VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

The importance of geriatric physiotherapy in the prevention of falls and concomitant injuries of the spine

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ABSTRACT

Due to demographic issues, world population tends to age gradually. Physiological deterioration over time can lead to decreased balance capacity and increased risk of falls in old age. Frailty syndrome is therefore defined as the age-related reduction of multiple physiological processes and functions, with a negative impact on multiple areas of health such as disability, injury, various diseases, hospitalizations, falls and mortality, affecting the spine directly and indirectly.

Prevention of falls among the elderly is therefore imperative for healthcare systems. Interventions such as resistance training, balance training, endurance training, coordination training, combination exercises (ie, simultaneous strength, endurance and balance training) as well as Tai-chi, have yielded beneficial results in some functional parameters.

Recent technological developments have also led to the introduction of new virtual reality-based practice methods for performing different tasks. There is evidence that falls can be prevented by screening for risk factors and prescribing custom interventions. Determining the type of exercise intervention that is safest, most effective and most easily applicable would greatly assist clinical physiotherapists and caregivers in making informed decisions about which interventions to perform, always depending on the given clinical goals and budgets restrictions.

Key words: elderly, falls, prevention, physical therapy, spinal cord injury

Introduction

The World Health Organization identifies falls as the second leading cause of death-related injuries and prioritizes related research and development programs [1-9]. Of the elderly living in the community over the age of 64, 28–35% of them sustain a fall each year and the incidence of falls increases with age and the level of disability, up to 50% in the elderly over the age of 80 [10]. It represents a serious public health problem due to the high demands of healthcare and has a significant impact on patient's quality of life. The aging process, accompanied by mental changes in the elderly, increases the risk of falling more than 10 times, compared to young adults and middle-aged individuals

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VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

[11]. Almost the entire brain is involved in maintaining the right balance [12]. As a result, the effectiveness of the systems responsible for stability decreases progressively with age [13].

Furthermore, pain is an important public health issue among the elderly living in the community as it is diagnosed with a prevalence of 45-80%. It is closely linked to reduced physical function, loss of independence, psychological distress, lower quality of life and even the risk of premature death. Recent research has also found that concomitant pain in the elderly is associated with a higher risk of falls, which is another complementary health problem in the current situation [14].

Fall, by definition, occurs when a part of the human body touches the floor due to loss of balance or stability without necessarily some external stimulus in daily life or due to loss of consciousness, and this results in physical injury, reduced daily activity, loss of confidence and lifestyle changes, especially in the elderly [15]. Injury can include bruises, hematomas, fractures and even brain damage or other minor complications with reduced normal function and muscle weakness, leading to other falls in the future [16].

However, these conditions are largely preventable, with more and more evidence suggesting that exercise can be a safe and effective way to reduce falls [7]. Training techniques aim to prevent these complications in the elderly. Studies have extensively reported the effectiveness of multifactoral prevention programs that include training, exercise, environmental modification and psychological interventions [17]. Referral to a physiotherapist is one of the evidence-based interventions proposed by the CDC and the United States Preventive Disaster Management Team [18]. Physiotherapists can also help connect seniors with programs and resources provided by the community to increase physical activity, reduce the risk of falling or manage chronic diseases [19].

To optimize the plan of training and achieve these goals in the elderly with physical disability, the most effective type of exercise program should be identified taking into account the optimal combination of intensity, volume and frequency of weekly training that will promote neuromuscular cardiovascular adaptations [4]. Therefore, the overall review was

A review of the current literature was performed with the aim to create a guide to direct the physiotherapist's practice using existing programs that treat falls in older adults living in the community, using the online PUBMED database and the following keywords: elderly, falls, prevention, physical therapy, spinal cord injury. Inclusion criteria in the review comprised: (a) date of publication (2000 and later), (b) age of subjects (at least 65 years old), (c) physical condition enabling movement and performance of everyday activities, (d) mental state ensuring cooperation during the performance of tests, (e) referral for physiotherapy. Exclusion criteria comprised: (a) uncompleted studies, (b) severe comorbidities like stroke, heart attacks and other diagnosed neurological, musculoskeletal, or systemic disorders, (c) previous operations related to knee or hip joint replacement, (d) data on exercise interventions that were associated with hormonal treatments, drug therapy, or other supplements.

Discussion

The search resulted in 1472 studies. After checking titles and summaries, 1369 articles were rejected as irrelevant to the subject. Of the 103 remaining publications, 62 were rejected due to specific reasons. After reviewing the reference lists of the included studies, 2 more studies were included. Finally, 43 studies were included in the present review. (Figure 1- Flowchart).

Combination exercise - key to prevent falls in the elderly

Combination interventions are known to prevent falls among the elderly, but the relative importance between different strategies is unknown [20]. Balance is a variable that can be effectively increased by different means of exercise. Therefore, it is essential to promote physical activity in old age. There is evidence that some types of exercise programs have long-term benefits and results can be maintained for up to two years after intervention [21]. These programs should provide gradual increases in their frequency, intensity and complexity to be the best strategy to improve gait, balance and strength, as well as to maintain functional capacity during aging [4]. Exercise interventions, especially the combination of strength training and balance, immediately show their effectiveness in preventing falls [22]. Most of the studies showing improvements in gait, balance and risk of falling have used this combi-

VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

nation [4]. However, due to the physical characteristics of the elderly, the exercises should not pose a risk of injury and should be easy to apply, even at home [16]. The aim of this study, therefore, was to determine the results of such a program in the measurements related to this risk. Preventive screening for instability factors can lead to the creation of a personalized intervention, parts of which will be applied directly by the physiotherapist in consultation with other health professionals. Exercise, including structured physiotherapy, is an effective component of a fall prevention program and physiotherapists can always provide additional advice on both the modification of the environmental space as well as the footwear and other aids which are part of the general education about risk of fall [6].

International education and fall prevention programs for the elderly

Referral for appropriate interventions is a necessary follow-up after the screening. In the USA, the majority of physiotherapists who report to assess the elderly for risk of falls in the community are aware that the National Council on Aging (NCOA) recommends institutionalized and implemented programs for the elderly [18]. The most common references are in the Otago, A Matter of Balance, Tai Chi and YMCA Moving for Better Balance exercise programs. More specifically, performing Otago-based exercises can additionally reduce pain, both in the short and long term, making it a valuable tool for both pain management and fall prevention, in the higher-risk target population [14].

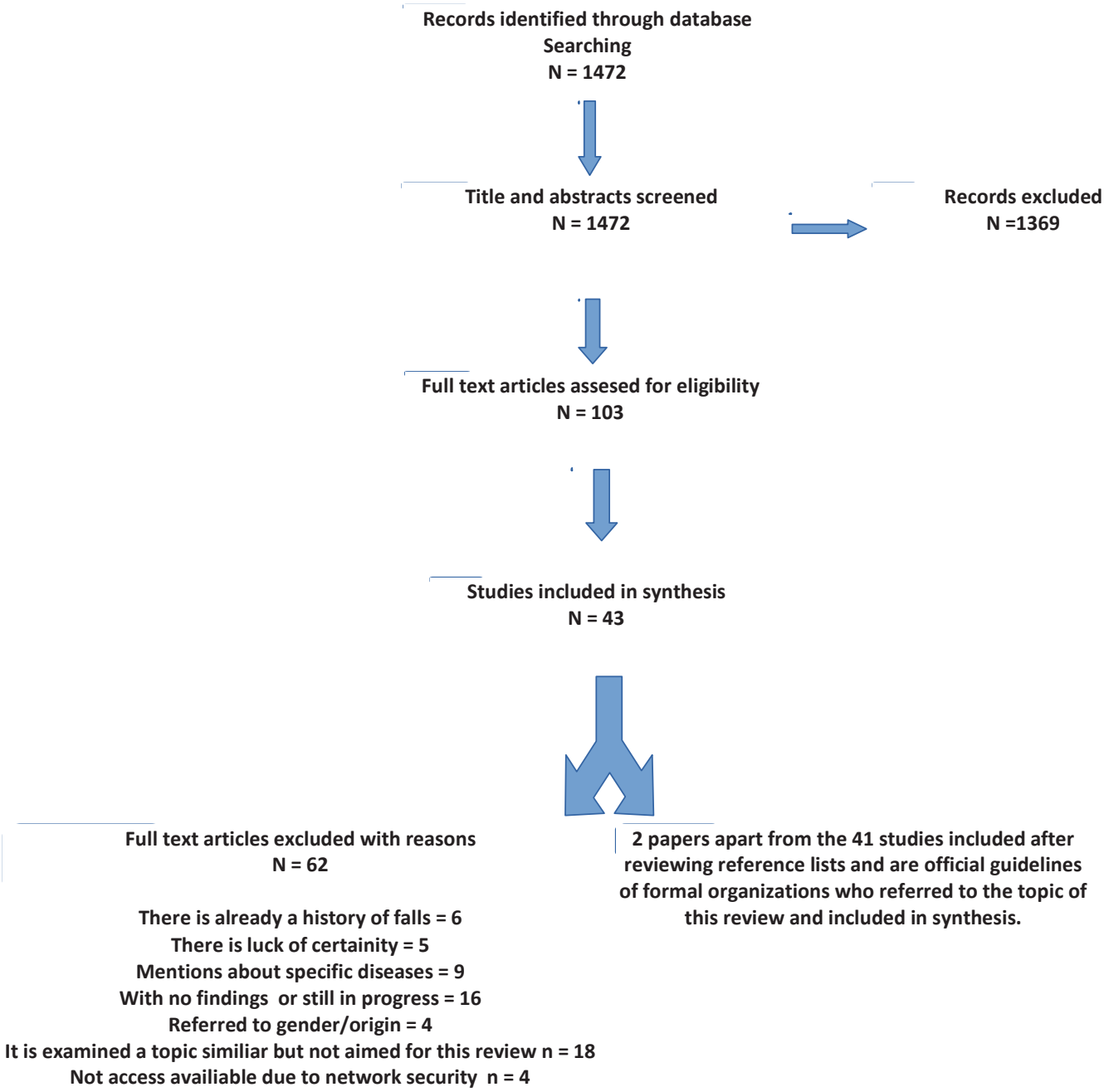
However, there are other proven programs that, depending on their clinical goal, further cover the range of prevention in old age. In an effort to assess the fear that is directly related to the functional isolation of the elderly, the program "Activity, Balance, Learning and Exposure" (ABLE) has been developed. The application of ABLE, which integrates cognitive-behavioral therapy and exercise, reduces the fear and avoidance of activities in the elderly with disproportionate fear of falls during the intervention period of 8 weeks [23]. Decreased risk and fall rates have also been observed in the HOP-UP-PT (Home-based Older Persons Upstreaming Prevention-Physical Therapy) program. The HOP-UP-PT also uses a multifactorial approach with the unique element that referrals in the program do not originate from health professionals, but directly from the local rehabilitation centers for the elderly [24].

The LiFE program provides an alternative to traditional exercise as well, with functional exercise and the daily background of the elderly being the focus of interventions, so as to protect against falls and to improve and maintain functional capacity [25]. Reference is additionally made to the Multisystemic Exercise Program (MPE), which is designed based on the components of fall risk assessment, using the Physiological Profile Assessment (PPA). MPE, in accordance with the above, consists of four parts: susceptibility training, muscle strengthening training, reaction time training with acoustic signals and rational balance training with the results indicating that MPE is a tolerable and sustainable method, which leads to reducing the fear of falls and depression and increasing the quality of life [2].

Technological interventions in the field of prevention

The findings of this work suggest that both visual training and cognitive training enhance physical performance, reaction time, executive functions, obstacle avoidance, and significantly reduce the rate and fear of falling. More specifically, visual biofeedback training is believed to help improve balance through sensory integration, because it creates reflex reactions through visual information against body movement [15]. Center of gravity improves following virtual reality training, indicating that the balance ability of the elderly is gradually ameliorated. Participating in such programs makes the elderly understand the importance of orthostatic control by observing their dummy on a screen. Indicatively, in a special assessment of balance with the eyes open or closed, virtual reality training has equally improved the ability to balance, both with and without visual information [5]. The observed improvements in distraction as well as in gait with simultaneous execution of various tests underline the condition that an exercise program should include at least one element of cognitive-virtual challenge [26]. The benefits of these interventions are found in exercise programs such as EMAT, a 2-hour workout in which participants complete a ladder-type, mesh-type and circular-type exercise-game, weekly, for a total of 3 months, effec-

VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023



(Fig.1). Flowchart of the present review.

VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

tively reducing the risk of falling and increasing gait for multiple tasks. Other study findings show that unsupervised Interactive Cognitive-Motor Step Training (ICMT) in which participants perform four gait games that require attention span, inhibition of irrelevant stimuli, toggle between tasks, rotation of objects, and rapid decision-making has led to improvements with regard to certain cognitive functions associated with falls in old age. Also, the widespread Wii, has now the potential to serve as a useful training tool for vulnerable populations at home or even during hospital stay. Training can be achieved with the safety of a fixed device that can be equipped with balance rods or straps [27].

Similar adaptive improvements could be gained by perturbation training that improves reactive balance and the frequency of falls after slips and vibrations, caused by special machines on a treadmill [28]. Given the positive findings after a single session, such a slip-training is strongly suggested as a complement to conventional training or in combination with other similar approaches [28]. The combination of a low-cost balance plate or disc and a workout-exercise seems to be an ideal approach to the risk of falls in the elderly based on improvements in orthostatic oscillation [29]. Slip and Trip training is an emerging field, which has been shown to have significant benefits in laboratory clinical trials. However, these exercises, applied in open ground of different type and quality, can have a synergistic effect, reflecting a great advantage for the elderly to maintain their independence with a simple and easy activity in their daily lives and providing evidence to facilitate the transfer of clinical practice trials from indoor to outdoor activities [30].

These results provide a new benchmark for fall prevention protocols, suggesting that similar to the "fall-learning" seen in early childhood, through the experience of slipping and falling, the elderly can utilize the experience provided by these programs and novel technologies.

Conflicts of interest

The authors declared no conflicts of interest.

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VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

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VOLUME 74 | ISSUE 2 | APRIL - JUNE 2023

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