CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

Is the Otago Exercise Program (OEP) more effective than a group exercise program at reducing reported falls through evidence-based exercises in an independent community-dwelling 70-year-old adult with poor balance and history of at least one fall in the past year?

AUTHOR

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CLINICAL SCENARIO

The patient is a 70-yeard-old female who lives independently with her husband in a 2-story home. She does not work but is active in her community and home including volunteering in the kitchen at her church, light housework, and light gardening mostly tending potted plants on her patio. The patient notes she feels "unsteady" and wishes to improve her balance after a recent fall in her living room in which she believes she "tripped over a rug or mess on the floor." She was uninjured in the fall but reports a fear of falling since the incident. She is interested in beginning a program to help improve her balance and decrease her risk of falls, but is unsure if she will feel more confident in a one-on-one scenario versus taking group exercise classes with some of her friends, who are unaware of her fall and she is embarrassed to admit her falls history because she "doesn't want to feel old." During her evaluation, the patient exhibits 4-/5 lower extremity strength globally, denies dizziness or loss of sensation, does not use an assistive device, and reports no pain or significant past medical history beyond pharmacologically controlled cholesterol and hypertension.

At least one in four adults over the age of 65 fall each year and falls are the leading cause of fatal and nonfatal injuries in older adults.[1] Multiple risk factors are associated with falls in the aging population such as reduced muscle mass and inactivity, however exercise programs that include strength and balance components have been shown to reduce falls risk in the elderly.[1]

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

Eight studies were identified to meet the inclusion and exclusion criteria including 1 Cochrane review, 2 systematic reviews, 4 randomized controlled trials, and 1 cross sectional study.

- No direct comparisons between OEP and group-based exercise programs were yielded by the literature search, however there was significant evidence available regarding the individual interventions that could be used to extrapolate findings for the focused clinical question.
- The majority of evidence yielded by the search demonstrates low risk of bias and moderately high relevance to interventions to reduce falls risk in older adults.
- Balance and falls prevention techniques are highly researched with a general consensus that exercise intervention decreases patient-reported falls.

CLINICAL BOTTOM LINE

Both OEP and group-based exercise programs reduce falls among community-dwelling older adults therefore other variables may need to be considered when prescribing exercises to reduce risk of future falls for patients with a history of falls. Other variables may include availability of group exercise programs versus supervised OEP, time commitment and transportation availability, personal preference, and motivation for compliance with exercise regimen. Evidence suggests exercising as little as 3 times per week for 6 weeks can reduce falls risk significantly, with consistent results seen 6 months to 2 years with a continued exercise program. The inclusion of balance and mobility exercises for the lower extremity are most important to reducing falls risk regardless of method advised to the patient.

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

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Balance "fall* risk" "fall* prevention"	Otago Otago Exercise Program OEP	Group exercise Exercise program	Patient-reported falls Falls

Final search strategy (history):

Show your final search strategy (full history) from PubMed. Indicate which "line" you chose as the final search strategy.

1. balance OR "fall* risk" OR "fall* prevention"
2. "older adult" OR elderly OR senior
3. "community" OR "community-dwelling"
4. independent
5. Otago[Title/Abstract]
6. "group exercise" OR "exercise program"
7. **#1 AND #2 AND (#3 OR #4) AND (#5 OR #6)**

(((((balance OR "fall* risk" OR "fall* prevention")) AND ("older adult" OR elderly OR senior)) AND (("community" OR "community-dwelling") OR independent))) AND ((Otago[Title/Abstract]) OR ("group exercise" OR "exercise program"))

In the table below, show how many results you got from your search from each database you searched.

Databases and Sites Searched	**Number of results**	**Limits applied, revised number of results (if applicable)**
PubMed	**425**	**79** – Applied Filters: Randomized Controlled Trial, Review, Systematic Review, From 2000/01/01 to 2019/12/31, Aged: 65+ years, Title/Abstract
Cochrane	**206**	**52** – Cochrane Reviews, Between Jan 2000 and Dec 2019
PEDro	**234**	**50** – Score of at least 8/10

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
• Systematic reviews and meta-analyses • Quasi-experimental studies • Randomized controlled trials • Cross sectional studies • Standardized patient-reported measures used to assess falls risk (e.g. Berg, Tinetti, 30s Chair Rise, etc.) and patient-reported falls • Study details standardized training and/or credentials of instructors/administering physical therapists of Otago and/or Matter of Balance • Study describes frequency of prescribed exercises or group exercise classes • Published since 2000

Exclusion Criteria
• Narrative review articles • Not published in English • Case studies • Case series

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
Gillespie et al (2012)[2]	**11/11 AMSTAR**	**1a**	**moderate**	**Cochrane review**
Hill et al (2015)[3]	**8/11 AMSTAR**	**1a**	**high**	**Systematic review**
Martin et al (2013)[4]	**7/11 AMSTAR**	**1a**	**moderate**	**Systematic review**
Barnett et al (2003)[5]	**9/10 PEDro**	**1b**	**high**	**RCT**
Dadgari et al (2016)[6]	**4/10 PEDro**	**2b**	**low**	**RCT**
Kim et al (2014)[7]	**9/10 PEDro**	**1b**	**moderate**	**RCT** with 1-yr follow-up
Hayashi et al (2018)[8]	**16/20 AXIS**	**3b**	**moderate**	**Cross-sectional study**
Means et al (2005)[9]	**7/10 PEDro**	**2b**	**high**	**RCT** (37.8% attrition rate)

*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:

- **Hill et al: Individualized home-based exercise programs for older people to reduce falls and improve physical performance: A systematic review and meta-analysis.**
  - Five[10-14] of the 11 randomized controlled trials included in this systematic review specifically list OEP as the investigated intervention in a one-on-one clinician-patient scenario, and an additional 2 studies[15,16] utilized the principles of OEP though not by name. A forest plot by the authors compared intervention groups to control (mostly typical care or patient education without directed exercise) for number of fallers over 12-months of follow-up. In the conclusions, the authors referenced benefits of home-based exercises such as OEP over group-based exercise however the results of the study did not examine this particular comparison specific to the focused clinical question of this critical appraisal. Based on the AMSTAR scoring, this systematic review has low risk of bias (8/11) and is a high level of evidence for this critical appraisal.
- **Means et al: Balance, Mobility, and Falls Among Community-Dwelling Elderly Persons**
  - Means et al examined group-based exercise to reduce falls providing the intervention in groups of 6-8 at an outpatient facility. This RCT study gives excellent data and parameters to act as the comparative arm of the focused clinical question. While it does not compare directly to OEP, the control group was a non-exercise directed intervention (educational seminars) thus can be a less biased approach to answer the focused clinical question. Based on the PEDro rating of 7/10, this RCT has a moderately low risk of bias however, despite being an excellently modelled RCT there was less than 80% follow-up dropping its level of evidence from 1b to 2b, though the authors discuss this poor attrition rate in their discussion section extensively therefore it does not grossly affect its inclusion for critical appraisal.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of "Individualized Home-Based Exercise Programs for Older People to Reduce Falls and Improve Physical Performance: A Systematic Review and Meta-analysis" by Hill et al. 2015.[3]

Aim/Objective of the Study/Systematic Review:

The aim of this systematic review and meta-analysis was to review the effectiveness of tailored, home-based exercise programs aimed at reducing falls and improving physical performance in community-dwelling older adults.

Study Design

[e.g., systematic review, cohort, randomized 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.

Hill et al. is a systematic review of 12 articles, including 11 randomized controlled trials (RCTs) and 1 pragmatic trial, with each examining individualized home exercise programs for community-dwelling older adults aimed at reducing falls while also improving physical activity, balance, mobility, and strength.

Search Strategy: A literature search was performed in Medline (ProQuest), CINAHL, PubMed, PsychInfo, EMBASE, and Scopus between January 1974 and December 2014. Search terms and syntax were adapted dependent on the database, but keywords were identified in the title or abstract for article inclusion. The authors listed their CINAHL search strategy as:

1. person* exercise ti,ab.
2. person* activity ti,ab.
3. individ* exercise ti,ab.
4. individ* activity ti,ab.
5. 1 or 2 or 3 or 4
6. fall* ti,ab.
7. accidental fall ti,ab.
8. fall* prevent ti,ab.
9. 6 or 7 or 8
10. older ti,ab.
11. age* ti,ab.
12. elder ti,ab.
13. 10 or 11 or 12
14. 5 and 9 and 13

Selection Criteria: Article selection was a three-stage process and utilized a PRISMA checklist for systematic reporting of results: 1) one author scanned titles and abstracts to exclude articles not meeting inclusion criteria, 2) one author fully screened abstracts, and 3) two authors read the entirety of articles to identify those that met inclusion criteria as well as analyzing reference lists for additional articles not identified by the original database searches. When disagreement on inclusions arose in stage 3, the two authors referred to the original inclusion criteria and study protocol and discussed for consensus on final inclusion or exclusion.

- **Inclusion Criteria:** The authors limited study eligibility to the following characteristics:
  - Study participants at least 60 years old accounting for 50% or more of the sample who lived in the community.
  - Interventions of individualized home-based exercise programs that are directed to reduce falls or risk of falls. Interventions could be single or multifactorial approaches with separate exercise results reported.
  - Studies must utilize outcome measures including number of falls, falls rate, number of participants reporting falls, and time to first fall. Authors also included outcomes such as fear of falling, function, balance and strength, and adherence to an exercise regimen.
  - Studies must be randomized controlled trials or quasi-experimental trials.
  - Studies must be published in English.
- **Exclusion Criteria:** Studies not matching the inclusion criteria and studies that reported from the same sample (i.e. only one study per data set was included in the meta-analysis). Additionally, no grey literature including unpublished data, books, conference proceedings, theses or poster presentations/abstracts were included.

Data Collection: Study design, purpose, intervention characteristics, sample size, average age, gender breakdown, attrition rate, outcome measures, number of falls, intervention effects, and length of follow-up were tabulated from included studies.

Quality Assessment: Three authors used the Cochrane Risk of Bias tool for quality assessment of each

included study. Authors specifically analyzed selection bias, performance bias, attrition bias, reporting bias, and other bias. Articles were scored as "low risk," "unclear risk," or "high risk" of bias; the pragmatic trial was not assessed for bias as it was not an RCT thus the authors deemed the Cochrane tool to be inappropriate, but the remaining 11 RCTs were scored. Of the 11 RCTs, 9 scored "low risk" across all areas of bias and the remaining 2 RCTs had "unclear risk" for allocation concealment of selection bias.

Data Analysis: Included studies were detailed in a table to list qualities of study design, purpose, interventions, sample characteristics, number of falls, effects of intervention(s), and follow-up. Forest plots were created using Review Manager (RevMan) version 5.3 and I^2 statistic and visual inspection of the forest plots assess heterogeneity of the stats. Summary estimates were calculated using a random-effects model when I^2 was greater than 50%, however a fixed-effect model was applied in cases where studies were homogeneous. Dichotomous outcomes were analyzed with Mantel-Haenszel's fixed-effects model and continuous outcomes used the inverse variance DerSimonian and Laird method to calculate mean differences or standardized mean differences with 95% confidence intervals based on available data.

Setting

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

The primary authors were affiliated with physiotherapy schools in Australia (Curtin University in Perth, Western Australia) and Canada (The University of Western Ontario) and the National Ageing Research Institute of Australia. All included studies involved home-based activities in English-speaking countries.

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.

Combined characteristics of participants across all 12 included studies are as follows:

- N = 2,999 for baseline testing with ultimately N = 2,570 completing post-testing assessments;
    - 1,466 participants were placed in intervention groups and 1,054 were placed in control groups;
- Average sample size of 250 (range from 40 to 981);
- Average age of 80.1 years (average range from 72.2 to 84.1 years);
- Average retention rate of 82.24%;
- Populations included older adults with no specified health conditions, older adults recently discharge from the hospital, hip fracture, older adults living with dementia, and older adults with Parkinson's disease; and
- Participants were randomized to intervention and control groups, where intervention groups were asked to complete exercises for various frequencies.

Of studies that utilized OEP as the exercise intervention, participant details included:

- Gardner et al. (2002)[10]
    - Pragmatic trial
    - N = 981
        - 700 in exercise group, 281 in control group
        - 66.5% female, mean age 83.6 years (generally ≥80 years)
- Liu-Ambrose et al. (2008)[11]
    - RCT
    - N = 59
        - 31 in exercise group, 28 in control group
        - 69.4% female, mean age 82.25 years (generally ≥70 years)
- Robertson et al. (2001)[12]
    - RCT
    - N = 240
        - 121 in exercise group, 119 in control group
        - 67.5% female, mean age 80.95 years (generally ≥75 years)
- Suttanon et al. (2012)[13]
    - RCT
    - N = 40
        - 19 in exercise group, 21 in control group
        - 62.5% female, mean age 81.9 years, older adults with Alzheimer's Disease
- Yang et al. (2012)[14]
    - RCT
    - N = 165
        - 82 in exercise group, 83 in control group
        - 55.7% female, mean age 80.5 years (generally ≥65 years)
- Campbell et al. (1997)[15]

- RCT
- N = 233
  - 116 in exercise group, 117 in control group
  - 100% female, mean age 84.1 years (generally ≥75 years)

- Campbell et al. (1999)[16]
  - RCT
  - N = 152
    - 71 in exercise group, 81 in control group
    - 100% female, mean age 83.9 years (generally ≥80 years)

Intervention Investigated

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

Control

All studies included in the systematic review utilized usual care such as patient education on falls prevention and/or follow-up phone calls or home visits by a healthcare provider (e.g. nurse, physical therapist, occupational therapist) as the comparative control group.

Of the studies that utilized OEP or its principles as the exercise intervention, control groups are as follows:

- Gardner et al. (2002)[10]
  - Control = usual care
- Liu-Ambrose et al. (2008)[11]
  - Control = care guided by American Geriatrics Society Fall Prevention Guidelines
- Robertson et al. (2001)[12]
  - Control = usual care
- Suttanon et al. (2012)[13]
  - Control = equal number of home visits as the intervention group consisting of education and information on dementia and aging by an occupational therapist
- Yang et al. (2012)[14]
  - Control = provided a falls prevention booklet
- Campbell et al. (1997)[15]
  - Control = 4 home visits over 8 weeks and regular phone calls by a nurse
- Campbell et al. (1999)[16]
  - Control = 4 home visits over 8 weeks and regular phone calls by a nurse

Experimental

All studies included in the systematic review investigated exercise as the primary intervention. Intervention periods ranged from 6 weeks to 2 years with various frequencies of exercises per week.

Studies that did not utilize OEP used protocols that focused on lower body strength, balance, and mobility. Other named programs included in the systematic review were Weight Bearing Exercise for Better Balance (WEBB), the LiFE program, the Exercise Plus Program, and two unnamed programs.

OEP (N = 7 studies) included strengthening exercises, balance exercises, and a walking program. Participants under OEP guidelines used ankle weights to progress strengthening exercises and had an illustrated booklet with instructions for exercises. Generally, OEP was performed 30 minutes 3 times per week for balance and strengthening with an additional 30 minutes 2 times per week of walking. Exercises consisted of lower extremity strengthening, static and dynamic balance tasks, stair climbing, and range of motion exercises.

Of the studies that utilized OEP or its principles as the exercise intervention, exercise groups are as follows:

- Gardner et al. (2002):[10]
  - Exercise = Strengthening and balance exercises 3 times per week and an individualized walking plan at least 2 times per week. Nurses completed 5 home visits and monthly phone calls to remind patients to utilize post card calendars for exercise tracking.
- Liu-Ambrose et al. (2008):[11]
  - Exercise = Exercises performed 3 times per week and walking for 30 minutes 2 times per week. Physical therapists provided 4 home visits with 2 weeks between visits and a final assessment visit at 6 months.
- Robertson et al. (2001):[12]
  - Exercise = Strength exercises 3 times per week and walking 2 times per week over 12 months. Individualized exercises for balance and strength were provided based on assessment over 5 home visits by nurses, whom also called participants between home visits to encourage compliance.
- Suttanon et al. (2012):[13]
  - Exercise = Exercises 5 times per week, including standing balance, strengthening, and walking programs. Physical therapists oversaw participants for 6 home visits and provided follow up with phone calls between visits. Caregivers were also instructed in the exercises to participate with the participants to further encourage physical activity.

- Yang et al. (2012):[14]
    - Exercise = Exercises for 30 minutes, 3 times per week and additional exercises from the Visual Health Informational Balance and Vestibular Exercise kit for participants requiring more challenge as deemed by the assessing physical therapist. Participants also were asked to walk outside for 5 times per week for 6 months. Participants filled out exercise diaries to track activity.
- Campbell et al. (1997)[15]
    - Exercise = Exercises for 30 minutes, 3 times per week and walking outside for 3 times per week. Participants were instructed by a physical therapist in 4 1-hour sessions during the first 8 weeks then regular phone calls to continue participant motivation.
- Campbell et al. (1999)[16]
    - Exercise = Continuing the protocol from the 1997 Campbell et al. study, exercises were performed for 30 minutes, 3 times per week and walking outside for 3 times per week. Participants were instructed by a physical therapist in 4 1-hour sessions during the first 8 weeks then regular phone calls to continue participant motivation.

Outcome Measures

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

Authors tabulated 17 outcome measures utilized across all 12 studies, 70.5% of which involved counting number of falls/fallers or fall rate. Balance, mobility, and strength were measured by various means and were administered by a healthcare provider (e.g. nurse, physical therapist, occupational therapist) during home visits; these were secondary outcomes across all studies and were not the aim of the systematic review. Though the balance, mobility, and strength measures do not align with the focused clinical question, these measures are valuable to a multifactorial approach to reduce falls risk.

- Primary measures by studies included (N)
    - Number of falls (6)
    - Number of fallers (4)
    - Fall incidence rates (2)
- Secondary measures by studies included (N)
    - Physical activity via the Physical Activity Scale for the Elderly (2)
    - Balance (7)
        - Functional reach (4)
        - Step test (3)
    - Strength based on knee extensor force (3)
    - Mobility (4)
        - Sit to stand (2)
        - Timed up and go (2)

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. You may summarize results in a table but you must explain the results with some narrative.]

A total 752 falls occurred across intervention groups (51.3% of exercise participants) compared to 818 in control groups (77.6%).

Not all studies were included in the meta-analysis due to incomplete data reporting. For studies with 12-month follow-up (N=4), there was no significant difference in number of fallers between intervention and control groups as determined by a risk ratio of 0.93 (0.72-1.21) for 95% confidence interval with an I^2 = 71% and Z = 0.52 indicating a p-value of 0.60. However, a sensitivity analysis of intervention compared to control for number of fallers showed a significant difference, noting the number of fallers at follow-up was statistically lower for exercise participants than control participants. This sensitivity analysis resulted in a risk ratio of 0.84 (0.72-0.99) for 95% confidence interval with an I^2 = 0% and Z = 2.11 indicating a p-value of 0.04.

For secondary measures, there were significant differences between intervention and control for physical activity, functional reach (balance), knee extensor force (strength), and sit to stand (mobility; there were no significant differences with step test (balance) and timed up and go (mobility).

Intervention effects of the individual studies investigating OEP or its principles include:

- Gardner et al. (2002):[10]
    - The exercise program saw a 30% reduction in falls and overall balance improved compared to controls over 12 months. Additionally, there was a 28% reduction in injury in the exercise group.
    - Number of falls/fallers after 12 months as reported:
        - Exercise = 103 participants (44%)
        - Control = 51 participants (52%)
- Liu-Ambrose et al. (2008):[11]

    - There was no significant difference between exercise and control groups for fall risk or functional mobility over 6 and 12 months.
    - Number of falls/fallers after 12 months as reported:
        - Adjusted incident rate ratio of 0.47 (95% confidence interval of 0.24-0.96)
- Robertson et al. (2001):[12]
    - There was a 46% reduction in falls for the exercise group over 12 months. Also, there were no hospital admissions for fall-related injury in the exercise group but 5 admissions for control participants.
    - Number of falls/fallers after 12 months as reported:
        - Exercise = 80 per 121 participants
        - Control = 109 per 109 participants
- Suttanon et al. (2012):[13]
    - Falls rate/1000 person days in the exercise group were reduced by 33% compared to an 89% increase in the control group. There was also a greater change in proportion of fallers in the control, indicating that the exercise group reduced falls over 6 months.
    - Number of falls/fallers after 6 months as reported:
        - Exercise = 5 per 19 participants
        - Control = 6 per 21 participants
- Yang et al. (2012):[14]
    - Exercise = Exercises for 30 minutes, 3 times per week and additional exercises from the Visual Health Informational Balance and Vestibular Exercise kit for participants requiring more challenge as deemed by the assessing physical therapist. Participants also were asked to walk outside for 5 times per week for 6 months. Participants filled out exercise diaries to track activity.
    - Number of falls/fallers after 6 months as reported:
        - Exercise = 12 per 82 participants
        - Control = 18 per 83 participants
- Campbell et al. (1997)[15]
    - Exercise group participants demonstrated improvements in balance compared to controls over 6 to 12 months.
    - Number of falls/fallers after 12 months as reported:
        - Exercise = 88 per 116 participants
        - Control = 152 per 117 participants
- Campbell et al. (1999)[16]
    - The exercise program demonstrated a significant reduction in falls over 24 months.
    - Number of falls/fallers after 24 months as reported:
        - Exercise = 138 per 71 participants
        - Control = 220 per 81 participants

Original Authors' Conclusions

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

Home-based exercise programs that are tailored to individuals are supported to reduce number of falls while also improving physical performance measures such as balance, leg strength, function, and physical activity in older community-dwelling adults.

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.]

AMSTAR score: **9/11**; a priori design provided: can't answer; two independent data extractors: yes; comprehensive search: yes; status of publication: no; list of studies: yes; characteristics of studies: yes; quality assessment: yes; quality assessment used in conclusions: yes; appropriate methods to combine studies: yes; publication bias assessed: yes; conflict of interest stated; yes.

Strengths:

- **Selection bias**: The authors utilized 6 databases for the literature search and further sought to improve applicable results by scanning reference lists of identified studies to be inclusive of studies that did not match the inputted search keywords. The authors instituted a staged review process for inclusion further reducing risk of bias.
- **Quality assessment**: The authors utilized the Cochrane Risk of Bias tool to determine any bias present in 11 studies that met inclusion criteria. The authors stated the inappropriate nature to use the tool for one study (pragmatic trial by Gardner et al.) based on the study design. They outline their assessment protocol clearly, used three independent assessors, and note agreement between assessors during examination of the studies for quality.
- **Quality of selected studies**: The authors note the high quality of research that met inclusion criteria

for the systematic review and meta-analysis as determined by their use of the Cochrane Risk of Bias tool. Nine of 11 RCTs included scored low risk of bias across all domains and the remaining 2 RCTs only lacked complete low risk of bias across all domains in the assessment of allocation concealment.

- **External validity**: The studies included in the systematic review appear easily applicable to the broad population of older adults regardless of comorbidities and other characteristics. A diverse set of outcome measures were used to assess primary and secondary outcomes that are easily administered and have been proven to valid predictors of falls risk.

Weaknesses:

- **Publication bias**: Grey literature was excluded, limiting potential data sets from unpublished works, books, conference proceedings, theses, and posters which could have furthered the discussions and conclusions. There was no explanation for the exclusion of grey literature.
- **Limited studies utilized**: Only 12 studies were included despite the vast amounts of research available surrounding older adults and falls prevention interventions. Inclusion criteria for only individualized home-based exercise programs may be a limiting factor.
- **Internal validity**: Despite the high AMSTAR score noted above and concluding that individualized home-based exercise programs can reduce falls risk, there is question to the manipulation of data to support this argument. The forest plot and risk ratios calculated for number of fallers only included 5 studies though the authors argued this was limited because of the length of studies as they selected to only include data for at least 12 months of follow-up. There was no statistical significance for number of fallers between intervention and control for these 5 studies, however removing one study that the authors deemed inappropriate because of the high-risk population involved (Sherrington et al. involved older adults recently discharged from the hospital[17]) lead to statistical significance in the sensitivity analysis for number of fallers.
- **Statistical power/effect size**: The variety of secondary outcome measures used and the variance in study lengths limited statistical analyses utilized to create the meta-analysis portion of the paper.

Overall, the evidence included in the systematic review and meta-analysis is high quality however relatively few studies are included because of strict inclusion criteria despite the wealth of literature published regarding older adults and falls prevention/risk.

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.]

While falls still occurred in 51.3% of participants allocated to intervention groups, this is considerably less than the incidence of 77.6% for participants in control groups who fell throughout all studies examined in this systematic review and meta-analysis. Clinically, evidence supports the significance of implementing an individualized home-based exercise program as any reduction in falls is a positive outcome in the community-dwelling older adult population. There is excellent external validity of individual studies included in this systematic review to implement such programs despite questionable internal validity when combining those studies as seen in the meta-analysis, of which not all studies examined were included.

Evidence for home-based, individualized exercise programs is very high as highlighted by the low risk of bias when utilizing the Cochrane Risk of Bias tool for RCTs included. The authors set strict inclusion criteria potentially limiting the results of articles applicable for this systematic review, however what was included demonstrated little bias. Additional to the strict inclusion criteria, OEP can be implemented in a variety of settings, not just home-based therapies. Inclusion of other settings as well as other study types (e.g. grey literature) could have broadened the scope of the systematic review and thus increased the power and implications of the results.

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.]

This study has high applicability to the focused clinical question as the majority of the evidence included (7 of 12 articles) includes OEP or its principles. Home-based exercises appear to be easily implemented and tailored with proper oversight, however the authors note that compliance and adherence can be issues with any home program. Home programs such as OEP allow for flexibility and autonomy as participants can choose when to complete exercises based on their schedule and lifestyle. Additionally, individualizing interventions that can be completed as part of a home program furthers autonomy and motivation to complete exercises as the participants' interests can be incorporated by the program builder (e.g. physical therapist). This flexibility, autonomy, and inclusion of interests may increase compliance. OEP provides a framework of balancing, strengthening, and mobility/walking that is applicable to many older adults and is shown to reduce falls in this systematic review whether statistically significant or not.

(2) Description and appraisal of "Balance, Mobility, and Falls Among Community-Dwelling Elderly Persons" by Means et al. 2005.[9]

Aim/Objective of the Study/Systematic Review:

The aim of this randomized controlled trial (RCT) was to assess short-term effects of moderate-intensity group exercise participation on balance and mobility in by older adults living in the community who have or have not suffered a fall.

Study Design

[e.g., systematic review, cohort, randomized 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.

Means et al. is a RCT designed as a repeated measures experiment to assess exercise intervention on falls as well as balance and mobility in community-dwelling older adults with or without a history of falls.

Tested Hypotheses: The authors sought to test these null hypotheses:

1. "There were no differences between persons who participated in the intervention program ad controls who did not participate in FOC performance before, immediately after, or 6 mos after intervention."
2. "There were no differences between those with and without a history of falls in FOC performance at preexercise, postexercise, and 6 mos postexercise."
3. "There were no group-by-time periods of the study interactions on the four secondary health measures: activity level, symptoms of balance and mobility dysfunction, range of motion, and muscle strength."
4. "There were no differences in number of falls or fall-related injuries at preexercise and 6 mos postexercise for the intervention and control groups."

The fourth null hypothesis is most relevant to the focused clinical question.

Determining Sample Size: The authors determined estimated sample size based on a pilot intervention study unpublished dataset of fallers and non-fallers completing a functionally oriented obstacle course (FOC). That data determined a minimum detectable change due to therapeutic effect with a completed FOC in 20 seconds, therefore for four groups of participants (fallers, non-fallers, intervention, and control) there needed to be at least 31 subjects per group for a 10% improvement in FOC completion time with a power of 80%. Considering potential attrition due to randomization and loss to follow-up, researchers planned to recruit 2.5 times this minimum thus aiming to recruit at least 77 subjects per group.

- **Inclusion Criteria**: the researchers limited participants to the following qualities:
  - Age 65 or older
  - Able to walk minimum 30 feet with or without an assistive device and without physical assistance
  - Able to comprehend instructions and give informed consent
  - If cognitive impairment is in question, must score >24 on a Mini-Mental Status Examination (MMSE) administered by a study assessor
- **Exclusion Criteria**:
  - Living in a nursing home
  - Current acute medical complications
  - Cognitive impairment apparent to evaluating physiatrist at the time of examination resulting in test results <24 on MMSE

Randomization and Blinding: Participants were allocated to intervention and control groups via a coin flip and a research member no involved in data collection conducted the allocation process. This was a single-blind study as participants were aware of their group allocation but assessors for data collection were blinded to group allocation. Participants were instructed not to disclose their group assignment to other participants outside of their intervention/control group.

Timing of Assessments/Data Collection: Evaluations were administered at baseline, post-intervention or control at 6 weeks, and at 6 months post-intervention or control. Assessors utilized a FOC at evaluations, however as this outcome is not directly related to the focused clinical question only data collection relevant to the question will be addressed for the remainder of this appraisal.

Definition of a "Fall": The authors agreed on a "fall" definition that was consistent with prior research that involved multi-center frailty interventions. This definition of a fall reads as: "any involuntary change from a starting position of bipedal support (standing, walking, bending, reaching, etc.) to a position of no longer being supported by both feet, accompanied by (partial or full) contact with the ground or floor." Syncopal episodes were excluded. Participants were asked about history falls within 6 months prior to beginning the intervention/control (i.e. the baseline measurement) and at 6 months post-intervention in the final follow-up.

Falls Data: Participants were given preprinted postcards weekly to record falls and fall-related injuries and this

data was reported monthly either by mailing the postcard to the investigators or by phone calls to study personnel. The researchers noted that no falls or "other adverse events" occurred during intervention exercise sessions.

Data Analysis: Due to type 1 error being dispersed across fours variables (intervention, control, faller, and non-faller), a P of 0.0125 is required to be considered statistically significant based on a 0.008 level of significance using a Bonferroni adjustment. Alpha was set at 0.025 for each outcome (FOC, falls, and secondary measures). A three-factor repeated-measures analysis of variance was used to analyze null hypotheses: two factors between subjects, intervention (experimental or control) and fall status (faller or non-faller) and one factor within subjects and time study periods (baseline, immediate post-intervention/6 weeks, and 6 months post-intervention).

Setting

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

Group exercise sessions were performed in therapy areas of the Physical Medicine and Rehabilitation Service at the University of Arkansas for Medical Sciences Medical Center in Little Rock, Arkansas, USA. Control group education sessions were held in a classroom at the same medical center. Data collection including participant interviews and evaluations were conducted at the same medical center in private rooms.

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.

N = 338 evaluated at baseline

- 181 participants were randomized to the exercise intervention due to the coin flip allocation method
  - Including 80 fallers (44%) and 101 non-fallers
- 157 participants were allocated to the control group
  - Including 59 fallers (38%) and 98 non-fallers

Participant Recruitment: Participants were recruited from 17 senior centers located throughout central Arkansas and operated by the Central Arkansas Area Agency on Aging. Recruitment tactics included presentations at each center that were advertised in advanced by signs and flyers on display in each center as well as paid advertising in a statewide newspaper.

There was a 37.8% attrition rate through the length of the study. Participants in the exercise intervention group were lost at 6 weeks due to not attending exercise session or drop-out for various reasons (death, lack of transportation, scheduling conflicts, other). Participants in the control group were lost at 6 weeks due to not attending seminars or drop-out (illness, death, lack of transportation scheduling conflicts, other). Participants for both groups were lost at 6 months due to illness, death, moving, or other reasons not stated. Thus, the final sample size was 210; complete data was only available on 205 participants and 238 participants were able to be matched for falls-relevant data analysis.

- 123 participants finished assessment in the exercise intervention group
  - Including 46 fallers (37%) and 76 non-fallers
- 87 participants finished assessment in the control group
  - Including 29 fallers (33%) and 54 non-fallers

Final Participant Characteristics:

- 57% female
- 89% white
- 67% married
- Mean age of 73.5 years
- No significant difference between intervention and control participants on demographics

Intervention Investigated

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

Control

The control consisted of a series of educational seminars that presented non-health-related topics of interest to the target population, including fraud prevention, tax preparation, gardening, fire safety, pet care, fishing, genealogy, etc. Presentations were given by volunteers knowledgeable in the session's topic though at least one researcher was present at all seminars to record participant attendance. Eighteen total seminars were offered and totaled equal time to what the intervention group spent in exercise classes (27 hours across the

length of the study). Participants who missed 5 total seminars or more than 3 consecutive seminars were accounted for as drop-outs and thus not included in the final analyses.

Experimental

The exercise intervention consisted of a 6-week protocol that included stretching, postural control, endurance walking, repetitive muscle coordination exercises, and strengthening (abdominal supine curl-ups, seated push-ups, leg extensions, leg curls, and side-lying leg lifts). Exercise sessions consisted of 6-8 participants in each group and were held 3 times per week for 90 minutes including warm-up and cool-down periods in addition to the previously stated exercises. A physical therapist with >8 years exercise supervised all exercise session. Frequency, repetitions, and resistance of exercises were tailored to individuals to accommodate participant variance for moderate intensity as determined by a subject ratings of perceived exertion scale. Participants who missed 5 total exercise sessions or more than 3 consecutive sessions were accounted for as drop-outs and thus not included in the final analyses.

Outcome Measures

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

Falls and fall-related injury data was collected via preprinted postcards that were returned by mail monthly or reported by telephone calls monthly to research personnel. Researchers summarized the data for baseline (up to 6 months pre-intervention) and 6 months post-intervention.

The listed primary outcome measure of the study was the FOC time for completion and quality of performance. All FOCs were conducted in "an easily accessible, well lighted space with vinyl tile floors" and with minimal distractions. Lead investigators trained all research personnel to conduct the FOC with standard procedures. The FOC required participants to complete 12 simulations of "functionally oriented mobility tasks or situations commonly encountered in and around home during functional activities" that challenge balance and gait. Four stations involved various floor textures, two involved graded surfaces, two involved stairs, and four involved completion of functional tasks and object negotiation (e.g. "opening and closing a door, arising from a chair, and stepping over foam cylinders"). Each run of the FOC was performed on the same, specified path and was demonstrated by research personnel prior to the participant completing the course. Participants were allowed rest breaks as needed and those rest periods did not affect elapsed time score or quality of performance scores. Participants were instructed that research personnel were recording their steadiness throughout the course with a video camera but were not told they were being timed though time was recorded later from the playback of the video recording. Quality of performance scores were scored on a 0-3 scale where 0 indicated no observed difficulty and 3 indicated unsteadiness; there were 12 items for scoring on this scale resulting in a final quality of performance score ranging from 0 to 36 with higher scores indicating more unsteadiness.

Secondary outcomes included activity level, symptoms of balance dysfunction, bilateral lower extremity range of motion, and bilateral lower extremity strength; each were obtained by the below described means and were assigned ratings as determined by the investigators.

- Activity
    - A research assistant conducted subjective structured interviews regarding how much assistance participants required to complete activities of daily living. Activities included bathing, toileting, medication, dressing both upper and lower body, continence, walking frequency, need for assistance with walking, exiting/entering home, and distance traveled from home.
    - Participants self-rated themselves based on the questions asked by the research assistant on the following scale:
        - 0 = independent and active
        - 1 = mildly restricted with physical activity
        - 2 = moderately restricted with physical activity
        - 3 = severely restricted with limited physical activity
    - Activity scores were summed for each question and the total ranged from 0 to 12 where a 12 indicated minimal activity and lower scores corresponded with greater activity/independence.
- Symptoms
    - A physiatrist took a medical history of each participant and noted balance dysfunction symptoms, including dizziness, vertigo, syncope, generalized weakness, fatigue or pain, visual problems, and numbness, tingling, or weakness specific to the lower extremities. Symptoms that were present were scored as 1 while symptoms absent were scored as 0.
    - Symptom scores were summed for each question and the total ranged from 0 to 10 where 10 indicated more balance dysfunction symptoms were present.
- ROM
    - A physical therapist evaluated range of motion bilaterally of selected joints as either normal, scored as 0, or limited, scored as 1. The following joint motions were evaluated:
        - Hip abduction/adduction
        - Hip flexion/extension
        - Knee flexion/extension
        - Ankle plantarflexion/dorsiflexion

        - Ankle eversion
    - ROM scores were summed and ranged from 0 to 10 where 10 indicated more limited joint range of motion bilaterally.
- Strength
    - The same physical therapist who assessed ROM also assess strength bilaterally in 8 paired lower extremity muscle groups. Muscles were assessed using standard manual muscle testing rating of 0 to 5. The following muscle groups were evaluated:
        - Hip flexors
        - Hip extensors
        - Hip abductors
        - Knee flexors
        - Knee extensors
        - Ankle dorsiflexors
        - Ankle everters
        - Ankle plantarflexors
    - Strength scores were summed and ranged from 0 to 80 where 80 indicated normal strength and lower scores indicated decreased muscle strength.

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.]

The authors noted large variances between intervention and control groups in regards to falls, likely due to the increased number of participants that remained in the exercise program compared to the control. That data collected regarding falls for each group is detailed in the table below:

Falls Experienced, Mean ±SD (range)	**Exercise (N = 144)**	**Control (N = 94)**
Baseline (6 months before intervention)	2.01 ±15.30 (0-180)	0.48 ±0.89 (0-5)
6 months post-intervention	0.24 ±0.74 (0-6)	0.59 ±1.01 (0-5)

Because of the large variances demonstrated above, the authors dichotomized the falls reporting into No Falls or Having One or More Falls. The results of falls reported based on this dichotomy are detailed in the table below:

Falls, % (N)	**Exercise (N = 144)**	**Control (N = 94)**
Baseline (6 months before intervention)	31.9 (46)	30.9 (29)
6 months post-intervention	15.3 (22)	38.3 (36)
P	0.002	0.25

As demonstrated by these results, the authors noted a significant decrease (P = 0.002, where significance determined by P <0.0125) in the intervention group between baseline and 6 months post-intervention whereas the control group was relatively unchanged in the same period.

Though not addressed in the focused clinical question, FOC and secondary outcomes data are also notable in this study. Results from these outcome measures are detailed in the tables below.

FOC Time and Quality of Performance Mean and Standard Deviation Values

	Fallers		**Non-Fallers**		**Total**	
	Exercise (N = 46)	**Control (N = 29)**	**Exercise (N = 76)**	**Control (N = 54)**	**Exercise (N = 122)**	**Control (N = 83)**
Baseline Time (s)	263 ±105	250 ±104	233 ±66.7	226 ±84.7	244 ±83.9	235 ±92
Baseline Quality	32.2 ±5.76	32.9 ±4.14	33.6 ±3.29	33.9 ±3.13	33.1 ±4.41	33.5 ±3.52
Immediate Post-Intervention Time (s)	239 ±87.6	240 ±97.4	217 ±60.9	218 ±71.3	226 ±72.6	226 ±81.5

Immediate Post-Intervention Quality	33.3 ±4.57	32.7 ±3.43	34.1 ±3.23	34.1 ±3.07	33.8 ±3.79	33.6 ±3.25
6 Months Post-Intervention Time (s)	239 ±85.7	245 ±98.8	215 ±57.2	217 ±56.8	224 ±70.1	227 ±74.8
6 Months Post-Intervention Quality	33.3 ±4.72	31.7 ±5.52	33.7 ±3.37	33.6 ±3.07	33.6 ±3.92	33 ±4.16

Exercise group by time (baseline, immediately post-, and 6 months post-) interactions were significant for time (P = 0.016) and quality (0.001).

Secondary Outcomes Mean and Standard Deviation Values

	Fallers		**Non-Fallers**		**Total**	
	Exercise (N = 45)	**Control (N = 29)**	**Exercise (N = 75)**	**Control (N = 55)**	**Exercise (N = 120)**	**Control (N = 84)**
Baseline Activity	2.84 ±1.85	2.55 ±1.96	2.63 ±1.99	2.05 ±1.43	2.71 ±1.93	2.23 ±1.64
Baseline ROM	557.5 ±58.2	563.7 ±64.88	572.3 ±46.33	559.6 ±49.34	566.7 ±51.41	560.9 ±54.57
Baseline Strength	76.52 ±7.29	76.55 ±6.40	78.52 ±2.52	78.39 ±2.19	77.77 ±4.95	78.07 ±4.34
Baseline Symptoms	5.62 ±2.45	4.93 ±2.27	3.79 ±2.43	3.25 ±2.08	4.48 ±2.59	3.83 ±2.28
Immediate Post-Intervention Activity	2.38 ±1.76	2.66 ±1.91	2.21 ±2	2.53 ±1.54	2.28 ±1.91	2.57 ±1.67
Immediate Post-Intervention ROM	565.7 ±55.13	545.3 ±65.95	573.8 ±43.04	560.1 ±49.25	570.7 ±47.9	555.2 ±55.34
Immediate Post-Intervention Strength	78.91 ±3.42	77.47 ±4.40	79.30 ±1.82	78.90 ±1.93	79.16 ±2.53	78.38 ±3.11
Immediate Post-Intervention Symptoms	5.27 ±3.19	5.1 ±2.78	3.44 ±3.04	2.76 ±2	4.14 ±3.21	3.57 ±2.54
6 Months Post-Intervention Activity	2.58 ±1.9	2.93 ±2.53	2.77 ±2.32	2.73 ±2.05	2.7 ±2.16	2.8 ±2.22
6 Months Post-Intervention ROM	556.6 ±59.26	550.2 ±67.13	572.9 ±43.09	556.6 ±56.17	566.7 ±50.21	554.5 ±59.66
6 Months Post-Intervention Strength	77.53 ±4.45	76.95 ±4.66	78.77 ±3.19	78.78 ±2.44	78.30 ±3.75	78.12 ±3.50
6 Months Post-Intervention Symptoms	4.64 ±2.82	4.93 ±2.98	3.04 ±2.41	3.35 ±2.87	3.64 ±2.68	3.89 ±2.99

P values for intervention group by time interaction indicating effect of group assignment over time: Activity

<0.001*; ROM = 0.006*; Strength = 0.024; Symptoms = 0.015. *statistically significant based on P<0.0125, effect of group assignment over the timeframe

Original Authors' Conclusions

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

There is statistical evidence that moderate-intensity exercise that includes balance and mobility tasks has the potential to reduce falls thus decreasing incidence of fall-related injuries while also improving functional balance and mobility. The pilot study investigated prior to this trial noted greater clinical change than statistical, therefore this trial adds to the statistical nature of the findings. Exact exercise program administration may not matter in obtaining positive outcomes (i.e. reduced falls) as long as balance and mobility exercises are included, exercisers are encouraged to participate with moderate intensity, and methods to measure dynamic balance and mobility are used to assess outcomes.

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.]

PEDro score: **7/10**; specified eligibility criteria: yes; random subject allocation: yes; concealed allocation: yes; similar groups at baseline: yes; blinding of subjects: no; blinding of administering therapists: yes; blinding of assessors: yes; measures of key outcomes for more than 85% of initially allocated subjects: no; intention to treat: no; between-group statistical comparison for at least one key outcome: yes; point measures and measures of variability for at least one key outcome: yes.

Strengths:

- **Internal validity**: The above PEDro score of 7/10 demonstrates moderately high internal validity. Additionally, based on the statistically significant reduction in falls from baseline to 6 months post-intervention in the intervention group but not the control, the authors have a valid claim that the intervention protocol that included balance and mobility exercises had a direct effect on this outcome.
- **Allocation methods**: A simple coin flip is an unbiased method of assigning participants to groups, especially considering this is a single-blind study in which the participants must be aware of their group allocation in order to fully participate and thus might question the validity of their assignment. The authors note their reasoning behind using the coin flip from the previous pilot study as subjects were suspicious of computer randomization but felt the simple randomization coin flip method was "fair." The only caveat of the coin flip was that more participants were randomly allocated to the intervention group (N = 181) compared to the control (N = 157).
- **Test-retest reliability, construct validity, concurrent validity, and interrater agreement for FOC**: Researchers noted a >0.98 interrater agreement and 0.99 test-retest reliability for the FOC. These are excellent metrics for the use of this primary measure.
- **Inclusion of exercise protocol in Appendix**: The weekly breakdown of exercises and key areas for intervention are easily interpreted thus have high potential to be replicated in future studies or similar program implementation. Including target muscle groups, body mechanics, sets, and repetitions is very helpful.
- **External validity**: The results of this RCT can be generalized to the population of the focused clinical question and the protocol is easily replicated.

Weaknesses:

- **High attrition rate**: Of 338 participants evaluated at baseline, only 62% completed all measures through the entirety of the study which the authors note is somewhat surprising compared to previous falls intervention investigations. The time commitment of exercise intervention sessions occurring 3 times per week and of the control educational seminars that may not always be on a topic of interest to the participants could be considered a limitation. The authors note that attrition rates did not differ between fallers and non-fallers, therefore representation in the data might not have been affected by the high drop-out rate.
- **Recruitment tactics**: Based on the volunteer nature of the recruitment strategies (advertising and presentations in local senior centers), participants may or may not be a true representation of an at-risk population. The authors do note that the participants matched a good representation of the focused geographical are of recruitment, however the majority of recruitment occurred in senior centers where participants may be receiving services and/or are already pro-active in their aging dynamic including falls awareness. Recruiting in other areas, such as clinics, churches, etc. could have further improved the representation of fallers versus non-fallers in the community-dwelling older adult population.

Overall, the evidence quality of this RCT is moderately high despite the attrition rate. The authors were careful to note the homogeneity between intervention and control groups allowing for accurate matched-data comparisons.

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.]

A group-based exercise program 3 times per week for as little as 6 weeks can reduce falls suffered by participants as long as balance and mobility exercises heavily involving the lower extremities are key components of the program. Many factors need to be considered to improve compliance, such as the time commitment, transportation availability, and interest of the participants in the activities. While group-based activities are cost-effective and easily implemented with the proper staffing and location availability, individualization is lacking in this exercise method therefore participants may benefit from having a physical therapist or other exercise specialist present in order to allow for modifications as necessary; these modifications may alter results but more importantly may improve adherence/attendance thus engaging more participants in a healthy lifestyle that aims to reduce falls risk. Ensuring that group-based activities are well-known throughout the community so that all who might benefit can choose to participant is vital.

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.]

This trial has high applicability to the focused clinical question as it utilized group-based exercise programs to reduce falls in community-dwelling older adults compared to a control of educational seminars not directly related to falls. This comparison allows the investigators to isolate the exercise program as the relevant component to the statistically and clinically significant falls reduction seen in the exercise intervention group. Group exercise may be an excellent alternative to one-on-one exercise programs for older adults in the community looking to decrease their falls risk with or without a history of falls; assessment of the program will be important, however, as the inclusion of balance and mobility exercises in the program is what the authors credit their findings. Provided there are available resources such as senior centers with staff and space available to host such a program, the feasibility and practicality of implementing a group exercise program is reasonable. The small exercise group size of this trial (6-8 participants per session) allows for participant interest to grow in the program prior to introducing more than one exercise class, though the frequency (3 times per week) may be prohibitive based on room and staff availability. Particularly for persons who are unable to attend one-on-one sessions but would benefit from supervised activity, group-based exercise would be a great recommendation for older adults who fear falling or have suffered a recent fall.

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.]

To conclude, both the Hill et al. systematic review and the Means et al. RCT demonstrate exercise methods that can reduce the risk of falls in community-dwelling older adults. Both OEP and group-based exercise can reduce falls among this population as the most important factor of each method relies on balance, strength and mobility interventions.

Synthesis of Evidence: Hill et al. focused on home-based interventions, including 7 studies that utilized OEP and the program's principles, while Means et al. investigated group-based exercises at a community center.[3,9] These internally and externally valid studies suggest that both home-based and group-based exercises can reduce incidence of falls in community-dwelling older adults with as little as 6 weeks of intervention when measuring self-reported falls over a 6- to 12-month period. While statistical significance is important in research, the clinical significance of any reduction in falls is exceptionally important when considering the implications and consequences of falls among older adults.

As demonstrated by the literature search for this critical appraisal, there is overall quite extensive evidence for methods to reduce falls risk among community-dwelling older adults. Wide-ranging reviews show that multifactorial interventions whether group-based or home-based reduce falls risk.[2-4] Group-based exercise may offer additional psychological benefits through socialization[8] though OEP is a viable home-based option when access to exercise facilities is limited;[6] therefore it may be more a matter of what type program is available or feasible to be implemented as well as what is ideal for both the prescribing/supervising healthcare provider and participant.

Attrition is an issue in the available research as research participants are lost from data collection for multiple reasons, many inherent to the older adult population (e.g. chronic conditions, death, access to transportation/timing issues, etc.). Therefore, increasing adherence rates and compliance in exercise programs is important when discussing and supervising exercise programs for older adults. As with all exercise, finding activities of interest that are functional and applicable to daily life is important especially if participants can see their own change over time (i.e. falling prior to intervention but no falls after 6 weeks of intervention).

Implications for Clinical Practice: It is very well-documented[2-9] that exercise is often the intervention of choice to reduce or prevent falls in community-dwelling older adults based on the literature search for this critical appraisal. The methods of exercise may differ across studies, however the presence of activities that focus on lower extremity strength and mobility as well as balance exercises are common practice among the investigations. Both OEP and group-based exercise programs incorporate these strength, mobility, and balance principles therefore the implementation of either program has strong evidentiary support to reduce falls risk in older adults living in the community. Other factors such as resource availability and personal preference and ability/desire to commit to regular physical activity should also be considered when prescribing exercises as these components may improve exercise adherence.

In addition to tracking incidence of falls, incorporating secondary outcome measures such as those sensitive and specific to strength, dynamic and static balance, and functional mobility can further track improvements over time. These measures increase the amount of data collected to determine individualized effects of exercises and can be used to guide future interventions based on areas of needed improvement in the participant.

Implications for Future Research: Future research is merited to investigate methods to improve participant compliance with exercise protocols including frequency/duration of activities. Effective implementation methods should be explored for both home-based and group-based activities for community-dwelling older adults. There is currently a vast and diverse selection of outcome measures to supplement data beyond the incidence of falls in this population, thus a standardized group of outcome measures that are independently and collectively valid, reliable, and sensitive to detecting change can assist in future meta-analyses. The question of standardization versus individualization may continue to arise in what is better for research versus clinical improvements in the population therefore compromise between these factors may drive future research.

REFERENCES
[List all references cited in the CAT]

1. Bergen G, Stevens MR, Burns ER. Falls and fall injuries among adults aged ≥65 years — United States, 2014. MMWR Morb Mortal Wkly Rep 2016;65:993–998. DOI: http://dx.doi.org/10.15585/mmwr.mm6537a2.
2. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst. Rev.* 2012;(9):CD007146. doi:10.1002/14651858.CD007146.pub3.
3. Hill KD, Hunter SW, Batchelor FA, Cavalheri V, Burton E. Individualized home-based exercise programs for older people to reduce falls and improve physical performance: A systematic review and meta-analysis. *Maturitas* 2015;82(1):72-84. doi:10.1016/j.maturitas.2015.04.005.
4. Martin JT, Wolf A, Moore JL, Rolenz E, DiNinno A, Reneker JC. The effectiveness of physical therapist-administered group-based exercise on fall prevention: a systematic review of randomized controlled trials. *J Geriatr Phys Ther* 2013;36(4):182-193. doi:10.1519/JPT.0b013e3182816045.
5. Barnett A, Smith B, Lord SR, Williams M, Baumand A. Community-based group exercise improves balance and reduces falls in at-risk older people: a randomised controlled trial. *Age Ageing* 2003;32(4):407-414. doi:10.1093/ageing/32.4.407.
6. Dadgari A, Aizan Hamid T, Hakim MN, et al. Randomized control trials on Otago exercise program (OEP) to reduce falls among elderly community dwellers in Shahroud, Iran. *Iran Red Crescent Med J* 2016;18(5):e26340. doi:10.5812/ircmj.26340.
7. Kim H, Yoshida H, Suzuki T. Falls and fractures in participants and excluded non-participants of a fall prevention exercise program for elderly women with a history of falls: 1-year follow-up study. *Geriatr Gerontol Int* 2014;14(2):285-292. doi:10.1111/ggi.12095.
8. Hayashi T, Kondo K, Kanamori S, et al. Differences in falls between older adult participants in group exercise and those who exercise alone: a cross-sectional study using Japan Gerontological Evaluation Study (JAGES) data. *Int. J. Environ. Res. Public Health* 2018;15(7). doi:10.3390/ijerph15071413.
9. Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons. *Am. J. Phys. Med. Rehabil.* 2005;84(4):238-250. doi:10.1097/01.PHM.0000151944.22116.5A.
10. Gardner MM, Phty M, Robertson MC, McGee R, Campbell AJ. Application of a falls prevention program for older people to primary health care practice. *Prev. Med.* 2002;34(5):546-553. doi:10.1006/pmed.2002.1017.
11. Liu-Ambrose T, Donaldson MG, Ahamed Y, et al. Otago home-based strength and balance retraining improves executive functioning in older fallers: a randomized controlled trial. *J. Am. Geriatr. Soc.* 2008;56(10):1821-1830. doi:10.1111/j.1532-5415.2008.01931.x.
12. Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. *BMJ* 2001;322(7288):697-701.
13. Suttanon P, Hill KD, Said CM, et al. Feasibility, safety and preliminary evidence of the effectiveness of a home-based exercise programme for older people with Alzheimer's disease: a pilot randomized controlled trial. *Clin. Rehabil.* 2013;27(5):427-438. doi:10.1177/0269215512460877.
14. Yang XJ, Hill K, Moore K, et al. Effectiveness of a targeted exercise intervention in reversing older people's mild balance dysfunction: a randomized controlled trial. *Phys. Ther.* 2012;92(1):24-37. doi:10.2522/ptj.20100289.
15. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *BMJ* 1997;315(7115):1065-1069.
16. Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Falls prevention over 2 years: a randomized controlled trial in women 80 years and older. *Age Ageing* 1999;28(6):513-518. doi:10.1093/ageing/28.6.513.
17. Sherrington C, Lord SR, Vogler CM, Close JCT, Howard K, Dean CM, Heller GZ, Clemson L, O'Rourke SD, Ramsay E, Barraclough E, Herbert RD, Cumming RG. A post-hospital home exercise program improved mobility but increased falls in older people: a randomised controlled trial. *PLoS ONE* 2014;9(9):e104412. doi:10.1371/journal.pone.0104412.