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Effects of physical exercise in frail older adults: a systematic review

Efeitos do exercício físico em idosos fragilizados: uma revisão sistemática

Efectos del ejercicio físico en ancianos fragilizados: una revisión sistemática

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ABSTRACT | Frailty is an unstable condition related to functional decline, which affects the individual's interaction with the environment and may cause limitation in the activities of daily living and result in loss of autonomy. This study aimed to provide a theoretical background on the effects of physical exercise on frail older people. This is a systematic review of studies published between 2011 and 2016 in the Medline, PubMed, PEDro, SciELO and Lilacs databases. After data search, 12 articles were included in the investigation, which highlight the positive effects of physical exercise on frailty, emphasizing multicomponent training with regularity of two to three times a week. We can conclude that physical exercises bring beneficial effects to frail older people in terms of quality of life and physical and cognitive aspects.

Keywords | Frail Elderly; Exercise; Health Promotion; Review.

RESUMO | A fragilidade é uma condição instável relacionada ao declínio funcional, que afeta a interação do indivíduo com o ambiente, podendo causar limitação no desempenho das atividades de vida diária e perda de autonomia. O objetivo deste estudo foi realizar um aprofundamento teórico sobre os efeitos do exercício físico em idosos fragilizados. Trata-se de uma revisão sistemática de estudos publicados entre 2011 e 2016 nas bases de dados Medline, PubMed, PEDro, SciELO e Lilacs. Após a busca de dados, 12 artigos foram incluídos na pesquisa, os quais salientam os efeitos positivos do exercício físico sobre a fragilidade, enfatizando o treinamento multicomponente com regularidade de duas a três vezes por semana. Pode-se concluir que os exercícios físicos trazem efeitos benéficos para os idosos fragilizados quanto aos aspectos físicos e cognitivos e na qualidade de vida.

Descritores | Idoso Fragilizado; Exercício; Promoção da Saúde; Revisão.

RESUMEN | La fragilidad es una condición inestable relacionada con la declinación funcional, que afecta la interacción del individuo con el ambiente, causando limitación en el desempeño de las actividades de vida diaria y pérdida de autonomía. El objetivo de este estudio fue realizar una profundización teórica sobre los efectos del ejercicio físico en ancianos fragilizados. Se trata de una revisión sistemática de estudios publicados entre 2011 y 2016 en las bases de datos Medline, PubMed, PEDro, SciELO y Lilacs. Después de la búsqueda de datos, 12 artículos fueron incluidos en la investigación, los cuales resaltan los efectos positivos del ejercicio físico sobre la fragilidad, enfatizando el entrenamiento multicomponente con regularidad de dos a tres veces por semana. Se puede concluir que los ejercicios físicos traen efectos benéficos para los ancianos fragilizados en cuanto a los aspectos físicos y cognitivos y en la calidad de vida.

Palabras clave | Anciano Frágil; Ejercicio; Promoción de la Salud; Revisión.

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INTRODUCTION

Population aging is considered a worldwide phenomenon, and the fall in the birth rate and the increasing number of older people have led to changes in the population pyramid in an accelerated and significant way[1]. In the 2000s, 30% of the population was in the age group from 0 to 14 years, while those over 65 represented 5% of Brazilians. In contrast, the estimate for 2050 is that these two groups equalize, each representing 18% of the population[2]. Also, Brazil is expected to be the sixth in the world in absolute number of older people by 2025, totaling 33.8 million individuals in this age group, with its proportion increasing from 2.7% to 14.7% of the population[3].

The aging process is a period of decline characterized by two aspects: senescence and senility. On the one hand, aging is a progressive process of diminishing the functional reserve – senescence – and, on the other hand, the development of a pathological condition due to emotional stress, accidents or illness – senility[4], which generates limitations in the daily life of older people, making them less autonomous and more dependent. Thus, the decrease in the activity level may lead the older adult to a state of frailty[5].

In the last decades, the term frailty has been highlighted in studies on aging[6]. This term is used to define older adults with clinical characteristics attributed to aging, associated with the existence of comorbidities, such as unintentional weight loss, exhaustion, decreased muscle strength, gait and balance disorders, and sedentary lifestyle[7].

Three physiological systems are affected with the development of frailty, with neuromuscular, endocrine and immunological changes[8]. Immunological changes include the increase in the circulating levels of inflammatory markers and variations of environmental factors that contribute to the elevation of inflammatory activity in older people[9]. Endocrine changes may reduce hormones, such as testosterone, estrogen, luteinizing hormone and dehydroepiandrosterone, and increase the levels of cortisol[10]. Neuromuscular changes occur with the appearance of sarcopenia and dynapenia, which means loss of mass and muscular strength, respectively[8].

The neuromuscular changes affect the functionality of older adults, leading to a low tolerance to physical exercise and, consequently, an increase in functional dependence, besides predisposing to a greater risk of falls, fractures, hospitalizations and mortality[11]. Thus, frailty is an unstable condition related to functional decline, which affects the individual's interaction with the environment, limiting the performance of activities of daily living (ADL) and causing the loss of autonomy[12].

Considering that the aging process can generate limitations, physical exercise is a strategy that can soften the decline processes observed during aging, maintaining the individual's functional capacity and quality of life in good conditions[13]. Current evidence shows that physical exercise brings health benefits to older adults, maintaining functional independence and improving their quality of life[14].

New studies need to use existing definitions of frailty validated to assess participants before classifying them as frail, and use frailty as an outcome measure to show whether physical exercise can reverse frailty or whether older people can transition from a state of greater frailty to a state of less frailty[15]. Given this theoretical context, this article aimed to carry out a theoretical study on the effects of physical exercise on frail older adults.

METHODOLOGY

This is a systematic review, based on the PRISMA guidelines, developed with articles published from 2011 to 2016 in the following electronic databases: Medline, PubMed, PEDro, SciELO and Lilacs. The search was performed in October 2016 and *frail elderly*, *exercise* and *clinical trial* and their respective synonyms were used as keywords in Portuguese and English, as shown in Chart 1.

Chart 1. Search strategy

	"Frail Elderly" [Mesh] OR "Elderly, Frail" OR "Frail Elders" OR "Elder, Frail" OR "Elders, Frail" OR "Frail Elder" OR "Functionally-Impaired Elderly" OR "Elderly, Functionally-Impaired" OR "Functionally Impaired Elderly" OR "Frail Older Adults" OR "Adult, Frail Older" OR "Adults, Frail Older" OR "Frail Older Adult" OR "Older Adult, Frail" OR "Older Adults, Frail"
AND	*"Exercise" [Mesh] OR "Exercises" OR "Exercise, Physical" OR "Exercises, Physical" OR "Physical Exercise" OR "Physical Exercises" OR "Exercise, Isometric" OR "Exercises, Isometric" OR "Isometric Exercises" OR "Isometric Exercise" OR "Exercise, Aerobic" OR "Aerobic Exercises" OR "Exercises, Aerobic" OR "Aerobic Exercise"*
AND	*"Clinical Trial" [Mesh] OR "Intervention Study"*

The articles identified by the initial search strategy were independently assessed by two researchers, according to the following inclusion criteria: the article was recognized as a randomized controlled trial published in all languages; the study participants were identified

as frail and had physical exercise as intervention. As for the exclusion criteria, repeated articles were established; other treatments along with physical exercise; older adults hospitalized; populations with specific diseases; interventions without control group; review articles and case studies. The divergent articles among the assessors were reviewed by them again to reach an agreement of inclusion or exclusion.

In the data collection of articles, the search for the following information was emphasized: inclusion criteria used in the study, intervention and control groups, interventions performed, and the main results presented. The articles included were evaluated independently by two assessors regarding methodological quality according to the criteria selected by the PEDro scale, which was validated by Morton[16]. This scale has a score of up to 10 points – higher values represent better methodological quality – and analyzes the specification of inclusion criteria, form of allocation of research subjects, similarity of groups in the initial phase, masking of subjects, therapists and assessors, measure of at least one primary endpoint in 85% of subjects, analysis contemplating treatment intent, and measures of variability and parameter estimation[17].

RESULTS

We selected 110 articles in the electronic databases PubMed, Medline and PEDro. After the initial reading by the researchers, 12 articles were selected for the final analysis. The processes performed in the selection of the articles and the exclusion criteria are described in Figure 1.

Table 1 shows the description of the articles selected in this investigation, with authors, methodological quality, inclusion criteria, group allocation, interventions and main results.

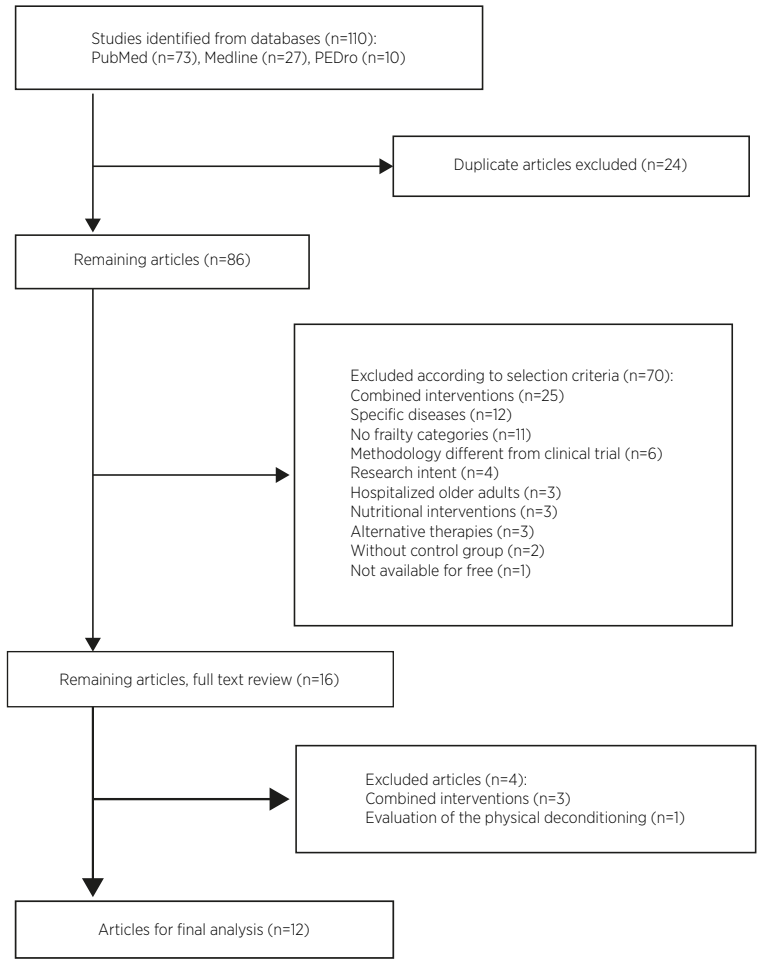

Figure 1. Flowchart of article selection

Table 1. Description of articles reporting the effects of physical exercise on frail older adults

Authors	Methodological quality	Inclusion criteria	Groups	Intervention	Results
Tieland et al.[18]	4	Pre-frail and frail individuals, ≥65 years old.	CG: 57 IG: 51	IG: Resistance exercises for upper and lower limbs. Performed twice a week under personal supervision for 24 weeks. The workload began at 50% of 1-MR and increased to 75% of 1-MR.	Increased handgrip strength in both groups. Increased strength in leg extension and adduction and physical performance when compared with IG with CG.
Szturm et al.[19]	7	65 to 85 years, MMSE>24 points, ability to understand the study and independent walking, with or without an auxiliary device.	CG:13 IG: 14	Participants received 16 sessions, twice a week, lasting 45 minutes. CG: Strengthening exercises, balance, gait re-education and walking without supervision. IG: Dynamic balance exercises along with computer game.	Improvements in overall balance, balance in tasks performed on spongy surface and balance in DLA were higher for IG compared with CG.
Cadore et al.[20]	6	≥85 years and frail.	CG: 13 IG: 11	CG: Passive and active movements in different joints for 30 minutes, four days a week. IG: Multi-component exercises for 12 weeks, twice a week. The program included resistance training of upper and lower limbs with progressive increase of loads (40-60% of 1MR) combined with exercises for balance and gait with functional progression.	Improvement in functional capacity, physical performance, isometric hip flexion and knee extension strength, maximal strength, cross-sectional area of the thigh, and reduction in the incidence of falls in IG.
Zech et al.[21]	6	65-94 years old and who agreed to participate in the study.	CG: 22 GS: 20 GP: 18	Before the intervention period, all participants took vitamin D3 for eight weeks. Both training groups completed a program of warm-up, balance, and muscle strength exercises twice a week for 12 weeks with increasing intensity. GPower: moved as quickly as possible during the concentric phase of each repetition and slowly during the eccentric phase. GStrength: performed concentric and eccentric contractions with a medium speed.	Both interventions improved physical function.
Pollock et al.[22]	5	older adults of both sexes, referred for risk assessment of falls.	CG+IG=56	both received supervised training three times a week, combining strength, balance and functional mobility for eight weeks. IG: performed whole-body vibration therapy session at the end of the exercise period.	Improvement in functional capacity, balance, self-report of fear of falling and quality of life in both groups. Increase in the length of the IG step in relation to the CG.
Zhang et al.[23]	6	≥75 years and frail, without severe cognitive impairment and without a disease likely to be associated with a life expectancy of less than 12 months.	CG: 18 IG: 19	Duration of eight weeks. CG: included usual care, physical therapy (using manual appliances and techniques), and exercise routine. IG: Whole-body vibration exercise three to five times a week.	Both groups showed improvements in mobility, knee extension strength, balance, balance in DLA, and general health status. But significant differences were found in some assessments, indicating that improvements in IG were more pronounced.
Daniel[24]	4	≥65 years, pre-frail.	CG: 5 GE: 7 GWii: 7	CG: instructed to continue any physical activity conducted before the study period. GExercise: aerobic exercises in the sitting position. Gwii: group exercises using a Nintendo Wii, using basic games, such as bowling, tennis and boxing. Participants also wore a weighted vest with 2% of their body weight added to the weighted vest every two weeks. The two types of interventions were performed in groups for 45 minutes, three times a week for 15 weeks.	Improvements in functional physical states in both groups that underwent intervention when compared with CG.
Giné-Garriga; Guerra; Unnithan[25]	6	80 to 90 years and frail.	CG: 19 IG: 22	CG: Instructed to continue their daily activities and received their primary care. IG: training in functional circuits aiming at functional balance and inferior strength. Participants went to the training center twice a week for 12 weeks.	Improvement in the fear of falling and self-reported quality of life in IG compared with CG.

(continues)

Table 1. Continuation

Authors	Methodological quality	Inclusion criteria	Groups	Intervention	Results
Jorgensen et al.[26]	7	>65 years, self-reported poor to medium balance and ability to understand verbal instructions.	CG: 30 IG: 27	CG: instructed to wear the EVA insoles in their shoes every day throughout the study period. IG: Wii training conducted twice a week for ten weeks, with sessions lasting approximately 35 minutes aiming at balance and muscular conditioning.	Improvements in maximal isometric leg muscle strength, force-generating capacity, and functional performance in IG.
Cesari et al.[27]	5	70-89 years, have a sedentary lifestyle and a higher risk of functional impairment.	CG: 211 IG: 213	CG: were invited to meet once a week in small groups for the first 26 weeks of the study and, thereafter, on a monthly basis. Health education was discussed and soft stretches of upper extremities were performed. IG: aerobic, strength, flexibility and balance training exercises. The intervention was organized in three following phases: weeks 1-8: three exercise sessions (40-60 minutes) per week conducted under supervision. Weeks 9-24: two supervised sessions per week and resistance, flexibility and strength exercises at home (at least three times a week). Week 25 until the end of the study: home intervention with the option of going once or twice for supervision and monthly telephone contact. For resistance, the intensity of 70% of the effort was used and, for strengthening, an intensity of 15-16 on the Borg scale.	Reductions in the number of frailty criteria associated with the intervention against CG were observed for younger and black people with frailty and multimorbidity. The sedentary behavior was the only frailty criterion that showed significant difference between the groups randomized throughout the intervention.
Langlois et al.[28]	4	61-89 years, able to perform a low-risk physical exercise program.	CG: 36 IG: 36	CG: instructed to maintain their current level of activity throughout the study period. IG: One hour-long exercise training with stretching, balance, aerobic and strength for 12 weeks, three times a week. The training was performed in subgroups of three to five participants. The intensity was moderate to strong.	Improvement in functional capacity and physical resistance, cognitive processing speed, working memory, executive functions, quality of life of the IG compared with the CG. Benefits were equivalent in fragile and non-fragile participants.
Ng et al.[29]	8	≥65 years, pre-frail or frail, able to wander without personal assistance and living at home.	GN: 44 GCO: 46 GPI: 48 GCOM: 47 CG: 47	GPhysical: Exercise was moderate, gradually increasing intensity, lasting 90 minutes, twice a week for 12 weeks, followed by 12 weeks of exercise at home. The exercise program was designed to improve strength and balance from 8 to 15 maximal repetitions (MR), or 60% to 80% of 10 MR, starting with <50% of 1 MR involving 8-10 major muscle groups. GNutrition: A commercial formula, iron and vitamin B6 folate supplement of vitamin B12 and calcium supplement, and vitamin D were provided, taken daily for 24 weeks. GCOgnition: In the first 12 weeks, participants attended weekly two-hour sessions of cognitive training designed to stimulate short-term memory, increase attention, information-processing skills, reasoning and problem-solving skills. For the subsequent 12 weeks, participants assessed the cognitive skills learned in the first 12 weeks. GCOMbined: submitted to all three interventions. CG: they had access to a standard treatment of health services and care of older adults that were normally available to older people. They received an equal volume of artificially sweetened, vanilla flavored liquid that was identical in appearance to the active nutritional supplements.	Reduction in the frailty of 15% of the participants in the CG and from 35.6% to 47.8% in the groups submitted to the intervention. The nutritional and cognition interventions reduced the frailty by three times, and the physical intervention, by four times, compared with the CG. Gain in knee strength was observed for cognition, physical and combined groups, and gains in gait speed were observed for the physical intervention group.

MMSE: mini mental state examination; ADL: activities of daily living; CG: control group; IG: intervention group; GS: group with strength exercises; GP: group with power exercises; GPE: physical exercise group; GWii: group with exercises using Wii; GN: group with nutritional intervention; GCO: group with cognitive intervention; GPI: group with physical intervention; GCOM: group with combined intervention; MR: maximum repetition

DISCUSSION

The results of this investigation show that physical exercises are beneficial to frail older adults, with improvements in the functional aspects, such as increase in palmar grip strength, lower limb strength, mobility, physical performance, muscle mass, balance, gait and stride length; aspects related to quality of life, such as reduction in the incidence of falls, self-reported fear of falling, and general health; and cognitive aspects, such as increased processing speed, improvements in working memory and executive functioning.

Some studies suggest that physical exercise is more beneficial to frail people when compared with other types of interventions, and resistance and balance training should precede aerobic training[30,31]. Physical exercises also reduce frailty in older adults; the research conducted by Ng et al.[29] shows that physical exercise reduces the frailty by four times when compared with sedentary older adults. The study by Cesari et al.[27] found that the sedentary behavior was the only criterion that showed difference with the physical training, and when this criterion was omitted from the analyzes, no more differences were found in the frailty of the study population. Frail individuals are more likely to have non-active behavior, and sedentarism has a positive relation to several adverse health outcomes[32]. Thus, we observed that the change to an active lifestyle is able to attenuate the frailty in the older population.

Multicomponent physical training was used as a strategy for physical gains in frail older adults, and it includes resistance, balance, gait and strength exercises[20,21,25,27-29]. Multicomponent physical training programs are recommended for their potential to positively alter different components of the functional fitness of older adults[31]. In addition, a multicomponent exercise program that includes strength, resistance, and balance training is considered to be the most effective strategy for improving gait, balance and strength, decreasing fall rates, and consequently maintaining the functional capacity during the aging process[33]. The results of this review still show positive effects with the physical training associated with the vibration of the entire body[22,23] and virtual games[19,24,26].

The frequency of physical training ranged from two to three times a week, with a duration of 30 to 45 minutes per session, with intensity increasing gradually from 60% to 80% of a maximal repetition (MR). The beginning of low-intensity training is a safe strategy for sedentary populations to learn the correct way to perform the exercises. In addition, it leads to better adaptation, adherence and technique during the intervention, reducing the risk of injury due to poor performance[33]. Moreover, musculoskeletal injuries related to poorly performed exercise are a contraindication for strength training, but they can be avoided with proper familiarization with the exercise and correct progressions of intensity and volume[33].

We observed that the interventions proposed in the studies found covered older individuals of different age groups, including ages between 65 and 94 years, and in all phases there were benefits with the recommended physical training. Regarding the objectives of interventions in frail older adults, priority should be given to reducing the severity of frailty and the adverse health effects in those whose frailty is not reversible, which will probably bring benefits to the older adult, the family and the society[34]. These benefits will include greater independence and quality of life for the older adults and better relationships with their families, which will not be burdened with care tasks. In addition, this review is in line with the National Policy on Health Promotion (PNPS) within the priority themes, such as physical practices and physical activities[35].

CONCLUSION

We can conclude that physical exercises are beneficial effects to frail older people in terms of quality of life and physical and cognitive aspects. In addition, we suggest that physical exercise is capable of attenuating frailty in older adults, proving to be more efficient when compared with other interventions. The studies have shown multicomponent physical training as a beneficial intervention for frail older adults, considering that it is ideal to include resistance, balance, gait and muscular strength exercises for this population.

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