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Review Article

Effectiveness of physical exercise on osteosarcopenia in older adults: A systematic review

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ABSTRACT

Background: Osteosarcopenia is a geriatric syndrome characterized by the coexistence of sarcopenia and osteopenia/osteoporosis, which can lead to frailty and mortality. The effectiveness of physical exercise on osteosarcopenia, particularly on muscular and skeletal parameters, remains unclear. This systematic review aimed to analyze the impact of exercise interventions on osteosarcopenia in older adults and to describe the diagnostic methods used in different clinical trials.

Methods: Randomized clinical trials conducted in older adults (≥65 years) diagnosed with osteosarcopenia were included, sourced from PubMed, Embase, Cochrane, and Scopus databases without language or publication year restrictions, up to July 2024. Osteosarcopenia was defined as the coexistence of sarcopenia and osteopenia/osteoporosis based on dual-energy X-ray absorptiometry (DXA) criteria. Exercise interventions of at least four weeks were considered, with comparisons to non-exercise control groups. This systematic review followed the PRISMA guidelines and was registered in PROSPERO (CRD42016043310).

Results: A total of 250 articles were identified, but only four studies met the eligibility criteria, involving 195 participants. All included studies utilized resistance training (RT) as the exercise intervention. The most common diagnostic criteria for osteosarcopenia were based on the T-score of the lumbar spine and/or femur, measured via DXA, using World Health Organization cut-off points for bone mineral density (BMD) and the criteria from the European Working Group on Sarcopenia in Older People for sarcopenia. RT was found to be effective in increasing strength and muscle mass in older adults diagnosed with osteosarcopenia, though it did not significantly improve physical performance.

Conclusion: There are few studies on this topic, making it difficult to draw definitive conclusions regarding the effectiveness of physical exercise in older adults with osteosarcopenia. Resistance training showed positive results, particularly in improving strength and muscle mass.

PROSPERO registration number: https://www.crd.york.ac.uk/PROSPERO/view/CRD42020215659.

Background

The global aging phenomenon makes it increasingly important to understand geriatric syndromes, with a focus on osteosarcopenia characterized by the coexistence of sarcopenia and osteopenia/osteoporosis in the same individual.[1] Sarcopenia is identified by low muscle strength associated with low quantity or quality of muscle[2] and is associated with increased frailty, falls, and reduced functionality in the older adults population.[3–6]

On the other hand, osteopenia/osteoporosis is detected by low bone mineral density (BMD), leading to an increased incidence of fractures, chronic pain,[7] and hospitalizations.[8,9] Therefore, the coexistence of these two morbidities, also known in the literature as the "hazardous duo",[10] with an estimated prevalence ranging from 5 % to 37 %, which increases with age and in women,[11] leads to greater bone fragility,[12] higher risk of falls and fractures,[13] impaired lower limb strength and performance, and affects balance, depression,[14]

Abbreviations: BMC, body mass content; BMD, bone mineral density; DXA, Dual-energy X-ray absorptiometry; RT, resistance training; SMDbs, between-subject standardized mean differences; TUG, Timed Up and Go

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and multimorbidity due to increased susceptibility to various chronic diseases caused by osteosarcopenia.[15,16] Although there are current clinical trials involving individuals with osteosarcopenia and physical exercise intervention, the outcomes analyzed were not related to osteosarcopenia variables.[16–18]

Previous systematic reviews and meta-analyses with randomized clinical trials have shown that physical exercise can improve certain measures related to sarcopenia in older adults, including muscle strength (including grip strength and knee extension strength) and physical performance (incorporating gait speed and dynamic balance).[19–21] An Umbrella Review of Randomized Clinical Trials found that high-volume and high-intensity resistance training was the most effective intervention in improving muscle mass, muscle strength, and gait speed in older adults with sarcopenia.[22]

With regards to osteoporosis/osteopenia, a systematic review with 37 clinical trials confirmed that physical activity plays an important role in osteoporosis prevention, with greater effects on lumbar spine bone mineral density than on the hip, and resistance exercises appear to be more effective in prevention.[23] Another systematic review with 5 clinical trials found that interventions using resistance training can improve physical function and activities of daily living in older adults with osteoporosis or osteopenia.[24]

Among the few studies that have evaluated this syndrome, i.e., osteosarcopenia, physical inactivity was one of the main risk factors.[21,25] Although there are systematic review studies on osteoporosis and sarcopenia separately in relation to physical exercise,[21,25] however there is no systematic review where osteosarcopenia as a primary outcome. These studies are directly relevant to the topic and offer insights into multicomponent modalities not covered in the current review. The evidence can assist healthcare professionals in the geriatrics/gerontology field in prevention and treatment efforts, seeking a positive effect on improving outcomes related to osteosarcopenia in older adults. Therefore, the objective of this systematic review was to analyze the effectiveness of physical exercise on osteosarcopenia in older adults. Additionally, we aimed to describe the methods used for diagnosing osteosarcopenia in different clinical trials.

Methods

Protocol and registration

This systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols) guidelines.[26] It was registered in PROSPERO (International Prospective Register of Systematic Reviews) under the protocol number: CRD42016043310 and its protocol was previously published.[27]

Eligibility criteria

We used the PICO framework to specify our eligibility criteria. Thus, "P" represented older adults, "I" represented physical exercise, "C" represented no physical exercise, and "O" represented osteosarcopenia. The inclusion criteria were as follows: (a) controlled, randomized, blinded, or open-label clinical trials conducted with older adults diagnosed with osteosarcopenia, (b) studies that implemented any form of physical exercise intervention for a minimum of 4 weeks, (c) no language or publication period limitations.

We considered the diagnosis of osteosarcopenia when the same individual presented osteopenia/osteoporosis and sarcopenia.[1] Osteopenia and/or osteoporosis were diagnosed based on dual-energy X-ray absorptiometry (DXA) measurements at the femoral neck, lumbar spine, or total hip, according to the diagnostic criteria of the World Health Organization for bone mineral density.[28] For sarcopenia, we included studies that used previously proposed criteria and cut-off points for musculoskeletal measurements.[2,29–31] We included studies with older adults exhibiting reduced strength, muscle mass, and physical performance. Additionally, we included studies conducted with older adults with sarcopenic obesity. The participants aged 60 years or older, or 65 years depending on the country where the study was conducted since each country may have different age categorizations for older adults.

The exclusion criteria were defined as follows: (a) animal research, (b) studies with hospitalized older adults or focusing on specific conditions (e.g., stroke), (c) observational studies, opinion articles, editorials, narrative reviews, case series, and comments, (c) duplicated studies, (d) publications with unavailable data even after contacting the authors, (e) repeated studies with different follow-ups, where only the article with the longest follow-up duration would be included.

Search strategy

The searches were conducted in PubMed (National Library of Medicine), Embase, Cochrane, and Scopus databases by two researchers (GVES and LPR). Articles published until July 2024, were considered. The reference search strategy was performed in PubMed, also utilizing the use of Mesh Terms (Medical Subject Headings), and is illustrated below:

((Osteosarcopenia [Title/Abstract]) OR (osteosarcopenic [Title/Abstract])) AND (((((exercise [MeSH Terms]) OR (exercise [Title/Abstract])) OR (physical activity [Title/Abstract])) OR (physical activities [Title/Abstract])) OR ("Physical Fitness"[Title/Abstract]))) AND ((((((((aged[MeSH Terms]) OR (aged[Title/Abstract])) OR (elderly [Title/Abstract])) OR (older adult [Title/Abstract])) OR (older adults [Title/Abstract])) OR (elder[Title/Abstract])) OR (Ageing[Title/Abstract])) OR (aging[Title/Abstract])).

Then, the "clinical trial" filter was added. This search strategy was adapted to the other databases (Supplementary Material).

Review process

After conducting the search strategy, the identified articles were grouped, and duplicates were removed using the Mendeley software. Subsequently, two researchers (GVES and LPR) read the titles and abstracts of all identified articles, and discrepancies regarding inclusions were resolved by a third senior reviewer (MN). All researchers used the Rayyan software[32] during this stage of the review. Afterwards, the articles were read in full and evaluated to determine their eligibility based on the inclusion and exclusion criteria. Finally, eligible articles were included in this systematic review. The entire article selection process for the systematic review was completed in July 2024.

Data extraction and evaluation of study quality

Data extraction and study quality assessment were performed by two reviewers (GVES and LPR) with discrepancies resolved by a third reviewer (MN). A standardized form developed by the authors was used to extract data from the articles, including the following information: Author, year, and location; sample size and mean age; osteosarcopenia diagnostic criteria; intervention and control characteristics; main results.

Risk of bias was assessed using the Downs and Black Scale, which consists of 27 items, with a score calculated for each manuscript (0–27 points).[33] The Grading of Recommendations, Assessment, Development and Evaluation tool was used to assess the quality of evidence. For each research outcome, the quality of evidence was classified as moderate, low, or very low.[34] Additionally, we also analyzed whether the authors of the included studies addressed the impact of potential conflicts of interest and provided information on ethical approval.[35]

Reviewer training

The reviewers who conducted the systematic review, despite having previous experience with systematic reviews, underwent training to ensure alignment and minimize review bias. They evaluated 50 abstracts in relation to the inclusion and exclusion criteria.[36] They also received training on bias risk instruments and were trained to employ standardized analyses using the Mendeley and Rayyan software.[36,37]

Results

A total of 250 articles were identified on databases, of which 38 were duplicates and were excluded. One study was identified by citation search, but subsequently excluded for missing eligibility criteria. Out of the remaining 212 studies, after reading the titles and abstracts, 195 were excluded. Seventeen articles remained for full-text reading, and after this stage, four met the eligibility criteria and were included in this review. The reasons for exclusions can be found in Fig. 1.

All included studies used Resistance Training (RT) as the physical exercise intervention. One study did not specify how it was performed,[38] while another study performed utilized machines,[39] and two studies used elastic bands.[40,41] The follow-up period ranged from 12[38,40,41] to 78 weeks.[39] Three studies were conducted with older adults women diagnosed with obesity/adiposity osteosarcopenia[39–41] and one study included only older male individuals.[39]

The sample size of all included articles varied from 27[41] to 63[40] older adults participants, with a total of 195 individuals, of whom 86 (44.1 %) were in the control group, and 77.4 % were women. The mean age ranged from 64.05 ± 3.35[42] to 79.2 ± 4.7.[39]

Regarding the diagnostic criteria used for osteosarcopenia, one study[38] used the obesity osteosarcopenia Z-score formula, and all other studies[39–41] used the T-score of the lumbar spine and/or femur or femoral neck measured by DXA, with cutoff points from the World Health Organization.[28] For sarcopenia, three studies[38,39,41] used cutoff points from the European Working Group on Sarcopenia in Older People,[2] and one study[41] used other cutoff points.

Muscle mass, strength and performance

Results on strength and muscle mass parameters concerning the effect of Resistance Training (RT) in older women were analyzed. Two studies[40,41] utilized Hand Grip Strength with p-values ranging from 0.013 (ES = 0.065)[40] to 20.35 (3.53, p = 0.957).[41] One study[38] used other measures, such as muscle strength by one repetition maximum testing ($p < 0.001$, ES = 1.1), and skeletal muscle mass ($p < 0.001$, ES = 0.72). Consequently, two studies[38,40] showed significant effects on strength ($p < 0.001$, ES = 1.1 for study,[38] p = 0.013, ES = 0.065 for study[40] and skeletal muscle mass ($p < 0.001$, ES = 0.72 for study,[38] p = 0.043, ES = 3.53 for study[40]), while one study[41] did not reveal a significant effect (p = 0.980) after the intervention. Two studies assessed physical performance in women,[40,41] with one study showing no significant improvements in physical performance variables,[40] and the other study[41] identifying significant improvements in gait speed ($p < 0.001$) and Tug Up Go test (TUG) ($p < 0.001$) when comparing the exercise group with the control group.

In the study with older male participants,[39] Skeletal Muscle Mass Index was used, with a mean of 0.34 (95 % CI = 0.23–0.45), $p < 0.001$, and Hand Grip Strength of 2.65 (95 % CI = 0.75–4.56), p = 0.008. Thus, RT had a significant effect on muscle mass ($p < 0.001$) and grip

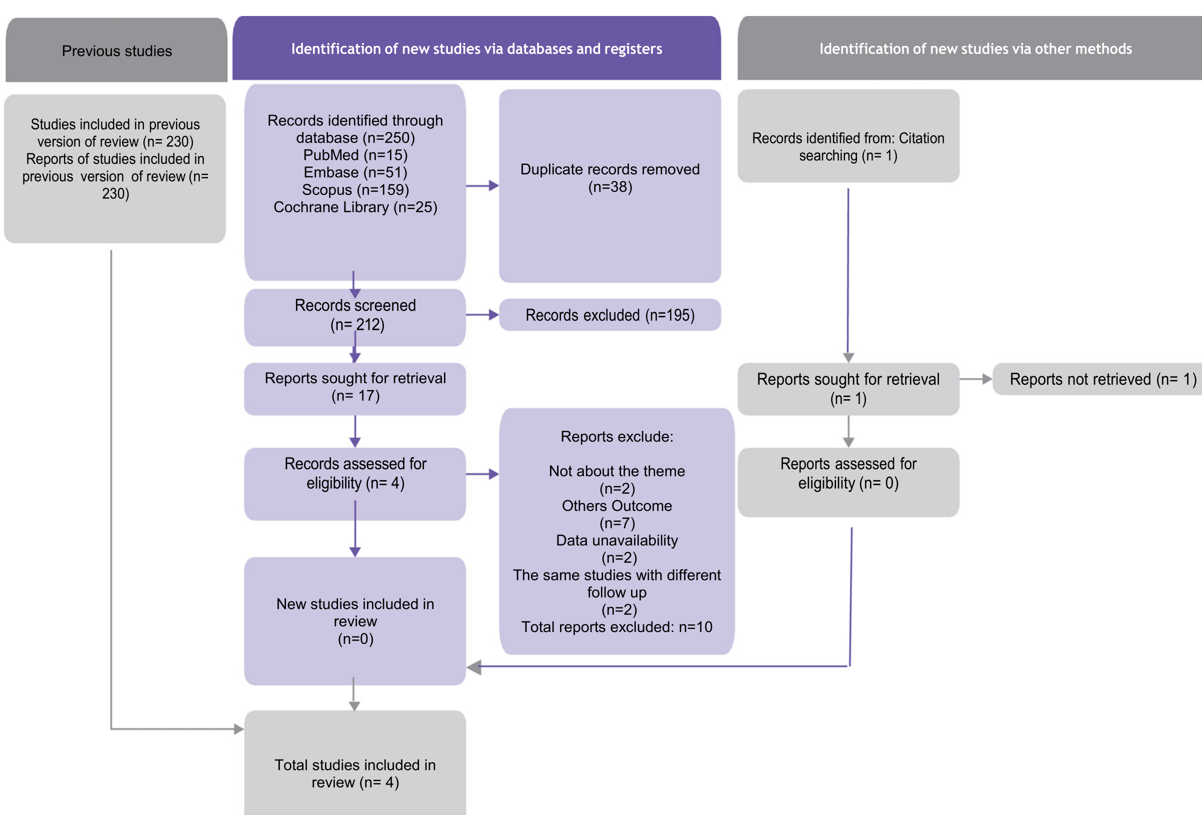

Fig. 1. Flow diagram of literature search and study selection across databases included in the systematic review.

strength ($p < 0.05$). With regards to physical performance, RT was not effective, as gait speed in the exercise group (mean difference=0.02; 95 % CI = −0.06−0.01, $p = 0.209$) did not show a significant increase ($p > 0.05$) compared to the control group.

Bone mineral density parameters

Three studies assessed RT in women with Obesity/Adiposity Osteosarcopenia.[38,42,43] In evaluating the effect of exercise on osteoporosis, two studies used BMD with a p-value of 0.022 (ES = 0.081)[41] and 0.36 (ES = 0.1),[38] while one study[40] used both Bone Mass Content (BMC) and BMD, with a p-value of 0.862 (ES = 0.001). Of these, two studies[38,40] did not demonstrate significant effects ($p > 0.005$) of RT on BMD, and only one study[41] showed a significant effect on lumbar spine BMD ($p = 0.022$) after the intervention.

In the study[39] with male participants, the effect of RT on BMD parameters was evaluated using lumbar spine and total hip BMD with means of 0.012 (95 % CI = 0.001−0.020) and 0.013 (95 % CI = 0.002−0.022), respectively. Therefore, significant effects were observed in both lumbar spine and total hip ($p = 0.024$; $p = 0.025$, respectively) after the intervention (Table 1).

Evaluation of study quality

The scores obtained on the Downs & Black scale ranged from 70 % to 85 % (Table 2), and only two studies included in the review had scores below 75 %.[38,40] Therefore, one study presented a moderate risk of bias[38] and three studies showed low risk of bias.[39−41] Regarding the assessment of methodological quality using GRADE, three studies were considered moderate quality because they had short intervention durations, small sample sizes,[41] and a single-sex sample .[38,40,41] Well-powered RCTs are needed to more accurately assess the effects of these interventions. For the high-quality study,[39] the intervention was conducted over a long period, allowing for the observation of its long-term effects, particularly in changes in muscle mass parameters during the first 36 weeks of the study. All studies declared no conflicts of interest and ethical approval for conducting the research (Table 3).

Discussion

To the best of our knowledge, this is the first systematic review to evaluate the effect of physical exercise on osteosarcopenia in older adults. There are only few studies on the topic, and the only exercise intervention used was RT. We observed a positive effect of RT, regardless of whether it was performed using machines or elastic bands, on strength and muscle mass parameters.

Regarding muscle mass parameters, the results of the present review are consistent with a systematic review of 25 randomized clinical trials conducted in older adults, which found improvement in muscle strength (SMDbs=1.57; 95 % CI = 1.20−1.94) with machine-based RT.[44] A randomized clinical trial with RT in older adults with osteosarcopenia showed a significant increase in skeletal muscle mass index ($p < 0.001$).[42] Physical exercise is one of the proven effective strategies for improving muscle health across ages[43] as it can counteract muscle dysfunction and the neuromuscular damage caused by aging,[45] reducing visceral adipose tissue, and decreasing the risk of cardiovascular and metabolic diseases.[16] This is because significant gains or losses in muscle mass and quality are controlled by the dynamic balance between protein synthesis and breakdown, which are regulated by various anabolic stimuli, including physical exercise.[46]

For physical performance, two studies, one with older women[41] and another with older men,[39] did not find significant improvements after RT. However, one study in older women[41] showed a significant increase in physical performance following the intervention, which was also observed in a randomized clinical trial with 57 osteopenic older women where RT influenced physical performance.[47] Conversely, a systematic review of 2 randomized clinical trials in older adults found that RT did not influence physical performance.[48] In this systematic review, we observed limited and conflicting results regarding this outcome, which may be related to differences in RT intensity and frequency, as well as the influence of strength gains directly on physical performance outcomes.[49]

The effects of RT on BMD were also conflicting in this review, as out of a total of four studies, two did not identify positive results,[38,40] while two[39,41] found a positive effect of RT on BMD. The Frost study with osteosarcopenic older adults, which evaluated the effect of RT on BMD with a follow-up of 28, 36, 54, and 78 weeks, reported significant improvements in lumbar spine BMD only after 54 weeks[50] and in both lumbar spine and total hip BMD after 78 weeks[51] of training. This discrepancy in results may be related to the short follow-up period (12 weeks) of the two studies in this review that did not identify positive results, considering that bone remodeling occurs over long periods of time.[38]

With regards to the diagnostic criteria used for osteosarcopenia, for the assessment of osteoporosis using BMD, 75 % of the studies used T-scores of the lumbar spine and/or femur or femoral neck, using the cutoff points from the World Health Organization. In the evaluation of sarcopenia, 75 % of the studies used the cutoff points from the European Working Group on Sarcopenia in Older People. Although there are valid criteria for the accurate diagnosis of osteoporosis and sarcopenia,[2] there is currently no uniform criterion for the diagnosis of osteosarcopenia, as it is a recently defined multifactorial condition.[52] Therefore, in osteosarcopenia, studies use diagnostic criteria used for osteoporosis and sarcopenia, such as the assessment of bone quality through T-score values and muscle strength and function through the handgrip strength test.[53]

Além do treinamento resistido, há programas de exercícios físicos que combinam diferentes modalidades, como programas de força, impacto e treino funcional, que sugerem benefícios significativos para a função física e redução do risco de queda. Esses resultados são relevantes para a população idosa, mesmo quando os efeitos da BMD são modestos. No entanto, ainda são necessários estudos que abordem os impactos dessas abordagem multicomponentes especificamente em indivíduos com osteosarcopenia.

A limitation of this study is the small number of clinical trials found that evaluated resistance training intervention for osteosarcopenia, which makes it difficult to draw conclusions and propose prevention and/or treatment strategies. The short duration (12 weeks) of some included studies[38,40,41] was likely insufficient to produce measurable changes in BMD, as demonstrated by RCTs with longer follow-up periods,[39] necessitating studies with a longer intervention period. In addition to resistance training, there are physical exercise programs that combine different modalities, such as strength, impact, and functional training, which suggest significant benefits for physical function and reduced fall risk.[54,55] These results are relevant for the elderly population, even when the effects on BMD are modest. However, studies addressing the impact of these multicomponent approaches specifically in individuals with osteosarcopenia are still needed. Additionally, the studies included in this review utilized different criteria for Sarcopenia, differences in the ethnicity of the studied groups, some of them included protein supplementation along with resistance training in their intervention, which might introduce bias. As a strength of this review, there was no restriction on language or year of publication of the studies, and the risk of bias and quality of evidence were evaluated.

Considering the limited number of studies, we recommend conducting more randomized clinical trials to investigate which type of exercise (continuous aerobic, high-intensity interval training,

Table 1
Characteristics and main results of the studies included in the systematic review on the effectiveness of interventions with physical exercise in osteosarcopenia in older adults.

Author/year/location	Characteristics/ sample size/age	Diagnostic criteria for osteosarcopenia	Intervention		Group Control	Results	
			Exercise	Time/ weekly frequency		Osteo	Sarc
Cunha et al. 2018, Brazil[38]	**Osteosarcopenia obesity women** n = 62 G1s = 21 Gs3 = 20 CG = 21 **Age** G1s = 66.6 ± 5.1 G3s = 68.3 ± 4.2 CG = 67.3 ± 3.6	Z−osteosarcopenia obesity score Muscle strength (Z-core) + (SMM Z-score) + (−1 x Fat mass (Z-score) +(BMD Z-score)/4	Resistance Training	12 weeks 3x/week G1s = 30min G3s = 50 min	Not performing any regular physical exercise	***Mean; SD; (ES), p value*** **G1s** **BMD:**1.09 ± 0.1; (0.00) g/cm² p = 0.36 **G3s** **BMD**:1.03 ± 0.1; (0.1) g/cm² p = 0.36	***Mean; SD; (ES), p value*** **G1s** **MS:**120.5 ± 16.1; (1.1); $p < 0.001$ **SMM:**18.0 ± 1.2; (0.72) kg; $p < 0.001$ **G3s** **MS:**25.8 ± 19.8; (1.38); $p < 0.001$ **SMM:**18.0 ± 1.9; (0.65) kg; $p < 0.001$
Banitalebi et al. 2020, Iran[40]	**Osteosarcopenia obesity women** n = 63 EG = 32 CG = 31 **Age** EG = 64.11 ± 3.81 CG = 64.05 ± 3.35	%BFP≥32 %; BMI≥30kg/m² BMD−2.5 ≤ T score ≤−1,0 Total femur or femoral neck (DXA) GS ≤ 1 m/s2 SMI≤ 28 % ou ≤7,76 kg/m² (DXA)	Elastic band resistance training	12 weeks 3x/week 60min/session	Participants received telephone calls or face-to-face interviews once a week to be sure, there has been no changes in their physical activity and diet habits during this study	***p value; ES*** **BMC:**p = 0.862 g/cm² ES = 0.001 **BMD:**p = 0.564 g/cm² ES = 0.004	***p value;ES*** **MQ:** p = 0.043; ES = 0.044 **CST:** p = 0.036; ES = 0.063 **GS:** p = 0.013; ES = 0.065 **Gait Speed**: p = 0.220; ES = 0.016 **6MWT**: p = 0.284; ES = 0.017 **TUG:** p = 0.225 ES = 0.022
*Kemmler et al.2020, Germany[39]	**Men** n = 43 EG = 21 CG = 22 **Age** EG = 77,8 ± 3,6 CG = 79.2 ± 4.7	BMD lumbar spine or total hip T score <−1 (DXA) SMI<7,26kg/m² (DXA)	High Intensity resistance training machines	78 weeks 2x/week 60min/session	Maintained the practice of usual physical activities	**Difference in MV (95 %CI), p value** **BMD (lumbar spine):** 0.012 (0.001 - 0.020) g/cm², p = 0.024 **BMD (total hip):** 0.013 (0.002 - 0.022) g/cm², p = 0.025	**Difference in MV (95 %CI), p value** **SMI:**0.34 (0.23- 0.45) kg/m² $p \leq 0.001$ **GS:**2.65 (0.75−4.56) kg p = 0.008 **Gait Speed**: 0.02 (−0.06−0.01) m/s p = 0.209
Lee et al. 2021, Taiwan[41]	**Osteosarcopenic adiposity women** n = 27 EG = 15 CG = 12 **Age** EG = 70.13 ± 4.4 CG = 71.82 ± 5.2	%BFP≥35 % BMD lumbar spine T score<−1 SMI<5.67 kg/m² GS<20kgf Gait Speed<0.8 m/s	Elastic band resistance training	12 weeks 3x/week 55min/session	Participants performed exercises with the yellow band at home according to instruction received in the lecture	***Mean;(ES); p value*** **3 months** **BMD (lumber spine):** 0.987 (0.081) p = 0.022 g/cm² **9 months** **BMD (lumber spine):** 0.959 (0.088) g/cm²	***Mean;(ES);p value*** **3 months** **SMI:** 5.01 (0.94) p = 0.980 kg/m² **ALM**: 13.58 (2.14) p = 0.980 kg **GS:** 20.35 (3.53) p = 0.957 kg **Gait Speed:** 0.71(0.21) p < 0001 m/s **TUG:** 7.63 (0.96) $p < 0.001$ **9 months** **SMI:** 5.03 (0.83) kg/m² p = 0.847 **ALM:** 13.64 (2.27) kg p = 0.832 **GS:** 19.40 (3.85) kg p = 0.136 **Gait Speed:** 0.81 (0.20) m/s p = 0.239 **TUG:** 8.98 (1.20) p = 0.452

* Both groups received calcium and vitamin D supplementation, in addition to protein intake to reach 1.5−1.6 g/kg/d in the intervention group and 1.2 g/kg/d in the control group; ALM = appendicular lean mass; BFP: body fat percentage; BMC: body mass content; BMD: bone mineral density (g/cm²); BMI: body mass index; CG: Control Group; CST: Chair stand test; DXA: Dual-energy X-ray absorptiometry; EG: Experimental Group; ES: Effect Size; GS: grip strength (kg); Gs1: 1 set per exercise; Gs3: 3 sets per exercise; min: minutes; MS: Muscular strength; MQ: muscle quality; SD: standard deviation; SMI: skeletal muscle mass index (kg/m²); SMM: skeletal muscle mass (kg); TUG: *Timed Up and Go;* 6MWT: 6 min walk test; %BFP: Body fat percentage.

Table 2
Risk of bias assessed using the Downs and Black checklist.

STUDY (YEAR)	DOWNS AND BLACK CHECKLIST																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total	Score
Cunha et al., 2018[38]	1	1	1	1	0	1	1	0	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	0	1	1	19	70 %
Banitalebi et al., 2020[40]	1	1	1	1	0	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	1	20	74 %
Lee et al., 2021[41]	1	1	1	1	0	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	0	1	1	21	77 %
Kemmler, W et al., 2020[39]	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	1	1	23	85 %

Table 3
Evidence quality assessment, conflict of interest and ethical approval.

STUDY (YEAR)	CONFLICT OF INTEREST	ETHICAL APPROVAL	GRADE
Banitalebi et al., 2020[40]	NO	YES	●●●○
Cunha et al., 2018[38]	NO	YES	●●●○
Lee et al., 2021[41]	NO	YES	●●●○
Kemmler, W et al., 2020[39]	NO	YES	●●●●

GRADE: Grading of Recommendations, Assessment, Development and Evaluation.

concurrent training) and the frequency, duration, volume, and intensity may be more effective for the treatment of osteosarcopenia in older adults. Future studies should also consider stratification by sex, comorbidities, and level of frailty, since some trials have reported exercise effects that differ between men and women. Future research should focus on high-quality, long-term, multicomponent RCTs that assess outcomes such as falls, quality of life, and cost-effectiveness in the older adults.

Conclusion

We found a small number of studies on exercise interventions in older adults with osteosarcopenia as an outcome. Overall, the studies evaluated either the outcome of sarcopenia or only osteopenia/osteoporosis, but not specifically osteosarcopenia, which is a limitation in research on the geriatric syndrome of osteosarcopenia. Another challenge, given the limited scientific evidence, is that only one type of exercise was used. Resistance training demonstrated significant improvements in muscle strength and mass but yielded inconsistent results in physical performance and bone mineral density outcomes. The most used diagnostic criterion in osteosarcopenia studies was the T-score of the lumbar spine obtained by DXA, following the cutoff points from the World Health Organization for osteoporosis variables and the cutoff points from the European Working Group on Sarcopenia in Older People for sarcopenia.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Erika Aparecida Silveira: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Guilherme Vinícius Elias Souza:** Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Luciana Pereira Rodrigues:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Andréa Toledo de Oliveira Rezende:** Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation. **Amanda Maria de Sousa Romeiro:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation. **Matias Noll:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision. **Cesar de Oliveira:** Writing – review & editing, Visualization, Validation, Supervision.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.gerinurse.2026.103878.

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