

The effect of a multicomponent exercise programme on elderly adults' risk of falling in nursing homes: A systematic review

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Abstract

Objective: To determine the effect of a multi-component exercise programme on elderly adults' risk of falling in nursing homes.

Methods: A computerised search of published randomised controlled trials in the English language was performed using PubMed, Cochrane Library, the Cumulative Index of Nursing and Allied Health Literature, Physiotherapy Evidence Database (PEDro), and the Institute for Scientific Information up to December 2017. We included high-quality articles that reported a score of ≥ 5 on the Physiotherapy Evidence Databasescale which compared multi-component exercise with a single exercise programme in nursing homes, with the risk of falling as an outcome, among participants aged ≥ 65 years.

Results: A total of 8 articles, comprising 382 participants, were included. All these articles scored 6-8 points out of 10 on the PEDro scale, with an average of 6.7 points. The mean age of participants in the included articles was ranged from 76 ± 8.0 to 92 ± 2.0 years, and 286 (75%) participants were females. A multi-component exercise programme in the experimental group, which had 204 (53.4%) subjects significantly reduced the risk of falling in nursing homes compared to a single-exercise programme, which was used in the control group that had 178 (46.6%) subjects.

Conclusion: A multi-component exercise programme was found to be useful for reducing elderly adults' risk of falling in nursing homes.

Keywords: Exercise, Elderly, Nursing home, Systematic review, Fall. (JPMA 70: 699; 2020)

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Introduction

The risk of falling increases as the muscles weaken, and balance declines sharply as people grow older.¹ The elderly living in a nursing home have declined mobility and balance compared to the community-dwelling elderly. Evidence indicates that there is double the risk of falling among the elderly adults in nursing homes compared to the community-dwelling older adults.² More than half of nursing home residents have a risk of falling each year.³ Moreover, the cost related to fall injuries in nursing homes are very high, and this also increases with age.⁴

Various types of exercise programmes, such as muscle strengthening exercises, flexibility training, aerobic exercises, whole body vibration (WBV) exercises, and walking, reduce the risk of falling in the elderly.⁵ Some researchers have also suggested that appropriate and adequate training programmes are effective in improving strength and balance, thus reducing the risk of falling in

nursing homes among the elderly.^{6,7} Exercises represent a common strategy for reducing the risk of falling in nursing homes.⁸ However, chronic health conditions and decline in physical and mental health are limitations for the elderly in performing exercises in nursing homes.⁶

Many reviews have described and drawn conclusions regarding the effectiveness of exercise programmes to improve muscles strength, balance control and reducing the risk of falling in community-dwelling elderly.^{9,10} A Cochrane review provided substantial evidence that multifactorial interventions with a multidisciplinary team minimised the risk of falling (risk ratio 0.85, 95% confidence interval [CI] 0.86-1.01) among 1925 participants from 5 trials in nursing care facilities.¹¹ However, systematic reviews and meta-analyses have shown inconsistent evidence for exercise interventions in long-term care facilities.¹² Thus, the current review was planned to critically evaluate the current evidence from high-quality randomised controlled trials (RCTs) of exercise programmes to determine whether such programmes can prevent the elderly's risk of falling in nursing homes. Also, it was planned to examine the effect of multi-component exercise programmes on the elderly in nursing homes.

Methods

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This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.¹³ A systematic literature search of PubMed, Cochrane, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), Physiotherapy Evidence Database (PEDro), and Institute for Scientific Information (ISI) electronic databases was done up to December 2017. Key Words used included physical activity, physical training, motor activity, gait training, balance training, bicycling, walk, dance, yoga, 'tai chi', 'Tai Ji', exercise therapy, exercise training, balance, risk of falling, the elderly, older adult, aged, and nursing home.

The titles and abstracts of all identified articles were read by the three investigators independently. The articles included were related to multicomponent exercise programme intervention compared with a single-exercise programme intervention or another type of response; RCTs conducted in nursing homes with outcomes that included

risk of falling; the participants were aged 65 years and above; PEDro scale¹⁴ scores were 5 or higher; and the full-text article was written in the English language. Next, the full-text articles of all the eligible studies were obtained and evaluated by two investigators. After all disagreements were resolved, the following data from each included article was extracted: patient characteristics (group, the number of participants, mean age, and gender distribution); chance of an outcome of falling; and intervention (type of exercise, frequency, and duration). PEDro scale was utilised to assess the quality of the included articles. However, a meta-analysis could not be performed with the included articles due to considerable heterogeneity in the duration of interventions and outcome measures.

Results

Of the 95 studies initially located, 8(8.4%) RCTs were included for analyses (Figure). All studies included in this review scored 6-8 points out of 10 points on the

Table-1: Methodological quality assessment of the included studies.

Study	Eligibility criteria	Random allocation	Concealed allocation	Baseline similarity	Blind subjects	Blind therapists	Blind assessors	Adequate follow-up	Intention-to-treat analysis	Between-group comparisons	Point estimates and variability	Total Score
Bruyere ¹⁵	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Donat ¹⁶	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	6/10
Serra-Rexach ¹⁹	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	7/10
Gusi ¹⁸	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8/10
Beaudart ¹⁷	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7/10
Buckinx ¹⁴	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	7/10
Alvarez-Barbosa ⁸	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	6/10
Tzu-Ting Huang ²⁰	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8/10

Table-2: Descriptive characteristics of the included studies.

Study, year	Country	Females %		Age, Mean±SD		Study group, (n)		Intervention
		E	C	E	C	E	C	
Bruyere, ¹⁵ 2005	Belgium	81	65	84 ± 5.9	79 ± 6.9	22	20	E: Controlled WBV+PT C: PT, standard EXs program.
Donat, ¹⁶ 2007	Turkey	66	59	79 ± 6.2	81 ± 4.3	15	17	Both group: Balance, strengthening, stretching, posture EXs and functional activities.
Serra-Rexach, ¹⁹ 2011	Spain	80	80	92 ± 2.0	92 ± 2.0	20	20	E: UC + Aerobic training, stretching and strength EXs. C: UC: mobility EXs program.
Gusi, ¹⁸ 2012	Spain	70	75	76 ± 8.0	76 ± 8.0	20	20	E: UC + balance and weight shifting training. C: UC.
Beaudart, ¹⁷ 2013	Belgium	64	87	82 ± 9.0	84 ± 6.8	31	31	E: UC + WBV for 3 months. C: UC.
Buckinx, ¹⁴ 2014	Belgium	64	87	82 ± 9.0	84 ± 6.8	31	31	E: UC + WBV for 6 months. C: UC.
Alvarez-Barbosa, ⁸ 2014	Spain	80	86	82 ± 6.7	84 ± 3.0	14	15	E: UC + WBV for 8 weeks. C: UC: mobility and stretching EXs
Tzu-Ting Huang, ²⁰ 2016	Taiwan	13	11	79 ± 6.9	81 ± 5.4	51	24	E: Cognitive behavioural + EXs for 8 weeks (twice a week for 30 min.) C: UC

C: control group; E: experimental group; EXs: exercises; PT: physical therapy; UC: usual care; WBV: whole-body vibration.

Table-3: Detailed intervention characteristics and outcome of included studies.

Study, Year	Type of exercises	Repetitions	Session duration	times/ week	No. of weeks	Dropout rates	Patients adherence	Outcomes	Results
Bruyere, ¹⁵ 2005	UC:PT program (gait and strengthening EXs. Controlled WBV training.	4 series 1st and 3rd:10Hz 2nd and 4th: 26 Hz	1 min	3	(6 weeks)	14%	Two adverse effects	Tinetti test TUG Test	Significant improve: Tinetti and TUG scores in E group
Donat, ¹⁶ 2007	Balance training. Strengthening and stretching EXs. Flexibility EXs. Posture EXs	As tolerated	(45-50) min	3	(8 weeks)	21%	1 died	TUG test BBS	Significant improve TUG test and BBS both groups.
Serra-Rexach, ¹⁹ 2011	Stretching EXs. Aerobic training. Strength training. Resistance training.	For strength training: 2-3 sets and 8-10 repetitions. For resistance training: 1set and 8-10 repetitions.	(45-50) min	3	(8 weeks)	5%	4 (one died, one hospitalised, one edema, and one urinary infection)	TUG test	Muscle strength increased, fall risk decreased in E group.
Gusi, ¹⁸ 2012	Balancing, posture stability EXs with/without visual feedback. Weight shift EXs.	N/A	15 min	2	(12 weeks)	None	None	Fall Risk Test (Biodex Balance System)	Dynamic balance improved in E group more than C group.
Beaudart, ¹⁷ 2013	WBV training	5 series. 30 Hz.	15 sec. each set	3	(12weeks)	8%	4 (2 died, 1 refused, 1 unable to Perform the test)	Tinetti test TUG test Quantitative Walking analysis	No significant difference in risk of fall between E and C group.
Buckinx, ¹⁴ 2014	WBV training.	5 series. 30 Hz.	1 min 15 sec. 30 sec. Between series.	3	(24 weeks)	41%	4 (1 died, 2 hospitalised, 1 physical inability)	Tinetti test TUG Quantitative Walking analysis	No significant Improvement or different in fall risk between E and C group.
Alvarez-Barbosa, ⁸ 2014	Isometric squatting, WBV. Step up and down, lunge, squat, calf raises and pivot in front and lateral positions.	Gradually increased every 2 weeks started from 6 repetitions and reached 12 at last 2 weeks. 30 Hz in 1st month. 35 Hz in the 2nd month.	Duration of Session Increased from (12.3) min in the first 2 weeks to (17.1) min in the last 2 weeks.	3	(8 weeks)	13%	None	TUG test	TUG score improved in E group.
Tzu-Ting Huang, ²⁰ 2016	Cognitive Behaviour and EXs.	N/A	30 min	2	(8 Weeks)	4%	None	GFFM and FES	GFFM scores for E decreased and FES scores increased.

BBS: berg balance scale; C: control group; E: experimental group; EXs: exercises; FES: falling efficacy scale; GFFM: geriatric fear of falling measurement; PT: physical therapy; S: supervised exercise; TUG: time up & go; US: Unsupervised exercise; WBV: whole-body vibration.

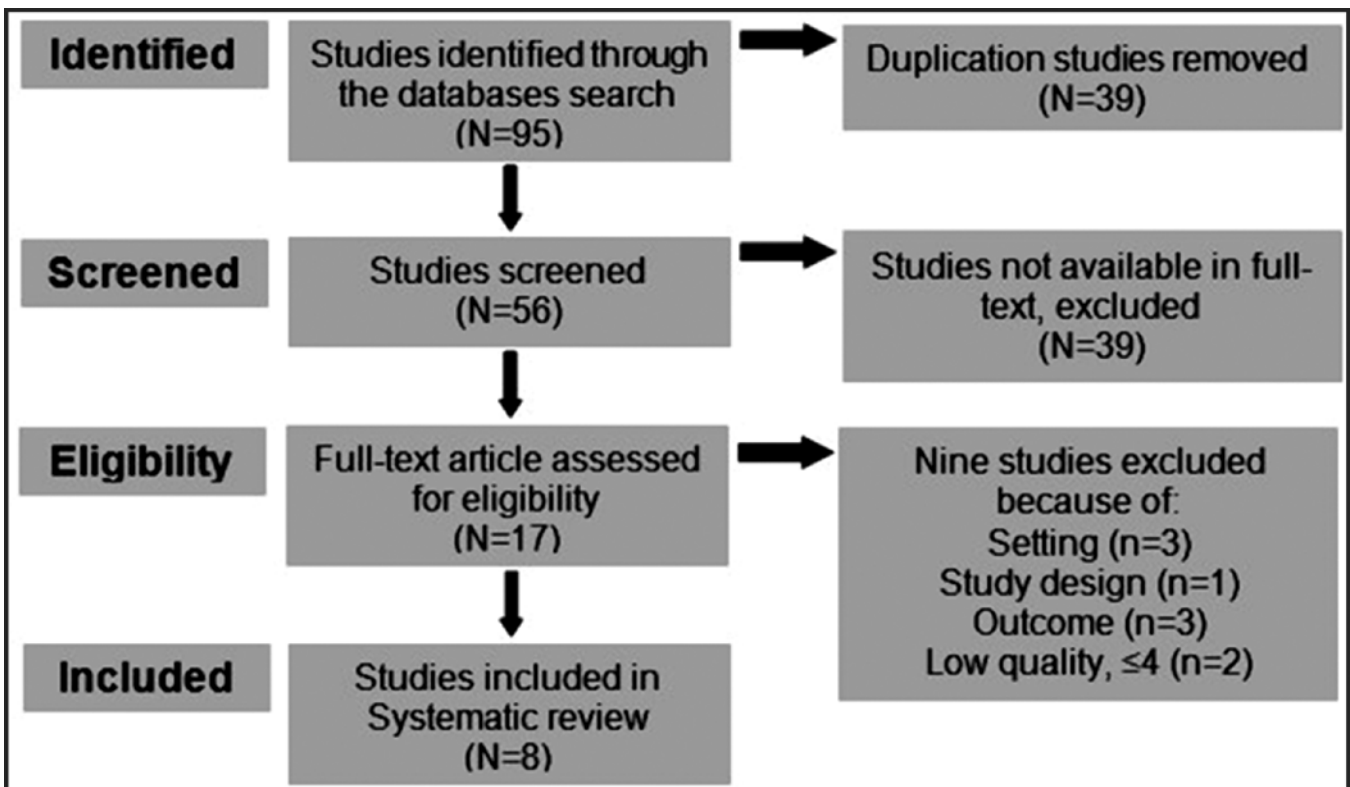


Figure: Flowchart of the articles selected, included, and analysed.

PEDro scale,¹⁴ with an average of 6.7 points. None of the included studies had blinded subjects; one study had a blinded therapist,¹⁴ and two studies^{8,15} did not have blinded assessors in their outcome measures. Three studies^{8,14,16} did not have adequate follow-up (Table-1).

The studies had a total of 382 participants; 204(53.4%) in the experimental group exposed to multicomponent exercise programmes, and 178(46.6%) in the control group exposed to a single-exercise programme.^{8,15-21} The mean age of participants in the included articles ranged from 76±8.0 to 92±2.0 years, and 286(75%) participants were females. Of the eight studies, 3 each were conducted in Belgium,^{14,15,17} and Spain,^{8,18,19} while one each was done in Turkey¹⁶ and Taiwan.²⁰ All the studies had a multicomponent exercise programme including whole-body vibration (WBV), physical therapy, balance, strengthening, flexibility, posture, lower-limb stretching, and Biodex Balance System (England) for the experimental group (Table-2).

Each study had interventions of different frequencies and durations: 1(12.5%) study¹⁵ exposed the participants to the intervention 3 times per week for up to six weeks; 3(37.5%) studies^{8,16,19} 3 times per week for up to 8 weeks; 1(12.5%) study¹⁸ 2 times per week for up to 12 weeks; 1(12.5%) study¹⁷

2 times per week for up to 3 months; 1(12.5%) study¹⁴ 3 times per week for up to 6 months; and 1(12.5%) study²⁰ two times per week for up to 8 weeks. The length of each session of the intervention varied from 8 to 50 minutes. Each study used various tools to measure the risk of falling (Table-3).

Discussion

This systematic review set out to examine the effect of a multi-component exercise programme on the elderly's risk of falling in nursing homes. Our assessment illustrated that all of the articles performed adequate random sequence generation. The present review revealed that a multi-component exercise programme might be useful in lowering the risk of falling in nursing homes. Regarding the overall outcome, a multi-component exercise programme of shorter duration may be helpful in reducing the risk of falling in nursing homes.

A total of 6(75%) studies^{8,15,16,18-20} found that the multi-component exercise programme was effective in reducing the risk of falling in nursing homes, while 2(25%) studies^{14,17} concluded that multi-component exercise programme was not sufficient in both the experimental and control groups. Compared to the control group, the experimental group lowered the risk of falling after a multi-component exercise programme by improving balance,^{15,16,18} muscle

strength,^{15,19} and functional mobility.¹⁶ An interesting finding of this review was that out of the 8 articles, 4 showed that the risk of falling among older adults was reduced after whole-body vibration (WBV) exercises with usual care. This finding is consistent with the results of previous studies.^{21,22}

In this review, none of the patients from the included articles were blinded to the study and its objectives, which could confound the results. The nature of the interventions and the prerequisite of obtaining informed consent often make it challenging to maintain blinding. For the most part, it is difficult to blind the therapists because they must be acquainted with the intervention that they are controlling. However, one study¹⁴ blinded the therapist. Two of the included articles^{8,15} did not use a blinded assessor, which can introduce considerable bias into the results of the study. In particular, specialists frequently have firm convictions about their support of a specific methodology. The inclusion of these articles did not affect the results, and the methodological features of the RCTs of interventions were improved.

The outcome of the included studies showed that the multi-component exercise programme improved balance, muscle strength, and functional mobility in elderly adults, thus reducing their risk of falling in nursing homes. These findings collectively indicate that multi-component exercise programme might be useful in lowering the risk of falling among older adults. Multi-component exercises, such as those that enhance muscle strength, mobility and balance, contribute to a reduced age-related risk of falling by improving muscle conditioning, which is followed by improved mobility and balance.^{23,24} None of the studies showed that a single-exercise programme was effective in reducing the risk among the elderly, likely because a single-exercise programme cannot improve the multiple conditions associated with the risk of falls in older adults.²⁵ We identified only two studies^{14,17} that showed no significant differences between the two types of interventions in reducing the risk of falling.

The findings of this review are consistent with the results of previous studies.^{23,26} For example, a study investigated the effects of different exercises on the risk of falling among physically frail elderly adults.²⁷ It found that multi-component exercise programmes that include balance, strength, and endurance exercises improved stability and strength, and decreased the risk of falling. Another review²⁸ evaluated the effects of exercise on elderly adults' risk of falling and suggested that an exercise programme with short or long duration can lower the risk of falling.

An interesting finding of this review was a significant

improvement in berg balance scale (BBS), Time up & go (TUG) and Tinetti test scores after the intervention. One study also indicated that when the BBS score went ≥ 50 ,²⁹ and the Tinetti score ≥ 24 ,³⁰ the fall risk was considered low.³¹ Therefore, clinical tests, such as the BBS, Tinetti, and TUG, are suitable for assessing the effects of an exercise programme on balance in older adults at risk of falling.³² A study³³ showed that a 12-week multi-component exercise programme improved fall-related physical performance and gait, as measured using the TUG test, indicating a reduced risk of falls in community-dwelling older adults.

A major strength of this review is our inclusion of high-quality RCTs. This review has some limitations. First, there was no follow-up, which prevented studying the effects of a multi-component exercise programme on the actual rate of falling. Second, the total number of included articles in this review was small and limited to elders living in nursing homes; thus, it omitted some relevant literature. Third, some of the included studies had short follow-up periods. These characteristics may decrease their generalisability. Fourth, the lack of publication bias underpins the production inclination evaluation. Fifth, the heterogeneity of the included studies was not acknowledged. Finally, the articles that were included in this review were limited to full-text articles written in the English language, and it is possible that some studies may have been missed.

Future research is needed to confirm the frequency and duration needed for a multi-component exercise programme to reduce elderly adults' risk of falling in nursing homes. The use of standardised outcome measures for the risk of falling in future studies would facilitate meta-analyses on the effectiveness of multi-component exercise programme interventions.

Conclusion

A multi-component exercise programme was more useful in reducing the elderly adults' risk of falling in nursing homes than a single-exercise programme.

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