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EFFECTIVENESS OF INTRADIALYTIC STRETCHING EXERCISES IN PREVENTING MUSCLE CRAMPS IN INDIVIDUALS UNDERGOING HEMODIALYSIS : A SYSTEMATIC REVIEW

Tadi Tadi[1,2], Ika Yuni Widyawati[3] , Ira Suarilah[3]
[1]Master Student of Medical Surgical Nursing, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia
[2]Dr. Soegiri Regional General Hospital, Lamongan, East Java, Indonesia
[3]Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia
tadi-2024@fkp.unair.ac.id

Abstrak
Individu dengan Penyakit Ginjal Kronik (PGK) dapat mengalami berbagai gejala sindrom uremik. Latihan peregangan intradialitik telah diusulkan sebagai metode untuk meningkatkan tingkat aktivitas sekaligus mengurangi gejala uremik. Kram otot merupakan komplikasi yang sering terjadi selama terapi hemodialisis dan kerap menyebabkan penghentian sesi dialisis lebih awal. Oleh karena itu, intervensi yang tepat waktu untuk mengatasi kram otot pada pasien hemodialisis menjadi prioritas yang sangat penting. Tujuan menganalisis secara sistematis efektivitas latihan peregangan intradialitik terhadap kram otot pada individu yang menjalani hemodialisis. Metode tinjauan sistematik dilakukan melalui lima basis data utama, yaitu Scopus, PubMed, Science Direct, ProQuest, dan Wiley, dengan rentang tahun publikasi lima tahun terakhir (2020–2025). Studi yang memenuhi kriteria inklusi adalah penelitian yang menerapkan intervensi latihan peregangan intradialitik yang berfokus pada kram otot pada individu yang menjalani hemodialisis. Data yang diekstraksi meliputi karakteristik studi, demografi sampel, desain penelitian, serta luaran yang diukur. Kualitas studi dinilai menggunakan alat *critical appraisal* dari Joanna Briggs Institute (JBI), dan temuan disintesis melalui analisis naratif. Hasil sebanyak sebelas studi (n=11) dengan skor penilaian kualitas JBI berkisar antara 77% hingga 92% dimasukkan dalam analisis akhir. Total partisipan yang terlibat berjumlah 809 orang dari tujuh negara, dengan durasi intervensi antara 4 hingga 24 minggu. Intervensi latihan peregangan intradialitik yang ditelaah mencakup aspek kram otot, kadar urea, dan kelelahan. Kesimpulan latihan peregangan intradialitik menunjukkan potensi yang signifikan dalam mencegah kram otot pada individu yang menjalani hemodialisis. Penelitian lanjutan masih diperlukan untuk mengevaluasi luaran jangka panjang serta mengoptimalkan desain intervensi.
Kata Kunci: *Hemodialisis; Latihan Peregangan Intradialitik; Kram Otot; Efektivitas.*

Abstract
Individuals with Chronic Kidney Disease (CKD) may experience symptoms of uremic syndrome. Intradialytic stretching exercises have been proposed as a method to increase activity levels while reducing uremic symptoms. Muscle cramps are a common complication of hemodialysis treatment and often lead to early termination of sessions, therefore, timely intervention to address muscle cramps in hemodialysis patients is a critical priority. Objective to systematically analyse the effectiveness of intradialytic stretching exercises on muscle cramps among individuals undergoing hemodialysis Methods a systematic review was conducted through five major databases: Scopus, PubMed, Science Direct, ProQuest, and Wiley, for the last five years publication (2020 to 2025). Eligible studies included those that implemented intradialytic stretching exercises interventions focused on muscle cramps for individuals undergoing hemodialysis. Data extracted included study characteristics, sample demographics, design, and measured outcomes. Study quality was assessed using the Joanna Briggs Institute (JBI) critical appraisal tool, and findings were synthesized through narrative analysis. Result eleven studies (n=11) that obtained JBI quality assessment scores ranging from 77% to 92% were included in the final analysis, involving 809 participants from 7 countries, with intervention durations ranging from 4 to 24 weeks. The reviewed intradialytic stretching exercise interventions addressed aspects of muscle cramps, urea levels, and fatigue. Conclusion intradialytic stretching exercises demonstrate significant potential in preventing muscle cramps of individuals undergoing hemodialysis. Further research is needed to evaluate long-term outcomes and optimise intervention designs.
Keywords: *Haemodialysis; Intradialytic Stretching Exercises; Muscle Cramps; Effectiveness.*

* Corresponding author : Tadi
Address : Master Student of Medical Surgical Nursing, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia; Dr. Soegiri Regional General Hospital, Lamongan, East Java, Indonesia
Email : tadi-2024@fkp.unair.ac.id
Phone : -

INTRODUCTION

Chronic kidney disease (CKD) is a progressive condition that impacts millions of individuals worldwide, leading to a gradual decline in kidney function over time. Data from several studies show that the quality of life of individuals diagnosed with CKD progressively declines at all stages, causing issues in productivity (Kefale *et al.*, 2019). Most individuals on hemodialysis tend not to engage in excessive physical activity, especially on days when they are receiving HD treatment (Li *et al.*, 2024). In the current era, CKD is known as a major challenge for the health sector that will affect the survival of millions of people worldwide. The International Society of Nephrology-Global Kidney Health Atlas (ISN-GKHA) in 2023 reported that 850 million people in the world suffer from CKD and in 2040 it is estimated to be the fifth leading cause of death globally (Ortiz *et al.*, 2022). Given that around 2.6 million individuals aged 16 years and over have CKD stages 3 to 5 in the UK, and it is estimated that this number will rise to 4.2 million by 2036 (Walklin *et al.*, 2023). In Taiwan, the incidence and prevalence of ESRD is among the highest in the world (Li *et al.*, 2024). In Iran, the proportion and frequency of occurrence of end-stage renal failure are about 357 and 57 per million per year. Based on health data, The number of people diagnosed with CKD in Iran in 2016 reached about 55 thousand, with 27,500 of them undergoing hemodialysis (Arad *et al.*, 2021).

Physicochemical changes can cause uremia in CKD individuals (Access, 2021). The most visible symptoms include neurological, gastrointestinal, cardiovascular, hematological, immune system, hormonal, and metabolic problems, while hypotension, muscle cramps, nausea, disequilibrium syndrome, and fatigue can occur due to HD. Muscle cramps are a common problem for individuals undergoing HD. Individuals often experience cramps in the arms, hands, and abdomen, ranging from 33% to 78% (Goldust, 2021). Meanwhile, according to the (Shraida, Abd-ali and Mohammad, 2021). Muscle cramps caused by HD are associated with contractions, hypotension, plasma osmolality, hyponatremia, and tissue hypoxia. In addition, individuals generally show fatigue of 92% associated with CKD and HD (Fleishman, Dreiher and Shvartzman, 2020).

Individuals undergoing hemodialysis require comprehensive care, studies have shown that intradialytic muscle stretching exercises (IDMSE) provide benefits in preventing muscle cramps and increasing comfort, and that regular use of IDMSE can significantly improve quality of life. individuals who performed IDMSE reported a 40% reduction in muscle cramps compared to those without therapy (Shraida, Abd-ali and Mohammad, 2021). A further study by (Albadry *et al.*, 2020) also demonstrated improved muscle flexibility and dialysis-related discomfort after IDMSE. These results emphasize that IDMSE is not only effective in helping reduce muscle cramps but can also improve comfort during dialysis. This study explored the efficacy of IDMSE in reducing uremic symptoms, including muscle cramps, in individuals with chronic kidney disease (CKD) undergoing hemodialysis.

Although intradialytic stretching exercises have shown promise in preventing muscle cramps in patients undergoing hemodialysis, research specifically addressing their application in the context of hemodialysis remains limited. Consequently, there is a pressing need to analyse existing evidence on the use of intradialytic stretching exercises an intervention. Therefore, This study aims to deeply evaluate the implementation intradialytic stretching exercises for individuals undergoing hemodialysis.

METHOD

Design

This study is a systematic review exploring intradialytic stretching exercises implementation in individuals undergoing hemodialysis. The articles used were obtained from five major databases, namely Scopus, PubMed, Science Direct, ProQuest and Wiley. The systematic review process includes searching, analyzing, and compiling conclusions from various studies that have been published in a structured manner (Brink *et al*., 2006). This study follows the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines to ensure the quality and transparency of the analysis (Bolan *et al.*, 2021).

Eligibility Criteria

This study establishes eligibility criteria that include inclusion and exclusion criteria. The inclusion criteria used are as follows: (1) Articles originating from scientific journals or proceedings, (2) Article sources are taken from the Scopus, PubMed, Science Direct, ProQuest and Wiley databases, (3) Journals or proceedings

Table 1. PICOS

Category	Description
P (Population)	Indidual(s) undergoing Hemodialisys
I (Intervention)	Intradialytic stretching exercises
C (Comparison)	Individuals who did not perform intradialytic stretching exercises.
O (Outcome)	Physiological signs and symptoms before, during, and after hemodialyis.
S (Study Design)	Randomized Controlled Trial (RCT), experimental Study

Table 2. Search Strategy

Database	Search Strategy	Study (n)
Scopus	*("Intradialytic" OR "dialysis" OR hemodyalisis) AND ("stretching" OR "exercise" OR "physical activity" OR "mobility') AND ("muscle cramps" OR "cramping" OR "spasms") AND ("patient" OR "individual" OR "subjects" OR "participans")*	77
PubMed	*("Intradialytic" OR "dialysis" OR hemodyalisis) AND ("stretching" OR "exercise" OR "physical activity") AND ("muscle cramps" OR "cramping" OR "spasms") AND ("patient" OR "individual" OR "subjects" OR "participans")*	38
Science Direct	*("Intradialytic" OR "dialysis" OR hemodyalisis) AND ("stretching" OR "exercise" OR "physical activity" OR "mobility') AND ("muscle cramps" OR "cramping" OR "spasms") AND ("patient" OR "individual" OR "participans")*	6
ProQuest	*("Intradialytic" OR "dialysis" OR hemodyalisis) AND ("stretching" OR "exercise" OR "physical activity) AND ("muscle cramps" OR "cramping" OR "spasms") AND ("patient" OR "individual" OR "participans")*	47
Wiley	*("Intradialytic" OR "dialysis" OR hemodyalisis) AND ("stretching" OR "exercise" OR "physical activity") AND ("muscle cramps" OR "cramping" OR "spasms") AND ("patient" OR "individual" OR "participans")*	5

are open access, (4) Articles are available in full text format, (5) Publications are written in English or Indonesian, (6) Publication year range between 2020 and 2025, (7) Article content discusses intradialytic stretching exercises of individuals undergoing hemodialysis, (8) Using research designs Randomized controlled clinical trials (RCT) and Experimental Studies. Meanwhile, the exclusion criteria in this study are articles that do not meet one or more of the inclusion criteria. To clarify the scope of the study, the PICOS method (Population, Intervention, Comparison, Outcomes, Study Design) is used as an approach in article selection, as shown in the following table 1.

Selection process

The selection process began by identifying articles from the five databases using MeSH-adjusted keywords. Researchers independently screened them based on the inclusion criteria, resulting in 173 articles, with the following distribution: Scopus (n = 77), PubMed (n = 38), Science Direct (n = 6), ProQuest (n = 47), and Wiley (n = 5). After removing duplicate articles (n = 31), the next process was to review the titles and abstracts to exclude irrelevant studies (n = 23). Articles that had full text but did not discuss Intradialytic stretching exercises of individuals undergoing hemodialysis were also excluded (n = 59). Finally, a total of 11 articles were selected for analysis in this systematic review in (Table 2 and Figure 1).

Methodological Quality Assessment

The authors identified the quality of the research article with respect to the possibility of bias by assessing the methodological quality of the study and identifying the extent to which the study addressed potential bias in its design, conduct, and analysis. In this case, the systematic review used the critical appraisal tools from the Joanna Briggs Institute (JBI), which followed the study design used. The second and third authors independently assessed articles that met the inclusion criteria by assessing methodological validity before inclusion as extracted articles by using JBI critical appraisal scoring for the multiple study types used, including randomized controlled trials (RCTs) and quasi-experimental studies. The JBI critical appraisal contains several questions to assess the quality of the study. The JBI assessment for quasi-experimental studies consists of nine questions about similar characteristics related to the exposure, the way the exposure was measured, the presence of bias factors, the outcomes measured and reported, the follow-up period, methods for dealing with incomplete follow-up, and the type of statistical analysis applied.

The JBI assessment for RCTs consists of 13 questions relating to the randomization method applied, the closed grouping process, the treatment group, the subjects randomized, the assessors, the post-intervention monitoring, the outcome of the intervention, and the statistical analysis method applied. The assessment criteria are rated as "yes," "no," "unclear," or "none"; each answer in the "yes" domain is given one point, and any other rating is given a value of zero. Each assessment was then measured and totaled. If a study scored at least 50%, it was considered to meet the critical evaluation standard at the threshold. Potential bias in this literature review was applied by assessing the research methods of each study, including elements such as theory, design, sample, variables, tools, and data analysis.

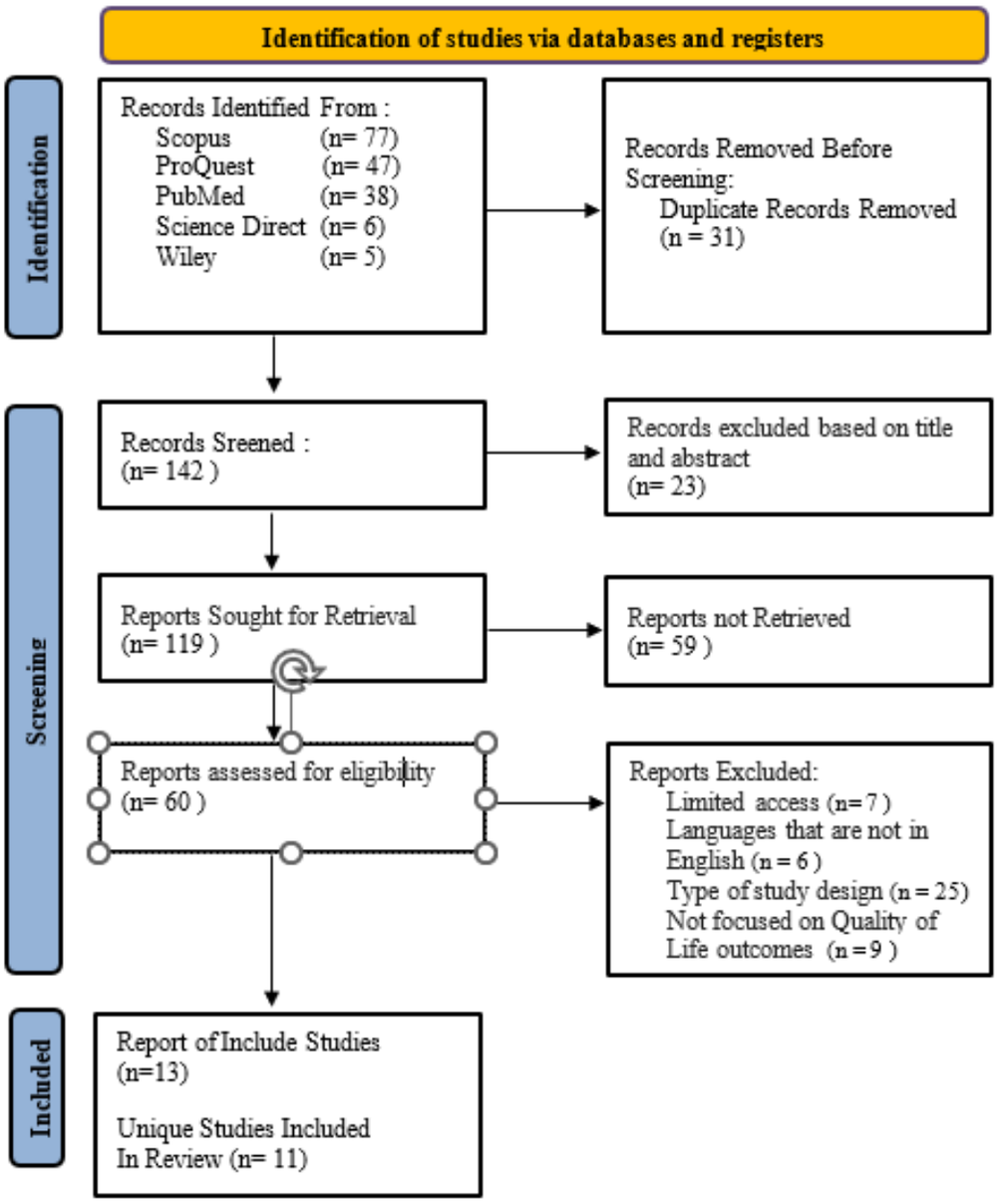

Fig. 1. Flowchart of records and studies included in the systematic review

RESULT AND DISCUSSION

Characteristics of the Selection Studied

The assessment results obtained from the participating articles are presented in Table 3. Of the eleven (n=11) articles with RCT designs with criteria questions 1-13, six articles received a "no" answer of 3 points with a score of 10/13 (77%), four articles received a "no" answer of 2 points with a score of 11/13 (84.6%), and one article received a "no" answer with a score of 12/13 (92%), all of which were included in the good quality category. The review of the 11 articles all scored above 50%, thus meeting the criteria for critical appraisal, and will be used for analysis purposes.

Types of health problems experienced by individuals undergoing hemodialysis

Extraction data shows that all reviewed studies involved individuals undergoing hemodialysis, which is the process of cleaning the blood from accumulated waste. Health problems experienced by individuals undergoing hemodialysis are muscle cramps are a common complication of haemodialysis treatments and they often result in the early termination of the session (Shraida et al., 2021); (Infancia & Bhuvaneswari, 2025); (Ponmari, 2024), Fatigue and sleep disturbances are also common complaints (Amri et al., 2023); (Salem & Elhadary, 2017), Therefore, providing timely interventions to improve muscle cramps in hemodialysis individuals is a critical priority (Anbu and Rathiga, 2021). Patients with end-stage renal disease (ESRD) typically exhibit symptoms of the “uremic” syndrome and lower quality of life. Intradialytic muscle stretching exercise has been proposed as a method to improve activity levels by reducing uremic symptoms (Rahbi *et al.*, 2025).

Types of Intradialytic Stretching Exercise Interventions

The extracted data shows various types of intradialytic stretching exercise interventions given to individuals undergoing hemodialysis,

Table 3. Criteria for Assessment of Research Results.

No.	Authors, years	Study Design	JBI (%) Critical Apraissal
1.	Anbu & Rathiga, 2021	RCT	10/13 (77%)
2.	Rahbi *et al*., 2025	RCT	11/13 (84,6%)
3.	Infancia & Bhuvaneswari, 2025	RCT	12/13 (92%)
4.	Shraida *et al*., 2021	RCT	10/13 (77%)
5.	Tabibi *et al*., 2023	RCT	10/13 (77%)
6.	Sánchez-tocino *et al*., 2022	RCT	10/13 (77%)
7.	Id *et al*., 2021	RCT	11/13 (84,6%)
8.	Amri *et al*., 2023	RCT	11/13 (84,6%)
9.	Ponmari, 2024	RCT	10/13 (77%)
10.	Elsedawy *et al*., 2023	RCT	11/13 (84,6%)
11.	Albadry *et al*., 2020	RCT	10/13 (77%)

namely intradialytic stretching exercises that include flexion, extension, and rotation of the ankles of both legs clockwise and counterclockwise (Anbu and Rathiga, 2021). Types of interventions based on IDMSE include ankle dorsiflexion, stretching of the gastrocnemius, soleus, hamstring, and quadriceps (Rahbi *et al.*, 2025). The implementation of the intradialytic program begins with a warm-up of breathing exercises and joint mobility exercises, then continued with lower limb strength exercises that include hip flexion, hip/knee extension, hip abduction and adduction, and ankle flexion-extension/abduction-adduction. Exercises can be performed using elastic bands and foam balls (Sánchez-tocino *et al.*, 2022). Individuals undergoing hemodialysis can perform exercises in a supine position, each training session begins with a warm-up period and is followed by stretching exercises, lower extremity exercises, namely leg extension, straight leg raise, hip abduction, and hip flexion (Id *et al.*, 2021). Whereas according (Salem and Elhadary, 2017) to Intradialysis leg stretching exercises for muscle cramps include the ankles, knees, hip flexors, inner thigh muscles, outer thigh muscles, front thigh muscles, back thigh muscles, gluteal muscles, and inner back muscles.

Duration and Frequency of Intradialytic Stretching Exercise Interventions

Details of intradialytic stretching exercise protocols vary across studies. The minimum duration of each session was 15 minutes ((Anbu & Rathiga, 2021)), 20 to 30 minutes ((Rahbi *et al.*, 2025); (Infancia & Bhuvaneswari, 2025); (Shraida et al., 2021); (Sánchez-tocino *et al.*, 2022); (Id *et al.*, 2021); (Albadry *et al.*, 2020); Amri *et al*., 2023), and the maximum was 60 minutes ((Tabibi *et al.*, 2023)). Exercises were administered at the end of the second hour of hemodialysis ((Infancia & Bhuvaneswari, 2025); (Tabibi *et al.*, 2023)) and between the third and fourth hours of hemodialysis ((Anbu & Rathiga, 2021)).The training frequency was 2 times a week ((Shraida et al., 2021)) or 3 times a week ((Rahbi *et al.*, 2025); (Tabibi *et al.*, 2023); (Sánchez-tocino *et al.*, 2022); (Id *et al.*, 2021); (Elsedawy *et al.*, 2023)). The intervention durations were 4 weeks ((Shraida et al., 2021); Amri *et al*., 2023; (Ponmari, 2024)), 10 weeks ((Rahbi *et al.*, 2025)), 12 weeks ((Sánchez-tocino *et al.*, 2022)), and 24 weeks ((Tabibi *et al.*, 2023)).

Impact of Intradialytic Stretching Exercise Interventions

Data extraction showed that intradialytic stretching exercise intervention had a positive impact on preventing muscle cramps, improving comfort, and improving the quality of life of individuals undergoing hemodialysis ((Infancia & Bhuvaneswari, 2025)). Regular intradialytic stretching exercises are highly effective in preventing muscle cramps ((Anbu & Rathiga, 2021); (Shraida et al., 2021); (Ponmari, 2024); (Elsedawy *et al.*, 2023)), reducing uremia levels ((Rahbi *et al.*, 2025)), improving physical function in older adults ((Id *et al.*, 2021)), and increasing life expectancy in adult hemodialysis patients ((Tabibi *et al.*, 2023)). Intradialytic leg ergometry and stretching exercises were beneficial in reducing fatigue and muscle cramps in hemodialysis individual (Amri *et al*., 2023).

This systematic review aimed to systematically analyze the implementation of intradialytic stretching exercise interventions for individuals undergoing hemodialysis. The results indicate that intradialytic stretching exercises have benefits for individuals. Overall, the articles yielded several findings that varied in terms of content, including the duration of each session, the time of exercise, the frequency of exercise per week, and the length of the intervention program. This study found that the duration of each session ranged from 15 minutes to 60 minutes. However, most articles provided a guideline for 20-30 minutes of exercise ((Rahbi *et al.*, 2025); (Infancia & Bhuvaneswari, 2025); (Shraida et al., 2021); (Sánchez-tocino *et al.*, 2022); (Id *et al.*, 2021); (Albadry *et al.*, 2020)). Regarding the frequency of exercise a week, almost all articles presented exercises three times a week ((Rahbi *et al.*, 2025); (Tabibi *et al.*, 2023); (Sánchez-tocino *et al.*, 2022); (Id *et al.*, 2021)), while most articles administered the exercises during the second hour of hemodialysis. The duration of the intervention program was 12 weeks ((Sánchez-tocino *et al.*, 2022)), with almost all articles providing different types of exercises. Therefore, further comprehensive evaluation of the effectiveness of

intradialytic stretching exercises in preventing muscle cramps is necessary. This gap underscores the need for further research to optimize the design.

Several challenges in implementing intradialytic stretching exercise interventions for individuals undergoing hemodialysis. For example, declining health status, fatigue, advanced age, and comorbidities can prevent individuals from performing the exercises ((Rahbi *et al.*, 2025); (Infancia & Bhuvaneswari, 2025); (Shraida et al., 2021); (Sánchez-tocino *et al.*, 2022); (Id *et al.*, 2021); (Albadry *et al.*, 2020); Amri *et al*., 2023). Intradialytic stretching exercises are crucial in hemodialysis care, but individuals undergoing hemodialysis report that their condition during hemodialysis declines, leading them to refrain from performing intradialytic stretching exercises ((Albadry *et al*., 2020)). These findings align with previous studies examining self-efficacy through various nursing interventions related to intradialytic stretching exercise programs ((Ramos-daguman *et al*., 2024)). Therefore, strengthening the intradialytic stretching exercise program provided to individuals undergoing hemodialysis is expected to prevent muscle cramps, reduce uremia levels, and improve comfort and quality of life.

Due to hemodialysis, there are many reports regarding symptoms of decreased physical activity that are significantly associated with poor prognosis outcomes and are not influenced by baseline physical activity. Those involved in hemodialysis tend to be less physically active, especially on days when they attend HD treatment sessions (Li *et al.,* 2024). Individuals report fatigue as one of their most frequent and earliest problems (Amri *et al*., 2023). This symptom is then manifested by reduced physical or mental activity that can affect an individual's efficiency and productivity, reduced energy, and decreased drive for activity. Previous research has shown a link between the level of fatigue experienced and depression. (Alishahi *et al*., 2024).

Strenght and Limitations

This systematic review provides a comprehensive synthesis of current evidence regarding intradialytic stretching interventions in preventing muscle cramps, reducing uremia, reducing fatigue, and improving comfort and quality of life in individuals undergoing hemodialysis. A notable strength lies in the inclusion of studies from a variety of settings and interventions, offering insight into the various types, durations, and frequencies of intradialytic stretching exercises that can be implemented by healthcare practitioners.

Several limitations of this study should be acknowledged. The included studies varied widely in design, duration, type of intervention, and outcome measures, which may limit the comparability of findings and the generalizability of conclusions. Furthermore, individuals' ability and health status to implement muscle stretching interventions varied significantly based on demographic and clinical factors such as age and comorbidities. This variation underscores the need for evaluating the implementation of muscle stretching interventions and the need for future studies to explore subgroup analyses.

Implications for Practice and Future Research

Implementing intradialytic stretching exercise interventions in individuals undergoing hemodialysis has significant potential to prevent muscle cramps, reduce urea levels, reducing fatigue, and improve comfort and quality of life. For clinical practice, intradialytic stretching exercise interventions are one form of intervention expected to reduce the incidence of complications during hemodialysis. Healthcare providers should consider continuing to provide intradialytic stretching exercise interventions in routine care. To maximize their impact, healthcare providers must ensure that these interventions are implemented appropriately and correctly in accordance with standard operating procedures (SOPs) in healthcare settings. Long-term interventions delivered during hemodialysis care will have a positive impact on individuals. Future research examining a comprehensive evaluation of intradialytic stretching exercises, including evidence-based types, durations, and frequencies, is needed. Furthermore, more randomized controlled trials with standardized outcomes and longer follow-up periods are needed to validate the clinical benefits of intradialytic stretching exercise interventions. Involving individuals undergoing hemodialysis and their caregivers in the design and development process can increase relevance, usability, and sustained engagement.

CONCLUSIONS

In summary, intradialytic stretching exercises demonstrate significant potential in in preventing muscle cramps, reducing uremic symptoms, reducing fatigue, increasing comfort and improve quality of life in individuals with chronic kidney disease (CKD) undergoing hemodialysis.

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Tabel 4 Sumary of included studies

No	Citation/Country	Studies Design	Participants Characteristics		Interventions Characteristics				Outcomes (scale)
			Sample Size (n)	Mean SD of Age Intervention /control	Intervention group	Control group	Frekuensi and Duration Intervention	Intervention and follow up length (month)	
1.	Anbu & Rathiga, 2021/ India	RCT	n :138 I : 69 C : 69	30-60	Intradialytic stretching exercises	Received usual care	15 min, twice a day between 3rd and 4th hour for three days.	Baseline and post intervention	Intradialytic stretching exercises is an effective method which can be used as a preventive therapy in the treatment of muscle cramps.
2.	Rahbi *et al*., 2025 / Oman	RCT	n :78 I : 39 C : 39	≥ 18	Intradialytic stretching exercises	Received usual care	20-30 min, 3 times a week on alternate days for 10 weeks.	Baseline and post intervention	IDMSE effectively decreased muscle cramp.
3.	Infancia & Bhuvaneswari, 2025 / India	RCT	n : 60 I : 30 C : 30	20-70	Intradialytic stretching exercises	Received usual care	20 min, the second hour of dialysis	Baseline and post intervention	Intradialytic stretching exercises are effective intervention to reduce muscle cramps, enhance comfort during hemodialysis and improve the well-being of the individuals.
4.	Shraida *et al*., 2021/ Iraq	RCT	n : 60 I : 30 C : 30	≥ 20	Intradialytic stretching exercises	Received usual care	20-30 min, 2 times a week for 4 weeks	Baseline and post intervention	Intradialytic stretching exercise efficient for reducing and preventing muscle cramps among individuals hemodialysis.
5.	Tabibi *et al*., 2023 / Iran	RCT	n : 74 I : 37 C : 37	62 ± 13/ 65 ± 11	Intradialytic stretching exercises	Received usual care	60 min, the second hour of dialysis, 3 times a week for 6 months	Baseline and post intervention	Intradialytic exercise performed for at least 60 min during thrice weekly dialysis sessions improves sur vival in adult patients receiving HD
6.	Sánchez-tocino *et al*., 2022 / Spain	RCT	n : 60 I : 23 C : 37	82.0±5.8/ 81.7±5.3	Intradialytic stretching exercises	received usual care	30 min, 3 times a week for 12 weeks	Baseline and post intervention	EWGSOP2 steps remain stable in stable very elderly persons on HD and STS-5 is responsive to a short-term intradialytic lower limb exercise programme.
7.	Id *et al*., 2021/ Japan	RCT	n : 101 I : 51 C : 50	78.7±6.3 / 79±6.7	Intradialytic stretching exercises	received usual care	20 min, 3 times a week for 6 months	Baseline and post intervention	These findings suggest of intra dialytic training could improve physical function in older individuals undergoing

									hemodialysis.
8.	Amri *et al*., 2023 / India	RCT	n : 58 I : 29 C : 29	≥ 18	intradialytic leg ergometry and stretching exercises	received usual care	25 min, for 4 week	Baseline and post intervention	Intradialytic leg ergometry and stretching exercises were beneficial in reducing fatigue and muscle cramps in hemodialysis individual
9.	Ponmari, 2024 / India	RCT	n : 60 I : 30 C : 30	> 20	Intradialytic stretching exercises	received usual care	the first 2 hrs of dialysis session for 4 weeks	Baseline and post intervention	Intradialytic stretching exercises are significantly to reduce the muscle cramps among patients undergoing hemodialysis
10.	Elsedawy *et al*., 2023 / Saudi Arabia	RCT	n : 60 I : 30 C : 30	20-60	Intradialytic stretching exercises	received usual care	Duration 3 and 4 hours Frequency 3 and 4 times per week	Baseline and post intervention	Intradialytic stretching exercise is an effective intervention to reduce leg muscle cramp among hemodialysis individuals.
11.	Albadry *et al*., 2020/ Egypt	RCT	n : 60 I : 30 C : 30	18-65 43.80± 12.089	Intradialytic stretching exercises	received usual care	20 min, for 2 months	Baseline and post intervention	The findings of the study revealed that there were statistical significance differences as regard cramps questionnaire chart, visual analogue scale and fatigue severity scale pre &post intradialytic exercises.

Abbreviations : SD. standard deviation., RCT. Randomised controlled trial, HD. Hemodialysis, EWGSOP2. European Working Group on Sarcopaenia in Older People, STS-5. five times sit-to-stand.