Systematic Review

The effects of physical exercise on patients undergoing hemodialysis: a systematic review

Os efeitos do exercício físico em pacientes submetidos à hemodiálise: uma revisão sistemática

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ABSTRACT | INTRODUCTION: Patients with chronic kidney disease submitted to hemodialysis are sedentary due to pain, muscle fatigue and poor physical condition. Recent studies demonstrate the beneficial effects of physical exercise programs to these patients during hemodialysis resulting in better control of hypertension, functional capacity, cardiac function, muscle strength and thus quality of life. **OBJECTIVES:** To analyze research works that show whether or not exercise produces beneficial clinical outcomes in individuals on hemodialysis. **METHODOLOGY:** This article is a systematic review of randomized controlled trials published between 2014 and 2019 that related hemodialysis, exercise and quality of life and had a PEDro score > 5. Studies that were not in conformity with the proposed theme, duplicate articles among the databases and research intentions were excluded. The keywords used for the search followed the description of DECS and MESH terms: Hemodialysis, exercise and quality of life. These words were found in any section of the article. **RESULTS:** 15 studies were selected according to the eligibility criteria. The articles analyzed had a total of 1057 participants of both sexes aged between 18 and 80 years. They were submitted to aerobic, anaerobic and respiratory exercises, and presented beneficial clinical outcomes in the three modalities of physical exercise. **CONCLUSION:** Physical exercise programs during hemodialysis optimize mass gain, strength and muscle endurance, physical fitness, quality of sleep, self-perception of health, functional capacity and consequently quality of life.

KEYWORDS: Hemodialysis. Physical exercise. Quality of life.

RESUMO | INTRODUÇÃO: Pacientes portadores de doença renal crônica submetidos à hemodiálise são sedentários devido a dor, fadiga muscular e baixo condicionamento físico. Estudos recentes demonstram os efeitos benéficos de programas de exercícios físicos para estes pacientes durante a hemodiálise resultando em melhor controle da hipertensão arterial, da capacidade funcional, da função cardíaca, da força muscular e, assim, da qualidade de vida. **OBJETIVOS:** Analisar pesquisas que mostram se o exercício físico produz ou não desfechos clínicos benéficos para indivíduos em hemodiálise. **METODOLOGIA:** Este artigo constitui-se de uma revisão sistemática composta por ensaios clínicos randomizados publicados entre 2014 e 2019 que relacionassem hemodiálise, exercício físico e qualidade de vida e que apresentassem escore de PEDro superior a 5. Foram excluídos os estudos que estavam em desconformidade com o tema proposto, artigos duplicados entre as bases de dados e intenções de pesquisa. As palavras-chave utilizadas para a busca seguiram a descrição dos termos DECS e MESH, sendo elas: Hemodiálise, exercício físico e qualidade de vida. Essas palavras estavam presentes em qualquer seção do artigo. **RESULTADOS:** Foram selecionados 15 estudos segundo os critérios de elegibilidade. Os artigos analisados obtiveram um total de 1057 participantes de ambos os sexos com idades entre 18 e 80 anos. Esses foram submetidos a exercícios aeróbicos, anaeróbicos e respiratórios, apresentaram desfechos clínicos benéficos nas três modalidades de exercício físico. **CONCLUSÃO:** Programas de exercício físico durante a hemodiálise otimizam o ganho da massa, força e resistência muscular, aptidão física, qualidade do sono, autopercepção de saúde, capacidade funcional e consequentemente a qualidade de vida.

PALAVRAS-CHAVE: Hemodiálise. Exercício físico. Qualidade de vida.

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Introduction

Chronic renal failure (CRF) is a general term for heterogeneous changes affecting both structure and renal function, with multiple causes and multiple prognostic factors[1]. According to the Brazilian Dialysis Census of the Brazilian Nephrology Society of 2018[2], more than 133,000 patients underwent renal replacement therapy, an increase of approximately 85,000 patients compared to the 2002 census in which 48,000 patients were involved.

The etiological factors of CRF involve primary kidney diseases, systemic diseases and hereditary diseases. Its most common causes are: diabetes mellitus (DM), glomerular nephritis, Hypertensive nephrosclerosis, renovascular disease, polycystic kidneys, obstructive uropathies and congenital malformations[3].

Among the different therapeutic modalities, hemodialysis (HD) is the most widely used, as it provides a faster change in the composition of plasma solutes and the removal of excess body water, compared to other types of renal replacement therapy modalities[4]. HD, as a renal function support procedure, consists of the removal of toxic substances and excess fluid by a dialysis machine, in a procedure that takes between 2 to 4 hours, requiring the patient to go to the treatment unit 3 times a week[5].

Hemodialysis treatment causes a monotonous and restrictive daily routine, favoring sedentariness and diminishing functional capacity; interfering negatively in the emotional and social contexts of these patients, who generally feel weakened due to the situation of dependence in which they live. These and other factors, such as pain, systemic inflammation, decreased muscle strength and mobility reflect in a reduction of quality of life[6].

Some authors[7,9] indicate that a physical exercises program during dialysis promotes improvement of functional capacity, strength and muscle resistance, cardiac function and, consequently, quality of life. Reboredo et al.[9] defended the fact that exercise during hemodialysis sessions increases adherence to treatment, reduces the monotony of the dialysis process and facilitates medical follow-up. This systematic review aims to analyze research that shows whether or not physical exercise produces beneficial clinical outcomes for individuals on HD.

Methodology

It was a systematic review, according to the PRISMA protocol guidelines. The search was performed using PEDro, PubMed, SciELO and LILACS databases, by crossing the keywords Hemodialysis, Exercise and Quality of life. These words were taken from DeCS and MESH and were present in any section of the article. Figure 1 represents the search strategy for the PubMed database.

Figure 1. Search strategy for PubMed database (September, 2019)

- 1 Hemodialysis
- 2 Hemodialysis AND Exercise
- 3 Hemodialysis AND Exercise AND Quality of life
- 4 Hemodialysis AND Exercise AND Quality of life
- 5 Hemodialysis AND Exercise AND Quality of life (filters: Clinical Trial)
- 6 Hemodialysis AND Exercise AND Quality of life (filters: Clinical Trial, 5 years)

Randomized controlled trials published between 2014 and 2019 that related hemodialysis, exercise and quality of life and had a PEDro score>5 were selected as inclusion criteria. Exclusion criteria: non-conformity with the proposed theme, duplicate articles among the databases and research intentions.

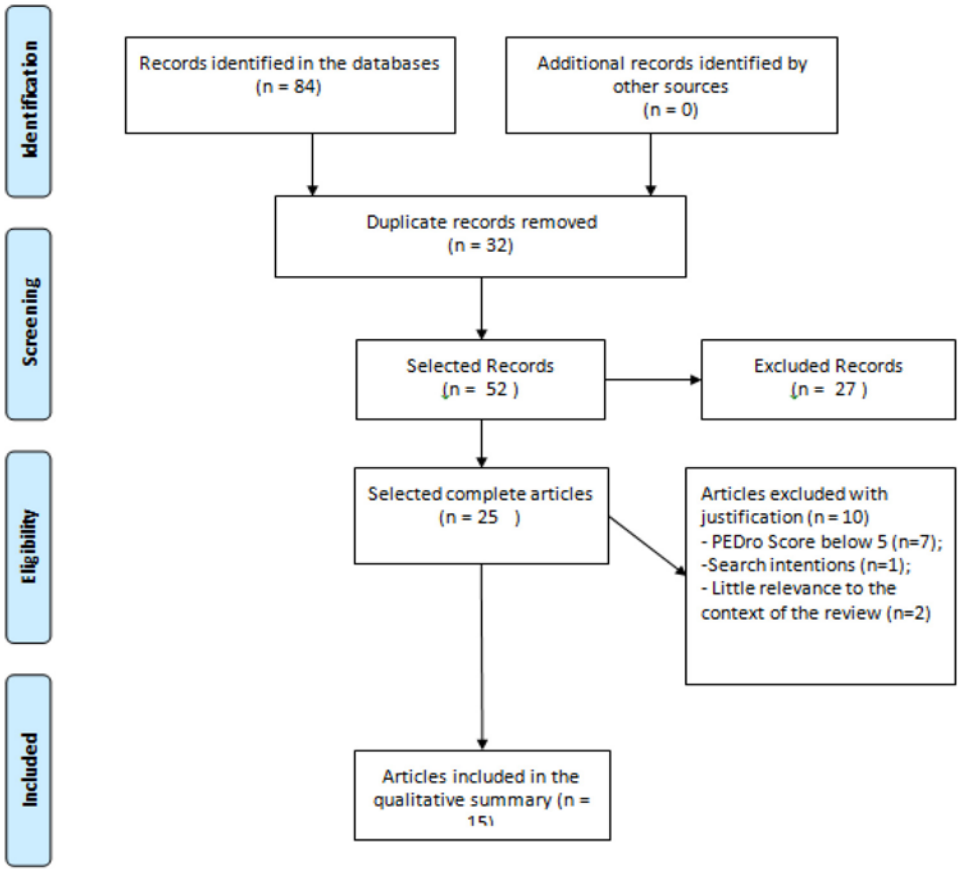
The database search was conducted in September 2019. The articles were initially selected by reading the title and abstract, then the selected studies were analyzed by reading the full text in order to confirm the eligibility criteria.

The methodological quality of the studies was assessed according to the criteria of the PEDro scale[10], which scores 11 items, namely: 1- Eligibility criteria, 2 - Random allocation, 3 - Hidden allocation, 4 - Baseline comparability, 5 - Blind subjects, 6 - Blind therapists, 7 - Blind assessors, 8 - Proper follow-up, 9 - Intent to treat analysis, 10 - Group comparisons, 11 - Point estimates and variability. Items are scored as present (1) or absent (0), generating a maximum sum of 10 points, and the first item is not counted.

Results

In the initial research 497 articles were found (PUBMED: 401; PEDro: 46; LILACS: 29; SCIELO: 21). After applying the "article types", "year of publication" and "language" filters, 84 studies remained potentially relevant for review, of which 59 were excluded because they did not meet the inclusion criteria, resulting in 25 studies for detailed reading. After analysis of the full texts, 10 more studies were excluded, leaving 15 articles included in the review. The selection process of the studies is completely described in the flowchart of Figure 2.

Figure 2. Flowchart of systematic selection of studies with population undergoing HD, according to the PRISMA recommendation (2019)



The selected articles had a total of 1057 participants of both sexes aged between 18 and 80 years. They were submitted to aerobic[11,12,15,16,21,23-25], anaerobic[13-15,17-21,23] and respiratory[11] exercises. The characterization of the sample, the exercise programs and the main outcomes obtained from the included studies are outlined in Table 1, the studies are organized in descending order according to the scores acquired in the PEDro score.

Table 1. Characterization of the randomized clinical trials included in the systematic review as sample, exercise programs and outcomes for HD treated population (2019) (to be continued)

Authors (Publication year)	PEDro score	Age (years)	Sample	Program	Endpoints
Figueiredo et al (2018)[11]	8	48,2	37	G1: IMT at 50% of PImáx. G2: low intensity BP. G3: AT + IMT.	The combined IMT and AT improved the functional parameters and inflammatory biomarkers.
Tao, Chow, Wong (2015)[12]	8	27 –74	113	G1: Resisted exercise + aerobic exercise + exercise management G2: Resisted exercise + aerobic exercise.	Exercise at home is practical and effective in improving the physical function and self-perception of the health of HD patients.
Bennett et al (2016)[13]	8	68.1 (12.6)	171	All groups performed progressive resistance physical exercise. G1: 36 weeks of intervention. G2: 24 weeks of intervention. G3: 12 weeks of intervention.	Intradialytic resistance training can improve the physical function of individuals in HD.
Olvera-Soto et al (2016)[14]	7	21-39	61	G1: Resisted exercises. G2: Just hemodialysis.	Resistance exercise is safe and able to improve muscle mass and strength in HD patients.
Marchesan, Nunes, Rombaldi (2014)[15]	7	21-40	22	G1: Aerobic training + resistance exercise. G2: Just hemodialysis.	Physical training has improved the physical fitness and quality of life of HD patients.
Aoike et al (2017)[16]	7	55,8 ± 8,3	40	G1: Aerobic exercise in the center of HD. G2: Home aerobic exercise. G3: Routine care for HD patients.	Home aerobic training was as effective as in hemodialysis center training to improve physical performance , functional capabilities, quality of life and sleep in HD patients.
Rahimimoghadam, et al (2017)[17]	6	18 - 65	50	G1: Routine care for patients on hemodialysis + Pilates exercises. G2: Routine care for HD patients.	Pilates can be considered an effective alternative to improve HD, general health, physical, mental and social status of patients.
Suhardjono et al (2019)[21]	5	48,9 (12,2)	120	G1: Aerobic exercise. G2: Aerobic exercise + resistance. G3: No intervention.	Both exercise programs have increased the strength of the MMII muscles and the quality of life index. The combined exercise was no more effective than aerobic exercise for HD patients.
Lopes et al (2019)[18]	5	30-70	50	G1: High intensity resistance training. G1: Resistance training of moderate intensity. G3: Stretching.	High-intensity resistance training was associated with lean mass gains in MMII and quality of life, while functional capacity and sarcopenia were improved regardless of training intensity.
Rosa et al (2018)[20]	5	55,7 ± 14,03	52	G1: Progressive resistance training. G2: Mobilization of MMSS and MMII without load and progression.	Progressive resistance training provided increased lean mass, strength, bone mineral content and flexibility in MMII.

Table 1. Characterization of the randomized clinical trials included in the systematic review as sample, exercise programs and outcomes for HD treated population (2019) (conclusion)

Authors (Publication year)	PEDro score	Age (years)	Sample	Program	Endpoints
Tayebi, Ramezani, Kashef (2018)[19]	5	18-80	34	G1: Isometric resistance exercise. G2: No intervention.	Isometric exercise can increase muscle capacity and help maintain albumin levels in HD patients.
Zhao et al (2017)[23]	5	56.9± 7.5	189	G1: Escitalopram daily. G2: Escitalopram daily + ride a bike 6 times a week. G3: Placebo medication + riding a bike 6 times a week.	Aerobic exercise improves the quality of life and improves the severity of depression in hemodialysis patients, affecting Interleukin 6 and 18 levels.
Frih et al (2017)[22]	5	64,7± 3,2	41	G1: Progressive resistance exercise + progressive aerobic exercise. G2: No intervention.	The combined aerobic and anaerobic training program has had a beneficial effect on physical capacity and quality of life in HD patients.
Matsufuji et al (2015)[25]	5	61-79	17	G1: Patients were advised to get up and sit in a wheelchair for 15 minutes, with short breaks between repetitions. G2: Muscle stretching.	Wheelchair exercise has improved daily living activities in HD patients.
Bohm et al (2014)[24]	5	53 ± 16.9	60	G1: Cycloergometer during hemodialysis. G1: Gradual aerobic exercise based on the pedometer, aimed at 10,000 steps per day.	The intradialytic cycloergometer and home pedometer program showed similar improvements in function and flexibility of MMII, but did not change the aerobic capacity of individuals in HD.

Legend: G1= Group 1; G2= Group 2; G3= Group 3; MMII= Lower limbs; MMSS= Upper limbs; IMT= Inspiratory muscle training; AT= Aerobic training.

Quality of life was assessed in seven studies[15,16,20,22-25] by applying the SF-36 questionnaire; In five other studies[11-13,18,21] the KDQOL-SF questionnaire was applied, which assessed the quality of life in renal patients. Functional capacity was assessed in nine studies by the Sit-to-stand test (STS)[11-16,20,22,25] and the 6-minute walk test (TC-6) in seven studies[11,15,16,20,22,24,25].

Regarding the methodological quality of the studies, ten articles[11-17,19,21,23] had adequate follow-up; six articles[11-13,15,16,25] had hidden allocation and six[11-14,18,22] had blinded outcome assessors. The PEDro scores for all the studies included in the review are listed in Chart 1.

Chart 1. PEDro scores for articles included in the systematic review with HD treated population (2019)

Items (PEDro) / Authors	1	2	3	4	5	6	7	8	9	10	11	Total Score
Figueiredo et al.[11]	1	1	1	1	0	0	1	1	1	1	1	8
Tao, Chow, Wong[12]	1	1	1	1	0	0	1	1	1	1	1	8
Bennett et al.[13]	1	1	1	1	0	0	1	1	1	1	1	8
Olvera-Soto et al.[14]	1	1	0	1	1	0	1	1	0	1	1	7
Marchesan, Nunes, Rombaldi[15]	1	1	1	1	0	0	0	1	1	1	1	7
Aoike et al.[16]	1	1	1	1	0	0	0	1	1	1	1	7
Rahimimoghadam, et al.[17]	1	1	0	1	0	0	0	1	1	1	1	6
Suhardjono et al.[21]	1	1	0	1	0	0	0	1	0	1	1	5
Lopes et al.[18]	0	1	0	1	0	0	1	0	0	1	1	5
Rosa et al.[20]	1	1	0	1	0	0	0	0	1	1	1	5
Tayebi, Ramezani, Kashef[19]	1	1	0	1	0	0	0	1	0	1	1	5
Zhao et al.[23]	1	1	0	1	0	0	0	1	0	1	1	5
Frih et al.[22]	1	1	0	1	0	0	1	0	0	1	1	5
Matsufuji et al.[25]	1	1	1	1	0	0	0	0	0	1	1	5
Bohm et al.[24]	1	1	0	1	0	0	0	0	1	1	1	5

Discussion

It is known that the HD treated population has grown considerably in recent years. Due attention should be given to these individuals, as they are a group with a high mortality rate and severe complications[25]. The outcomes of the studies analyzed showed physical exercise as an excellent resource to improve functional capacity, quality of life, self-perception of health and the mental and social status of HD patients.

Olvera-Soto et al.[14] developed a protocol for patients on HD with the inclusion of resisted physical exercises with elastic bands and ankle weights during a period of 12 weeks. In this study the authors proved the relevance of inserting resisted physical exercises during hemodialysis to improve mass and muscle strength. However, it is worth noting that optimizing strength does not necessarily mean improving physical function.

Bennett et al.[13] in their study observed a decline in strength and physical function of patients who had been in HD for 3, 6 and 9 months without any physical exercise. After a program of resisted exercises it was found an improvement in both muscle strength and physical function of these individuals.

Bohm et al. [24] proposed two protocols of interventions based on aerobic exercises with cycloergometer and using the pedometer and found that both modalities were able to improve the physical function of patients in HD. Similar results were found by Marchesan, Nunes, Rombaldi[15] when applying a physical exercise protocol that included aerobic training during cycloergometer and progressive resistance training.

In opposition to these results, a resistance exercise protocol proposed by Rosa et al.[22] was ineffective in improving the functional capacity and quality of life of individuals in HD. However, the unfavorable results may have been due to the control group carrying out simulated exercise, which may have influenced a potential placebo effect on this group. In addition, the study had some limitations, such as non-secret and nonblinding allocation of therapists,

evaluators and participants, which may also have interfered with the results.

Figueiredo et al.[11] observed in their study that the group submitted to inspiratory muscle training had a significant improvement in functional parameters and levels of C-reactive protein, a biomarker of chronic inflammation. Two other important biomarkers of inflammation are IL6 and IL18. Zhao et al.[23] observed that participants who rode a bicycle for 1 hour, 6 times per week for 18 weeks had reduced serum levels of these two biomarkers.

In contrast, the aerobic exercise protocol proposed by Suhardjono et al.[21] did not change the levels of the assessed inflammation biomarkers. However, the authors point out that the exercise protocol may not have been adequately effective and that the levels of biomarkers in the participants had a wide variation, which made analysis between groups difficult.

Aoike et al.[16] and Tao, Chow, Wong[12] investigated the effects of a home exercise program under supervision, compared to training in HD centers. Both studies concluded that a home exercise program under supervision is as effective in improving functional capacity and quality of life as that carried out in HD centers, showing that home exercise can be a method to ensure the involvement of these patients in physical training programs.

Although the benefits of exercise to the HD treated population are already well elucidated in the literature, the implementation of physical activity programs in hemodialysis centers is still a challenge, whether by barriers raised by the patients themselves or by resource constraints. Thus, strategies are needed to ensure the involvement of this population in physical training programs.

The study presents some limitations: the methodological and outcome variability of the analyzed articles interfered in the comparison of the results obtained in the research, mainly in relation to the physical exercise programs that varied in terms of follow-up time, training intensity and the type of intervention applied. Inspiratory muscle training was used in only one study and whcih was performed in association to the aerobic training, this way it is not possible to confirm the real benefits of this modality of intervention in the HD treated population. In addition, none of the studies performed the interventions with the blinded participants and therapists, which interfered with their methodological quality.

Conclusion

Exercise programs during HD produce beneficial clinical outcomes. These optimize mass gain, strength and muscle endurance, physical fitness, quality of sleep, self-perception of health, functional capacity and consequently quality of life.

Author contributions

All the authors also contributed to the development of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, corporations, private foundations, etc.) have been declared for any aspect of the work submitted (including, but not limited to grants and funding, participation in advisory board, study design, preparation of manuscript, statistical analysis, etc.).

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