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Review Article

Effects of intradialytic exercise on physical and psychological outcomes in patients undergoing hemodialysis: A systematic review

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Abstract

Background: Patients undergoing maintenance hemodialysis frequently experience physical and psychological problems, including fatigue, reduced functional capacity, muscle weakness, anxiety, stress, depression, and a decline in quality of life. These conditions are influenced by chronic kidney disease, long-term hemodialysis, limitations in physical activity, and dependence on dialysis therapy. Intradialytic exercise, defined as physical exercise performed during a hemodialysis session, is a nonpharmacological intervention with the potential to improve patients' physical and psychological conditions.
Objective: To evaluate the effectiveness of intradialytic exercise on physical and psychological outcomes in patients undergoing hemodialysis.
Methods: This systematic review was conducted in accordance with the PRISMA guidelines and was registered in PROSPERO under registration number CRD420261386106. Literature searches were conducted in PubMed, ScienceDirect, Scopus, Web of Science, and CINAHL. Articles published from 2020 to 2026 were searched, with the final search conducted in May 2026. The included studies were quantitative studies, primarily randomized controlled trials, quasi-experimental studies, or other intervention studies that evaluated exercise performed during hemodialysis and reported physical and/or psychological outcomes. Study selection, data extraction, and quality assessment were performed independently by the reviewers. A total of 18 studies met the inclusion criteria and were analyzed in this systematic review.
Results: The synthesis showed that intradialytic exercise had positive effects on physical outcomes, including improvements in functional capacity, muscle strength, activity tolerance, and physical performance, as well as reductions in fatigue. Several studies also reported improvements in psychological outcomes, including reductions in anxiety, stress, and depression and improvements in quality of life.
Conclusion: Intradialytic exercise may be an effective nonpharmacological intervention for improving physical and psychological outcomes in patients undergoing hemodialysis, while taking into account each patient's clinical condition, safety, and individual capabilities.

Background

Patients with advanced-stage chronic kidney disease who undergo maintenance hemodialysis frequently experience various physical and psychological problems resulting from the disease process, long-term dialysis therapy, activity restrictions, and changes in social roles in daily life. The latest KDIGO guideline emphasizes that chronic kidney disease has broad effects on patients' clinical condition, physical function, and quality of life; therefore, management should comprehensively address physical, psychological, and quality-of-life aspects (KDIGO CKD Work Group, 2024). Hemodialysis plays an essential role in sustaining life; however, patients receiving this therapy commonly continue to experience fatigue, reduced physical activity, sleep disturbances, depression, anxiety, impaired functional capacity, and poor quality of life (Almutary et al., 2022; Bossola et al., 2023; Hu et al., 2024). Recent evidence also indicates that low physical activity among patients receiving maintenance hemodialysis is associated with poorer quality of life, whereas higher levels of physical activity and better exercise habits are associated with better health-related quality of life (Hu et al., 2024).

Fatigue is one of the most common complaints among patients undergoing hemodialysis and may reduce their ability to perform daily activities, decrease productivity, and limit social participation (Wahida et al., 2023). In addition to physical problems, patients undergoing hemodialysis are vulnerable to psychological problems such as anxiety, stress, depression, and reduced mental well-being because of dependence on dialysis machines, repeated treatment

schedules, changes in physical condition, and uncertainty regarding disease progression (Pu et al., 2019).

Reduced physical activity among patients undergoing hemodialysis may worsen their physical condition, lead to muscle deconditioning, reduce exercise tolerance, and increase the risk of psychological disorders and deterioration in quality of life (Baker et al., 2022). One nonpharmacological intervention that can be implemented to address these problems is intradialytic exercise, which refers to physical exercise performed during a hemodialysis session and commonly includes aerobic exercise, resistance exercise, stretching, or a combination of exercises tailored to the patient's clinical condition (Chung et al., 2017).

These physical and psychological problems are interrelated. Reduced functional capacity may cause patients to become increasingly inactive, easily fatigued, and less confident in performing activities, whereas psychological problems may reduce their motivation to undergo treatment, maintain physical activity, and preserve their quality of life.

Intradialytic exercise is considered a practical intervention because it is performed while patients are undergoing hemodialysis, thereby reducing time-related barriers, improving adherence to exercise, and enabling direct monitoring by healthcare professionals (Lin et al., 2021). Several systematic reviews and meta-analyses have shown that intradialytic exercise may improve functional capacity, muscle strength, walking ability, physical performance, and quality of life among patients undergoing hemodialysis (Chung et al., 2017).

In addition to its physical benefits, intradialytic exercise has been reported to positively affect psychological outcomes, including reductions in depressive and anxiety symptoms and improvements in patients' mental health status (Pu et al., 2019). Exercise programs that are regular, structured, and tailored to patients' abilities have the potential to become an important component of nursing care and rehabilitation for patients undergoing hemodialysis (Lin et al., 2021).

Therefore, intradialytic exercise focuses not only on improving physical function but also has the potential to improve quality of life, reduce fatigue, decrease the risk of frailty, and support the psychological health of patients undergoing hemodialysis (Wahida et al., 2023; Zou et al., 2025). Low physical activity among these patients may aggravate physical deconditioning, reduce cardiorespiratory endurance, increase the risk of falls, and accelerate the decline in physical function (Baker et al., 2022).

Nevertheless, the types, duration, frequency, and intensity of exercise, as well as the outcomes measured across studies, remain highly variable. A systematic review is therefore required to synthesize the scientific evidence regarding the effectiveness of intradialytic exercise on physical and psychological outcomes in patients undergoing hemodialysis (Wahida et al., 2023).

One nonpharmacological intervention that may help address these problems is intradialytic exercise, defined as physical exercise performed during a hemodialysis session. This intervention may include aerobic exercise, resistance exercise, flexibility exercises, breathing exercises, or a combination of exercise types tailored to the patient's clinical condition. Intradialytic exercise is considered practical because it is performed while patients are undergoing hemodialysis, thereby reducing time-related barriers, improving exercise adherence, and enabling direct monitoring by healthcare professionals (Jiang et al., 2025; Li et al., 2025).

Previous evidence indicates that intradialytic exercise has the potential to improve physical function, physical activity, quality of life, and several psychological outcomes among patients undergoing hemodialysis. A recent systematic review showed that exercise performed during hemodialysis can increase physical activity and support patients' physical and psychological health; however, the available evidence remains heterogeneous in terms of exercise type, duration, intensity, and measured outcomes (Li et al., 2025). Another meta-analysis also showed that exercise therapy may improve depression and the physical component of quality of life among patients receiving maintenance hemodialysis, although the effect on anxiety should be interpreted cautiously because of the limited number of studies and heterogeneity of findings (Li et al., 2026).

Although previous studies and reviews have examined the benefits of intradialytic exercise, most have focused separately on specific outcomes, such as dialysis adequacy, physical activity, cognitive function, depression, anxiety, or quality of life. For example, Jiang et al. (2025) primarily compared different exercise types in relation to dialysis adequacy, whereas Li et al. (2026) focused on depression, anxiety, and physical health-related quality of life. A research

gap therefore remains because few systematic reviews have comprehensively integrated physical, psychological, and clinical outcomes into a single synthesis.

Based on this gap, this systematic review aimed to evaluate the effectiveness of intradialytic exercise on physical, psychological, and clinical outcomes in patients undergoing hemodialysis. This review is expected to provide a more comprehensive understanding of the benefits of intradialytic exercise as a nonpharmacological intervention that can be integrated into nursing care and rehabilitation for patients undergoing hemodialysis.

This systematic review is important because few reviews have integrated physical, psychological, and clinical outcomes into one comprehensive synthesis. Most previous reviews have focused separately on specific outcomes, such as functional capacity, fatigue, depression, or quality of life. However, physical, psychological, and clinical problems are interrelated among patients undergoing hemodialysis and may collectively affect their overall quality of life. Therefore, this review aimed to provide a comprehensive overview of the benefits of intradialytic exercise as a nonpharmacological intervention for patients undergoing hemodialysis.

Methods

Study Design

This study employed a systematic literature review approach to comprehensively examine the effects of intradialytic exercise on physical, psychological, and clinical outcomes in patients undergoing hemodialysis. A systematic review was selected to synthesize scientific evidence in a structured, transparent, and methodologically rigorous manner regarding the effectiveness of exercise performed during hemodialysis sessions, particularly its effects on functional capacity, muscle strength, fatigue, physical performance, quality of life, anxiety, stress, depression, and mental well-being.

This review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure completeness of reporting, clarity of the literature-selection process, accountability in data extraction, and transparency in the synthesis of study findings. The review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420261386106. The PROSPERO registration number had already been included in the abstract and Methods sections of the original manuscript.

Research Question

The research question in this systematic review was: *"What are the effects of intradialytic exercise on physical, psychological, and clinical outcomes in adult patients undergoing maintenance hemodialysis?"*

The research question was developed using the PICO framework. The Population comprised adult patients undergoing maintenance hemodialysis. The Intervention was intradialytic exercise, defined as physical exercise performed during hemodialysis sessions, including aerobic exercise, resistance exercise, flexibility exercises, range-of-motion exercises, combined exercise, or physical exercise with a cognitive component. The Comparison included standard care, no exercise, usual exercise outside hemodialysis sessions, or other comparison interventions. Outcomes included physical, psychological, and clinical outcomes, such as functional capacity, muscle strength, physical performance, fatigue, frailty, quality of life, anxiety, stress, depression, mental well-being, dialysis adequacy, blood pressure, and other relevant clinical parameters.

Inclusion and Exclusion Criteria

The eligibility criteria for this systematic review were established to ensure that the included studies were directly relevant to the study objective, namely, to examine the effects of intradialytic exercise on physical and psychological outcomes in patients undergoing hemodialysis. Articles were selected based on topic relevance, methodological rigor, type of intervention, population characteristics, and each study's contribution to an evidence-based understanding of the benefits of exercise during hemodialysis.

Studies were included if they met the following criteria: original research examining intradialytic exercise or physical exercise performed during hemodialysis sessions; inclusion of adult patients undergoing maintenance hemodialysis; use of a quantitative design, such as a randomized controlled trial, quasi-experimental study, or other intervention study; and reporting of physical and/or psychological outcomes. Physical

outcomes included functional capacity, muscle strength, physical performance, fatigue, frailty, quality of life, and activity tolerance, whereas psychological outcomes included anxiety, stress, depression, mental well-being, and other psychosocial outcomes (Lin et al., 2022; Wahida et al., 2023; Zou et al., 2025).

Search Strategy

Studies were included when the intervention comprised aerobic exercise, resistance exercise, flexibility exercises, range-of-motion exercises, combined exercise, or physical exercise with a cognitive component performed during hemodialysis. Eligible articles were peer-reviewed, available in full text, written in English, and published between January 2020 and May 2026, in accordance with the literature-search period.

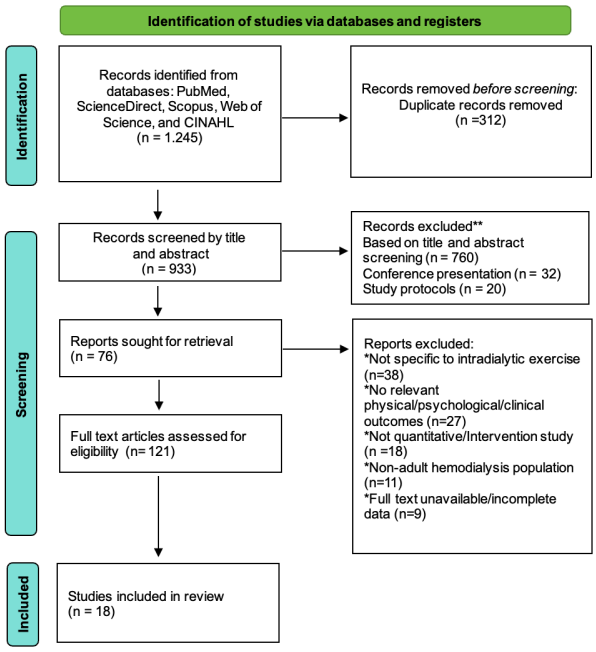

Figure 1. PRISMA flow diagram

The search strategy was developed using combinations of keywords and the Boolean operators AND and OR, adapted to the indexing system of each database. The keywords included "intradialytic exercise," "hemodialysis," "maintenance hemodialysis," "physical function," "fatigue," "quality of life," "depression," "anxiety," "psychological outcomes," "frailty," "exercise therapy," and "resistance exercise". The search strategy was as follows: ("intradialytic exercise" OR "exercise during hemodialysis" OR "exercise therapy") AND ("hemodialysis" OR "maintenance hemodialysis") AND ("physical function" OR "fatigue" OR "quality of life" OR "depression" OR "anxiety" OR "psychological outcomes").

Data Extraction

Data from studies that met the inclusion criteria were independently extracted by the reviewers using a structured data-extraction form. The information collected included author names, year of publication, country, study design, participant characteristics, sample size, type of hemodialysis, form of intradialytic exercise intervention, exercise frequency, exercise duration, intervention period, comparison group, physical outcomes, psychological outcomes, measurement instruments, and the main findings of each study.

Data extraction focused on outcomes aligned with the study objective, namely, the effects of intradialytic exercise on the physical and psychological conditions of patients undergoing hemodialysis. Extracted physical outcomes included functional capacity, muscle strength, physical performance, fatigue, frailty, activity ability, and quality of life, whereas psychological outcomes included anxiety, stress, depression, mental well-being, and emotional aspects of quality of life (Wahida et al., 2023; Zou et al., 2025).

Study selection was conducted systematically through several stages: identification of articles from the databases, removal of duplicates, screening of titles and abstracts, full-text assessment, and determination of the final studies that met the inclusion criteria. Disagreements among reviewers during study selection and data extraction were resolved through discussion until consensus was reached (Honda et al., 2026; Uchida et al., 2026).

Quality Assessment and Risk of Bias

The methodological quality of the included studies was assessed using critical appraisal tools appropriate to each study design, such as the Joanna Briggs Institute Critical Appraisal Tools or other relevant methodological quality-assessment instruments for randomized controlled trials and quasi-experimental studies. This assessment evaluated the validity, reliability, and relevance of the study findings included in the systematic review.

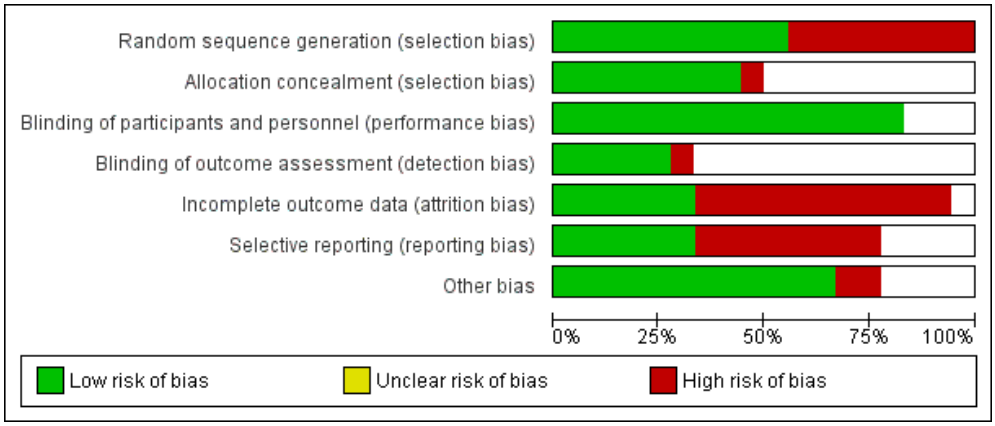

Table 1. Distribution of respondent demographics across intervention and control groups

The assessed aspects included clarity of the inclusion criteria, sample-selection methods, the randomization process where applicable, equivalence of group characteristics at baseline, clarity of the intervention, appropriateness of the comparison group, completeness of outcome data, validity of the measurement instruments, and appropriateness of the statistical analyses. Quality assessment was important because studies of intradialytic exercise varied in design, sample size, exercise type, and outcome-measurement methods.

Risk of bias in the included studies was assessed by considering domains such as selection bias, performance bias, detection bias, attrition bias, reporting bias, and overall risk of bias. Each study was independently assessed by the reviewers, after which the findings were compared and discussed when interpretations differed (Honda et al., 2026; Uchida et al., 2026).

Data Synthesis and Analysis

Findings from the included studies were synthesized according to methodological characteristics, type of intradialytic exercise intervention, exercise duration and frequency, patient characteristics, comparison group, and reported physical and psychological outcomes. The synthesis aimed to identify patterns of benefit, consistency of findings, and variations in the effects of intradialytic exercise among patients undergoing hemodialysis (Lin et al., 2022; Wahida et al., 2023).

Studies were categorized by exercise type, including aerobic exercise, resistance exercise, flexibility exercises, combined exercise, or physical exercise combined with cognitive training. This categorization was applied because different exercise types may produce different effects on functional capacity, muscle strength, fatigue, frailty, quality of life, and psychological outcomes.

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Studies were categorized by exercise type, including aerobic exercise, resistance exercise, flexibility exercises, combined exercise, or physical exercise combined with cognitive training. This categorization was applied because different exercise types may produce different effects on functional capacity, muscle strength, fatigue, frailty, quality of life, and psychological outcomes (Bogataj et al., 2024; Boukadida et al., 2026).

The analysis also considered intervention duration because the length of an exercise program may influence the magnitude of its effects on quality of life and physical performance among patients undergoing hemodialysis. Studies involving more structured interventions conducted over sufficiently long periods tended to provide a clearer understanding of the effects of intradialytic exercise on physical and psychological outcomes (Honda et al., 2026; Uchida et al., 2026).

Synthesis Analysis

Overall, the analyzed articles showed that intradialytic exercise primarily benefited physical outcomes, particularly functional capacity, muscle strength, walking performance, balance, frailty, fatigue, and quality of life. The large study by Anding-Rost et al. provided the strongest evidence because it involved a large sample and used a multicenter cluster RCT design; its findings showed significant improvements in the 60-second sit-to-stand test, timed up-and-go test, and 6-minute walk test compared with usual care. These findings were supported by Kim et al., Yabe et al., Michou et al., Feng et al., and Boukadida et al., who also reported improvements in physical function based on measures such as the SPPB, 6MWT, gait speed, handgrip strength, and body composition.

Psychological and quality-of-life outcomes also tended to improve, although not all studies specifically assessed psychological outcomes. Feng et al. was among the most relevant studies for psychological outcomes because it assessed anxiety, depression, fatigue, sleep, and cognitive function. The study showed that elastic-band exercise performed during hemodialysis reduced fatigue, sleep disturbances, depression, and anxiety. Elghoneimy et al. and Moeinzadeh et al. also reported improvements in quality of life, including physical and mental domains.

Results

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Regarding clinical outcomes, several studies reported positive effects on dialysis adequacy and physiological parameters. Kim et al. showed an increase in Kt/V, Boukadida et al. reported improvements in the urea reduction ratio and creatinine reduction ratio, and Lakshmi et al. reported improvements in urea, creatinine, and fatigue. Agustin et al. and Rossum et al. contributed evidence regarding cardiovascular outcomes and safety, including the effects of exercise on blood pressure and the risk of intradialytic hypotension. Rossum et al. showed that the timing of cycling, whether early or late in the hemodialysis session, did not significantly increase the risk of intradialytic hypotension.

Table 2. Data Extraction

Authors (Year)	Country	Design	Sample	Intervention	Comparator	Physical/ Psychological / Clinical Outcomes	Main Findings
Rossum et al. (2023)	Canada	Multicenter randomized crossover trial	98 adult patients undergoing HD	Intradialytic cycling early vs late in the HD session	Cycling at different times	Intradialytic hypotension, symptomatic IDH, recovery time	No significant difference was found between early and late cycling during HD in relation to IDH; cycling late in the session was also considered safe.

Authors (Year)	Country	Design	Sample	Intervention	Comparator	Physical/ Psychological / Clinical Outcomes	Main Findings
Takahashi et al. (2023)	Japan	Historical cohort	76 hospitalized patients undergoing HD	Intradialytic exercise plus rehabilitation	Non-IDE	ADL, Barthel Index, grip strength, IKES, 10-meter walking speed, SPPB	IDE improved the Barthel Index and 10-meter walking speed and supported functional recovery among hospitalized patients undergoing HD.
Tabibi et al. (2023)	Iran	Randomized controlled trial	74 patients undergoing HD	Intradialytic exercise for 60 minutes, 3 times/week, for 6 months	No intradialytic exercise	Survival, 6-minute walk test, nutritional status, hematological measures	One-year survival was higher in the exercise group (94% vs 73%); secondary outcomes also improved.
Shehata et al. (2026)	Egypt	Parallel-group RCT	60 patients undergoing HD	Nurse-led lower-limb stretching during HD, 2 times/week for approximately 8 weeks	Usual care	Cramp intensity, frequency, duration, pain, discomfort	Intradialytic stretching significantly reduced the intensity, frequency, duration, pain, and discomfort of muscle cramps.
Lakshmi et al. (2024)	India	Non-randomized interventional study	295 patients undergoing HD	Aerobic intradialytic exercise for 15 minutes during a 2-hour HD period for 8 weeks	Routine care	Fatigue, blood urea, creatinine, potassium, hemoglobin	Intradialytic exercise significantly improved urea, creatinine, and fatigue; potassium and hemoglobin remained relatively unchanged.
Anding-Rost et al. (2023)	Germany	Multicenter cluster RCT	917 patients analyzed	Combined endurance and resistance exercise during HD for 12 months	Usual care	STS60, TUG, 6MWT, QoL, hospitalization, survival	Exercise improved STS60, TUG, 6MWT, the physical summary score, and vitality; adverse events were similar to those in the control group.
Baião et al. (2023)	Brazil	Quasi-experimental	18 patients undergoing HD	Intradialytic resistance training 2 times/week for 8 months	Pre-post	Handgrip, sit-to-stand, TUG, gait speed, body composition, inflammatory markers	Improvements were primarily observed in TUG, BMI, and basal metabolic rate; inflammatory markers did not change significantly.
Shrivastava & Sakhardande (2022)	India	Quasi-experimental	60 patients undergoing HD	Intradialytic aerobic exercise	Pre-post/intervention	Muscle cramp score	Intradialytic aerobic exercise effectively reduced muscle cramps among patients undergoing hemodialysis.
Kim et al. (2022)	South Korea	RCT	39 patients undergoing HD	Ergometer cycling for 40-70 minutes, 3 times/week, for 12 weeks	Education/usual care	Frailty, gait speed, grip strength, SPPB, Kt/V, SF-36 QoL	Exercise improved frailty, gait speed, grip strength, SPPB, dialysis adequacy, and quality of life.
Michou et al. (2023)	Greece	Randomized interventional study	29 patients undergoing HD who were kidney	Combined aerobic and resistance intradialytic	Usual care	6MWD, 10-STS, handgrip, body composition	Exercise improved 6MWD, handgrip strength, lean mass, phase angle,

Authors (Year)	Country	Design	Sample	Intervention	Comparator	Physical/ Psychological / Clinical Outcomes	Main Findings
			transplant candidates	exercise for 4 months			and body composition.
Yabe et al. (2021)	Japan	RCT	101 older patients undergoing HD	Aerobic and resistance exercise 3 times/week for 6 months	Usual care	Lower-extremity strength, SPPB, 10-meter walking speed	Intradialytic exercise improved SPPB among older patients undergoing HD, but did not significantly improve lower-extremity strength or the 10MWT.
Sefidgaran et al. (2024)	Iran	Double-blind randomized clinical trial	30 patients with ESRD undergoing HD	Intradialytic aerobic exercise for 6 months	Control	Dialysis adequacy, biochemical markers, QoL, physical performance	The study assessed the effects of exercise on dialysis adequacy, biochemical markers, quality of life, and physical performance among patients undergoing HD.
Moeinzadeh et al. (2022)	Iran	Randomized clinical trial	110 patients undergoing HD	Intradialytic cycling for 30 minutes, 3 times/week, for 12 weeks	Usual HD	Quality of life, recovery time	Intradialytic cycling improved quality-of-life domains and evaluated post-HD recovery time.
Agustin et al. (2022)	Indonesia	Quasi-experimental pre-post study with a control group	30 patients with CKD undergoing HD	Intradialytic exercise	Control	Systolic and diastolic blood pressure	The intervention group experienced a significant reduction in blood pressure; exercise was considered beneficial for blood-pressure control during HD.
Boukadida et al. (2026)	Tunisia	Pre-experimental clinical trial	21 patients receiving maintenance HD	Intradialytic resistance training 2-3 times/week for 12 weeks	Pre-post	6MWT, blood pressure, URR, creatinine reduction ratio, nutritional status	Exercise improved the 6MWT, reduced blood pressure, increased the URR and creatinine reduction ratio, and improved nutritional status.
Ali et al. (2020)	Egypt	Sectional/interventional study	60 patients with ESRD undergoing HD	Physical therapy program during the intradialytic period for 6 months	Pre-post	SF-36 QoL, urea, creatinine, physical ability	Intradialytic exercise improved several SF-36 components and reduced urea and creatinine.
Feng et al. (2025)	China	RCT	60 patients receiving maintenance HD	Elastic-band exercise during HD for 0.5-2 hours, 3 times/week, for 12 weeks	Routine HD care	SPPB, MoCA, fatigue, PSQI, HAMA, HAMD	Elastic-band exercise improved physical and cognitive function and reduced fatigue, sleep disturbances, depression, and anxiety.
Elghoneimy et al. (2022)	Egypt	Experimental study	30 patients undergoing HD	Aerobic pedal exercise for 30 minutes, 3 times/week, for 8 weeks	Control	6MWT, KDQOL-SF physical and mental components	Exercise improved the 6MWT and quality of life, including physical and mental components.

Discussion

This systematic review showed that intradialytic exercise consistently improved physical function among patients undergoing hemodialysis, including functional capacity, muscle strength, activity performance, and fatigue. Physiologically, exercise during hemodialysis may increase muscle perfusion, improve oxygen-use efficiency, and enhance energy metabolism, thereby supporting greater activity capacity. Exercise also helps reduce deconditioning caused by prolonged immobility during dialysis. These findings are consistent with rehabilitation theory in chronic disease, which states that structured physical activity can maintain musculoskeletal function and prevent progressive declines in functional capacity (Bogataj et al., 2024; Battaglia et al., 2024).

Intradialytic exercise also demonstrated positive effects on clinical indicators, including dialysis adequacy, blood pressure, and several metabolic parameters. Exercise during hemodialysis may increase blood flow to the muscles, thereby enhancing the clearance of uremic solutes and dialysis efficiency. This mechanism may explain why several studies reported increases in Kt/V and the urea reduction ratio following intradialytic exercise interventions. Physical activity may also contribute to hemodynamic stability during dialysis and help reduce the risk of complications such as intradialytic hypotension. These findings are supported by recent studies reporting that intradialytic exercise improves dialysis efficiency and cardiovascular stability among patients undergoing hemodialysis (Uchida et al., 2026; Honda et al., 2026).

For psychological outcomes, the findings indicated a tendency toward improvements in depression, anxiety, stress, and sleep quality, although the effects were less pronounced than those observed for physical outcomes. The psychological mechanisms of physical exercise are multifactorial and may involve increased endorphin release, neurotransmitter regulation, and improvements in patient self-efficacy and coping. However, variations across studies suggest that effects on psychological outcomes are strongly influenced by factors such as intervention duration, exercise intensity, baseline clinical condition, and patient adherence. Therefore, intradialytic exercise intended to improve psychological outcomes requires a more individualized approach integrated with other psychosocial interventions (Lin et al., 2022; Zou et al., 2025).

From a nursing perspective, intradialytic exercise has important implications as an evidence-based intervention that can be integrated into clinical practice in hemodialysis units. Nurses have a strategic role in conducting initial assessments, determining appropriate exercise types, monitoring patients' responses during exercise, and enhancing motivation and adherence. Integrating exercise programs into routine care may comprehensively improve patients' physical and psychological quality of life. Nevertheless, implementation should continue to consider each patient's clinical condition, comorbidities, and potential exercise-related risks (Battaglia et al., 2024; Honda et al., 2026).

This systematic review has several limitations. Variations in study design, exercise type, intervention duration, and measurement instruments resulted in substantial heterogeneity. In addition, some studies had a risk of bias related to blinding and randomization, which may have affected the validity of the findings. Further research using more rigorous RCT designs, larger sample sizes, and more standardized interventions is therefore required to obtain more conclusive evidence regarding the effectiveness of intradialytic exercise among patients undergoing hemodialysis (Bogataj et al., 2024; Uchida et al., 2026).

Variations in intradialytic exercise, ranging from aerobic exercise and resistance training to combinations of both, showed differing effectiveness across measured outcomes. Combined exercise generally produced more optimal results because it improved both cardiorespiratory capacity and muscle strength. Exercise intensity and duration, however, were key determinants of intervention success. Moderate-intensity exercise performed consistently over several weeks to months produced more significant effects than short-term interventions. Therefore, intradialytic exercise programs should be planned according to the frequency, intensity, time, and type (FITT) principle to optimize outcomes (Bogataj et al., 2024; Uchida et al., 2026).

Patient adherence and support from healthcare professionals also play important roles in the

successful implementation of intradialytic exercise. Patients undergoing hemodialysis often experience chronic fatigue, low motivation, and physical limitations that may hinder participation in exercise programs. A multidisciplinary approach involving nurses, physiotherapists, and physicians is therefore necessary to improve adherence and exercise safety. Patient education, periodic monitoring, and individualized adjustment of exercise programs may improve intervention success and reduce the risk of adverse effects during exercise. This approach is consistent with patient-centered care, which emphasizes patients' active involvement in the management of chronic disease (Battaglia et al., 2024; Honda et al., 2026).

Future studies should use more standardized intradialytic exercise protocols based on the FITT principle: frequency, intensity, time, and type. Exercise type, intensity, duration, frequency, timing during the hemodialysis session, exercise-termination criteria, and safety-monitoring procedures should be described in detail. Standardization is important because previous studies have shown considerable variation in intervention formats, including aerobic exercise, cycling, resistance training, stretching, and combined exercise. More uniform protocols would facilitate comparison and replication of findings and support the development of nursing practice guidelines for hemodialysis units.

Future research should also assess outcomes more comprehensively by including not only physical function but also psychological and clinical outcomes. Physical outcomes may include functional capacity, muscle strength, fatigue, frailty, walking ability, and activity tolerance. Psychological outcomes should include anxiety, depression, stress, sleep quality, mental well-being, and quality of life. Clinical outcomes may include dialysis adequacy, blood pressure, intradialytic hypotension, muscle cramps, biochemical parameters, hospitalization, and exercise-related adverse events. The use of valid and reliable measurement instruments is also essential to improve the methodological strength of study findings.

Studies with long-term follow-up are also needed to assess the sustainability of the effects of intradialytic exercise. Several previous studies used relatively short intervention periods and therefore did not adequately explain whether exercise benefits persisted after the program ended. Future studies should evaluate patient adherence, continued exercise participation, long-term effects on quality of life, and possible effects on broader clinical outcomes, such as reduced hospitalization or complications during hemodialysis.

Finally, future research should explore implementation models for nurse-led intradialytic exercise programs in hemodialysis practice. Nurses have strategic roles in patient assessment, education, motivation, safety monitoring, and evaluation of exercise responses. Implementation studies are therefore needed to assess feasibility, patient acceptability, implementation barriers, nurse-training needs, workload, and the cost-effectiveness of intradialytic exercise programs. This approach would provide stronger practical contributions by not only demonstrating intervention effectiveness but also explaining how the intervention can be safely, realistically, and sustainably implemented in hemodialysis units.

Conclusion and Recommendation

Intradialytic exercise has the potential to benefit patients undergoing maintenance hemodialysis, particularly by improving physical outcomes such as functional capacity, muscle strength, walking ability, activities of daily living, and quality of life and by reducing fatigue and frailty. Several RCTs and quasi-experimental studies showed that exercise during hemodialysis, including aerobic exercise, resistance exercise, cycling, stretching, and combined exercise, is relatively safe and may be incorporated into rehabilitation interventions during dialysis sessions.

In addition to physical benefits, intradialytic exercise may improve psychological outcomes such as anxiety, depression, sleep quality, and mental well-being, although the evidence for psychological outcomes remains more limited than that for physical outcomes. Overall, this intervention may be considered an evidence-based nursing approach to improve the quality of life of patients undergoing hemodialysis, provided that clinical condition, exercise tolerance, intensity, duration, and professional supervision are carefully considered during implementation.

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AI-assisted tools (ChatGPT) were used for language editing and improving the clarity of the manuscript. All content was reviewed and validated by the authors.

Data Availability Statement
Data sharing is not applicable to this article.

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