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THE IMPORTANCE OF RESISTANCE EXERCISE IN THE REDUCTION OF FALLS IN THE ELDERLY: A SYSTEMATIC REVIEW

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Abstract: Objective: to systematically review the literature on the influence of resistance exercise on muscle strength, balance and on reducing the number of falls in the elderly. **Methods:** A systematic review of studies published between the years 2014 and 2019 was carried out in the LILACS, MEDLINE, PEDro and SciELO databases. Articles with scores below 5 on the PEDro scale were excluded, as well as articles of the type reviews and case reports, articles that involved elderly people with specific diseases, such as stroke, diabetes, Parkinson's disease, among others, and with elderly people. hospitalized. **Results:** a total of 258 articles were identified: 9 in LILACS, 41 in PEDro, 206 in MEDLINE and finally 2 in SciELO. After analysis and consensus among reviewers of the present systematic review, only 3 articles met all eligibility criteria. The methods and interventions performed in the studies differed, however, the three selected studies found a significant improvement in the balance of the elderly. **Conclusion**: Resistance training performed by the studies in this review improved balance, reduced the number of falls and improved the functional capacity of the evaluated elderly. Only one study evaluated and found a gain in peripheral muscle strength.
Keywords: Postural balance, elderly and resistance training.

INTRODUCTION

The increase in the number of elderly people, as well as their longevity, generates some demands for attention to Public Health, among them, the occurrence of falls stands out. Sensory information, whether vestibular, proprioceptive or visual, is responsible for maintaining balance and postural control. When this information does not interact correctly, it causes a disturbance in the state of balance, causing "body imbalance", which is a probable cause of the high occurrence of falls among the elderly.[1]

Injuries resulting from falls in the elderly are major health concerns worldwide. According to the literature, 32% of the elderly aged between 65 and 74 years and 51% of the elderly aged 85 years and over already suffer falls at least once a year, reducing their mobility and independence, resulting in a decrease in quality of life and an increase in risk of death due to secondary complications, for this reason, it is important to develop and implement interventions to prevent such incidents.[2]

Balance involves the reception, integration of sensory stimuli, planning and execution of movements to control the center of gravity over the base of support, performed by the postural control system that integrates information from the vestibular system, visual receptors and the system. somatosensory.[3]

During the aging process, these systems may become incapable of performing these functions and lead to physical decline in the elderly, which means impaired performance of daily tasks, as well as reduced muscle strength and coordination of the lower extremities, accompanied by decreased gait safety and balance control, which will result in physical deterioration in an older body.[4]

Many elderly people are more sedentary, which further accentuates the aging process, rapidly losing their functional capabilities. The regular practice of specific physical exercises, such as resistance training, can contribute to their functional independence in activities of daily living. The benefits of strength training, as perspectives of health maintenance in elderly individuals, have as main objectives to improve quality of life, physical and psychological aspects.[5]

Based on what was described above, this systematic review will be based on analyzing the effects of resistance physical exercise on muscle strength, balance and the number

of falls, to investigate whether there is a theoretical basis that justifies the use of this type of training in this specific population.

METHODOLOGY

RESEARCH CHARACTERIZATION

This is a systematic review study that gathered articles, which are randomized and quasi-experimental clinical trials, independently analyzed by the authors and strictly obeying the inclusion criteria determined by them.

Electronic searches were carried out from August to October 2019 in the Latin American and Caribbean Health Sciences Literature (LILACS), *Physiotherapy Evidence Database* (PEDro), *Scientific Electronic Library Online* (SciELO) and Online System of Search and Analysis of Medical Literature (MEDLINE) and in them the same search strategies were used.

The three keywords used in the searches according to the Health Sciences Descriptors (DeCS) were: "postural balance", "elderly" and "resistance training" as well as their English equivalents, "*postural balance*", "*elderly*" and "*resistance training*". These terms were combined with the Boolean operators "*O*" and "*AND*" in order to make the intersection of the searched words.

IDENTIFICATION OF STUDIES

Only clinical trials that applied resistance training as a physical therapy treatment, which had balance, muscle strength and number of falls as the outcomes to be evaluated were included. Studies with protocols or programs applied to the elderly were also included, that is, subjects aged over 60 years, of both sexes, whether institutionalized or non-institutionalized, with publication period between the years 2014 to 2019.

On the other hand, articles with scores below 5 on the PEDro scale were excluded, as well as articles of the type reviews and case reports, articles that involved elderly people with specific diseases, such as stroke, diabetes, Parkinson's disease and hospitalized elderly.

SELECTION OF STUDIES

The methodological quality of the studies was evaluated using the PEDro Scale (*Physiotherapy Evidence Database*) [6,] in which each criterion was scored according to its presence (P) or absence (A) in the evaluated study, except for the 11th criterion that was not enters as an evaluative item.

The selected articles that were indexed in this database and that already had a methodological quality assessment by members of PEDro, the score was maintained, while those unindexed studies were independently evaluated by two reviewers, as in the other databases. Dice.

Having assessed the level of agreement between the reviewers in relation to the score of the articles by the PEDro scale and for the final classification of the quality and tie-breaking of the articles, the discrepant items were reviewed and discussed until reaching consensus on the score and, in cases of doubts and disagreements, a third reviewer was asked to express an opinion on whether or not to include the study.

RESULTS

A total of 258 articles were identified: 9 in LILACS, 41 in PEDro, 206 in MEDLINE and, finally, 2 in SciELO. After analysis and consensus among the reviewers of the present systematic review, only 3 articles met all the eligibility criteria and answered the question proposed by this research. Figure 1 shows the flowchart of the selection process of the studies that were included in this research and Table 1 shows their characteristics such as: sample characterization, intervention methods and evaluated outcomes.

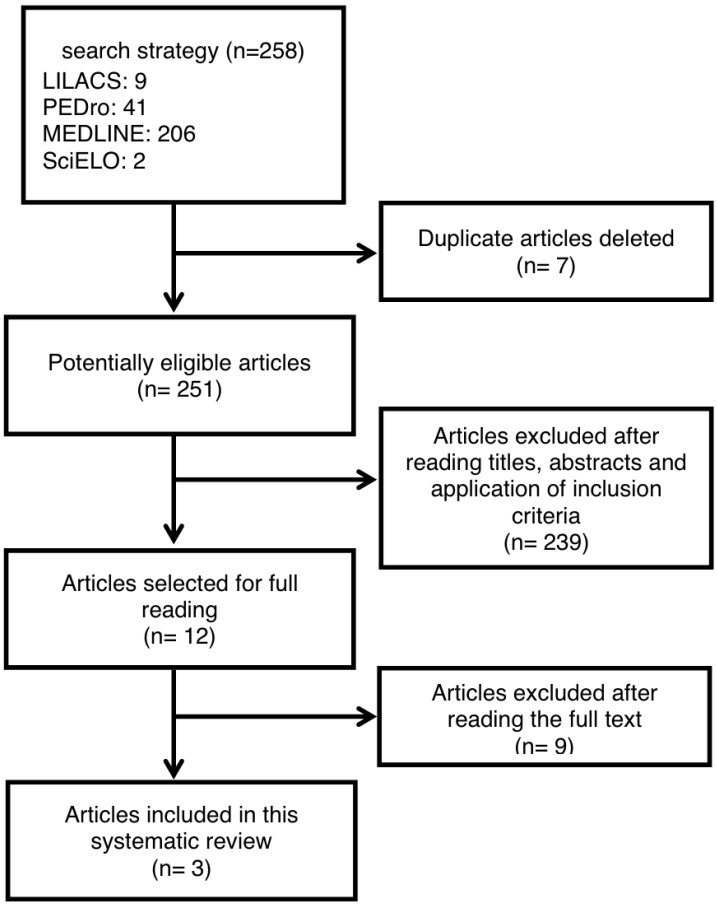

Figure 1. Flowchart of the study selection process.

Article Reference	PEDro scale score	Sample	Variables studied - collection instruments	interventions	Outcomes
Liu-Ambrose et al [7] 2019	7	344 elderly, 115 males and 229 females, aged >70 years, who suffered a fall in the last 12 months and were recruited from a fall prevention clinic. GE: 172 GC: 172	-Functional Comorbidity Index - Geriatric Depression Scale -Lawton and Brody's Instrumental Activities of Daily Living Scale -Mini Mental State Examination (MMSE) - Montreal Cognitive Assessment - Physical Activity Scale for the Elderly	EG: 45 min of training, 3x a week and walking of 30 min 2x a week, for a period of 12 months. *OtagoExerciseProgram* was carried out, which consists of home exercises to prevent falls in the elderly, including 5 lower limb muscle strengthening exercises and 11 balance exercises. A licensed physical therapist visited participants at home and prescribed exercises from a manual, returning every 15 days to adjust home interventions. GC: no intervention	- There was a reduction in the number of falls recorded in the EG. -Average follow-up of 338 days, with a total of 236 falls among 172 EG participants versus 366 falls among 172 CG participants. -Improvement in the functional performance and balance of the elderly in the EG compared to the GC, evaluated through the physical activity scale for the elderly.

Joshua et al [8] 2014	6	54 elderly people, divided into three groups; 18 individuals in each group, the article does not define the number of men and women, over 65 years old, from the centers and elderly care of Mangalore, South India. TFR: 18 ETE: 18 COMBI: 18	- Berg Balance Scale (BSE) Mental State Examination (MMSE) -Delorme and *Watkins protocol* (based on performing sets with repetitions, using progressive loads) -Functional Range Test (10 repetition maximum test to assess strength)	TEE: 45 min, 4x a week for 6 months. It consisted of 8 components, standing with unipodal support, feet in heel-toe position in short steps, cross gait, gait in figure eight, gait training on a mat forward, backward and sideways, balance sitting on a Swiss ball. TFR: 1 hour per session, consisted of lifting sandbags ranging from 250g to 5 kg for 1 to 2 seconds and then progressing the load, having 1 second of rest between movements. COMBI: 2 days of TFR and ETE alternately.	-All groups had significant improvement over a 6-month period in balance, functional reach, and incidence of falls. However, the TRF group had higher change scores compared to the TEE group and the COMBI group.
Lacroixet al [9] 2015	6	66 healthy elderly people from the community, 25 males and 41 females, aged between 65 and 80 years, underwent training at a local gym. GSA: 22 GNS: 22 GAFH: 22	- Romberg test. -10 meter walk test) at steady state. -Timed Up and Go test. -Functional Range Test. -Push and Release Test. - Chair support test. -Test going up and down the stairs. It was tested before and after the active training phase, as well as after detraining.	GSA: 45 min of training, 3x per week for a total of 36 sessions, being unsupervised by the instructor in one session during the week. The program included static and dynamic balance exercises, 4 sets, each with a duration of 20 seconds and 30 seconds of rest between them. Strength/ power exercises, 3 sets, each consisted of 8 to 15 reps and 60 to 120 seconds rest in between. Muscle groups: Global lower limbs and latissimus dorsi, trapezius and rhomboids. GNS: Followed the same exercise routine as the GSA group, except they trained unsupervised and at home, 3x a week. GAFH: maintained their usual level of physical activity, thus without intervention.	-12 weeks of TEF proved to be safe (no training-related injuries) and feasible (high rates of care of >90%) and was more effective in GSA compared to GNS. It was possible to analyze a greater positive effect on the variables of GSA compared to GNS on risk factors for intrinsic falls. Primary Outcomes: Improved steady-state static/dynamic balance (stride speed), proactive balance, reactive balance, and lower extremity muscle energy consumption. The GAFH failed to improve gait, temporal space, parameters during a short dual task and in its balance.

Siglas: GE=grupo experimental; GC=grupo controle; TFR=treinamento de força de resistência progressiva; ETE=exercício tradicional de equilibrio; COMBI=combinado; GSA=grupo supervisionado alternadamente; GNS=grupo não supervisionado; GAFH=grupo de atividade física habitual; TEF=treinamento de equilíbrio e força.

Quadro 1. Características dos artigos selecionados nesta revisão sistemática.

DISCUSSION

The three articles included in this research were carried out in Vancouver [7,] Mangalore South India [8] and Switzerland/Germany [9.] It was observed that resistance training was performed by physical therapists [7,8] and physical education professionals.[9]

The interventions carried out took place in an elderly care center [8,] in the homes of the evaluated elderly [7] and in a local gym.[9] Participants included had an age range, which spanned men and women between 65 and 80 years.

Two authors found cognitive impairment through the MMSE [7,8,] other factors taken into account in the sample were: medical screening, BBS score between 41-52, minimum score of 17.5 in the functional range test and grade 4 or superior for muscle groups in lower limbs.[8]

In the studies presented by Liu-Ambrose et al [7] and Lacroix et al[8], randomization was performed randomly by a central randomization service on the internet. In the study carried out by Joshua et al[9], eligible subjects were assigned to the study groups by generation sequenced using block randomization through sealed envelopes.

It was observed that the variables evaluated in common among the studies were: balance and analysis of the number of falls in the elderly [7, 8,9.] In the study by Liu-Ambroseetal [7] the variables studied also involved possible comorbidities, mood, independent life skills, cognitive function, being evaluated by scales, and for the number of falls, the elderly received an assessment based on the Physical Activity Scale for the Elderly.

Joshua et al[8] evaluated the strength of the elderly after resistance training for the lower muscles based on the *DeLormes* and *Watkins protocol,* which is based on the use of 10 maximum repetitions, that is, the maximum amount of weight that an individual can move 10 times in full range of joint motion chosen. The Functional Range Test (TAF) to identify dynamic changes in postural control was the choice of the other two studies to assess muscle strength.[8, 9] Joshua et al [8] and Lacroix et al [9] found a significant improvement in the functional range test after a program to strengthen the muscles of the lower limbs.

Lacroixet al [9,] also used the Romberg test to identify changes in balance, *TimedUpand Go Test* (TUG) for gait speed, 10-meter walk test to identify changes in dynamic balance, Push and Release Test, Climb and stair descent and chair support test to assess lower limb strength resistance.

Balance was an outcome evaluated by three studies[7,8,9], with similar positive results, a significant reduction in the number of falls, but only one study found an improvement in lower limb muscle strength gain.[9]

The forms of resistance training intervention differed in some aspects between the studies, even with similar outcomes. Joshua et al [8] used two different protocols for two groups, and the association of the two protocols was performed in the third group, while Liu-Ambrose et al [7] and Lacroix et al [9] developed only one protocol for the intervention groups. Training supervised by specialized professionals was carried out during the execution of the protocols[8,9], while the other study had visits supervised by a professional every 15 days.[7]

Joshua et al[8] and Lacroix et al[9] differed regarding the resources used for muscle strength training, with the exception of Liu-Ambrose et al [7] who did not describe load and which materials were used as a form of training, the intervention time varied between 6[8] to 12 months[7] and 12 weeks[9], being performed four [8] to three times a week.[7,9]

Liu-Ambrose et al[7] found that the home strength and balance training exercise program significantly reduced the rate of subsequent falls compared to usual care

provided by a geriatrician alone. These findings support the implementation of home exercise programs for secondary prevention of falls, in conjunction with guidelines formed by physicians and other professionals.

This systematic review revealed the scarcity of studies that have addressed this issue, and the great challenges of working with this population for ethical reasons, high frequencies of mortality and dropouts, another factor related to the reduced number is the low methodological quality of the studies that are found in the literature, another limitation of this review was the different intervention protocols as well as the assessment instruments that the other authors of the studies used, making comparison and discussion between them difficult.

CONCLUSION

The articles included in this systematic review used different intervention methods and assessment instruments, but reaching common results, such as improved balance and reduced number of falls, only one study evaluated and found a gain in strength, which could also be observed after reading the articles, improves the functional capacity of the elderly. It is believed that it is necessary to carry out more studies that specifically evaluate each type of resistance training.

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