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 trend continues, then the elderly population will reach up to 2 billion by the end of 2050. There are many changes associated with the ageing process, such as decrease in muscle strength, balance, endurance, etc. 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. Decreases in functional independence may result in increased risk of fall and injuries. More than one-third of people aged 65 and above suffer a fall at least once each year. It has been reported that the rate of disabilities are significantly increasing in the elderly age group, especially after the age of 85. 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. Previous studies have shown that physical exercises for at least 6 months can reduce the risk and rate of falls. WHO endorses at least thirty minutes of moderate-intensity physical activity five days a week for the geriatric population.

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

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

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 compared to controlled interventions 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 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 (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, short physical performance battery (SPBB) test, 6-minute walk test (6MWT) and the Berg balance scale (BBS). 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 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). 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%) investigated the effect of mobility, flexibility, aerobic and strengthening exercises

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 Chi 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, Frailty and Injuries Cooperative Studies of Intervention Techniques-4 (FICSIT-4), BBS, and Tinneti Performance-Oriented Mobility Assessment (POMA) test were used to examine balance.

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

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Table 2: Characteristics of the studies included.

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<th>Author Name</th>
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<th>Study Population</th>
<th>Intervention</th>
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</table>
| Ellien Freiberg (2012)       | Single blinded | 280 participants with age 70-90 years | CG: No intervention  
IG: strength & balance  
Strength balance & endurance  
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)      | 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 measured by modified physical performance test. Quality of life measured by life systemic inventory questionnaire. (QLSI). |
| Eduardo L (2013)             | 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 test  
Risk factor for fall: Physiological profile assessment (PPA)  
Mobility: short physical performance battery test (SPBB)  
4 minute walk test. |
| Nicola Fairhall et al. (2013) | Single blinded | 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; 20-30 minutes session. | Balance: Tinetti performance oriented mobility assessment (POMA)  
Mobility: TUG test.  
Dynamic balance and functional mobility: TUG Test  
Predictor of fall & dynamic balance: Functional reach test (FRT)  
Lower body strength & endurance: CS 30  
Dynamic balance: SEBT (star excursion balance test). |
| Anna Mulaso et al. (2015)    | RCT          | 112 participants with age above 65 | CG: No treatment  
Mobility: TUG test. |
| Jie Zhuang Liang (2014)      | RCT          | 56 participants with age 60-80 years | CG: Usual physical activity  
IG: Balance exercises; Tai Chi 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: SEBT (star excursion balance test).  
Functional mobility: TUG Test  
Hand grip strength: dynamometer  
Cognitive function: Mini Mental state examination  
Depression & functionality: Katz Scale. |
| Hartz Arrierta et al. (2017)  | RCT          | 114 participants with age above 70 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: stabilometry  
Standard gait speed, step frequency, cadence: instrumented walking. |
| Albernon Costa (2017)         | 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  
Bench stretch; 30s chair test; 8ft up & go; 6 min walk test; Cognition measured by Mini Mental; Quality of life measured by WHOQOL-BREF  
Functional mobility: TUG Test  
Hand grip strength: dynamometer  
Cognitive function: Mini Mental state examination  
Depression & functionality: Katz Scale. |
| Cristiane Batisti Ferreira (2018) | 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. | Static balance: Berg Balance Scale  
Mobility: TUG Test  
6 minute walk test; Fast 4 minute walking speed; Hand grip strength; Bilateral hand grip strength test  
Lower extremity function, static balance, gait speed: SPBB.  
Standard gait speed, step frequency, cadence: instrumented walking.  
Dynamic balance, mobility: TUG Test  
Hand grip strength: Dynamometer  
Static balance: Berg balance scale  
VO2 max; CRP C reactive protein.  
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. |
| Naveen Kauhal (2018)          | 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; 6 minute walk test; Fast 4 minute walking speed  
Hand grip strength: Bilateral hand grip strength test  
Lower extremity function, static balance, gait speed: SPBB.  
Dynamic balance, mobility: TUG Test  
Hand grip strength: Dynamometer  
Static balance: Berg balance scale  
VO2 max; CRP C reactive protein.  
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. |
| Hartz Arrierta et al (2018)   | RCT          | 112 participants aged above 70 years | CG: Routine activities  
IG: Strength, balance & walking retraining  
45 minutes session 6 months. | Static balance: Berg Balance Scale  
Mobility: TUG Test; 6 minute walk test; Fast 4 minute walking speed  
Hand grip strength: Bilateral hand grip strength test  
Lower extremity function, static balance, gait speed: SPBB.  
Dynamic balance, mobility: TUG Test  
Hand grip strength: Dynamometer  
Static balance: Berg balance scale  
VO2 max; CRP C reactive protein.  
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. |
| Utartha Sadjapog (2020)       | 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  
Hand grip strength: Dynamometer  
Static balance: Berg balance scale  
VO2 max; CRP C reactive protein.  
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. |
| Sylvia Sunde (2020)           | 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 Contesa (2021)         | RCT          | 52 participants with age 80 years above | CG: Routine care  
IG: Strength, aerobic  
Coordination & motor cognitive exercises  
ADLs | Hand grip Strength: Dynamometer  
Barthel 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). |
different tests in 4(28.6%) studies. The strength of knee and ankle flexor, extensors were measured using 30-sec chair stand (CS30) 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) 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 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. 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.

Our search strategy focused 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 focusing on many physical abilities (strength, endurance, balance, flexibility) improve performance in terms of older persons' overall functional ability.

Suzuki et al. 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. 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. Another study 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. 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.

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. 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. 

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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30. Ferreira CB, Teixeira PDS, Alves Dos Santos G, Dantas Maya AT, Souza VC, et al. Effects of a 12-Week Exercise


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