hemodialysis. ***Implications for Nursing***: Integrating relaxation techniques into routine nursing care may enhance nurses' role in non-pharmacological symptom management and improve patient-centered care in hemodialysis units.

Keywords: Hemodialysis, Relaxation techniques, Fatigue, Pain, Nursing intervention.

What does this paper add?

1. Evidence from this study indicates that structured relaxation techniques were associated with significant reductions in fatigue and pain among the hemodialysis patients studied.
2. Feasibility: Low-cost, nurse-led interventions can be seamlessly integrated into routine dialysis care.
3. Impact: The study offers a practical strategy to enhance patient-centered outcomes and quality of life.

Introduction

The pattern of diseases worldwide is continuously changing, with chronic diseases currently being the leading cause of disability and mortality. Among these, chronic kidney disease often occurs as a complication of diabetes and hypertension (Atkins, 2005). According to the World Health Organization, it is estimated that approximately 10% of the global population suffers from chronic kidney disease, which equals about 850 million people (World Health Organization, 2021).

Hemodialysis is a procedure used to filter and cleanse the blood of excess waste and fluids when the kidneys fail in the end stage of chronic kidney disease (National Kidney Foundation, 2024). Although hemodialysis is a life-saving alternative treatment, it is associated with many complications. Hemodialysis causes changes in heart rate due to acute fluctuations in blood volume and blood pressure during the session. Fatigue is among the most common symptoms in hemodialysis patients, as they experience a significant reduction in energy during and after dialysis sessions. This is attributed to acute physiological changes associated with the sessions, including fluid loss and fluctuations in fluid and electrolyte levels (Bossola & Tazza, 2016; MSD Manuals, 2022).

Patients undergoing hemodialysis often experience compromised quality of life and general well-being. Previous research has reported moderately low well-being scores, with physical health domains being the most negatively affected and high levels of depressive and somatic symptoms observed among patients (Alshraifeen et al., 2023). These findings emphasize the substantial physical and psychological burden associated with hemodialysis treatment and highlight the urgent need for supportive nursing interventions aimed at improving symptom management and overall patient outcomes.

To reduce complications resulting from hemodialysis, relaxation techniques (such as meditation, deep breathing, and mindfulness) emerge as effective tools for improving physical and psychological health. Studies have shown that regular practice of these techniques may contribute to reducing fatigue and symptoms associated with treatment (Pascoe et al., 2017).

A randomized controlled trial by Kaplan Serin et al. (2020) demonstrated the effectiveness of progressive relaxation exercises in reducing pain among hemodialysis patients, showing a statistically significant decrease (p <0.05) in mean pain scores measured using the Visual Analog Scale in the intervention group compared to the control group. Similarly, a quasi-experimental study by Haksara et al. (2024), which included 60 patients, specifically addressed needle insertion pain during hemodialysis sessions—a common patient complaint. The study found that behavioral relaxation training, a practical method focusing on body posture and overt behavior to achieve physical and mental calmness, significantly reduced this acute and specific pain (p <0.05) compared to the control group, as measured by the Numeric Rating Scale (NRS). These findings support the effectiveness of non-pharmacological relaxation interventions in alleviating one of the most distressing types of pain experienced by hemodialysis patients.

A case study by Priheningtyas et al. (2025) demonstrated the effectiveness of progressive muscle relaxation in reducing fatigue among hemodialysis patients. Fatigue levels decreased from a score of 24 (severe fatigue) to 11 (moderate fatigue) after the intervention, indicating a marked improvement in the patients' condition and confirming the positive impact of this non-pharmacological nursing intervention for managing hemodialysis-related fatigue.

Although several studies have examined relaxation techniques in hemodialysis populations, the majority of them have focused on efficacy under controlled conditions rather than on pragmatic integration into routine nursing care. Furthermore, few studies have addressed both fatigue and pain as co-primary outcomes, and no studies —to our knowledge— have evaluated a nurse-led structured relaxation program delivered during hemodialysis sessions within our regional healthcare context. This study therefore provides novel evidence on the real-world applicability of such interventions and addresses a gap in the literature regarding combined symptom management in this vulnerable population.

Methods

Design

A quasi-experimental, non-randomized, two-group design was employed. Randomization was not feasible, because patients in the hemodialysis unit are assigned to fixed morning and evening shifts based on their individual schedules and transportation arrangements. Randomly assigning patients within the same shift could have led to contamination, as patients share the same environment and may interact. To avoid this, one entire shift was assigned to the experimental group and the other to the control group. This design preserves internal validity while respecting the practical constraints of the clinical setting. The study reporting follows the TREND (Transparent Reporting of Evaluations with Non-randomized Designs) checklist recommended by the EQUATOR Network.

Sample and Setting

A convenient sample of 80 patients was recruited from two hemodialysis centers in Idlib city. These centers provide consistent dialysis schedules, ensuring a representative clinical environment.

The sample size was calculated using G*Power 3.1.9.7 for an independent-sample t-test with an allocation ratio of 1:1. The calculation used an alpha level of 0.05, a power of 0.80, and a medium effect size (Cohen’s d = 0.5), which yielded a minimum of 40 patients per group. A 10% attrition rate was considered during sample size calculation; however, no participants were lost to follow-up, and all 80 participants were included in the final analysis.

Group Assignment

Participants were allocated into two equal groups (experimental and control) using a systematic allocation procedure. To determine the starting group, a simple lottery (random draw) was conducted. Subsequently, eligible patients were assigned alternately to either the experimental or control group on a one-by-one basis until the target sample size was reached (n = 40 per group). This approach was adopted for organizational reasons related to the workflow within the dialysis centers and to ensure numerical balance. To mitigate potential selection bias, baseline equivalence between the two groups was statistically examined for key characteristics (age, sex, and duration of hemodialysis) prior to the intervention.

Inclusion Criteria

- Adults aged 18-60 years, Patients older than 60 years were excluded due to higher prevalence of comorbidities and potential frailty in this age group, which could confound the assessment of fatigue and pain and may affect the safety or feasibility of participation in the relaxation program.
- Undergoing regular hemodialysis for ≥3 months (twice weekly). Patients on dialysis for less than three months are generally considered to have acute kidney injury rather than stable chronic disease, and they often experience clinical instability. Therefore, this criterion was applied to ensure a stable chronic kidney disease population and to minimize confounding from acute-phase complications.
- Capable of performing relaxation techniques.

Exclusion Criteria

- Severe psychiatric or neurological disorders.
- Unstable medical conditions.
- Physical disabilities preventing participation.
- Use of strong sedatives or analgesics that could affect the study outcomes.

Measurements

Data was collected using a structured instrument developed by the researcher following an extensive review of the relevant literature. The instrument focused on the following components:

Socio-demographic and Clinical Data*:* This section recorded baseline characteristics, including age, gender, educational level, and duration of hemodialysis treatment.

Pain Assessment: Pain intensity was measured using the Numeric Rating Scale (NRS-11). This is a validated 11-point scale where participants rate their pain from 0 (no pain) to 10 (worst possible pain). It is widely used in clinical settings for its ease of administration during dialysis sessions.

Fatigue Assessment: Fatigue levels were assessed using the Visual Analogue Scale for Fatigue (VAS-F). Participants marked their subjective perception of fatigue on a 10-cm horizontal line, where 0 represents "no fatigue" and 10 represents "extreme fatigue." The distance from the starting point to the mark provided a quantitative score for fatigue intensity.

Validity and Reliability

The Visual Analog Scales (VAS) for fatigue and pain are well-validated instruments and were used without modification. Content validity was established for the demographic data form (developed for this study) and for the Arabic-translated instructions accompanying the VAS. A panel of five experts in nursing and nephrology reviewed these materials for clarity, relevance, and cultural appropriateness. Based on their feedback, the following modifications were made: two items (duration of hemodialysis and session frequency) were added to the demographic form; the VAS instructions were simplified using plain Arabic with illustrative examples for the anchor terms; and a brief definition of “relaxation techniques” was included to ensure patient understanding.

A pilot study was conducted on 10 patients (excluded from the main sample) to assess the feasibility of the data collection process and the clarity of the instructions. Test-retest reliability was confirmed by re-administering the tool after a one-week interval, showing high stability over time.

Procedures and Intervention

Data Collection Procedure

Data was collected during hemodialysis sessions over the course of the study. Baseline measurements (pre-test) for pain (NRS-11) and fatigue (VAS-F) were obtained for both groups before the start of the dialysis session. Post-intervention measurements (post-test) were recorded immediately after the completion of each session using the same instruments.

The Relaxation Intervention

Participants in the experimental group underwent a structured training phase followed by supervised practice. The researchers first explained the techniques and demonstrated them practically. Participants then practiced the steps under direct supervision until mastery was achieved.

The intervention was implemented during the dialysis session for a total duration of 20 minutes. The relaxation program was initiated 90 minutes after the start of the session to allow patients to reach a stable clinical state, minimizing potential confounding from early-session discomfort or hemodynamic fluctuations.

The structured relaxation program consisted of:

- Deep Breathing (4 minutes): Slow diaphragmatic breathing (4s inhale, 7s hold, 8s exhale).
- Progressive Muscle Relaxation (5 minutes): Systematic tensing and relaxing of muscle groups from head to toe.
- Mental Repetition (5 minutes): Calmly repeating a soothing phrase ("Alhamdulillah") to promote mental stillness.
- Guided Imagery (4 minutes): Visualizing a peaceful and comfortable place.
- Mindfulness (2 minutes): Focusing on the present moment to reduce anticipatory anxiety.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee (Approval Number: IRB-IU-00531; Date: July 21, 2025). Official permission was secured from the Idlib Health Directorate and the participating dialysis centers. All participants provided written informed consent after a full explanation of the study's aims and their right to withdraw at any time without affecting their treatment. To ensure confidentiality, all data was anonymized using identification codes. No adverse effects were reported during the intervention, and all 80 participants completed the study protocol.

Data Analysis

Data was analyzed using SPSS, version 27.0. Descriptive statistics (median, interquartile range, frequencies, and percentages) were used to summarize participants’ demographic and clinical characteristics. The Shapiro–Wilk test indicated non-normal distribution for pain and fatigue scores; therefore, non-parametric tests were applied.

Within-group comparisons (pre- vs. post-intervention) were performed using the Wilcoxon signed-rank test, and between-group comparisons were conducted using the Mann–Whitney U test. Effect size (r) was calculated for all comparisons and interpreted as small (0.10-0.29), medium (0.30-0.49), or large ($\geq$ .50). Statistical significance was set at p <0.05.

Results

A total of 95 participants were assessed for eligibility. Of these, 15 were excluded (9 did not meet the inclusion criteria and 6 declined to participate). Eighty participants were included and allocated equally into the intervention and control groups (n = 40 each). No participants were lost to follow-up, and all participants were included in the final analysis. The participant flow is illustrated in Figure 1.

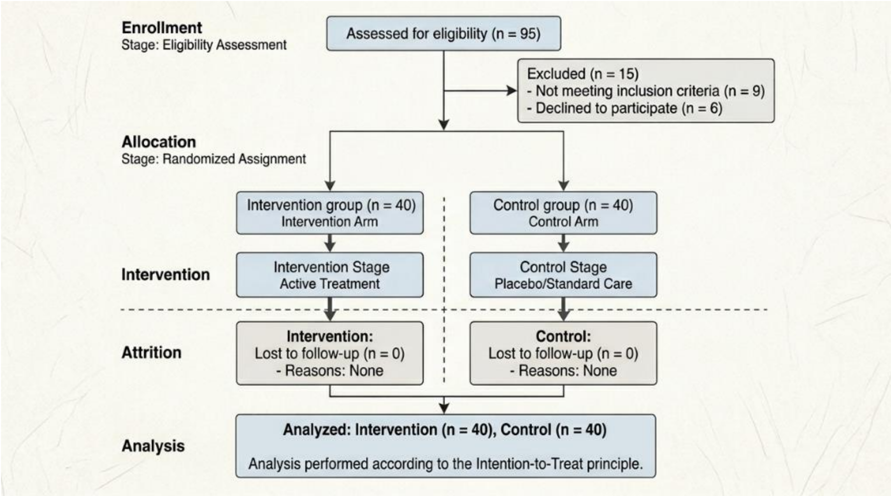

Figure 1. Flow diagram of participant recruitment, allocation, and analysis

Part I: Baseline Participant Characteristics and Group Equivalence

A total of 80 patients completed the study. More than a half of the participants (60%) were aged between 40 and 60 years, with a slight predominance of females (52.5%). Regarding educational status, approximately two-thirds of the sample (66.2%) were non-educated. In terms of clinical characteristics, cardiovascular diseases were the most frequently observed comorbidity (57.5%), and more than two-thirds of the participants (68.8%) had been receiving hemodialysis for more than five years.

Statistical analysis using the chi-square test revealed no significant differences between the experimental and control groups across all demographic and clinical variables (p >0.05). In addition, Mann–Whitney U tests demonstrated no significant baseline differences between groups in pain (NRS-11) or fatigue (VAS-F) scores (p *>0.05)*. Effect size estimates for baseline comparisons were negligible (r = 0.01-0.18), indicating a high level of baseline equivalence. These findings confirm that the two groups were statistically comparable prior to the intervention, allowing subsequent changes in pain and fatigue levels to be attributed to the relaxation techniques. A detailed description of the sample is presented in Table 1.

Table 1. Baseline demographic and clinical characteristics of participants by group (N = *80)*

Characteristics	Control Group (n = 40)		Experimental Group (n = 40)		Total (№ = 80)		Chi-Square p-value
	№	%	№	%	№	%	
Gender:							
Male	19	47.5%	19	47.5%	38	47.5%	1.000
Female	21	52.5%	21	52.5%	42	52.5%	
Age:							
18 - 39	17	42.5%	15	37.5%	32	40.0%	0.648
40 - 60	23	57.5%	25	62.5%	48	60.0%	
Educational level:							
Educated	12	30.0%	15	37.5%	27	33.8%	0.478
Uneducated	28	70.0%	25	62.5%	53	66.2%	
Medical history:							
No disease	11	27.5%	8	20.0%	19	23.8%	0.585

Diabetes	6	15.0%	9	22.5%	15	18.8%	
Cardiovascular	23	57.5%	23	57.5%	46	57.5%	
Duration of dialysis treatment:							
Less than 2 years	3	7.5%	7	17.5%	10	12.5%	
2–5 years	9	22.5%	6	15.0%	15	18.8%	0.364
More than 5 years	28	70.0%	27	67.5%	55	68.8%	

- The adopted level of significance (α =0.05); p-values greater than 0.05 were considered not statistically significant.

Part II: Comparison of Pre- and Post-Intervention Pain and Fatigue within the Control and Experimental Groups

This section evaluates the differences in pain and fatigue levels before and after the dialysis session for each group individually. The Wilcoxon Signed-Rank Test was used due to the non-normal distribution of the data.

Control Group: The results showed a limited, but statistically significant, increase in pain intensity post-session (p = 0.033, r = 0.33). No statistically significant change was observed in fatigue intensity ($p > 0.05$), indicating that routine care had a negligible effect on these physical symptoms, Table 2.

Experimental Group: Following the application of relaxation techniques, fatigue intensity showed a substantial decrease (p =0.001), while pain intensity exhibited a moderate, but statistically significant, reduction (p =0.014, r =0.38). These results indicate that relaxation techniques were effective in reducing pain and fatigue during the hemodialysis session, Table 2.

Table 2. Comparison of pain and fatigue before and after hemodialysis in control and experimental groups

Indicator		Pre-intervention measurement Median [Q1 – Q3]	Post-intervention measurement Median [Q1 – Q3]	Wilcoxon *p*-value	Effect size (r)
Control Group	Pain	2.50 [3.37 – 1.87]	2.87 [4.12 – 1.75]	0.033*	0.33
	Fatigue	2.5 [1.5 – 3.9]	2.5 [1.5 – 3.9]	0.20	0.36
Experimental Group	Pain	3.00 [3.75 – 2.25]	2.25 [3.37 – 1.25]	0.014*	0.38
	Fatigue	3.00 [4.60 – 2.00]	0.70 [1.40 – 0.20]	0.001***	0.85

- Values are expressed as the median [lower quartile – upper quartile]. The Wilcoxon signed-rank test was used for paired samples, with the level of statistical significance set at ($p < .05$).
- Effect size (r) was reported to estimate the practical strength of differences and classified as small (.10– .29), medium (.30– .49), and large (≥ .50).
- *: indicates statistical significance at $p < .05$; **: indicates statistical significance at $p < .01$; ***: indicates statistical significance at p < .001.

Part III: Comparison of Post-Intervention Pain and Fatigue between the Control and Experimental Groups

Table 3 presents the comparison of post-intervention pain and fatigue levels between the control and experimental groups following the relaxation intervention. Fatigue intensity was significantly lower in the experimental group compared to the control group (Median: 0.75 vs. 2.50, $p < 0.001$, r = 0.48), indicating a strong beneficial effect of the relaxation techniques. Pain intensity also decreased in the experimental group (2.25 vs. 2.87), although this reduction did not reach statistical significance (p = 0.382), suggesting a trend toward improvement.

Table 3. Comparison of post-intervention pain and fatigue between the control and experimental groups

Indicator	Control Group (n = 40) Median [Q1 – Q3]	Experimental Group (n = 40) Median [Q1 – Q3]	Mann-Whitney *p*-value	Effect size (*r*)
Pain	2.87 [4.12 – 1.75]	2.25 [3.37 – 1.25]	0.382	0.09
Fatigue	2.50 [3.87 – 1.50]	0.75 [0.50 – 0.25]	0.001***	0.48

Part IV: Cumulative Effect of Relaxation Techniques on Pain and Fatigue

This section evaluates the cumulative effect of relaxation techniques using a two-step approach:

1. Within the Experimental Group: The cumulative effect of the intervention was assessed by comparing baseline measurements (before the first session) with final measurements (after the last session) for pain and fatigue within the experimental group using the Wilcoxon Signed-Rank Test, Table 4. The results showed a statistically significant reduction in pain intensity, decreasing from 3.50 to 2.00 (p = 0.001, r = 0.44), and in fatigue intensity, decreasing from 3.50 to 0.50 (p = 0.001, r = 0.85).

Table 4. Cumulative impact of relaxation techniques on pain and fatigue within the experimental group

Indicator	Before the first dialysis session Median [Q1 – Q3]	After the last dialysis session Median [Q1 – Q3]	Wilcoxon *p*-value	Effect size (*r*)
Pain	3.50 [4.00 – 2.00]	2.00 [3.00 – 0.00]	0.001***	0.44
Fatigue	3.50 [5.00 – 2.50]	0.50 [1.00 – 0.00]	0.001***	0.85

2. Between-Group Comparison: To determine whether the cumulative improvement was attributable to the intervention, total change scores (Δ: pre- to post-intervention difference) for pain and fatigue were calculated for each participant and compared between the experimental and control groups using the Mann-Whitney *U* Test, Table 5. The experimental group showed significantly greater reductions in both pain (p = 0.001, r = 0.46) and fatigue (p = 0.001, r = 0.71) compared to the control group, confirming the effectiveness of the relaxation techniques in producing a meaningful cumulative improvement in these outcomes.

Table 5. Comparison of cumulative change scores (Δ) for pain and fatigue between the control and experimental groups

Indicator	Δ Control Group (n = 40) Median [Q1 – Q3]	Δ Experimental Group (n = 40) Median [Q1 – Q3]	Mann-Whitney *p*-value	Effect size (*r*)
Pain	0.25 [0.75 – -0.50]	-1.00 [0.00 – -1.37]	0.001***	0.46
Fatigue	0.75 [0.00 – -1.00]	0.00 [0.00 – -2.25]	0.001***	0.71

- Δ represents the total change (the difference between pre- and post-intervention measurements) for each indicator, where negative values indicate a decrease after the intervention, while positive values indicate an increase

Discussion

The present study demonstrated that the integrated relaxation techniques had a significant positive effect on reducing pain and fatigue among hemodialysis patients. Statistically, participants in the experimental group reported a marked decrease in pain intensity, while the control group showed a slight increase in median pain scores, likely due to cumulative fatigue and the psychological strain of repeated dialysis sessions without additional supportive interventions. This difference between groups indicates the effectiveness of the intervention, as improvements in the experimental group can be attributed to the application of relaxation techniques. These findings are consistent with previous studies, including Kaplan Serin et al. (2020), when reported significant reductions in pain after implementing progressive muscle relaxation exercises, and Al Hasbi et al. (2020), who observed a gradual, sustained decrease in pain with regular practice over time.

Physiologically, relaxation techniques, particularly progressive methods, reduce sympathetic nervous system activity and stimulate the parasympathetic system, resulting in decreased secretion of stress hormones, such as cortisol and catecholamines (adrenaline and noradrenaline). These hormones are known to increase vascular constriction and enhance nerve receptor sensitivity, amplifying pain perception. Reducing their levels contributes to muscle relaxation, improved blood circulation, and increased pain threshold, which is particularly relevant for hemodialysis patients prone to local pain (e.g., cannulation) and muscle cramps associated with fluid and electrolyte imbalances (Benson, 1982; Kaplan Serin et al., 2020).

Additionally, consistent practice over time produces cumulative benefits, as supported by Abu Maloh et al. (2022), who reported that significant pain reduction typically emerges after several weeks of regular application.

Regarding fatigue, participants in the experimental group experienced a substantial and statistically significant reduction in fatigue severity (p <0.001), with median scores decreasing from moderate (3.00) to low levels (0.75), while the control group remained relatively stable at a median of 2.50. This demonstrates the chronic and persistent nature of hemodialysis-related fatigue under standard care. The intervention not only achieved statistical significance, but also produced a large practical effect (r = 0.85), indicating a meaningful improvement in patients' functional status. These results align with previous studies showing the effectiveness of relaxation techniques in reducing fatigue, including the use of Benson's method (Wihastuti & Ismail, 2023), respiratory relaxation exercises (Sutinah & Azhari, 2020), and combined progressive muscle and deep breathing techniques (Fari et al., 2019).

The underlying mechanism for fatigue reduction appears to involve both physiological and psychological pathways. Relaxation techniques restore balance between the sympathetic and parasympathetic systems, lowering stress hormone levels and alleviating mental and physical exhaustion. Furthermore, by reducing psychological burdens, such as anxiety and stress, relaxation techniques free mental energy and enhance vitality. As with pain, cumulative practice over time was essential for achieving sustained improvements, consistent with findings by Bassiri Moghadam et al. (2014) and Ghozhdi et al. (n.d.), who indicated that significant reductions in fatigue typically require six to twelve weeks of regular practice.

While these findings highlight the potential of relaxation techniques as an effective complementary nursing intervention to alleviate pain and fatigue in hemodialysis patients, some limitations should be acknowledged. Despite the positive outcomes, the study's quasi-experimental design and use of a convenient sample may limit the generalizability of the findings.

Conclusion

This study concludes that structured relaxation techniques, including deep breathing, progressive muscle relaxation, and mindfulness, are highly effective non-pharmacological interventions for reducing fatigue and pain in patients undergoing hemodialysis. The significant reduction in symptom severity within the experimental group—supported by a large effect size—underscores the potential of these techniques to mitigate the physiological and psychological burdens of chronic kidney disease. While the results are promising, the cumulative nature of these benefits suggests that consistency and long-term practice are essential for sustaining patient well-being during dialysis therapy.

Implications for Nursing

The findings of this study have several practical implications for nursing practice and hemodialysis care:

- **Clinical Practice:** Nurses can integrate simple, low-cost relaxation exercises into routine dialysis sessions to enhance symptom management. This empowers nurses to take a leading role in non-pharmacological care, reducing reliance on analgesics.
- **Patient-Centered Care:** Implementing these techniques fosters a more holistic approach, addressing not only the physical needs, but also the psychological strain experienced by patients during sessions.
- **Nursing Education:** Training programs for dialysis nurses should include competency in teaching and supervising relaxation techniques, ensuring they can effectively guide patients toward self-management.
- **Policy and Protocols:** Hemodialysis units should consider incorporating structured relaxation "quiet time" into their clinical protocols to improve the overall quality of care and patient satisfaction.

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Conflict of Interests

The authors declare no conflict of interests.

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Author Contributions

Study Design: **SD, MAD**. Data Collection: **SD**. Data Analysis: **SD**. Study Supervision: **SD**. Manuscript Writing: **SD, MAD**. Critical Revision for Important Intellectual Content: **SD, MAD**.

REFERENCES

Abu Maloh, H.I.A., Soh, K.L., Chong, S.C., Ismail, S.I.F., Soh, K.G., Abu Maloh, D.I., Al Yateem, N., & AbuRuz, M.E. (2022). The effectiveness of Benson’s relaxation technique on pain and perceived stress among patients undergoing hemodialysis: A double-blind, cluster-randomized, active control clinical trial. *Clinical Nursing Research*, 32 (2), 288-297. https://doi.org/10.1177/10547738221112759

Al Hasbi, H., Chayati, N., & Nurul Makiyah, S.N. (2020). Progressive muscle relaxation to reduce chronic pain in hemodialysis patient. *Medisains*, 17 (3), 62–66. https://doi.org/10.30595/medisains.v17i3.5823

Alshraifeen, A., Al-Rawashdeh, S., & Rababa, M. (2023). Quality of life and general well-being in people receiving hemodialysis treatment: A cross-sectional study. *Jordan Journal of Nursing Research*, 2 (1). https://doi.org/10.14525/JJNR.v2i1.07

Atkins, R. C. (2005). The epidemiology of chronic kidney disease. *Kidney International Supplement*, 94, S14–S18. https://doi.org/10.1111/j.1523-1755.2005.09403.x

Bassiri Moghadam, M., Madadkar Dehkordi, S. H., Mohammadpour, A., & Vaezi, A. A. (2014). The effect of progressive muscle relaxation technique on fatigue in patients undergoing hemodialysis. *Journal of North Khorasan University of Medical Sciences*, 3 (2), 24–32.

Benson, H. (1982). The relaxation response: History, physiological basis and clinical usefulness. *Acta Medica Scandinavica*, 211 (S660), 231-237. https://doi.org/10.1111/j.0954-6820.1982.tb00378.x

Bossola, M., & Tazza, L. (2016). Fatigue in dialysis patients. *Seminars in Dialysis*, 29 (5), 429-430. https://doi.org/10.1111/sdi.12525

Fari, A.I., Sofiani, Y., & Warongan, A. W. (2019). Efektifitas progressive muscle relaxation (PMR) dan relaxation breathing exercise (RBE) terhadap tingkat fatigue dan selfcare pasien GGK. *Jurnal Keperawatan Silampari*, 2 (1), 99-110. https://doi.org/10.32524/jksp.v2i1.201

Ghozhdi, M. K., Ghaljeh, M., & Khazaei, N. (n.d.). The effect of progressive muscle relaxation technique on fatigue, pain and quality of life in dialysis patients: A clinical trial study. *Evidence Based Care Journal*. https://doi.org/10.22038/ebcj.2022.65275.2708

Haksara, E., Rahmanti, A., Pratama, D., & Puspitasari, Y. (2024). Pengaruh behavioral relaxation training terhadap nyeri kanulasi (Av-Shunt) pada pasien ginjal kronik yang menjalani hemodialisis di rumah sakit TK.II Dr. Soedjono Magelang. *Jurnal Kesehatan Amanah*, 8 (2), 287–292. https://doi.org/10.57214/jka.v8i2.733

Kaplan Serin, E., Ovayolu, N., & Ovayolu, Ö. (2020). The effect of progressive relaxation exercises on pain, fatigue, and quality of life in dialysis patients. *Holistic Nursing Practice*, 34 (2), 121-128. https://doi.org/10.

1097/HNP.0000000000000347

MSD Manuals. (2022, September 12). Dialysis (غسيل الكُلى). *MSD Manual Professional Version*. https://www.msdmanuals.com/ar/home/-اضطرابات الكلى-والسبيل-البولي/غسل-الكُلى/غسل-الكُلى

National Kidney Foundation. (2024, April 26). *Hemodialysis*. https://www.kidney.org/atoz/content/hemodialysis

Pascoe, M.C., Thompson, D.R., Jenkins, Z.M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. *Journal of Psychiatric Research*, 95, 156-178. https://doi.org/10.1016/j.jpsychires.2017.08.004

Priheningtyas, F. A. O., Syahruramdhani, S., & Tariyah, T. (2025). The effect of progressive muscle relaxation on fatigue levels in patients undergoing hemodialysis. *An Idea Health Journal*, 5 (3), 302-305. https://doi.org/10.53690/ihj.v5i02.506

Serin, E.K., Ovayolu, N., & Ovayolu, Ö. (2020). The effect of progressive relaxation exercises on pain, fatigue, and quality of life in dialysis patients. *Holistic Nursing Practice*, 34 (2), 121-128. https://doi.org/10.1097/HNP.0000000000000347

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. https://doi.org/10.33024/minh.v3i1.2335

Wihastuti, T.A., & Ismail, D.S.L. (2023). Differences between the effects of the Benson relaxation technique and deep breath on anxiety, sleep quality, and fatigue in hemodialysis patients. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*, 8 (2). https://doi.org/10.30504/jika.v8i2.1654

World Health Organization. (2021, March 11). *Chronic kidney disease*. https://www.who.int/news-room/fact-sheets/detail/chronic-kidney-disease