

O TREINO PROPRIOCEATIVO E DE EQUILÍBRIO POSTURAL NO IDOSO PARA A PREVENÇÃO DE QUEDAS: SCOPING REVIEW

EL ENTRENAMIENTO PROPICIO Y DE EQUILIBRIO POSTURAL EN EL ANCIANO PARA LA PREVENCIÓN DE CAÍDAS:
SCOPING REVIEW

THE PROPRIOCEPTIVE AND POSTURAL BALANCE TRAINING IN THE ELDERLY PEOPLE FOR THE PREVENTION OF FALLS:
SCOPING REVIEW

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RESUMO

A população mundial está cada vez mais envelhecida e o risco de queda está diretamente relacionado.

O objetivo do estudo é perceber qual o efeito do treino proprioceutivo e do equilíbrio postural no idoso para a prevenção de quedas.

Estudo baseado no modelo JBI. Os artigos foram extraídos das bases de dados CINAHL, MEDLINE e PEDro, redigidos em português e inglês, de janeiro de 2012 a julho de 2018, com população de 65 anos ou mais, sem condição patológica subjacente.

Incluíram-se 13 artigos que consideravam programas de treino e exercícios proprioceutivos e de equilíbrio postural, força muscular, resistência, treino de marcha e a implicação sobre o medo de cair.

Concluiu-se que, a implementação destes programas, têm um impacto positivo e significativo na prevenção de quedas. Considera-se fundamental a realização de mais estudos sem recurso a tecnologia que beneficiem o treino proprioceutivo e de equilíbrio postural preventivos de queda.

Palavras-Chave: Idoso, Proprioceção e Equilíbrio Postural.

RESUMEN

La población mundial está cada vez más envejecida y el riesgo de caída está directamente relacionado.

El objetivo del estudio es percibir cuál es el efecto del entrenamiento propicio y del equilibrio postural en el anciano para la prevención de caídas.

Estudio basado en el modelo JBI. Los artículos fueron extraídos de las bases de datos MEDLINE, CINAHL y Pedro, escritos en portugués y en Inglés, a partir de enero 2012-julio 2018, con una población de 65 años o más, sin condición patológica subyacente.

Se incluyeron 13 artículos que consideraban programas de entrenamiento y ejercicios propios y de equilibrio postural, fuerza muscular, resistencia, entrenamiento de marcha y la implicación sobre el miedo a caer.

Se concluyó que, la aplicación de estos programas, tienen un impacto positivo y significativo en la prevención de caídas. Se considera fundamental la realización de más estudios sin recurso a la tecnología que beneficien el entrenamiento propicio y de equilibrio postural preventivo de caída.

Palabras Clave: Anciano, Propriocepción y Equilíbrio Postural.

ABSTRACT

The world population is increasingly aging and the risk of falling is directly related.

This study aim is to understand the effect of proprioceptive training and postural balance on the elderly people for the prevention of falls.

Study based on the JBI model. The articles were extracted from the CINAHL, MEDLINE and PEDro databases, written in Portuguese and English, from January 2012 to July 2018, with a population of 65 years-old and over, with no underlying pathological condition.

We included 13 articles that considered training programs and proprioceptive exercises and postural balance, muscular strength, resistance, gait training and the implication about the fear of falling.

It was concluded that the implementation of these programs has a positive and significant impact on falls prevention. It is considered fundamental to carry out further studies without using technology to benefit the proprioceptive training and postural balance as falls preventatives.

Keywords: Aged people, Proprioception and Postural Balance.

INTRODUCTION

The aging of the world population is a reality that imposes new challenges and requirements in health promotion and disease prevention⁽¹⁾. Increasing age, physical inactivity, associated with degenerative processes in the central nervous and muscle systems result in a decline in proprioception, balance and muscle strength, which consequently leads to an increased risk of falls in the elderly population.

From the literature it emerges that the risk of falling is present in about 30% of people aged 65 and over and who suffer at least one fall per year, about 10 to 15% of serious injuries⁽²⁾.

Proprioception is the a capacity that the body has to adapt to different postures, an unconscious consequence of feeling, interpreting and interacting with movement and position in space⁽³⁾. It is characterized by cumulative neural afferents that originate from mechanoreceptors.

Body balance is described as the ability to maintain the center of body mass within the base of support. The body must be able to acquire and control certain postures to achieve a goal, with the ability to move quickly and accurately, in a multidirectional way, with coordination, safety and in the face of external disturbances⁽⁴⁾.

Studies report that balance and proprioception training improved the person's physical condition, increasing muscle mass and strength, increasing physical endurance and improving body balance, which, in turn, enhance functional abilities, obtaining gains in mobility as well as in self-confidence. When intervening in the elderly population with appropriate training programs that can improve performance in activities of daily living that demand proprioception and balance, these become essential to reduce the risk of falling⁽⁵⁾.

A deficit in proprioception and body balance in the elderly person, associated with limited mobility and fear of falling, are conditioning factors for the reduced ability to perform daily activities and physical exercise, increasing the risk of falling. In this more fragile generation, serious injuries such as fractures or head traumas lead to prolonged hospitalizations, with an increase in the economic burden not only for the elderly and for the family, but also for the whole society⁽⁶⁾.

This association of factors can then culminate in an important commitment to the quality of life of the elderly population, in which the occurrence of a fall can be the precipitating factor for a health/disease transition, moving from autonomy to a situation of dependence.

Thus, rehabilitation, as a multidisciplinary specialty, comprises a body of specific knowledge and procedures that help people with acute, chronic or sequelae to

maximize their functional potential and independence. Its general objectives are to improve the function, promote the person's independence and maximum satisfaction and, in this way, preserve self-esteem⁽⁷⁾.

The Rehabilitation Nurse (RN) designs, implements and monitors differentiated rehabilitation nursing plans, based on people's real and potential problems. The high level of knowledge added to experience allows the RN to make decisions regarding health promotion, prevention of secondary complications, treatment and rehabilitation, maximizing the person's potential. Its intervention aims to promote early diagnosis and preventive actions in Rehabilitation Nursing, in order to ensure the maintenance of the necessary needs of clients, prevent complications and avoid disabilities, as well as provide therapeutic treatment aimed at improving residual functions, maintaining or recovering the independence⁽⁷⁾.

In this way, the RN has an interventional and preponderant action in the prevention of falls in the elderly, through the implementation of exercises and training programs that can be replicated in the home environment.

In this line of thought, the preparation of this *scoping review* comes from identifying the need to prevent falls in the elderly population and what can be done to minimize this risk whose impact on the person, family and society is so relevant?

Balance and proprioception training programs are useful and effective in preventing injuries, but what impact do they have on preventing falls in this population? Thus, we are directed to the question of what is the effect of proprioceptive training and postural balance in the elderly for the prevention of falls.

METHODOLOGY

In scientific research, different goals and issues can be identified using new approaches. *Scoping reviews* are a type of approach designed to synthesize in a more effective and rigorous way the evidence, the mapping of knowledge about a certain area of investigation⁽⁸⁾.

The option to carry out a *scoping review* is based on the fact that it is a type of review whose main objectives are: to map the existing evidence underlying a research area, to identify gaps in the existing evidence, to constitute a preliminary exercise that justifies and informs the realization of a systematic review of the literature. Thus, the use of this methodology, according to the objectives described above, is not to find the best evidence, but to map the existing scientific evidence⁽⁸⁾.

Studies that included balance and proprioception exercise training programs without the use of technologies and/or equipment were sought, with the objective of being able to be performed at home by elderly people without specific underlying pathological conditions.

The search was carried out through the databases, MEDLINE, CINAHL and PEDro. Primary studies, randomized controlled studies and systematic literature reviews were included. Using the participants, concept and context (PCC) strategy, the scoping review covered studies that: a) regarding the type of participants, elderly people aged 65 years-old or over; b) regarding the concept, the effect of proprioceptive training and postural balance; c) regarding the context, the prevention of falls.

Research strategy

The research strategy included studies published on three different databases CINAHL, MEDLINE and PEDro. Our search limits were articles from January 2012 to July 2018, with participants aged 65 years-old or over and studies in Portuguese and English. To carry out the investigation we use the following Boolean phrases for each database. In the PEDro database, we used search terms, using the search method available in that database (Table 1).

Database: CINAHL (via EBSCO) Results: 415
((MM "Geriatrics") OR (MH "Aged+")) AND ((MM "Proprioception") OR (MM "Balance, Postural") OR (MM "Balance Training, Physical")) AND ((MM "Accidental Falls") OR (MM "Safety Behavior: Fall Prevention (Iowa NOC)") OR (MM "Fall Risk Assessment Tool") OR (MM "Hendrich Fall Risk Model") OR (MM "Morse Fall Scale") OR (MM "Fall Risk (Saba CCC)") OR (MM "Fall Prevention (Iowa NIC)") OR (MM "Safety Status: Falls Occurrence (Iowa NOC)"))
Database: MEDLINE (via EBSCO) Results: 539
((MM "Geriatrics") OR (MH "Aged+")) AND ((MM "Proprioception+") OR (MM "Postural, Balance") OR (MM "Feedback, Sensory")) AND ((MM "Accidental Falls") OR (MM "Accident Prevention") OR (MM "Risk") OR (MM "Risk Assessment") OR (MM "Risk Factors") OR (MM "Risk Redution BEHAVIOR"))
Database: PEDro Results: 27
"Balance" AND "Education" AND "Frailty" AND "Gerontology" clinical trial/practice guideline/systematic review

Table 1: Research strategy applied by database

Articles selection

The relevance of the articles to the scoping review was analyzed by three independent investigators based on the information provided in the title and abstract. In case of discrepancy, they were resolved by two other investigators. The full article was retrieved for all

studies that met the inclusion criteria. The first three investigators independently examined the full text of the articles to see if they met the inclusion criteria. The differences that arose between the investigators were resolved through discussion.

Data extraction

The data were extracted by three independent investigators, using an instrument developed by them. A table was created that includes the author of the article, year, place, aim of the study and respective obtained results.

RESULTS

As shown in Figure 1, the initial search identified a total of 1924 articles in the three databases. After including the aforementioned limiters, we identified a total of 981 potentially relevant articles. Afterwards and once removed the 219 duplicate articles, the final sample consisted of 762 studies.

From this sample and according to the inclusion criteria, 44 studies were involved. After reading the articles in full, 5 were excluded for illegible language, 2 articles for being inaccessible, 3 addressed other intervention models for the prevention of falls, 16 articles for using technology and equipment and 5 for addressing only theoretical content about the fall in the elderly.

13 articles were included for this *scoping review*.

The studies were carried out by physiotherapists, occupational therapists, orthopedists, professors in the areas of geriatrics, sports science and sports medicine, and only one study was carried out by Portuguese RN. The articles are from Australia, Japan, South Korea, United Kingdom, Sweden, Germany, Spain and Portugal. The research included a systematic review and 12 primary studies.

The proprioception and postural balance training programs in the elderly showed variability in the number of training weeks, from 4 to 52 weeks, where the authors analyzed balance recovery, functional capacity, physical mobility, gait, proprioceptive vestibular system, muscle strength, physical endurance and fear of falling.

The general population refers to elderly people over 65 years-old, the object of study, inserted in the community and without associated pathological conditions. The average age was around 70-75, mostly female. Only 4 studies mention that the selected population had already experienced one or more falls.

The population, in general, was evaluated using questionnaires and application of performance tests. Among which, we highlight: *Mini Mental State Examination (MMSE)* according to the version of each country, *Geriatric Depression Scale*, *The Late Life Function and Disability Instrument*, *Physical Activity Scale (PASE)*, *Body Mass Index (BMI)*, *Freiburger Questionnaire of Physical Activity (FQoPA)* and *Health Related Quality of Life (HRQOL)*. With regard to gait, speed, gait cycle and uni and bipodal support were considered. The authors used some

assessment scales, such as 10 Meter Walk Test and Step Test. Muscle strength tests were determined using dynamometers.

The balance tests have excelled in variety. Among them we highlight: *Functional Range Test (TAF)*, *Romberg Test*, *Timed Up and Go Test (TUG)*, *Berg Balance Scale (BBS)*, *Fullerton Advanced Balance Scale (FAB)*, *5 Times Site to Stand (5XSST)*. *The Vestibular Stepping Test (VST)*, *Proprioception Test (PT)*, *Functional Reach Test (FRT)*. They were decisive to assess proprioception.

The risk of falling and the fear of falling were assessed by some researchers using the scales - Fall Risk Index (FRI), Fall Risk Assessment Tool (FRAT), Falls Efficacy Scale International (FES-I) and The CONFbal Scale.

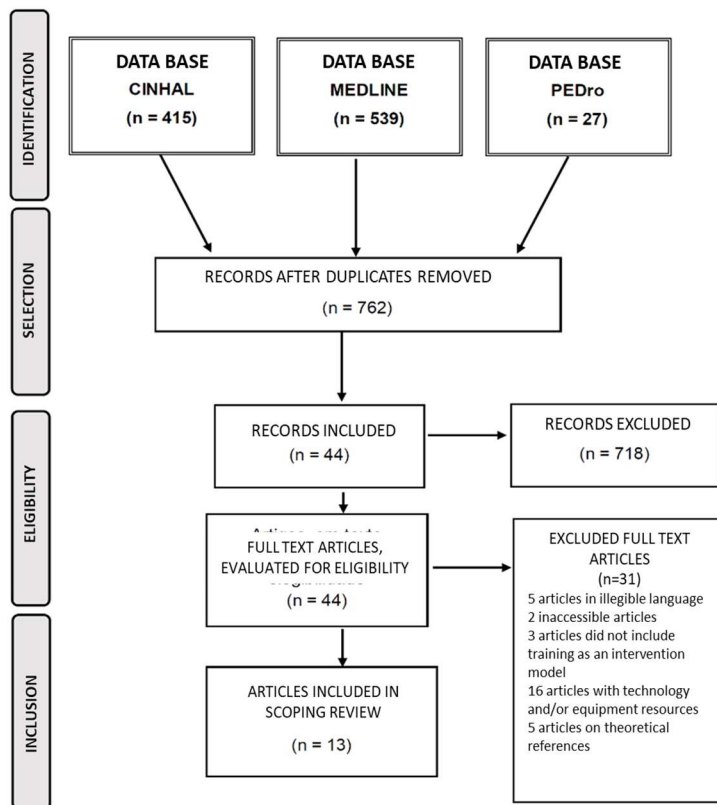


Figure1. PRISMA flowchart (adapted) of the selection process of studies.

Author (year)/country	Type of study/population	Objectives	Results
1. Sakamoto, K.; Endo, N.; Harada, A.; Sakada, T.; Tsushita, K.; Kita, K.; Hagino, H.; Sakai, A. et al. 2012 (Japan) (9)	Randomized controlled clinical trial. Seniors aged ≥ 75 years living in the community, dynamic group of flamingo exercises -DF (410 seniors): 86 ♂ and 324 ♀ group without exercise (455 seniors): 78 ♂ and 377 ♀.	To determine the effects of balance exercise in falls and prevention of fractures in elderly and poorly balanced people.	Group DF (6months): ↑ time spent on one leg with eyes open (more significant than in the non-exercise group); improvement in independence in women's daily life, ↓ Body weight, ↑ time on one leg 3x.. No exercise group: 11 fractures (10 ♀ 1 ♂). Group DF: 4 fraturas (3 ♀ 1 ♂).
2. Clemson, L.; Singh, M.; Bundy, A.; Cumming, R.; Manollaras, K.; O'Loughlin, P.; Black, D. 2012 (Australia) (10)	Randomized parallel trial. 70-year-old participants who suffered two or more falls or fall injuries in the past 12 months.	To determine whether an integrated lifestyle approach to balance and strength training is effective in reducing the rate of falls in community-dwelling older adults.	After 12 months, the overall incidence of falls in the LiFE group was 172 falls (1.66 per person/year), in the structured exercise group (SG) 193 falls (1.90 person/year) and in the control group (CG) 224 falls (2.28 person/year). Significant 31% reduction in the fall rate of the LiFE program compared to the CG (incidence rate 0.69 (95% confidence interval 0.48 to 0.99); the corresponding difference between the SG and CG was not significant (0.81 (0.56 to 1.17). LiFE group better in static balance, strength and function, the structured group had a significant and moderate improvement in dynamic balance, compared to CG.

<p>3. Yang, XJ.; Hill, K.; Moore, K.; Williams, S.; Dowson, L.; Borschmann, K.; Simpson, JÁ.; Dharmage, SC.</p> <p>2012 (Australia) (11)</p>	<p>Randomized controlled study.</p> <p>The sample consisted of 225 men and women living in the community aged ≥ 65 years-old. After a comprehensive assessment of balance, those classified as having mild balance dysfunction (n = 165) were randomized.</p>	<p>To evaluate the effectiveness of a balance intervention at home and strength exercise in the elderly.</p>	<p>Intervention group (n=59) better than the control group (n=62) after 6 months of training:</p> <ul style="list-style-type: none"> - Functional Range Test (mean difference 2.95 cm, 95% CI 1.75 to 4.15); - Step Test (2.10 steps / 15 seconds, 95% CI 1.17 to 3.02); - Hip abductor strength (0.02; 95% CI 0.01 to 0.03); - Walking step width (2.17 cm, 95% CI 1.23 to 3.11); <p>After the exercise program, there was a better balance performance in the IG (n=14) 23.7% against 4.8% in the CG (n=3).</p>
<p>4. Halvarsson, A.; Franzén, E.; Farén, E.; Olsson, E.; Oddsson, L.; Ståhle, A.</p> <p>2013 (Sweden) (12)</p>	<p>Randomized controlled study.</p> <p>59 community elders (age 67-93 years) were randomly allocated to the training group (TG) or control group (CG).</p>	<p>To evaluate the long-term effects of a specific, progressive program based on balance training in healthy elderly people at increased risk of falling.</p>	<p>Fast walking speed (p =0.004), dual task performance (p =0.006) and fear of falling (p = 0.001) were further improved in the TG at 9 months of follow-up. Self-perception of fear of falling remained significantly better (p = 0.012) at 15 months of follow-up. The fast gait speed: GT (1.49m/s) > GC (1.37m/s).</p>
<p>5. Cadore, EL.; Rodríguez-Mañas, L.; Sinclair, A.; Izquierdo, M.</p> <p>2013 (Spain) (13)</p>	<p>Systematic review</p> <p>3543 elderly people in a total of 20 articles included (randomized controlled studies).</p>	<p>The objective of this review was to recommend training strategies that improve functional capacity in physically frail elderly people, based on the scientific literature, focusing especially on supervised exercise programs that improve muscle strength, fall risk, balance and gait ability.</p>	<ol style="list-style-type: none"> 1. Resistance training programs should be performed 3x/week, with 3 sets of 8 to 12 repetitions at an intensity that starts at 20% - 30% and progresses to 80%; 2. To optimize functional capacity and endurance, training programs should include exercises that simulate daily activities such as sit-to-stand exercise; 3. Endurance training should include walking with changes in direction and pace, walking on treadmills, slopes, stair climbing and static pedals. They should start for 5-10min during the first weeks of training and progress to 15-30min in the rest of the program; 4. Balance training should include various exercise stimuli: tiptoeing, multidirectional weighting on tiptoes (lifts), walking on heels / tiptoes / over a line, standing on one leg and with weight transfers and modified Tai Chi exercises; 5. Multi-component training programs should include degrees in volume, intensity and complexity of exercises and with simultaneous performance of resistance and balance exercises.
<p>6. Freiburger, E.; Blank, WA.; Salb, J.; Geilhof, B. et al.</p> <p>2013 (Germany) (14)</p>	<p>Set of randomized controlled trials</p> <p>378 people ≥ 65 years old who have suffered a fall in the past 12 months. IG - intervention group GC- control group</p>	<p>To compare the effects of an exercise program with the physical and psychological component of fall risk, balance, strength, function, and fear of falling.</p>	<p>GI better than GR:</p> <ul style="list-style-type: none"> - Improved Timed Up and Go - 1.5 seconds (equivalent to a small to moderate effect); -On balance: a relative improvement of 0.8 seconds; - Anxiety about falls: □ at 3.7 points.
<p>7. Kim, JI.; Park, SD.; Song, HS.</p> <p>2014 (South Korea) (15)</p>	<p>Randomized controlled study</p> <p>30 healthy elderly people, >65 years-old, equally randomly divided into a vision-blocked group - VB (eyes blinded) and a vision-impaired group - VP.</p>	<p>To investigate the effect of a complex exercise program on balance, walking, vestibular and proprioceptive senses when the visual sense is blocked, in elderly people who have experienced a fall.</p>	<p>The walking speed and balance of both groups improved because muscle strength was enhanced by walking, squatting, climbing and descending stairs. The VST training (vestibular stepping test) changed significantly after the intervention in the VB group and a significant difference was identified in the VST between the two groups after the intervention. The PT (proprioception test) changed significantly after the intervention in the VB group.</p>

<p>8. Roaldsen, KS.; Halvarsson, A.; Sahlström, T.; Ståhle, A. 2014 (Sweden) (16)</p>	<p>Prospective, controlled and randomized study.</p> <p>59 healthy community-dwelling elderly (42 ♀ and 17 ♂) aged 67-93 years-old were randomized to the intervention group (IG=38) or the control group (CG=21).</p>	<p>To evaluate the effects of a 12-week balance training program on self-rated function and disability in healthy elderly people with self-perceived balance deficits and fear of falling.</p>	<p>The IG reported improvement in global function ($p = 0.016$), as well as in basic function ($p = 0.044$) and advanced lower limb function ($p = 0.025$) compared to the CG. The study showed no improvement in general disability or upper limb function.</p>
<p>9. Cho, S.; Na, D. 2014 (South Korea) (17)</p>	<p>Randomized controlled study</p> <p>55 elderly people over 75 years old who lived in the community.</p> <p>Balance exercise intervention group - INT 1; Elastic resistance exercise intervention group - INT 2; Control group - CON.</p>	<p>To investigate the effects of balance exercises and elastic resistance exercises on muscle strength and balance in the elderly to prevent falls in this population at risk, during an eight-week program.</p>	<p>INT 1: presentation statistically expressed improvement in muscle strength of 5 of the 7 muscle groups (except knee flexors and ankle plantar flexors); INT 2 was better in all 7 muscle groups. Comparing to the CON mean muscle transparencies, after balance exercises, INT 1 and INT 2 statistically significant improvements in muscle groups after the intervention; INT 1 and INT 2 with improved fall rate compared to CON; CON differences did not differ in the options of any muscle group nor in the fall rate after 8 weeks.</p>
<p>10. Kim, WJ.; Duk-Hyun, MC. 2014 (South Korea) (18)</p>	<p>Randomized controlled study</p> <p>Ten participants over 65 years-old, healthy and living in the community.</p>	<p>To identify the effects of a fall prevention exercise program on the participation in the activity and static balance of the elderly.</p> <p>The exercise program was based on fitness and physical mobility (FaME).</p>	<p>After exercise, participation in activity and static balance showed significant differences ($p < 0.05$). Participation in the activity increased from 22.90 ± 5.55 to 32.35 ± 11.16 points, and the fall index decreased from $64.60 \pm 27.0051.40 \pm 22.84$ points. However, there were no significant differences in any category for participation in activities before and after the intervention.</p>
<p>11. Gouveia, BR.; Jardim, HG.; Martins, MM.; Gouveia, ER.; Freitas, DL.; Maia, JÁ.; Rose, DJ. 2015 (Portugal) (19)</p>	<p>Randomized controlled study.</p> <p>52 seniors (65 - 85 years-old); control group (CG): 25 elderly; group submitted to the training program (TG): 27 elderly people.</p>	<p>To evaluate the effectiveness of the ProBalance program in the balance and risk of falling in a group of elderly people</p>	<p>Twelve weeks after the program, both groups were evaluated in relation to balance and the group submitted to the program obtained significantly better results.</p>
<p>12. Gawler, S., Skelton, DA., Dinan-Young, S., Masud, T., Morris, RW., Griffin, M., Kendrick, D. 2016 (The United Kingdom) (20)</p>	<p>Controlled and randomized clinical trial.</p> <p>1256 elderly people over 65 years-old (persons with a history of more than three falls in the past year or unstable medical conditions were excluded).</p>	<p>To evaluate the effectiveness of the OTAGO and FoME exercise programs in reducing falls and associated injuries.</p>	<p>FaME Group: \downarrow Harmful falls compared to the incidence rate (IRR) 0.55, 95% CI 0.31, 0.96; $p = 0.04$). After 12 months = (IRR 0.73, 95% CI 0.54, 0.99; $p = 0.05$); \square incidence of all falls (harmful and non-harmful) compared with usual care (IRR 0.74, 95% CI 0.55, 0.99; $p = 0.04$) within 12 months of cessation of intervention. OEP Group: \downarrow It is not significant in the incidence of all falls (harmful and non-harmful) compared to usual care (IRR 0.76, 95% CI 0.53, 1.09; $p=0.14$) in the 12 months following cessation of the intervention; the effects on falls did not persist through the 24 months of evaluation in any exercise group. Active FaME group (it reached 150 min/week of MVPA in the 2nd post-intervention period): \downarrow significant in the incidence of falls (IRR = 0.49; 95%CI 0.30; 0.79; $p = 0.004$) inactive FaME group.</p>

13. Lacroix, A.; Kressig, RW.; Muehlbauer, T.; Gschwind, YJ.; Pfenninger, B.; Bruegger, O.; Granacher, U. 2016 (Germany) (21)	Randomized controlled study. 66 elderly people with a mean age of 73 years-old (3 groups: control group, unsupervised training group and supervised training group).	To assess the impact of a 12-week balance and strength training (BST) program, followed by 12 weeks of inactivity, with and without supervision.	In the supervised group, at the end of the 12 weeks of training, there was an improvement in the balance tests as well as after the inactivity period (improvements related to the Romberg Test, stride speed, Timed Up and Go Test and Chair Stand Test, in favor of the group unsupervised).
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Table 2: Constituent studies of the bibliographic sample.

DISCUSSION

The aim of this scoping review was to analyze and map articles that addressed the effect of proprioceptive training and postural balance in the elderly people for the falls prevention.

The various articles included address isolated exercise and exercise programs and contribute to minimizing the risk of falling and the fear of falling in the elderly people.

Article number 2⁽¹⁰⁾ addresses an exercise program called LiFE, which consists of the practice of balance and muscle strength exercises to be performed at home, based on activities of daily living.

Elderly people who have already experienced falls were selected and followed for 12 months. Of the three study groups, the LiFE group had the best results with the fewest falls/year (172 falls), the overall incidence of falls in the LiFE program was 1.66 per person/year, compared to 1, 90 (193 falls) in the structured exercise group (SG) and 2.28 (249 falls) in the control group (CG). There was a significant 31% reduction in the rate of falls in the LiFE group compared to the CG (incidence rate 0.69), (95% confidence interval 0.48 to 0.99). between SG and CG was not significant=0.81 (0.56 to 1.17).

Static balance, muscle strength, ankle function and participation were significantly better in the LiFE group than in the CG. The LiFE and SG group had a significant impact on improving dynamic balance compared to the CG.

The authors of this article concluded that this type of exercise program had a significant impact and a moderate improvement in dynamic balance in the population studied.

Thus, LiFE program offers an alternative to traditional exercise to consider for fall prevention with an intervention focus on functional exercise.

Article number 3⁽⁴⁾ refers to the OTAGO program. This training program was specifically designed to prevent falls. It consists of a set of exercises for muscle strengthening of the lower limbs and balance training with progressive difficulty - home exercise program. The exercises last 30 minutes, participants must exercise three times a week and walk at least twice a week.

This study evaluated the effectiveness of a home balance and strength exercise intervention in the

elderly population, being systematically evaluated as having mild balance dysfunction.

The 83 intervention group (IG) participants received a six-month home strength and balance exercise program (prescribed by a physical therapist based on the OTAGO Exercise Program and Visual Health Information Balance and Vestibular Exercise Kit). The 82 CG participants continued with their usual activities.

After six months of study, the IG significantly improved compared to the CG for: the Functional Range Test (mean difference 2.95 cm, 95% confidence interval [CI] 1.75 to 4.15), in the Test of Step (2.10 steps / 15 seconds, 95% CI 1.17 to 3.02), hip abductor strength (0.02; 95% CI 0.01 to 0.03) and in the gait step width (2.17 cm, 95% CI 1.23 to 3.11).

The authors conclude that the prescription of a home exercise program such as OTAGO, aimed at balance and muscle strength, was effective in improving balance and reducing falls in elderly people with compromised body balance.

FaME (Falls Management Exercise) is a physical exercise training program that was studied in article number 10⁽¹⁷⁾, based on the fitness and mobility of physical exercise. This program, known since 2006 in Canada, aims to increase balance and muscle strength in seniors, as they are the class most predisposed to the risk of falling.

It consists of specific, individualized training aimed at dynamic balance, muscle strength, endurance, flexibility, gait and functional abilities to avoid falling. The exercise was performed three times a week for one hour, in which one session was held in a group and the rest at home, under the supervision of a physiotherapist and/or an occupational therapist, for three months.

Static balance improved as well as activity participation (22.90 ± 5.55 to 32.35 ± 11.16 points) and the fall index decreased from 64.60 ± 27.00 to 51.40 ± 22.84 points. However, there were no significant differences in any category for participation before and after the intervention. Nevertheless, these investigators report that other fall prevention exercise programs are as effective as the FaME program.

Reflecting on these three exercise training programs for the prevention of falls mentioned above, they are described by researchers that provide evidence for the promotion of balance, muscle strengthening and increased participation of the elderly population in the practice of physical exercise. We can admit that a home

exercise program for the prevention of falls can have a positive effect on participation in activities of daily living and on balance in seniors.

The ProAct65+, discussed in article number 12⁽¹⁹⁾, is a clinical trial in which the effectiveness of a home exercise program (OTAGO) and a physical exercise program (FaME) was investigated, in comparison with the usual care to increase moderate to vigorous physical activity (MVA), in reducing falls and associated injuries.

The FaME group experienced a significant reduction in harmful falls compared to the incidence rate (IRR) 0.55, 95% CI 0.31, 0.96; $p = 0.04$) and this continued through the 12 months after the end of the intervention (IRR 0.73, 95% CI 0.54, 0.99; $p = 0.05$).

There was also a significant reduction in the incidence of all falls (harmful and non-harmful) in the FaME group compared to usual care (IRR 0.74, 95% CI 0.55, 0.99; $p = 0.04$) in the period of 12 months after the termination of the intervention. In the OTAGO group, the reduction was not significant in the incidence of all falls compared to usual care (IRR 0.76, 95% CI 0.53, 1.09; $p = 0.14$) in the 12 months following cessation of the intervention.

After 24 months, the effects of training programs on fall prevention did not persist in any exercise group. However, a sample from the FaME group that continued to perform 150 minutes of MVA per week post-intervention showed a significant reduction in the incidence of falls (IRR = 0.49; 95%CI 0.30; 0.79; $p = 0.004$) compared to those who did not maintain their regular physical activity.

The researchers found that the elderly undergoing the FaME program did not fall during the training program. After 12 months they had fallen less and had fewer injuries associated with falls. However, 24 months after the program, the benefits of the intervention ended, except for those who maintained moderate physical activity. The OTAGO program was less effective in preventing falls.

It emphasizes here the importance and benefit of continuing regular physical exercise to prevent falls in the elderly population.

Article number 13⁽²⁰⁾ assesses the impact of a strength and balance training program, the Balance and Strength Training (BST) for 12 weeks, followed by the same period of inactivity time, with and without professional supervision.

The exercise program was performed three times a week, which included progressive exercises, with different levels of intensity. The program protocol consisted of static balance exercises, dynamic balance (walking) and strength/power exercises for the lower limbs and trunk muscles (squats, plank, among others). The participant's body weight and small equipment such as towels, bottles and balls were used as resources.

The supervised elderly group performed training three times a week, with one training session being held without supervision at home. The unsupervised group

performed the same exercises at home three times a week.

The results revealed that there was an improvement in the balance tests, improvements in the Romberg Test, in the step speed, in the Timed Up and Go Test and in the Chair Stand Test, even after the inactivity period, in favor of the supervised group.

The investigators in this article conclude that there have been improvements in strength and balance in the elderly when these exercises are performed under the supervision of a professional.

ProBalance is a rehabilitation program carried out by Portuguese RN that includes various types of exercise: balance, coordination, functional task training, gait training, strengthening and flexibility exercises, inspired by the FallProof balance and mobility program.

The ProBalance program takes a multifactorial approach to balance and mobility in independent elderly people with balance deficits.

In article number 11⁽¹⁸⁾, its effectiveness in improving balance and reducing the risk of falling in this age group is highlighted.

Each training session included six key exercise components: multisensory training (visual, somatosensory, and vestibular system); center of gravity control training; proactive and reactive postural strategy training, gait training, strengthening and resistance exercises and flexibility training for 12 weeks.

After the program, the two groups (intervention and control) were evaluated, in relation to balance, and the group submitted to the program obtained significantly better results: 5.15 (2.81) for the intervention group and ± 1.45 (2.80) for the control group on the Fullerton Advanced Balance scale (FAB). The authors also report that after a period of inactivity, the loss of balance is more evident.

This study demonstrated that the rehabilitation nursing program based on an exercise program for the prevention of falls is effective in improving balance and reducing risk in groups of elderly people with impaired balance.

Article number 7⁽¹⁴⁾ has investigated the effect of a complex exercise program on balance, gait, vestibular and proprioceptive senses when the visual sense is blocked, aimed at elderly people who have already suffered a fall. The group of participants was divided into blocked view group and allowed view group. The participants started the training with muscle warm-up exercises (about 10 minutes of stretching and 20 minutes of walking). After a three-minute rest, they started an obstacle course, proprioceptive training, for 10 minutes, with the help of an assistant.

There were significant improvements in the 10 meter walking test (10MWT), vestibular test (VST) and proprioceptive test (PT) performed by the vision-blocked group after the intervention ($p < 0.05$) compared to the vision-allowed group. No significant difference was identified in the stair up/down

test(SUDT) and in the Berg Balance Scale (BBS) within each group between before and after the intervention.

The authors of the article conclude that the exercise program applied to the group with blocked vision contributed to a significant improvement in balance and gait capacity and improved the vestibular sense of the elderly people's intervening.

The complex program of vestibular and proprioceptive training exercises for the elderly helped to improve the balance and gait capacity, as well as improved the participants' vestibular sense. When the visual senses are blocked, the muscular response is mainly organized and postural control is accomplished more quickly, because the maintenance of vestibular and proprioceptive function increases the capacities of postural control.

This is an exercise program for the prevention of falls that is useful to improve the balance and walking ability of elderly people who have already experienced a fall.

In view of the aforementioned studies, it is evident and recommended that in the prescription of an exercise program for the falls prevention, the continuity of physical practice by the elderly population is essential, as a decline in balance is verified after a period of physical inactivity, as well as the respective supervision of the professional to reduce falls and associated injuries.

Some articles in our research refer to specific balance exercises.

The study number 1⁽⁹⁾ addresses the Flamingo's Dynamic exercise. This exercise consists of standing in an orthostatic position on one leg with eyes open for one minute, three times a day for six months. The aim of this study was to determine the effects of balance exercise in preventing falls and fractures in elderly people with impaired balance.

In the intervention group, significant differences were observed in increased time spent on one leg with eyes open (was increased approximately 3 times), body weight decreased; there was an improvement in independence in women's daily lives.

A greater number of fractures occurred in the non-exercise group (10 women and 1 man) than the exercised group (3 women and 1 man). The number was higher in the group without exercise, but there was no significant difference, according to the authors of this study. The number of fractures was not significantly different for men or women.

Dynamic flamingo exercise leads to gains in increased standing, on one leg and in decreased body weight, but no significant difference in fracture prevention has been demonstrated in elderly women with impaired balance.

In article number 9⁽¹⁶⁾, the physiotherapists analyzed the effects of balance exercises and elastic resistance exercises on muscle strength and balance in the elderly over 75 years, over a eight-week program, with the objective of preventing falls. The elderly people were divided into three groups, intervention 1 (INT 1), intervention 2 (INT 2) and control group (CON). The INT

1 group performed balance exercises and the INT 2 group performed elastic resistance exercises and the CON group performed the exercises after eight weeks, as the intervention period had already ended.

Sessions consisted of one hour, five times a week for eight weeks, for a total of 40 sessions. The elderly performed the exercises in groups, under supervision, twice a week. On the remaining days, they performed the exercises at home, alone. The one-hour training sessions consisted of 10 minutes of warm-up and stretching, 40 minutes of core exercise, and 10 minutes of final stretch. The exercises were performed in three sets, with 10 repetitions per set, and there was a rest period of 30 seconds between each set and a period of three to five minutes of rest between each exercise. The balance exercises consisted of six types of exercise: stepping, tiptoeing, backwards walking, walk in circuits of eight, one-legged position with arms crossed anteriorly, and application of an external disturbance. The eight resistance exercises consisted of: squat, heel lift, hip flexion and extension, knee flexion and extension, and ankle dorsiflexion and plantar flexion.

The INT 1 group showed a statistically significant improvement in the muscle strength in five of the seven muscle groups, but not at the level of the knee flexors and ankle plantar flexors, being better in the INT 2 group, which improved in all seven muscle groups.

Both the INT 1 and INT 2 groups showed improvements in the fall index, obtaining better results compared to CON group, as well as the latter showed no differences in the strengths of any muscle group after eight weeks.

The INT 1 and INT 2 groups showed significant improvements after the intervention, which proves that both balance and resistance exercises are effective in improving balance. Although elastic resistance exercises were shown to be more effective than balance exercises in strengthening the ankle plantar flexors, there was not a large difference in the effectiveness of the two types of exercises.

The authors concluded that both types of exercise (balance and elastic resistance) showed statistically significant improvements in muscle groups after the intervention, as well as an improvement in the fall index, thus being acceptable as fall prevention exercises for the elderly population.

In 2013, a systematic review was carried out (article number 5)⁽¹²⁾, on the effects of different interventions of exercise, walking ability and balance in seniors in preventing the risk of falling.

The aim of this review was to recommend training strategies that optimize functional capacity in physically frail older adults, focusing especially on supervised exercise programs that improve muscle strength, balance and gait ability, reducing the risk of falling. Researchers argue that exercise intervention programs (strength, endurance and balance training) will be the best strategy to improve all of these components, as well as decrease the rate of falls in the elderly. Most of the studies included in the systematic review⁽¹²⁾ describe improvements in gait, balance and

risk of falling after applying a multi-component physical training program.

However, studies in which systematic resistance training was performed (alone or as part of multiple physical exercise components) revealed greater strength gains in elderly people with physical frailty or severe functional decline.

The absence of changes in strength and functional outcomes that have been measured in some of the investigations indicates that exercise prescription must be carefully adapted and provide sufficient stimulus to improve the capacity of frail subjects. In addition, this review focused only on the domains of physical function, the concepts of frailty and physical frailty. Thus, this systematic review is only able to recommend strategies to improve the function of physically frail individuals.

Based on recent evidence, exercise strategies to improve cardiovascular parameters and functional performance in frail older adults should include the following:

1. Resistance training programs should be performed three times a week, with three sets of 8 to 12 repetitions at an intensity that starts at 20%-30% and progresses to 80%:
2. To optimize individuals' functional capacity, endurance, training programs should include exercises that simulate daily activities such as sit-to-stand exercise.
3. Endurance training should include walking with changes in pace and direction, treadmill walking, step-ups, stair climbing and static bicycle. Resistance exercise can start in 5-10 minutes during the first few weeks of training and progress to 15-30 minutes for the remainder of the program. The perceived exertion rate scale is an alternative method for prescribing exercise intensity, and an intensity of 12-14 on the Borg scale appears to be well tolerated.
4. Balance training should include various exercise stimuli such as tiptoeing, multidirectional weight lifting on tiptoes, heel/toe walking, line walking, standing on one leg, weight transfers (from one leg to the other) and modified Tai Chi exercises.
5. Multi-component training programs should include gradual increases in exercise volume, intensity and complexity, along with simultaneous performance of resistance and balance exercises.

In all the studies selected in this *scoping review*, in a global way and described by the authors in the conclusions of their studies, proprioceptive and balance training are of greater value for health promotion and fall prevention in the elderly people.

In addition to proprioceptive and balance training, three studies address the fear of falling.

In article number 4⁽¹¹⁾, the long-term effects of a progressive and specific program based on balance training in healthy elderly people with increased risk of falling were addressed, establishing the relationship between fear of falling and balance training. This type

of progressive and specific program described by the authors, based on balance training with dual and multiple tasks for elderly people at risk of falling, provided important short-term positive benefits for gait, balance function and fear of falling.

Fast walking speed, dual task performance and fear of falling were improved in the training group at nine months of follow-up. Only the self-perceived fear of falling remained significantly better at 15 months of follow-up. Although brisk walking speed decreased to baseline in the training group (1.49 m/s) it remained significantly higher than in the control group (1.37 m/s) at the end of the study.

This new, progressive and specific program, based on balance groups, with dual and multiple tasks for older adults at risk of falling, provided important short-term positive benefits for gait, balance function and fear of falling. These benefits diminished over time, suggesting that periodic participation in balance training should be encouraged.

In article number 8⁽¹⁵⁾ the fear of falling in elderly people with deficits in self-perception of balance was analyzed. The objective was to assess the effects of a 12-week balance training program on self-rated function and disability in healthy community-dwelling older adults with balance deficits and fear of falling.

The intervention group reported improvement in global function ($p = 0.016$), as well as in basic function ($p = 0.044$) and advanced lower limb function ($p = 0.025$) compared with the control group. The study showed no improvement in upper limb function.

In this study, the authors conclude that a balance training program based on static and dynamic balance exercises, using gait disturbances, improves the elderly's self-perception of balance deficits and fear of falling.

Article number 6⁽¹³⁾ compares the effects of an exercise program with the physical and psychological component of the risk of falling, addressing balance, strength, function and fear of falling. The Timed Up and Go test, the five-repetition chair test and the modified Romberg test were used for physical assessment of the risk of falling. For psychological results, the German version of the Falls Efficacy Scale - International (FES-I) was used.

The elderly who participated in the intervention group showed an improvement in the Timed-Up-and-Go (TUG) test: 1.5 seconds greater than that shown by the control group, equivalent to a small to moderate effect. For balance, a relative improvement of 0.8 seconds was achieved, and anxiety about falling was reduced by 3.7 points on the Falls Efficacy Scale-International (FES-I) in the intervention group compared to the control group.

The authors of this study concluded that intervention with complex exercises to prevent falling effectively improved balance, physical condition and led to a reduction in fear of falling in the elderly population studied.

In the articles published by Yang et al.; Marques, L; and Peters et al.^(4,6,8), the respective conclusions

emphasize that balance training should be encouraged and maintained to minimize the elderly person's fear of falling.

A stable balance, greater muscle strength and elastic resistance lead to a considerable improvement in gait and a reduction in the fear of falling, which consequently contributes to a reduction in the falls risk.

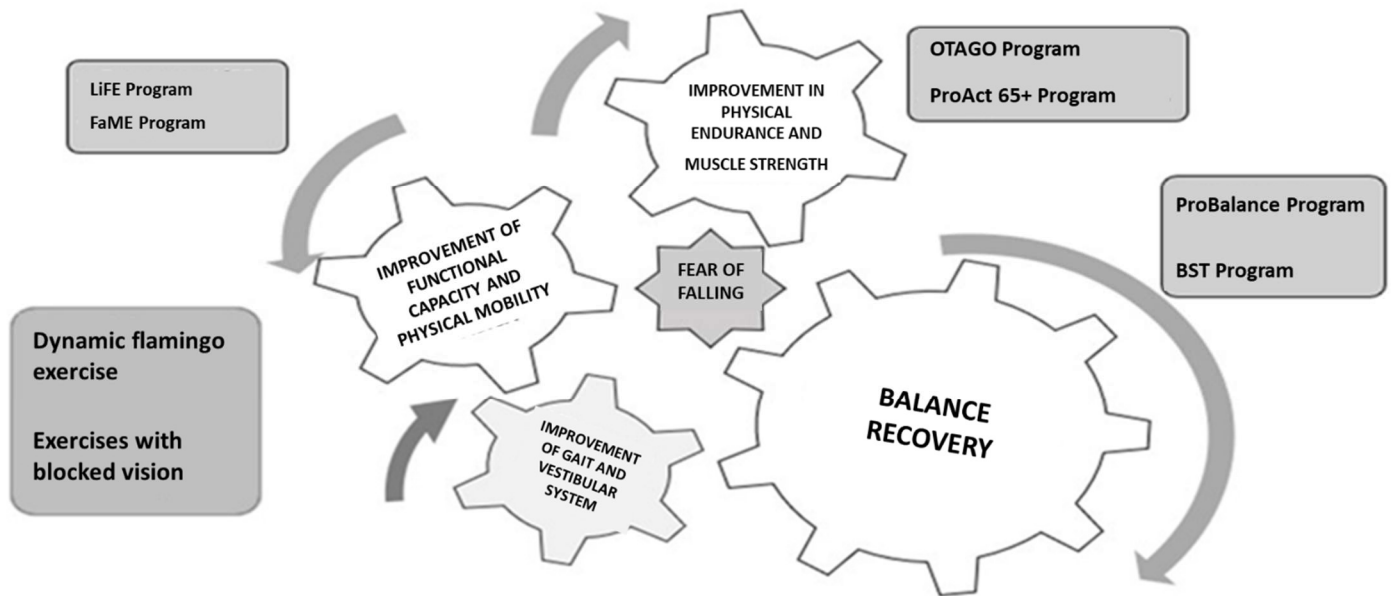


Figure 2 – Representative scheme of the types of training present in the selected studies

CONCLUSION

After a detailed analysis of the selected articles, it appears that, for the most part, training programs or specific exercises for the recovery of balance and muscle strength in the prevention of falls in the elderly are addressed. Other articles address training programs with intervention in the improvement of functional capacity and physical mobility, through the implementation of more specific programs. Unique exercise programs to increase muscle strength and balance are also described, some of which intervene in improving gait and the vestibular system, and others focus on balance and resistance exercises.

Generally speaking, they all consider that the implementation of training programs of this nature has a positive and significant impact on the importance of proprioceptive training and postural balance in the elderly, playing a significant role in the falls prevention.

There are several authors who defend the continuity of physical exercise, balance and proprioception training programs, because in their absence, the risk of falling in the elderly people increases substantially.

In short, the prescription of an exercise training program for the prevention of falls in the elderly population must take into account the individuality of each person and the type of exercise (balance, strength, resistance). The fear of falling, in this more fragile population, is always present, and the supervision and presence of a health professional is essential, not only to prevent falls due to the safety transmitted, but also to encourage the continuation of physical exercise.

Limitation of studies

The limitations for this study are considered to be the small number of articles with training exercises without the use of technology and/or technological equipment, since one of the objectives would be to transfer these trainings to the home environment, as well as only one article carried out by Specialist Nurses in Rehabilitation Nursing.

Implications for the investigation

Given the importance described on the benefits of proprioceptive training and postural balance in preventing falls in the elderly population, further studies are considered, particularly by RN, in the daily context of the interveners (home context) and without the use of technology to reinforce the benefit of implementing these same programs.

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