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Review

The Effect of Intradialytic Exercise on Fatigue in Patients Undergoing Hemodialysis: A Literature Review

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Abstract

Introduction: Fatigue is a common and debilitating symptom experienced by patients undergoing hemodialysis. Intradialytic exercise, which involves physical activity performed during dialysis treatment, has been studied as a potential intervention to alleviate this fatigue. This literature review aims to determine the effects of intradialytic exercise on fatigue in patients undergoing hemodialysis.
Methods: The literature review search was carried out using three databases, namely Google Scholar, PubMed, and Science Direct. The inclusion criteria for the literature review search were articles with publication years 2019-2024 in Indonesia and English. The articles could be open access. The keywords used in searching for the article were "intradialytic AND fatigue".
Results: The literature review identified fifteen studies for inclusion in the final analysis. Three articles used randomized control trials, seven articles used quasi-experiments, and five articles used pre-experiments. Many types of intradialytic exercises during hemodialysis were discovered.
Conclusion: Intradialytic exercises have proven successful in reducing the level of weakness in patients undergoing hemodialysis. Fifteen research articles were found to support the provision of intradialytic exercises to patients undergoing hemodialysis. Intradialytic exercises can include active movement exercises, leg exercises, and relaxation movements.

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INTRODUCTION

Fatigue is a pervasive and debilitating symptom affecting many patients undergoing hemodialysis. This fatigue can significantly impact quality of life, making it a crucial area of concern for both patients and healthcare providers. Fatigue in hemodialysis patients is multifaceted, involving physical, psychological, and lifestyle factors. Managing this fatigue requires a comprehensive approach, combining medical treatment, lifestyle modifications, and, notably, exercise interventions like intradialytic exercise (IDE).

Fatigue is a common and debilitating symptom experienced by a significant proportion of hemodialysis patients. Studies indicate that 60-97% of hemodialysis patients report experiencing fatigue [1]. The literature on the experience of fatigue in hemodialysis patients shows that fatigue appears to impact primarily on the physical and mental planes. Patients describe physical fatigue as a persistent lack of energy, which seems worse on dialysis days [2]. The importance of intervention to overcome fatigue in patients undergoing hemodialysis, one of which is intradialytic exercise. Exercise training has a myriad of potential benefits that can ameliorate a sustained decline in functional status [3].

The Intradilytic exercise program is very possible for patients undergoing hemodialysis. This program can be carried out by all staff (nurses, physiotherapists, doctors) [4]. Intradialytic exercise, which involves physical activity performed during dialysis treatment, has been studied as a potential intervention to alleviate this fatigue. Intradialytic exercise refers to physical activities performed during the dialysis session. These can range from low-intensity activities like pedaling on a stationary bike to more structured exercise programs, including resistance training. This literature review was prepared to find out the effect of intradialytic exercise in reducing the fatigue status of patients undergoing hemodialysis.

METHODS

Identify the research question

The research question investigated in this literature review was: 'How can intradialytic exercise prevent fatigue?'. This research question was intended to be broad, as was the aim of the literature review, to ensure the inclusion of several concepts to provide researchers with a deeper understanding of how intradialytic exercise prevents fatigue.

Identify relevant studies

The research design used in this research is a literature review. The literature review protocol and evaluation uses the PRISMA checklist to determine the selection of studies that have been found and adapted to the literature review. The literature search was carried out using three databases: Google Scholar, Pubmed, and Scient Direct. The inclusion criteria for the literature search were articles with publication years 2019-2024, in Indonesian or English, and were complete articles that could be open access. Searches utilized vital terms relating to the disease condition (e.g., hemodialysis; renal failure), the intervention (e.g., intradialytic

exercise (IDE); exercise therapy), and the outcome is fatigue.

Study selection

The number of articles used was 15 articles out of 3.583. Researchers used critical appraisal to assess studies that meet standards. The researcher excluded low-quality studies to avoid bias in the validity of results and review recommendations, so the final screening of articles used in the literature review was 15 articles.

Charting the data

Data in a literature review should be charted logically and descriptively, remaining relevant to the research question. From these data, two themes were identified:

1. Intradialytic exercise
2. Fatigue in patients undergoing hemodialysis

These themes were noted to be recurring throughout the articles and relevant to the research question.

Collating, summarising, and reporting the results

Of the 15 articles identified, they were focused on nursing. All studies were of an experiment design.

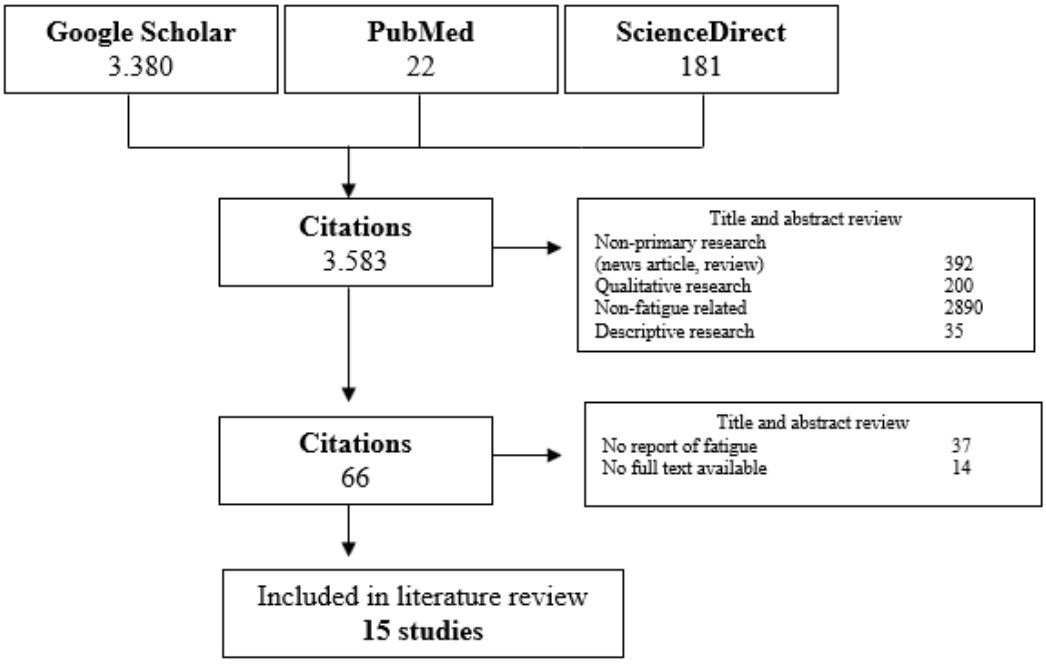

Fig. 1. Literature search: Intradialytic, Hemodialysis

RESULTS

A total of fifteen studies were selected for inclusion in the final analysis. Three articles used randomized control trials; seven articles used quasi-experiments, and five articles used pre-experiments. Fatigue in patients undergoing hemodialysis should be prevented as much as possible. One of the interventions carried out is intradialytic exercise, which can prevent fatigue and improve the quality of life of hemodialysis patients [5]. The negative impacts of fatigue on patients include discomfort in treatment, mental disorders and suffering, which can affect the patient's physiology [6].

Table 1 summarizes the findings based on the aim of determining the effects of intradialytic exercise on fatigue in patients undergoing hemodialysis.

Table 1

Summary of the literature review

Author and year	Result of factor analysis	Summary of finding
Malini et al [7]	Fatigue and dialysis characteristics were reported at baseline, at the midpoint (end of Week 4), and at the end of Week 8. Meanwhile, the mean Kt/V (dialysis adequacy) and urea reduction ratio increased, and the fatigue level decreased in the treatment group, but these variables did not change in the control group. Significant mean differences in Kt/V, urea reduction ratio, and fatigue between the groups were observed at the end of Week 8.	Intradialytic exercise in the form of ROM movements designed to achieve 50% –60% of resting heart rate intensity can significantly increase the effectiveness of dialysis by increasing blood flow in targeted muscle groups. The 8-week program also had a positive impact on fatigue scores in hemodialysis patients, with the treatment group showing a decrease in fatigue over time. Intradialytic ROM exercises are economical and easy to implement in the clinical setting and provide benefits to hemodialysis patients.
Ghonem et al. [8]	It showed that there was a higher statistically significant difference in terms of high post-knowledge scores in the study group who were exposed to educational programs than in the control group. The post-stable blood pressure scores of the study group were also improved compared to those of the control group. In addition, the study group exhibits lower fatigue levels post-program implementation than the control group.	The intradialytic range of motion exercises significantly improved the knowledge level and practice of hemodialysis patients regarding the exercises. The study found that the patients who received the intradialytic exercises had a higher level of knowledge and practice compared to those who did not receive the exercises. The results also showed that the patients who received the exercises had a significant reduction in fatigue levels and blood pressure compared to the control group.

Hutagaol et al. [9]	There is an effect of range of motion (ROM) training on the level of fatigue in hemodialysis patients with a p-value <0.05 using the independent sample test, and there is a difference in fatigue in the treatment and control groups with a p-value of 0.005	Range of motion (ROM) exercises have a significant influence on the level of fatigue in hemodialysis patients. The study found that patients who underwent ROM exercises experienced a decrease in fatigue levels compared to those who did not receive the exercise treatment.
Soliman et al [10]	Range of Motion Exercises program, a significant reduction was seen in fatigue level, serum phosphate and potassium, calcium, urea, creatinine and a slight increase in hemoglobin level. Systolic and diastolic blood pressure changed significantly in the exercise group ($p < .05$).	The intradialytic range of motion exercises significantly improved the knowledge level and practice of hemodialysis patients regarding the exercises. The study found that the patients who received the intradialytic exercises had a higher level of knowledge and practice compared to those who did not receive the exercises. The results also showed that the patients who received the exercises had a significant reduction in fatigue levels and blood pressure compared to the control group.
Elhameed et al. [11]	Effect of Exercise Program on Fatigue and Depression among Geriatric Patients Undergoing Hemodialysis Randomized controlled trial (pretest post-test)	In this study, the implementation of the exercise program, which consisted of a range of motion exercises and muscle relaxation exercises, proved to be effective in improving the level of fatigue and depression among the majority of geriatric patients undergoing hemodialysis in the study group. Moreover, the range of motion and relaxation exercises used in this study are inexpensive and accessible treatments and could be beneficial for health-hemodialysis geriatric patients.
Djufri et al. [12]	Showed a significant effect between breathing exercises and Range of Motion (ROM) exercise towards the decrease of intradialysis fatigue level (p value <0.05).	Based on the results of the research, there was a significant correlation between breathing exercises and Range of Motion (ROM) exercises in order to decrease the intradialysis fatigue level. There was a significant correlation between age, education, and the length of hemodialysis as the confounding of breathing exercises and Range of Motion (ROM) exercise to decrease the intradialysis fatigue level. Furthermore, there was also a significant correlation between sex and occupation as the

		confounding of breathing exercise and Range of Motion (ROM) exercise to decrease the intradialysis fatigue level.
Sari et al [13]	The intervention group (96.4%) had mild fatigue, and almost half (40%) had good quality of life. In the control group, most participants (54.5%) experienced severe fatigue, and most (53.6%) experienced a poor quality of life. Data analysis showed that the combination of AROM with deep breathing affected hemodialysis patients' fatigue and quality of life (P =0.000), which means that the combination of AROM with deep breathing affects the fatigue and quality of life of hemodialysis patients.	The combination of AROM with deep breathing exercises carried out routinely during hemodialysis therapy procedures can reduce fatigue and improve the quality of life of hemodialysis patients. In future research, researchers will develop self-care management for hemodialysis patients to prevent complications by involving families and the medical team.
Ibrahim et al. [14]	There has been a statistically significant distinction between pre- and post-tests regarding the Katz Index of Independence in Daily Living Activities, and there is a surprising statistically significant distinction between pre- and post-tests concerning the degree of fatigue among patient participants.	The majority of hemodialysis patients suffered from cramps in their legs, especially inside the calf muscle, and all of them didn't carry out any physical exercise at home or perform any exercise to reduce muscle cramps during hemodialysis sessions. There has been a statistically significant distinction between pre and post-tests concerning the Katz Index of Independence in daily activities, and it was found that a highly statistically significant distinction among pre and post-tests related to fatigue degree among participants who performed hemodialysis. A simplified bodily exercise program can be taken into consideration as a safe and effective medical nursing modality in patients with end-stage renal disease on hemodialysis to decrease fatigue degree and enhance the patient's daily activities.
Muliani et al. [15]	The pre-test average value was 25.70, and the post-test was 30.75, with a p-value of <0.001, which means that there is an effect of intradialytic exercise: flexibility on the fatigue score.	There is an influence of intradialytic exercise: good flexibility on fatigue scores in CKD patients undergoing hemodialysis. This physical exercise can be an alternative to treating fatigue while patients are undergoing hemodialysis.
Albadry et al. [16]	More than half of patients (58.3%) experienced muscle cramps in both legs. As regards muscle involvement in cramps, the majority of patients(83.3	The present study was done to evaluate the effect of intradialytic hemodialysis exercises on fatigue and

	%) experienced muscle cramps in the gastrocnemius muscle.	leg cramps. The findings of the study revealed that there were statistical significance differences as regard cramps questionnaire chart and visual
Chang et al [17]	Active subjects demonstrated significantly less fatigue and higher physical activity levels than those with a sedentary lifestyle at baseline. During the eight weeks of intervention, subjects in both the active and sedentary groups reduced their fatigue levels significantly, with the exception of sedentary subjects in the control group. Only active subjects in the experimental group demonstrated an increase in activity levels. The 36 subjects performed 3456 leg ergometry exercise sessions with three early terminations (<.01%) among the sedentary subjects.	Significant reduction in fatigue levels was observed in both active and sedentary patients in the experimental group. Intradialytic leg ergometry exercise effectively reduced fatigue and improved physical fitness in already active CKD patients. It also helped reduce fatigue in sedentary patients.
Motedayen et al. [18]	The mean of the fatigue score within the research units was 42.37. Overall, 42.2% and 56.1% of the participants experienced medium and severe fatigue, respectively. The fatigue scores decreased significantly from the beginning to two months after intervention in the experimental group.	The intradialytic exercise program significantly reduced fatigue in patients on hemodialysis. The study recommends incorporating intradialytic physical and mental exercises as a routine practice to improve the quality of life for CKD patients on hemodialysis.
Amilia et al. [19]	A paired t-test (p = 0,000) indicated there was a decrease in fatigue of 3.31 after being given an intradialytic exercise with a peaceful end-of-life approach.	The study concluded that intradialysis exercise combined with a peaceful end-of-life approach significantly reduced fatigue levels in ESRD patients. The intervention is effective in decreasing the fatigue of ESRD patients undergoing hemodialysis and could be recommended for application in hospital settings to improve patient outcomes.
Salama et al [20]	There were highly statistically significant differences in Children's fatigue before the intervention, after four weeks, and after eight weeks compared with the control group (P = 0.001).	Significant reduction in fatigue levels in the study group after four and eight weeks compared to the control group. Intradialytic exercise positively affects fatigue, psychological distress, and biochemical findings in children undergoing hemodialysis. It is recommended that these patients be included as part of the management plan.

		Fatigue: Common and debilitating in pediatric hemodialysis patients, affecting their quality of life.
Lazuardi N [21]	The fatigue level of hemodialysis patients has decreased after the intervention of predialysis exercise for five sessions. The fatigue score of Respondent 1 has decreased from a score of 4.8 (moderate fatigue) to 3.2 (mild fatigue), respondent 2 from a score of 6.3 (moderate fatigue) to 4.3 (moderate fatigue), respondent 3 from a score of 9 (severe fatigue) to 7 (severe fatigue), and respondent 1 from a score of 4.9 (moderate fatigue) to 2.4 (mild fatigue).	This study showed that there was a decrease in the level of fatigue after being given the intervention of predialysis exercise (post-test) 5 times, with mild fatigue levels.

DISCUSSION

This literature review found that intradialytic exercise has a significant effect on reducing fatigue in patients while undergoing hemodialysis. The problem of fatigue is a complaint often experienced by hemodialysis patients. Prevention of fatigue must receive special attention from caregivers in the hemodialysis room because one of the impacts of fatigue is reducing the quality of life of hemodialysis patients [22]. A complication often experienced by hemodialysis patients is decreased quality of life. Patients undergoing hemodialysis must undergo intervention to improve their quality of life [23].

One of the intradialytic exercise programs is Range of Motion (ROM) training. ROM to hemodialysis patients can increase the intensity of heartbeats, and this is triggered by increased blood flow in the muscles being moved. Exercise is recommended as an option to prevent fatigue in patients. ROM can significantly reduce levels of fatigue and blood pressure in hemodialysis patients [7]-[13]. ROM is a muscle training intervention that is often carried out in patients classified as partial or total care, with the aim of improving movement ability and blood circulation throughout the body [24]. ROM movements are the right choice to increase muscle ability and prevent fatigue in patients [25]. Providing ROM therapy can be combined with various actions, such as breathing exercises, which have been proven to reduce fatigue [13].

The intradialytic treatment option is leg exercises [14], which can reduce fatigue and increase the patient's daily activities. This program can be designed between caregivers and patients who are undergoing hemodialysis. This program can be combined with other relaxation measures, such as the breathing-based leg exercises program encompassing abdominal breathing and low-intensity leg exercise, including leg lifts, quadriceps femoris contraction and knee flexion [26].

Intradialytic exercise is not only helpful in preventing weakness in patients undergoing hemodialysis but many other benefits can be felt by patients, including electrolyte balance [10], blood pressure, reducing depression [11][20], improving quality of life [13], and increasing daily activities [14]. An intradialytic program is essential for patients, and the program can be a combination of progressive muscle relaxation movements, range of motion, and breathing exercise [21]. This intradialytic program has become a clinical standard for patients undergoing hemodialysis [27].

The role of nurses is vital in intervening to prevent fatigue in patients undergoing hemodialysis, one of which is intradialytic exercise, which can overcome or prevent this problem.

CONCLUSION

Based on fifteen articles, this study highlights that intradialytic exercise is very important for patients undergoing hemodialysis. Exercise can be in the form of ROM and physical exercise or a combination of ROM with other therapies such as deep breathing relaxation, leg exercises, or other relaxation movement actions. Providing intradialytic exercises can improve the patient's circulation and muscle strength so that the fatigue problem that patients often complain about can be overcome or prevented. Not only does it reduce fatigue, but intradialytic exercise can improve quality of life and daily activities, reduce stress/depression levels, and benefit other physiology.

REFERENCES

[1] A. E. Horigan, "Fatigue in Hemodialysis Patients: A Review of Current Knowledge," J. Pain Symptom Manage., vol. 44, no. 5, hlm. 715–724, Nov 2012, doi: 10.1016/j.jpainsymman.2011.10.015.

[2] Ju, A., Unruh, M. L., Davison, S. N., Dapueto, J., Dew, M. A., Fluck, R., Germain, M., Jassal, S. V., Obrador, G., O'Donoghue, D., Tugwell, P., Craig, J. C., Ralph, A. F., Howell, M., & Tong, A, "Patient-Reported Outcome Measures for Fatigue

[3] Rhee, S. Y., Song, J. K., Hong, S. C., Choi, J. W., Jeon, H. J., Shin, D. H., Ji, E. H., Choi, E.-H., Lee, J., Kim, A., Choi, S. W., & Oh, J, "Intradialytic exercise improves physical function and reduces intradialytic hypotension and depression in hemodialysis patients," Korean J. Intern. Med., vol. 34, no. 3, hlm. 588–598, Mei 2019, doi: 10.3904/kjim.2017.020.

[4] Young, H. M. L., Jeurkar, S., Churchward, D. R., Dungey, M., Stensel, D. J., Bishop, N. C., Greenwood, S. A., Singh, S. J., Smith, A. C., & Burton, J. O, "Implementing a theory-based intradialytic exercise programme in practice: a quality improvement project," Clin. Kidney J., vol. 11, no. 6, hlm. 832–840, Des 2018, doi: 10.1093/ckj/sfy050.

[5] Lin, C.-H., Hsu, Y.-J., Hsu, P.-H., Lee, Y.-L., Lin, C.-H., Lee, M.-S., & Chiang, S.-L, "Effects of Intradialytic Exercise on Dialytic Parameters, Health-Related Quality of Life, and Depression Status in Hemodialysis Patients: A Randomized Controlled Trial," Int. J. Environ. Res. Public. Health, vol. 18, no. 17, hlm. 9205,

Agu 2021, doi: 10.3390/ijerph18179205.

[6] K. E. Y. Gede, N. P. Kamaryati, I. N. Adiana, dan K. Sutini, "The Effectiveness of Non Pharmachological Therapy on Fatigue Level in Patients With Congestive Heart Failure (CHF)," Babali Nurs. Res., vol. 4, no. 4, hlm. 690–704, Okt 2023, doi: 10.37363/bnr.2023.44276.

[7] H. Malini, E. Forwaty, M. Cleary, D. Visentin, E. Oktarina, dan D. P. Lenggogeni, "The Effect of Intradialytic Range of Motion Exercise on Dialysis Adequacy and Fatigue in Hemodialysis Patients," J. Nurs. Res., vol. 30, no. 4, hlm. e221, Agu 2022, doi: 10.1097/jnr.0000000000000506.

[8] S. Elsayed Ghonem, N. Fares Mohamed, dan H. Mohamed Allam, "Intradialytic Range of Motion Exercises Program: its Effect on Knowledge, Fatigue, and Blood Pressure among Hemodialysis Patients," Egypt. J. Health Care, vol. 13, no. 3, hlm. 2186–2204, Sep 2022, doi: 10.21608/ejhc.2022.317620.

[9] R. Hutagaol dan Y. G. T. A. Trimawang, "Pengaruh Latihan Range Of Motion (ROM) terhadap Tingkat Fatigue pada Pasien Hemodialisis di Rumah Sakit Angkatan Udara (RSAU) dr Esnawan Antariksa: PENGARUH LATIHAN RANGE OF MOTION (ROM) TERHADAP TINGKAT FATIGUE PADA PASIEN HEMODIALISIS DI RSAU DR. ESNAWAN ANTARIKSA," J. KEPERAWATAN CIKINI, vol. 1, no. 1, hlm. 6–10, Jan 2020, doi: 10.55644/jkc.v1i1.25.

[10] H. M. Mohamed Soliman, "Effect of intradialytic exercise on fatigue, electrolytes level and blood pressure in hemodialysis patients: A randomized controlled trial," J. Nurs. Educ. Pract., vol. 5, no. 11, hlm. p16, Agu 2015, doi: 10.5430/jnep.v5n11p16.

[11] S. Hassan Abd Elhameed dan D. El Sayed Fadila, "Effect of Exercise Program on Fatigue and Depression among Geriatric Patients Undergoing Hemodialysis," Int. J. Adv. Nurs. Stud., vol. 8, no. 2, hlm. 23–32, Jul 2019, doi: 10.14419/ijans.v8i2.29316.

[12] D. Djupri, K. Yetti, dan Masfuri, "The Effect of Breathing Exercise and Range of Motion (ROM) Exercise towards the Decrease of Intradialysis Fatigue Level in Hemodialysis Unit at Dr. Adjidarmo Hospital, Banten," dalam Proceedings of the Third International Conference on Sustainable Innovation 2019 – Health Science and Nursing (IcoSIHSN 2019), Yogyakarta, Indonesia: Atlantis Press, 2019. doi: 10.2991/icosihsn-19.2019.48.

[13] R. Y. Sari, Y. Kartini, I. Faizah, R. Rohmawati, dan S. N. Hasina, "Combination of AROM with deep breathing exercise against fatigue and quality of life of hemodialysis patients; an experimental study," J. Nephropharmacology, vol. 13, no. 1, hlm. e10551, Jul 2023, doi: 10.34172/npj.2023.10551.

[14] M. M. Ibrahim dan I. M. Mokhtar, "Leg Exercise: Effect on Reducing Fatigue and Improving Activities of Daily Living For Hemodialysis Patients".

[15] R. Muliani, A. R. Muslim, dan I. Abidin, "Intradialytic Exercise: Flexibility terhadap Skor Fatigue pada Pasien

Penyakit Ginjal Kronis yang Menjalani Hemodialisis," J. Med. Health, vol. 3, no. 2, Agu 2021, doi: 10.28932/jmh.v3i2.3147.

[16] A. Albadr, S. Azer, N. Abd Elhamed, dan N. Mostafa, "Effect of Intradialytic Hemodialysis Exercises on Fatigue and Leg cramps," Assiut Sci. Nurs. J., vol. 8, no. 20, hlm. 131–140, Mar 2020, doi: 10.21608/asnj.2020.80746.

[17] Y. Chang, S.-Y. Cheng, M. Lin, F.-Y. Gau, dan Y.-F. C. Chao, "The effectiveness of intradialytic leg ergometry exercise for improving sedentary life style and fatigue among patients with chronic kidney disease: A randomized clinical trial," Int. J. Nurs. Stud., vol. 47, no. 11, hlm. 1383–1388, Nov 2010, doi: 10.1016/j.ijnurstu.2010.05.002.

[18] Z. Motedayen, B. Nehrir, A. Tayebi, A. Ebadi, dan B. Eynollahi, "The Effect of the Physical and Mental Exercises During Hemodialysis on Fatigue: a Controlled Clinical Trial," Nephro-Urol. Mon., vol. 6, no. 4, Jul 2014, doi: 10.5812/numonthly.14686.

[19] Y. Amilia, A. Bakar, dan I. Nadatien, "The Effect Of Intradialysis Exercise With Peaceful End Of Life Approach To Fatigue Of End Stage Renal Disease Patients Who Have Hemodialysis".

[20] A. H. Salama, M. Mahmoud Zaki, H. A . Radwan, E. Ramzy Elfiky, dan D. ,A.Zayed, "Effect of Intradialytic Exercise on Fatigue, Psychological Distress, and Biochemical Findings among Hemodialysis Children," Egypt. J. Health Care, vol. 13, no. 4, hlm. 1443–1457, Des 2022, doi: 10.21608/ejhc.2022.272201.

[21] N. Lazuardi, "Application Of Predialytic Exercise To Reduce Fatigue In-Patient Undergoing Hemodialysis," South East Asia Nurs. Res., vol. 3, no. 1, hlm. 28, Mar 2021, doi: 10.26714/seanr.3.1.2021.28-32.

[22] M. Mollaoglu, "Fatigue in People Undergoing Hemodialysis," Dial. Transplant., vol. 38, no. 6, hlm. 216–220, Jun 2009, doi: 10.1002/dat.20330.

[23] H. Li, Y. Jiang, dan C.-C. Lin, "Factors associated with self-management by people undergoing hemodialysis: A descriptive study," Int. J. Nurs. Stud., vol. 51, no. 2, hlm. 208–216, Feb 2014, doi: 10.1016/j.ijnurstu.2013.05.012.

[24] J. G. Pallarés, A. Hernández-Belmonte, A. Martínez-Cava, T. Vetrovsky, M. Steffl, dan J. Courel-Ibáñez, "Effects of range of motion on resistance training adaptations: A systematic review and meta-analysis," Scand. J. Med. Sci. Sports, vol. 31, no. 10, hlm. 1866–1881, Okt 2021, doi: 10.1111/sms.14006.

[25] G. E. McMahon, C. I. Morse, A. Burden, K. Winwood, dan G. L. Onambélé, "Impact of Range of Motion During Ecologically Valid Resistance Training Protocols on Muscle Size, Subcutaneous Fat, and Strength," J. Strength Cond. Res., vol. 28, no. 1, hlm. 245–255, Jan 2014, doi: 10.1519/JSC.0b013e318297143a.

[26] H.-Y. Huang, K.-S. Hung, M.-L. Yeh, H.-L. Chou, A. L. Yeh, dan T.-Y. Liao, "Breathing-based leg exercises during hemodialysis improve quality of life: A randomized controlled trial," Clin. Rehabil., vol. 35, no. 8, hlm. 1175–1184,

Agu 2021, doi: 10.1177/02692155211000738.

[27] B. S. B. Cheema, B. C. F. Smith, dan M. A. F. Singh, “A Rationale for Intradialytic Exercise Training as Standard Clinical Practice in ESRD,” Am. J. Kidney Dis., vol. 45, no. 5, hlm. 912–916, Mei 2005, doi: 10.1053/j.ajkd.2005.01.030.