REVIEW ARTICLE

EFFECTS OF MULTICOMPONENT EXERCISE ON FUNCTIONAL PERFORMANCE OF HEALTHY OLDER ADULTS: SYSTEMATIC REVIEW AND META-ANALYSIS

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Highlights: (1) Physical exercise is fundamental to preserve functional capacity in older adults. (2) Training for older adults should improve the physical components affected by aging. (3) Multicomponent exercises lead to improved functional performance in the elderly.

PRE-PROOF
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EFFECTS OF MULTICOMPONENT EXERCISE ON FUNCTIONAL PERFORMANCE OF HEALTHY OLDER ADULTS: SYSTEMATIC REVIEW AND META-ANALYSIS

ABSTRACT

Multicomponent exercise training is considered a form of general training that can help fight harmful aging processes, leading to improved functional ability. This review therefore sought to investigate the effects of multicomponent exercise training on the functional performance of healthy older adults. Two independent reviewers conducted the data search and extraction as well as the risk-of-bias analysis. Randomized clinical trials comparing the effects of multicomponent exercise training with the effects of another exercise intervention or no exercise in a control group in healthy individuals aged 60 years or older were included. A systematic search of the literature was carried out in the following databases: PubMed, PEDro, CINAHL and Embase. The risk of bias was assessed with the Risk of Bias 2 tool. A total of 19 studies were included in the qualitative synthesis. Most of the studies were considered to give rise to "some concerns" in terms of risk-of-bias. The quality of evidence and the strength of recommendations were evaluated using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach. The quality of evidence was rated as low for both functional capacity and functional performance, and very low for all other outcomes. The results of the meta-analysis showed that participants who underwent multicomponent exercise training had a better functional-performance outcome as measured by the timed up-and-go, gait-speed and 30-second sit-to-stand tests as well as the Short Physical Performance Battery. An improvement in functional ability as measured by the 6-minute walk test was observed. In healthy older adults, twice-weekly MCET can improve functional performance, especially when combining aerobic, strength, and other exercises at moderate intensity. However, the evidence is limited, and further well-designed studies with larger samples are needed.

Keywords: Aged, Movement and Exercise Techniques, Physical Functional Performance, Rehabilitation, Exercise.

INTRODUCTION

Population aging is a global event that results in epidemiological change in the population, leading to an increased incidence of chronic diseases. These in turn can have an impact on health, particularly the maintenance of physical capacity and functional performance. Changes inherent to aging, such as loss of lean mass and cardiorespiratory endurance as well as reduction in muscle tonus, balance and flexibility, are directly related to reduced mobility and disability, which can result in frailty in older adults and a reduction in their activities of daily living.[1, 2]

To ensure well-being in old age, the additional years of life resulting from increased life expectancy should be accompanied by good health and participation in society, which are made possible by healthy aging and continued functional ability. Healthy aging does not mean the absence of disease. Rather, aging should be considered a phase of life during which functional ability should be encouraged in order to allow elderly people to undertake activities they appreciate in spite of their comorbidities.[3]

Physical exercise is fundamental to preserve physical and functional capacity in older adults as the losses inherent to the aging process produce a decline in these capabilities with consequent functional losses and reduction in quality of life. These in turn can make older adults frailer and more dependent. Training for the elderly covering multiple components should therefore seek to preserve and improve those physical components most affected by aging, such as muscle mass and balance.[4]

Studies have shown that physical exercise is essential to prevent functional and cognitive decline caused by aging and often exacerbated by the presence of chronic diseases.[5, 6] It is in this context that multicomponent exercise training (MCET) can be used. MCET is considered a form of comprehensive training and can take the form of circuits covering muscle strength, aerobic-endurance, coordination, flexibility and balance or other types of physical training.[7]

In a study by Coelho-Junior et al.,[8] a program of multicomponent exercises combining strength, aerobic-endurance and mobility training was found to be effective in improving the mobility of older adults suffering from osteoarthritis. Another study carried

out with frail elderly individuals that used multicomponent training involving proprioception, balance, muscle-strength, aerobic-endurance and flexibility training was effective in reverting frailty, improving cognition and establishing emotional and social networks in this population.[7]

In addition to leading to physical improvement in elderly individuals with some prior physical or functional limitation, MCET proved effective in improving the performance of healthy elderly individuals. Toraman et al.[9], carrying out a randomized study in which they used a combination of aerobic exercise, strength training and flexibility exercises, observed an improvement in the participants' functional performance. In a review by Labata-Lezaun et al.,[10] MCET was effective in improving functional capacity in healthy elderly individuals, but the authors did not investigate the clinical importance of the benefits identified by the studies included in the review. In addition, the authors only searched three databases and included only studies that compared MCET with control groups that did not do any type of exercise.

In light of the scientific evidence of the benefits of physical exercise for older adults, a synthesis of the current literature is required to guide health professionals in their clinical practice. The present systematic review therefore sought primarily to investigate the effects of MCET on the functional performance of healthy elderly individuals.

METHODS

The present review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)[11] and was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (ref. no. CRD42020180752).

Inclusion and Exclusion Criteria

The inclusion criteria were: (a) controlled, randomized clinical trials, including simple blinded, non-blinded and cross-over trials (b) that compared the effects of MCET with another intervention with exercise or a control without exercise (c) in healthy

individuals aged 60 years or older and (d) that assessed functional performance by means of questionnaires or field tests. Exclusion criteria: studies that included individuals with cognitive impairment or dementia and studies in which all or most of the participants had a diagnosis of frailty or sarcopenia.

Multicomponent exercise training was considered to be an intervention that includes at least three distinct types of exercise training, such as strength, aerobic, balance, flexibility and agility training among other types of exercise training.[12]

Sources of Information and Search Strategy

The search was carried out from May 2023 to May 2025, and only studies published in Portuguese, English and Spanish were included. There was no limit on publication date for a study to be included. The research question "What are the effects of MCET on the functional performance of healthy older adults?" was used to define the keywords used in the search strategy.

The following databases were used for the searches: PubMed, PEDro, CINAHL and Embase. The search strategy used with all the databases is shown in Table 1 (Supplementary Material). In the PubMed and CINAHL databases, combinations of Mesh Terms and other terms for “elderly” and “multicomponent exercise” were used. In Embase, the Emtree Terms for the same terms were used. Six searches were performed in the PEDro database. The combination of Mesh Terms used for multicomponent exercise was inserted in the “Abstract & Title” field, and the term “Gerontology” was selected in the “Subdiscipline” field.

Data selection and collection process

The systematized literature search was performed by two independent researchers (C.C.M. e B.S.) and registered in the Mendeley Reference Manager program. All the titles and abstracts were assessed by the same reviewers, who also assessed the complete articles selected after the abstracts had been screened. Any differences between the reviewers were resolved by consensus or after a discussion with a third reviewer.

After the studies had been included, the following data were extracted and recorded in tables: author and year of publication, characteristics of the study population (number of participants and age), assessment method, intervention and results.

Data items and outcome measures

The primary outcome was functional performance, which was assessed by means of specific tests or scales, such as the Senior Fitness Test Battery, Short Physical Performance Battery (SPPB), gait speed, 5x sit-to-stand test, 30-second sit-to-stand test, timed up-and-go (TUG) test and others. The secondary outcome was functional capacity, which can be assessed with the 6-minute walk test (6MWT) or other field tests. Functional performance was defined as the participant's ability to perform activities of daily living, while functional capacity was defined as the individual's maximum capacity for performing activities.

Risk-of-bias assessment

The risk of bias was assessed with the Risk of Bias 2 (RoB 2) tool[13]. RoB 2 assesses studies in terms of the following five domains: randomization process, deviations from the intended interventions, missing outcome data, measurement of the outcome and selection of the reported result. The judgment for each domain was made with the algorithm in the Excel tool to implement RoB 2 (available at: https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool/current-version-of-rob-2). After the analysis, the articles included were judged to be "low risk", "high risk" or a cause for "some concerns." The assessment was performed by the same independent assessors, and in case of disagreement a third assessor was consulted.

Statistical analysis

Only continuous data were considered in the analysis, and the statistical method used was the inverse-variance method. The effect measure was the difference between the means, and the data from the study used for the meta-analysis were the mean and standard deviation of the post-intervention results. A random-effects model was used to calculate the combined effect with a 95% confidence interval. The heterogeneity between

the studies was assessed with the I^2 statistic for I^2 values of 0%, 25%, 50% and 75%, corresponding to no heterogeneity, low, moderate and high heterogeneity, respectively.[14] All the analyses were performed with the Cochrane Collaboration Review Manager (version 5.4), and p-values <0.05 were considered statistically significant in all the analyses. When p was < 0.1 and I^2 > 50%, the sources of heterogeneity were explored with subgroup analysis.

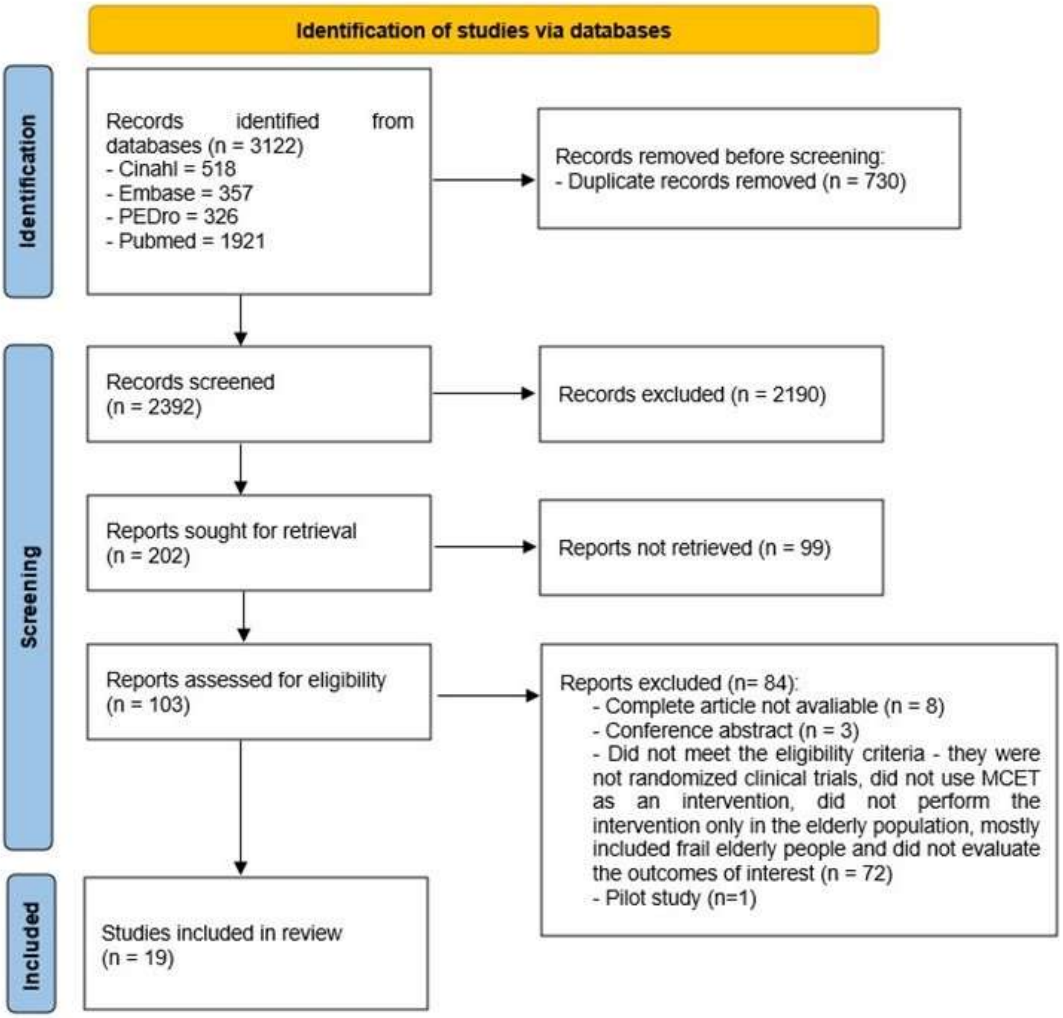
Assessment of the quality of the evidence

The quality of the evidence and the strength of the recommendations were assessed with the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) criteria[15]. Risk of bias, inconsistency, indirectness, imprecision and publication bias were assessed. When present, these can reduce the quality of the evidence. GRADEpro GDT (https://gdt.gradepro.org) was used to prepare the tables summarizing the results.

RESULTS

Study selection and characteristics

A total of 3122 titles were found in the initial search in all the databases, and this was reduced to 2392 after duplicate titles were removed. Screening of these titles identified 202 articles whose abstracts were then read. Ninety-nine studies were excluded after the abstracts had been read, and after the complete articles had been read 19 studies were included in the systematic review. Figure 1 shows the steps in the study-selection process and the reasons for excluding studies.



Source: The authors (2025).

Figure 1. PRISMA flowchart showing the systematic literature search.

Characteristics of the Included Studies

The total number of participants in the studies included in this review was 1424. The participants were healthy older adults of both sexes, and the average age in the studies varied from 59.8±7.5 to 85.1±7.6 years. The exercise types most commonly chosen for MCET were muscle-strength or muscle-endurance training, which were included in all the studies in this review, followed by flexibility and balance training, and aerobic

training. Other exercise types less frequently used in MCET included coordination, agility and mobility training, training to improve walking ability and Tai Chi exercises.

Of the eighteen studies included, five[16–20] compared the effects of MCET with strength training. The interventions for the control groups in the other studies did not include exercise training. With regard to the description of the exercise prescription, six studies failed to specify the intensity of the MCET exercises[16, 17, 21–24]. Of those that did specify the intensity, the majority used moderate intensity exercises for both aerobic and strength training, and the intensity was quantified on the original or modified BORG scale or by a percentage of the maximum heart rate or heart rate reserve.

MCET was performed three times a week in most studies, and once a week in only one study[25]. Program duration varied from nine weeks to a complete year, and sessions lasted from 40 to 90 minutes. The main details of the studies included in the review are given in Table 2, and the MCET prescription is shown in Table 3.

Table 2. Details of the studies included in the review.

Author, year	Objectives	Group characteristics	Outcomes	Results
Toraman, 2004[9]	To determine (a) the effect of a 9-week, supervised multicomponent exercise program on functional fitness and body composition in independent older adults, (b) which component of functional fitness was most affected by multicomponent training and (c) which component of body composition was most affected by multicomponent training.	Intervention MCET Sample size = 21 Age: 72.5 ± 7.4 years Control No exercise Sample size =21 Age: 72.3 ± 6.0 years	- Senior Fitness Test; - Waist and hip circumference; - Body composition: Electrical bioimpedance.	The MCET resulted in significant improvements in the chair-stand test, arm-curl test, 8-ft up-and-go test and 6-min walk test. No effect was observed on body composition.
Mian, 2006[21]	To determine whether a structured physical-conditioning program results in a reduction in the metabolic cost of walking in healthy older adults.	Intervention MCET +Tai Chi Sample size = 25 Age: 73.4 ± 3.4 years Control No exercise Sample size = 13 Age: 73.2 ± 3.7 years	- Metabolic cost assessed by spirometry; - Maximum voluntary isometric contraction torque; - Single leg balance time; - Sit-and-reach test; - Six-minute walk test.	Significant improvements in knee extensor isometric strength, balance time and distance in the 6-minute walk test were observed in the IG but not in the CG. No change was observed in cost of walking.
Park, 2008[26]	To investigate whether a multicomponent exercise program can improve risk factors for falls and bone mass loss.	Intervention MCET Sample size = 25 Age: 68.3 ± 3.6 years	- Bone mineral density: dual-energy X-ray absorptiometry (DEXA); - Body composition: electrical bioimpedance; - Body oscillation: dynamic posturography;	10MWT, MSL and OLST resulted in a significant improvement in the IG. Bone mineral density in the neck of the femur and trochanter in the IG increased significantly after the exercise program, and there was

		Control No exercise Sample size =25 Age: 68.4 ± 3.4 years	- Osteocalcin and parathyroid hormone; - Deoxypyridinoline; - 10-minute maximum walk time (10MWT) test; - Maximum step length (MSL) test; - Eyes-open one-legged-stand time (OLST) test.	a significant improvement in body oscillation.
Carvalho, 2009[27]	To investigate the effect of 8 months of multicomponent training and 3 months of detraining on functional fitness in elderly women.	Intervention MCET Sample size = 32 Age: 68.4 ± 2.9 years Control Kept up their exercise routine. Sample size = 25 Age: 69.6 ± 4.2 years	- Functional fitness tests (30-second chair- stand test, arm-curl test, chair sit-and-reach test, back-scratch test, 8-foot up-and-go test, 6-min walk test). - Body Mass Index (BMI); - Attendance rate.	The exercise training did not lead to changes in BMI or cardiovascular endurance but produced an improvement in the chair-stand, arm-curl, chair sit-and-reach, up-and-go and back- scratch tests.
Forte, 2013[16]	To compare the effects of two different exercise training programs on executive cognitive function and functional mobility in older adults and to explore the mediatory potential of training on executive function and functional mobility, particularly improvements in physical fitness.	Intervention MCET Sample size = 22 Age: Female = 69.0 ± 2.8 years; Male = 71.4 ± 2.9 years Control Muscle strengthening exercises Sample size = 20 Age: Female = 70.5 ± 3.9 years; Male= 69.1 ± 3.7 years	- Random number generation task; - Trail Making Test; - Measurement of cardiorespiratory fitness: gas analysis during an incremental test; - Measurement of muscle strength: maximum isokinetic knee extension and flexion torques; - Gait speed with and without a dual task.	The results showed that both types of exercise training increased inhibitory capacity and functional mobility.

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Leite, 2015[17]	To compare the effects of MCET and endurance-training programs on metabolic health parameters in healthy older adults.	Intervention MCET Sample size = 21 Age: 70 ± 3 years Control Strength training Sample size = 18 Age: 68 ± 3.5 years	- Body composition: dual-energy X-ray absorptiometry (DEXA); - Functional mobility: gait speed; - Lower-limb function: sit-to-stand test; - Handgrip strength Dynamometry; - Aerobic fitness level: progressive submaximal exercise test on a cycle ergometer; - Blood samples.	After 12 weeks of exercises both interventions proved effective in improving functional parameters. Only the CG showed a significant reduction in body fat and increase in lean mass.
Kang, 2015[22]	To determine whether a 4-week multicomponent exercise program could improve physical fitness of community-dwelling older women.	Intervention MCET Sample size = 11 Age: 71.4 ± 3.4 years Control No exercise Sample size = 11 Age: 68.9 ± 3.3 years	- Physical fitness: Senior Fitness Test (30 s sit-to-stand test; arm-curl test; chair sit-and-reach test; back-scratch test; 8-foot up-and-go test; 2-minute step test); - Body composition: body mass index (BMI).	IG participants showed improvements in lower and upper body strength, lower and upper body flexibility, and dynamic balance/agility after the 4 weeks of training. No significant changes in aerobic endurance and body composition were demonstrated.
Mulasso, 2015[23]	To assess the direct and indirect effects of a multicomponent exercise program on mobility and balance in institutionalized older adults.	Intervention MCET Sample size = 53 Age: 83 ± 7.5 years Control No exercise Sample size = 51 Age: 83 ± 7.0 years	- Physical function: Timed up and go; Tinetti Performance-Oriented Mobility Assessment (POMA-B). - Anthropometric variables.	MCET had positive effects on both mobility and balance.

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Ansai, 2016[18]	To compare the effects of multicomponent and strength training programs on physical variables associated with a greater fall risk and fall rate in long-lived community-dwelling older adults.	Intervention MCET Sample size = 23 Age: 81.9 ± 1.9 years Control 1 Strength training Sample size: = 23 Age: 82.8 ± 2.8 years Control 2 No exercise Sample size = 23 Age: 82.6 ± 2.6 years	- Physical performance: Five x sit-to-stand test; one-leg-standing and tandem tests; TUG_{Motor}; - History of falls.	There were no significant differences in any of the variables between the groups in the intention-to-treat analysis. The IG showed a significant improvement in the sit-to-stand and one-leg-standing tests between the first and second assessments as well as between the first and third assessments.
Bohrer, 2018[28]	To investigate the effects of a multicomponent exercise program designed to improve ankle-joint torque during high-speed movements in healthy older adults.	Intervention MCET Sample size = 12 Age: 69.7 ± 4.8 years Control No exercise Sample size = 14 Age: 70.86 ± 6.48 years	- Muscle function: isokinetic dynamometer (ankle flexors and extensors); - Reactive capacity: assessed with the step test using the gait analysis platform; - Functional mobility: TUG	There was an increase in peak ankle extensor torque in the IG compared with the CG. This improvement was converted into improvements in reactive capacity. Gains in functional mobility as a result of increased gait speed were observed in the IG.
Arrieta, 2018[29]	To assess the effects of a multicomponent exercise intervention on body measurements, physical function and physical activity in older adults living in long-stay institutions.	Intervention MCET Sample size = 57 Age: 85.1 ± 7.6 years Control	- Adherence, compliance and adverse events; - Anthropometric data; - Physical fitness: Senior Fitness Test; Short Physical Performance Battery (SPPB), bilateral handgrip strength, 4-	Three months of an exercise program proved sufficient for there to be a significant difference between the IG and CG in terms of upper and lower limb strength, gait

		No exercise Sample size = 55 Age: 84.7 ± 6.1 years	meter fast gait speed and static balance (Berg scale); - Level of physical activity: accelerometry.	speed and static and dynamic balance.
Gretebeck, 2019[19]	To determine the effect of functional circuit exercise training followed by a customized home-based program in improving mobility function in sedentary older adults with diabetes.	Intervention MCET Sample size = 56 Age: 70 ± 6 years Control 1 Exercise + health education Sample size = 19 Age: 71 ± 9 years Control 2 Flexibility and toning exercises Sample size = 36 Age: 71 ± 8.0 years	- Physical function: gait speed and 6-minute walk test; - Physical activity: community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire; - Metabolic measures: body mass index (BMI), fasting blood glucose, insulin, lipids and glycated hemoglobin (HbA1c) levels.	IG + physical activity showed a significantly greater improvement in comfortable gait speed than CG. IG + health education showed a similar trend in improving comfortable gait speed over CG.
Daly, 2019[30]	To investigate whether a multifaceted osteoporosis prevention program could improve bone mineral density and functional muscle performance in older adults at increased risk for fracture.	Intervention MCET Sample size = 77 Age: 67.7 ± 6.5 years Control No exercise Sample size = 71 Age: 67.2 ± 5.5 years	- Anthropometric data, bone mineral density and body composition; - Trabecular bone microarchitecture by MRI; - Muscle strength and functional performance - timed stair climb test and 3RM test;	After 12 months of exercise, IG showed improvements in bone mineral density of the lumbar spine and femoral neck, muscle strength and physical function, which persisted after 6 months.

			- Functional performance: four-square step test, 30-second sit-to-stand, functional reach and TUG; - Fall reports.	
Wolf, 2020[20]	To compare the effects of multicomponent and strength training programs on muscle strength, dynamic balance, functional capacity and gait ability in older women.	Intervention MCET Sample size = 12 Age: 68 ± 3.4 years Control Strength exercises Sample size = 18 Age: 67 ± 6 years	- Maximal voluntary isometric contraction using a load cell; - Dynamic balance using a force platform; - Physical function tests: 6-minute walk test, sit-and-reach test, 8-foot up-and-go test and 30-second chair-stand test; - Gait analysis; - Maximal dynamic strength test: one-repetition maximum test (1RM).	Peak torque of hip flexors and extensors and knee flexors in the CG was greater than in the IG during post-training. Only the CG improved the knee extensors torque development rate, which was also greater for the CG than for the IG during post-training. Dynamic balance and performance in the 30-second sit-to-stand test improved in both the CG and IG. Stride length and gait speed only improved in the IG.
Pepera, 2021[24]	To assess hemodynamic and functional-performance responses in older adults living in long-stay institutions during an MCET program.	Intervention MCET Sample size = 20 Age: 79.6 ± 7.38 years Control No exercise Sample size = 20 Age: 79.3 ± 5.49 years	- Anthropometric data; - Hemodynamic measures: blood pressure and heart rate; - Physical function: TUG, Berg Balance Scale (BBS).	There was a reduction in systolic blood pressure in the IG after training. There was a significant improvement in functional measures after the exercise training program.
Monteiro, 2022[31]	To investigate the effects of a 32-week multicomponent training program on body composition, isometric strength and functional fitness in elderly women.	Intervention MCET -Group A Sample size = 30 Age: 69.4 ± 5.24 years	- Anthropometric data and body composition: electrical bioimpedance; - Functional fitness: functional fitness test (30-s chair stand test, arm-curl test,	Significant differences were observed between the groups for the following variables: sit-and-reach between IG-B and CG; TUG between IG-A and CG and between

		-Group B Sample size = 32 Age: 70.63 ± 5.15 years * Both groups (A and B) received the same training, but the order of the aerobic and strength exercises was inverted. <u>Control</u> No exercise Sample size = 29 Age: 68.72 ± 5.09 years	chair sit-and-reach test, back-scratch test, 8-ft up-and-go test, 2-minute step test).	IG-B and CG; and chair-stand between IG-A and CG and between IG-B and CG.
Sobrinho, 2022[32]	To investigate the effect of stretching training combined with multicomponent training on physical abilities (muscle strength, aerobic endurance and agility) in physically inactive older women.	Sample age: 63.4 ± 5.6 years <u>Intervention</u> MCET Sample size = 52 <u>Control 1</u> MCET + stretching training Sample size = 43 <u>Control 2</u> No exercise Sample size = 47	- Systolic and diastolic blood pressure; - Physical activity in daily life: accelerometry; - Motor assessment: Senior Fitness Test.	Multicomponent training combined with flexibility training had a very large effect on strength, agility and aerobic-fitness variables, whereas multicomponent training on its own had a medium effect on agility and a large and very large effect on muscle-strength variables.

Chang, 2023[25]	To establish and assess the effectiveness of a multicomponent exercise training program in community-dwelling older adults during the COVID-19 pandemic.	Intervention MCET Sample size = 82 Age: 61.3 ± 9.8 years Control Health education + recommendation to take part in exercise programs. Sample size = 85 Age: 59.8 ± 7.5 years	- Level of physical activity: International physical activity questionnaire (IPAQ) and leisure-time physical activity (LTPA); - Physical performance: handgrip strength, Short Physical Performance Battery (SPPB), single-leg stance with eyes open, TUG, functional-reach test; - Frailty rate.	In comparison with the CG, the IG showed an improvement in leisure-time physical activity; vigorous physical activity; moderate-vigorous physical activity; pre-frailty rates and SPPB results.
Chen, 2023[33]	To confirm whether multicomponent exercise following vivifrail recommendations was an effective method for improving physical ability, cognitive function, gait, balance, and muscle strength in Chinese older adults.	Intervention MCET + usual care + health education Sample size = 44 Age: 83(80–87) years Control Usual care + health education. Sample size = 60 Age: 86(83–89) years	- Short Physical Performance Battery (SPPB) scale; - 4-meter gait speed test (4MGS); - 6-min walking distance (6MWD); - Hand grip strength (HGS) - Instrumental activities of daily living (IADL) and activities of daily living (ADL); - 12-item Short Form Survey (SF-12); - Geriatric Depression Scale-15 (GDS-15); - Mini Nutritional Assessment (MNA-SF); - Tinetti score; - Mini-Mental State Examination (MMSE); - Body composition: multifrequency bioelectrical impedance.	The exercise group showed a significant improvement in SPPB when compared to the usual care, and similar tendencies were observed with ADL. Compared to the control group, improvements were observed in the intervention group in the Tinetti, SF-12, 4MGS and 6MWD. No difference was observed between the groups in body composition after the intervention.

Source: The authors (2025).

10MWT: 10-minute maximum walk time test; 1RM: one-repetition maximum test; 3RM: Three-repetition maximum test; 4MGS: 4-meter gait speed test; 6MWD: 6-min walking distance; BBS: Berg Balance Scale; BMI: body mass index; CG: Control group; CHAMPS: Community Healthy Activities Model Program for Seniors questionnaire; DEXA: Dual-energy X-ray absorptiometry; F: Female; M: Male; HbA1c: Glycated hemoglobin; IG: Intervention group; IPAQ: International physical activity questionnaire; LTPA: Leisure-time physical activity; MCET: Multicomponent exercise training; MSL: Maximum step length test; OLST: Eyes-open one-legged-stand time test; POMA-B: Tinetti Performance-Oriented Mobility Assessment; RCT: Randomized Clinical Trial; SF-12: 12-item Short Form Survey; SIG: Strength-training intervention group; SPPB: Short Physical Performance Battery; TUG: Timed up and go test.

Table 3. Description of the MCET prescription used in the studies included in the review.

Author, year	Frequency	Intensity	Type of exercise	Session length	Program duration
Toraman, 2004[9]	3 x week	Aerobic training: started with 50% of HRR Strength training: 50%-80% of 1RM	Aerobic, endurance and flexibility	40-60 min	9 weeks
Mian, 2006[21]	2 x week + 1 home session	Not described	Aerobic, endurance, stretching and Tai Chi	1 h	12 months
Park, 2008[26]	3 x week	Weight-bearing exercises: 65%-70% of HRmax	Stretching and weight-bearing, balance and posture-correction exercises	1 h	48 weeks
Carvalho, 2009[27]	2 x week	Aerobic training: 12-14 on the BORG scale Strength training: 12-16 on the BORG scale	Aerobic, muscle endurance, agility and flexibility	1 h	8 months
Forte, 2013[16]	2 x week	Not described	Coordination, balance, strength and agility	1 h	12 weeks
Leite, 2015[17]	2 x week	Not described	Coordination, balance, strength, agility and stretching	75-90 min	12 weeks
Kang, 2015[22]	3 x week	Not described	Balance, strength and stretching	1 h	4 weeks
Mulasso, 2015[23]	2 x week	Not described	Amplitude, strength, balance and flexibility	75 min	36 weeks
Ansai, 2016[18]	3 x week	Aerobic training: 60-85% of HRR Strength training: 14-17 on the BORG scale	Aerobic, strength, balance and flexibility	1 h	16 weeks
Bohrer, 2018[28]	3 x week	Used a perceived effort of 12-16 on the BORG scale for all the exercises	Endurance, agility and coordination	45 min	12 weeks

Arrieta, 2018[29]	2 x week	Strength training: 40%-60% of 1RM and then up to 65%-70% if the loads were tolerated	Strength, balance and stretching exercises and walking recommendations	45 min	3 months
Gretebeck, 2019[19]	3 x week	Used a perceived effort of 11-13 on the BORG scale for all the exercises	Aerobic, strength, flexibility and instructions to do PA for 30 min a day	50 min	10 weeks
Daly, 2019[30]	3 x week	Strength training: 40%-60% of 1RM and 3-4 on the BORGm scale	Strength, balance and mobility	1 h	18 months
Wolf, 2020[20]	3 x week	Aerobic training: 12-14 on the BORG scale	Aerobic, strength, balance and stretching	1 h	12 weeks
Pepera, 2021[24]	2 x week	Not described	Balance, gait training, strength	45-50 min	2 months
Monteiro, 2022[31]	3 x week	Aerobic training: 12-14 on the BORG scale	Aerobic, strength, flexibility and balance	1 h	32 weeks
Sobrinho, 2022[32]	2 x week	Moderate to high intensity on the BORGm scale	Balance, coordination, strength and aerobic	90 min	14 weeks
Chang, 2023[25]	1 x week	Aerobic training: 13-15 on the BORG scale	Strength, balance, stretching and aerobic	90 min	16 weeks
Chen, 2023[33]	3 x week	Aerobic training: low to medium, 50–75%HRmax; Strength training: start at 30% 1RM, and gradually enhance the training intensity each week according to the patient's training response.	Stretch, aerobic, progressive resistance, and balance exercises	Aerobic for 20-40 minutes. The other exercises were not described.	12 weeks

Source: The authors (2025).

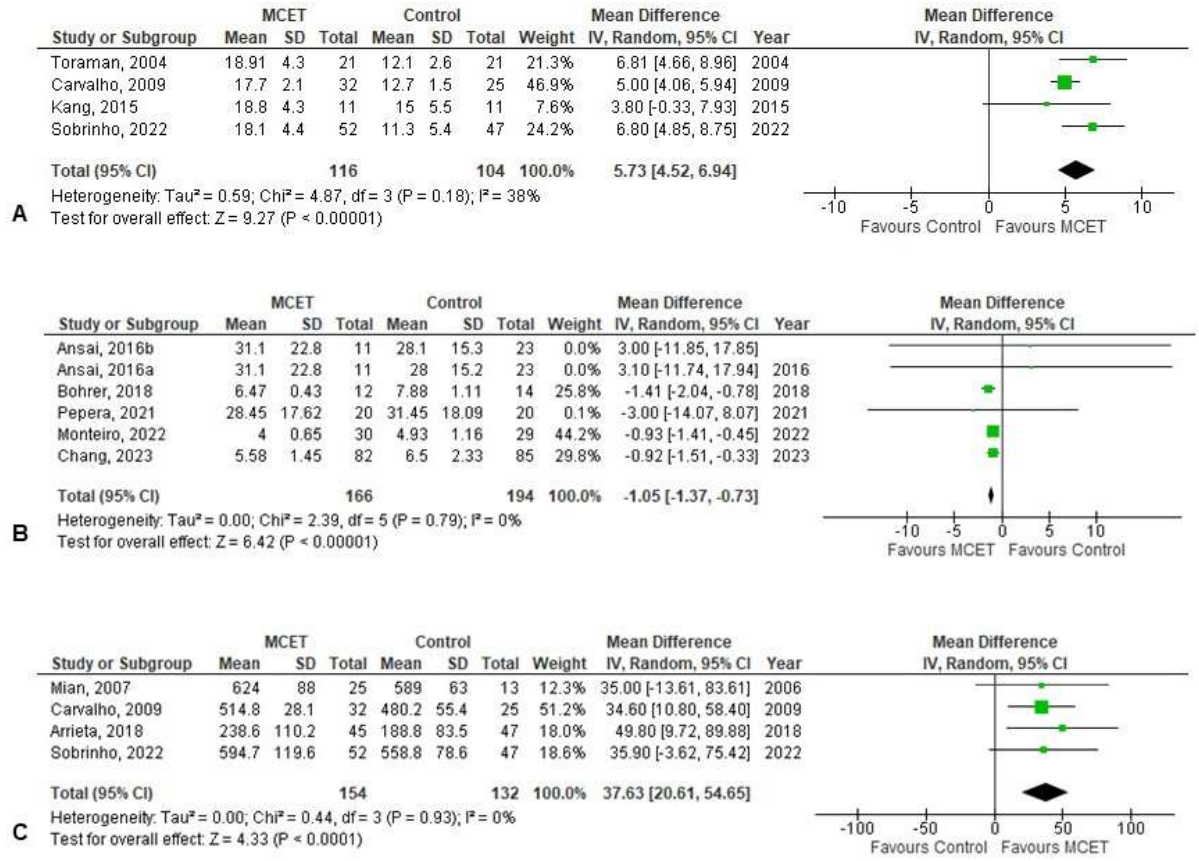
HRR: Heart rate reserve; 1RM: one-repetition maximum test; HRmax: Maximum heart rate; PA: Physical activity; BORGm: Modified BORG scale.

Risk of bias

The risk-of-bias assessment showed that 17 of the randomized clinical trials that were assessed fell into the category "some concerns" and only two were considered to have a low risk of bias (Figure 2 – Inserted as Supplementary Material). The greatest problems encountered that can lead to bias in the studies are in the following domains: "randomization process" (domain 1), "measurement of the outcome" (domain 4) and "selection of the reported result" (domain 5). The majority of the studies neither described how the randomization process was carried out nor stated whether the assessor was blinded regarding participant allocation at the time of the assessment. Furthermore, most of the studies did not include a previously specified analysis plan to determine whether the data were analyzed in accordance with what had been established before the non-blinded results were available.

Quantitative synthesis of the studies

The results of the studies that assessed functional performance with the 30-second sit-to-stand (Figure 3A) and TUG test (Figure 3B) show gains in the group that took part in MCET (MD = 5.73 [95% CI, 4.52 to 6.94], I^2 = 38%; and MD = -1.05 [95% CI, -1.37 to -0.73], I^2 = 0%, respectively). The meta-analysis of the five studies that assessed the distance covered in the 6MWT showed a significant improvement in the group that took part in MCET compared with the control groups that received no exercise intervention (MD = 37.63 [95% CI, 20.61 to 54.65], I^2 = 0%) (Figure 3C).

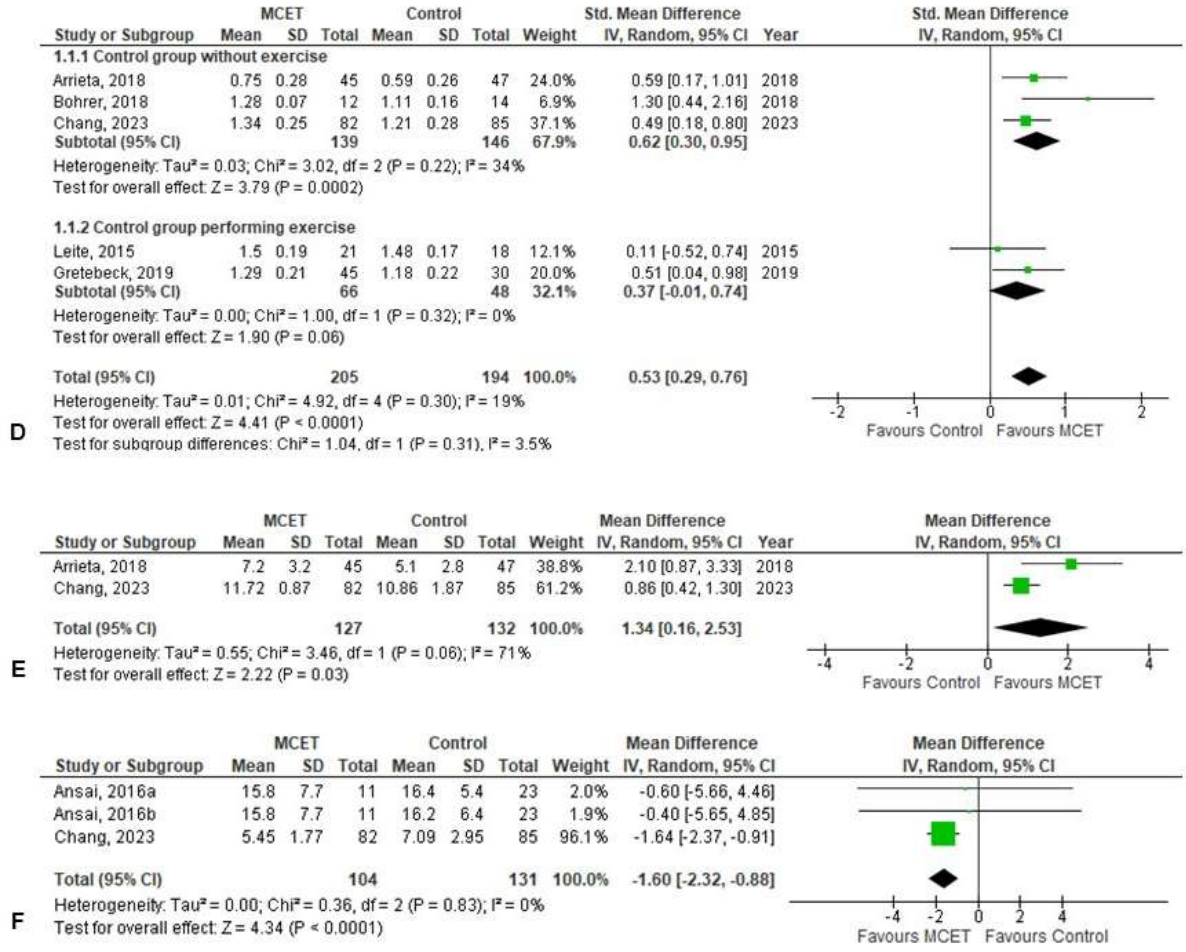


Source: The authors (2025).

Figure 3. A: Forest plot comparing number of repetitions in the 30-second sit-to-stand test after the intervention. B: Forest plot comparing pre and post-intervention times in seconds for the TUG. C: Forest plot comparing pre-and post-intervention distances covered in the 6-minute walk test.

When gait speed was assessed, a significant improvement was only observed when the MCET group was compared with the control group that did not receive any exercise-training intervention (MD = 0.62 [95% CI, 0.30 to 0.95], I^2 = 34%). When the subgroup analysis was carried out with the control group receiving another type of exercise training, MCET did not lead to any gain (MD = 0.37 [95% CI, -0.01 to 0.74], I^2= 0%) (Figure 4D). There was also an improvement in the MCET group in the results for the SPPB and 5x sit-to-stand test (MD =

1.34 [95% CI, 0.16 to 2.53], I^2 = 71%; and MD = -1.60 [95% CI, -2.32 to -0.88], I^2 = 0%, respectively) (Figure 4E and 4F respectively).



Source: The authors (2025).

Figure 4. D: Forest plot comparing pre and post-intervention gait speed. E: Forest plot comparing pre and post-intervention SPPB scores. F: Forest plot comparing pre and post-intervention times in the 5x sit-to stand test.

Assessment of the quality of the evidence

The evidence quality was deemed low for both functional capacity assessed with the 6MWT and functional performance assessed with the 30-second sit-to-stand test. For all the other variables, the quality of the evidence was very low. This was mainly because of the

presence of a risk of bias in the studies, inconsistency arising from variation in the effect estimate and imprecision due to small sample size and large confidence intervals. Table 4 (Supplementary Material) shows the GRADE evidence profile.

DISCUSSION

The aim of this review was to investigate the effects of MCET on the functional performance of healthy elderly individuals. A quantitative analysis of the studies revealed that in most of them there was an improvement in functional performance in older adults in the intervention groups, i.e., the results appear to indicate favorable outcomes for participants who underwent MCET. However, these results should be interpreted with caution, as the available evidence is limited and demonstrates low or very low methodological quality, according to GRADE.

Multicomponent exercise training can be a therapy option to improve functional performance as it involves three or more types of exercise required to improve various components of physical aptitude in the elderly. For older adults to maintain a healthy life, MCET should include exercises that improve muscle strength to allow the elderly individual to stand up and go up stairs; exercises that improve physical endurance to allow the individual to perform activities continuously; and balance training, which is required to maintain a stable posture and reduced fall risk.

Although the meta-analyses yielded positive results, it is important to assess whether these results actually correspond to real clinical benefits for the elderly population. In addition to the improvements in the quantitative analysis, five of the mean differences in each meta-analysis were greater than the minimum clinically important difference (MCID) for each test. For the TUG we considered an MCID of 1 second, for the 6MWT an MCID of 27 meters, and for the 30-second sit-to-stand test, an MCID of 3.3 repetitions.[34] For the normal gait speed test we used an MCID of 0.18 m/s,[35] and for the SPPB an MCID of 1 point.[36] The only test for which the mean difference was not greater than the MCID was the five-times sit-to-stand test (MCID of 2.25 seconds).[37]

As the MCID can be considered the minimum change needed for a significant change for the patient in the outcome being assessed[38], we can reasonably conclude that the improvement in functional performance as measured by the TUG, 30-second sit-to-stand, gait speed and SPPB tests does indeed correspond to clinical benefits for the patient. The same was true when functional ability was assessed with the 6MWT, where we observed a change of more than 27 m in the result of the meta-analysis. As mentioned earlier, the only outcome for which we failed to observe an improvement that could correspond to a real clinical benefit for the patient was when functional performance was assessed with the five-times sit-to-stand test. This result can be attributed to the small number of studies included in the meta-analysis, in which only the study by Chang et al. [(25)] reported a result favoring MCET for this outcome.[25] However, we emphasize that the results should be interpreted with caution, due to the low methodological quality of the studies as indicated by the GRADE approach.

The results indicate that functional performance can be improved by exercise training that includes more than three types of exercise. However, some studies[17, 20, 26, 29] included in this review showed that peripheral muscle strength training was also effective in improving mobility and functional performance. Our findings therefore suggest that although MCET is effective in preserving and improving functional performance in older adults; we cannot say that it is superior to other types of exercise.

Two RCTs included in our review[26, 29] directly compared the effects of MCET and strength training and showed that the type of training can be chosen according to the specific objectives. According to Wolf et al.,[20] strength training should be chosen if the aim is to improve muscle function and dynamic balance, whereas MCET is an option when the goal is to improve physical function and gait ability. In a study by Leite et al.,[17] there was no difference in functional performance gains between groups, indicating that both types of training can help to achieve this outcome. Bearing in mind the changes in functional performance caused by sarcopenia, which is defined as a skeletal-muscle disorder with progressive, generalized loss of muscle strength, quantity and/or quality that culminates in physical and functional decline in older adults,[31] strength training can be considered an important aspect of an MCET program.

The results of our study failed to show the superiority of MCET over different types of exercise on their own or a combination of two types of exercise together, as frequently happens

with aerobic and strength exercises. However, in a non-randomized study by Rodrigues et al.[39] which compared the effects of MCET with a combination of aerobic and strength training, although both groups showed an improvement in muscle strength, the benefit was greater in the MCET group. The authors argue that a combination of different types of exercises enhances the increase in muscle strength as MCET stimulates a greater variety of muscle groups. They stress that exercise components focusing on agility and balance also play an important role in improving neuromuscular performance.

Other types of exercise such as those that help to improve balance, coordination, flexibility and agility appear to be good choices for inclusion in an MCET program as they directly influence functional performance and gait ability. Changes in gait occur naturally with increasing age and represent an important risk factor for functional decline and falls in the elderly. Together with changes in balance they have a direct influence on postural stability.[32] Postural instability is a geriatric syndrome that is directly related to an increased number of falls and is influenced by other factors such as reduced muscle strength and cognitive disorders. A fall can be defined as the unintentional movement of the body to a level below the initial position which cannot be corrected in time and is determined by multifactorial circumstances[25, 34] related to poor functional performance.

Aerobic exercise was included in nine of the studies in this review, and it would appear to be important to include this type of exercise in a training program. Cardiorespiratory endurance is the ability to perform moderate to vigorous-intensity dynamic exercise and is directly related to functional status and cardiorespiratory and musculoskeletal function. While it can decline as a result of the natural aging process, this component of physical fitness would appear to be preserved and improved by MCET.

Rodrigues et al.[40] emphasize that a choice of specific exercises will help to improve the outcome being assessed. In their study, the authors compared the effects of MCET with those of a combination of (aerobic and strength) exercises in adults and elderly adults. They showed that the group that performed a combination of exercises had a greater improvement in the outcome maximum strength, while the MCET group had better results in the tests that assessed functional strength.

The benefits of exercise in terms of functional performance may be a consequence of the improvement in the performance of the musculoskeletal system as exercise results in acute lesions with suppression of synthesis of muscular protein and increased protein degradation. This leads to physiological adaptations that make the musculoskeletal system stronger as a result of muscle adaptation, in turn leading to an improvement in muscle strength and power and preventing sarcopenia. This benefit of physical exercise is cumulative, and older adults should ideally keep up a physically active routine as exposure to the physiological adaptations produced by exercise will bring the desired benefits.[41]

In addition to improving functional performance, which leads to an improved ability to perform activities of daily living, the choice of a combination of various types of exercise can help to prevent chronic diseases such as cardiovascular diseases and Alzheimer's disease. MCET should be used rather than other types of exercise on their own as a combination of different types of exercise appears to provide other benefits for older adults in addition to an improvement in functional performance.[41] The complexity involved when different types of exercises are combined appears to improve balance and reduce fall risk, as reflected in the TUG and SPPB scores in our meta-analysis. Furthermore, studies have shown that MCET improves cognitive function and working memory in older adults with mild cognitive impairment.[42, 43] This benefit appears to be a result of the greater stimulation of executive function as well as the reduction in inflammation and oxidative stress.[41]

Despite the large variation in MCET prescriptions in the studies included here, we believe that the ideal prescription to achieve an improvement in functional performance is a combination of aerobic and strength exercises with agility, flexibility or balance exercises at least twice a week. The aerobic and strength exercises should be performed at moderate intensity.

Despite its important findings, the present review has some limitations. The ages of the participants in the studies varied widely, and it was not possible to analyze subgroups in order to assess the impact of MCET in younger and older elderly adults. In addition, there was a large variation in the duration of the intervention protocol. Furthermore, as most of the studies fell into the “some concerns” category in the risk-of-bias analysis, the external validity of the results should be interpreted with caution. Finally, as most of the participants in the control groups did

not take part in any exercise intervention or any intervention to encourage them to do some physical activity, this may have enhanced the effect of MCET in the comparison with these groups.

We found low or very low confidence levels for primary and secondary outcomes in our GRADE assessment, which we believe can be attributed to the risk of bias in the studies as well as to the large confidence intervals and small sample sizes. In light of these factors, there is clearly a need for clinical trials with a more rigorous methodology.

This meta-analysis raises a number of important questions for future research and suggests that more in-depth studies are required into the effects of different types of exercise programs for healthy older adults to help them preserve their physical performance during the different phases of the aging process. Consideration should also be given to interventions that increase treatment adherence as there are still many barriers to performing any type of physical exercise in this population.

CONCLUSION

In healthy older adults, twice-weekly MCET can improve functional performance compared with inactivity. Programs should combine aerobic and strength training with agility, flexibility, or balance exercises, performed at moderate intensity. These findings should be interpreted with caution, and future studies with larger samples and greater methodological rigor are required to provide more robust and reliable evidence.

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EFFECTS OF MULTICOMPONENT EXERCISE ON FUNCTIONAL PERFORMANCE OF HEALTHY OLDER ADULTS: SYSTEMATIC REVIEW AND META-ANALYSIS

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