SYSTEMATIC REVIEW

Effects of physical exercise intervention on improving physical functioning and quality of life among geriatric population: A systematic review of randomized controlled trials

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Abstract

Objective: To assess the effectiveness of exercise intervention on elderly population's physical functioning and quality of life.

Method: The systematic review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, and comprised research on Cochrane Library, PubMed, Physiotherapy Evidence Database and Web of Science for randomised controlled trials published in the English language from January 2012 to December 2021. The trials included comprised individuals of either gender aged ≥60 years who were either community-dwelling elderly or patients living in residential facilities who could walk independently with or without assistive devices. Key words used for the search included age, exercise, physical function, quality of life and cognition. A 10-point scale from the Physiotherapy Evidence Database was used for methodological evaluation.

Results: Of the 1050 studies initially found, 14(1.33%) were analysed in detail. All 14(100%) included multi-component exercise interventions, like aerobic, strength and balance, 4(28.6%) trials included cognition and quality of life as well. Only 1(7.14%) trial showed little or no improvement in terms of quality of life. Of the 2(14.3%) studies that reported the effects of exercise on falls, 1(50%) found positive impact of exercise interventions, while 1(50%) showed no improvement on the risk of fall and psychosocial factors related to fall. Overall, 9(64.3%) trials investigated the effects of exercise training on several aspects of mobility, and showed marked improvement in mobility. Also, 8(57.14%) trials studied the effect of exercise intervention on balance performance, and 1(12.5%) of them showed no effect on balance. Of the 9(64.3%) trials investigating the effects of exercise intervention on muscle strength, 5(55.5%) reported increase in muscle strength.

Conclusion: Multi-component exercises were found to have a positive impact on functional and psychosocial health of geriatric population.

Keywords: Old age, Multicomponent exercises, Physical function, Quality of life. (JPMA 74: 1481; 2024)

DOI: https://doi.org/10.47391/JPMA.8289

Introduction

According to the World Health Organisation (WHO), the number of people aged >60 years is increasing at a tremendous rate compared to any other age group, and if this trends continues, then the elderly population will reach up to 2 billion by the end of 2050.[1] There are many changes associated with the ageing process, such as decrease in muscle strength, balance, endurance, etc.[2] All this takes place due to degeneration in the central nervous system (CNS), like loss of sensory and motor neurons, and muscles, like loss of type II muscle fibres, caused by reduced activity in the elderly, resulting in impaired balance and muscle strength.[3] Decreases in functional independence may result in increased risk of fall and injuries.[4] More than one-third of people aged 65 and above suffer a fall at least once each year.[5] It has been reported that the rate of disabilities are significantly increasing in the elderly age group, especially after the age of 85.[6]

Physical activities, such as aerobics, resistance and strength training, play a vital role in reducing the impairments of the elderly population. Adopting a more active lifestyle and doing regular physical activities, including aerobic and resistance exercises, have shown to improve cardiovascular, respiratory and musculoskeletal systems.[7] Previous studies have shown that physical exercises for at least 6 months can reduce the risk and rate of falls.[8] WHO endorses at least thirty minutes of moderate-intensity physical activity five days a week for the geriatric population.[9]

The American College of Sports Medicine[10] recommended that physical intervention should include strengthening, endurance and balance exercises that would provide greater benefits to the elderly.[11] Recently, studies have shown that multicomponent exercises, which include various physical interventions combined together, are

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Submission complete: 12-12-2022 **Review began:** 06-02-2023
Acceptance: 12-06-2024 **Review end:** 16-09-2023

beneficial in maintaining and improving the physical function of the elderly.[12] In addition, regular multicomponent training, based on combined strength, endurance and balance exercises, can also minimise the deteriorating effects of aging by decreasing the development and progression of disabling conditions and the risk of fall.[13]

Moreover, with decreased physical performance, the elderly show deficits in mental health, executive functioning, processing speed as well as reduced quality of life (QOL).[14] Health-related QOL (HRQOL) is defined as wellbeing in different aspects of an indiviual's life, such as mental or physical wellbeing. Physical exercises also have a role in improving cognition as well as QOL.[15]

The current systematic review was planned to assess the efficacy of physical exercise interventions in improving physical function and QOL in the geriatric population, with focus on mobility, balance, risk of fall, and cognitive functions. Specifically, the target was to determine the efficacy of exercises[1] compared to controlled interventions[2] and to identify the impact of physical interventions on cognition and QOL which, to our knowledge, have not been investigated yet.

Material and Methods

The systematic review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[16] and comprised research on Cochrane Library, PubMed, Physiotherapy Evidence Database (PEDro) and Web of Science for randomised controlled trials (RCTs) published in the English language from January 2012 to December 2021. The review was registered with the International Prospective Register of Systematic Reviews[17] (PROSPERO) (CRD42022370423).

Studies that examined the impact of multicomponent exercises (strength training, flexibility, balance, endurance training combined with other exercises) on physical functioning of older subjects were included. Studies had to mention the effects of exercise training on at least one of the four parameters: risk of falling, mobility, strength, balance, and QOL. Comparisons between the multicomponent and control groups were made.

In the first phase, theoretical framework was extracted which served as the foundation for the current review without restricting the years of the search and without inserting the search terms "old age," "multicomponent exercises", "physical function" and "quality of life." In the second phase the search was limited to period from January 2012 to December 2021. In the third phase, the literature was updated.

The four search words were combined through the Boolean operators "AND" and "OR". The physical function was evaluated by the time up and go (TUG) test,[18] short physical performance battery (SPBB) test,[19] 6-minute walk test (6MWT)[20] and the Berg balance scale (BBS).[21] References were also manually searched.

The RCTs included comprised individuals of either gender aged ≥60 years who were either community-dwelling elderly or patients living in residential facilities, who could walk independently with or without assistive devices. Studies that combined multicomponent exercises with other exercise protocols and non-exercise control groups were excluded.

The primary outcome was physical function measured by TUG test, SPBB test, 6MWT and BBS. Secondary outcome was QOL. The restriction to RCTs evenly distributing people in 2 groups reduced the possibility of biasness. Studies with alternative designs and studies in which the intervention or control groups were overseen by experts unqualified to recommend exercise were excluded.

Two independent reviewers chose appropriate articles for inclusion in the systematic review by going through titles and abstracts, rejecting only those that obviously did not fulfil the eligibility criteria. After removing duplicate articles, the full texts of all the articles that remained on the list following the initial selection were searched.

Data was extracted on a standard proforma to organize data about the authors, the year the study was published, details about the study participants, characteristics of the training that was conducted, and the methodology for evaluating the results. The PEDro scale[22] was used for methodological evaluation. The PEDro scale comprises 11 item scores, but the first one was designated as a component of external validity and was therefore not included in the overall assessment. On the 10-point scale, a score of 7 or higher was regarded as high-quality research, 5-6 as fair, and 4 or less as poor.

Results

Of the 1050 studies initially found, 14(1.33%) were analysed in detail (Figure).[5,15,23-34] The PEDro scale ranged 4-8, with a mean of 7.4±2.9 Except for 1(7.14%) study, PEDro score was >6, showing excellent quality of the RCTs analysed. All but 1(7.14%) studies made the eligibility requirements clear, 7(50%) contained concealment of allocation, and all 14(100%) had random grouping of the subjects. Also, 7(50%) RCTs showed similarities at baseline. No participant or therapist was blinded in any of the studies, and 7(50%) had a blinded evaluator. Further, 8(57.14%) RCTs showed retention rates of 85% or higher, and all 14(100%) studies

complied with the requirements for intention-to-treat analysis. Also, 8(57.4%) studies included point estimates and assessments of variability, and all 14(100%) studies used statistical analysis to examine intergroup differences. No study was excluded on the basis of methodological quality (Table 1).

The studies' overall sample comprised 1402 elderly with a mean age of 67.7±1.5 years. Of them, 1150(%) participants were community-dwelling elderly, while 102(%) were living in residential care institutions and 150(%) were residents of nursing care facilities. In terms of geographical distribution, 7(50%) studies were conducted in Europe, 2(14.3%) in Brazil, and 1(7.14%) each in Australia, China, Canada and the United States. All of the included studies had follow-up periods ranging 3-12 months.

All 14(100%) RCTs included multicomponent exercise interventions, like aerobic, strength and balance.

The intervention programme involved range of motion (ROM) exercises as well in 1(7.14%) study, 2(14.3%) investigated balance and strength training of lower extremities, 2(14.3%) investigated the effect of strength, balance and walking retraining, 2(14.3%) involved balance, strength and Tai Chai exercises, 1(7.14) investigated the effect of mobility, flexibility, aerobic and strengthening exercises[26] 1(7.14%) investigated the effect of muscle power training combined with balance and gait training, and 4(28.6%) studies investigated the effectiveness of physical interventions on QOL. There was 1(7.14%) RCT where the intervention lasted a year, while in the other 13(92.85%) trials the interventions lasted <6 months. The frequency of the training programmes was 3 times per week in 9(64.3%) studies, and twice weekly in 5(35.7%) trials. The duration of each session 60 minutes in 9(64.3%) studies, 75 minutes in 1(7.14) study, and 20-45 minutes in 4(28.3%).

Further, 4(28.6%) studies used external weights for upper and lower limb strengthening exercises by estimating one-repetition maximum (1-RM). Exercises were performed initially with light loads (40-60% 1-RM) and then weights were increased to 65-70% 1-RM. The repetitions were also increased. Resistance variable machine for upper and lower body strengthening with progressively increasing loads that optimised the muscle power output was used in 1(7.14%) study. Thera band was used in 2(14.3%) trials for strength training. Tai Chai exercises along with strength training were used by 2(14.3%) studies. Aerobic exercises were part of multicomponent exercises in 4(28.6%) trials, and 8(57.14%) trials used balance training in which exercises were progressed gradually by increasing the level of difficulty and complexity of movements.

Balance was tested in 8(57.14%) RCTs. Modified Romberg test.[35] Frailty and Injuries Cooperative Studies of Intervention Techniques-4 (FICSIT-4),[36] BBS, and Tinneti Performance-Oriented Mobility Assessment (POMA) test were used to examine balance.[37]

There were 9(64.3%) RCTs that measured various aspects of mobility. SPBB test was used by 4(28.6%), with 3(21.4%) showing significant improvement. The 6MWT was used by 4(28.6%) studies, with 2(14.3%) showing significant improvement, while TUG test was used by 9(64.3%) studies, and all of them showed marked improvement. The ability to rise from the chair was tested in 2(14.3%) studies that reported significant improvement.

Falls were observed in 2(14.3%) studies, with 1(7.14%) showing no marked improvement in fall-related psychological outcomes and risk of falls, and 1(7.14%) reporting reduced risk of fall with exercise intervention.

Muscle strength was evaluated by 9(64.3%) RCTs. The strength of upper and lower limbs was measured by using

Table-1: Quality assessment using PEDro scale of the studies analysed.

Reference	Eligibility criteria	Random allocation	Concealed allocation	Groups similar at baseline	Blinded subjects	Blinded therapist	Blinded assessor	< 15% droup out	Intention to treat analysis	Between-group comparisons	Point measure and variability	PEDRO score
Ellien Freiberg[5]	1	1	0	1	0	0	0	1	1	1	1	6
Francis Langlois[23]	1	1	1	0	0	0	1	1	1	1	1	7
Eduardo L[24]	1	1	1	1	0	0	1	1	1	1	1	8
Nicola Fairhall [25]	1	1	1	1	0	0	1	1	1	1	1	7
Anna Mulaso[26]	1	1	1	1	0	0	1	1	1	1	1	8
Jie Zuhang[27]	1	1	1	1	0	0	1	1	1	1	1	8
Hartiz et al[28]	1	1	1	1	0	0	1	1	1	1	1	8
Albernon Costa[29]	1	1	1	1	0	0	0	1	1	1	1	8
Cristiane Batisti Ferreira[30]	1	1	1	1	0	0	1	1	1	1	1	7
Navin kaushal[15]	1	1	1	1	0	0	1	1	1	1	0	7
Hartiz et al[31]	1	1	1	1	0	0	1	1	1	1	1	8
Uratcha Sadjapog[32]	1	1	1	1	0	0	1	1	1	1	1	7
Sylvia sunde[33]	1	1	1	1	0	0	1	1	1	1	1	7
Thomas Cordesa (2021)[34]	1	1	0	0	0	0	1	1	1	1	1	8
	14	12	12	12	0	0	10	12	14	14	13	

Table-2: Characteristics of the studies included.

Author Name	Study Design	Study Population	Intervention	Outcomes
Ellien Freiberg (2012)[5]	Single blinded Four group RCT	280 participants with age 70-90 years	CG: No intervention IG: strength & balance Strength balance & endurance Strength, endurance, fall risk reduction. 16 weeks; Twice weekly; 1-hour session.	Mobility measured by TUG test Balance measured by modified Romberg Test Lower limb strength: chair rise test.
Francis Langlois (2012)[23]	RCT	83 participants with age 60-90 years	CG: Maintain current activities IG: Aerobics, strengthening exercises 12 weeks; Thrice weekly; 1-hour session.	Grip strength measured by dynamometer. Physical endurance measured by 6 min walk test. Mobility measured by TUG test. Cognition measured by Mini Mental Scale. Functional capacity modified physical performance test. Quality of life quality of life systemic inventory questionnaire (QLSI).
Eduardo L(2013)[24]	RCT	24 participants with age 85 years above	CG:No intervention IG: muscle power training combined with balance & gait training Twice weekly; 12 weeks	Muscle strength: dynamometer Muscle cross-sectional-area & quality: computerized topography Risk factor for fall: questionnaire Gait ability & dual task performance : 5 minute habitual gait
Nicola Fairhall et al. (2013)[25]	Single blinded RCT	241 participants with age 70 years & above	CG: Routine medical care IG: home based programme of balance & lower limb strength training 3-5 times weekly; 12 months; 20-30minutes session.	Risk factor for fall: Physiological profile assessment (PPA) Mobility: short physical performance battery test(SPBB) 4 minute walk test.
Anna Mulaso et al. (2015)[26]	RCT	112 participants with age above 65	CG: No treatment IG: ROM, strength & balance exercises.	Balance: Tinetti performance oriented mobility assessment(POMA) Mobility: TUG Test.
Jie Zhaung Liang (2014)[27]	RCT	56 participants with age 60-80 years	CG: Usual physical activity IG: Balance exercises Strength exercises; Tai Chun exercises; 3 times/week; 12 weeks; 60 minute session	Dynamic balance and functional mobility: TUG Test Predictor of fall & dynamic balance: Functional reach test(FRT) Lower body strength & endurance :CS 30 Dynamic balance: SEBTs(star excursion balance test).
Hartiz Arrierta et al. (2017)[28]	RCT	114 participants with age above70 years	CG: Routine activities IG: Strength, balance & walking retraining 45 minutes session; 6 months.	Lower extremity function, static balance, gait speed & getting in & out of chair: Short physical performance battery test(SPBB) Dynamic balance: instrumented TUG Test Upper & lower limb strength, flexibility, static & dynamic balance Postural stability: Berg Balance Scale Hand grip strength: bilateral hand grip strength test Ability to control balance on platform: stabiliometry Standard gait speed, step frequency, cadence: instrumented walking.
Albernon Costa (2017)[29]	RCT	26 participants with age above 60 years	CG: Routine activities IG: Strength, balance & walking retraining 45 minutes session; 6 months.	Functional capacity measured by senior fitness test Bach stretch; 30s chair test; 8ft up & go; 6 min walk test; Cognition measured by Mini Mental; Quality of life measured by WHOQOL-BREF
Cristiane Batisti Ferreira (2018)[30]	RCT	37 participants with age 60 years above	CG: Routine medical care IG: Mobility, flexibility, strength, aerobic exercises) 3 times/week; 12 weeks; 40 minutes' session.	Functional mobility: TUG Test Hand grip strength: dynamometer Cognitive function: Mini Mental state examination Depression & functionality: Katz Scale.
Navin Kauhal (2018)[15]	RCT	112 participants with age 70 years above	CG: Routine activities IG: Strength, balance & walking retraining 45 minutes session; 6 months.	Static balance: Berg Balance Scale Mobility: TUG Test 6minute walk test; Fast 4 minute walking speed; Handgrip strength :Bilateral hand grip strength test; Lower extremity function, static balance, gait speed: SPBB.
Hartiz Arrierta et al (2018)[31]	RCT	112 participants aged above70 years	CG: Routine activities IG: Strength, balance & walking retraining 45 minutes session 6 months	Static balance: Berg Balance Scale Mobility: TUG Test; 6minute walk test; Fast 4-minute walking speed Handgrip strength: Bilateral hand grip strength test Lower extremity function, static balance, gait speed: SPBB
Uratcha Sadjapog (2020)[32]	RCT	64 participants with age 65 years above	CG: Usual Care IG: Chair aerobics ,strength, balance 24 weeks; 3 days/week; 60 minutes' session.	Dynamic balance, mobility: TUG Test Handgrip Strength: Dynamometer Static balance: Berg balance scale VO_2 max; CRP C reactive protein.
Sylvia Sunde (2020)[33]	RCT	89 participants with age 65-89 years above	CG: maintain routine care IG: Strength training, balance exercises. Twice weekly; 16 weeks; 50 minutes' session.	Physical performance measured by short physical performance battery test 6 min walk test; Balance measured by Berg balance scale Grip strength measured by dynamometer; Quality of life measured by HRQOL SF 36.
Thomas Cordesa (2021)[34]	RCT	52 participants with age 80 years above	CG: Routine care IG: Strength, aerobics Coordination & motor cognitive exercises ADLs	Hand grip Strength: Dynamometer Barthal index: independence of participants with ADLs Dynamic sitting balance: Modified FRT Cognition: (MOCA) Montreal cognitive assessment Manual dexterity: Purdue pegboard test Health related physical & mental wellbeing: short form of health survey(SF16).

G: Control group, IG: Interventional group, TUG test: Time up & go test; MOCA: Montreal cognitive assessment, HRQOLSF36: Health-related quality of life-short form, QLSI: Quality of life systemic inventory questionnaire.

different tests in 4(28.6%) studies. The strength of knee and ankle flexor, extensors were measured using 30-sec chair stand (CS30)[38] test by 2(14.3%) studies that showed marked improvement, with subjects walking at a faster pace with longer steps, had a shorter support phase, and more ROM in the sagittal plane at the hip and ankle joints. The hand grip strength using dynamometer was measured by 7(50%) RCTs which evaluated the dominant hand's grip strength. Increased strength was reported by 5(35.7%) studies, while 2(14.3%) showed no improvement.

HRQOL was measured in 5(35.7%) RCTs. Quality-of-Life Systemic Inventory questionnaire was used by 2(14.3%) studies to measure the ability to accomplish one's personal goals in 28 different life domains, such as marriage, self-esteem and sleep, scoring 9 different QOL dimensions, and reporting significant improvement. One (7.14%) study used the World Health Organization Quality of Life Brief Version (WHOQOL-BREF)[39] structured questionnaire, which evaluates individual perception in various groups and settings Through 26 questions that cover physical, psychological, social and environmental aspects. HRQOL was measured by 36-item Short-Form Health Survey (SF-36) by 2(14.3%) trials[34] with 1(7.14%) showing no or slight difference, and 1(7.14%) showing significant improvement (Table 2).

Discussion

The systematic review was planned to determine the value of multicomponent exercises for the aged population, showing how they can enhance balance, muscle strength, and overall QOL.[5,40] The majority of the trials in this review reported statistically significant effects for falls, mobility, balance, functional ability, muscle strength, and mental and social wellbeing, with the exception of one trial that found no improvement in QOL after the intervention.[41]

Our search strategy focussed on studies with a variety of exercise programmes and with a broad range of methods to assess the results. It is difficult to conclude which exercise programme would work the best for old-age group. It is suggested in the light of the findings that programmes focussing on many physical abilities (strength, endurance, balance, flexibility) improve performance in terms of older persons' overall functional ability.

Suzuki et al.[42] conducted a study consisting of an exercise programme of resistance training. They used 6MWT and the sit-and-reach test (SRT) to evaluate mobility and strength. There was a marked improvement in the intervention group. Catarina et al[43] concluded that a 12-week exercise protocol consisting of resistance training resulted in noticeable change in the strength of the upper limbs. In a study comprising supervised exercise programme for 12 weeks 10.74% increase in QOL was found without decrease in depression.[30] Another study[43] using a 12-week strength training programme showed improvement in physical functioning, evaluated by the Barthel Index of Activities of Daily Living (BI-ADL), and in dynamic balance, measured by five-time sit-to-stand (FTSTS) and TUG tests.

A trial by Naoto Taguchi et al[44] reported marked improvement in balance using BI-ADL FTSTS scores. Also, no apparent improvements related to HRQOL have also been reported. Similar findings were observed by Thomas Cordes et al., who worked on strength, endurance, balance, flexibility and psychosocial measures.[45]

Young Hee Cho completed an 8-week study comprising group fitness class. The intervention significantly reduced the risk of falling by improving balance and strength. (p=0.001).[46] Erik Rosendahl et al. tested out high-intensity exercises for 3 months to enhance balance and to lower the rate of falls. There was no difference in terms of incidence rate ratio, fall rate and the incidence of fall.[47]

The current systematic review has methodological limitations. There was a lot of variation among the studies included in terms of characteristics of the interventions and outcome measures. Multicomponent training, which provides a wide range of exercises with an enormous number of options and combinations, was the most advised intervention for study participants, but the review could not conclude which combination of exercises are best for the elderly. Besides, only a few studies were conducted in institutionalised and hospital settings that prevented significant comparisons between them, and the small sample sizes of some of the trials also contributed to the review's limitations, thus weakening the conclusion. Finally, the review considered studies published only in English language.

Future studies should investigate adherence to exercise plan, long-term effects of the exercises, and whether or not significant results transfer into significant benefits in clinical practice.

Conclusion

Multicomponent exercises were generally found to be good for the functional status, cognitive function, and QOL of the elderly. It was a successful method of lowering the fall risk and a useful technique to improve muscle strength and functional status. It is crucial to promote multicomponent exercises among the aged in order to increase their independence in daily life.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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SK: Conceived idea, literature search, data collection and writing.
SS: Data interpretation, literature search and critical analysis.
NJ: Data interpretation and critical analysis.