

The Pilates method as an intervention to reduce the risk of falls in the elderly

Edinete S. Brito¹, Aylton F. Junior^{2,3}, Yuri de Lucas X. Martins^{2,4}, Leonardo Emmanuel M. Lima^{2,5}

¹ University Center Jorge Amado, Paralela Campus, Salvador (BA), Brazil

² University São Judas Tadeu (USJT), Mooca Campus, São Paulo (SP), Brazil

³ University of Campinas (UNICAMP), Campinas (SP), Brazil

⁴ Federal Institute of Rondônia (IFRO), Ariquemes Campus, Ariquemes (RO), Brazil

⁵ University Metodista de Piracicaba, Piracicaba (SP), Brazil

Abstract

Background: The incidence of falls in the elderly population is linked to the decline in their physical and mental capacities. This accident negatively impacts the autonomy and survival of the elderly, in addition to representing a high cost for the healthcare system. Engaging in physical activity is described as essential for healthy aging, and the Pilates method stands out due to its popularity among this audience. **Objectives:** To evaluate whether the Pilates method can stimulate effective sensorimotor changes to reduce the risk of falls in the elderly. **Methods:** In this systematic review, clinical trials published between 2014 and 2024 in the Virtual Health Library (VHL), in Portuguese and English, were searched. Exclusion criteria included studies involving people under 60 years of age, pregnant women, patients with syndromes, neurological pathologies and/or musculoskeletal dysfunctions, and athletes, as well as publications focused on interventions not related to Pilates and those that did not evaluate the possible outcomes chosen for this review. **Results:** After applying the eligibility criteria, 8 out of 257 publications were selected for discussion. The obtained results are positive and demonstrate that the Pilates method is a promising intervention for reducing the risk of falls in the elderly. **Conclusion:** The analyzed studies have limitations regarding the number of participants. Thus, the results obtained are not sufficient to represent the analyzed population profile. Further research and large-scale studies are needed, with a sample capable of representing the elderly population in its entirety.

Keywords: Pilates method; elderly; aging; postural balance; fall accidents.

BACKGROUND

Population aging is already a global reality. According to data released in the document Decade of Healthy Aging, an action plan that outlines the World Health Organization's global strategy to improve the lives of older adults, with goals for the years 2021 to 2030, the estimate is that by the end of this period, the population aged over 60 will increase by 34% and by the end of 2050, double to 2.1 million people¹. In Brazil, the latest Census, conducted in 2022 by the Brazilian Institute of Geography and Statistics – IBGE, highlighted that the number of people aged 65 or older grew by 57.4% compared to the data released in 2010. The population aged 14 and under, on the other hand, has decreased by approximately five percentage points, highlighting the aging of the Brazilian population².

In light of this information, the challenge emerges to ensure that this population group has its needs met holistically, especially regarding access to health, defined by the WHO in 1948 as "a state of complete physical, mental, and social well-being and not merely the absence of disease"³. Providing healthy aging means facilitating the maintenance

Corresponding author: Edinete Souza de Brito

Email: esbfisioterapia@gmail.com

Received: 04 Dez, 2024.

Accepted: 10 Set, 2025.

Published: 20, Out, 2025.

Copyright © 2024. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License which permits unrestricted non-commercial use, distribution, and reproduction in any medium provided article is properly cited.



nance of the elderly's physical and mental abilities for their interaction in physical, social, and political environments, that is, maintaining their functional capacity³.

At a biological level, the aging process causes multiple molecular and cellular damages gradually, altering the functions of the organism, even if it is not associated with any pathology. Barsano et al.⁴ list some sensory-motor changes, called geriatric syndromes, naturally derived from aging; among them, the increase in thoracic cavity and greater effort to breathe, due to loss of pulmonary elasticity; sarcopenia, characterized by loss of muscle mass, reducing strength; the decrease in height, due to compression of the vertebral discs, thinning and stiffening of the cartilages, reduction in range of motion, more hunched posture, reducing the center of gravity and balance, which in addition, is also altered due to the reduction in the number of cells in the vestibular labyrinth. Hearing, smell, and vision decrease, as well as the sensitivity of touch.

Geriatric syndromes are closely linked to the reduction of physical and mental capacity in the elderly population, making them less able to adapt to the environment and more susceptible to diseases and fall accidents. Falls can be defined as "unexpected events in which people come into contact with the ground, floor, or a lower level"⁵ and their main risk factors include the presence of muscle weakness, balance deficits, and a history of previous falls⁶. Pereira et al.⁷ describe that body stability depends on the action of sensory, cognitive, and musculoskeletal components functioning in an integrated manner and that the effect of alterations in these functions can predispose to falls. Gonçalves et al.⁵ also emphasize that, although they can occur in people of any age, falls are more prevalent in the elderly population, where the consequences are also more severe, affecting their quality of life and that of their caregivers, usually family members.

In addition to physical injuries, which directly impact the reduction of mobility, falls also lead to psychological disturbances stemming from the fear of falling again⁸. Cordeiro et al.⁹ warn that fall accidents can also decrease the elderly's lifespan, as only about 50% of individuals who fell and were admitted to hospitals will be alive after one year. Moreover, hospitalizations represent a high cost for the public health system due to their frequency. Between the years 2000 and 2019, 135,209 deaths due to falls in the elderly were recorded, showing a growing trend during this period with an increase of 5.45% per year. Falls are the third leading cause of accidental death in Brazil, fatally affecting approximately 30% of seniors over 60 years old and around 40 to 50% of those over 80 years old.

Given the above, it can be stated that it is essential to seek evidence on interventions that can reduce the risk factors for this type of accident, as the aging population increases the likelihood of its occurrence. It is necessary to promote multidisciplinary care, including physiotherapeutic treatment to increase the physical capacity of the elderly⁹. The relationship between physical exercise and the health of the elderly has been the subject of many publications and it is a consensus among authors that it is an essential practice for healthy aging, as it not only limits the loss of strength and stimulates postural control but also improves cognition and social interaction¹⁰.

The WHO Guidelines on Physical Activity and Sedentary Behavior suggest, as a strong recommendation with moderate evidence, that elderly individuals over 65 years old should engage in exercises that involve multiple skills, emphasizing balance and

strength, to reduce the risk of falls¹¹. Among the numerous physical exercise methods, Pérez et al.¹² highlight the Pilates Method due to its popularity among the elderly. Created in Germany in the XX century, under the name Contrology, Pilates, which only received this new title after the death of its creator Joseph Hubertus Pilates, is defined as:

[...] a system of physical and mental conditioning that can improve physical strength, flexibility, and coordination, as well as reduce stress, enhance mental focus, and promote a better sense of well-being¹³.

From a clinical perspective, Pilates uses movement patterns similar to the functional activities of daily life, with a systematization of movements based on the basic principles of breathing, concentration, centering, control, precision, and flow¹⁴. Breathing, considered the most important principle due to its essentiality to human life, serves the function of supplying oxygen to cells and tissues for energy production. A controlled breathing pattern during exercise benefits relaxation and stress reduction, increases focus, reduces blood pressure, and lowers the risk of cardiovascular diseases.

Concentration promotes the individual's attention towards the positioning of their body and postural alignment, while centralization is related to the control of the center of gravity and the strengthening of core muscles, which in the Pilates method is known as Power House, responsible for stabilizing the body.

The core is the center of the body. It refers to the rectus abdominis, internal and external obliques of the abdomen, erector spinae, iliopsoas, latissimus dorsi, and quadratus lumborum muscles. Some literature also considers the gluteus maximus and the pelvic floor muscles, which work together to provide stabilization and mobility during body movements¹⁵.

The principles of control, precision, and fluidity intertwine. The evolution in the degree of difficulty of the exercises aims to elevate the practitioner's level of motor control to refine their coordination, making their movements increasingly precise and fluid. While precision is associated with understanding the correct muscle activation for performing each exercise, flow adds timing control to this execution. Understanding that Pilates, in addition to gaining popularity among the elderly, presents characteristics that meet the requirements of the WHO Guidelines on Physical Activity and Sedentary Behavior, this systematic review aims to investigate through online searches in clinical trials published between the period of 2014 to 2024, whether this exercise method is capable of stimulating effective sensorimotor changes to reduce the risk of falls in the population over 60 years old.

METHODS

The present study is a systematic review aimed at identifying, synthesizing, and analyzing clinical trials published in articles from 2014 to 2024 on the use of the Pilates fitness method to reduce the risk of falls in the elderly. Through the identification of descriptors on the DeCS (Health Sciences Descriptors) platform, the terms "Pilates

method," "elderly," "aging," "postural balance," and "falls accidents" were identified, along with their corresponding English terms in Medical Subject Headings (MeSH) and used for research on the online platform Virtual Health Library (VHL) both individually and with the following combinations: "Pilates method AND elderly OR aging," "Pilates method AND postural balance," "elderly OR aging AND falls accidents," "Pilates method AND falls accidents AND aging," "Pilates method AND aging AND postural balance."

Inclusion criteria were defined such that the articles were clinical trials conducted with individuals of both sexes, aged 60 years or older, without neurological and/or musculoskeletal comorbidities, whose study object was the intervention of the Pilates Method, and the evaluated outcome was relevant for reducing the risk of falls in the elderly. Regarding the exclusion criteria, studies that were systematic, narrative, or integrative reviews, paid or restricted access clinical trials, those conducted only with individuals of one sex, those including people under 60 years old, pregnant women, patients with syndromes, neurological pathologies and/or musculoskeletal dysfunctions, and athletes, as well as publications focusing on physiotherapeutic interventions unrelated to the Pilates Method and that did not assess the potential outcomes chosen for this review, were eliminated. For the selection of articles, there was indifference regarding social class, ethnicity, or whether the participants lived in the community and/or in a long-term care institution for the elderly (ILPI).

After applying filters related to the researched topic, selecting the languages English and Portuguese, and the publication year between 2014 and 2024, 257 publications were tracked, but only 48 were selected for more in-depth analysis, as 109 already indicated in the title that they included pregnant women, patients with neurological or orthopedic pathologies, patients under 60 years of age, athletes of any sport, or did not address the topics of Pilates and fall risks, demonstrating irrelevance for this review. Of these, 04 were excluded due to duplication during the translation of titles, leaving 44. During the reading of abstracts and full-text analysis, an additional 35 articles were excluded for not meeting the initially defined inclusion criteria: two of these were restricted-access articles, and 33 dealt with systematic, integrative, or narrative reviews, or evaluated only patients of one sex, or used some other intervention that was not the Pilates Method, or the proposed outcome was not relevant for assessing the effectiveness of this method in reducing the risk of falls in the elderly.

Among the 09 remaining articles, one was not a clinical trial and therefore was not included in the investigation, but it was used to support the introduction topic, along with other publications and journals from public platforms obtained through manual search, such as the World Health Organization (WHO), the Brazilian Institute of Geography and Statistics (IBGE), the Brazilian Society of Geriatrics and Gerontology (SBGG), and the Brazilian Journal of Epidemiology, used as essential data sources for the foundation of this study; 08 articles remained for discussion, two in portuguese and six in english.

RESULTS

In the course of the article selection process defined in the methodology, eight articles were considered relevant and eligible for inclusion in this systematic review, which were used to compile the following results, where information regarding the authors, journal and year of publication, title, study objective, methodology, and results obtained in the analyses are described (Table 1).

Table 1. Clinical Trials that evaluated the Pilates training method and/or its principles as an intervention to reduce the risk of falls in the elderly or to improve indicators related to this outcome.

Authors	Newspaper - year	Title	Objectives	Methodology	Results
PATA, Rachel W.; SENHOR, Katrina; CORDEIRO, Jamie.	Journal of Body-work and Movement Therapies - 2014	The effect of Pilates based exercise on mobility, postural stability, and balance in order to decrease fall risk in older adults.	Determine if a Pilates-based program is effective in improving dynamic balance, mobility, and postural stability in order to reduce the number of falls in the elderly.	Almost experimental clinical trial. 35 elderly individuals (aged 61 to 87) participated in a Pilates-based exercise program with core muscle activation, smooth movement transitions, and breath control. The duration of the classes was 60 minutes, with a frequency of twice a week for eight weeks.	There was an improvement in balance, postural stability, and mobility, which, according to the authors, are risk factors associated with falls in the elderly population.
BARKER, Anna L.; BRAN, Caroline A.; CAMERON, Peter A.; et al.	Clinical Rehabilitation - 2016	Feasibility of Pilates exercise to decrease falls risk: a pilot randomized controlled trial in community-dwelling older people.	Evaluate the Pilates method to reduce the risk of falls in community-dwelling elderly. Discuss the feasibility of a larger study.	Clinical Trial Pilot randomized, single-blind. 53 people participated, aged between 61 and 84 years (mean age of 69.3 years). Pilates Group (n=22) and Control Group (n=31). Both received instructions to carry out a personalized program of 20 minutes of daily exercises at home. But, only the intervention group attended a 60-minute Pilates class twice a week for 12 weeks.	Potential for increased balance and strength in the intervention group, demonstrating significant improvements in fall risk factors. Besides being a pleasant and acceptable form of exercise for the elderly.
GABIZON, Hadas; PRESS, Yan; VOLKOV, Ilia; MELZER, Itshak.	Human Kinetics - 2016	The Effects of Pilates Training on Balance Control and Self-Reported Health Status in Community-Dwelling Older Adults: A Randomized Controlled Trial.	Evaluate the effect of a Pilates program on balance control and the health status of healthy elderly individuals.	This double-blind, randomized, controlled clinical trial was conducted with a total of 88 community-dwelling elderly individuals (age 71.15 ± 4.30 years), randomly allocated to either a Pilates intervention group (n = 44) or a control group (n = 44). The intervention group received 12 weeks of 60-minute training sessions, three times a week. The control group did not receive treatment.	Pilates training did not improve balance control and self-reported health status when compared to a control group. However, there was a significant improvement in the mental health subscore.

JOSEPHS, Sharon; WAGNER, Amy; MEADOW, Emily Calk; PRATT, Mary Lee; THURMOND, Stephanie.	Journal of Body-work and Movement Therapies - 2016	The effectiveness of Pilates on balance and falls in community dwelling older adults	Determine if Pilates is more effective than traditional strength, balance, and flexibility exercises in reducing the risk of falls in community-dwelling older adults.	Randomized, double-blind, controlled clinical trial. 31 elderly individuals were randomly divided into Pilates Group (PG - age: 75.6 ± 6.2) or Traditional Exercise Group (TEG - age: 74.5 ± 6.9). Both participated in 12 weeks of exercise, 2 times/week for 1 hour. The patients received an exercise brochure and a calendar to record their participation in home exercises and any possible falls.	The results of this study suggest that both a Pilates program and a traditional exercise program can improve balance in patients at risk of falling. However, the Pilates program improved self-confidence in balance compared to the traditional program.
SILVA, Amanda Terra; <i>et al.</i>	Revista Kairós Gerontologia - 2018	Influence of age on the functional capacity and mobility of elderly Pilates practitioners	Evaluate the functional capacity of elderly individuals participating in a Pilates group.	Analytical cross-sectional clinical study, with a sample composed of 24 elderly individuals, aged 60 to 76 years, subjected to 60 minutes of Pilates class, twice a week, for 4 months.	Improvement in functional capacity, dexterity, and mobility. In addition to showing lower BMI indices and better results in the 6-minute walk test and TUG test.
PACHECO, L. de A.; MENEZES, E. C.; CANO, F. W.; MAZO, G. Z.	Arquivos de Ciências e Saúde UNIPAR - 2019.	Contributions of Pilates practice to physical fitness and grip strength in the elderly	Verify the influence of mat Pilates on the physical fitness and handgrip strength of the elderly.	Quasi-experimental clinical trial. Eleven elderly individuals participated, with an average age of 68.73 (± 6.06), who completed 34 sessions of Mat Pilates exercises over 17 weeks, twice a week, with each session lasting 60 minutes.	Improvement in the strength of the lower and upper limbs and the flexibility of the lower limbs. Greater agility, dynamic balance, and aerobic endurance. There were no improvements in grip strength and upper limb flexibility.
PATTL, Antonino; PALMA, Antonio; ZANGLA, Daniele; <i>et al.</i>	Medicine - 2021	Physical exercise and prevention of falls. Effects of a Pilates training method compared with a general physical activity program: A randomized controlled trial.	Compare a general physical activity program for the elderly with a Pilates program to assess the effects on balance and the reduction of fall risk.	Randomized clinical trial (RCT). 41 people participated in the study, with 18 in the pilates group: GP (age 63.94 ± 4.37) and 23 in the general activity program: GP-a (age 63.94 ± 4.37). The GP attended classes 3 times a week, lasting 50 minutes for 13 weeks, while the GP-a followed a nonspecific physical activity program during the same period.	The participants in the Pilates Group produced more improvements in terms of balance and static and dynamic stability than the control group. Furthermore, they also showed improvement in performance on the Berg Balance Scale, specifically designed to assess fall risk.

FERNANDES S Ilha G.; MACEDO, Maria C. G. S.; SOUZA, Matheus A.; et al.	International Jour- nal of Environ- mental Research and Public Health - 2022.	Does 8-Week Resistance Training with Slow Movement Cadenced by Pi- lates Breathing Affect Muscle Strength and Balance of Older Adults? An Age- Matched Con- trolled Trial.	Compare the bal- ance and dorsiflex- ion strength of el- derly individuals after eight weeks of resisted training with movement speeds controlled by the Pilates breathing technique and the volume modulated by the session duration.	Age-controlled Clinical Trial. A total of 44 volunteers who reported a his- tory of falls in the past 12 months were evaluated, equally divided into 2 groups: TR alone (n = 22, ages 70 ± 6) TR with breathing technique and Pilates cadence (n = 22, ages 69 ± 6). The participants underwent 50- minute sessions twice a week for eight weeks.	Only the TR group showed an increase in dorsiflexion strength after the protocol, with no dif- ference in any balance pa- rameters. On the other hand, the TR + P group improved all balance pa- rameters compared to their own baseline.
--	---	---	--	--	--

DISCUSSION

The aging process affects neuromuscular function, negatively impacting individuals' physical and cognitive performance, increasing the predisposition to falls and fractures¹⁶. Falls can be defined as "unexpected events in which people come into contact with the ground, floor, or a lower level"⁵. Gonçalves et al.⁵ also emphasize that, although they can occur in people of any age, falls are more prevalent in the elderly population, where the consequences are more severe, resulting in lower limb fractures and traumatic brain injury, affecting their quality of life and that of their caregivers, usually family members.

Baker et al.¹⁷ provide statistical data to emphasize the importance of preventing falls in this population, whose main cause of hospitalization comes from this type of accident, in which approximately 30% of the victims suffer from severe to moderate injuries, in addition to being a factor that increases the risk of death. Josephs et al.⁸ complement that, in addition to physical injuries, which directly impact the reduction of mobility, falls also lead to psychological disturbances resulting from the fear of falling again.

The relationship between physical exercise and the health of the elderly has been the subject of many publications, and it is a consensus among authors that it is an essential practice for healthy aging, as it not only limits the loss of strength and stimulates postural control but also improves cognition and social interaction.¹⁰ Baker et al.¹⁷ ponder that, among the elderly at risk of falls, 72% are not interested in participating in conventional gym classes, and only 37% of those who start continue exercising after 1 year. However, Pérez et al.¹² highlight the Pilates Method as an alternative to sedentarism in this population profile, due to the popularity of the activity among individuals in this age group.

Pilates is a physical conditioning method that uses movement patterns similar to the functional activities of daily life, with a systematization of movements based on the basic principles of breathing, concentration, centering, control, precision, and fluidity¹⁴. Gabizon et al.¹⁸ emphasize that Pilates is an exercise method that improves balance, flexi-

bility, postural alignment, and the strengthening of deep abdominal muscles. The loss of these characteristics is related to sensory-motor changes derived from aging and constitutes risk factors for the occurrence of falls in elderly people¹⁹.

In general, the selected studies applied the Pilates method at least twice a week, with sessions ranging from a minimum of 50 minutes to a maximum of 60. Pata et al.¹⁴, Josephs et al.⁸, and Fernandes et al.¹⁶ applied the intervention for 8 consecutive weeks, while Baker et al.¹⁷ and Gabizon et al.¹⁸ used 12 weeks; Patti et al.¹⁰, 13 weeks; Pacheco et al.¹², 17 weeks; and Silva et al.¹⁹ for 4 months. Regarding the method of applying the exercises, Pacheco et al.¹² used floor Pilates, also known as Mat Pilates, while the others applied the intervention using furniture and accessories characteristic of the method. Pata et al.¹⁴ and Fernandes et al.¹⁶ employed only the basic principles of Pilates, such as the activation of the core muscles, fluid movement transitions, breath control, and the use of breathing techniques to modulate the cadence and speed of the exercises, performed with a focus on balance, stretching, strengthening the core muscles, lower and upper limbs, as well as the flexibility of the spinal segments.

For the control groups, other exercise methods were implemented, such as conventional resistance training, nonspecific physical activity programs, or no intervention. Baker et al.¹⁷ instructed the control group to perform a 20-minute exercise program at home, conducted in an upright position, focusing on improving balance and muscle strengthening. The control group in the study conducted by Josephs et al.⁸ received a brochure with guidelines for home exercise sessions along with a monthly calendar to record their participation and any possible fall occurrences, with continued follow-up for 1 year after discharge. In the studies by Pata et al.¹⁴, Silva et al.¹⁹, and Pacheco et al.¹², there was no control group; the results were obtained through the evaluation of the individuals' performance before and after the intervention.

With the aim of quantifying and measuring the results, questionnaires and standardized scales were used to assess balance deficits, flexibility, strength, and fall prediction in the elderly, among which the following should be mentioned: Berg Balance Scale (BBS), Fullerton Advanced Balance Scale (FAB), Timed Up and Go (TUG), Senior Fitness Test (SFT), Activity-Specific Balance Confidence Scale (ABC), 6-Minute Walk Test (6MWT), and Handgrip Strength Test. In addition to these physical assessment instruments, Gabizon et al.¹⁸ applied the Mini-Mental State Examination (MMSE) in their pre-test analysis with the aim of assessing the cognitive capacity of the participants, excluding those who scored below 17. It should be noted that, according to the premises of this test, which has 30 questions, scores below 27 can already indicate some cognitive impairment, with a score between 10 and 20 indicating moderate impairment.

The EEB is a widely used scale to assess the risk of falls due to its ease of application. Patti et al.¹⁰. Although they agree with this statement, Josephs et al.⁸ used the FAB, justifying their choice over the EEB due to the possible ceiling effect of the latter, which can occur when assessing elderly individuals with better functional capacity, masking the final score. The Fullerton Advanced Balance Scale (FAB) consists of 10 items with scores ranging from 0 to 4, totaling 40 points, and obtaining a score of 25 or lower is associated with the risk of falls. Just like the Berg Balance Scale (BBS), it also includes static and dynamic balance tasks, but it is more sensitive for analyzing patients with higher

functional capacity because it includes the reactivity component during the static assessment and a simultaneous walking task during the dynamic assessment⁸.

Although the BBS has been mentioned as the most used for fall risk assessment, of the eight studies included in this review, four used the Timed Up and Go (TUG) for assessing functional mobility and balance. Pata et al.¹⁴ recognize the importance of the TUG as an indicator of basic mobility, as it measures the time required for an adult to stand up from a chair, walk three meters, and sit down again, also stating that a TUG >13.5 seconds is associated with the risk of falling. Silva et al.¹⁹ adds that this test simply evaluates the speed of performing a set of daily life movements and, therefore, is important for predicting the individual's functional independence. Despite the choice of the audience being within the age group above 60 years, all the studies investigated claimed that the participants were physically independent, without cognitive impairments or the presence of conditions that would hinder their ability to perform the exercises.

Some of the outcomes evaluated directly included the reduction of fall risk in the elderly, such as the studies by Pata et al.¹⁴, Baker et al.¹⁷, Josephs et al.⁸, and Patti et al.¹⁰. The research conducted by Pata et al.¹⁴ demonstrated that a Pilates-based exercise program improved the participants' postural balance, stability, and mobility in general, but there was no control group to compare whether these results could be obtained with another intervention. However, the findings of Baker et al.¹⁷, whose control group performed a home exercise program, confirm this response regarding balance gains and add a potential increase in the participants' muscle strength. Both agree that these are significant improvements to reduce the risk factors associated with falls in the elderly population.

According to Josephs et al.⁸, the functional results obtained with the intervention group do not differ from a traditional exercise program that involves multiple skills, with components of strength, flexibility, and balance, as both demonstrated potential to reduce fall risks. However, the Pilates program improved the participants' self-confidence in balance, a result obtained through the Activity-Specific Balance Confidence Scale (ABC Scale), a 16-question questionnaire aimed at quantifying the elderly's confidence in performing a specific activity without losing balance. He attributes this fact to the learning of new skills on unfamiliar equipment, leading them to improve their perception of confidence in this aspect. In the study by Patti et al.¹⁰, the participants in the Pilates Group produced greater results in terms of improvements in balance and static and dynamic stability capabilities compared to the control group; moreover, they also showed improved performance on the Berg Balance Scale, which is specific for assessing fall risk.

Even though they did not directly assess the risk of falls in the elderly population, the other studies evaluated functional patterns related to the sensory-motor changes typical of senescence, which constitute risk factors for the occurrence of this event, as mentioned by Pata et al.¹⁴ and Baker et al.¹⁷. The clinical trial conducted by Pacheco et al.¹² investigated the influence of Pilates on the physical fitness and handgrip strength of the elderly. To obtain the results, the 11 participants, with an average age of 68 to 73 years, were subjected to the handgrip test conducted with a hydraulic dynamometer and the Senior Fitness Test (SFT) before and after the intervention. The SFT assesses flexibility,

strength, agility, balance, and endurance, in short, the skills necessary for performing daily life activities independently¹².

The results obtained by Pacheco et al.¹² showed that there was an improvement in the physical fitness of the elderly, as Pilates influenced lower limb strength, flexibility, balance, and endurance, although no difference was observed in the handgrip test or in the flexibility of the upper limbs. Similar to Pacheco et al.¹², the study conducted by Fernandes et al.¹⁶ also showed that the Pilates Method improves balance and stability. The latter investigated 44 elderly individuals who reported a history of falls within the 12 months prior to the start of the assessment. They were equally divided into two groups, a control group that participated in conventional resistance training and an intervention group, for which resistance training with movement speeds controlled by the Pilates breathing technique was applied. The Falls Efficacy Scale (FES-I-Brazil) was used to determine the level of fear of falling among the participants, and a hydraulic dynamometer was used to assess the dorsiflexion strength of the right and left ankles, before and after the eight weeks of method application. Although the control group did not show improvements in balance, it achieved better results in dorsiflexion strength, which is attributed to the fact that this group spent less time performing each set, allowing for a greater number of exercise repetitions compared to the Pilates group, which, due to the slower pace, performed fewer sets of exercises per session.

Gabizon et al.¹⁸ conducted a double-blind, randomized, controlled clinical trial with the aim of investigating the effect of the Pilates training method on balance control and health status in healthy elderly individuals. For this, 88 elderly individuals, with an average age of 71.15 years, were divided into an intervention group, which participated in Pilates classes, and a control group that did not receive any treatment during the 12-week study. The results obtained did not show improvement in balance and self-reported health status when compared to the control group, but there was a significant increase in the mental health subscore, unlike the outcomes observed by Silva et al.¹⁹, who conducted a cross-sectional analytical study to evaluate the influence of age on the functional capacity and mobility of elderly Pilates practitioners. They concluded that there was progress in dexterity, mobility, and functional capacity of the elderly, in addition to improvements in the TUG and 6-Minute Walk Test (6MWT) results, a test in which the individual is instructed to cover the greatest tolerable distance within a 6-minute period, allowing for the analysis of their physical fitness and functional capacity through the distance covered in this time, considering parameters such as sex, age, height, and weight in this diagnosis.

Despite the methodological variations found in the application of the method and its principles and the data being derived from healthy and independent elderly individuals, it was observed that the results obtained in all studies are positive and demonstrate that the Pilates method is an intervention with a great possibility of reducing the risk of falls in the elderly, through the improvement of physical and cognitive functional capacity indicators, such as strength in lower and upper limbs and, above all, in central muscle chains, which provide midline stability and postural alignment, fostering static and dynamic balance and, therefore, making the elderly less susceptible to these accidents.

CONCLUSION

Geriatric syndromes are sensory-motor alterations, naturally derived from the aging process, that modify body composition and reduce the cognitive abilities of the elderly, increasing the components of frailty that are linked to difficulties in adapting to the environment and making them more susceptible to fall accidents. These changes present themselves differently in each individual, highlighting the need to develop treatment plans aligned with individual needs and that can delay the effects of aging at different levels. The articles analyzed in this review showed improvement in all parameters of functional capacity, in physical and cognitive functions, of the participants who practiced the method for the period determined in the studies.

Among the possibilities for the evolution of functional capacities through the practice of Pilates, the increase in indicators on the balance scales used, in mobility, in core strength, and in postural alignment stood out, which are evidence of great importance for locomotion and the performance of daily life activities in an independent and safe manner. Moreover, in some approaches, the effectiveness of the method for improving psychological factors, such as self-esteem and self-perception of confidence, was observed. Although other physical activity programs focusing on balance and strength can achieve similar gains in behavioral and physiological indices, the Pilates Method presents itself as a promising intervention due to its increasing popularity among the elderly, as opposed to other modalities in which they have no interest in participating or staying. It is known that the longer the time spent practicing a particular exercise, the more benefits are observed in the physical fitness and functional capacity of its practitioners.

The occurrence of falls in the elderly population is a problem that increases the financial costs of the healthcare system and promotes negative clinical and social repercussions for the victim and their caregivers. Given this statement and aware that the studies analyzed have limitations regarding the number of participants, making it impossible for the obtained results to be sufficient to represent the entire elderly population, it is necessary to conduct new research and large-scale studies to test the potential of this training method compared to other exercise programs, and with a sample capable of more faithfully representing this population profile.

Author Contributions: E.S.B.: Writing and design of analysis methods; A.F.J.: Review and textual editing; Y.L.X.M.: Textual editing, review and contributions to analysis methods; L.E.M.L.: Supervision, review, and contributions to analysis methods.

Financial Support: There was no financial support

Conflict of interest: The authors declare that there is no conflict of interest.

REFERENCES

1. OPAS (Organização Pan-Americana da Saúde). Década do Envelhecimento Saudável: Plano de Ação. World Health Organization. 2020.
2. Gomes I, Britto V. Censo 2022: número de pessoas com 65 anos ou mais de idade cresceu 57,4% em 12 anos. Agência IBGE Notícias. 2023.
3. OMS (Organização Mundial da Saúde). Basic documents: forty-ninth edition (including amendments adopted up to 31 May 2019). World Health Organization. 2020.
4. Barsano PR, Barbosa RP, Gonçalves E. Evolução e Envelhecimento Humano. 2014.
5. Gonçalves ICM, Freitas RF, Aquino EC, Carneiro JA, Lessa AG. Tendência de mortalidade por quedas em idosos, no Brasil, no período de 2000–2019. *Revista Brasileira de Epidemiologia*. 2022;25:1 -10.
6. Duarte GP, Santos JLF, Lebrão ML, Duarte YAO. Relação de quedas em idosos e os componentes de fragilidade. *Revista Brasileira de Epidemiologia*. 2018;21:1-9.
7. Pereira SEM, Buksman S, Perracini MPL, Barreto KML, Leite VMM. Quedas em idosos. Prevenção. Projeto Diretrizes, Sociedade Brasileira de Geriatria e Gerontologia. 2008.
8. Josephs S, Pratt ML, Meadows EC, Thurmond S, Wagner A. The effectiveness of Pilates on balance and falls in community dwelling older adults. *Journal of Bodywork and Movement Therapies*. 2016;20:815-823.
9. Stolt LROG, Kolisch DV, Tanaka C, Cardoso MRA, Schmitt ACB. Internação hospitalar, mortalidade e letalidade crescentes por quedas em idosos no Brasil. *Revista de Saúde Pública*. 2020;54:54-76.
10. Patti A, Zangla D, Sahin FN, Cataldi S, Lavanco G, Palma A, Fischietti F, et al. Physical exercise and prevention of falls. Effects of a Pilates training method compared with a general physical activity program: A randomized controlled trial. *Medicine*. 2021;2(100):1-7.
11. OMS (Organização Mundial de Saúde). WHO guidelines on physical activity and sedentary behaviour: at a glance. World Health. Organization. 2020.
12. Pacheco LA, Menezes EC, Cano FW, Mazo GZ. Contribuições da prática de pilates na aptidão física e na força de preensão manual de idosos. *Arq. Cienc. Saúde UNIPAR*. 2019;23(3):189-195.
13. Isacowitz R, Clippinger K. Anatomia do Pilates: Guia Ilustrado de Pilates de Solo para Estabilidade do Core e Equilíbrio. Editora Manole. 2013.
14. Pata RW, Lord K, Lamb J. The effect of Pilates based exercise on mobility, postural stability, and balance in order to decrease fall risk in older adults. *Journal of Bodywork and Movement Therapies*. 2014;18(3):361-367.
15. Liebman HL. Estabilidade do Core: Anatomia Ilustrada – Guia Completo de Exercícios. Editora Manole. 2015.

16. Fernandes IG, Macedo MCGS, Souza MA, Silveira-Nunes G, Barbosa MCSA, Queiroz ACC, et al. Does 8-Week Resistance Training with Slow Movement Cadenced by Pilates Breathing Affect Muscle Strength and Balance of Older Adults? An Age-Matched Controlled Trial. *International Journal of Environmental Research and Public Health*. 2022;19(17):1-15.
17. Barker AL, Talevski J, Bohensky MA, Brand CA, Cameron PA, Morello RT. Feasibility of Pilates exercise to decrease falls risk: a pilot randomized controlled trial in community-dwelling older people. *Clinical Rehabilitation*. 2016;30(10):984-996.
18. Gabizon H, Press Y, Volkov I, Melzer I. The Effects of Pilates Training on Balance Control and Self-Reported Health Status in Community-Dwelling Older Adults: A Randomized Controlled Trial. *Human Kinetics*. 2016;24(3):376-383.
19. Silva AT, de Sá AM, Carvalho BA, Costa KS, Nascimento RS, Guedes IM, et. al. Influência da idade na capacidade funcional e mobilidade de idosos praticantes de Pilates. *Revista Kairós-Gerontologia*. 2018;21(3):267-279.