

Comparing the Cost-Effectiveness of Multimodal versus Unimodal Interventions that Include Exercise to Prevent Falls among Community-Dwelling Older Adults: A Systematic Review

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Background
Falls among older adults are a major public health concern that impose a significant health and economic burden. ¹ Around 20% to 30% of older adults experience at least one fall annually. ² Exercise training alone or in conjunction with other falls prevention strategy can prevent falls. Systematic reviews demonstrate that exercise delivered as a unimodal intervention or in conjunction with other strategies (i.e., a multimodal intervention) can be cost-effective. ³ Yet, how their cost-effectiveness compares remains unknown.
Purpose: We conducted a systematic review to compare the cost-effectiveness of exercise, delivered as a unimodal intervention (EX) or in conjunction with other fall prevention strategies for preventing falls (EX-Plus) among community-dwelling older adults.
Methods
<ul style="list-style-type: none">Databases searched: Medline, Embase, NHS EED, and CINAHL (1 Jan 1946 to 31 Jul 2021)Search terms: Fall prevention, cost-effectiveness, cost-utility, unimodal, multimodal, exercise, community-dwelling older adults.Inclusion criteria: 1) Trial- or model-based economic evaluations of trial-design randomized controlled trials of exercise-only interventions or multimodal interventions that include exercise. 2) Community-dwelling older adults 60 years and older.Exclusion criteria: Protocols, systematic reviews, conference publications, and non-English publications.Quality & Bias Appraisal: 1) Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist, 2) Cochrane Risk of Bias Assessment (RoB2)

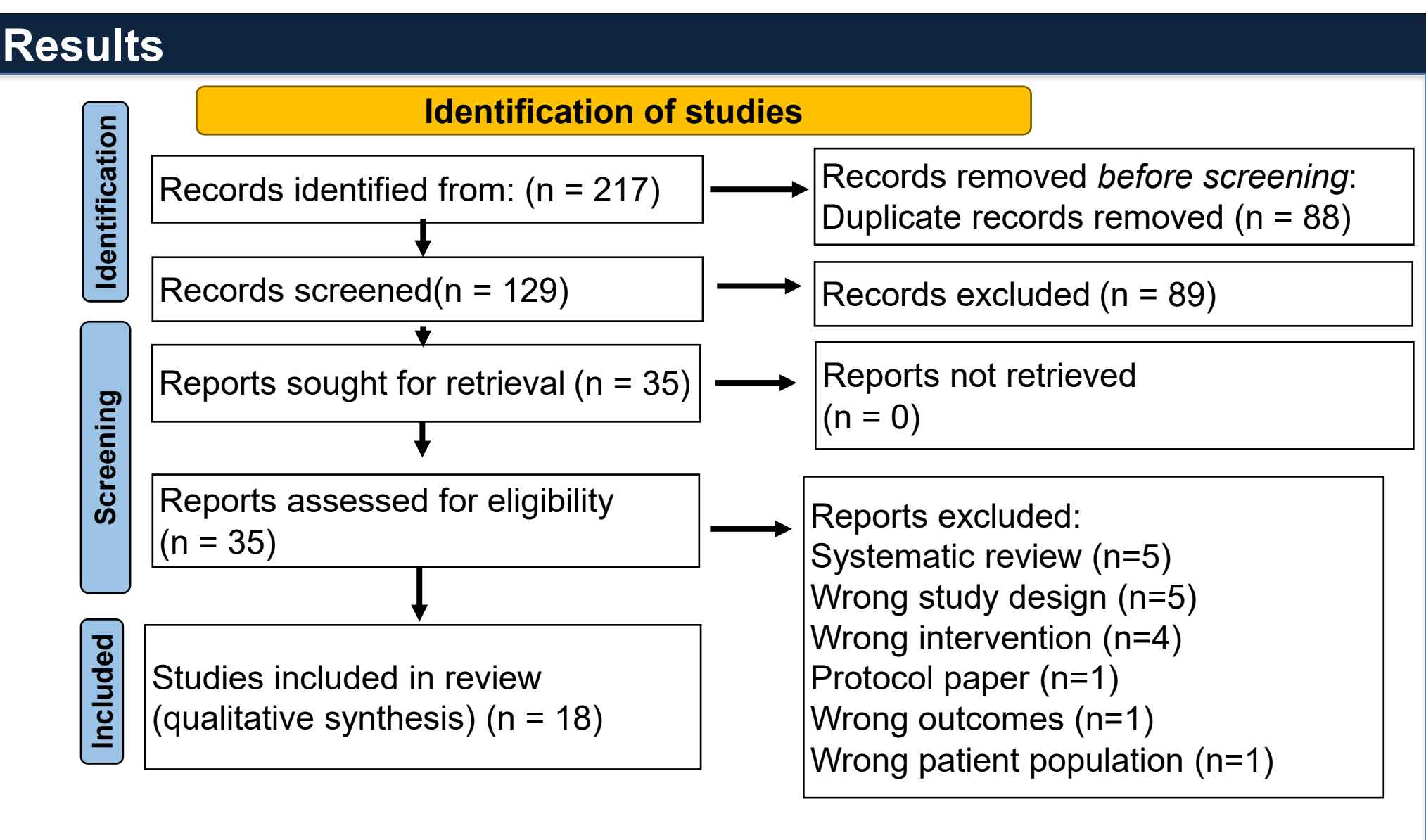


Figure 1: Prisma diagram

Study descriptions				
Table 1: Summary of included studies				
Reference	Intervention Type	Economic evaluation method; outcome measure	Cost-effective?	ICER/ICUR in 2021 USD
Unimodal (EX)				
Davis et al., 2010	Group-based resistance training exercise	CEA: Fall prevented	✓	1) once-weekly RT = (1,959.55)/ 11 = \$(178.14) 2) Twice-weekly RT = (1,136.48)/ -7 = \$162.36
Davis et al., 2011	Group-based resistance training exercise	CEA: Fall prevented; CUA: QALY gain.	✓	1) Once and twice-weekly RT dominates balance and tone classes
Farag et al., 2015	Home-based muscle and balance exercise	CEA: Extra person showing improvement in mobility performance; health status; CUA: QALY gained	✓	a) Mobility improvement = \$17,762.97 b) Health status = \$14,716.08 c) QALY gained = \$59,887.95
Iliffe et al., 2014	1) Home-based exercise program (OEP) 2) Community-based group exercise program (FAME)	CEA: Extra person exercising; CUA: mean difference in QALY scores	✗ ✓	ICER: 1) Not cost-effective 2) Mean total cost per 100 person for FAME program is \$20,782.85. ICUR: No significant difference between groups
McLean et al., 2015	Group-based exercise program	CEA: Fall, injurious fall, and fracture averted; CUA: Incremental QALYs	✗	ICER= \$543.31 (cost effective for women only = \$513.31); \$979.96 (women only = \$842.46) ICUR: Incremental cost per QALY (95% CI): not cost-effective; 42,900.42 (83,049.30) (women only = \$19,154.06 (40,174.71))
Munro, et al., 2004	Group-based exercise classes	CUA: QALY	✓	Mean cost per QALY of \$20,238.73
Robertson, Gardner, et al., 2001	Group-based exercise	CEA: Fall event prevented		ICER = \$1,755.08
Robertson, Devlin, Gardner, et al., 2001	Home-based exercise	CEA: Fall prevented, fall with an injury prevented	✓	ICER per fall prevented = \$2,083.24
Robertson, Devlin, Scuffham, et al. 2001	Muscle and balance retraining	CEA: Fall prevented	✗	ICER (per fall prevented) a)year 1 = \$384.26 b)after year 2 = \$324.29; (per fall resulting in moderate or serious injury prevented); a)year 1 = \$559.25 b) after year 2= \$521.32
Multimodal (EX-Plus)				
Irvine et al., 2010	Multifactorial fall assessment and referral	CEA: Fall averted	✗	ICER = \$ 3,694.23
Beard et al., 2006	Multi-strategic, community based intervention	Cost-benefit analysis based on hospital admission rates	✓	NPV (benefit cost ratio): Average (M1, M2): i) State government: \$8,008,567.21 (8:5:1); ii) Commonwealth government: \$13,642,623.05 (13:75:1); iii) Community: \$15,766,210 (20:6:1)
Matchar et al., 2019	Multifactorial program	CUA: QALYs gained	✗	ICUR = \$115,219.64/ QALY
Peeters et al., 2011	Multifactorial fall risk assessment	CEA: avoided faller and recurrent faller; CUA: Incremental cost per QALY	✗	ICER: a) % fallers = \$255.10 b) % recurrent fallers = \$(316.06) ICUR: not cost-effective \$(262,477.17)
Rizzo et al., 1996	Targeted multifactorial intervention	CEA: fall (and fall resulting in medical care) prevented	✓	a) ICER per fall prevented = \$3,079.54 b) ICER per medical fall prevented = \$15,343.81
van Haastregt et al., 2013	Multicomponent cognitive behavioral group program	CEA: additional patient who is not afraid of falling and no longer avoiding activity due to fear of falling	✓	ICER: a) fear of falling = \$1,274.12 b) activity avoidance = \$813.30
Both Unimodal (EX) and Multimodal (EX-Plus)				
Bruce et al., 2021	a) Otago Exercise program b) Multifactorial falls prevention	CUA: QALY , net health benefit and net monetary benefit	✓ ✗	a) Unimodal cost-effective b) Multimodal not cost-effective
Church et al., 2012	a) Home-based exercise b) Group-based exercise c) Tai-chi d) Multifactorial	CEA: Fall avoided; CUA: QALYs	✗ ✓ ✓ ✗	a) Home based exercise: ICER = \$5,067.07; ICUR = \$72,289.84; b) Group based exercise: ICER = \$3,839.96; ICUR = \$54,805.40; c) Tai chi: ICER= \$2,396.97; ICUR = \$34,202.11; d) Multifactorial: ICER= \$6,825.72; ICUR = \$97,386.08
Patil et al., 2016	a) exercise + placebo b) exercise + vitamin D	CEA: Fall prevented	✓ ✗	ICER per fall prevented: 1) Exercise+ placebo = \$271.31 2) Exercise + Vitamin D= \$ 4,254.07

Legend:
CEA – Cost-effectiveness analysis
CUA – Cost-utility analysis
✓ Cost-effective
✗ Not cost-effective

Results of synthesis	
We included 18 studies in our systematic review: 9 EX only, 6 EX-Plus and 3 studies that included both EX and EX-Plus fall prevention strategies. There were a total of 15 EX and 9 EX-Plus intervention. EX interventions included 9 group-based, 5 home-based exercise programs and 1 tai-chi program. EX-Plus interventions included exercise in addition to medication adjustment, hazard assessment, home modification, and vitamin D supplementation.	
Cost-effectiveness analysis (CEA)	
EX <ul style="list-style-type: none">➤ 13 EX interventions were evaluated using CEA➤ 61% (n=8/13) of these interventions were cost-effective: ICERs ranged from \$162.36 to \$2,396.97. Five of these interventions were group-based programs, 2 were home-based, and tai-chi program.➤ 7.7% (n=1/13) was potentially cost-effective➤ 30.8% (n=4/13) were not cost-effective	EX-Plus <ul style="list-style-type: none">➤ 6 EX-Plus interventions were evaluated using CEA➤ 33.3% (n=2/6) were cost-effective: ICERs raged from \$813.30 to \$3,079.54➤ 66.7% (n=4/6) were not cost-effective
Cost-utility analysis (CUA)	
EX <ul style="list-style-type: none">➤ 10 EX interventions were evaluated using CUA➤ 60% (n=6/10) of these interventions were cost-effective: ICER per QALY ranged from \$20,238.73 to \$59,887.95. Cost-effective interventions included 4 group-based exercise programs, 1 home-based program and 1 tai-chi program.➤ 40% (n=4/10) of these interventions were not cost-effective	EX- Plus <ul style="list-style-type: none">➤ 4 EX-Plus interventions were evaluated using CUA➤ None of these interventions were cost-effective
Discussion	
Exercise delivered as a unimodal intervention demonstrates greater cost-effectiveness compared to exercise in conjunction with other falls prevention strategies. This was found for both cost-effectiveness and cost-utility analyses.	
<ul style="list-style-type: none">Resistance training comprising of strength and balance training was the most cost-effective intervention.In general, EX intervention was less costly to implement compared to EX-Plus interventions. Mean cost of EX interventions was \$1,355.94 compared to \$4,565,60 for EX-Plus interventions.	
Limitations	
<ul style="list-style-type: none">Methodological heterogeneity of costing and effectiveness methodsDifferent healthcare systems across countries may lead to different health resources utilization patterns.Variation in study design (i.e., differences in intervention type and intensity) and time horizons limited comparability.	

References

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