Resistance training and walking speed improvement for the elderly: a systematic review*

Entrenamiento de resistencia y mejora de la velocidad de marcha en ancianos: una revisión sistemática

Treino de resistência e melhoria da velocidade de marcha em idosos: uma revisão sistemática

Marckson da Silva Paula[1] Carlos José Nogueira[2]
Jani Cleria Pereira Bezerra[3] Neilson Duarte Gomes[4]
Carlos Eduardo de Souza Pinto[5] Nilber Soares Ramos[6]
Estélio Henrique Martin Dantas[7]

Submission date: 18/08/2024 | Approval date: 14/09/2024

Abstract

This systematic review evaluated the effects of resistance training on walking speed in the elderly. A total of 2,081 articles were identified by searching PubMed, Web of Science, Scopus, Embase, and Lilacs. Of these, 522 results were assessed based on eligibility criteria, and 12 studies were selected for inclusion, with a total sample of 776 elderly individuals. It was found that 58.33 % of the studies showed improvements in walking speed with resistance training. The methodological quality of the studies was classified as high (n=5), moderate (n=5) and low (n=2). It was concluded that resistance training is effective in improving walking speed in elderly individuals, but alternative interventions such as muscular power training and multicomponent training were also suggested.

Keywords:

elders; resistance training; walking speed.

∗ Review article. Unfunded and unassociated.

Resumen

Esta revisión sistemática evaluó los efectos del entrenamiento de resistencia sobre la velocidad de la marcha en ancianos. Se encontraron 2.081 artículos en las bases de datos Pubmed, Web of Science, Scopus, Embase y Lilacs. Se evaluaron 522 resultados según los criterios de elegibilidad y se seleccionaron 12 para este estudio, con una muestra total de 776 ancianos. El 58,33 % de los estudios mostraron mejoras en la velocidad de la marcha con el entrenamiento de fuerza. La calidad metodológica de los estudios se clasificó como alta (n=5), moderada (n=5) y baja (n=2). Se puede concluir que el entrenamiento de fuerza es eficaz para mejorar la velocidad de la marcha en las personas ancianas, pero también se han sugerido entrenamientos alternativos, como el entrenamiento de la potencia muscular y el entrenamiento multicomponente.

Palabras clave:

anciano; entrenamiento de fuerza; velocidad al caminar.

Resumo

Esta revisão sistemática avaliou os efeitos do treinamento resistido na velocidade de caminhada de idosos. Foram encontrados 2.081 artigos após buscas nas bases de dados Pubmed, Web of Science, Scopus, Embase e Lilacs. 522 resultados foram avaliados pelos critérios de elegibilidade e 12 selecionados para compor esse estudo, tendo uma amostra total de 776 idosos. Encontrou-se que 58,33% dos estudos mostraram melhorias na velocidade de caminhada com treinamento de força. A qualidade metodológica dos estudos foi classificada como alta (n=5), moderada (n=5) e baixa (n=2). Conclui-se que o treinamento de força é eficaz para melhorar a velocidade de caminhada em idosos, mas também foram sugeridos treinamentos alternativos, como o treinamento de potência muscular e o multicomponente.

Palavras-chave:

idoso; treinamento resistido; velocidade de caminhada.

Introducción

Aging is a natural and progressive process that promotes physical, physiological, mental, and emotional changes. One significant change is the loss of physical function due to sarcopenia, which affects 10-20 % of the elderly and worsens with age (Zeng *et al.*, 2023). Shen et al. (2023) estimate that approximately 50 million people currently suffer from sarcopenia, and this number is expected to increase to 200 million in the next 40 years.

As sarcopenia progresses in the elderly, loss of functional autonomy becomes inevitable, especially in those who are physically inactive. Zhao *et al.* (2022) state that sarcopenia causes negative changes, such as decreased strength and muscle mass, resulting in functional incapacity, frailty, and increased susceptibility to falls and other problems. Balachandran *et* *al.* (2022) state that maintaining physical function in the elderly is as important as extending life expectancy.

According to Keating *et al.* (2021), changes in body composition and muscle physiology in the elderly compromise functional autonomy and affect gait. A walking speed above 1.20 m/s is associated with functional independence, while a speed below 0.8 m/s is associated with functional dependence, cognitive decline, need for medical care, hospitalization, and even mortality. Wolf *et al.* (2020) define functional dependence as related to the loss of strength and the ability to generate force rapidly, resulting in decreased dynamic balance, ambulation, and overall functionality.

According to Mende *et al* (2022) a healthy and active lifestyle is a recommended strategy to minimize the negative effects of aging. However, Fujita *et al.* (2021) point out that there is still no consensus on the most effective method to improve walking speed in the elderly. Studies suggest that ST can promote positive effects in walking speed in the elderly (Sipilä *et al.*, 1996; Schlicht *et al*, 2001; Henwood *et al*, 2008; Persh *et al.*, 2009; Holviala *et al.*, 2012; Pinto *et al.*, 2014; Nicklas *et al.*, 2015). Therefore, the purpose of the present study was to evaluate the effects of resistance training (RT) on improving walking speed (WS) in the elderly.

Method

Search Strategy

The present systematic review was carried out in accordance with the PRISMA guidelines (Page et al., 2021) and the Cochrane handbook (Higgins et al., 2023). The searches were carried out in four databases, namely: PUBMED, Web of Science, Scopus, and Lilacs, during the first half of 2024. The keywords used in the searches were inserted after consulting DeCs (Health Sciences Descriptors), MeSh (PUBMED), and corresponding synonyms. The following descriptors were adopted: "aged", "elderly", "idosos", "resistance training", "strength training", "treinamento resistido", "treinamento de força", "walking speed", "velocidade de caminhada", "velocidade de marcha". To improve the search strategies, the Boolean operators OR and AND were used. No date and language restrictions were applied. The search protocol was registered on the PROSPERO platform, under the registration number CRD42024549616.

Due to the heterogeneity of the studies in terms of interventions, outcomes, and instruments used to measure outcomes, it was not possible to perform the meta-analysis of this systematic review. It is suggested that more homogeneous results be compiled in other studies.

Selection of studies

To include studies in the systematic review, the following eligibility criteria were applied: A) studies conducted with the elderly (both sexes, aged 60 years or older); B) studies that implemented interventions through resistance training protocols; C) the effects of the studies analyzed should be related to the improvement of walking speed in the elderly; D) the selected studies would be randomized controlled trials (RCTs). The exclusion criteria were A) bibliographic reviews, opinion articles, abstracts; B) studies not published in peer-reviewed journals; C) studies without a control group; D) studies performed on animals.

After the search, the results obtained in the selected databases were sent for independent evaluation by two reviewers through the Rayyan platform (Ouzzani et al., 2016). The titles and abstracts of all the results found were evaluated, and if there were no elements that justified inclusion or exclusion, the studies were kept for later analysis of the full text. Subsequently, the selected studies were fully assessed by the reviewers to ensure their eligibility, and the references of the analyzed studies were also examined to select eligible articles through manual search. In case of disagreement regarding the inclusion or exclusion of a study, the conflict would be resolved by consensus, or ultimately, the opinion of a final reviewer would be required.

Data extraction

After the final selection and full access to the articles, data extraction was performed in June 2024, which included: source, methods, interventions, outcomes, results, participants, and other aspects such as funding, conclusions, and limitations of the studies. The data were analyzed and grouped according to their characteristics to optimize the discussion.

Analysis of the methodological quality of the studies

The methodological quality of the selected studies was assessed using the Physiotherapy Evidence Database risk of bias scale (Maher et al., 2003) for randomized controlled trials (RCTs). Trials were analyzed for criteria such as randomization sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete data, selective reporting of outcomes, and other types of bias. The assessment included eleven criteria with possible answers of “yes”, “no”, and “not applicable”.

Results

Figure 1 shows the process of identification, screening, and selection of studies. The total sample consisted of 776 individuals between the ages of 60 and 93 years. It was not possible to determine gender distribution, as this information was not available in all studies.

Cuerpo, Cultura y Movimiento
ISSN impreso: 2248-4418 - ISSN online: 2422-474X
Vol.15 Núm 2 (2025) | julio-diciembre
ISSN:2248-4418 eISSN:2422-474X

The studies were conducted in different countries: Australia (n=2), Finland (n=2), the United States (n=2), England (n=1), Brazil (n=1), and other unspecified locations (n=4).

The results indicate that 58.33 % of the studies showed improvements in walking speed with strength training (Henwood *et al*, 2008; Holviala *et al.*, 2012; Nicklas *et al.*, 2015; Persch *et al.*, 2009; Pinto *et al.*, 2014; Schlicht *et al*, 2001; Sipilä *et al.*, 1996), while 41.67 % found no significant results (Buchner et al., 1997; Henwood & Taaffe, 2006; Skelton et al., 1995; Topp *et al.*, 1993; Wolf *et al.*, 2020). Table 1 provides details of the studies, including the location of the interventions, objectives, characteristics of the sample, and the groups involved.

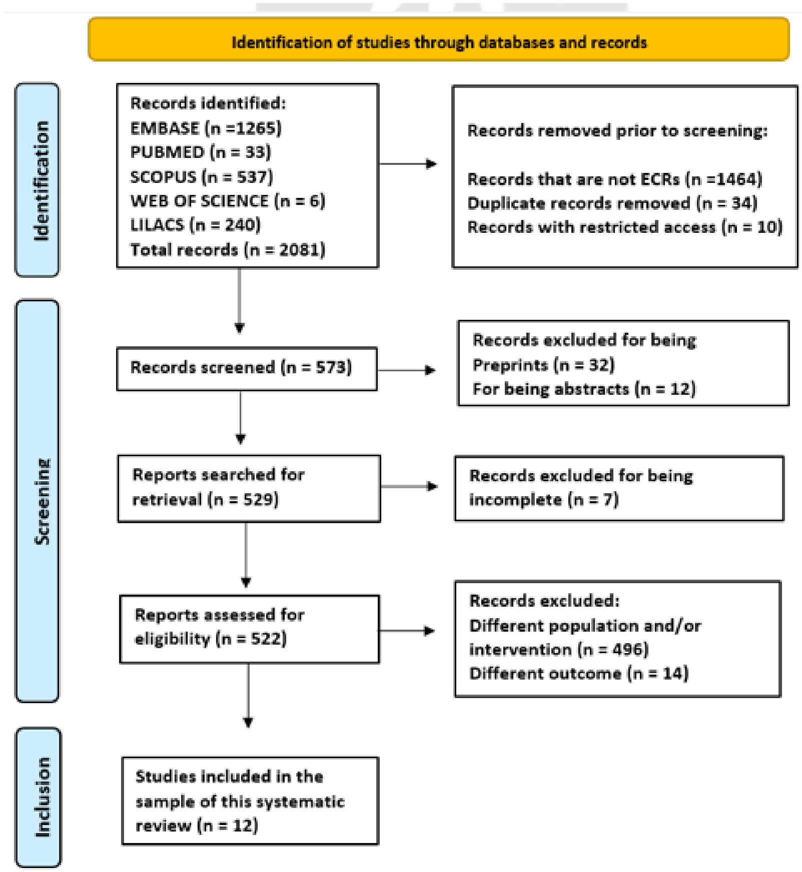

Figura 1. *Arquitectura de un modelo híbrido de computación cuántica, basado en las buenas prácticas de Microsoft Azure*

Fuente: elaboración propia.

Vol.15 Núm 2 (2025) | julio-diciembre
ISSN:2248-4418 eISSN:2422-474X

Reference	Local	Objective	Sample	Groups
Buchner *et al.* (1997)	N/I	To assess whether ST and AT can reduce RF and health care utilization	N=105; ages 68 to 85; X: 75 years old; 51 % F/49 %M	ST (n=25; X̄: 74 years old; 52%F/48%M); AT (n=25; X̄: 75 years old; 52%F/48%M); ST+TA (n=25; X̄: 75 years old; 52%F/48%M); CG (n=30; X̄: 75 years old; 50%F and 50%M)
Henwood & Taaffe (2006)	Queensland, Australia	To compare the effectiveness of three short-term training protocols on MS and FC in the elderly	N=67; ages 65 to 84	HST (n=23; 9M/14F), ST (n=22; 11M/11F) and CG (n=22; 10M/12F)
Henwood *et al.* (2008)	Queensland, Australia	To compare ST with HST, focusing on MP in the elderly, and to verify the benefits of both on the FP	N=67; ages 65 to 84	HST (n=23; 71.2 ± 1.3 years; 11M/12F) ST (n=22; X̄: 69.6 ± 1.1 years; 10M/12F) and CG (n=22; X̄: 69.3 ± 1.0 years; 10M/12F)
Havila *et al.* (2012)	Jyväskylä, Finland	To investigate the effects of ST in different weekly time frames on MS, WS, and balance in the elderly	Initial N=135 (72F and 63M); 0-21 wk: N=126; 68F (X̄: 58 ± 7 years); and 58M (X̄: 58 ± 6 years); 21-42 wk: N = 113 (62F and 51M)	0-21 none: ST F: (n=48; X̄: 58 ± 6 years); ST M: (n=41; X̄: 59 ± 6 years); CG F: (n=20; X̄: 58 ± 7 years) and CG M: (n=17; X̄: 57 ± 6 years). 21-42 weeks: ST F 1x/week: (n=21); ST M 1x/week: (n=18); ST F 2x/week: (n=21); ST M 2x/week: (n=16); CG F: (n=20) and CG M: (n=17)
Nicklas *et al.* (2015)	Forsyth, North Carolina, USA	To determine the effects of adding CR for weight loss on MS, MP, MQ, and other physical function responses to ST in overweight and obese elders	Baseline N=126 (71F and 55M; age 65 to 79; BMI between 27 and 35 kg/m²; sedentary; non-smokers, stable weight; with no disease). Final N=111 (88 % of baseline n)	ST: (n=63; 34F and 29M; X̄: 69.4 ± 3.6 years; BMI: 30.7 ± 2.4 kg/m²) and ST+CR: (n=63; 37F and 26M; X̄: 69.6 ± 3.9 years; BMI: 30.4 ± 2.2 kg/m²). After withdrawals, ST: (n=56; 89% completed the study) and ST+CR: (n=55; 87% completed the study)
Persch *et al.* (2009)	N/I	To determine the effects of a lower limb ST program on gait patterns associated with RF in elderly women	N=27F, age ≥ 60 years; active; BMI ≤ 29 kg/m²)	ST: (n=14; X̄: 61.1 ± 4.3 years; BMI: 26.4 ± 2.8 kg/m²) and CG: (n=13; X̄: 61.6 ± 6.6 years; BMI: 25.9 ± 3.0 kg/m²)
Pinto *et al.* (2014)	N/I	To examine changes in knee extensor MQ induced by short-term ST in elderly women	N=36F; sedentary; X̄: 66.0 ± 8 years, ALT: 159.1 ± 9.2 cm, MC: 68.3 ± 12.1 kg, %F: 37.0 ± 4.2 %)	ST: (n=19) and CG: (n=17)
Schlicht *et al.* (2001)	Connecticut, USA	To determine whether ST could improve RF-related FC in the elderly	N=24; age ≥ 60 years; X̄: 72 ± 6.3 years; moderately active; final N=22	ST: (n=12) and CG: (n=12). After 2 dropouts, both groups ended with n=11
Sipilä *et al.* (1996)	Jyväskylä, Finland	To investigate the effects of progressive and intensive ST and endurance on maximum isometric knee extension and flexion strength, in addition to WS in elderly women	N=42F; age between 76 and 78	ST: (n=16); AT: (n=15) and CG: (n=11). After dropouts, ST: (n=12); AT: (n=12) and CG: (n=11)
Skelton *et al.* (1995)	London, England	To determine the effects of 12 weeks of progressive MR training on IS, MP, and FC in elderly women	Baseline N=52F, 5 withdrawals before and 7 during the study. Final N=40F; age between 75 and 93; med: 79.5; healthy	ST: (n=20; 76 to 93 years; mean: 79.5 years) and CG: (n=20; range from 75 to 90 years; mean: 79.5 years)
Topp *et al.* (1993)	N/I	To determine if ST can alter GS and improve balance in the elderly	N=55; ≥ 65 years; X̄: 71.1 years	ST: (n=25; 17F and 8M; X̄: 69.2 ± 0.8 years) and CG: (n=30; 17F and 13M; X̄: 72.8 ± 1.0 years)
Wolf *et al.* (2020)	Curitiba, Brazil	To compare the effects of MT and ST programs on dynamic balance, FC, and gait ability in elderly women	Baseline N=40F; 10 withdrawals. Final N=30F; X̄: 67 ± 4.3 years; BMI: 30.6 ± 3.9 kg/m²; sedentary, functionally independent	ST: (n=18; X̄: 67 ± 6 years; BMI: 30.1 ± 3.3 kg/m²) and MT (n=12; X̄: 68 ± 3.4 years; BMI: 30.9 ± 4.3 kg/m²)

Table 1. *General characteristics of the studies*

Source: The author.

X̄: medium; med: median; M: male; F: female; n: sample; N/I: not informed; ST: strength training; AT: aerobic training; HST: high-speed training; MT: multicomponent training; CG: control group; FC: functional capacity; FP: physical performance; RF: risk of falls; MS: muscle strength; MP: muscle power; MR: muscular resistance; WS: walking speed; GS: gait speed; IS: isometric strength; MQ: muscle quality; CR: caloric restriction; BMI: Body Mass Index; LL: lower limbs; HEI: height; BM: body mass; %F: body fat percentage.

Table 2 shows the instruments used to measure walking speed and the results of each study. The 10-meter walk test (W10m) was the most commonly used, mentioned three times (25 %). Heterogeneity in the use of instruments was observed in the studies analyzed.

Reference	Instrument used	Results
Buchner *et al.* (1997)	W40m (3 attempts)	No SD on GS
Henwood; Taaffe (2006)	Normal and rapid GS (Fiatarone *et al.*, 1990)	No SD at 6m UW
Henwood *et al.* (2008)	W6m (Henwood & Taaffe, 2006)	UW: ST (3.88 ± 0.11s); CG: 3.95 ± 0.13s) at 8 weeks. ST: (3.81 ± 0.08s); CG: (4.09 ± 0.09s) at 24 weeks. BW: ST (2.91 ± 0.08s); CG: (3.13 ± 0.09s)
Holviala *et al.* (2012)	W10m (Häkkinen & Pakarinen, 1993; Sipilä *et al.*, 1996; Holviala *et al.*, 2006)	0-21 weeks: improvement in WS 10 meters (female ST: -8 ± 7 %, p<0.001; male ST: -18 ± 7 %, p<0.001). Exercise-trained males showed greater improvement than females (p<0.001). 31.5-42 weeks: significant improvements WG1x/wk: (p=0.003; -4 ± 6 % over time); WG2x/week: (p=0.046; -9 ± 19 % over time)
Nicklas *et al.* (2015)	W4m - normal GS - SPPB (Guralnik *et al.*, 1994)	ST: there was SD on GS (7.9 %)
Persch *et al.* (2009)	Range of motion and strength testing with camera analysis (MX-13, Vicon, USA)	ST: there was SD on GS (1.1 AU; p<0.001; CI -1.4 - 0.8)
Pinto *et al.* (2014)	8-foot stand and walk test (Rikli & Jones, 2013)	There was SD in time on the 8-foot step-back test (p<0.001), with significant positive correlations between individual changes in gait and on this test (r= -0.71, p<0.001), providing a 22 % reduction after 6 months without intervention
Schlicht *et al.* (2001)	Timed 25-foot walk test in 2 trials	There was SD in GS after the intervention ST and CG (F (1,19) = 5.03, p<0.05), using repeated measures analysis of covariance (ANCOVA)
Sipilä *et al.* (1996)	W10m	There was an increase in WS in women undergoing ST (p<0.007), with a significant percentage increase between baseline and 18 weeks measurements (11 ± 6 %), and a significant positive correlation between the number of heel lift sessions and improvement in WS (r = -0.608, p<0.047)
Skelton *et al.* (1995)	Corridor walk (118m corridor walk, average WS in the last 60 seconds)	No SD in self-determined stair climbing speed, self-determined walking rate, step rate, heart rate during stair climbing or corridor walking
Topp *et al.* (1993)	W10m (infrared sensor triggered stopwatch) as described by Blanke and Hageman (1989)	The ST group had a significantly lower GS in the post-test (X̄: 1.19 m/s ± 0.04) than in the pre-test (X̄: 1.24 m/s ± 0.04)
Wolf *et al.* (2020)	Gait analysis using plug-in gait (Cebolla *et al.*, 2015)	No SD in the pre-test (X̄: 1.11 ± 0.18 m/s) and post-test (X̄: 1.11 ± 0.19 m/s); (p=0.024)

Table 2. *Study characteristics*

Source: The author.

X̄: mean; SD: significant differences; UW: usual walking; BW: brisk walking; RT: resistance training group; CG: control group; wk: weeks; WS: walking speed; GS: gait speed; WG1x/week: group of women who exercised once a week; WG2x/week: group of women who exercised twice a week; CI: confidence interval; AU: arbitrary units; w/o: week(s); W4m: 4-meter walk test; W10m: 10-meter walk test; W40m: 40-meter walk test.

Table 3 shows the resistance training protocols used. In eight of the studies, interventions were performed with ST alone, without combining it with any other interventions (Nicklas et al., 2015; Persch et al., 2009; Pinto et al., 2014; Schlicht et al., 2001; Sipilä et al., 1996; Skelton et al., 1995; Topp et al., 1993; Wolf et al., 2020). Two studies included high-speed training (Henwood & Taaffe, 2006; Henwood et al., 2008) and two studies included ST combined with caloric restriction (n=1) (Nicklas et al., 2015) and aerobic training (n=1) (Buchner et al., 1997).

Reference	WF/ST/IT	Intensity	Description
Buchner *et al.* (1997)	WF: 3x/week; ST: 60'; TI: 24-26 wk	AT: 75 %MHR; ST: 50-75 %1RM	AT: 30'; ST: 1x10 (50-60 %1RM) and 1x10 (75 %1RM); AT+ST: 20' BIKE + 1x10 (75 %1RM)
Henwood & Taaffe (2006)	WF: 2x/week; ST: 60'; IT: 8 weeks, IES: 2 days	ST, HST, CT: 45-75 %1RM	6 exercises; HST, CT: 1x8 (45 %1RM), 1x8 (60 %1RM), 1x8 (75 %1RM) - CAD: fast CONC and 3" EXC; ST: 3x8 (75 % 1RM - CAD: 3" TAM)
Henwood *et al.* (2008)	WF: 2x/week; ST: 60' TI: 24 weeks, IES: 2 days	ST: 75 % 1RM; HST: 45-75 %1RM	6 exercises; ST: 3x8 (75 %1RM - CAD: 3" TAM); HST: 1x8 (45 %1RM), 1x8 (60%1RM), 1x8 (75 %1RM - CAD: Fast CONC and 3" EXC)
Holviala *et al.* (2012)	WF: 2x/week; ST: 60'-90'; IT: 21 w/w	0-21 week: 40-80 %1RM	Total Body Training: UL, LL and Trunk. 0-7 wk: 40-60 % 1RM; 8-14 weeks: 50-70 %1RM and 15-21 weeks: 50-85 % 1RM. 20 % of lower limb exercises: Explosive strength (50 % 1RM). 22-42 weeks: Training similar to previous; exception: 22-28 weeks (+ 5-10 % load)
Nicklas *et al.* (2015)	WF: 3x/week; IT: 5 months.	70 %1RM	8 exercises; 3x10; IBS: 1"
Persch *et al.* (2009)	WF: 3x/week; practitioners performed 93 % of the sessions (34); IT: 12 w/w	Load adjusted based on 12RM	8 exercises; 10-12 rep, IBS: 2'
Pinto *et al.* (2014)	WF: 2x/week; IBI: 48h; all of them performed 100 % of the sessions (12); IT: 6 wk	1-3 week: 2x15-20RM; 4-6 week: 3x12-15RM	3 exercises; 2-3x12-15; IBS: 2'
Schlicht *et al.* (2001)	WF: 3x/week; IT: 8 wk	0-2 week: adaptation; 3-8 week: 75 %1RM	6 exercises; 2x10
Sipilä *et al.* (1996)	WF: 3x/week; ST: 60'; IT: 18 weeks	0-3 week: 60 %1RM; 4-14 week: 70 %; 15-18 week: 75 %	4 exercises; 4x8-10; IBS: 30"; IBR: up to 2"
Skelton *et al.* (1995)	WF: 1x/week (supervised) + 2x/week at home; ST: 40-50'; all of them held 83.3 % of the sessions (30); IT: 12 w/w	4RM	8 MG involved; 3-4x8
Topp *et al.* (1993)	WF: 3x/week; ST: 60'; IT: 12 w/w	3x10-12 CONF	12 exercises (6 UL+LL) 3x10 CONF
Wolf *et al.* (2020)	WF: 3x/week; ST: 60'; IT: 12 w/w	ST: 60 %1RM; AT: 12-14 BORG (6-20)	ST: LL: 6 moves; UL: 4 moves; 3x8 (60 %1RM); IBI: 50" BORG (12-14); MT: gait drills; MS, balance and aerobics. Gear: Quick change of direction; MS: 3x12; IBI: 50"; balance: static, dynamic and unstable; aerobics: 20-25" BORG walk (12-14)

Table 3. *Training protocols*

Source: The author.

ST: strength training; AT: aerobic training; HST: high speed training; FUNCT: functional training; CT: combined training (HST+FUNCT); MT: multi-component training; UL: upper limbs; LL: lower limbs; MG: muscle group(s); 1RM: 1 repetition maximum test; MHR: maximal heart rate; IBI: interval between increments; WF: weekly frequency;

ST: session time; IT: intervention time; IBS: interval between sets; IBR: interval between repetitions; CAD: cadence; TAM: total muscle action; CONC: concentric; EXC: eccentric; CONF: concentric failure; N/I: not informed.

Table 4 shows the risk of bias ratings of the studies using 11 criteria established by the PEDro scale (Maher *et al.*, 2003). Each of the twelve studies was assessed for risk of bias. The studies were of high quality - HQ (n=5) (Buchner *et al.*, 1997; Henwood *et al.*, 2008; Holviala *et al.*, 2012; Sipilä *et al.*, 1996; Skelton *et al.*, 1995), moderate quality - MQ (n=5) (Nicklas *et al.*, 2015; Pinto *et al.*, 2014; Schlicht *et al.*, 2001; Topp *et al.*, 1993; Wolf *et al.*, 2020), and low quality - LQ (n=2) (Henwood & Taaffe, 2006; Persch *et al.*, 2009).

Reference	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	TS	QM
Buchner *et al.* (1997)	S	1	0	1	0	0	1	1	1	1	1	7	HQ
Henwood & Taaffe (2006)	S	1	0	1	0	0	0	0	0	0	0	2	LQ
Henwood *et al.* (2008)	S	1	1	1	0	1	1	1	1	1	1	9	HQ
Holviala *et al.* (2012)	S	1	0	1	0	0	1	1	1	1	1	7	HQ
Nicklas *et al.* (2015)	N	1	0	1	0	1	1	0	1	0	1	5	MQ
Persch *et al.* (2009)	S	0	0	0	0	0	0	1	0	1	1	3	LQ
Pinto *et al.* (2014)	S	1	0	0	0	0	1	0	1	1	1	5	MQ
Schlicht *et al.* (2001)	S	1	0	1	0	0	0	1	0	1	1	5	MQ
Sipilä *et al.* (1996)	S	1	0	1	0	0	0	1	1	1	1	6	HQ
Skelton *et al.* (1995)	S	1	0	1	0	1	1	1	1	1	0	7	HQ
Topp *et al.* (1993)	S	1	0	1	0	0	0	1	0	1	1	5	MQ
Wolf *et al.* (2020)	S	1	0	1	0	0	0	1	0	1	1	5	MQ

Table 4. *Risk of bias assessment, PEDro scale (points)*

Source: The author.

C0-C10 (criteria score): criteria from the PEDro risk of bias scale; TS (total score): all criteria; QM: methodological quality; HQ: high quality; MQ: moderate quality; LQ: low quality.

Criteria	Meaning
0	Eligibility Criteria
1	Randomization of participants
2	Confidentiality of allocation of participants
3	Similarity of groups on relevant study variables
4	Blinding of participants
5	Blinding of therapists
6	Blinding of assessors (at least one key outcome)
7	Measurement of at least one key outcome completed (> 85% of participants)
8	Treatment of participants according to allocation group or intention-to-treat analysis performed
9	Description of comparison between groups
10	Measures of precision/variability presented (at least one key outcome)

Figure 2. *Description of the criteria of the PEDro risk of bias scale*

Source: The author.

Figure 2 shows the criteria for the analysis of the risk of bias, according to Maher *et al.* (2003), that were verified in the studies included in this systematic review. The scores range from 0 to 10 and are classified as high quality (8-10 points), moderate quality (5-7 points) and low quality (<5 points).

Discussion

This systematic review aims to evaluate the effects of RT on GS in the elderly. Due to the relationship between GS and functional autonomy in the elderly, it is relevant to verify which interventions are efficient in promoting positive results in this variable of functional capacity in the elderly.

Several studies have shown improvements in WS in the elderly, and most studies in this systematic review (58.33 %) showed positive results (Henwood *et al.*, 2008; Holviala *et al.*, 2012; Nicklas *et al.*, 2015; Persch *et al.*, 2009; Pinto *et al.*, 2014; Schlicht *et al.*, 2001; Sipilä *et al.*, 1996). The significant differences between ST and WS in these studies are associated with predictors of diseases that affect cognitive function and mobility in the elderly.

The reviewed studies indicate that ST interventions resulted in significant increases in WS in elderly individuals. However, Henwood *et al.* (2008) suggest that muscular power training protocols may be more effective than resistance training alone in improving functional capacity in elderly. This conclusion is supported by Holviala et al. (2012), who observed improvements in WS by incorporating 20 % power training into their protocol.

Nicklas *et al.* (2015) observed improvements in WS in overweight and obese elders, emphasizing that in addition to benefits such as increased strength, power, and muscle quality, interventions to reduce body weight are essential to optimize outcomes in this mobility variable.

Persch *et al.* (2009) report that ST not only improved WS, but also other factors such as stride length, cadence, and muscle strength. They dispute previous studies by Barak *et al.*

(2006) and Kerrigan *et al.* (2003, as cited in Nicklas *et al.*, 2015) that suggested improvements in WS were more related to plantar flexor strength, arguing that it is more influenced by the strength of the muscles around the knee and hip.

These findings differ from the conclusions in Sipilä et al. (1996), who suggested that increased strength in the lower limbs, particularly in the plantar flexors, may indicate improvements in gait ability.

Pinto *et al.* (2014) found a significant improvement in the muscle quality of knee extensors (14.8 %) and correlated these findings with improvements in the standing and sitting tests, in addition to the 8-foot standing and walking test used to measure WS. The authors stated that aging impairs muscle quality, and that ST may be an effective strategy to mitigate these effects and directly influence WS. Increases in knee extensor muscle thickness (8.7 % to 18.1 %) and muscle strength (23.5 %) were associated with improvements in WS. Schlicht *et al.*, (2001) also found positive association between the practice of ST and improvement in WS.

Lu *et al.* (2021),in a systematic review of 26 studies, confirmed the efficacy of ST for WS in the elderly, as well as for increasing knee extensor muscle strength, corroborating the findings of Pinto *et al.* (2014).

Chen *et al.* (2021), in another systematic review evaluating 14 randomized controlled trials, reinforced the previous findings by showing improvements in WS and increased knee extensor strength in the elderly. The authors highlighted the relationship between lower limb strength and improvements in mobility, locomotion, performance of daily activities, and reduction of falls. They observed an average increase in WS of 0.28 m/s, which is considered substantial according to Perera *et al.* (2006, as cited in Chen *et al.*, 2021).

Other systematic reviews have also shown improvement in GS after intervention with ST (Mende et al., 2022; Font-Jutglà *et al.*, 2020; Talar *et al.*, 2021; Song *et al.*, 2023; Prevett *et al.*, 2022; Chen *et al.*, 2023).

Buchner *et al.* (1997) observed negative results in their study of ST in the elderly, attributing this to the fact that the participants were close to a threshold of physiological decline in cardiorespiratory strength and capacity. They mention that this can complicate balance and gait, making it difficult to achieve positive results in these areas. The authors also emphasized that balance was not improved by the exercise protocol used in the study, suggesting a limitation that was not overcome and affects gait.

Henwood and Taaffe (2006) suggest that the ST can increase muscle strength but point out that muscular power training is more effective in producing significant improvements in this indicator of functional capacity. They recommend at least one session in the gym and one session at home to achieve these benefits.

Lopez *et al.* (2023), in a systematic review that included 80 studies (79 trials, n = 3575), confirmed the effectiveness of muscular power training compared to ST. They note that in some cases the methods were equally effective.

Morrison *et al.* (2023) conducted a systematic review in 19 trials (n = 1055) and found similar results between ST and muscular power training. However, the authors highlighted the uncertainty of the results due to the varying quality of the studies, with an average score of 53 % on the Consensus on Exercise Reporting Template (CERT). Among the trials, two were classified as high quality and four as moderate quality. In addition, muscular power training showed superior results compared to ST, but it was also contested due to the quality of the studies, as noted by Da Rosa Orssato *et al.* (2019).

Skelton *et al.* (1995) point out that although strength training can increase the muscle strength of knee extensors, compared to younger ones , there is an annual loss of 1% to 2% in strength and a 3.5% loss in knee extensor power, which suggests that training can only slow down a natural and progressive physiological process. They associate the results of GS with the fact that training may not have been task-specific, a point also mentioned by Wolf *et al.* (2020). These authors suggest that improvements in GS may be more related to interventions with multicomponent training, which includes exercises that simulate daily activities and involve several muscle groups. The importance of improving GS is highlighted, as a 0.1 m/s reduction in this variable is associated with a 10 % decrease in the ability to perform tasks.

Topp *et al.* (1993) note that their results may seem contradictory in relation to other studies on the relationship between GS, muscle strength and balance. They explain that, for a group that performed ST, an increase in post-test GS compared to pre-test would not be expected. Research reveals a decline in GS between the ages of 20 and 65, followed by stabilization and slight increase after age 65, due to the body's natural compensation to maintain balance. In addition, the authors suggest that participants may have walked at a speed more compatible with their age group during the post-test, rather than the actual average for the 67-73 age population (1.18 m/s).

There are limitations to this systematic review. Firstly, the heterogeneity between studies in terms of interventions, outcomes and instruments used precluded a meta-analysis. In addition, the small number of studies may have limited the ability to draw more comprehensive and robust conclusions. The studies included were outdated and used different training protocols, making it difficult to identify the most effective for improving walking speed. The variety of instruments used to assess walking speed may also have affected the consistency of results due to different cut-off points. Three trials had relatively short intervention periods (between six and eight weeks), which may have influenced the results. Despite these limitations, the review was of high quality, with 83.3 % of the results being of moderate to high methodological quality.

Conclusion

It can be concluded that resistance training is relevant to produce positive effects in terms of strength and functional capacity in the elderly, especially regarding walking speed, which increases the functional autonomy of the elderly and prevents domestic accidents caused by falls. However, it was also possible to verify that not only muscle strength is able to promote these positive effects on walking speed, but muscle power is also a factor to be considered in the prescription of training aimed at improving walking speed in the elderly.

References

Balachandran, A. T., Steele, J., Angielczyk, D., Belio, M., Schoenfeld, B. J., Quiles, N., Askin, N., & Abou-Setta, A. M. (2022). Comparison of power training vs traditional strength training on physical function in older adults: A systematic review and meta-analysis. *JAMA Network Open*, *5*(5), e2211623. https://doi.org/10.1001/jamanetworkopen.2022.11623

Blanke, D. J., & Hageman, P. A. (1989). Comparison of gait of young men and elderly men. *Physical Therapy*, *69*(2), 144–148. https://doi.org/10.1093/ptj/69.2.144

Buchner, D. M., Cress, M. E., Lateur, B. J. de, Esselman, P. C., Margherita, A. J., Price, R., & Wagner, E. H. (1997). The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. *Journal of Gerontology: Series A, Biological Sciences and Medical Sciences*, *52*(4), 218–224. https://doi.org/10.1093/gerona/52a.4.m218

Cebolla, E. C., Rodacki, A. L., & Bento, P. C. (2015). Balance, gait, functionality and strength: Comparison between elderly fallers and non-fallers. *Brazilian Journal of Physical Therapy*, *19*(2), 146–151. https://doi.org/10.1590/bjpt-rbf.2014.0085

Chen, N., He, X., Feng, Y., Ainsworth, B. E., & Liu, Y. (2021). Effects of resistance training in healthy older people with sarcopenia: A systematic review and meta-analysis of randomized controlled trials. *European Review of Aging and Physical Activity*, *18*(1). https://doi.org/10.1186/s11556-021-00277-7

Chen, Y. C., Chen, W.-C., Liu, C.-W., Huang, W.-Y., Lu, I., Lin, C. W., & Li, C. H. (2023). Is moderate resistance training adequate for older adults with sarcopenia? A systematic review and network meta-analysis of RCTs. *European Review of Aging and Physical Activity*, *20*(1), 7. https://doi.org/10.1186/s11556-023-00333-4

Da Rosa Orssatto, L. B., Rocha Freitas, C. de la, Shield, A. J., Silveira Pinto, R., & Trajano, G. S. (2019). Effects of resistance training concentric velocity on older adults' functional capacity: A systematic review and meta-analysis of randomised trials. *Experimental Gerontology*, *127*, 110731. https://doi.org/10.1016/j.exger.2019.110731

Fiatarone, M. A., Marks, E. C., Ryan, N. D., Meredith, C. N., Lipsitz, L. A., & Evans, W. J. (1990). High-intensity strength training in nonagenarians: Effects on skeletal muscle. *JAMA*, *263*(22), 3029–3034. https://doi.org/10.1001/jama.1990.03440220053029

Font-Jutglà, C., Mur Gimeno, E., Bort Roig, J., Gomes da Silva, M., & Milà Villarroel, R. (2020). Efectos de la actividad física de intensidad suave sobre las condiciones físicas de los adultos mayores: Revisión sistemática. *Revista Española de Geriatría y Gerontología*, *55*(2), 98–106. https://doi.org/10.1016/j.regg.2019.10.007

Fujita, K., Umegaki, H., Makino, T., Uemura, K., Hayashi, T., Inoue, A., Uno, C., Kitada, T., Huang, C. H., Shimada, H., & Kuzuya, M. (2021). Short- and long-term effects of different exercise programs on the gait performance of older adults with subjective cognitive decline: A randomized controlled trial. *Experimental Gerontology*, *156*, 111590. https://doi.org/10.1016/j.exger.2021.111590

Guralnik, J. M., Simonsick, E. M., Ferrucci, L., Glynn, R. J., Berkman, L. F., Blazer, D. G., Scherr, P. A., & Wallace, R. B. (1994). A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, *49*(2), M85–M94. https://doi.org/10.1093/geronj/49.2.m85

Häkkinen, K., & Pakarinen, A. (1993). Muscle strength and serum testosterone, cortisol and SHBG concentrations in middle-aged and elderly men and women. *Acta Physiologica Scandinavica*, *148*(2), 199–207. https://doi.org/10.1111/j.1748-1716.1993.tb09549.x

Henwood, T. R., Riek, S., & Taaffe, D. R. (2008). Strength versus muscle power-specific resistance training in community-dwelling older adults. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, *63*(1), 83–91. https://doi.org/10.1093/gerona/63.1.83

Henwood, T. R., & Taaffe, D. R. (2006). Short-term resistance training and the older adult: The effect of varied programmes for the enhancement of muscle strength and functional performance. *Clinical Physiology and Functional Imaging*, *26*(5), 305–313. https://doi.org/10.1111/j.1475-097x.2006.00695.x

Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (Eds.). (2023). *Cochrane handbook for systematic reviews of interventions (version 6.4)*. Cochrane. https://www.training.cochrane.org/handbook

Holviala, J., Häkkinen, A., Alen, M., Sallinen, J., Kraemer, W., & Häkkinen, K. (2012). Effects of prolonged and maintenance strength training on force production, walking, and balance in aging women and men. *Scandinavian Journal of Medicine & Science in Sports*, *24*(1), 224–233. https://doi.org/10.1111/j.1600-0838.2012.01470.x

Holviala, J., Sallinen, J., Kraemer, W. J., Alen, M., & Häkkinen, K. (2006). Effects of strength training on muscle strength characteristics, functional capabilities, and balance in middle-aged and older women. *Journal of Strength and Conditioning Research*, *20*(2), 336–344. https://doi.org/10.1519/R-17885.1

Keating, C. J., Cabrera-Linares, J. C., Párraga-Montilla, J. A., Latorre-Román, P. A., Castillo, R. M. del, & García-Pinillos, F. (2021). Influence of resistance training on gait & balance parameters in older adults: A systematic review. *International Journal of Environmental Research and Public Health*, *18*(4), 1759. https://doi.org/10.3390/ijerph18041759

Lopez, P., Rech, A., Petropoulou, M., Newton, R. U., Taaffe, D. R., Galvão, D. A., & Steele, J. (2023). Does high-velocity resistance exercise elicit greater physical function benefits than traditional resistance exercise in older adults? A systematic review and network meta-analysis of 79 trials. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, *78*(8), 1471–1482. https://doi.org/10.1093/gerona/glac230

Lu, L., Mao, L., Feng, Y., Ainsworth, B. E., Liu, Y., & Chen, N. (2021). Effects of different exercise training modes on muscle strength and physical performance in older people with sarcopenia: A systematic review and meta-analysis. *BMC Geriatrics*, *21*(1). https://doi.org/10.1186/s12877-021-02642-8

Maher, C. G., Sherrington, C., Herbert, R. D., Moseley, A. M., & Elkins, M. (2003). Reliability of the PEDro scale for rating quality of randomized controlled trials. *Physical Therapy*, *83*(8), 713–721. https://doi.org/10.1093/ptj/83.8.713

Mende, E., Moeinnia, N., Schaller, N., Weiß, M., Haller, B., Halle, M., & Drey, M. (2022). Progressive machine-based resistance training for prevention and treatment of sarcopenia in the oldest old: A systematic review and meta-analysis. *Experimental Gerontology*, *163*, 111767. https://doi.org/10.1016/j.exger.2022.111767

Nicklas, B. J., Chmelo, E., Delbono, O., Carr, J. J., Lyles, M. F., & Marsh, A. P. (2015). Effects of resistance training with and without caloric restriction on physical function and mobility in overweight and obese older adults: A randomized controlled trial. *The American Journal of Clinical Nutrition*, *101*(5), 991–999. https://doi.org/10.3945/ajcn.114.105270

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Persch, L. N., Ugrinowitsch, C., Pereira, G., & Rodacki, A. L. F. (2009). Strength training improves fall-related gait kinematics in the elderly: A randomized controlled trial. *Clinical Biomechanics (Bristol, Avon)*, *24*(10), 819–825. https://doi.org/10.1016/j.clinbiomech.2009.07.012

Pinto, R. S., Correa, C. S., Radaelli, R., Cadore, E. L., Brown, L. E., & Bottaro, M. (2014). Short-term strength training improves muscle quality and functional capacity of elderly women. *Age (Dordrecht)*, *36*(1), 365–372. https://doi.org/10.1007/s11357-013-9567-2

Prevett, C., Moncion, K., Phillips, S. M., Richardson, J., & Tang, A. (2022). Role of resistance training in mitigating risk for mobility disability in community-dwelling older adults: A systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation*, *103*(10), 2023–2035. https://doi.org/10.1016/j.apmr.2022.04.002

Rikli, R. E., & Jones, C. J. (2013). Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years. *The Gerontologist*, *53*(2), 255–267. https://doi.org/10.1093/geront/gns071

Schlicht, J., Camaione, D. N., & Owen, S. V. (2001). Effect of intense strength training on standing balance, walking speed, and sit-to-stand performance in older adults. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, *56*(5), M281–M286. https://doi.org/10.1093/gerona/56.5.m281

Shen, Y., Shi, Q., Nong, K., Li, S., Yue, J., Huang, J., Zhang, L., & Wang, Y. (2023). Exercise for sarcopenia in older people: A systematic review and network meta-analysis. *Journal of Cachexia, Sarcopenia and Muscle*, *14*(3), 1199–1211. https://doi.org/10.1002/jcsm.13225

Sipilä, S., Multanen, J., Kallinen, M., Era, P., & Suominen, H. (1996). Effects of strength and endurance training on isometric muscle strength and walking speed in elderly women. *Acta Physiologica Scandinavica*, *156*(4), 457–464. https://doi.org/10.1046/j.1365-201x.1996.461177000.x

Skelton, D. A., Young, A., Greig, C. A., & Malbut, K. E. (1995). Effects of resistance training on strength, power, and selected functional abilities of women aged 75 and older. *Journal of the American Geriatrics Society*, *43*(10), 1081–1087. https://doi.org/10.1111/j.1532-5415.1995.tb07004.x

Song, S., Kim, G., & Kim, H. (2023). A systematic review and meta-analysis of exercise beneficial for locomotion in community-dwelling elderly people with sarcopenia. *Journal of Functional Morphology and Kinesiology*, *8*(3), 92. https://doi.org/10.3390/jfmk8030092

Talar, K., Hernández-Belmonte, A., Vetrovsky, T., Steffl, M., Kałamacka, E., & Courel-Ibáñez, J. (2021). Benefits of resistance training in early and late stages of frailty and sarcopenia: A systematic review and meta-analysis of randomized controlled studies. *Journal of Clinical Medicine*, *10*(8), 1630. https://doi.org/10.3390/jcm10081630

Topp, R., Mikesky, A., Wigglesworth, J., Holt, W., & Edwards, J. E. (1993). The effect of a 12-week dynamic resistance strength training program on gait velocity and balance of older adults. *Gerontologist*, *33*(4), 501–506. https://doi.org/10.1093/geront/33.4.501

Wolf, R., Locks, R. R., Lopes, P. B., Bento, P. C. B., Rodacki, A. L. F., Carraro, A. N., & Tiggemann, C. L. (2020). Multicomponent exercise training improves gait ability of older women rather than strength training: A randomized controlled trial. *Journal of Aging Research*, *2020*, 1–8. https://doi.org/10.1155/2020/6345753

Zeng, D., Ling, X.-Y., Fang, Z.-L., & Lu, Y.-F. (2023). Optimal exercise to improve physical ability and performance in older adults with sarcopenia: A systematic review and network meta-analysis. *Geriatric Nursing*, *52*, 199–207. https://doi.org/10.1016/j.gerinurse.2023.06.005

Zhao, H., Cheng, R., Song, G., Teng, J., Shen, S., Fu, X., & Sun, Y. (2022). The effect of resistance training on the rehabilitation of elderly patients with sarcopenia: A meta-analysis. *International Journal of Environmental Research and Public Health*, *19*(23), 15491. https://doi.org/10.3390/ijerph192315491

About the authors

[1] **Marckson da Silva Paula**

Federal University of the State of Rio de Janeiro, Brazil. Specialist in Sports Training and Exercise Physiology, Castelo Branco University, Rio de Janeiro, Brazil. Visiting student in the Stricto Sensu Postgraduate Course in Nursing and Biosciences, Federal University of the State of Rio de Janeiro, Rio de Janeiro, Brazil. email: profmarckson@gmail.com. ORCID: 0009-0009-9575-0720.

[2] **Carlos José Nogueira**

Federal University of the State of Rio de Janeiro, Brazil. PhD in Nursing and Biosciences. Professor at Federal University of the State of Rio de Janeiro, Rio de Janeiro, Brazil. email: carlosjn29@yahoo.com.br. ORCID: 0000-0003-2136-2177.

[3] **Jani Cleria Pereira Bezerra**

Federal University of the State of Rio de Janeiro, Brazil. PhD in Nursing and Biosciences. Professor at Federal University of the State of Rio de Janeiro, Rio de Janeiro, Brazil. email: j.cleria@gmail.com. ORCID: 0000-0001-6247-5480.

[4] **Neilson Duarte Gomes**

Federal University of the State of Rio de Janeiro, Brazil. Graduate student specializing in Sports Training, Federal University of the State of Rio de Janeiro, Rio de Janeiro, Brazil. email: neilsondg@hotmail.com. ORCID: 0009-0005-1149-7141.

[5] **Carlos Eduardo de Souza Pinto**

Federal University of the State of Rio de Janeiro, Brazil. Specialist in Physiological Basis of Personalized Training, Sports Nutrition and Advanced Medicine, Metropolitan University of Vale do Aço, Belo Horizonte, Minas Gerais, Brazil. email: carlostop10@yahoo.com.br. ORCID: 0009-0008-8319-7617.

[6] **Nilber Soares Ramos**

Federal University of the State of Rio de Janeiro, Brazil. Specialist in Sports Training and Exercise Physiology, Castelo Branco University, Rio de Janeiro, Brazil. email: nilber123@yahoo.com.br. ORCID: 0009-0001-4572-4075.

[7] **Estélio Henrique Martin Dantas**

Federal University of the State of Rio de Janeiro, Brazil. PhD in Physical Education. Graduate Program in Health and Environment (PSA), Tiradentes University (UNIT), Aracaju, Brazil. Graduate Program in Nursing and Biosciences. email: estelio.dantas@unirio.br. ORCID: 0000-0003-0981-8020.

How to cite

Paula, M. da S., Nogueira, C. J., Pereira Bezerra, J. C., Duarte Gomes, N., de Souza Pinto, C. E., Soares Ramos, N., & Martin Dantas, E. H. (2025). Treino de resistência e melhoria da velocidade de marcha em idosos: uma revisão sistemática. *Cuerpo, Cultura Y Movimiento*, 15(2), 163-180. https://doi.org/10.15332/2422474X.10128