CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

In an 87-year-old male with a history of falls, is eccentric resistance exercise more effective than traditional resistance exercise for increasing strength and preventing falls?

AUTHOR

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CLINICAL SCENARIO

The patient is an 87-year-old male with a significant history of falls, being treated for decreased strength and impaired balance after his most recent fall. The patient presents with 3-/5 global strength, displays difficulty with sit-to-stand activities, and reports limiting ambulation due to fear of falling. The patient demonstrates decreased endurance; requiring seated rest breaks throughout strengthening exercises and community-distance ambulation. The patient's vitals are within normal limits.

Developing a strengthening program is essential for this patient, as many studies indicate decreased strength as a strong predictor of falls[1]. However, it can be difficult to implement and progress traditional strengthening programs when a patient presents with decreased exercise tolerance and age-related muscle atrophy. Despite a steady decline in muscle strength with aging, research indicates eccentric strength is relatively spared during the aging process[2]. Eccentric contractions involve a lengthening contraction that provides greater force than shortening contractions, resulting in less energy expenditure[2]. Ultimately, the goal of strengthening interventions should be to provide easily performed exercises that will improve muscle force and velocity[2].

Physical therapists must consider alternative methods for improving strength in older adults at risk for falls, especially when patients are not appropriate or unable to participate in traditional strength training. Therefore, exercises utilizing eccentric strength—which is relatively intact with aging—should be considered to improve muscle strength and reduce falls.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

- Only 1 study compares the effects of eccentric resistance exercise to traditional resistance exercise for increasing strength and reducing falls in older adults. As a result, I searched for the effects of both eccentric-based and traditional strength programs on strength and fall prevention in older adults.
- Eccentric resistance exercise has an equivalent effect to traditional resistance exercise for improving mobility, balance, and lower extremity power. Both methods of resistance exercise have identical effects on fall risk.
- Progressive LE loading through traditional mixed-chain exercises, combined with balance training and education, significantly improves dynamic balance, LE strength, and reduces the risk of falling. Strengthening exercises are most effective for reducing falls when part of a multi-component program.
- Future research should focus on more randomized controlled trials comparing eccentric vs. traditional resistance exercise on strength, balance, falls risk, and rating of perceived exertion. Additionally, more research should assess the effectiveness of eccentric strengthening as part of a multi-component fall reduction program, as traditional strength training has been proven effective.

CLINICAL BOTTOM LINE

While there is insufficient research comparing the effectiveness of eccentric resistance exercise to traditional resistance exercise for increasing strength and reducing falls in older adults, lower extremity strengthening to counteract age-related atrophy is a proven method to reduce falls. The limited research available indicates eccentric resistance exercise has the same effects on strength, balance, and fall reduction as traditional resistance exercise, suggesting this form of strength training is useful for older adults unable to tolerate traditional strength training.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Older adult* Geriatric* Elderly Fall* Fall risk	Eccentric “negative work” “eccentric exercise”	Resistance “weight training” weight* exercis*	Strength Muscle balance Fall* prevent*

Final search strategy (history):

1. Falls [MeSH Terms]
2. (Elderly OR older adult* OR geriatric*) AND (“fall risk” OR falls)
3. Strength OR balance
4. Eccentric OR “negative work” OR “eccentric exercise”
5. "Weight training" OR “resistance exercise” OR “strength training”
6. Fall* prevention
7. (#1 OR #2) AND #3 AND #4 AND #5
8. (#1 OR #2) AND (#4 OR #5) AND #3
9. #6 AND #8

Databases and Sites Searched	**Number of results**	**Limits applied, revised number of results (if applicable)**
PubMed	**198 (search #8)**	**67- search: #6 AND #8** **5- search: #7**
CINAHL	**73 (search #8)**	**39- search: #6 AND #8**
Cochrane	**47 (search #9)**	

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
Adults at least 65-years-old
Utilized eccentric resistance exercise and/or traditional strength training in a fall prevention program
Reported subjective and/or objective measures of falls risk pre- and post-intervention
Reported incidence of falls pre and post-intervention (acceptable if self-reported)
Measured LE strength pre and post-intervention
Randomized control trials or systematic reviews of RCTs
Exclusion Criteria
Exclude studies with cognitively impaired older adults
Exclude case series, case reports, conference proceedings, letters to the editor, dissertations, narrative review articles

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
LaStayo, et al (2017)[3]	**PEDro Score: 8/11**	**Level 1b**	**High**	**Prospective RCT**
Cho (2014)[4]	**Downs & Black checklist: 15/29**	**Level 2b**	**Mod**	**Quasi-experimental, pretest-posttest control group design**
LaStayo, et al (2003)[5]	**Downs & Black checklist: 14/29**	**Level 2b**	**High**	**Quasi-experimental, pretest-posttest control group design**
Joshua, et al (2014)[6]	**PEDro Score: 7/11**	**Level 1b**	**Mod**	**Prospective RCT**
Howe, et al (2011)[7]	**AMSTAR: 9/11**	**Level 1a**	**Low**	**Systematic Review**
De Labra, et al (2015)[8]	**AMSTAR: 9/11**	**Level 1a**	**Low**	**Systematic Review**
Clemson, et al (2010)[9]	**PEDro Score: 9/11**	**Level 1b**	**Mod**	**Prospective RCT**
Topp, et al (1993)[10]	**PEDro Score: 6/11**	**Level 1b**	**Mod**	**Prospective RCT**

*Indicate tool name and score

**Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- **LaStayo, et al (2017)[3]** – This study was selected based off its high relevance to my PICO question, and its high quality of evidence. Additionally, both this study and the Clemson study met my inclusion criteria for my search.
- **Clemson, et al (2010)[9]** – This study was selected because it assessed the outcomes stated in my PICO question (balance, LE strength, and falls prevalence). Additionally, this RCT scored the highest on the PEDro scale, signifying high quality evidence.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of "Eccentric versus traditional resistance exercise for older adult fallers in the community: a randomized trial within a multi-component fall reduction program" by LaStayo et al, 2017[3].

Aim/Objective of the Study/Systematic Review:
The purpose of this study was to compare the effects of eccentric resistance exercise (RENEW) to traditional resistance exercise (TRAD) on mobility, balance confidence, muscle strength, muscle cross-sectional area, and fall prevention in older adults over the course of a 1 year period.
Study Design
[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes

measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

- The study design is a prospective, two group randomized trial. The "control group" did not receive an intervention.
- Participants followed a multi-step screening process for eligibility before being randomized.
- A ten block system (5 from TRAD and 5 from RENEW) was used in the randomization process to ensure equal numbers of subjects and the same amount of men and women in each group.
- There are no further details as to how randomization occurred, and it is not mentioned if and how allocation was concealed.
- While subjects in both intervention groups were not explicitly blinded and exercises were performed in small groups, all training sessions were individualized. Additionally, investigators performing measurements of muscle cross sectional area were blinded to timeframe and location of the sample. There is no other mention regarding blinding of investigators for the other outcomes.
- Outcome measures were assessed over the course of 1 year, with four collection times at baseline, 3 months post-intervention, 9 months post-intervention, and at the 1-year follow-up.
- Intention-to-treat analysis was utilized in this study. Primary outcomes were analyzed using a mixed effects modelling method, and secondary outcomes were analyzed using the Kaplan-Meier procedure for survival analysis.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

All training sessions took place over the course of 3-hour sessions at a rehabilitation and wellness center at the University of Utah.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

- After 3,292 potential participants were contacted through a patient database at the University of Utah Health Sciences Center, a total of 134 subjects (47 males, 87 females) were recruited for the study.
- After randomization, there were 68 subjects assigned to RENEW group, and 66 to TRAD group.
- There were no significant differences between groups regarding baseline characteristics such as age, gender, race, BMI, comorbidities, medications, marital status, educational status, and employment status.
- Eligibility criteria: older than 65 years old (mean age of subjects randomized= 76.1 years old), one or more falls in the previous year, BMI >25 $kg*m^2$, and managing more than 5 comorbidities. Exclusion criteria: diagnosed with neurological condition, cognitive impairment, or contraindications to exercise and MRI.
- Dropout rates for RENEW and TRAD were 13% and 6%, respectively. However, all 134 participants completed the minimum required number of sessions (18), and greater than 90% of participants participated in at least 29 of the 36 exercise sessions.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

- While there was no specified control group in this study, traditional resistance exercise as part of a multi-component fall prevention program was compared to eccentric resistance exercise.
- All study subjects participated in supervised aerobic, flexibility, balance, and strengthening exercises for 60 minutes per session, 3 times per week, for 3 months. Only the method of lower extremity resistance training (traditional or eccentric) differed between groups.
- Aerobic exercise took place on a NuStep, seated stationary cycle ergometer, or treadmill. Flexibility exercises consisted of pectoralis stretching in a doorway, seated hamstrings stretching, standing calf stretching, trunk rotation stretches, and prone positioning for hip flexor stretching. Balance exercises were performed for a 15 to 20 minutes and were individualized and progressed. Upper extremity resistance exercises were performed with free weights and focused on shoulder and scapular muscles for 15 to 20 minutes.
- In regards to lower extremity strengthening, the traditional resistance exercise group (TRAD) performed 3 sets of 15 repetitions of seated bilateral leg press at 60–65% of their one repetition maximum for the initial 2 weeks

- For the next 10 weeks, exercise was performed at 70% of their one repetition maximum, which was re-assessed every 2 weeks.
- Additionally, the traditional group performed standing hip abduction and extension with ankle weights. Loads for this exercise were increased as tolerated every 2 weeks, performed at 3 sets of 15 repetitions.
- The total amount of time spent performing traditional lower extremity resistance exercises was capped at 15 minutes.

Experimental

- The eccentric resistance group (RENEW) performed progressive resistive eccentric exercise of the knee and hip extensor muscles on a recumbent stepper-ergometer.
- Participants resisted the stepper pedal action, resulting in eccentric muscle contractions in the knee and hip extensor muscles. Visual feedback in the form of a computer monitor tracked the amount of work performed.
- Participants performed eccentric resistance exercise from 15–75 degrees of knee flexion as they resisted the movement of the motorized pedals.
- Rating of perceived exertion was assessed using the Borg rating scale. In the first and second weeks, sessions lasted 3-5 minutes and were performed at the "very, very light" intensity of the Borg scale while resisting the stepper pedal action.
- Over subsequent training session, participants were gradually allowed to resist the pedal action with more exertion as they progressed from a "fairly light" intensity at weeks 3-4, to a "somewhat hard" intensity at weeks 5–12.
- The duration of each session was progressively increased to a maximum 15 minutes.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

- Primary outcomes: mobility, balance confidence, leg extensor power output and thigh muscle lean tissue cross sectional area
- Secondary outcomes: days to fall and days to near-fall
- All primary outcomes were measured pre-intervention (0 months), post-intervention (3 months), 6 months following the intervention (9 months), and 9 months following the intervention (12 months).
- Only investigators recording muscle cross-sectional area were blinded to time point and location of sample.
- Balance Confidence was measured by the Activities-Specific Balance Confidence, scored from 0% to 100%, with 100% being full confidence in the ability to perform the specified activity without losing balance.
- Mobility was measured via the 6 Minute Walk Test (6MWT).
- Leg extensor power was measured by project personnel using the Nottingham power rig.
- Cross-sectional area of lean muscle mass was measured by blinded investigators using MRI
- Secondary outcomes (fall and near-fall events) were obtained in person by investigators during months 0-3, as participants came to the rehabilitation center for the intervention 3x/week. After the intervention period (3 months), participants were provided stamped monthly postcards in order to report of falls, near-falls, changes in medication use, and changes in physical condition for months 3–12.
- A designated research assistant monitored all monthly postcards as well as a telephone report line. If a postcard was not received for a month, the research assistant initiated contact.

Main Findings

- [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

- In both groups, annual fall event rates improved in the year following enrollment, with less than 50% of participants experiencing a fall or near fall; compared to 100% of participants in the year prior to the intervention. 61 participants (46%) had at least one fall, and 66 participants (49%) had at least one near-fall over the 12 months.
- There were no significant group differences in the number of days survived without a fall (RENEW= 239.00 ± 18.00; TRAD= 249.67 ± 16.38, p= 0.565), or near-fall (RENEW= 216.35 ± 18.38; TRAD= 226.92 ± 18.76, p= 0.678).
- There was no significant treatment effect between groups for average leg extensor muscle power (p= 0.570), mobility (p= 0.604), muscle tissue cross-sectional area (p = 0.390), and balance confidence (p= 0.242).
- After the 3-month intervention, there was a significant time effect ($p < 0.001$) in the combined groups, demonstrating an increase in leg extensor muscle power (W) [0 months = 94.989 ± 3.867; 3 months = 107.928 ± 3.937]. This increase was maintained at 12 months [116.496 ± 4.005]. There was no significant group effect (p= 0.139) for leg extensor muscle power after the intervention.

- Absolute effect size within and between groups was calculated (table below) using group mean estimates and 95% confidence interval of primary outcomes from pre- and post-intervention time points (0-3 months).

Table 1: Absolute Effect Size:

Primary Outcomes:	Absolute Effect Size (within groups)		Absolute Effect Size (between groups)
	RENEW	TRAD	Post-intervention (at 3 months)
Mobility, 6MWT (m)	20.6	22.9	-13.3
Activities-Specified Balance Confidence (%)	9.4	5.2	1.8
LE Muscle Power (W)	17.7	11.3	-3.9
Cross-sectional Area (cm^2)	0.82	0.73	-0.24

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

The authors concluded that eccentric resistance exercise and traditional resistance exercise had identical effects on fall risk and fall events, with no differential effect between interventions on the number of days high fall risk older adults survived without a fall or near-fall. Both eccentric resistance and traditional resistance exercise as part of a multi-component fall prevention program had the same effects on mobility, balance confidence, muscle power, and lean muscle tissue cross-sectional area.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

- 8/11 PEDro Scale Score based on- Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: No; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: Yes; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: Yes.
- Intention-to-treat approach was performed to preserve randomization and reduce the risk of bias due to differences between groups due to dropouts.
- Blinding of assessors for muscle cross-sectional area reduced the risk of observer bias. However, there is still an increased risk of observer bias regarding the mobility, balance confidence, and muscle power outcome measures due to no mention of assessor blinding and lack of concealed allocation.
- Falls and near-falls were self-reported and could have been over- or under-reported due to their subjective nature. Investigators attempted to reduce the risk of inaccurate data through extensive training of participants on what constitutes a fall or near fall.
- By including near falls in the study design, investigators decreased doubt surrounding fall events subjectively reported by participants.
- There is an increased risk of performance bias, as there was no attempt to match workloads of the lower extremity resistance exercise groups. Only the maximum amount of time spent performing the exercise was monitored, with investigators capping exercise at 15 minutes for both groups. However, a difference between groups could have existed since intensity and minimum duration was not consistent between groups.
- Another potential source of bias results from the principle authors position as co-inventor of the eccentric ergometer used in the study. The author reports no special interest and did not receive any financial incentives from the content of the paper.
- Secondary outcome data was appropriately assessed using survival analysis for group comparisons of number of days to fall and number of days to near-fall.
- Lastly, this study shows good external validity, as the recruitment strategy successfully targeted a large number of community-ambulating older adults at risk for falling. The participants appropriately represented the general older adult population targeted for fall prevention programs, as they experienced one or more falls in the past year, and averaged 5+ comorbidities.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

- The difference in treatment effects between RENEW and TRAD groups were not significant across all outcome measures, therefore indicating that RENEW and TRAD exercise have similar effects on fall risk.
- All outcome measures improved over the 3-month intervention for both groups; however, the improvements over time were statistically and clinically meaningful, but not the treatment effect between groups.
- In regards to absolute effect size, lower extremity muscle power increased by 3.9 W in favor of the TRAD group at post-intervention. However, the *p*-value of 0.570 indicates the difference between groups was not significant.
- The absolute effect size for balance confidence was calculated to be 1.8%, indicating a 1.8% improvement in balance confidence favoring the RENEW group over the TRAD group. Improvements for all other outcome measures favored the TRAD group compared to the RENEW group, however, no improvements were statistically significant.
- Ultimately, the 95% confidence interval and absolute effect size within groups suggests that both RENEW and TRAD have clinically meaningful improvements in all outcomes over a 3-month intervention period. Thus, it is difficult to determine which outcomes have the greatest influence on fall risk, considering both groups demonstrated meaningful improvements over time, but not meaningful differences in effectiveness.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

While treatment effects between groups were equal for all outcomes, one surprising finding is that improvements in balance confidence favoured RENEW over TRAD exercise after the intervention. Similar to the patient described in the clinical scenario described above, many older adults who have fallen demonstrate activity avoidance that can lead to restricted mobility and a loss of functional independence, further contributing to an increased risk of falls[11]. As a result, it is important to not only improve balance, but also balance confidence. Therefore, clinicians could utilize eccentric exercise to improve balance confidence, while still achieving the same effects on fall risk as traditional resistance exercise. However, in terms of feasibility, not all clinics have access to equipment similar to the motorized eccentric ergometer used in the study. The study results demonstrate that without access to eccentric resistance equipment, traditional resistance exercise can be utilized with the same effect on fall risk, with clinically meaningful improvements in strength, mobility, and lean muscle cross-sectional area maintained over 12 months. Finally, previous research referenced in the study indicates that eccentric contractions produce high muscle force at low energy cost. While the study did not find eccentric resistance exercise to be more effective than traditional resistance exercise for reducing fall events, it did prove equally effective for improving strength, mobility, and fall risk over 12 months. Therefore, in older adults who are limited by muscular strength and endurance, eccentric resistance exercise is an appropriate and effective substitute for traditional resistance exercise.

(2) Description and appraisal of "LiFE Pilot Study: A randomised trial of balance and strength training embedded in daily life activity to reduce falls in older adults" by Clemson et al, 2010[9].

Aim/Objective of the Study/Systematic Review:

To determine the feasibility and effectiveness of the LiFE program, a home-based balance and strengthening program designed to reduce falls in older adults.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

- The study design was a randomized controlled trial with blinded outcome assessors.
- An investigator who was not involved in outcome assessment or the intervention performed randomization.
- Randomization occurred using a random numbers table and stratifying by age and fall history.
- Allocation occurred from the generated lists by the blinded investigator. After allocation, the principle therapist contacted participants to advise them of their group.
- A single investigator conducted follow-up assessments and was masked to group allocation. The investigator was asked to guess group membership of each participant, demonstrating only 43% accuracy, indicating successful masking.
- Baseline outcome were measured prior to randomization, and were repeated at three and six months.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

The LiFE intervention was implemented through home visits over a three-month period, with follow-up sessions occurring over the phone.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

- 599 potential participants were recruited via the Department of Veterans Affairs Home Front database.
- N= 34. After randomization, intervention group: n= 16, control group: n= 18.
- Age (mean ± SD)- intervention group: 81 ± 5.6, control group: 82 ± 6.3
- Gender, n (% women)- intervention group: 9 (50%), control group: 7 (44%)
- Eligibility criteria: Community-dwelling older adults aged 70 years and above, with two or more previous falls or an injurious fall in the past year.
- Exclusion criteria: moderate to severe cognitive problems (>2 errors on the Short Portable Mental Status Questionnaire), inability to ambulate independently, resident in a nursing home, unstable or terminal medical illness, and neurological conditions that result in motor performance difficulties.
- Dropout Data: 4 participants from the control group withdrew because they were not receiving the intervention. Two of these completed all follow-up assessments except the six months falls calendar. Four participants withdrew from the intervention group. One withdrew because of health reasons and did not complete the assessments or the full six months falls calendar. Three additional participants withdrew- two because of illness and one without giving a reason. All provided fall and follow-up data.
- The two groups were similar in regards to baseline characteristics prior to the intervention; except for scores on the static balance test and tandem stand with eyes open.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

- The control group did not receive any intervention, and with the exception of follow-up assessments, had no additional contact with investigators.
- After the study concluded, all participants were provided with a falls prevention self-help book.

Experimental

- The LiFE intervention includes 4 balance strategies and 7 strengthening exercises taking place in the home.
- Participants are told to practice each balance activity until it is mastered, then progress to a more challenging level. The four balance strategies were: reduce base of support; move to the limits of sway; shift weight from foot to foot; and step over objects.
- Suggested activities used to reduce base of support included tandem walking down a hallway or one leg standing. Activities for move to the limits of sway included leaning to one side as far as possible while performing ADLs like brushing teeth.
- The strengthening exercises focused on progressively loading muscles through repetition, moving slowly, using fewer muscles to move the same weight, and increasing the weight lifted.
- The body and objects commonly found around the home were used as weight, or work was performed against gravity. Strengthening strategies were: bend your knees; on your toes; on your heels; up the stairs; sit to stand; move sideways and tighten muscles.
- Examples of activities included squatting to pick up something, placing regularly used items on a high shelf, or walking sideways when setting and clearing the table.
- A detailed LiFE manual was provided to participants, including safety precautions and step-by-step, pictures and instructions for activities and progressions.
- After participants were evaluated on functional balance and strength, physical activity patterns and goals were collected, LiFE principles were taught, and participants and therapists created a daily plan of activities.
- Before starting the intervention at home, the participants practiced the balance and strength activities to ensure understanding and obtained advice regarding safety, form, and progression of intensity and frequency.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

- Outcome measures included rate of falls, balance, strength, quality of life, and self-efficacy.
- A research assistant not involved in the intervention and blinded to group allocation conducted all outcome assessments.

- Falls surveillance was collected via a daily calendar, mailed monthly by participants. An investigator telephoned any participant who failed to return the calendar or who reported a fall.
- Static balance was measured using the 4-stage balance test (narrow base, half tandem stand, tandem stand and one-leg stand). Participants were asked to stand in the desired position for 15 seconds.
- Dynamic balance was assessed through a timed tandem walk, instructed to walk heel-to-toe as quickly as possible.
- Maximal isometric lower limb strength was determined using a dynamometer, with the highest of three measurements recorded. Muscle groups tested: hip abductors, knee extensors and ankle dorsiflexors.
- Self-efficacy was measured using the Modified Falls Efficacy Scale (MFES), a 14-item test evaluating confidence in avoiding falls during daily activities. The MFES was scored on a 4-point Likert scale rating.
- The Activities Specific Balance Confidence (ABC) Scale, a 16-item scale, 0–100 analogue scale, was used to measure balance confidence.
- The Marcus Exercise Self-Efficacy scale, an 18-item measure of confidence regarding exercise barriers, was scored on a five-point Likert scale.
- The SF- was used to measure health-related quality of life.
- The Life Space Assessment was used to measure community-distance mobility.

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

- After six months, there were 12 falls in the intervention group, compared to 35 falls in the control group. 44% of intervention and 31% of control participants reported 1+ falls, and 17% of intervention and 31% of control participants reported 2+ falls.
- Relative Risk (RR) of fall outcomes was statistically significant at 0.21 with 95% confidence interval (CI: 0.06 to 0.67) using negative binomial regression analysis.
- When adjusting for the baseline differences in timed tandem stance, RR remained significant (RR = 0.23; CI: 0.07 to 0.83).
- There were significant improvements in the intervention group compared with the control group for dynamic balance in tandem walk (p= 0.04), left knee strength (p= 0.02), and modified falls self-efficacy (p= 0.02) in the first three months. Additionally, trends for right knee and hip strength were positive, but not statistically significant.
- Balance confidence was statistically significant at 6 months (p= 0.04).
- At 6 months, the intervention group demonstrated greater median change in all strength categories compared to the control group, except left hip strength. However, treatment effects on strength were not statistically significant at 6 months.
- Secondary physical and health status outcomes demonstrated minimal and inconsistent improvements.

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

The LiFE intervention was effective in reducing recurrent falls in a small sample of at-risk older adults. Significant improvements in dynamic balance and left knee strength were observed in the intervention group compared to the control. However, the intervention effect on secondary outcomes is difficult to determine due to inconsistent, minimal changes and a small sample size.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

- 8/10 PEDro Scale Score based on: Eligibility criteria: Yes; Random allocation: Yes; Concealed allocation: Yes; Baseline comparability: Yes; Blind subjects: No; Blind therapists: No; Blind assessors: Yes; Adequate follow-up: Yes; Intention-to-treat analysis: Yes; Between-group comparisons: Yes; Point estimates and variability: Yes.
- All data was assessed using intention-to-treat analysis to protect randomization.
- Differences between the groups regarding fall outcomes over time were appropriately analyzed using the negative binomial regression model, as this model measures rate of falls and statistically accounts for both multiple falls and days in follow-up.
- While there was no blinding of therapists, the study avoids data collection bias by ensuring research assistants who was blinded to group allocation performed all outcome assessments.
- Participants were not blinded or kept naïve to group assignment. While the study design makes subject blinding unpractical, the use of a no-intervention control group likely contributed to a decreased sample size, evident by participants dropping out after being told they were not in the intervention group.
- As mentioned, one key limitation to this study was the unequal dropout rates (25% in control group compared to 6% in the intervention group). Per study design, the research team encouraged participants to continue mailing in their falls data even if they did not want to participate in follow-up home assessments. However, this results in the potential for contamination, especially if the control

participants sought out other fall prevention programs.

- Another reported limitation of the study is decreased power due to a small sample size. Despite a 77% reduction in falls post-intervention, the study was not sufficiently powered to detect statistical significance of the treatment effect.
- The internal validity of this study is jeopardized by the unsupervised intervention design and self-reporting of fall outcomes. The reduction in falls in the intervention group could have been attributed to other activities performed at home outside the study design, similar to how strength improvements could have resulted from increased activity around the home or incorporation of additional strengthening exercises not included in the intervention.
- External validity is limited by the small sample size. One would expect older adults in the general population who meet the eligibility criteria for this study to have a greater recurrence of falls than was reported in this study; especially considering that after the intervention, a smaller percentage of control subjects reported recurrent falls compared to intervention subjects.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

- The adjusted relative risk for fall outcomes was significant (RR = 0.23; CI: 0.07 to 0.83), suggesting that the balance and strengthening interventions in the LiFE program had both statistically and clinically meaningful impacts on fall reduction compared to a no-intervention control group.
- It is difficult to determine which factors had the greatest effect on reducing fall outcomes, as secondary measures varied, and the only statistically significant improvements in the treatment group were left knee strength and dynamic balance.
- Despite few statistically significant treatment effects, the study still demonstrates clinically meaningful results. For instance, intervention subjects demonstrated greater improvements in strength overall from 0-6 months compared to control subjects, despite the median changes lacking statistical significance.
- Similarly, while improvements in dynamic balance in the treatment group were significant, slight improvements in static one-leg stance in the intervention group over 6 months prove clinically meaningful, as median changes in the control group indicate a decrease in single-leg stance ability.
- Therefore, results indicate that the LiFE program reduces the risk of falls at 6 months through statistically significant improvements in dynamic balance and self-efficacy, and clinically meaningful improvements in strength compared to no intervention.
- Finally, as previously mentioned, non-significant improvements in strength and balance could have resulted from a lack of power due to the small sample size. With the interventions effect on reducing falls over 6 months compared to the control, it is likely that a larger sample size would have yielded more significant treatment effects.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

While this study did not assess eccentric resistance training, it did utilize a more traditional strength training approach as a component of a fall prevention program in older adults. The study supports that increasing strength can have a beneficial effect on reducing falls in high-risk samples. However, strength training was combined with balance training in this study, so it is difficult to determine how great of an effect strength alone had on fall outcomes. While this study addressed the outcome measures posed in my PICO question, and utilized strength training in a high fall risk population, I would not say it is a feasible and practical intervention for my clinical scenario. An unsupervised program that challenges balance and strength in already deconditioned individuals who high fall risks is a safety concern. The program would likely be more beneficial if it is monitored and progressed under supervision in the clinic or in a group setting. This would ensure strengthening exercises are being performed safely and with proper form in order to yield results, and also increase adherence. Additionally, the LiFE program requires creativity in order to use everyday activities and supplies around the home for balance and strength exercises. Furthermore, some of the strengthening exercises, like standing on toes and heels, are balance challenges in themselves, and may pose an increased risk of falling. This intervention also lacks practicality for deconditioned patients similar to the one in my scenario. For example, progressing exercises can be dangerous without close supervision and advice from therapists regarding intensity and duration. Additionally, failure to appropriately progress exercises due to lack of physical fitness education or endurance could prevent greater strength and balance gains and an ultimate reduction in falls.

SYNTHESIS AND CLINICAL IMPLICATIONS

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

Evidence from the reviewed articles clearly supports the use of strength training to reduce the risk of falls in older adults. However, whether one type of resistance exercise is more beneficial for reducing fall outcomes in severely deconditioned older adults than another remains unclear. The findings by LaStayo et al[3] found eccentric resistance exercise to have the same effects as traditional resistance exercise on the rate of falls and near-falls after a 3-month intervention. The lack of differential effect between groups on the number of days survived without a fall or near-fall signifies the potential for eccentric exercise as an effective alternative for severely deconditioned older adults. Further supporting this is the fact that both interventions equally improved lower extremity strength, while another study by Dias et al[12] reports eccentric training can produce greater force at lower levels of perceived exertion than conventional resistance training. Therefore, eccentric resistance exercise provides more than adequate resistance to improve strength, while also requiring less self-perceived demand on an already weakened body.

Another factor to consider in both reviewed studies is multicomponent effects. Both interventions used strength training as a component of a fall prevention program, not as an independent intervention to reduce fall risk. LaStayo et al[3] states that multi-component exercise interventions that also challenge balance can reduce the rate of falls in at-risk older adults by 39%. Therefore, while it is important to determine a mode of resistance training that is appropriate for deconditioned patients with age-related muscle atrophy, it is also important to incorporate balance exercises into the intervention to reduced fall-related outcomes. Increasing muscle strength and power is proven to contribute to a reduction in falls risk; however, a strength intervention alone does not address dynamic balance deficits that may be contributing to a persons fall risk[3]. As shown by the Clemson et al[9] study, a multi-component program consisting of balance and strengthening exercises has statistically significant effects on dynamic balance and lower extremity strength. In the case of a patient who has a fear of falling and is still ambulating in the community, dynamic balance as it relates to fall risk is an equally important outcome to address.

One clear area for future research is the need for more randomized controlled trials directly comparing the effects of eccentric resistance exercise to traditional resistance exercise on outcomes such as force production, lower extremity strength, balance, falls, and near-fall events. Several studies also mention that eccentric exercise is associated with decreased metabolic demand, so rating of perceived exertion is another useful outcome measure to investigate that was not assessed in the LaStayo study[3, 12, 13]. Additionally, many clinics lack equipment capable of providing consistent, reliable eccentric lower extremity resistance such as the motorized study described in the LaStayo et al study[3]. Therefore, future studies should investigate the efficacy and feasibility of adapted eccentric exercises as a component of a fall prevention program. For example, Dias[12] describes two different approaches to utilize isotonic eccentric training: 1) manual support provided by researchers during the concentric phase, while the subject concentrates only on the eccentric phase, and 2) execution of the concentric phase bilaterally and the eccentric phase with only one limb. These alternative methods would be useful to investigate in fall prevention programs similar to the LiFE program, as well as their effect on outcomes like strength and rating of perceived exertion. Comparing the same exercises performed in different modes, like the traditional progressive loading in the LiFE intervention compared to one of the eccentric methods described by Dias, would provide more insight into the efficacy of an eccentric program implemented in a clinic without proper equipment, or even in the home.

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