Exercise prescriptions for patients on hemodialysis in Brazil: a scoping review

Prescrições de exercícios físicos para pacientes em hemodiálise no Brasil: uma revisão de escopo

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Abstract

Introduction: Exercise is being incorporated into the treatment of patients on hemodialysis; however, little is known about the major characteristics of these interventions. **Objective:** To describe the exercise protocols prescribed for hemodialysis patients in Brazil. **Methods:** A scoping review was conducted following JBI and Prisma-ScR guidelines. Searches were carried out in Medline, Embase and three other databases until May 2024. Other sources (websites, books and guidelines) were also investigated. Evidence from patients on hemodialysis describing exercise protocols in all settings and designs in Brazil was included. **Results:** Forty-five pieces of evidence were found, resulting in 54 exercise protocols from 16 Brazilian states. Strength exercises (33.3%), followed by aerobic exercises (22.2%), were the most prescribed, mainly to be performed during dialysis (85.2%). The most prevalent professionals supervising the programs were physiotherapists and exercise physiologists (37.0% and 18.5%, respectively). All protocols implemented the principles of type and frequency training, while progression was adopted in only 53.7%. The main prescription was three times per week (88.9%). Exercise intensity was predominantly determined by subjective methods (33.3%). **Conclusion:** Aerobic and strength exercises during dialysis were the most commonly prescribed modalities in Brazil, with the majority of programs being properly supervised by qualified professionals. However, existing protocols have not employed systematic progression throughout the intervention, which would be appropriate for providing better physiological responses and adaptations.

Keywords: Renal Insufficiency, Chronic; Dialysis; Exercise; Resistance Training; Endurance Training.

Resumo

Introdução: O exercício físico está sendo incorporado ao tratamento de pacientes em hemodiálise, porém pouco se sabe sobre as principais características dessas intervenções. **Objetivo:** Descrever os protocolos de exercício físico prescritos para pacientes em hemodiálise no Brasil. **Métodos:** Uma revisão de escopo foi conduzida de acordo com as diretrizes JBI e Prisma-ScR. Foram realizadas pesquisas na Medline, Embase e em outras três bases de dados até maio de 2024. Outras fontes (sites, livros e diretrizes) também foram pesquisadas. Foram incluídas evidências de pacientes em hemodiálise, descrevendo protocolos de exercício físico em todos os ambientes e desenhos no Brasil. **Resultados:** Encontradas 45 evidências, resultando em 54 protocolos de exercício físico de 16 estados brasileiros. O exercício de força (33,3%), seguido do exercício aeróbico (22,2%), foi o mais prescrito para ser realizado durante a diálise (85,2%). Os profissionais mais prevalentes na supervisão dos programas foram fisioterapeutas e profissionais de educação física (37,0% e 18,5%, respectivamente). Todos os protocolos adotaram os princípios de treinamento tipo e frequência, enquanto a progressão foi adotada em apenas 53,7%. A frequência mais prescrita foi três vezes por semana (88,9%). A intensidade do exercício foi determinada predominantemente por métodos subjetivos (33,3%). **Conclusão:** Os exercícios aeróbicos e de força durante a diálise foram as modalidades mais prescritas no Brasil, com a maioria dos programas sendo adequadamente supervisionada por profissionais qualificados. No entanto, os protocolos existentes não adotaram a progressão sistemática no decorrer da intervenção, o que seria adequado para proporcionar melhores respostas e adaptações fisiológicas.

Descritores: Insuficiência Renal Crônica; Diálise; Exercício Físico; Treinamento Resistido; Treino Aeróbico.

Introduction

Hemodialysis is the most commonly prescribed kidney replacement therapy in Brazil. Brazilian data from the 2022 dialysis survey revealed that 95% of patients with kidney failure were undergoing hemodialysis[1]. Patients on hemodialysis commonly experience sedentary behavior[2] and physical disability[3–6], which increases their morbidity and mortality. Exercise interventions have been introduced as an attempt to change this scenario[7], but their implementation as part of the treatment routine is still lacking[8]. Furthermore, there is a need for evidence that describes exercise protocols in detail to support the expansion of viable programs.

Previously, results of a worldwide analysis from a scoping review showed that Brazil was the leading country in reporting exercise protocols for this population[9]. However, Barros et al.[10] recently found that only 16% of dialysis centers in Brazil had an intradialytic exercise program integrated into their clinical routine. In an effort to increase awareness and knowledge within the Brazilian Society of Nephrology to support the implementation of exercise programs, we conducted a secondary analysis of a scoping review to describe exercise prescriptions for patients on hemodialysis in Brazil.

Methods

The protocol for our scoping review and the article with global data have been previously published[9,11], and further details on the methodology can be found in those publications. Briefly, the JBI[12] and Prisma-ScR[13] guidelines for scoping reviews were adopted. A comprehensive search strategy was conducted in the Medline, Embase, SportDiscus, Cinahl and Lilacs databases using terms related to "hemodialysis", "dialysis", "physical exercise" and "physical training". Full search strategy for each database may be seen in **Supplementary Material 1** The databases were searched from inception until December 2021, and additional manual searching for new Brazilian evidence was undertaken until May 2024.

The PCC framework was followed, selecting any evidence from reports/studies with adults on hemodialysis (participants), prescribing exercise interventions (concept), in all settings and study designs in Brazil (context). Two independent reviewers (HR and FA) selected titles and abstracts. Full-text reading was performed by the primary reviewer (HR). Discrepancies were discussed with an additional reviewer (DL).

Relevant data were extracted by the lead reviewer (HR), and double-checked by others (FA and DL) using an adapted spreadsheet[14]. Those data included details on exercise prescription (e.g. type, frequency, duration, location, volume, progression, intensity, professionals involved, periodization, etc.). Discrepancies were resolved with an additional reviewer (JV).

The data were described according to Prisma-ScR guidelines[13]. Protocols were analyzed according to the exercise principles outlined by the American College of Sports Medicine (ACSM) (FITT-VP: frequency, intensity, time, type, volume, and progression)[15]. A more in-depth description of the data analysis can be found in another publication[9].

Results

Selection of Studies

A total of 21,312 records were found; of these, 285 were included in our main global review[8]. From Brazil, 39 were included in this secondary analysis. In an additional search conducted in May 2024, 6 articles published between 2022 and 2024 were identified, yielding 54 exercise protocols (Figure 1; complete list of articles in Supplementary Material 2). All exercise protocols were reported in original articles.

Characteristics

The included reports originated from 16 states and all regions of Brazil. Figure 2 shows that the most prevalent state was São Paulo (n = 14; 25.9%). Strength training (n = 18; 33.3%) was the most frequently prescribed type. Table S2 shows the characteristics of the included reports.

General Findings

Table 1 outlines the key characteristics of the exercise programs. The median duration of interventions was 12 [interquartile range: 8 – 13] weeks. Exercise was predominantly prescribed during dialysis (i.e. intradialytic; n = 45; 83.3%). For exercise programs that prescribed any intradialytic component, the intervention was mainly performed during the first half of the dialysis session (n = 35; 77.8%). The most prevalent professionals supervising exercise programs were

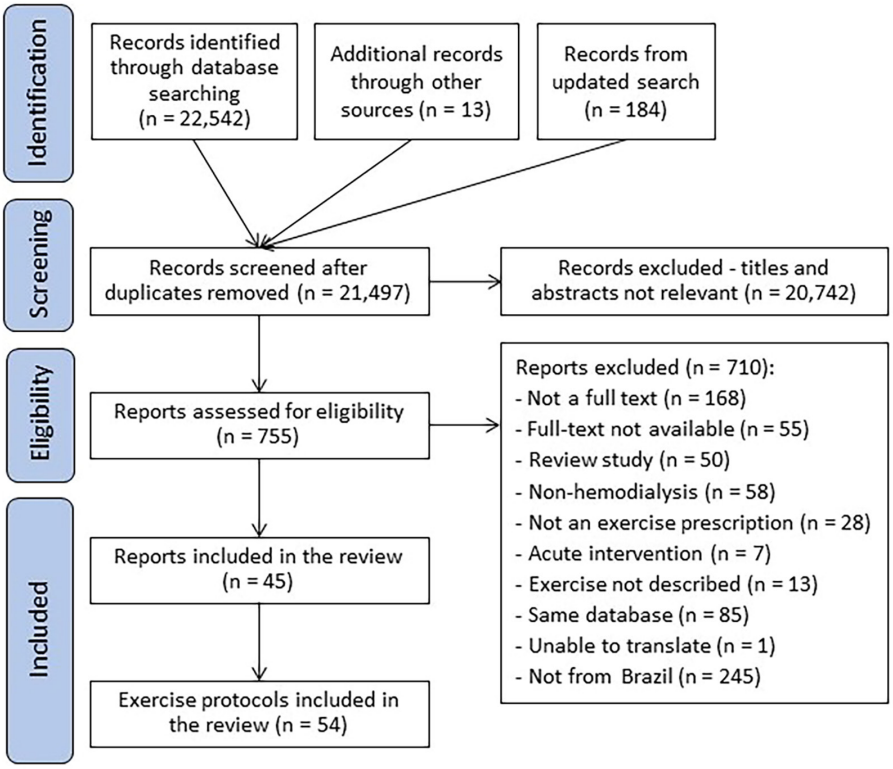


Figure 1. Flowchart of the scoping review.

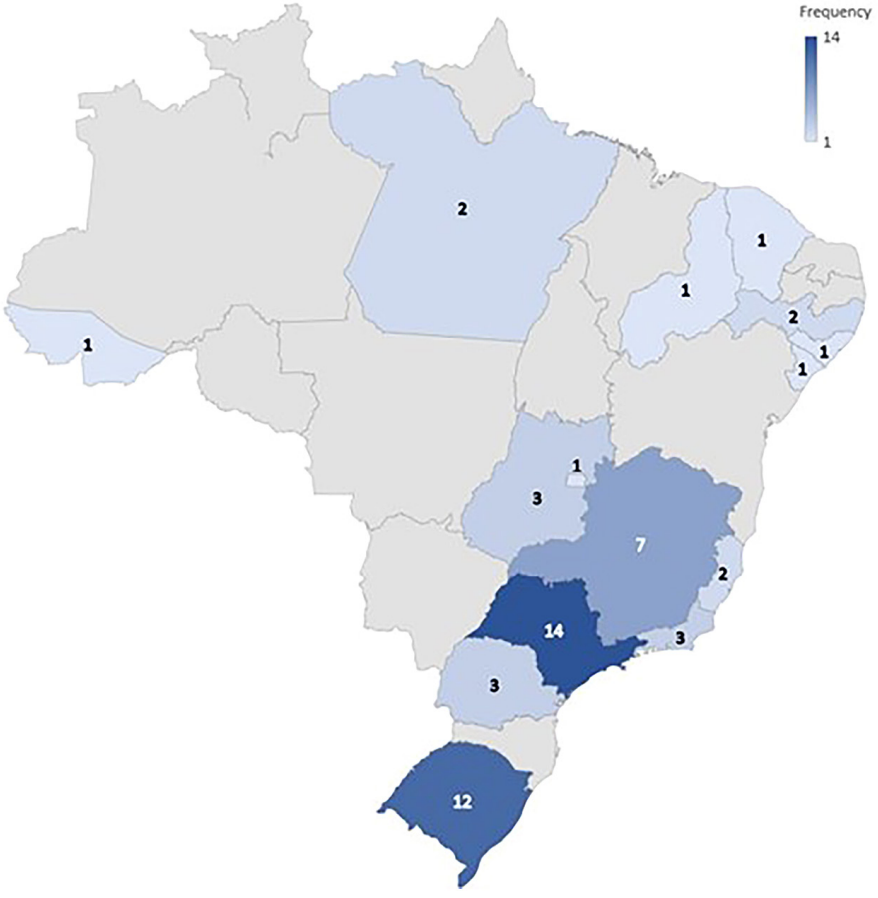


Figure 2. Geographical heat map of exercise protocols prescribed for patients on hemodialysis in Brazil.

Table 1 Characteristics of the exercise protocols

	Aerobic (n = 12)	Strength (n = 18)	Combined* (n = 6)		Mobility (n = 3)	Respiratory (n = 8)	Neuromuscular electrical stimulation (n = 5)	Virtual reality (n = 1)	Vibration platform (n = 1)
Duration (weeks), median [IQR]	12 [12 – 17]	12 [10 – 26]	12 [8 – 44]		13 [8 – 13]	8 [8 – 12]	8	12	12
Setting, n (%)									
Intradialytic#	12 (100)	15 (83.3)	5 (83.3)		2 (66.7)	6 (75.0)	5 (100)	1 (100)	0
Interdialytic	0	0	1 (16.7)		0	1 (12.5)	0	0	1 (100)
Pre-hemodialysis	0	3 (16.7)	0		0	0	0	0	0
Post hemodialysis	0	0	0		0	0	0	0	0
Pre- and intradialytic	0	0	0		0	0	0	0	0
Home	0	0	0		0	0	0	0	0
Home and intradialytic	0	0	0		0	1 (12.5)			
Non-reported	0	0	0		1 (33.3)	0	0	0	0
Moment of dialysis†, n (%)									
First half	10 (83.3)	11 (73.3)	4 (80.0)		2 (100)	5 (62.5)	4 (80.0)	1 (100)	–
Second half	0	3 (20.0)	0		0	0	0	0	–
Non-reported	2 (16.7)	2 (13.3)	1 (20)		0	1 (12.5)	1 (20.0)	0	–
Professional supervision†, n (%)									
Physiotherapist	0	5 (27.8)	5 (83.3)		3 (100)	3 (37.5)	3 (60.0)	1 (100)	0
Exercise physiologist	3 (25.0)	6 (33.3)	1 (16.7)		0	0	0	0	0
Healthcare professional	2 (16.7)	4 (22.2)	0		0	0	0	0	0
Non-supervised	0	0	0		0	1 (12.5)	0	0	0
Non-reported	8 (66.7)	8 (44.4)	0		0	5 (62.5)	2 (40.0)	0	1 (100)
Components of the session, n (%)			**Aerobic**	**Strength**					
Warm-up	6 (50.0)	5 (27.8)	4 (66.7)	1 (16.7)	0	0	4 (80.0)	0	0
Conditioning	11 (91.7)	14 (77.8)	6 (100)	5 (83.3)	2 (66.7)	8 (100)	5 (100)	1 (100)	1 (100)
Cool down	6 (50.0)	3 (16.7)	2 (33.3)	1 (16.7)	0	0	3 (60.0)	0	0

Abbreviation: IQR, interquartile range.
Notes: *Combining aerobic and strength training. #Only during dialysis, not including other settings. †The sum may exceed 100% because some exercise programs included more than one type.
There are missing values due to the absence of data in some included studies.

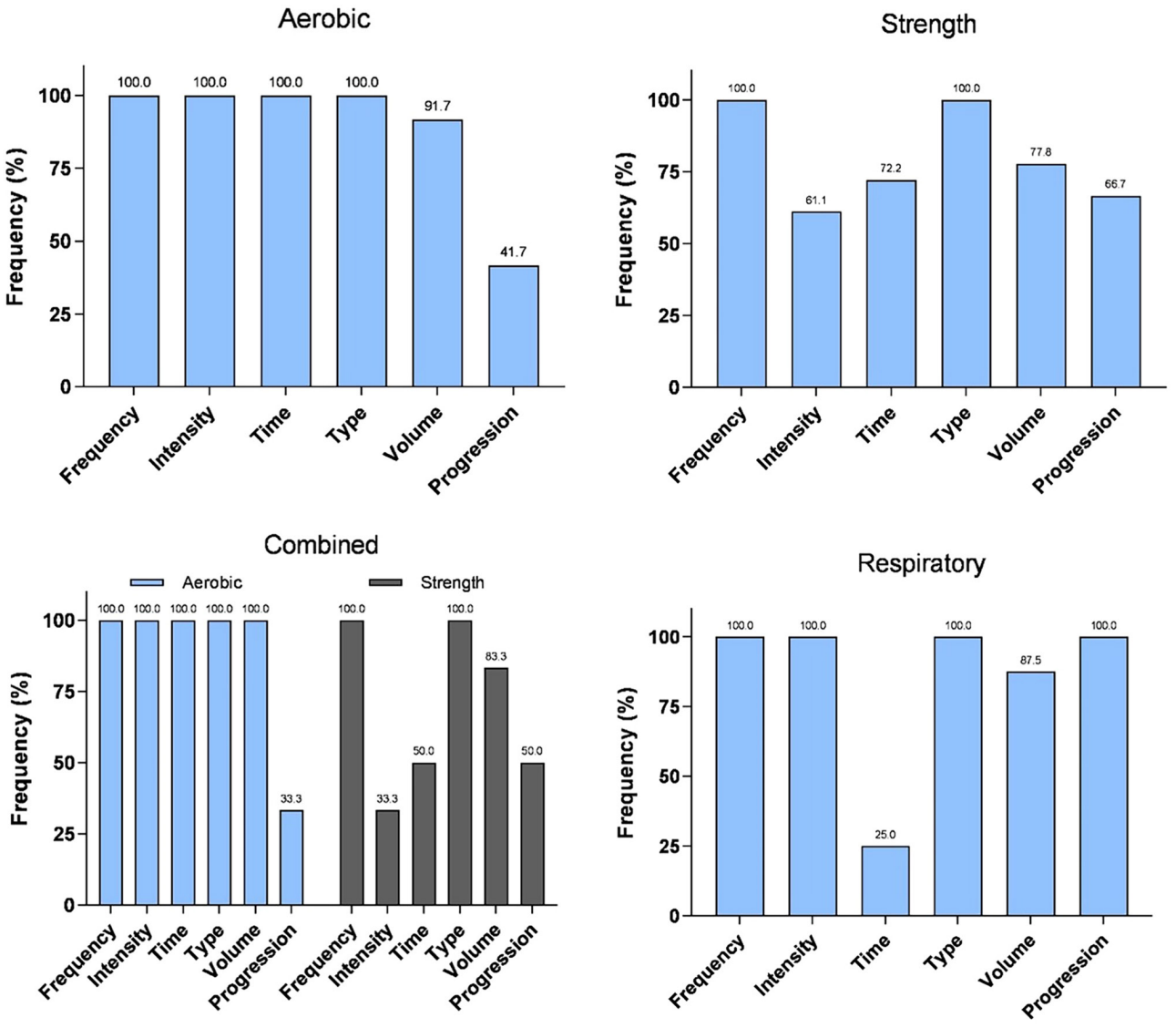
physiotherapists and exercise physiologists (n = 20; 37.0%, and n = 10; 18.5%, respectively).

The principles of exercise adopted in the prescribed protocols are shown in Figure 3. All protocols included type and frequency, but only 53.7% (n = 29) considered progression. Most protocols prescribed exercises three days a week (n = 47; 88.9%) and used subjective methods (n = 18; 33.3%) to determine exercise intensity, while 14 (25.9%) protocols did not report intensity control.

Characteristics of Exercise Protocols

Aerobic

The cycle ergometer was used in all aerobic protocols (n = 12; 100%), and one included partial restriction of blood flow in the lower limbs. All protocols prescribed exercises three days per week, and most of them monitored exercise intensity by objective methods (n = 9; 75.0%), primarily through heart rate scales (n = 9; 75.0%), and rate of perceived exertion (RPE) (n = 6; 50.0%).



Abbreviations: ACSM, American College of Sports Medicine; FITT-VP, Frequency, Intensity, Time, Type, Volume, and Progression.
Figure 3. FITT-VP training principles (ACSM) adopted in the most prescribed protocols.

Strength

Six strength protocols included lower limb exercises (33.3%), and 11 combined exercises for both lower and upper limbs (61.1%). Six protocols used dumbbells and free weights (33.3%). Two studies incorporated bodyweight exercises (11.1%). Most protocols prescribed exercises three days a week (n = 16; 88.9%), and monitored exercise intensity using subjective methods through RPE scales (n = 10; 55.6%).

Combined

All combined protocols prescribed both aerobic and strength training within the same session (n = 6; 100%), with aerobic training being predominantly performed first (n = 5; 83.3%).

Aerobic Component

Cycling was prescribed for all protocols, and one also included walking/running on a treadmill[16]. Five protocols prescribed exercises three days a week (83.3%), and most of them monitored exercise intensity using subjective methods (n = 5; 83.3%), mainly through RPE scales (n = 4; 66.7%).

Strength Component

Four protocols included exercises for both lower and upper limbs (66.6%), while two focused only

on the lower limbs (33.3%). Most protocols used dumbbells and free weights (n = 5; 83.3%), and one incorporated elastic bands or balls (16.7%). Five protocols prescribed exercises three days a week (83.3%), and only three described exercise intensity monitoring (50%).

Respiratory

Respiratory interventions (n = 8) were primarily performed three days a week (n = 6; 75.0%) with objective intensity methods applied in all of them, mainly through maximal inspiratory pressure (n = 7; 87.5%), ranging from 40 to 70%.

Mobility

Mobility protocols (n = 3) were mainly prescribed three days per week (n = 2; 66.3%), with duration ranging from 25 to 45 minutes. No intensity or progression approach was described.

Neuromuscular Electrical Stimulation

Five protocols employed neuromuscular electrical stimulation three days a week (100%), with sessions lasting between 20 and 60 minutes each. The intensity was objectively prescribed through pulse rate (100%), which ranged from 20 to 80 Hz.

Virtual Reality

A single protocol used non-immersive exergames and was prescribed three days per week. The exercise intensity was monitored through RPE, ranging from 12 to 14 on the Borg scale of 6 to 20, representing a somewhat hard to hard intensity.

Vibration Platform

One exercise protocol used vibration platforms at a frequency of 35 Hz. The protocol consisted of performing consecutive 30-second isometric semi-squats separated by 30-second rest periods for a total of 10 to 20 minutes, twice a week.

Discussion

Our scoping review described the exercise protocols prescribed for patients on hemodialysis in Brazil. Evidence came mainly from the states of São Paulo and Rio Grande do Sul, with strength training being the most commonly prescribed type of exercise. Physiotherapists supervised the majority of protocols. The principle of systematic progression was applied in only half of protocols, and exercise intensity was predominantly determined by subjective methods. The exercise frequency was primarily three times a week and during dialysis, highlighting the need for a more holistic approach to exercise and physical activity in this population, including a lifestyle that involves "moving more"[17].

Unlike the global analyses, strength training, rather than aerobic exercises, was the most prescribed type among the included protocols[9]. Aerobic exercise often requires minimal professional supervision and incurs lower costs. In Brazil, exercise can only be prescribed and supervised by physiotherapists and/or exercise physiologists. This suggests that strength exercises have been more widely adopted than in other countries across the world. Additionally, they are more affordable and require simpler equipment when compared to aerobic exercises using a cycle ergometer. However, despite such professional support, other types of exercise programs (e.g. neuromuscular electrical stimulation, virtual reality, and vibration platforms) have been poorly prescribed. Such interventions are generally expensive and require modern equipment, making their implementation in clinical practice more challenging.

In our global analysis[9], a large number of protocols did not properly describe the exercise-related variables recommended by the ACSM (i.e. FITT-VP principles)[15]. However, in this Brazilian analysis, there was a greater number of exercise protocols that followed all or most of those principles. Nevertheless, progression was little adopted in both aerobic and combined exercise programs. Proper exercise progression plays a major role in producing long-term physiological adaptations and may have an impact on health benefits[18,19]. Therefore, efforts from Brazilian societies of nephrology, physiotherapy, and exercise physiology are needed to provide guidelines on the implementation, prescription, monitoring, and supervision of exercises for patients undergoing hemodialysis, as recently done by the UK Renal Association[20]. The newly created *Grupo Brasileiro de Reabilitação em Nefrologia* (GBREN, Brazilian Group for Rehabilitation in Nephrology)[21,22] has so far operated as a collaborative network to support exercise professionals working in this area. In clinical practice, until there is a national guideline, we recommend that professionals involved in the

prescription and supervision of physical exercise for this population follow recommendations such as those of the ACSM[15].

To the best of our knowledge, this is the first scoping review describing the evidence on how exercise has been prescribed for patients on hemodialysis in Brazil. We followed well-known guidelines, conducted a comprehensive search strategy, and included most types of exercise, which contributed to a robust number of studies included. Despite these strengths, there are some limitations. The full text was read only by the lead reviewer; however, to minimize this bias, the data extraction was double-checked by two other reviewers. In addition, the search strategy did not include any Brazilian-specific terms or the Brazilian Portuguese language, which may have impacted the capture of non-English publications.

In conclusion, strength and aerobic exercise interventions were the most commonly prescribed in Brazil, although other modalities have recently been prescribed. However, we found a low number of protocols adopting systematic progression of exercise training principles over the course of the intervention. Future protocols should adopt these criteria to ensure better physiological responses and adaptations. Therefore, we believe our findings could provide the nephrology community with a better understanding of how to provide, implement, monitor, and supervise exercise programs for individuals undergoing hemodialysis. Furthermore, public policies should encourage the increased presence of qualified professionals to supervise exercise programs (namely, physiotherapists and exercise physiologists).

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Authors' Contributions

All authors contributed to the conception and design of the study. The research problem, literature review, and data extraction were conducted by HSR, FPA, DVL, and JLV. Data analysis and the first draft of the manuscript were conducted by HSR. All authors provided comments on previous versions of the manuscript; they also read and approved the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

The following online material is available for this article:

Supplementary Material 1 – Search strategies.

Supplementary Material 2 – References of the included reports.

Table S1 – Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (Prisma-ScR) Checklist.

Table S2 – Characteristics of the exercise protocols.

References

1. Nerbass FB, Lima HDN, Moura-Neto JA, Lugon JR, Sesso R. Brazilian Dialysis Survey 2022. J Bras Nefrol. 2024;46(2):1–8. doi: http://doi.org/10.1590/2175-8239-jbn-2023-0062en. PubMed PMID: 38078834.
2. Almeida LS, Ribeiro HS, Duarte MP, Dourado GÍ, Ferreira TL, Inda-Filho AJ, et al. Physical activity is associated with nutritional biomarkers in hemodialysis patients: a cross-sectional study. Ther Apher Dial. 2022;26(5):924–31. doi: http://doi.org/10.1111/1744-9987.13782. PubMed PMID: 34939328.
3. Lim K, McGregor G, Coggan AR, Lewis GD, Moe SM. Cardiovascular functional changes in chronic kidney disease: integrative physiology, pathophysiology and applications of cardiopulmonary exercise testing. Front Physiol. 2020;11:1–14. doi: http://doi.org/10.3389/fphys.2020.572355. PubMed PMID: 33041870.
4. Leal DV, Ferreira A, Watson EL, Wilund KR, Viana JL. Muscle-bone crosstalk in chronic kidney disease: the potential modulatory effects of exercise. Calcif Tissue Int. 2021;108(4):461–75. doi: http://doi.org/10.1007/s00223-020-00782-4. PubMed PMID: 33388899.
5. Ribeiro HS, Neri SGR, Oliveira JS, Bennett PN, Viana JL, Lima RM. Association between sarcopenia and clinical outcomes in chronic kidney disease patients: a systematic review and meta-analysis. Clin Nutr. 2022;41(5):1131–40. doi: http://doi.org/10.1016/j.clnu.2022.03.025. PubMed PMID: 35430544.
6. Duarte MP, Almeida LS, Neri SGR, Oliveira JS, Wilkinson TJ, Ribeiro HS, et al. Prevalence of sarcopenia in patients with chronic kidney disease: a global systematic review and meta-analysis. J Cachexia Sarcopenia Muscle. 2024;15(2):501–12. doi: http://doi.org/10.1002/jcsm.13425. PubMed PMID: 38263952.
7. Wilund K, Thompson S, Bennett PN. A global approach to increasing physical activity and exercise in kidney care: the international society of renal nutrition and metabolism global renal exercise group. J Ren Nutr. 2019;29(6):467–70. doi: http://doi.org/10.1053/j.jrn.2019.08.004. PubMed PMID: 31591041.
8. Bennett PN, Kohzuki M, Bohm C, Roshanravan B, Bakker SJL, Viana JL, et al. Global policy barriers and enablers to exercise and physical activity in kidney care.

J Ren Nutr. 2022;32(4):441–9. doi: http://doi.org/10.1053/j.jrn.2021.06.007. PubMed PMID: 34393071.
9. Ribeiro HS, Andrade FP, Leal DV, Oliveira JS, Wilund KR, Viana JL. How is exercise being prescribed for patients on hemodialysis? A scoping review. J Nephrol. 2022;36(5):1307–19. doi: http://doi.org/10.1007/s40620-022-01513-8. PubMed PMID: 36418777.
10. Barros FS, Pinheiro BV, Lucinda LMF, Rezende GF, Segura-Ortí E, Reboredo MM. Exercise training during hemodialysis in Brazil: A national survey. Artif Organs. 2021;45(11):1368–76. doi: http://doi.org/10.1111/aor.14018. PubMed PMID: 34153118.
11. Ribeiro HS, Andrade FP, Leal DV, et al. How is exercise prescribed for hemodialysis patients? A Scoping review protocol. *medRxiv* 2021;1–9. doi: http://doi.org/10.1101/2021.12.21.21268178.
12. Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. JBI Evid Synth. 2020;18(10):2119–26. doi: http://doi.org/10.11124/JBIES-20-00167. PubMed PMID: 33038124.
13. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467–73. doi: http://doi.org/10.7326/M18-0850. PubMed PMID: 30178033.
14. Peters M, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping Reviews. In: E Aromataris, Z Munn, editor. JBI Manual for Evidence Synthesis. Australia: JBI; 2020. doi: http://doi.org/10.46658/JBIMES-20-12.
15. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 11th ed. Philadelphia: Wolters Kluwer; 2021.
16. Tomich GM, Bernardino LS, Ferreira FO. Impact of physical therapy on functional capacity and life quality of patients with chronic kidney disease. Fisioter Mov. 2014;27(4):643–51. doi: http://doi.org/10.1590/0103-5150.027.004.AO16.
17. Wilund KR, Viana JL, Perez LM. A critical review of exercise training in hemodialysis patients. Exerc Sport Sci Rev. 2020;48(1):28–39. doi: http://doi.org/10.1249/JES.0000000000000209. PubMed PMID: 31453844.
18. Spiering BA, Mujika I, Sharp MA, Foulis SA. Maintaining physical performance: the minimal dose of exercise needed to preserve endurance and strength over time. J Strength Cond Res. 2021;35(5):1449–58. doi: http://doi.org/10.1519/JSC.0000000000003964. PubMed PMID: 33629972.
19. Smart NA, Williams AD, Levinger I, Selig S, Howden E, Coombes JS, et al. Exercise & Sports Science Australia (ESSA) position statement on exercise and chronic kidney disease. J Sci Med Sport. 2013;16(5):406–11. doi: http://doi.org/10.1016/j.jsams.2013.01.005. PubMed PMID: 23434075.
20. Baker LA, March DS, Wilkinson TJ, Billany RE, Bishop NC, Castle EM, et al. Clinical practice guideline exercise and lifestyle in chronic kidney disease. BMC Nephrol. 2022;23(1):75. doi: http://doi.org/10.1186/s12882-021-02618-1. PubMed PMID: 35193515.
21. Ribeiro HS, Andrade FP, Reboredo MM. Rehabilitation and exercise in Brazilian nephrology: where we are and future perspectives. Rev Bras Pesqui em Ciências da Saúde. 2021;8:1–2.
22. Andrade FP, Ribeiro HS, Krug RR, Reboredo MM. Grupo Brasileiro de Reabilitação em Nefrologia (GBREN). Biomotriz. 2022;16(1):7–8. doi: http://doi.org/10.33053/biomotriz.v16i1.733.