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The effect of intradialytic exercise and classical music therapy on comfort in hemodialysis patients: A quasi-experimental study

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Abstract

Background: Hemodialysis is the primary treatment for patients with stage 5 chronic kidney disease (CKD). However, patients often face complications during the procedure, such as intradialytic hypertension, which can significantly reduce their comfort and increase morbidity and mortality rates. Safe and non-pharmacological interventions, including intradialytic exercise and classical music therapy, have emerged as promising strategies to alleviate these complications and improve patient well-being.
Objective: This study aimed to assess the combined effect of intradialytic exercise and classical music therapy on the comfort levels of hemodialysis patients.
Methods: A quasi-experimental pretest-posttest design with a control group was utilised. A total of 36 patients were recruited through purposive sampling and evenly assigned to two groups: an intervention group (n = 18) and a control group (n = 18). The intervention group received combined 30-minute sessions of intradialytic exercise and classical music therapy twice a week for four consecutive weeks. Comfort was assessed using a modified Zung Self-Rating Anxiety Scale for physiological and psychological comfort, and a modified Multidimensional Scale of Perceived Social Support for social comfort. Statistical analyses were performed using the Wilcoxon signed-rank test and the Mann-Whitney U test.U test.
Results: The intervention group showed a statistically significant improvement in both physiological comfort (p = 0.023) and psychological comfort (p = 0.002) following the therapies. However, no significant improvement was observed in the social comfort domain (p = 0.463).
Conclusion: The combination of intradialytic exercise and classical music therapy may improve the physiological and psychological comfort of CKD patients undergoing hemodialysis. This approach shows potential as an applicable, cost-effective, and easily accessible nursing intervention in clinical hemodialysis settings, although it does not significantly improve social comfort. However, given the quasi-experimental design and the small sample size, further research is needed to confirm these causal effects.

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Introduction

Hemodialysis (HD) is a vital treatment for patients with end-stage renal disease, but it often brings significant physical and psychological discomfort. One major complication that contributes to this distress is intradialytic hypertension (IDH), which is often not adequately managed (Prasad et al., 2022). IDH is characterised by an abnormal increase in systemic blood pressure during or immediately after a dialysis session and affects approximately 15% to 30% of patients undergoing hemodialysis (Adejumo et al., 2024; Georgianos et al., 2015). Unlike intradialytic hypotension, which has received more immediate clinical attention in the past, IDH remains a hidden threat. It is strongly associated with negative cardiovascular outcomes, left ventricular hypertrophy, and increased all-cause mortality rates in patients undergoing routine hemodialysis (Adejumo et al., 2024; Iatridi et al., 2022). Additionally, spikes in blood pressure during dialysis can lead to severe headaches, excessive fatigue, and acute anxiety, significantly impacting a patient's overall comfort and quality of life (Gomes et al., 2023; Sav et al., 2014).

When intradialytic hypotension (IDH) occurs during a dialysis session, standard clinical responses typically involve immediate mechanical and pharmacological adjustments. Common treatments include reducing the blood pump speed or administering fast-acting antihypertensive agents, such as beta-blockers or loop diuretics (Kanbay et al., 2020; Sułowicz & Radziszewski, 2007). While these approaches may be necessary for acute management, they come with significant physiological drawbacks. Reducing the blood flow rate directly compromises dialysis adequacy, so uremic toxins and excess fluids are not effectively removed from the patient's system. Additionally, administering antihypertensive medications during the session can lead to dangerous rebound hypotension post-dialysis, as well as muscle cramps, extreme weakness, and an unstable hemodynamic state. These physiological disruptions do not address the underlying mechanisms of IDH, such as sympathetic overactivation and endothelial dysfunction, and may even worsen the patient's physical stress and overall discomfort (Georgianos et al., 2015; Georgianos & Agarwal, 2018).

Due to the limitations and adverse side effects of pharmacological management, there is a growing clinical imperative to integrate non-pharmacological interventions into routine hemodialysis care. Two particularly promising modalities for managing blood pressure and enhancing patient comfort are intradialytic exercise (Lakshmi et al., 2024) and classical music therapy (Lin et al., 2024; Zhu & Peng, 2024). Intradialytic exercise, specifically tailored aerobic or light resistance training performed during the early stages of dialysis, has demonstrated profound cardiovascular and metabolic benefits. According to a comprehensive meta-analysis by Pu et al. (2019), exercising during dialysis improves endothelial function, enhances vasodilation, and facilitates better fluid shifts from the interstitial spaces into the vascular compartment. This physiological mechanism ensures a more stable and efficient removal of urea and uremic toxins by the dialyzer (Pu et al., 2019). Consequently, intradialytic exercise not only helps stabilize blood pressure but also combats dialysis-related fatigue, significantly elevating the patient's physiological and physical comfort.

Complementing the physical benefits of exercise, classical music therapy serves as a potent, non-invasive intervention targeting the autonomic nervous system. Hemodialysis is an inherently stressful procedure that often triggers sympathetic nervous system dominance, leading to severe vasoconstriction and subsequent blood pressure spikes. Listening to classical music with a slow, steady rhythm has been shown to counteract this stress response by stimulating the parasympathetic nervous system (Laloan, 2025). This auditory stimulation reduces the secretion of stress hormones, such as cortisol and adrenaline, while simultaneously encouraging the endothelial release of nitric oxide. Nitric oxide acts as a natural vasodilator,

relaxing blood vessel walls and effectively lowering systemic vascular resistance (Mitsiou et al., 2022; Inayama et al., 2022; Nopriani & Xesti, 2025).
Ultimately, the convergence of stable hemodynamics and reduced neuromuscular tension results in a profound sense of relaxation. When intradialytic exercise and classical music therapy are administered concurrently, they offer a highly synergistic effect. Exercise addresses the mechanical and metabolic aspects of fluid and toxin removal, while music therapy mitigates autonomic dysregulation and psychological distress. Together, these non-pharmacological therapies hold significant potential to safely control intradialytic blood pressure, minimize reliance on intradialytic medications, and holistically improve the comfort and well-being of hemodialysis patients. Thus, this study aimed to assess the combined impact of intradialytic exercise and classical music therapy on patients' physiological, psychological, and social comfort levels during regular hemodialysis.

Methods

Research design

This study employed a quasi-experimental pretest-posttest design with a control group. The research was conducted at a regional public hospital in West Nusa Tenggara Province, Indonesia.

Setting and samples

The sample size was determined using the formula for the mean difference between two independent groups. The sample size was determined using the formula for the mean difference between two independent groups. By setting the significance level (α) at 5%, statistical power at 80% (β = 20%), and an estimated moderate effect size (Cohen's d = 0.5) based on previous related studies evaluating non-pharmacological interventions in hemodialysis (Pu et al., 2019). Accounting for an estimated 10% dropout rate, justified by the expected low attrition typical of captive populations receiving routine, mandatory in-center hemodialysis care (Polit & Beck, 2020), a total of 36 participants were required. These respondents were evenly allocated into an intervention group (n = 18) and a control group (n = 18).

Purposive sampling was used based on specific inclusion and exclusion criteria. The inclusion criteria comprised patients who: (a) had been undergoing routine hemodialysis for at least three months, (b) were aged between 15 and 64 years, (c) received physician clearance to engage in physical exercise during dialysis, (d) were prescribed comparable antihypertensive medications, (e) had an interdialytic weight gain (IDWG) of ≤ 3 kg, (f) presented with pre-dialysis blood pressure of ≥ 140/90 mmHg, and (g) provided informed consent to participate and listen to classical music. Patients were excluded if they: (a) had musculoskeletal disorders or neurological impairments, (b) experienced severe hemodynamic instability or dyspnea, (c) utilized femoral venous access, or (d) suffered from hearing loss.

Intervention

The experimental treatment consisted of a combined intradialytic exercise and classical music therapy program. This intervention was administered exclusively during the first hour of the patients' hemodialysis sessions to ensure optimal hemodynamic stability and minimize the risk of late-dialysis hypotensive episodes.

Concurrently, participants were provided with MP3 players and earphones to listen to non-lyrical classical music set at a relaxing tempo of 60–80 beats per minute. This dual intervention

lasted for a continuous 30 minutes per session and was conducted twice a week for four consecutive weeks (Hidayati, 2015; Sarayar et al., 2013).

The physical exercise protocol was conducted while patients were seated or in a semi-recumbent position in their dialysis chairs. To ensure patient safety and protect the vascular access, all upper-body exercises were strictly performed using the non-access arm (the limb without the arteriovenous fistula or graft). The 30-minute exercise protocol was structured into three distinct phases:

- Warming up (5 minutes): Consisted of light, unweighted active range-of-motion (ROM) exercises focusing on the neck, shoulders, wrists, and ankles to prepare the joints and muscles.
- Main physical activity (20 minutes): Utilized a 1-kg dumbbell for the non-access arm (e.g., bicep curls and shoulder flexions) and a 1-kg ankle cuff for both legs (e.g., seated knee extensions and ankle pumps). Movements were performed at a slow, controlled pace.
- Cooling down (5 minutes): Involved static stretching and guided deep breathing exercises to safely lower the heart rate back to resting levels.

To ensure scientific rigor and patient safety, the entire intervention was directly supervised by a trained hemodialysis nurse and researcher. Vital signs (blood pressure, heart rate, and respiratory rate) were monitored prior to the start, halfway through the session (at 15 minutes), and immediately upon completion. Strict stopping criteria were enforced; the intervention was immediately terminated if a patient experienced chest pain, severe dyspnea, dizziness, muscle cramps, a sudden drop in systolic blood pressure (> 20 mmHg), or bleeding from the vascular access site.

The control group received standard hospital care, which included routine intradialytic monitoring and standard medical management, without the addition of the exercise or music protocols.

Measurement and data collection

Data were collected through questionnaires administered to both groups at baseline (pretest) and immediately following the four-week treatment period (posttest).

Patient comfort was evaluated using two modified instruments:

- Physiological and Psychological Comfort: Assessed using a modified version of the Zung Self-Rating Anxiety Scale (Zung, 1971). This customized scale included four specific items focusing on hemodynamics, physical complaints, and psychological well-being. Responses were scored on a 4-point Likert scale (1 = None/A little of the time, to 4 = Most/All of the time). The modified instrument demonstrated acceptable internal consistency with a Cronbach's alpha of 0.82, and content validity was established through expert review.
- Social Comfort: Measured using a modified version of the Multidimensional Scale of Perceived Social Support (Zimet et al., 1988). This scale utilized a 7-point Likert scale ranging from 1 (Very Strongly Disagree) to 7 (Very Strongly Agree). Prior to implementation, the modified scale was pilot-tested, yielding a Cronbach's alpha of 0.85, indicating strong reliability. Construct validity was verified using Pearson product-moment correlation ($r > 0.3$).

Data analysis

Statistical analyses were performed to evaluate the efficacy of the intervention. Baseline homogeneity between the intervention and control groups was assessed using the Chi-square test. Given the sample size of fewer than 50 respondents, the Shapiro-Wilk test was utilized to

evaluate data normality. The normality test resulted in a p-value of < 0.05, indicating that the data were not normally distributed.

Consequently, non-parametric statistical methods were applied. The Wilcoxon signed-rank test was employed to analyze the differences between pre- and post-intervention data within each respective group. Furthermore, the Mann-Whitney U test was utilized to compare the post-intervention outcomes between the intervention and control groups to determine the overall effect of the therapy (Dahlan, 2008).

Results

The characteristics of respondents in this study were grouped by age, sex, education, occupation, adherence to taking antihypertensive drugs, the period of undergoing hemodialysis, and IDWG. The characteristics of respondents is presented in Table 1.

Table 1. Distribution of respondents based on the characteristics and homogeneity test in the intervention group and the control group (n=36).

Characteristics	Groups				Total		p
	Intervention		Control				
	f	%	f	%	f	%	
Age							0.505
24-44	8	44.4	10	55.6	18	50	
≥45	10	55.6	8	44.4	18	50	
Sex							0.735
Male	8	44.4	7	38.9	15	41.7	
Female	10	55.6	11	61.1	21	58.3	
Education							0.612
Uneducated	3	16.7	4	22.2	7	19.4	
Elementary	0	0	2	11.1	2	5.6	
Junior High	6	33.3	4	22.2	10	27.8	
Senior High	5	27.8	5	27.8	10	27.8	
Higher Education	4	22.2	3	16.7	7	19.4	
Employment							0.735
Unemployed	7	38.9	8	44.4	15	41.7	
Employed	11	61.1	10	55.6	21	58.3	
Adherence to taking antihypertensive drugs							
Not adherent	0	0	0	0	0	0	
Adherent	18	100	18	100	36	100	
Period of undergoing HD (months)							0.630
<12	3	16.7	2	11.1	5	13.9	
≥12	15	83.3	16	88.9	31	86.1	
IDWG (kg)							0.674
≤1.6	15	83.3	14	77.8	29	80.6	
>1.6	3	16.7	4	22.2	7	19.4	

Table 1 details the baseline demographic and clinical characteristics of the participants. Overall, the sample was predominantly female, employed, and fully compliant with their

prescribed antihypertensive medications. Most participants had been undergoing hemodialysis for 12 months or longer and maintained an interdialytic weight gain (IDWG) of ≤ 1.6 kg. The baseline homogeneity analysis revealed no statistically significant differences between the intervention and control groups across all measured variables (all $p > 0.05$), indicating that the two groups were well-matched and comparable prior to the intervention.

Table 2. Physiological, psychological, and social comfort in the intervention group pre and post the intervention (n=36)

Comfort	Pre Mean ± SD (min-max)	Post Mean ± SD (min-max)	P
Physiological	1.94 ± 0.87 (1-4)	0.72 ± 1.12 (0-3)	0.001
Psychological	65.6 ± 11.5 (44-78)	52.3 ± 12.9 (30-75)	0.000
Social	1.78 ± 0.42 (1-2)	1.67 ± 0.48 (1-2)	0.41

Based on Table 2, it can be seen that there was a significant difference in the physiological comfort (p=0.001) and psychological comfort (p=0.000) between pre and post intervention, whereas, in the social comfort, no significant difference was found (p=0.41).

Table 3. Physiological, psychological, and social comfort in the control group pre and post the intervention (n=36)

Comfort	Pre Mean ± SD (min-max)	Post Mean ± SD (min-max)	P
Physiological	1.61 ± 1.03 (0-3)	1.67 ± 1.18 (0-3)	0.725
Psychological	67.5 ± 10.8 (51-79)	67.1 ± 11.7 (47-79)	0.615
Social	1.72 ± 0.46 (1-2)	1.78 ± 0.42 (1-2)	0.65

Based on Table 3, it can be seen that there was no significant difference in all levels of comfort between pre and post-intervention in the control group, including physiological comfort (p=0.725), psychological comfort (p=0.615), and social comfort (p=0.65).

Table 4. Physiological, psychological, and social comfort after the intervention in the intervention group and the control group (n=36)

Comfort	Intervention Mean ± SD (min-max)	Control Mean ± SD (min-max)	P
Physiological	0.72 ± 1.17 (0-3)	1.67 ± 1.18 (0-3)	0.023
Psychological	52.3 ± 12.9 (30-75)	67.1 ± 11.7 (47-79)	0.002
Social	1.67 ± 0.48 (1-2)	1.78 ± 0.42 (1-2)	0.463

The results of Mann-Whitney test for both physiological and psychological comfort obtained p-value=0.023 and p=0.002, respectively, meaning that there were significant differences in the levels of comfort between the intervention group and the control group. Meanwhile, the

test result for social comfort obtained a p-value of 0.463, indicating that there was no significant difference between the intervention group and the control group.

Discussion

Demographic characteristics

The demographic analysis of this study indicates that the age distribution across both the intervention and control groups was comparable, with the majority of respondents aged 24 years and older. Advancing age is fundamentally linked to physiological degeneration, particularly vascular remodeling. Over time, arterial walls thicken due to collagen accumulation in the muscular layers, leading to progressive vascular narrowing and arterial stiffness. Concurrently, renal blood flow and the glomerular filtration rate inevitably decline. Consequently, age is a critical determinant of prognosis and life expectancy in end-stage renal disease (ESRD), as patients over the age of 40 are significantly more susceptible to comorbid complications that exacerbate renal decline (Bikbov et al., 2020).

This study included a higher proportion of female respondents, which aligns with recent epidemiological data indicating that the global prevalence of chronic kidney disease (CKD) is often higher in women than in men. This discrepancy is primarily due to physiological and hormonal differences, as well as women's longer life expectancies (Carrero et al., 2018).

Regarding educational background, most respondents had attained secondary education (junior high and high school). Health literacy, which is closely linked to educational attainment, plays a crucial role in how proactively patients manage their diseases. Higher health literacy enhances a patient's understanding of their condition and encourages positive health behaviours, including adherence to complex treatment regimens (Taylor et al., 2017). In this cohort, participants showed high compliance with both the experimental interventions and their prescribed antihypertensive medications. Moreover, most respondents remained employed, which seemed to serve as a psychological buffer. Patients reported that working distracted them from feelings of grief related to their illness and provided essential peer motivation, thereby reducing depressive symptoms and allowing them to focus on therapeutic outcomes.

All participants in this study had been undergoing hemodialysis for over a year and exhibited an interdialytic weight gain (IDWG) of ≤ 1.6 kg. A prolonged dialysis vintage is a recognised risk factor for increased arterial stiffness, which stimulates overactivity of the sympathetic nervous system, a primary driver of intradialytic hypertension (IDH). Additionally, fluid shifts and volume depletion during dialysis can lead to paradoxical sympathetic activation and significant vasoconstriction, exacerbating episodes of IDH (Georgianos & Agarwal, 2018).

Physiological, Psychological, and Social Comfort

Intradialytic hypertension (IDH) is a well-documented factor contributing to increased physical discomfort, higher cardiovascular risk, and increased mortality in patients undergoing routine hemodialysis (Georgianos & Agarwal, 2018). The causes of IDH are multifactorial, primarily driven by sympathetic nervous system overactivity and the retention of uremic toxins.

This study demonstrates that combining intradialytic exercise with classical music therapy effectively alleviates these pathophysiological triggers. Physiologically, engaging in light exercise during dialysis increases capillary surface area in the active muscles. This exercise-induced vasodilation promotes the movement of fluid and uremic toxins from the extravascular space into the vascular system. As a result, the dialyser can more efficiently clear urea and toxins, thereby lowering vascular resistance and reducing systemic blood pressure (Lakshmi et al., 2024; Verrelli et al., 2024).

Simultaneously, classical music therapy has a calming effect on the central nervous system. Listening to slow-tempo music has been shown to down-regulate the hypothalamic-pituitary-adrenal (HPA) axis, leading to reduced secretion of corticotropin-releasing factor (CRF) and adrenocorticotropic hormone (ACTH). This reduction in hormonal activity results in lower cortisol levels, decreased sympathetic nervous system activity, and a subsequent drop in blood pressure (Pu et al., 2021). Additionally, listening to soothing music stimulates the release of endorphins, promoting a deep sense of relaxation.

The combination of these two interventions aligns well with Kolcaba's Comfort Theory. By employing active exercise and passive music therapy as holistic "comfort measures," the interventions effectively optimise hemodynamic stability by decreasing blood pressure, heart rate, and respiratory rate while also fostering positive emotional responses.

The intervention was strategically implemented during the first hour of hemodialysis. This timing aligns with current literature identifying the early phase of dialysis as the period of greatest hemodynamic stability, allowing patients to exercise safely under the direct supervision of the clinical team (Sheshadri et al., 2019). Furthermore, this approach represents an accessible, cost-effective strategy that utilizes existing treatment time without imposing additional scheduling burdens on patients.

Our data demonstrates that integrating intradialytic exercise with classical music therapy significantly enhances both physiological and psychological comfort. While the theoretical framework suggests these therapies stabilize autonomic functions, we cannot definitively claim they prevented "acute cardiovascular distress" without continuous hemodynamic monitoring data. Instead, based on our instrument measurements, the observed improvements are more directly aligned with the alleviation of perceived physical complaints and the reduction of procedure-related anxiety. This finding is consistent with recent meta-analyses by Pu et al. (2019) and Lin et al. (2024), which affirm that combined non-pharmacological interventions effectively mitigate somatic symptoms and stress during dialysis.

Conversely, it is noteworthy that the intervention did not produce a statistically significant improvement in social comfort. This outcome highlights a critical distinction in therapeutic targets. The instruments used in our study measure social comfort based on perceived support from family, friends, and significant others. Because our intervention was strictly individual-focused and confined to the clinical setting, it inherently lacked the mechanisms to enhance interpersonal relationships. This suggests that while exercise and music are excellent for somatic and psychological symptom management, factors related to the environment, family, or interpersonal relationships require different therapeutic approaches (e.g., family-centered care or peer support groups) to achieve a substantial impact on the social dimension of comfort for hemodialysis patients.

Implication and limitations

The findings of this study have significant implications for nursing practice in hemodialysis settings. The integration of intradialytic exercise and classical music therapy provides a safe, non-pharmacological, and cost-effective method for managing intradialytic hypertension and enhancing patient comfort. Nurses can effectively incorporate these evidence-based comfort measures during the first hour of hemodialysis to optimise hemodynamic stability and reduce psychological distress, without requiring additional time beyond the patient's scheduled treatment. However, the lack of improvement in social comfort indicates that holistic nursing care should also explore alternative strategies, such as involving family members or implementing peer-support systems, better to address the social aspects of chronic kidney disease.

This study does have some limitations that should be noted. Firstly, the research utilised a quasi-experimental design with a relatively small sample size of 36 participants from a single regional public hospital in West Nusa Tenggara Province. This may restrict the generalizability of the findings to larger populations. Secondly, the short intervention period of four weeks may not adequately assess the long-term sustainability of the observed improvements in patient comfort. Finally, although the study accounted for variables such as interdialytic weight gain (IDWG) and adherence to antihypertensive medications, it is recommended that future randomised controlled trials include larger sample sizes across multiple centres to validate these findings and monitor outcomes over a longer time frame.

Conclusion

The combined approach of intradialytic exercise and classical music therapy shows potential to improve the physiological and psychological comfort of patients undergoing routine hemodialysis. Although no significant changes were observed in social comfort, this strategy offers a practical and accessible non-pharmacological nursing intervention in clinical settings. Incorporating such holistic and non-invasive comfort measures into standard hemodialysis care warrants consideration, though larger randomized controlled trials are needed to validate these preliminary findings.

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Author contribution

N. F.: Conceptualisation, methodology, investigation, data curation, and writing of the original draft.
S. C.: Supervision, validation, clinical advice, and writing for review and editing.
A. N.: Formal analysis, refinement of methodology, and contribution to review and editing.

Conflict of interest

The authors declare that they have no conflicts of interest regarding the research, authorship, and/or publication of this article.

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