Evidence Portfolio – Aging Subcommittee, Question 1

What is the relationship between physical activity and risk of injury due to a fall?

a. Is there a dose-response relationship? If yes, what is the shape of the relationship?
b. Does the relationship vary by age, sex, race/ethnicity, socio-economic status, or weight status?
c. What type(s) of physical activity are effective for preventing injuries due to a fall?
d. What factors modify the relationship between physical activity and risk of injury due to a fall?

Sources of Evidence: Existing Meta-Analyses, High-Quality Existing Report, and Original Research

Conclusion Statements and Grades

Strong evidence demonstrates that participation by community-dwelling older adults in multicomponent group or home-based fall prevention physical activity and exercise programs can significantly reduce the risk of injury from falls, including severe falls that result in bone fracture, head trauma, open wound soft tissue injury, or any other injury requiring medical care or admission to hospital. **PAGAC Grade: Strong.**

Limited evidence suggests that a dose-response relationship exists between the amount of moderate-to-vigorous physical activity or home and group exercise and risk of fall-related injury and bone fracture. However, the small number of studies available and the diverse array of physical activities studied make it difficult to describe the shape of the relationship. **PAGAC Grade: Limited.**

Insufficient evidence is available to determine whether the relationship between physical activity and risk of injury and bone fracture due to a fall varies by age, sex, race/ethnicity, socioeconomic status, or weight status. **PAGAC Grade: Not assignable.**

Moderate evidence indicates that the risk of fall-related injury and bone fracture may be reduced using a variety of community-based group and home physical activities. Effective multicomponent physical activity regimens generally include combinations of balance, strength, endurance, gait, and physical function training, along with recreational activities. **PAGAC Grade: Moderate.**

Insufficient evidence is available to determine whether other factors (e.g., level of physical function ability and pre-existing gait disability) modify the relationship between physical activity and risk of injury due to a fall. **PAGAC Grade: Not assignable.**

Description of the Evidence

An initial search for systematic reviews, meta-analyses, pooled analyses, and reports did not identify sufficient literature to fully answer the research question as determined by the Aging Subcommittee. All identified studies addressed randomized controlled trials. A supplementary search for cohort studies was conducted to capture the most complete literature.

Existing Meta-Analyses

Overview

A total of 3 meta-analyses, published between 2012 and 2016, were included as sources of evidence.[1-3]

The meta-analyses included a range of 15 to 159 randomized controlled trials and searched an extensive timeframe: from inception to 2013 and 2015,[1, 3] and from 1946 to 2012.[2]

Exposures

The meta-analyses reviewed fall prevention exercise programs and interventions. The interventions focused on resistance or strength training; gait, balance, and functional training; 3D training (movement through all three spatial planes); general physical activity (walking); weight-bearing exercise; and flexibility training.

Outcomes

One meta-analysis[1] addressed rate ratios of injurious falls, including subgroup analysis for all injurious falls, falls resulting in medical care, falls resulting in serious injuries, and falls resulting in fractures. One meta-analysis[3] examined fall-related fractures only, and another meta-analysis[2] addressed the rate of falls, number of fallers, and number of participants with fall-related fractures.

High-Quality Existing Report

Overview

One report from Health Quality Ontario[4] was included. The report provided a meta-analysis of studies published between January 2000 and September 2007.

Exposures

The review examined physical exercise interventions that contained a combination of exercises designed to improve balance, strength, endurance, coordination, and flexibility. Most interventions were conducted in a group setting, and several incorporated a home-based exercise program to be completed between group sessions.

Outcomes

The outcomes included the number of fallers and number of falls resulting in injury or fracture. Stratification was provided by fall risk: high (extremely frail or history of previous falls) versus low.

Original Research

Overview

Four original research studies were included as sources of evidence. Three of the studies were prospective cohorts[5-7] and 1 was a case-control study.[8] The studies were published between 2006 and 2013.

The analytic sample size varied between 378[8] and 6,468.[6] Two studies[6, 8] were conducted in Australia, 1 study was conducted in the United States,[5] and the remaining study was conducted in Finland.[8]

Exposure

All 4 studies used self-reported data in the form of questionnaires, texts, or phone calls to assess physical activity. One study[5] also used a multi-sensor arm band to examine physical activity. The

collected data included frequency, intensity, and type of physical activity. Cauley et al[5] used the device to also collect total energy expenditure per day.

Outcomes

The included studies examined the self-reported number of falls, number of injurious falls,[5-7] and risk of fall-related hip fractures.[8] Two studies[5, 7] also conducted a medical record review.

Populations Analyzed

The table below lists the populations analyzed in each article.

Table 1. Populations Analyzed by All Sources of Evidence

	Sex	Age
Cauley, 2013	Male	Adults ≥65
El-Khoury, 2013		Adults ≥60
Gillespie, 2012		Adults ≥60
Health Quality Ontario, 2008	Male	Adults ≥65
Heesch, 2008	Female	Adults 70–75
Iinattiniemi, 2008		Adults ≥85
Peel, 2006		Adults ≥65
Zhao, 2016		Adults 53.6–85.1

Supporting Evidence

Existing Meta-Analyses

Table 2. Existing Meta-Analyses Individual Evidence Summary Tables

<table>
<tr><td colspan="2">Meta-Analysis
Citation: El-Khoury F, Cassou B, Charles MA, Dargent-Molina P. The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. BMJ. 2013;347:f6234. doi:10.1136/bmj.f6234.</td></tr>
<tr><td>Purpose: To review the current evidence about the effect of exercise interventions designed for community-dwelling older adults on different outcomes of injurious falls, based on severity or medical care.</td><td rowspan="5">Abstract: Objective To determine whether, and to what extent, fall prevention exercise interventions for older community dwelling people are effective in preventing different types of fall related injuries. Data sources Electronic databases (PubMed, the Cochrane Library, Embase, and CINAHL) and reference lists of included studies and relevant reviews from inception to July 2013. Study selection Randomised controlled trials of fall prevention exercise interventions, targeting older (>60 years) community dwelling people and providing quantitative data on injurious falls, serious falls, or fall related fractures. Data synthesis Based on a systematic review of the case definitions used in the selected studies, we grouped the definitions of injurious falls into more homogeneous categories to allow comparisons of results across studies and the pooling of data. For each study we extracted or calculated the rate ratio of injurious falls. Depending on the available data, a given study could contribute data relevant to one or more categories of injurious falls. A pooled rate ratio was estimated for each category of injurious falls based on random effects models. Results 17 trials involving 4305 participants were eligible for meta-analysis. Four categories of falls were identified: all injurious falls, falls resulting in medical care, severe injurious falls, and falls resulting in fractures. Exercise had a significant effect in all categories, with pooled estimates of the rate ratios of 0.63 (95% confidence interval 0.51 to 0.77, 10 trials) for all injurious falls, 0.70 (0.54 to 0.92, 8 trials) for falls resulting in medical care, 0.57 (0.36 to 0.90, 7 trials) for severe injurious falls, and 0.39 (0.22 to 0.66, 6 trials) for falls resulting in fractures, but significant heterogeneity was observed between studies of all injurious falls (I2=50%, P=0.04). Conclusions Exercise programmes designed to prevent falls in older adults also seem to prevent injuries caused by falls, including the most severe ones. Such programmes also reduce the rate of falls leading to medical care.</td></tr>
<tr><td>Timeframe: Inception–2013</td></tr>
<tr><td>Total # of Studies: 17</td></tr>
<tr><td>Exposure Definition: Fall prevention exercise programs in facility and at home. Most included strengthening exercises. Others included gait, balance, functional training, and flexibility.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Rate ratio of injurious falls (ratio of the total number of injurious falls divided by the total length of time falls were monitored [person years]). Subgroup analyses conducted for 4 categories of injurious falls: All injurious falls; falls resulting in medical care; falls resulting in serious injuries; and falls resulting in fractures.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Adults ≥60</td><td>Author-Stated Funding Source: No funding source used.</td></tr>
</table>

Meta-Analysis

Citation: Gillespie LD, Robertson M, Gillespie WJ, Sherrington C, Gates S, Clemson LM, Lamb SE. Interventions for preventing falls in older people living in the community. Cochrane Database of Systematic Reviews. 2012;9:CD007146. doi:10.1002/14651858.CD007146.pub3.

Purpose: To assess the effects of interventions designed to reduce the incidence of falls in older people living in the community.

Timeframe: 1946–2012

Total # of Studies: 159

Exposure Definition: Any intervention designed to reduce falls in older people (i.e., designed to minimize exposure to, or the effect of, any risk factor for falling). Interventions grouped into 6 categories: gait/balance/functional training; strength/resistance training; flexibility; 3D (Tai Chi, dance, etc.); general PA (walking); and endurance. Individual and group exercise assessed independently.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No

Outcomes Addressed: Rate of falls. Number of fallers. Number of participants sustaining fall-related fractures.
Examine Cardiorespiratory Fitness as Outcome: No

Abstract: Background: Approximately 30% of people over 65 years of age living in the community fall each year. This is an update of a Cochrane review first published in 2009.Objectives: To assess the effects of interventions designed to reduce the incidence of falls in older people living in the community.Search methods: We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (February 2012), CENTRAL (The Cochrane Library 2012, Issue 3), MEDLINE (1946 to March 2012), EMBASE (1947 to March 2012), CINAHL (1982 to February 2012), and online trial registers. Selection criteria: Randomised trials of interventions to reduce falls in community-dwelling older people. Data collection and analysis: Two review authors independently assessed risk of bias and extracted data. We used a rate ratio (RaR) and 95% confidence interval (CI) to compare the rate of falls (e.g. falls per person year) between intervention and control groups. For risk of falling, we used a risk ratio (RR) and 95% CI based on the number of people falling (fallers) in each group. We pooled data where appropriate. Main results: We included 159 trials with 79,193 participants. Most trials compared a fall prevention intervention with no intervention or an intervention not expected to reduce falls. The most common interventions tested were exercise as a single intervention (59 trials) and multifactorial programmes (40 trials). Sixty-two per cent (99/159) of trials were at low risk of bias for sequence generation, 60% for attrition bias for falls (66/110), 73% for attrition bias for fallers (96/131), and only 38% (60/159) for allocation concealment. Multiple-component group exercise significantly reduced rate of falls (RaR 0.71, 95% CI 0.63 to 0.82; 16 trials; 3622 participants) and risk of falling (RR 0.85, 95% CI 0.76 to 0.96; 22 trials; 5333 participants), as did multiple-component home-based exercise (RaR 0.68, 95% CI 0.58 to 0.80; 7 trials; 951 participants and RR 0.78, 95% CI 0.64 to 0.94; 6 trials; 714 participants). For Tai Chi, the reduction in rate of falls bordered on statistical significance (RaR 0.72, 95% CI 0.52 to 1.00; 5 trials; 1563 participants) but Tai Chi did significantly reduce risk of falling (RR 0.71, 95% CI 0.57 to 0.87; 6 trials; 1625 participants). Overall, exercise interventions significantly reduced the risk of sustaining a fall-related fracture (RR 0.34, 95% CI 0.18 to 0.63; 6 trials; 810 participants). Multifactorial interventions, which include individual risk assessment, reduced rate of falls (RaR 0.76, 95% CI 0.67 to 0.86; 19 trials; 9503 participants), but not risk of falling (RR 0.93, 95% CI 0.86 to 1.02; 34 trials; 13,617 participants). Overall, vitamin D did not reduce rate of falls (RaR 1.00, 95% CI 0.90 to 1.11; 7 trials; 9324 participants) or risk of falling (RR 0.96, 95% CI 0.89 to 1.03; 13 trials; 26,747 participants), but may do so in people with lower vitamin D levels before treatment. Home safety assessment and modification interventions were effective in reducing rate of falls (RaR 0.81, 95% CI 0.68 to 0.97; 6 trials; 4208 participants) and risk of falling (RR 0.88, 95% CI 0.80 to 0.96; 7 trials; 4051 participants). These interventions were more effective in people at higher risk of falling, including those with severe

	visual impairment. Home safety interventions appear to be more effective when delivered by an occupational therapist. An intervention to treat vision problems (616 participants) resulted in a significant increase in the rate of falls (RaR 1.57, 95% CI 1.19 to 2.06) and risk of falling (RR 1.54, 95% CI 1.24 to 1.91). When regular wearers of multifocal glasses (597 participants) were given single lens glasses, all falls and outside falls were significantly reduced in the subgroup that regularly took part in outside activities. Conversely, there was a significant increase in outside falls in intervention group participants who took part in little outside activity. Pacemakers reduced rate of falls in people with carotid sinus hypersensitivity (RaR 0.73, 95% CI 0.57 to 0.93; 3 trials; 349 participants) but not risk of falling. First eye cataract surgery in women reduced rate of falls (RaR 0.66, 95% CI 0.45 to 0.95; 1 trial; 306 participants), but second eye cataract surgery did not. Gradual withdrawal of psychotropic medication reduced rate of falls (RaR 0.34, 95% CI 0.16 to 0.73; 1 trial; 93 participants), but not risk of falling. A prescribing modification programme for primary care physicians significantly reduced risk of falling (RR 0.61, 95% CI 0.41 to 0.91; 1 trial; 659 participants). An anti-slip shoe device reduced rate of falls in icy conditions (RaR 0.42, 95% CI 0.22 to 0.78; 1 trial; 109 participants). One trial (305 participants) comparing multifaceted podiatry including foot and ankle exercises with standard podiatry in people with disabling foot pain significantly reduced the rate of falls (RaR 0.64, 95% CI 0.45 to 0.91) but not the risk of falling. There is no evidence of effect for cognitive behavioural interventions on rate of falls (RaR 1.00, 95% CI 0.37 to 2.72; 1 trial; 120 participants) or risk of falling (RR 1.11, 95% CI 0.80 to 1.54; 2 trials; 350 participants). Trials testing interventions to increase knowledge/educate about fall prevention alone did not significantly reduce the rate of falls (RaR 0.33, 95% CI 0.09 to 1.20; 1 trial; 45 participants) or risk of falling (RR 0.88, 95% CI 0.75 to 1.03; 4 trials; 2555 participants). Thirteen trials provided a comprehensive economic evaluation. Three of these indicated cost savings for their interventions during the trial period: home-based exercise in over 80-year-olds, home safety assessment and modification in those with a previous fall, and one multifactorial programme targeting eight specific risk factors. Authors' conclusions: Group and home-based exercise programmes, and home safety interventions reduce rate of falls and risk of falling. Multifactorial assessment and intervention programmes reduce rate of falls but not risk of falling; Tai Chi reduces risk of falling.Overall, vitamin D supplementation does not appear to reduce falls but may be effective in people who have lower vitamin D levels before treatment.
Populations Analyzed: Adults ≥60	**Author-Stated Funding Source:** Department of Health Cochrane Review Incentive Scheme

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Zhao R, Feng F, Wang X. Exercise interventions and prevention of fall-related fractures in older people: a meta-analysis of randomized controlled trials. Int J Epidemiol. 2016. doi:10.1093/ije/dyw142.</td></tr>
<tr><td>Purpose: To explore whether exercise interventions were effective in preventing fall-related fractures in older people.</td><td rowspan="5">Abstract: BACKGROUND: This meta-analysis aimed to determine whether exercise interventions were effective in preventing fall-related fractures in older people. The treatment effects on rate of falls, leg strength and balance were also examined. METHODS: An electronic database search was conducted in PubMed, EMBASE, the Cochrane library and PEDro up to 1 September 2015. Randomized controlled trials (RCTs) that conducted exercise interventions and reported fall-related fracture data in older people were included. The primary outcome was the treatment effects on fall-related fractures determined by relative risk (RR) and 95% confidence interval (CI). The treatment effects on falls, leg strength and balance were also reported using rate ratio (RaR) with 95% CI and standardized mean difference (SMD) with 95% CI, respectively. Random effects models were used for meta-analysis. RESULTS: Fifteen studies including 3136 participants met the inclusion criteria. Exercise had a beneficial effect on reduction of fall-related fractures, with pooled estimates of RR 0.604 (95% CI 0.453 - 0.840, P = 0.003, I2 = 0%). The rate of falls (RaR 0.856, 95% CI 0.778 - 0.941, P = 0.001, I2 = 45%) and leg strength (SMD 0.613, 95% CI 0.119 - 1.107, P = 0.015, I2 = 76.7%) were also potentially affected by exercise interventions. These only had a marginally beneficial effect on balance (SMD 0.468, 95% CI -0.011 - 0.947, P = 0.055, I2 = 93.6%). CONCLUSIONS: Our findings implied that exercise interventions were effective in preventing fall-related fractures and reducing risk factors of fall-related fractures in older people.</td></tr>
<tr><td>Timeframe: Inception–2015</td></tr>
<tr><td>Total # of Studies: 15</td></tr>
<tr><td>Exposure Definition:
Randomized controlled trials with exercise interventions, grouped into 6 categories: 1) resistance or strength training; 2) gait, balance, and functional training; 3) 3D training (movement through all three spatial planes); 4) general PA: walking; 5) weight-bearing exercise; and 6) flexibility training. The intervention duration ranged from 1.4 months to 4 years,
with training frequencies of 2–6 times per week. The follow-up ranged from 6 months to 6 years.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Fall-related fractures: Fractures reported were mainly caused by an event resulting in an individual unintentionally coming to rest on the ground, floor, or other lower level.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Adults 53.6–85.1</td><td>Author-Stated Funding Source: Zhejiang Provincial Natural Science Foundation of China</td></tr>
</table>

Table 3. Existing Meta-Analyses Quality Assessment Chart

AMSTARExBP: SR/MA	El-Khoury, 2013	Gillespie, 2012	Zhao, 2016
Comprehensive literature search performed.	Yes	Yes	Yes
Duplicate study selection and data extraction performed.	Yes	Yes	No
Search strategy clearly described.	Yes	Yes	Yes
Relevant grey literature included in review.	No	Yes	No
List of studies (included and excluded) provided.	Yes	Yes	Yes
Characteristics of included studies provided.	Yes	Yes	Yes
FITT defined and examined in relation to outcome effect sizes.	No	No	No
Scientific quality (risk of bias) of included studies assessed and documented.	Yes	Yes	Yes
Results depended on study quality, either overall, or in interaction with moderators.	Yes	Yes	Yes
Scientific quality used appropriately in formulating conclusions.	Yes	Yes	Yes
Data appropriately synthesized and if applicable, heterogeneity assessed.	Yes	Yes	Yes
Effect size index chosen justified, statistically.	Yes	Yes	Yes
Individual-level meta-analysis used.	No	No	No
Practical recommendations clearly addressed.	Yes	Yes	Yes
Likelihood of publication bias assessed.	Yes	Yes	Yes
Conflict of interest disclosed.	Yes	Yes	Yes

High-Quality Existing Report

Table 4. High-Quality Existing Report Individual Evidence Summary Table

<table>
<tr><td colspan="2">Report
Citation: Health Quality Ontario. Prevention of falls and fall-related injuries in community-dwelling seniors: an evidence-based analysis. Ont Health Technol Assess Ser. 2008;8:1-78.</td></tr>
<tr><td>Source/Sponsor: Ontario Medical Advisory Secretariat, Ministry of Health and Long-Term Care</td><td rowspan="5">Relevant Conclusions: High-quality evidence indicates that long-term exercise programs in mobile seniors in the homes of frail elderly persons will effectively reduce falls and possibly fall-related injuries in Ontario’s elderly population.</td></tr>
<tr><td>Purpose: To identify interventions that may be effective in reducing the probability of an elderly person’s falling and/or sustaining a fall-related injury.</td></tr>
<tr><td>Timeframe: January 2000–September 2007</td></tr>
<tr><td>Exposure Definition: Physical exercise interventions: Most contained a combination of exercises designed to improve balance, strength, endurance, coordination, and flexibility. Most were conducted in a group setting; several incorporated a home-based exercise program to be completed between group sessions. Exercise programs were stratified by type—targeted (exercise tailored to the individual’s needs) and untargeted (programs that were identical among subjects)—and by program duration (<6 months and ≥6 months).
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Number of fallers; number of falls resulting in injury/fracture. Fall defined as unexpected event in which the participant comes to rest on the ground, floor, or lower level. Stratification by fall risk: high (extremely frail or history of previous falls) vs. low.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Adults ≥65</td><td>Author-Stated Funding Source: Not reported</td></tr>
</table>

Table 5. High-Quality Existing Report Quality Assessment Chart

	Health Quality Ontario, 2008
Research question(s) or purpose and inclusion/exclusion criteria or scope delineated prior to search.	Yes
Inclusion criteria permitted grey literature.	Yes
Comprehensive search performed.	Yes
Scientific quality of sources documented.	Yes
Limitations reported and discussed.	No
Conclusions substantiated by and logically connected to evidence and findings.	Yes
Recommendations for future research provided.	Yes
Recommendations were relevant to the report and supported by evidence, findings, and conclusions.	Yes
Potential conflicts of interest explained.	No
Reference list provided.	Yes

Original Research

Table 6. Original Research Individual Evidence Summary Tables

<table>
<tr><td colspan="2">Original Research
Citation: Cauley JA, Harrison SL, Cawthon PM, Ensrud KE, Danielson ME, Orwoll E, Mackey DC. Objective measures of physical activity, fractures and falls: the osteoporotic fractures in men study. J Am Geriatr Soc. 2013;61:1080-1088. doi: 10.1111/jgs.12326.</td></tr>
<tr><td colspan="2">Purpose: To determine the association of total and active energy expenditure and time spent in sedentary and moderate activities with incident falls and fractures in older men.</td></tr>
<tr><td>Study Design: Prospective cohort study</td><td rowspan="4">Abstract: OBJECTIVES: To determine the association between objectively measured physical activity (PA), fractures, and falls. DESIGN: Longitudinal cohort study. SETTING: Six U.S. clinical sites. PARTICIPANTS: Two thousand seven hundred thirty-one men with a mean age of 79. MEASUREMENTS: Total and active energy expenditure (EE) and minutes per day spent in sedentary and moderate intensity activities were measured for at least 5 days. Energy expended at a metabolic equivalent of greater than three was termed active EE. Incident nonspine fractures and falls were identified every 4 months. RESULTS: Seven hundred fifty-nine (28.2%) men fell at least once over 12 months of follow-up; 186 (6.8%) experienced one or more fractures over an average follow-up of 3.5 +/- 0.9 years. The association between PA and falling varied according to age (P interaction = .02). Men younger than 80 with the lowest active EE had a lower risk of falling than men with the highest active EE (relative risk (RR) = 0.75; P trend = .08), whereas men aged 80 and older with the lowest active EE had a higher risk of falling than men with the highest active EE (RR = 1.43, P trend = .09). In multivariate models including health status, men in the lowest quintile of active EE had a significantly higher risk of fracture (hazard ratio (HR) = 1.82, 95% confidence interval (CI) = 1.10-3.00, P trend = .04) than men in highest quintile. Men with <33 min/d of moderate activity had a 70% greater risk of fracture (HR = 1.70, 95% CI = 1.03-2.80). CONCLUSION: Age modifies the association between PA and falling. Interventions aimed at obtaining more than 30 minutes of moderate PA per day may reduce fractures, extending PA guidelines to the oldest old, the fastest-growing proportion of those aged 65 and older.</td></tr>
<tr><td>Location: United States</td></tr>
<tr><td>Sample: 2,731
Attrition Rate: 41.67%
Sample Power: Not reported</td></tr>
<tr><td>Exposure Measurement
Self-Reported: Physical Activity Scale for the Elderly (PASE), physical activity.
Device-Measured: Multi-sensor armband, estimated total energy expenditure (EE) in kilocalories per day. Moderate or greater intensity was termed active EE; minutes per day spent in sedentary (metabolic equivalent of task [MET] <1.5), moderate (MET 3<6), and vigorous (MET >6) intensity activities were quantified.
Measures Steps: No
Measures Bouts: No</td></tr>
<tr><td>Refers to Other Materials: Yes
Examine Cardiorespiratory Fitness as Outcome: No</td><td>Outcomes Examined: Fracture and fall events: Participants were asked if they had fallen, number of times, and whether any fractures occurred; study physicians centrally adjudicated reported fractures from medical records.</td></tr>
<tr><td>Populations Analyzed: Male, Adults ≥65</td><td>Author-Stated Funding Source: National Institutes of Health (NIH), National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institute of Aging, National Center for Research Resources, and NIH Roadmap for Medical Research</td></tr>
</table>

<table>
<tr><td colspan="2">Original Research
Citation: Heesch KC, Byles JE, Brown WJ. Prospective association between physical activity and falls in community-dwelling older women. J Epidemiol Community Health. 2008;62:421-426.</td></tr>
<tr><td colspan="2">Purpose: To explore prospective associations between PA and the risk of falls and fractured bones among older women.</td></tr>
<tr><td>Study Design: Prospective cohort study</td><td rowspan="4">Abstract: OBJECTIVE: To explore associations between physical activity and the risk of falls and fractured bones in community-dwelling older women. DESIGN, SETTING AND PARTICIPANTS: A prospective observational survey with three and six-year follow-ups. The sample included 8188 healthy, community-dwelling women, aged 70-75 years in 1996, who completed surveys as participants in the Australian Longitudinal Study on Women's Health. Women who reported a recent serious injury from falling were excluded. Outcomes were reports of a fall to the ground, injury from a fall, and a fractured bone in 1999 and 2002. The main predictor variable was physical activity level in 1996, categorised on the basis of weekly frequency as none/very low, low, moderate, high and very high. Covariates were demographic and health-related variables. Logistic regression models were computed separately for each outcome in 1999 and 2002. MAIN RESULTS: In multivariable models, very high physical activity was associated with a decreased risk of reporting a fall in 1999 (odds ratio (OR) 0.67; 95% CI 0.47 to 0.95) and in 2002 (OR 0.64; 95% CI 0.43 to 0.96). High/very high physical activity was associated with a decreased risk of a fractured bone in 2002 (OR 0.53; 95% CI 0.34 to 0.83). No significant association was found between physical activity and injury from a fall. CONCLUSIONS: The results suggest that at least daily moderate to vigorous-intensity physical activity is required for the primary prevention of falls to the ground and fractured bones in women aged 70-75 years.</td></tr>
<tr><td>Location: Australia</td></tr>
<tr><td>Sample: 6,468
Attrition Rate: 21.01%
Sample Power: Not reported</td></tr>
<tr><td>Exposure Measurement
Self-Reported: Final text, moderate to vigorous-intensity PA: number of times in a normal week engaged in exercise “which makes you breathe harder” (vigorous) and in exercise “which does not make you breathe harder” (less vigorous) for at least 20 minutes. Total score created by weighting vigorous exercise by 5.0 (metabolic equivalents of task [METs]) and less vigorous exercise by 3.0 (METs) and summing both scores. Scores were also categorized as none/very low (<5); low (5–15); moderate (15–25); high (25–40); and very high (>40).
Measures Steps: No
Measures Bouts: No</td></tr>
<tr><td>Refers to Other Materials: No
Examine Cardiorespiratory Fitness as Outcome: No</td><td>Outcomes Examined: Fall and fracture: Respondents were asked whether they had experienced “a fall to the ground (does not include stumbles, trips),” “been injured as a result of a fall,” or “broken or fractured any bone/s” in the past 12 months.</td></tr>
<tr><td>Populations Analyzed: Female, Adults 70–75</td><td>Author-Stated Funding Source: Australian Government Department of Health and Aging</td></tr>
</table>

<table>
<tr><td colspan="2">Original Research
Citation: Iinattiniemi S, Jokelainen J, Luukinen H. Exercise and risk of injurious fall in home-dwelling elderly. Int J Circumpolar Health. 2008;67:235-244.</td></tr>
<tr><td colspan="2">Purpose: To examine the relationship between different types of physical exercise and the risk of subsequent fall-related injury among older adults.</td></tr>
<tr><td>Study Design: Prospective cohort study</td><td rowspan="4">Abstract: OBJECTIVES: To examine the relationship between different types of physical exercise and the risk of subsequent fall-related injury. STUDY DESIGN: A prospective study of the home-dwelling elderly. METHODS: A population sample of home-dwelling subjects aged 85 years or older (n = 512) in northern Finland participated in the study. Baseline data were collected by home-nursing staff through postal questionnaires and clinical tests. Frequency and times of physical exercise--that is, walking exercise and other exercise (home exercise, group exercise, gardening, cross-country skiing, dancing, swimming, bicycling)--and falls were recorded by a nurse examiner, who telephoned the participants 8 times during a 2-year follow-up period. Statistical analyses were based on Cox regressions and pooled logistic regressions. RESULTS: The risk of injury-causing falls was reduced by other exercise taken at least 1 hour per week compared with corresponding non-exercise; adjusted odds ratio 0.37 (0.19-0.72) but not by walking exercise. The risk of injury-causing falls was not increased by any kind or amount of exercise taken. Female sex, a history of recent fall-related injury and poor baseline near-vision acuity were the other significant predictors of injury-causing falls. CONCLUSIONS: Habitual physical exercise proved to be safe and some of the exercises were associated with reduced risk of subsequent fall-related injury. Female sex, an injury-causing fall in the recent past and problems with near vision increased the risk.</td></tr>
<tr><td>Location: Finland</td></tr>
<tr><td>Sample: 512
Attrition Rate: 0%
Sample Power: Not reported</td></tr>
<tr><td>Intervention: Yes
Intervention Type: Provision of information/education
Intervention Length: 16 months</td></tr>
<tr><td>Exposure Measurement
Self-Reported: Phone call, physical exercise during preceding 2 weeks. Frequency (times) and approximate duration (minutes) ascertained using an open-ended question; walking exercise stratified into quartiles (none, <60 minutes, 60–140 minutes and >140 minutes per week); other exercises were categorized (none, <60 minutes, and >60 minutes during a week).
Measures Steps: No
Measures Bouts: No
Exposure
Frequency: Not reported
Intensity: Not reported
Time: Not reported
Type: Received recommendations composed of walking exercise, home exercise, group exercise, or self-care exercise.
Examines HIIT: No</td></tr>
<tr><td>Refers to Other Materials: Yes
Examine Cardiorespiratory Fitness as Outcome: No</td><td>Outcomes Examined: Injury-causing falls (per-person year): Medical records of all participants in the health center and local hospital were examined at the end of follow-up to check for injury-causing falls.</td></tr>
<tr><td>Populations Analyzed: Adults ≥85</td><td>Author-Stated Funding Source: Juho Vainio Foundation and Northern Ostrobothnia Hospital District Research Fund</td></tr>
</table>

<table>
<tr><td colspan="2">Original Research
Citation: Peel NM, McClure RJ, Hendrikz JK. Health-protective behaviours and risk of fall-related hip fractures: a population-based case-control study. Age Ageing. 2006;35:491-497.</td></tr>
<tr><td colspan="2">Purpose: To contribute to the evidence for the promotion of healthy aging as a population-based intervention for fall injury prevention among adults.</td></tr>
<tr><td>Study Design: Case-control study
Location: Australia
Sample: 378
Attrition Rate: 2.33%
Sample Power: Yes
Exposure Measurement
Self-Reported: Questionnaire, PA categorized as sufficient or insufficient based on minutes per week in an average week in the last 6 months spent walking, doing moderate and/or vigorous activity. Sport involvement over the life stages.
Measures Steps: No
Measures Bouts: No</td><td rowspan="2">Abstract: BACKGROUND: Fall-related hip fractures are one of the most common causes of disability and mortality in older age. The study aimed to quantify the relationship between lifestyle behaviours and the risk of fall-related hip fracture in community-dwelling older people. The purpose was to contribute evidence for the promotion of healthy ageing as a population-based intervention for falls injury prevention. METHODS: A case-control study was conducted with 387 participants, with a case-control ratio of 1:2. Incident cases of fall-related hip fracture in people aged 65 and over were recruited from six hospital sites in Brisbane, Australia, in 2003-04. Community-based controls, matched by age, sex and postcode, were recruited via electoral roll sampling. A questionnaire designed to assess lifestyle risk factors, identified as determinants of healthy ageing, was administered at face-to-face interviews. RESULTS: Behavioural factors which had a significant independent protective effect on the risk of hip fracture included never smoking [adjusted odds ratio (AOR): 0.33 (0.12-0.88)], moderate alcohol consumption in mid- and older age [AOR: 0.49 (0.25-0.95)], not losing weight between mid- and older age [AOR: 0.36 (0.20-0.65)], playing sport in older age [AOR: 0.49 (0.29-0.83)] and practising a greater number of preventive medical care [AOR: 0.54 (0.32-0.94)] and self-health behaviours [AOR: 0.56 (0.33-0.94)]. CONCLUSION: With universal exposures, clear associations and modifiable behavioural factors, this study has contributed evidence to reduce the major public health burden of fall-related hip fractures using readily implemented population-based healthy ageing strategies.</td></tr>
<tr><td>Refers to Other Materials: No
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Adults ≥65</td><td>Outcomes Examined: Risk of fall-related hip fractures (AOR).
Author-Stated Funding Source: Australian Association of Gerontology</td></tr>
</table>

Table 7. Original Research Bias Assessment Chart

Nutrition Evidence Library (NEL) Bias Assessment Tool (BAT): Original Research				
	Cauley, 2013	Heesch, 2008	Iinattinie mi, 2008	Peel, 2006
(???) = Can't Determine				
Strategy for recruiting or allocating participants similar across study groups.	Yes	Yes	Yes	Yes
Distribution of critical confounding factors similar across study groups at baseline, or analysis controlled for differences between groups.	Yes	Yes	???	Yes
Accounted for variations in execution of study from proposed protocol or research plan.	???	???	???	Yes
Adherence to study protocols similar across study groups.	Yes	Yes	Yes	Yes
Investigators accounted for unintended concurrent exposures that were differentially experienced by study groups and might bias results.	No	Yes	No	???
Valid and reliable measures used consistently across study groups to assess inclusion/exclusion criteria, exposures, outcomes, and confounders.	Yes	Yes	No	Yes
Length of follow-up similar across study groups.	Yes	Yes	Yes	???
In cases of high or differential loss to follow-up, impact assessed through sensitivity analysis or other adjustment.	No	Yes	???	???
Other sources of bias taken into account in design and/or analysis of study through matching or other statistical adjustment.	Yes	Yes	Yes	Yes
Adequate statistical methods used to assess primary outcomes.	Yes	Yes	Yes	Yes

Appendices

Appendix A: Analytical Framework

Topic Area
Aging

Systematic Review Questions

What is the relationship between physical activity and the risk of injuries from falling?

a. Is there a dose-response relationship? If yes, what is the shape of the relationship?
b. Does the relationship vary by age, sex, race/ethnicity, socio-economic status, or weight status?
c. What type(s) of physical activity are effective for preventing injuries due to a fall?
d. What factors modify the relationship between physical activity and risk of injury due to a fall?

Population
Adults, 50 years and older (Lower age range for included data must be a minimum of 50 years)

Exposure
All types and intensities of physical activity

Comparison
Adults, 50 years and older, who participate in varying levels of physical activity, including no reported physical activity

Key Definitions

- Fall: The act of moving without control from being upright to not being upright
- Injury from a fall: An injury resulting from a fall
- Risk of injury from a fall: The statistical odds of experiencing an injury from a fall

Intermediate Outcomes

- Balance
- BMI
- Bone health
- Disease diagnosis
- Falls
- Functional limitations
- Mobility
- Strength

Endpoint Health Outcomes

- All/any injuries from falls
- Fractures from falls
- Head injuries from falls
- Intraabdominal injuries from falls
- Limitation of daily activities
- Medically attended injuries from falls
- Neck, back, and spine injuries from falls
- "Pooled" injuries from falls
- Reduction in routine activities
- Sprains from falls

Appendix B: Final Search Strategy

Search Strategy: PubMed (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: PubMed; Date of Search: 12/2/2016; 93 results

Set	Search Terms
Limit: Language	(English[lang])
Limit: Exclude animal only	NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))
Limit: Exclude child only	NOT (("infant"[Mesh] OR "child"[mesh] OR "adolescent"[mh]) NOT (("infant"[Mesh] OR "child"[mesh] OR "adolescent"[mh]) AND "adult"[Mesh]))
Limit: Publication Date (Systematic Reviews/Meta-Analyses)	AND ("2006/01/01"[PDAT] : "3000/12/31"[PDAT])
Limit: Publication Type Include (Systematic Reviews/Meta-Analyses)	AND (systematic[sb] OR meta-analysis[pt] OR “systematic review”[tiab] OR “systematic literature review”[tiab] OR metaanalysis[tiab] OR "meta analysis"[tiab] OR metanalyses[tiab] OR "meta analyses"[tiab] OR "pooled analysis"[tiab] OR “pooled analyses”[tiab] OR "pooled data"[tiab])
Limit: Publication Type Exclude (Systematic Reviews/Meta-Analyses)	NOT (“comment”[Publication Type] OR “editorial”[Publication Type])
Falls	AND (("Accidental falls"[mh]) OR (("Fall"[tiab] OR "Falls"[tiab] OR "Slip"[tiab] OR "Slips"[tiab] OR "Trip"[tiab] OR "Trips"[tiab] OR "Fell"[tiab] OR "Slipped"[tiab] OR "Tripped"[tiab]) NOT medline[sb]))
Injury	AND (("Brain concussion"[mh] OR "Hemorrhage"[mh] OR "Wounds and injuries"[mh] OR (Limit*[tiab] AND activities[tiab]) OR (Limit*[tiab] AND activity[tiab]) OR (Reduc*[tiab] AND activities[tiab]) OR (Reduc*[tiab] AND activity[tiab])) OR (((Broken[tiab] AND bone*[tiab]) OR "Bruise"[tiab] OR "Bruises"[tiab] OR "Bruised"[tiab] OR "Concussion"[tiab] OR "Concussions"[tiab] OR "Contusion"[tiab] OR "Contusions"[tiab] OR "Fracture"[tiab] OR "Fractured"[tiab] OR "Fractures"[tiab] OR "Hemorrhage"[tiab] OR "Hemorrhages"[tiab] OR "Hemorrhaging"[tiab] OR "Injuries"[tiab] OR "Injury"[tiab] OR "Injured"[tiab] OR "Internal bleeding"[tiab] OR "Sprain"[tiab] OR "Sprained"[tiab] OR "Sprains"[tiab]) NOT medline[sb]))
Physical Activity	AND (("Exercise"[mh] OR "Exercise"[tiab] OR "Physical activity"[tiab] OR "Sedentary lifestyle"[mh] OR "Lifestyle activities"[tiab] OR "Lifestyle activity"[tiab] OR "Recreational activities"[tiab] OR "Recreational activity"[tiab] OR "Tai ji"[mh]

Set	Search Terms
	OR "Yoga"[mh] OR "Activities of daily living"[tiab] OR "Activity of daily living"[tiab] OR "Free living activities"[tiab] OR "Free living activity"[tiab] OR "Balance training"[tiab] OR "Qigong"[mh] OR "Functional training"[tiab]) OR (("Aerobic activities"[tiab] OR "Aerobic activity"[tiab] OR "Cardiovascular activities"[tiab] OR "Cardiovascular activity"[tiab] OR "Endurance activities"[tiab] OR "Endurance activity"[tiab] OR "Physical activities"[tiab] OR "Physical conditioning"[tiab] OR "Resistance training"[tiab] OR "strength training"[tiab] OR "Sedentary"[tiab] OR "Tai chi"[tiab] OR "Tai ji"[tiab] OR "Yoga"[tiab] OR "Walk"[tiab] OR "Walking"[tiab] OR "Chi kung"[tiab] OR "Qigong"[tiab] OR "stretching"[tiab]) NOT medline[sb]))

Search Strategy: CINAHL (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: CINAHL; Date of Search: 12/8/2016; 4 results
Terms searched in title or abstract

Set	Search Terms
Falls	("Fall" OR "Falls" OR "Slip" OR "Slips" OR "Trip" OR "Trips" OR "Fell" OR "Slipped" OR "Tripped")
Injury	AND ((Broken AND bone*) OR "Bruise" OR "Bruises" OR "Bruised" OR "Concussion" OR "Concussions" OR "Contusion" OR "Contusions" OR "Fracture" OR "Fractured" OR "Fractures" OR "Hemorrhage" OR "Hemorrhages" OR "Hemorrhaging" OR "Injuries" OR "Injury" OR "Injured" OR "Internal bleeding" OR "Sprain" OR "Sprained" OR "Sprains" OR (Limit* AND activities) OR (Limit* AND activity) OR (Reduc* AND activities) OR (Reduc* AND activity))
Physical Activity	AND ("Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Exercise" OR "Physical activity" OR "Physical activities" OR "Physical conditioning" OR "Resistance training" OR "strength training" OR “Sedentary” OR "Lifestyle activities" OR "Lifestyle activity" OR "Recreational activities" OR "Recreational activity" OR "Tai chi" OR "Tai ji" OR "Yoga" OR "Walk" OR "Walking" OR “Activities of daily living” OR “Activity of daily living” OR “Free living activities” OR “Free living activity” OR "Balance training" OR "Chi kung" OR "Qigong" OR "Functional training" OR "stretching")
Limit: Publication Type Include (Systematic Reviews/Meta-Analyses)	AND (“systematic review” OR “systematic literature review” OR "metaanalysis" OR "meta analysis" OR metanalyses OR "meta analyses" OR "pooled analysis" OR “pooled analyses” OR "pooled data")
Limits	2006-present English language Peer reviewed Exclude Medline records Human

Search Strategy: Cochrane (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: Cochrane; Date of Search: 12/8/16; 42 results
Terms searched in title, abstract, or keywords

Set	Search Terms
Falls	("Fall" OR "Falls" OR "Slip" OR "Slips" OR "Trip" OR "Trips" OR "Fell" OR "Slipped" OR "Tripped")
Injury	AND ((Broken AND bone*) OR "Bruise" OR "Bruises" OR "Bruised" OR "Concussion" OR "Concussions" OR "Contusion" OR "Contusions" OR "Fracture" OR "Fractured" OR "Fractures" OR "Hemorrhage" OR "Hemorrhages" OR "Hemorrhaging" OR "Injuries" OR "Injury" OR "Injured" OR "Internal bleeding" OR "Sprain" OR "Sprained" OR "Sprains" OR (Limit* AND activities) OR (Limit* AND activity) OR (Reduc* AND activities) OR (Reduc* AND activity))
Physical Activity	AND ("Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Exercise" OR "Physical activity" OR "Physical activities" OR "Physical conditioning" OR "Resistance training" OR "strength training" OR “Sedentary” OR "Lifestyle activities" OR "Lifestyle activity" OR "Recreational activities" OR "Recreational activity" OR "Tai chi" OR "Tai ji" OR "Yoga" OR "Walk" OR "Walking" OR “Activities of daily living” OR “Activity of daily living” OR “Free living activities” OR “Free living activity” OR "Balance training" OR "Chi kung" OR "Qigong" OR "Functional training" OR "stretching")
Limits	2006-present Cochrane Reviews and Other Reviews Word variations will not be searched

Search Strategy: PubMed (Original Research)

Database: PubMed; Date of Search: 12/8/2016; 210 results

Set	Search Terms
Limit: Language	(English[lang])
Limit: Exclude animal only	NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))
Limit: Exclude child only	NOT (("infant"[Mesh] OR "child"[mesh] OR "adolescent"[mh]) NOT (("infant"[Mesh] OR "child"[mesh] OR "adolescent"[mh]) AND "adult"[Mesh]))
Limit: Exclude subheadings (Original)	NOT (ad[sh] OR aa[sh] OR ci[sh] OR cn[sh] OR dh[sh] OR de[sh] OR dt[sh] OR em[sh] OR en[sh] OR es[sh] OR eh[sh] OR ge[sh] OR hi[sh] OR is[sh] OR ip[sh] OR lj[sh] OR ma[sh] OR mi[sh] OR og[sh] OR ps[sh] OR py[sh] OR pk[sh] OR pd[sh] OR po[sh] OR re[sh] OR rt[sh] OR rh[sh] OR st[sh] OR sd[sh] OR tu[sh] OR th[sh] OR tm[sh] OR tr[sh] OR ut[sh] OR ve[sh] OR vi[sh])
Limit: Publication Date (Original)	AND ("2006/01/01"[PDAT] : "3000/12/31"[PDAT])
Limit: Publication Type Exclude (Original)	NOT (“comment”[Publication Type] OR “editorial”[Publication Type] OR “review”[Publication Type] OR systematic[sb] OR "meta-analysis"[publication type] OR “systematic review”[tiab] OR “systematic literature review”[tiab] OR metaanalysis[tiab] OR "meta analysis"[tiab] OR metanalyses[tiab] OR "meta analyses"[tiab] OR "pooled analysis"[tiab] OR “pooled analyses”[tiab] OR "pooled data"[tiab])
Falls	AND (("Accidental falls"[mh]) OR (("Fall"[tiab] OR "Falls"[tiab] OR "Slip"[tiab] OR "Slips"[tiab] OR "Trip"[tiab] OR "Trips"[tiab] OR "Fell"[tiab] OR "Slipped"[tiab] OR "Tripped"[tiab]) NOT medline[sb]))
Injury	AND (("Brain concussion"[mh] OR "Hemorrhage"[mh] OR "Wounds and injuries"[mh] OR (Limit*[tiab] AND activities[tiab]) OR (Limit*[tiab] AND activity[tiab]) OR (Reduc*[tiab] AND activities[tiab]) OR (Reduc*[tiab] AND activity[tiab])) OR (((Broken[tiab] AND bone*[tiab]) OR "Bruise"[tiab] OR "Bruises"[tiab] OR "Bruised"[tiab] OR "Concussion"[tiab] OR "Concussions"[tiab] OR "Contusion"[tiab] OR "Contusions"[tiab] OR "Fracture"[tiab] OR "Fractured"[tiab] OR "Fractures"[tiab] OR "Hemorrhage"[tiab] OR "Hemorrhages"[tiab] OR "Hemorrhaging"[tiab] OR "Injuries"[tiab] OR "Injury"[tiab] OR "Injured"[tiab] OR "Internal bleeding"[tiab] OR "Sprain"[tiab] OR "Sprained"[tiab] OR "Sprains"[tiab]) NOT medline[sb]))
Physical Activity	AND (("Exercise"[mh] OR "Exercise"[tiab] OR "Physical activity"[tiab] OR "Sedentary lifestyle"[mh] OR "Lifestyle

Set	Search Terms
	activities"[tiab] OR "Lifestyle activity"[tiab] OR "Recreational activities"[tiab] OR "Recreational activity"[tiab] OR "Tai ji"[mh] OR "Yoga"[mh] OR "Activities of daily living"[tiab] OR "Activity of daily living"[tiab] OR "Free living activities"[tiab] OR "Free living activity"[tiab] OR "Balance training"[tiab] OR "Qigong"[mh] OR "Functional training"[tiab]) OR (("Aerobic activities"[tiab] OR "Aerobic activity"[tiab] OR "Cardiovascular activities"[tiab] OR "Cardiovascular activity"[tiab] OR "Endurance activities"[tiab] OR "Endurance activity"[tiab] OR "Physical activities"[tiab] OR "Physical conditioning"[tiab] OR "Resistance training"[tiab] OR "strength training"[tiab] OR "Sedentary"[tiab] OR "Tai chi"[tiab] OR "Tai ji"[tiab] OR "Yoga"[tiab] OR "Walk"[tiab] OR "Walking"[tiab] OR "Chi kung"[tiab] OR "Qigong"[tiab] OR "stretching"[tiab]) NOT medline[sb]))

Search Strategy: CINAHL(Original Research)

Database: CINAHL; Date of Search: 12/29/2016; 11 results
Terms searched in title or abstract

Set	Search Terms
Falls	("Fall" OR "Falls" OR "Slip" OR "Slips" OR "Trip" OR "Trips" OR "Fell" OR "Slipped" OR "Tripped")
Injury	AND ((Broken AND bone*) OR "Bruise" OR "Bruises" OR "Bruised" OR "Concussion" OR "Concussions" OR "Contusion" OR "Contusions" OR "Fracture" OR "Fractured" OR "Fractures" OR "Hemorrhage" OR "Hemorrhages" OR "Hemorrhaging" OR "Injuries" OR "Injury" OR "Injured" OR "Internal bleeding" OR "Sprain" OR "Sprained" OR "Sprains" OR (Limit* AND activities) OR (Limit* AND activity) OR (Reduc* AND activities) OR (Reduc* AND activity))
Physical Activity	AND ("Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Exercise" OR "Physical activity" OR "Physical activities" OR "Physical conditioning" OR "Resistance training" OR "strength training" OR “Sedentary” OR "Lifestyle activities" OR "Lifestyle activity" OR "Recreational activities" OR "Recreational activity" OR "Tai chi" OR "Tai ji" OR "Yoga" OR "Walk" OR "Walking" OR “Activities of daily living” OR “Activity of daily living” OR “Free living activities” OR “Free living activity” OR "Balance training" OR "Chi kung" OR "Qigong" OR "Functional training" OR "stretching")
Limit: Publication Type Exclude (Original)	NOT (“systematic review” OR “systematic literature review” OR "metaanalysis" OR "meta analysis" OR metanalyses OR "meta analyses" OR "pooled analysis" OR “pooled analyses” OR "pooled data")
Limits	2006-present English language Peer reviewed Exclude Medline records Human

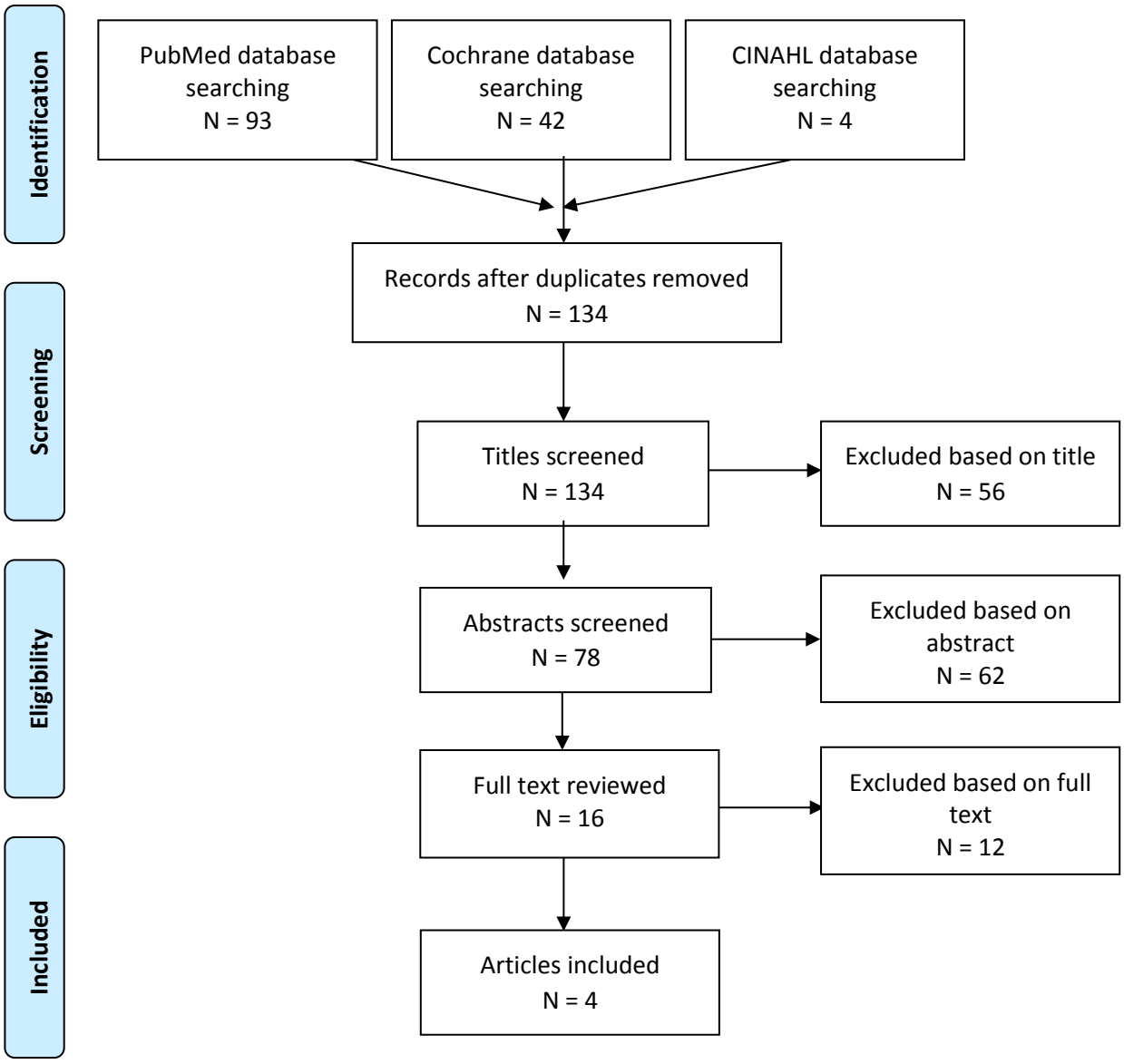
Search Strategy: Cochrane (Original Research)

Database: Cochrane; Date of Search: 12/29/16; 51 results
Terms searched in title, abstract, or keywords

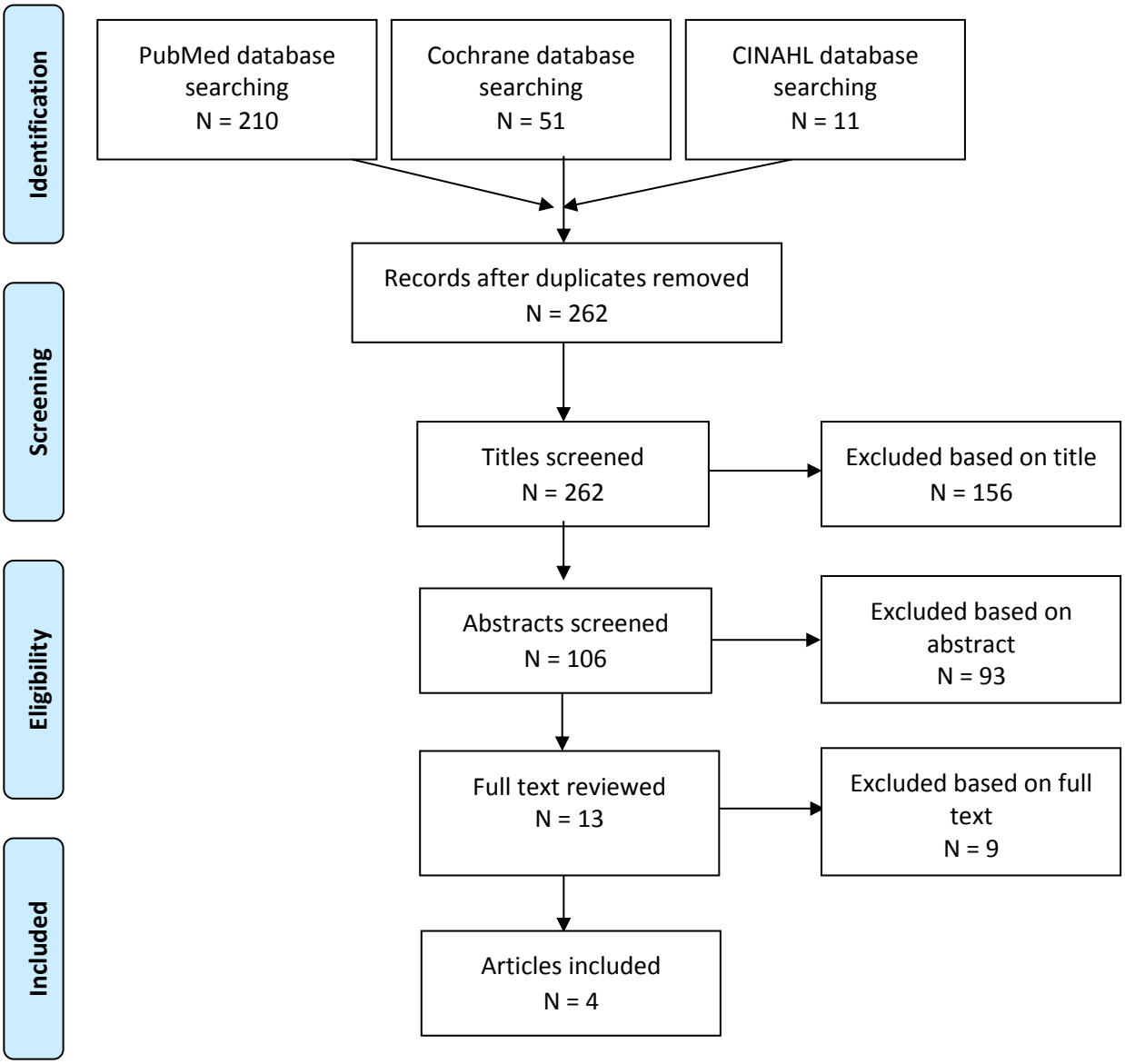
Set	Search Terms
Falls	("Fall" OR "Falls" OR "Slip" OR "Slips" OR "Trip" OR "Trips" OR "Fell" OR "Slipped" OR "Tripped")
Injury	AND ((Broken AND bone*) OR "Bruise" OR "Bruises" OR "Bruised" OR "Concussion" OR "Concussions" OR "Contusion" OR "Contusions" OR "Fracture" OR "Fractured" OR "Fractures" OR "Hemorrhage" OR "Hemorrhages" OR "Hemorrhaging" OR "Injuries" OR "Injury" OR "Injured" OR "Internal bleeding" OR "Sprain" OR "Sprained" OR "Sprains" OR (Limit* AND activities) OR (Limit* AND activity) OR (Reduc* AND activities) OR (Reduc* AND activity))
Physical Activity	AND ("Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Exercise" OR "Physical activity" OR "Physical activities" OR "Physical conditioning" OR "Resistance training" OR "strength training" OR “Sedentary” OR "Lifestyle activities" OR "Lifestyle activity" OR "Recreational activities" OR "Recreational activity" OR "Tai chi" OR "Tai ji" OR "Yoga" OR "Walk" OR "Walking" OR “Activities of daily living” OR “Activity of daily living” OR “Free living activities” OR “Free living activity” OR "Balance training" OR "Chi kung" OR "Qigong" OR "Functional training" OR "stretching")
Limits	2006-present Trials Word variations will not be searched

Appendix C: Literature Tree

Existing Systematic Reviews, Meta-Analyses, Pooled Analyses, and Reports Literature Tree



Original Research Literature Tree



Appendix D: Inclusion/Exclusion Criteria

Aging Subcommittee
What is the relationship between physical activity and the risk of injury due to a fall?

a. Is there a dose-response relationship? If yes, what is the shape of the relationship?
b. Does the relationship vary by age, sex, race/ethnicity, socio-economic status, or weight status?
c. What type(s) of physical activity are effective for preventing injuries due to a fall?
d. What factors modify the relationship between physical activity and risk of injury due to a fall?

Category	Inclusion/Exclusion Criteria	Notes/Rationale
Publication Language	**Include:** • Studies published with full text in English	
Publication Status	**Include:** • Studies published in peer-reviewed journals • Reports determined to have appropriate suitability and quality by PAGAC **Exclude:** • Grey literature, including unpublished data, manuscripts, abstracts, conference proceedings	
Research Type	**Include:** • Original research • Meta-analyses • Systematic reviews • Pooled analyses • Reports determined to have appropriate suitability and quality by PAGAC	
Study Subjects	**Include:** • Human subjects	
	Exclude: • Athletes only	
Age of Study Subjects	**Include:** • Adults ages 50 and older • When data are analyzed by age groups, only data with lower range of 50 or older may be included (e.g., in a study with individuals 45–90 where data are presented for three age groups: 45–55, 55–65, and 65–90, only data for 55–65 and 65–90 may be included)	
Health Status of Study Subjects	**Include:** • Individuals with chronic conditions • Frequent fallers • Individuals in emergency room, care homes, assisted living, or long-term care facilities • Individuals who need a cane to walk	

	Exclude: • Hospitalized patients only (acute care, admitted into the hospital) • Nonambulatory adults only (can't walk, need wheelchair, need walker)	
Comparison	**Include:** • Adults ages 50 and older who participate in varying levels of physical activity, including no reported physical activity	
Date of Publication	**Include:** • Original research published from 2006 to Present • Systematic reviews and meta-analyses published from 2006 to Present	
Study Design	**SR/MA/Pooled Analysis/Report Search** **Include:** • Randomized controlled trials • Non-randomized controlled trials • Prospective cohort studies • Retrospective cohort studies • Case-control studies • Systematic reviews • Meta-analyses • Pooled reports • PAGAC-Approved reports **Exclude:** • Narrative reviews • Commentaries • Editorials • Cross-sectional studies • Before-and-after studies **Original Research Search** **Include:** • Prospective cohort studies • Retrospective cohort studies **Exclude:** • Randomized controlled trials • Non-randomized controlled trials • Case-control studies • Systematic reviews • Meta-analyses • Pooled reports • PAGAC-Approved reports • Narrative reviews	

	• Commentaries • Editorials • Cross-sectional studies • Before-and-after studies	
Exposure/ Intervention	**Include studies in which the exposure or intervention is:** • All types and intensities of physical activity **Exclude:** • Studies missing physical activity (mental games such as Sudoku instead of physical activities) • Studies of a single, acute session of exercise • Studies of a disease-specific therapeutic exercise delivered by a medical professional (e.g., physical therapist) • Studies with measures of physical fitness as the exposure • Studies of multimodal interventions that do not present data on physical activity alone • Studies that only use physical activity as a confound variable	
Outcome	**Include studies in which the outcome is:** • All/Any injuries from falls • Fractures from falls • Head injuries from falls • Intraabdominal injuries from falls • Medically attended injuries from falls • Neck, back, and spine injuries from falls • "Pooled" injuries from falls • Sprains from falls • Limitation of daily activities • Reduction in routine activities	

Appendix E: Rationale for Exclusion at Abstract or Full-Text Triage for Existing Systematic Reviews, Meta-Analyses, Pooled Analyses, and Reports

The table below lists the excluded articles with at least one reason for exclusion, but may not reflect all possible reasons.

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
Allen NE, Schwarzel AK, Canning CG. Recurrent falls in Parkinson's disease: a systematic review. *Parkinsons Dis*. 2013;2013:906274. doi:10.1155/2013/906274.	X				
Arnold CM, Sran MM, Harrison EL. Exercise for fall risk reduction in community-dwelling older adults: a systematic review. *Physiother Can*. 2008;60(4):358-372. doi:10.3138/physio.60.4.358.	X				
Balzer K, Bremer M, Schramm S, Lühmann D, Raspe H. Falls prevention for the elderly. *GMS Health Technol Assess*. 2012;8(Doc01). doi:10.3205/hta000099.					X
Batchelor FA, Dow B, Low MA. Do continence management strategies reduce falls? A systematic review. *Australas J Ageing*. 2013;32(4):211-216. doi:10.1111/ajag.12047.	X			X	
Bird ML, Cheney MJ, Williams AD. Accidental fall rates in community-dwelling adults compared to cancer survivors during and post-treatment: a systematic review with meta-analysis. *Oncol Nurs Forum*. 2016;43(2):E64-E72. doi:10.1188/16.ONF.E64-E72.	X				
Bischoff-Ferrari HA. The role of falls in fracture prediction. *Curr Osteoporos Rep*. 2011;9(3):116-121. doi:10.1007/s11914-011-0059-y.			X		
Boehm J, Franklin RC, King JC. Falls in rural and remote community dwelling older adults: a review of the literature. *Aust J Rural Health*. 2014;22(4):146-155. doi:10.1111/ajr.12114.					X
Booth V, Hood V, Kearney F. Interventions incorporating physical and cognitive elements to reduce falls risk in cognitively impaired older adults: a systematic review. *JBI Database System Rev Implement Rep*. 2016;14(5):110-135. doi:10.11124/JBISRIR-2016-002499.	X				
Booth V, Masud T, Bath-Hextall F. The effectiveness of virtual reality interventions in improving balance in adults with impaired balance compared to standard or no treatment: a systematic review. *JBI Libr Syst Rev*. 2012;10(48):3048-3079.					X
Bunn F, Dickinson A, Simpson C, et al. Preventing falls among older people with mental health problems: a systematic review. *BMC Nurs*. 2014;13(1):4. doi:10.1186/1472-6955-13-4.					X
Burton E, Cavalheri V, Adams R, et al. Effectiveness of exercise programs to reduce falls in older people with dementia living in the community: a systematic review and meta-analysis. *Clin Interv Aging.* 2015;10:421-434. doi:10.2147/CIA.S71691.	X				
Cameron ID, Gillespie LD, Robertson MC, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev.*	X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
2012;12:CD005465. doi:10.1002/14651858.CD005465.pub3.					
Campbell GB, Matthews JT. An integrative review of factors associated with falls during post-stroke rehabilitation. *J Nurs Scholarsh.* 2010;42(4):395-404. doi:10.1111/j.1547-5069.2010.01369.x.				X	
Crandall M, Duncan T, Mallat A, et al. Prevention of fall-related injuries in the elderly: An Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg.* 2016;81(1):196-206. doi:10.1097/TA.0000000000001025.					X
Crouse JJ, Phillips JR, Jahanshahi M, Moustafa AA. Postural instability and falls in Parkinson's disease. *Rev Neurosci.* 2016;27(5):549-555. doi:10.1515/revneuro-2016-0002.	X			X	
de Kam D, Smulders E, Weerdesteyn V, Smits-Engelsman BC. Exercise interventions to reduce fall-related fractures and their risk factors in individuals with low bone density: a systematic review of randomized controlled trials. *Osteoporos Int.* 2009;20(12):2111-2125. doi:10.1007/s00198-009-0938-6.					X
English C, Hillier S. Circuit class therapy for improving mobility after stroke. *Cochrane Database Syst Rev.* 2010;7:CD007513. doi:10.1002/14651858.CD007513.pub2.				X	
Foster C, Richards J, Thorogood M, Hillsdon M. Remote and web 2.0 interventions for promoting physical activity. *Cochrane Database Syst Rev.* 2013;9:CD010395.	X				
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French B, Thomas LH, Coupe J, et al. Repetitive task training for improving functional ability after stroke. *Cochrane Database Syst Rev*. 2016;11:CD006073. doi:10.1002/14651858.CD006073.pub3.				X	
Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? *JAMA.* 2007;297(1):77-86.	X				
Gates S, Fisher JD, Cooke MW, Carter YH, Lamb SE. Multifactorial assessment and targeted intervention for preventing falls and injuries among older people in community and emergency care settings: systematic review and meta-analysis. *BMJ*. 2008;336(7636):130-133.					X
Granacher U, Gollhofer A, Hortobágyi T, Kressig RW, Muehlbauer T. The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: a systematic review. *Sports Med.* 2013;43(7):627-641. doi:10.1007/s40279-013-0041-1.	X				
Gravesande J, Richardson J. Identifying non-pharmacological risk factors for falling in older adults with type 2 diabetes mellitus: a systematic review. *Disabil*				X	

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
Rehabil. 2016;39(15):1459-1465. doi:10.1080/09638288.2016.1199741.					
Gregory H, Watson MC. The effectiveness of Tai Chi as a fall prevention intervention for older adults: a systematic review. *Int J Health Promot Educ.* 2009;47(3):94-100. doi:http://dx.doi.org/10.1080/14635240.2009.10708166.					X
Gunn H, Markevics S, Haas B, Marsden J, Freeman J. Systematic review: the effectiveness of interventions to reduce falls and improve balance in adults with multiple sclerosis. *Arch Phys Med Rehabil.* 2015;96(10):1898-1912. doi:10.1016/j.apmr.2015.05.018.	X				
Handoll HH, Madhok R, Howe TE. Rehabilitation for distal radial fractures in adults. *Cochrane Database Syst Rev*. 2002;2:CD003324.				X	
Harding P, Rasekaba T, Smirneos L, Holland AE. Early mobilisation for elbow fractures in adults. *Cochrane Database Syst Rev*. 2011;6:CD008130. doi:10.1002/14651858.CD008130.pub2.				X	
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.					X
Hollands KL, Pelton TA, Tyson SF, Hollands MA, van Vliet PM. Interventions for coordination of walking following stroke: systematic review. *Gait Posture*. 2012;35(3):349-359. doi:10.1016/j.gaitpost.2011.10.355.				X	
Hollands K, van Vliet P, Pelton T. Interventions for improving coordination of axial segments and lower limbs during walking following stroke: systematic review. *JBI Libr Syst Rev.* 2012;10(22):1260-1362.				X	
Howe TE, Shea B, Dawson LJ, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database Syst Rev*. 2011;7:CD000333. doi:10.1002/14651858.CD000333.pub2.					X
Hwang PW, Braun KL. The effectiveness of dance interventions to improve older adults' health: a systematic literature review. *Altern Ther Health Med.* 2015;21(5):64-70.	X				
de Kam D, Smulders E, Weerdesteyn V, Smits-Engelsman BC. Exercise interventions to reduce fall-related fractures and their risk factors in individuals with low bone density: a systematic review of randomized controlled trials. *Osteoporos Int.* 2009;20(12):2111-2125. doi:10.1007/s00198-009-0938-6.					X
Karlsson MK, Nordqvist MK, Karlsson C. Physical activity, muscle function, falls and fractures. *Food Nutr Res.* 2008;52. doi:10.3402/fnr.v52i0.1920.			X		
Kemmler W, von Stengel S. Exercise and osteoporosis-related fractures: perspectives and recommendations of the sports and exercise scientist. *Phys Sportsmed.* 2011;39(1):142-157. doi:10.3810/psm.2011.02.1872.			X		

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
Kendrick D, Kumar A, Carpenter H, et al. Exercise for reducing fear of falling in older people living in the community. *Cochrane Database Syst Rev*. 2014;11:CD009848. doi:10.1002/14651858.CD009848.pub2.	X				
Kümmel J, Kramer A, Giboin LS, Gruber M. Specificity of balance training in healthy individuals: a systematic review and meta-analysis. *Sports Med.* 2016;46(9):1261-1271. doi:10.1007/s40279-016-0515-z.	X				
Lach HW, Parsons JL. Impact of fear of falling in long term care: an integrative review. *J Am Med Dir Assoc*. 2013;14(8):573-577. doi: 10.1016/j.jamda.2013.02.019.			X		
Lee HC, Chang KC, Tsauo JY, Hung JW, Huang YC, Lin SI; Fall Prevention Initiatives in Taiwan (FPIT) Investigators. Effects of a multifactorial fall prevention program on fall incidence and physical function in community-dwelling older adults with risk of falls. *Arch Phys Med Rehabil.* 2013;94(4):606-615, 615.e1. doi:10.1016/j.apmr.2012.11.037.			X	X	
Leung DP, Chan CK, Tsang HW, Tsang WW, Jones AY. Tai chi as an intervention to improve balance and reduce falls in older adults: a systematic and meta-analytical review. *Altern Ther Health Med.* 2011;17(1):40-48.	X				
Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. *Cochrane Database Syst Rev*. 2009;3:CD002759. doi:10.1002/14651858.CD002759.pub2.	X				
March S, Torres E, Ramos M, et al. Adult community health-promoting interventions in primary health care: a systematic review. *Prev Med.* 2015;76(suppl):S94-S104. doi:10.1016/j.ypmed.2015.01.016.	X				
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McMahon S, Fleury J. External validity of physical activity interventions for community-dwelling older adults with fall risk: a quantitative systematic literature review. *J Adv Nurs.* 2012;68(10):2140-2154. doi:10.1111/j.1365-2648.2012.05974.x.	X				X
Meyer C, Hill S, Dow B, Synnot A, Hill K. Translating falls prevention knowledge to community-dwelling older PLWD: a mixed-method systematic review. *Gerontologist*. 2013;55(4):560-574. doi:10.1093/geront/gnt127.					X
Michael YL, Lin JS, Whitlock EP, et al. Interventions to prevent falls in older adults: an updated systematic review. *U.S. Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews.* Report No.: 11-05150-EF-1.2010. Rockville, MD: Agency for Healthcare Research and Quality, US Department of Health and Human Services; 2010.	X				
Moayyeri A. The association between physical activity and osteoporotic fractures: a review of the evidence and					X

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
implications for future research. *Ann Epidemiol.* 2008;18(11):827-835. doi:10.1016/j.annepidem.2008.08.007.					
Oh EG, Lee JE, Yoo JY. A systematic review of the effectiveness of lifestyle interventions for improving bone health in women at high risk of osteoporosis. *JBI Libr Syst Rev.* 2012;10(30):1738-1784.					X
Oliver D, Connelly JB, Victor CR, et al. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses. *BMJ*. 2007;334(7584):82. doi:10.1136/bmj.39049.706493.55.					X
Porto EF, Castro AAM, Schmidt VGS, et al. Postural control in chronic obstructive pulmonary disease: a systematic review. *Int J Chron Obstruct Pulmon Dis.* 2015;10:1233-1239. doi:10.2147/COPD.S63955.	X				
Pritchard E, Brown T, Lalor A, Haines T. The impact of falls prevention on participation in daily occupations of older adults following discharge: a systematic review and meta-analysis. *Disabil Rehabil.* 2014;36(10):787-796. doi:10.3109/09638288.2013.814720.	X				
Richards J, Hillsdon M, Thorogood M, Foster C. Face-to-face interventions for promoting physical activity. *Cochrane Database Syst Rev*. 2013;9:CD010392. doi:10.1002/14651858.CD010392.pub2.	X				
Rolland Y, Abellan van Kan G, Bénétos A, et al. Frailty, osteoporosis and hip fracture: causes, consequences and therapeutic perspectives. *J Nutr Health Aging.* 2008;12(5):335-346.	X				
Russell MA, Hill KD, Day LM, et al. A randomized controlled trial of a multifactorial falls prevention intervention for older fallers presenting to emergency departments. *J Am Geriatr Soc.* 2010;58(12):2265-2274. doi:10.1111/j.1532-5415.2010.03191.x.			X		
Sherrington C, Tiedemann A, Cameron I. Physical exercise after hip fracture: an evidence overview. *Eur J Phys Rehabil Med.* 2011;47(2):297-307.			X		
Silva RB, Eslick GD, Duque G. Exercise for falls and fracture prevention in long term care facilities: a systematic review and meta-analysis. *J Am Med Dir Assoc.* 2013;14(9):685-689.e2. doi:10.1016/j.jamda.2013.05.015.					X
Skelton DA, Howe TE, Ballinger C, Neil F, Palmer S, Gray L. Environmental and behavioural interventions for reducing physical activity limitation in community-dwelling visually impaired older people. *Cochrane Database Syst Rev*. 2013;6:CD009233. doi:10.1002/14651858.CD009233.pub2.				X	
Stubbs B, Brefka S, Denkinger MD. What works to prevent falls in community-dwelling older adults? Umbrella review of meta-analyses of randomized controlled trials. *Phys Ther.* 2015;95(8):1095-1100. doi:10.2522/ptj.20140461.					X
Stubbs B, Eggermont L, Soundy A, Probst M, Vandenbulcke M, Vancampfort D. What are the factors associated with physical activity (PA) participation in community dwelling	X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search
adults with dementia? A systematic review of PA correlates. *Arch Gerontol Geriatr.* 2014;59(2):195-203. doi:10.1016/j.archger.2014.06.006.					
Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off". *JAMA.* 2010;303(3):258-266. doi:10.1001/jama.2009.2024.			X		
Toot S, Devine M, Akporobaro A, Orrell M. Causes of hospital admission for people with dementia: a systematic review and meta-analysis. *J Am Med Dir Assoc.* 2013;14(7):463-470. doi:10.1016/j.jamda.2013.01.011.	X			X	
Tungpunkom P, Maayan N, Soares-Weiser K. Life skills programmes for chronic mental illnesses. *Cochrane Database Syst Rev*. 2012;1:CD000381. doi:10.1002/14651858.CD000381.pub3.	X			X	
Turner S, Arthur G, Lyons RA, et al. Modification of the home environment for the reduction of injuries. *Cochrane Database Syst Rev*. 2011;2:CD003600. doi:10.1002/14651858.CD003600.pub3.				X	
Valenzuela T, Okubo Y, Woodbury A, Lord SR, Delbaere K. Adherence to technology-based exercise programs in older adults: a systematic review. *J Geriatr Phys Ther.* 2016.	X				
Verheyden GS, Weerdesteyn V, Pickering RM, et al. Interventions for preventing falls in people after stroke. *Cochrane Database Syst Rev.* 2013;5:CD008728. doi:10.1002/14651858.CD008728.pub2.	X				
Vermeiren S, Vella-Azzopardi R, Beckwée D, et al; Brussels Study group. Frailty and the prediction of negative health outcomes: a meta-analysis. *J Am Med Dir Assoc.* 2016;17(12):1163.e1-1163.e17. doi:10.1016/j.jamda.2016.09.010.				X	
Wildes TM, Dua P, Fowler SA, et al. Systematic review of falls in older adults with cancer. *J Geriatr Oncol.* 2015;6(1):70-83. doi:10.1016/j.jgo.2014.10.003.				X	
Winter H, Watt K, Peel NM. Falls prevention interventions for community-dwelling older persons with cognitive impairment: a systematic review. *Int Psychogeriatr.* 2013;25(2):215-227. doi:10.1017/S1041610212001573.					X
Wooton AC. An integrative review of Tai Chi research: an alternative form of physical activity to improve balance and prevent falls in older adults. *Orthop Nurs.* 2010;29(2):108-116; quiz 117-118. doi:10.1097/NOR.0b013e3181d243b3.	X				
Wu G, Keyes L, Callas P, Ren X, Bookchin B. Comparison of telecommunication, community, and home-based Tai Chi exercise programs on compliance and effectiveness in elders at risk for falls. *Arch Phys Med Rehabil.* 2010;91(6):849-856. doi:10.1016/j.apmr.2010.01.024.			X		
Yeung SS, Yeung EW, Gillespie LD. Interventions for preventing lower limb soft-tissue running injuries. *Cochrane Database Syst Rev*. 2011;7:CD001256. doi:10.1002/14651858.CD001256.pub2.	X	X			
Zanotto T, Bergamin M, Roman F, et al. Effect of exercise on dual-task and balance on elderly in multiple disease conditions. *Curr Aging Sci.* 2014;7(2):115-136.	X				

Rationale for Exclusion at Abstract or Full-Text Triage for Original Research

The table below lists the excluded articles with at least one reason for exclusion, but may not reflect all possible reasons.

Citation	Outcome	Population	Study Design	Exposure
Abolhassani F, Moayyeri A, Naghavi M, Soltani A, Larijani B, Shalmani HT. Incidence and characteristics of falls leading to hip fracture in Iranian population. *Bone*. 2006;39(2):408-13. doi:10.1016/j.bone.2006.01.144.				X
Allan LM, Ballard CG, Rowan EN, Kenny RA. Incidence and prediction of falls in dementia: a prospective study in older people. *PLoS One.* 2009;4(5):e5521. doi:10.1371/journal.pone.0005521.	X			
Almeida LR, Sherrington C, Allen NE, et al. Disability is an independent predictor of falls and recurrent falls in people with Parkinson's disease without a history of falls: a one-year prospective study. *J Parkinsons Dis.* 2015;5(4):855-864. doi:10.3233/JPD-150651.				X
Almeida TL, Alexander NB, Nyquist LV, et al. Minimally supervised multimodal exercise to reduce falls risk in economically and educationally disadvantaged older adults. *J Aging Phys Act.* 2013;21(3):241-259.	X		X	
Amatachaya S, Pramodhyakul W, Wattanapan P, Eungpinichpong W. Ability of obstacle crossing is not associated with falls in independent ambulatory patients with spinal cord injury. *Spinal Cord.* 2015;53(8):598-603. doi:10.1038/sc.2015.22.				X
Armstrong ME, Cairns BJ, Banks E, Green J, Reeves GK, Beral V; Million Women Study Collaborators. Different effects of age, adiposity and physical activity on the risk of ankle, wrist and hip fractures in postmenopausal women. *Bone.* 2012;50(6):1394-4000. doi:10.1016/j.bone.2012.03.014.	X			
Arnau A, Espaulella J, Serrarols M, Canudas J, Formiga F, Ferrer M. Risk factors for functional decline in a population aged 75 years and older without total dependence: a one-year follow-up. *Arch Gerontol Geriatr.* 2016;65:239-247. doi:10.1016/j.archger.2016.04.002.				X
Ayalon L. Satisfaction with aging results in reduced risk for falling. *Int Psychogeriatr.* 2016;28(5):741-747. doi:10.1017/S1041610215001969.				X
Barnett L, Green S, van Beurden E, Campbell E, Radvan D. Older people playing ball: what is the risk of falling and injury? *J Sci Med Sport.* 2009;12(1):177-183. doi:10.1016/j.jsams.2007.12.007.		X		
Batra A, Melchior M, Seff L, Frederick N, Palmer R. Evaluation of a community-based falls prevention program in South Florida, 2008-2009. *Prev Chronic Dis.* 2012;9(1):E13. doi:10.5888/pcd9.110057.	X		X	
Bird ML, Pittaway JK, Cuisick I, Rattray M, Ahuja KDK. Age-related changes in physical fall risk factors: results from a 3 year follow-up of community dwelling older adults in Tasmania, Australia. *Int J Environ Res Public Health.* 2013;10(11):5989-5997.	X			
Bishop MD, Patterson TS, Romero S, Light KE. Improved fall-related efficacy in older adults related to changes in dynamic gait ability. *Phys Ther.* 2010;90(11):1598-1606. doi:10.2522/ptj.20090284.	X		X	
Boyé ND, Mattace-Raso FU, Van Lieshout EM, Hartholt KA, Van Beeck EF, Van der Cammen TJ. Physical performance and quality of life in single and recurrent fallers: data from the Improving Medication Prescribing to Reduce Risk of Falls study. *Geriatr Gerontol Int.* 2015;15(3):350-355. doi:10.1111/ggi.12287.	X			X

Citation	Outcome	Population	Study Design	Exposure
Brogårdh C, Lexell J. Falls, fear of falling, self-reported impairments, and walking limitations in persons with late effects of polio. *PM R.* 2014;6(10):900-907.	X		X	
Brotherton SS, Krause JS, Nietert PJ. A pilot study of factors associated with falls in individuals with incomplete spinal cord injury. *J Spinal Cord Med.* 2007;30(3):243-250.	X			
Brown J, Kurichi JE, Xie D, Pan Q, Stineman MG. Instrumental activities of daily living staging as a possible clinical tool for falls risk assessment in physical medicine and rehabilitation. *PM R*. 2014;6(4):316-323; quiz 323. doi:10.1016/j.pmrj.2013.10.007.			X	
Caban-Martinez AJ, Courtney TK, Chang WR, et al. Preventing slips and falls through leisure-time physical activity: findings from a study of limited-service restaurants. *PLoS One.* 2014;9(10):e110248. doi:10.1371/journal.pone.0110248		X		
Callisaya ML, Blizzard L, McGinley JL, Srikanth VK. Risk of falls in older people during fast-walking--the TASCOG Study. *Gait Posture.* 2012;36(3):510-515. doi:10.1016/j.gaitpost.2012.05.003.	X			
Chan BK, Marshall LM, Winters KM, Faulkner KA, Schwartz AV, Orwoll ES. Incident fall risk and physical activity and physical performance among older men: the Osteoporotic Fractures in Men Study. *Am J Epidemiol.* 2007;165(6):696-703.	X			
Chen T, Chou LS. Altered center of mass control during sit-to-walk in elderly adults with and without history of falling. *Gait Posture*. 2013;38(4):696-701. doi:10.1016/j.gaitpost.2013.03.007.	X			
Cheng KY, Lin WC, Chang WN, et al. Factors associated with fall-related fractures in Parkinson's disease. *Parkinsonism Relat Disord.* 2014;20(1):88-92. doi:10.1016/j.parkreldis.2013.09.024.		X		
Chien MH, Guo HR. Nutritional status and falls in community-dwelling older people: a longitudinal study of a population-based random sample. *PLoS One.* 2014;9(3):e91044. doi:10.1371/journal.pone.0091044.	X			
Clement ND, Duckworth AD, McQueen MM, Court-Brown CM. The outcome of proximal humeral fractures in the elderly: predictors of mortality and function. *Bone Joint J.* 2014;970-977. doi:10.1302/0301-620X.96B7.32894.	X			X
Córcoles-Jiménez, Villada-Munera MP, Del Egido-Fernández A, et al. Recovery of activities of daily living among older people one year after hip fracture. *Clin Nurs Res.* 2015;24(6):604-623. doi:10.1177/1054773815573261.	X			
Cramer H, Sibbritt D, Adams J, Lauche R. The association between regular yoga and meditation practice and falls and injuries: results of a national cross-sectional survey among Australian women. *Maturitas.* 2016;84. doi:10.1016/j.maturitas.2015.10.010.			X	
Di Monaco M, Vallero F, Tappero R, De Lauso L, De Toma E, Cavanna A. Incident falls impair ability to function in hip-fracture survivors: a prospective study of 95 elderly women. *Arch Gerontol Geriatr.* 2009;48(3):397-400. doi:10.1016/j.archger.2008.03.008.	X			X
Edwards B, Langman CB, Martinez K, Johnson M, Mille ML, Rogers MW. Women with wrist fractures are at increased risk for future fractures because of both skeletal and non-skeletal risk factors. *Age Ageing.* 2006;35(4):438-441. doi:10.1093/ageing/afl018.			X	
Eggermont LH, Penninx BW, Jones RN, Leveille SG. Depressive symptoms, chronic pain, and falls in older community-dwelling adults: the MOBILIZE Boston Study. *J Am Geriatr Soc.* 2012;60(2):230-237. doi:10.1111/j.1532-5415.2011.03829.x.	X			X

Citation	Outcome	Population	Study Design	Exposure
Ensrud KE, Ewing SK, Cawthon PM, et al; Osteoporotic Fractures in Men Research Group. A comparison of frailty indexes for the prediction of falls, disability, fractures, and mortality in older men. *J Am Geriatr Soc.* 2009;57(3):492-498. doi:10.1111/j.1532-5415.2009.02137.x.				X
Ensrud KE, Ewing SK, Taylor BC, et al. Frailty and risk of falls, fracture, and mortality in older women: the study of osteoporotic fractures. *J Gerontol A Biol Sci Med Sci.* 2007;62(7):744-751.				X
Fink HA, Kuskowski MA, Marshall LM. Association of stressful life events with incident falls and fractures in older men: the Osteoporotic Fractures in Men (MrOS) Study. *Age Ageing.* 2014;43(1):103-108. doi:10.1093/ageing/aft117.				X
French DD, Werner DD, Campbell RR, et al. A multivariate fall risk assessment model for VHA nursing homes using the minimum data set. *J Am Med Dir Assoc.* 2007;8(2):115-122.	X			
Gawler S, Skelton DA, Dinan-Young S, et al. Reducing falls among older people in general practice: The ProAct65+ exercise intervention trial. *Arch Gerontol Geriatr*. 2016;67:46-54. doi:10.1016/j.archger.2016.06.019.			X	
Gewandter JS, Dale W, Magnuson A, et al. Associations between a patient-reported outcome (PRO) measure of sarcopenia and falls, functional status, and physical performance in older patients with cancer. *J Geriatr Oncol.* 2015;6(6):433-441. doi:10.1016/j.jgo.2015.07.007.				X
Gill DP, Zou GY, Jones GR, Speechley M. Injurious falls are associated with lower household but higher recreational physical activities in community-dwelling older male veterans. *Gerontology*. 2008;54(2):106-115. doi:10.1159/000116113.	X			X
Góes SM, Leite N, Shay BL, Homann D, Stefanello JM, Rodacki AL. Functional capacity, muscle strength and falls in women with fibromyalgia. *Clin Biomech (Bristol, Avon).* 2012;27(6):578-583. doi:10.1016/j.clinbiomech.2011.12.009.	X			X
Grahn Kronhed A-C, Hallberg I, Ödkvist L, Möller M. Effect of training on health-related quality of life, pain and falls in osteoporotic women. *Adv Physiother.* 2009;11(3):154-165. doi:10.1080/14038190902896659.	X		X	
Hao Q, Yang M, Luo L, Hai S, Ding X, Dong B. The association of falls and various physical activities in Chinese nonagenarians/centenarians. *Arch Gerontol Geriatr.* 2015;61(1):21-26. doi:10.1016/j.archger.2015.04.008.			X	
Helgadottir B, Moller J, Laflamme L. Patterns in health-related behaviours and fall injuries among older people: a population-based study in Stockholm County, Sweden. *Age Ageing*. 2015;44(4):604-610. doi:10.1093/ageing/afv051.				X
Henry-Sánchez JT, Kurichi JE, Xie D, Pan Q, Stineman MG. Do elderly people at more severe activity of daily living limitation stages fall more? *Am J Phys Med Rehabil.* 2012;91(7):601-610. doi:10.1097/PHM.0b013e31825596af.	X			
Hu J, Xia Q, Jiang Y, Zhou P, Li Y. Risk factors of indoor fall injuries in community-dwelling older women: a prospective cohort study. *Arch Gerontol Geriatr.* 2015;60(2):259-264. doi:10.1016/j.archger.2014.12.006.		X		
Huisingh-Scheetz M, Kocherginsky M, Schumm PL, et al. Geriatric syndromes and functional status in NSHAP: rationale, measurement, and preliminary findings. *J Gerontol B Psychol Sci Soc Sci.* 2014;69(suppl 2):S177-S190. doi:10.1093/geronb/gbu091.	X			

Citation	Outcome	Population	Study Design	Exposure
Hwang HF, Lee HD, Huang HH, Chen CY, Lin MR. Fall mechanisms, bone strength, and hip fractures in elderly men and women in Taiwan. *Osteoporos Int.* 2011;22(8):2385-2393. doi:10.1007/s00198-010-1446-4.				X
Jefferis BJ, Merom D, Sartini C, et al. Physical activity and falls in older men: the critical role of mobility limitations. *Med Sci Sports Exerc.* 2015;47(10):2119-2128. doi:10.1249/MSS.0000000000000635.	X			
Johansson J, Nordström A, Nordström P. Greater fall risk in elderly women than in men is associated with increased gait variability during multitasking. *J Am Med Dir Assoc.* 2016;17(6):535-540. doi:10.1016/j.jamda.2016.02.009.				X
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