

Evidence Synthesis

Number 236

Interventions to Prevent Falls in Older Adults: An Evidence Update for the U.S. Preventive Services Task Force

Prepared for:

Agency for Healthcare Research and Quality
U.S. Department of Health and Human Services
5600 Fishers Lane
Rockville, MD 20857
www.ahrq.gov

Contract No. HHS A75Q80120D00004

Task Order: 75Q80121F32004

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AHRQ Publication No. 23-05309-EF-1

June 2024

This report is based on research conducted by the Kaiser Permanente Research Affiliates Evidence-based Practice Center (EPC) under contract to the Agency for Healthcare Research and Quality (AHRQ), Rockville, MD (Contract No. HHS A75Q80120D00004, Task Order 75Q80121F32004). The findings and conclusions in this document are those of the authors, who are responsible for its contents; the findings and conclusions do not necessarily represent the views of AHRQ. Therefore, no statement in this report should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services.

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Acknowledgments

The authors gratefully acknowledge the following individuals for their contributions to this project: Howard Tracer, MD, at the Agency for Healthcare Research and Quality; current and former members of the U.S. Preventive Services Task Force who contributed to topic deliberations; National Institute on Aging, National Institute on Minority Health and Health Disparities, National Institute of Child Health and Human Development, and the Office of Research on Women's Health for providing federal partner review of the draft report; David Ganz, MD, PhD, Manuel Montero-Odasso, MD, PhD, AGSF, FGSA, FRCPC, and Elizabeth Phelan, MD, MS, who provided expert review of the draft report; and Melinda Davies, MAIS, and Jill Pope, BS, for technical and editorial assistance at the Center for Health Research.

Suggested Citation

Guirguis-Blake JM, Perdue LA, Coppola EL, Bean SI. Interventions to Prevent Falls in Older Adults: An Evidence Update for the U.S. Preventive Services Task Force. Evidence Synthesis No. 236. AHRQ Publication No. 23-05309-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2024.

Structured Abstract

Background: Falls are the leading cause of injury-related morbidity and mortality among older adults in the United States.

Purpose: To systematically review evidence on the effectiveness of interventions to prevent falls in community-dwelling older adults.

Data Sources: We searched MEDLINE, Cumulative Index for Nursing and Allied Health Literature, and Cochrane Central Register of Controlled Clinical Trials for relevant English-language literature published between January 1, 2016, and May 8, 2023. Additionally, we re-evaluated all studies included in the 2018 review. We supplemented our searches with suggestions from experts and articles identified through news and table-of-contents alerts. We conducted ongoing surveillance through March 22, 2024, to identify any major studies published in the interim.

Study Selection: Two investigators independently reviewed identified abstracts and full-text articles against a set of a priori inclusion and quality criteria.

Data Analysis: One investigator abstracted data into an evidence table and a second investigator checked these data. When we had an adequate number of studies, we conducted random-effects meta-analyses with a Knapp-Hartung adjustment to estimate the effect of fall prevention interventions on falls, falls-related morbidity, and all-cause mortality.

Results: We included 83 fair- to good-quality randomized, controlled trials (RCTs) (n=48,839) examining the effectiveness of fall prevention interventions in older adults. Most of the included studies examined the effectiveness of multifactorial (k=28, n=27,784) and exercise (k=37, n=16,117) interventions. The remaining studies examined environment (k=6, n=4,162), exercise plus environment (k=3, n=935), exercise plus education (k=4, n=1,047), medication review/modification (k=4, n=1,052), psychological (k=3, n=9279), and education interventions (k=1, n=310). Based on a pooled analysis, multifactorial interventions were associated with a statistically significant reduction in the number of falls (20 RCTs, n=22,115; incidence rate ratio (IRR), 0.84 [95% CI, 0.74 to 0.95]; $I^2=85.0\%$), but not a statistically significant reduction in the number of people with a fall (26 RCTs, n=23,626; relative risk (RR), 0.96 [95% CI, 0.91 to 1.02]; $I^2=48.2\%$; k=26). Multifactorial interventions also showed no statistically significant association with the number of falls resulting in injury and people with a fall resulting in injury. Exercise interventions were associated with statistically significant reductions in the number of falls (29 RCTs, n=14,475; IRR, 0.85 [95% CI, 0.75 to 0.96]; $I^2=82.7\%$), the number of people with a fall (25 RCTs, n=13,384; RR, 0.92 [95% CI, 0.87 to 0.98]; $I^2=24.3\%$), the number of falls resulting in injury (12 RCTs, n=3,984; IRR, 0.84 [95% CI, 0.74 to 0.95]; $I^2=14.6\%$), but not the number of people with a fall resulting in injury (9 RCTs, n=3,924; RR, 0.90 [95% CI, 0.79 to 1.02]; $I^2=26.7\%$). Environment interventions were not statistically significantly associated with the number of falls and the number of people with a fall. Results from the other interventions did not show a consistent beneficial relationship with falls or fall-related morbidity. No interventions had a statistically significant association with all-cause mortality. Harms were poorly reported, but were usually rare, minor, and associated with exercise components of the interventions.

Limitations: The precision and generalizability of the body of literature for any single intervention type is limited by the marked heterogeneity of population characteristics, including baseline falls risk, and wide variation in intervention protocols. No specific effective exercise or multifactorial protocol has been widely replicated in larger population trials. Limited literature exists for falls prevention interventions in community-dwelling individuals with mild dementia. There are limited trials examining multifactorial and exercise interventions' effectiveness on outcomes beyond falls and fall injuries like hospitalizations, institutionalizations, and mortality or the overall effectiveness of environmental interventions, medication review, and psychological interventions.

Conclusions: The current evidence base demonstrates that exercise is associated with fewer falls, fewer people with a fall, and a reduced number of injurious falls in average- and increased-risk community-dwelling older adults. Multifactorial interventions appear to reduce falls but not people with a fall or injuries; trials are clinically and statistically heterogeneous. Other single falls prevention interventions, including environmental modification, medication review/modification, education, and psychological interventions as well as falls interventions with multiple components like exercise plus education and exercise plus environment have either few trials showing no statistically significant effect or a few trials reporting inconclusive results.

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Chapter 1. Introduction

Purpose

The Agency for Healthcare Research and Quality (AHRQ) has requested an updated evidence report on interventions to prevent falls in older adults. This report will be used by the U.S. Preventive Services Task Force (USPSTF) to update its 2018 recommendation.¹

Prevalence and Burden

People age 65 years or older constitute the fastest-growing segment of the U.S. population. The U.S. Census Bureau projects that the number of people age 65 years or older will be 95 million in 2060, almost double the estimated population of 49 million in 2016.² The number of people age 85 years or older is expected to increase from 6.5 million in 2016 to 11.8 million in 2035, and nearly triple to 19 million by 2060.²

Falls—unexpected events in which a person comes to rest on the ground, floor, or lower level—are the leading cause of injury-related morbidity and mortality among older adults in the United States.³ In 2018, 27.5 percent of community-dwelling people age 65 years or older reported at least one fall in the past year (714 falls per 1,000 older adults) and 10.2 percent reported a fall-related injury (170 fall-related injuries per 1,000 older adults).⁴ The Centers for Disease Control and Prevention (CDC) estimates that, in 2018, there were 3 million emergency department (ED) visits and 950,000 hospitalizations or transfers to another facility due to falls. Further, between 1999 and 2020, 478,214 deaths from falls occurred among adults age 65 years or older, increasing from 10,097 in 1999 to 36,508 in 2020.⁵ The risk of falling or experiencing a fall-related injury increases with age. In 2018, 25.9 percent of older adults ages 65 to 74 years reported falling and 9.3 percent reported fall-related injuries. Among adults age 85 years or older, 33.8 percent reported falling and 13.9 percent reported fall-related injuries.⁴ Since 2001, the age-adjusted fall-related death rate has been steadily increasing for older adults, increasing by 41 percent in the most recent 10 years (55.3/100,000 in 2012 to 78.0/100,000 in 2021). Most fall-related deaths occur in those age 85 years or older—this group also has the fastest growing death rate (**Figure 1**).⁶

Disparities in falls exist by sex, race and ethnicity (terminology used for race and ethnicity in this report described in the **Methods** chapter), and geographic location. Women are more likely to experience nonfatal falls and fall-related injuries than men (29.1% of women versus 25.5% of men report a fall; 11.9% of women versus 7.9% men experience a fall-related injury).⁴ However, after adjustment for age, men have a higher rate of fall-related deaths than women (73.2 per 100,000 men versus 54 per 100,000 women).⁷ In 2018, American Indian/Alaska Native older adults reported more falls (32.2%) compared to White (28.3%), Black (22.5%), Hispanic/Latino (28.1%), Asian/Pacific Islander (15.6%), and multiracial or other race (29.6%) older adults. In addition, American Indian/Alaska Native older adults age 65 years or older had a higher percentage of fall-related injuries (15.2%) compared to White older adults age 65 years or older (10.2%).⁴ Some hypotheses to explain these racial differences have been postulated related to

cultural differences, home support, and engagement in outdoor activity.⁴ In the same year, older adults living in rural areas reported a higher percentage of falls compared to those living in urban areas (29.5% versus 27.0%, respectively). However, when stratified by age group, this was only true for persons ages 65 to 74 years.⁴

Falls predict quality of life, disability, admission to long-term care facilities, and death. Between 20 and 30 percent of those who fall incur moderate to severe injuries, such as fractures, lacerations, and head trauma (including traumatic brain injury), that result in decreased mobility and potentially reduced independence.⁸ In a 2017 analysis⁹ conducted in the United Kingdom of 6,800 non-spinal fractures, the most common fall-related fractures among adults ages 60 to 90 years or older included the upper arm, forearm, hip, and ankle. Among the very elderly (i.e., 90 years or older), 50 percent of fall-related fractures occurred in the hip.⁹ For people who are admitted to a hospital after a fall, the length of stay is longer and referral to long-term care facilities is significantly higher among older adults age 65 years or older than for younger people. Moreover, older adults age 65 years or older with hip fractures are three to four times more likely to die within one year after surgery than the general population.^{10, 11} Between 25 and 75 percent of older adults age 65 years or older who lived independently before their hip fracture do not recover their pre-injury functional status.^{12, 13}

Falls represent a significant economic burden on the U.S. healthcare system. A 2018 analysis¹⁴ estimated that the combined medical costs of fatal and nonfatal falls in 2015 was approximately \$50 billion. Overall medical spending for fatal falls was estimated to be \$754 million, and more than \$49.5 billion for medically treated, nonfatal fall-related injuries.¹⁴ In 2017, an average of \$9,389 was spent per fall for fall-related injuries among U.S. Medicare beneficiaries.¹⁵

Etiology and Natural History

Falls are caused by complex interactions among multiple risk factors, including long-term or short-term predisposing factors. Interactions between these factors may be modified by age, disease, and environment. A single fall may have multiple causes or contributors, and repeated falls are typically due to multiple (intrinsic and extrinsic) contributors.

Risk Factors

Risk factors for falls can be classified as intrinsic (within an individual) or extrinsic (external to an individual). Intrinsic (i.e., patient-related) risk factors include age; cognitive and sensory deficits; gait, strength, and balance deficits; acute and chronic conditions; and behaviors. Extrinsic factors include environmental hazards or hazardous activities, medications, footwear, assistive devices, home or neighborhood features, alcohol and drugs, and physical support provided by caregivers. Certain risk factors may be modifiable through interventions: gait, strength, balance, and sensory deficits; behaviors; medications; footwear; assistive devices; home environment; alcohol or drug use; and physical support provided by caregivers.

A person's functional capacity may decrease with aging because of physical and cognitive alterations that lead to impairments in balance, gait, and strength. A 2021 systematic review and

meta-analysis¹⁶ of 22 studies concluded that older adults with markers of frailty in balance and mobility were associated with a 33 percent increased risk of recurrent falls (95% CI, 1.11 to 1.60; $p = 0.007$). In addition to balance and mobility, medication (relative risk (RR), 1.53 [95% CI, 1.11 to 2.10]), psychological (RR, 1.35 [95% CI, 1.03 to 1.78]), and sensory and neuromuscular (RR, 1.51 [95% CI, 1.18 to 1.92]) risk factor domains were the greatest predictors of recurrent falls.¹⁶

As people age, they may also develop more than one risk factor. Appreciating the interaction and probable synergism among multiple risk factors is important in making a clinical assessment. The risk for injuries that results from falling increases dramatically as the number of risk factors increases.

Fall Risk Screening Tools Feasible for Primary Care

Fall risk screening tools and fall risk assessment tools are important in identifying older adults at risk of falling and implementing appropriate interventions to prevent falls. Fall risk screening tools are standardized tools that are designed to quickly identify individuals at risk of falling and may be used to identify individuals who may benefit from a comprehensive fall risk assessment, which may include a one- to three-item fall-risk questionnaire (e.g., history of falls, feeling unsteady, and/or worry about falling or balance) to discriminate those at increased risk for falls from those at average risk. Older adults with positive screening questionnaires may or may not then complete a brief physical function assessment of strength, gait, and balance prior to referral to a single fall-prevention intervention or multiple interventions, as needed. Alternatively, both a questionnaire and an assessment of physical function could be administered to all older adults; results indicating a high risk of falls would trigger interventions aimed at reducing this risk. Again, these risk reduction interventions may include immediate advice and referrals or may involve an in-depth multifactorial risk assessment with subsequent individualized advice and referrals.

Several fall risk screening tools are available for use in primary care settings (**Table 1**). Risk tools that are feasible for primary care need to account for time, space, and personnel limitations. Ideally, fall risk tools would take less than 5 minutes to complete with no requirement for expensive equipment, much space beyond a clinic room or hallway, or additional training for implementation. Physical function tests feasible for use in primary care focus on assessing lower extremity strength, endurance, balance, and/or mobility. These tests vary in their ability to predict future falls, and many were originally intended for research purposes rather than primary care practice.

A 2021 systematic review ($k=27$, $N=8,660$)¹⁷ examined the performance of fall risk screening tools for predicting falls in community-dwelling adults. Seven primary care feasible tools with performance outcomes were identified: Timed Up and Go (TUG) test, Gait Speed test, Berg Balance Scale, Performance Oriented Mobility Assessment-Balance (POMA-B), Performance Oriented Mobility Assessment-Gait (POMA-G), Functional Reach test, and falls history. Most of the identified studies captured fall risk among older adults over a period of 12 months (mean duration of followup, 15 months; range of followup, 6 months to 9 years). Results showed that none of the tools performed adequately; however, falls history performed equally to or better

than any other tool (**Table 1**). The reported area under the curve (AUC) for all tools included prospective falls ascertainment 6 months to 108 months after the tool's administration. The AUCs typically ranged from 0.5 to 0.7 and were considered inadequate for discrimination.¹⁷ More specifically, for the TUG, which provides a quick assessment of an individual's strength, mobility capacity, and dynamic balance, 12 studies (N=5,240) reported an AUC that ranged from 0.46 to 0.89; sensitivity and specificity (k=8, N=1,433) ranged from 10 to 83.3 percent and 28.4 to 96.6 percent, respectively. For the Gait Speed Test, which measures the time it takes an individual to walk a set distance at their usual pace, one study (N=541) reported AUCs ranging from 0.54 to 0.68 for various followup periods; sensitivity and specificity (k=2, N=118) ranged from 38.4 to 100 percent and 23.9 to 84.7 percent, respectively. For the Berg Balance Scale, which provides a standardized assessment of balance, one study (N=187) reported an AUC of 0.59 while another study (N=98) reported an AUC of 0.47; sensitivity and specificity were reported in two studies (N=312) at various cut-off scores and varied widely. For the Tinetti POMA-B, which measures nine different movements to assess balance, four studies (N=442) reported sensitivities of 7.6 to 64 percent and specificities of 66.1 to 91 percent for cut-offs ranging from ≤ 8 to ≤ 10 . For the Tinetti POMA-G, which measures six different movements to assess gait, two studies (N=252) reported sensitivities of 21 and 64 percent and specificities of 62.5 and 95 percent for a cut-off score of 9. For the Functional Reach test, which assesses balance and mobility, two studies (N=1,544) reported AUCs of 0.509 and 0.60; one study (N=50) reported a sensitivity of 73 percent and a specificity of 88 percent. For falls history, which assesses fall risk by asking older adults if they had fallen in the previous year, two studies (N=811) reported AUCs of 0.64 and 0.71; sensitivity and specificity were reported in three studies (N=1,411) and ranged from 39 to 69 percent and 63 to 82 percent, respectively. The lack of conclusive evidence to identify fall risk assessment tools with adequate predictive performance and accuracy are consistent with other systematic reviews.¹⁷⁻¹⁹ Additional attempts to examine other screening tools or develop new risk screening tools have had similar results.²⁰ ²¹ One large trial that included a mailed questionnaire including history and number of falls in the past 12 months, problems with balance while walking, and difficulty with activities of daily living (ADLs) reported an AUC of 0.66 (95% CI, 0.64 to 0.68) for a single fall, 0.72 (95% CI, 0.69 to 0.74) for repeat falls, and 0.60 (95% CI, 0.55 to 0.64) for fracture.²² Researchers have argued that future studies should focus on the effectiveness of fall risk assessment tools in the reduction of falls and injuries using a randomized trial design rather than on prognostic accuracy.²⁰

While current literature shows that all prognostic tools have inadequate discrimination, some experts have recommended an expert-guided approach to risk assessment.²³ However, research is limited. For example, the CDC's Stopping Elderly Accidents, Deaths, and Injuries (STEADI) initiative provides healthcare professionals with a standardized fall risk screening protocol (i.e., a 12-question screening tool and comprehensive fall risk assessment) and a comprehensive list of recommended interventions based on individualized risk factors. A 2022 systematic review²⁴ synthesized findings from three prospective studies (N=4,025) examining the predictive validity of the STEADI questionnaires. The three identified studies were small and only one study (N=77) reported the sensitivity and specificity of the STEADI algorithm for predicting falls in the next 6 months (68.4% and 44.9%, respectively). All three studies, however, reported the predictive validity of the 12-question screening tool alone, with sensitivity ranging from 52.6 to 77.7 percent and specificity ranging from 61.2 to 88.0 percent for 6- to 12-month prospective falls. Using three key questions from the tool resulted in increased sensitivity (range, 68.7% to

93.9%), but lower specificity (range, 34.7% to 75%).²⁴ An additional small study (N=95) reported AUCs of 0.87 to 0.91 when only two to three questions from the STEADI tool were administered.²⁵ While results showed fair predictive ability, large-scale studies are needed to further examine the effectiveness of the STEADI in clinical settings.

Treatment Approaches

Interventions to prevent falls in older adults are varied and complex, with multiple components involving multidisciplinary teams in different implementation settings. Interventions can be delivered alone, in combination, or as part of an individualized multifactorial assessment and intervention. Depending on the risk factors identified, patients may need to receive interventions for multiple risk factors, and this is often referred to as a multifactorial assessment and intervention. Interventions to reduce falls may include exercise (including physical therapy), reduction or alteration of medications to reduce fall risk, occupational therapy to assist with identifying home hazards, referrals to specialists for visual impairment or podiatric issues, and treatment of comorbidities, including conditions like osteoporosis, which increases fracture risk after falls.²⁶

Current Clinical Practice in the United States and Recent Recommendations

There are many reported barriers to implementation of fall-prevention interventions in current U.S. clinical practice, including competing demands, clinician education, and logistical issues (limitations in patient transportation, mobility). Furthermore, fewer than half of patients who experience a fall mention it to their doctor.²⁷ A 2018 survey of primary care providers found that 87 percent believed fall risk assessments could be effective in reducing fall risk among their older patients; 96 percent believed that older adults should be assessed for fall risk. However, only 52 percent of providers felt they had the expertise to conduct risk assessment for falls.²⁸

After an initial risk assessment in the context of a primary care visit or an annual prevention or wellness visit, primary care clinicians may elect to refer all patients identified as being at high risk of falls to individual or multiple services for further risk assessment and tailored intervention or interventions (e.g., home health, physical therapy, occupational therapy). Alternatively, where available, clinicians can refer a patient at high risk of falls to a “falls clinic.” These clinics are not widely available in the United States and vary substantially in personnel staffing, content of the visit, and duration of the intervention. A falls clinic may have a single or multiple specialties staffed by advanced registered-nurse practitioners, physical therapists, occupational therapists, and/or a variety of physician specialists (e.g., geriatrician, physical medicine and rehabilitation physician, ophthalmologist, otolaryngologist, neurologist, orthopedist). The clinic can provide multicomponent risk assessments in a patient encounter lasting between 30 minutes to 3 hours and generate tailored referrals. It may also provide ongoing interventions to prevent falls.

The Centers for Medicare & Medicaid Services (CMS) sponsors the Initial Preventive Physical Examination (IPPE, known as the “Welcome to Medicare Preventive Visit”), a one-time benefit for all new Medicare beneficiaries within the first 12 months of their first Medicare Part B

coverage period, along with the Annual Wellness Visit. As part of these visits, healthcare providers collect the plan member’s medical history, including risk factors for depression and other mood disorders, and review the beneficiary’s functional ability and level of safety. Appropriate screening questions and standardized questionnaires are used to review functional elements, including the risk of falls, hearing impairment, ADLs, and home safety.

To help incentivize primary care physicians to perform fall risk assessment and intervention, CMS also provides a five-star quality rating to insurance plans that measure the percentage of plan members with a risk of falling who discussed this risk with their physicians and received a fall-prevention intervention.^{29, 30} Despite efforts, implementation and utilization of annual wellness visits are suboptimal. A 2018 analysis³¹ of Medicare claims data from 2008 to 2015 concluded that roughly half of primary care practices offer annual wellness visits and less than 20 percent of eligible Medicare beneficiaries receive them. Results also highlighted disparities among demographic and geographic characteristics. For example, annual wellness visit rates in rural practices were lower compared to metropolitan practices (8.1% versus 24.4%, respectively). Further, Black, Asian, “Hispanic,” “North American Native” or other race individuals, patients with dual enrollment in Medicare and Medicaid, and patients with higher medical risk were less likely to receive an annual wellness visit compared to other patients (i.e., White individuals, patients with low medical risk) in the same practice.

Healthcare providers can also use the CDC STEADI toolkit, which was designed to help providers incorporate fall risk assessments and individualized fall interventions into current clinical practice.³² The Royal Australian College of General Practitioners recommends assessment of risk for falls in older adults and, if indicated, a complete physical examination, medical history, and cognitive and functional assessments. Recommended first-line interventions include: exercise programs, medication review, and other multicomponent lifestyle modifications.³³ The U.S. Department of Health and Human Services’ activity guidelines recommend that older adults get at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week, as well as muscle-strengthening activities twice per week.³⁴ Balance training three or more days per week for older adults at risk of falls due to a recent fall or difficulty walking is also recommended.³⁴ The National Institute on Aging outlines several interventions for falls: exercise for strength and balance, monitoring for environmental hazards, regular medical care to ensure optimized hearing and vision, and medication management.³⁵

Recommendations from other professional societies or organizations are listed in **Table 2**. While all endorse interventions to prevent falls among older adults, the recommended interventions vary.

Previous USPSTF Recommendation

The USPSTF recommends exercise interventions to prevent falls in community-dwelling adults age 65 years or older who are at increased risk for falls (**B recommendation**). The USPSTF recommends that clinicians selectively offer multifactorial interventions to prevent falls to community-dwelling adults age 65 years or older who are at increased risk for falls. Existing evidence indicates that the overall net benefit of routinely offering multifactorial interventions to

prevent falls is small. When determining whether this service is appropriate for an individual, patients and clinicians should consider the balance of benefits and harms based on the circumstances of prior falls, presence of comorbid medical conditions, and the patient's values and preferences (**C recommendation**). The USPSTF recommends against vitamin D supplementation to prevent falls in community-dwelling adults age 65 years or older (**D recommendation**).

Chapter 2. Methods

Scope and Purpose

This current review is an update of the 2018 review^{36, 37} that supported the 2018 USPSTF recommendation¹ to prevent falls among older adults. The USPSTF will use this report to update its recommendation. While no substantive changes were made to the key questions (KQs) and analytic framework, compared to the 2018 review, this update excludes interventions of vitamin D supplementation and allows for the inclusion of participants with mild dementia, osteoporosis, osteoarthritis, and sarcopenia.

Key Questions and Analytic Framework

With input from the USPSTF, we developed an Analytic Framework (**Figure 2**) and two KQs to guide the literature search, data abstraction, and data synthesis.

Key Questions

1. Do interventions to prevent falls in unselected- or increased-risk community-dwelling older adults reduce falls, fall-related morbidity, or mortality?
 - a. How is “increased risk” defined in the included trials?
2. Do interventions to prevent falls in unselected- or increased-risk community dwelling older adults result in any adverse effects?

Data Sources and Searches

In addition to re-evaluating all studies included in the 2018 review,^{36, 37} we searched the following databases for relevant English-language literature published between January 1, 2016, and May 8, 2023: MEDLINE, Cumulative Index for Nursing and Allied Health Literature, and Cochrane Central Register of Controlled Clinical Trials. A research librarian developed and executed the search, which was peer reviewed by a second research librarian (**Appendix A**). We supplemented our searches with suggestions from experts and articles identified through news and table-of-contents alerts. We also searched ClinicalTrials.gov for ongoing trials and have conducted ongoing surveillance for relevant literature for all bodies of evidence through March 22, 2024. We imported the literature from these sources directly into EndNote® X9 (Thomson Reuters, New York, NY).

Study Selection

We developed specific criteria to guide our study selection (**Appendix A Table 1**). Two independent reviewers independently screened all records in the updated searches based on the

titles and abstracts, using the inclusion and exclusion criteria as a guide. Subsequently, at least two reviewers assessed the full text of potentially relevant studies, including all the previously included studies. Disagreements were resolved through discussion and consensus. We kept detailed records of all included and excluded studies, including the reason for exclusion.

Population

We included trials of community-dwelling older adults age 65 years or older. Participants could be unselected for their risk of falling or selected due to their increased risk of falling. We excluded trials recruiting populations living in specialized settings, such as people living in long-term care facilities. We further excluded older adults with moderate to severe dementia (or major neurocognitive disorder) but did include trials recruiting those with mild dementia or mild cognitive impairment. If we were unable to determine the severity of cognitive impairment among participants, the study was excluded. We also included trials that recruited participants with osteopenia/osteoporosis, osteoarthritis, or sarcopenia.

Interventions and Comparators

We included interventions that were feasible to conduct in or refer from primary care. Specifically, we included the following categories of interventions, delivered alone or in combination:

- Multifactorial assessment and intervention (hereafter referred to as multifactorial intervention)
- Exercise (supervised or unsupervised, individual or group)
- Environmental assessment/modification
- Medication review/modification
- Psychological (individual or group)
- Education

We excluded interventions in social marketing and policy (out of scope for the USPSTF); surgery (e.g., cataract extraction, pacemaker placement, podiatry surgery), fluid or nutrition therapy, management of urinary incontinence, and assistive technology (these interventions are performed as treatment of medical conditions); and vitamin D or other supplements (vitamin D has been included in another USPSTF evidence review³⁸). We also excluded interventions that are considered disease management, such as osteoporosis pharmacotherapy, joint replacement, and cognitive function interventions. Trials of multifactorial interventions that incorporated any of the excluded intervention categories as one part of their assessment, referral, or treatment components were included; trials of multiple interventions (where all participants received all interventions) where an excluded intervention was a major category of intervention were excluded.

We captured the components of exercise interventions according to taxonomy developed by ProFaNE.³⁹ These categories included: gait, balance, and functional training; strength/resistance;

flexibility; 3D (e.g., tai chi or dance); general physical activity; and endurance.

We required a minimal control or usual care comparison group. Any study with an active comparison group or a relatively intense comparison group was excluded.

Outcomes

Trials were required to report at least one fall or a fall-related injury outcome. We abstracted the following outcomes: falls, people with a fall, mortality, fall-related injuries (mild injuries, serious injuries, injuries resulting in medical care), people with fall-related injuries (people with mild injuries, serious injuries, or injuries resulting in medical care), hospitalizations or ED visits (fall-related hospitalizations/ED visits were preferentially abstracted when available, otherwise all hospitalizations/ED visits were abstracted), people with hospitalizations or ED visits, fractures, people with fractures, institutionalizations, people institutionalized, instrumental activities of daily living (IADLs), quality of life, and any harms outcomes as reported in the trials. We did not include basic ADLs, as community-dwelling older adults are typically still functional in their basic ADLs and we would not expect to see an improvement in this outcome over a relatively short intervention duration.

We allowed any instrument measuring IADLs. For quality of life (QOL), we required overall or component scores (e.g., SF-36 mental component score). Falls and fall injuries could be measured using a falls diary, recall under 6 months, or via the use of administrative records. We required a minimum followup of 6 months. All outcomes had to capture the outcome starting at baseline; we excluded trials that reported only a segment of followup (e.g., only 12 to 24 months post-baseline).

Study Design

We included randomized, controlled trials (RCTs) and cluster RCTs. All intervention harms were restricted to trials included for KQ1. Trials were required to have a primary or secondary aim of preventing falls or an aim related to fall prevention (e.g., fear of falling) and falls measured as a primary or secondary outcome.

Quality Assessment

We quality rated all studies for potential risks of bias that may impact the reported effects and assigned each study a quality rating of “good,” “fair,” or “poor.” We applied signaling questions from the Cochrane Risk of Bias (RoB 2)⁴⁰ tool along with the USPSTF-design specific criteria. **Appendix A Table 2** lists the criteria applied. We quality rated the trials with a focus on the falls outcomes (**Appendix A Figures 1–3**), and because the preferred measurement method is to use self-reported falls diaries, blinding of the outcome assessor was not possible. Therefore, we did not use that signaling question. For new evidence, two independent reviewers rated each study. For the previously included studies, one investigator reviewed the previous risk of bias assessments and assigned domain ratings to those studies. If needed, domains were reassessed.

Discordant quality ratings were reviewed and discussed; a third reviewer adjudicated as needed.

Good-quality studies were those that met nearly all specified quality criteria. We rated a study as good quality if comparable groups were assembled initially and maintained throughout the study, reliable and valid measurement instruments were used and applied equally to the groups, procedures for maintaining fidelity to the intervention were in place, followup was adequate (i.e., $\geq 80\%$ retention overall) and not differential between groups, data were complete, and there was no evidence of selective reporting. Fair-quality studies did not meet these criteria but did not have serious threats to their internal validity related to the design, execution, or reporting of the study.

Studies rated as poor-quality had several important risks of potential bias or one critical flaw and were excluded from this review. Potential risk of bias for intervention trials resulting in poor-quality ratings included very high risk of bias due to confounding and imbalances in baseline characteristics between groups, high or differential rates of attrition between groups, or no information on the number of participants with complete data or reasons for missing data, falls outcome ascertainment validity concerns (i.e., recall >6 months), and evidence of possible selective reporting.

Data Abstraction

One reviewer extracted key elements for each included study into standardized abstraction forms in DistillerSR. A second reviewer checked the data for accuracy.

We abstracted general characteristics of the study (e.g., study design, country), clinical and demographic characteristics of the sample and setting (e.g., recruitment strategy and setting, age, race and ethnicity, baseline clinical characteristics), intervention details (e.g., type, provider, frequency, duration), methods to collect information on falls, and relevant outcomes. A study in which participants prospectively collected information (e.g., onto calendars, postcards, or diaries) about their falls and sent the information to the research team was referred to as “diary” collection. When multiple intervention and/or control groups were available, we abstracted the most intense and comprehensive intervention group and the control group most similar to no intervention or usual care.

Data Synthesis and Analysis

We synthesized data separately for each KQ. Many outcomes did not allow for quantitative pooling due to the limited number of contributing studies ($k < 5$), so those data are summarized narratively. For outcomes with enough contributing studies, we ran random-effects meta-analyses with a Knapp-Hartung adjustment⁴¹ to calculate the pooled relative risks. When available, we favored the author-reported relative risks or incidence rate ratios over those we calculated for the analysis and data tables. When authors did not report relative risks or incidence rate ratios, we calculated a crude effect estimate and this unadjusted effect is presented in figures and tables. Within each study, we selected the longest followup available for pooled analyses and figures. Data from other followup times are presented in tables. As noted above, only one

intervention and one control arm for each intervention category were abstracted and included in the analysis.

We grouped our outcomes as follows: number of falls, number of falls resulting in injury or medical care (also referred to as injurious falls), number of fall-related fractures, number of hospitalizations or ED visits, people with a fall, people with a fall resulting in injury or medical care (also referred to as people with an injurious fall), people with a fracture, people with a hospitalization or ED visit, people transitioning to institutionalized care, people hospitalized, mortality, QOL, and IADLs.

All fall and fall-related injury outcomes were reported either as an incident event (where a person could contribute more than one event to the analysis [e.g., falls, fractures]) or the number of persons experiencing the event (where a person could contribute only once to an analysis, regardless of the number of times the event occurred [e.g., people experiencing a fall, people experiencing an injurious fall]). For injurious fall outcomes, we included minor or severe injuries resulting from a fall, falls resulting in medical care, or any fall-related outcome the author categorized as injurious. The most inclusive outcome was used in meta-analysis if multiple outcomes in that injury category were reported (e.g., fall-related injuries instead of fall-related hospital admissions). For studies that did not report a composite injury outcome, we used the most prevalent outcome (e.g., falls leading to an ED visit was selected over falls leading to hospital admission). The number of injurious falls analyzed in the forest plots included both the number of fall-related injuries and the number of falls resulting in injury as reported in the trials. For fracture outcomes, we first selected fall-related fractures, but if that outcome was not available, we included data on hip fractures and overall fractures, even if the study may not have reported if the fracture was associated with a fall.

In cases where a cluster RCT was used but the authors did not account for the nested nature of the data, we adjusted for the clustering effect by applying a design effect, which was based on an estimated average cluster size (i.e., the total number of randomized participants divided by the total number of clusters) and multiplied by an estimated intraclass correlation. We estimated the intraclass correlation to be 0.05.

We examined statistical heterogeneity among the pooled studies by applying standard χ^2 tests and estimated the proportion of total variability in point estimates by using the I^2 statistic.⁴² We applied the Cochrane Collaboration's rules of thumb for interpreting heterogeneity⁴³: less than 40 percent likely represents unimportant heterogeneity; 30 to 65 percent, moderate heterogeneity; 50 to 90 percent, substantial heterogeneity; and more than 75 percent, considerable heterogeneity. In addition, we generated funnel plots to evaluate small-study effects (a possible indication of publication bias) and ran the Egger test to assess the statistical significance of imbalance in study size and findings that suggest a pattern.⁴⁴

We investigated whether the heterogeneity among the main results (the outcome of falls and the outcome of people with one or more fall) was associated with any prespecified population or intervention characteristics of the studies. First, we used visual displays and tables grouped or sorted by these potentially important characteristics. For visual displays that suggested a difference between groups or a pattern in sorted results, we conducted meta regression.

Specifically, we examined the publication year, study quality, recruitment setting, duration of followup, mean age, percentage female, recruitment for increased fall risk, and fall rate or the percent falling in the control group as they related to the effect estimates. For exercise interventions, we also examined the presence of a behavior change component, presence of cognitive task exercises, individual exercise components (e.g., balance, flexibility, strength), and format (group, individual, or both). We used Stata version 16.1 (Stata Corp LP, College Station, TX) for all quantitative analyses. All significance testing was two-sided. Results were considered statistically significant if the p-value was 0.05 or less.

Grading the Strength of the Body of Evidence

We graded the strength of the overall body of evidence for each KQ to reflect our confidence in the findings. We adapted the Evidence-based Practice Center (EPC) approach,⁴⁵ which is based on a system developed by the Grading of Recommendations Assessment, Development, and Evaluation Working Group.⁴⁶ Our method explicitly addresses four of the five EPC-required domains: consistency (similarity of effect direction and size), precision (degree of certainty around an estimate), reporting bias, and study limitations. We did not address the fifth required domain—directness—as it is implied in the structure of the KQs (i.e., whether the evidence links the interventions directly to a health outcome).

Consistency was rated as consistent, inconsistent, or not applicable (e.g., single study). Precision was rated as precise, imprecise, or not applicable (e.g., no evidence). The body of evidence limitations field highlights important restrictions in answering the overall KQ (e.g., suspected reporting bias, lack of replication of interventions, nonreporting of outcomes).

We graded the overall strength of evidence as high, moderate, low, or insufficient.⁴⁵ These grades reflect our level of confidence in the estimate of effect (direction and magnitude) for benefit or harm—equating to our judgement as to how much the evidence reflects a true effect and our assessment of the level of deficiencies in the body of evidence and our belief in the stability of the findings. The strength of evidence grade does not reflect the actual magnitude of the effect (e.g., a “small” effect, “low” sensitivity).

“High” indicates high confidence that the evidence reflects the true effect, and that further research is very unlikely to change our confidence in the estimate of effect. “Moderate” suggests moderate confidence that the evidence reflects the true effect, and that further research may change our confidence in the estimate of effect and may change the estimate. “Low” indicates low confidence that the evidence reflects the true effect, and that further research is likely to change our confidence in the estimate of effect and is likely to change the estimate. A grade of “insufficient” indicates that evidence is either unavailable or does not permit estimate of an effect. We developed our overall strength of evidence grade based on consensus discussion involving at least two reviewers.

Race and/or Ethnicity Terminology

For consistency, in this report we use the following default terminology:

1. Black and White (in capitals) as descriptors for populations rather than nouns
2. Black persons as opposed to African Americans
3. Hispanic/Latino persons as opposed to Hispanic, Latine, or Latinx persons

We realize there are no perfect or universally preferred terms for many of these categorizations and concepts; however, we have tried to stay away from terms that are inaccurate or perceived as marginalizing. In select instances, when using nonpreferred terms referenced by the source material, we note this using quotation marks (e.g., “diverse populations”).

Contextual Questions

In addition to the systematically reviewed questions (KQs 1 and 2), we also addressed a contextual question (CQ) to aid with the broader interpretation of the evidence. CQs are important considerations that may not be readily answerable from the KQ evidence or RCT literature. One CQ was prespecified in our Research Plan:

1. What is the prognostic accuracy of falls risk assessment tools that are feasible for administration in primary care?

The CQ was not systematically reviewed. Evidence for the CQ was identified based on literature retrieved for the systematic search for KQs as well as targeted searches and scanning bibliographies of relevant articles. A best evidence approach was used to identify the most recent, applicable, and robust evidence. The CQ is addressed in the Introduction and in **Table 1**.

Expert Review and Public Comment

The draft Research Plan was posted from April 21 to May 19, 2022. In response to public comment, fall prevention trials recruiting older adults with osteopenia/osteoporosis, osteoarthritis, and sarcopenia were included. The population designation “average-risk” was also replaced with “unselected-risk.” The intervention name “medication management” was also changed to “medication modification/review” to better reflect our intended inclusion criteria.

A draft version of this report was reviewed by three invited experts and four USPSTF federal partners. Experts were selected based on their expertise in fundamental methodologic and content aspects of the review and were selected to obtain diverse informed perspectives. Reviewer comments were presented to the USPSTF during its deliberations and subsequently addressed in revisions of this report. All expert comments were considered, and the report was updated to improve clarity, ensure accuracy, and address scientifically relevant concerns.

In addition, the draft evidence report was posted on the USPSTF website for public comment from December 5, 2023, through January 8, 2024. In response to comments received, we provided some additional information and clarification in the introduction and evaluated studies suggested for possible inclusion but found that none met our inclusion criteria.

USPSTF and AHRQ Involvement

We worked with USPSTF members at key points throughout this review, particularly when determining the scope and methods and developing the Analytic Framework and KQs. The USPSTF members approved the final Analytic Framework, KQs, and inclusion and exclusion criteria after revisions reflecting the public comment period. AHRQ staff provided oversight for the project, coordinated systematic review, reviewed the draft report, and assisted in an external review of the draft evidence synthesis.

Chapter 3. Results

KQ 1. Do Interventions to Prevent Falls in Unselected or Increased-Risk Community-Dwelling Older Adults Reduce Falls, Fall-Related Morbidity, or Mortality?

KQ1a. How Is “Increased Risk” Defined in the Included Trials?

KQ 2. Do Interventions to Prevent Falls in Unselected or Increased-Risk Community-Dwelling Older Adults Result in Any Adverse Effects?

We reviewed 5,142 abstracts and 403 full-text articles for KQ 1 and KQ 2 (**Appendix B Figure 1**). Overall, we included 83 trials (reported in 145 publications); 32 were newly identified trials and 51 were carried forward from the previous review. Lists of included and excluded studies (with the reasons for exclusion) are available in **Appendix C** and **Appendix D**, respectively.

Most of our included studies investigated the effectiveness of multifactorial (k=28) and exercise (k=37) interventions. The remaining studies examined interventions including exercise with the addition of an education component (k=4), exercise with the addition of an environment assessment (k=3), environment assessments with or without modifications (k=6), medication review with or without modification (k=4), psychological interventions (k=3), and education interventions (k=1). An evidence map with total number of studies by intervention group is shown in **Figures 3 and 4**.

The most robust results with consistent associations across fall-related outcomes were found for exercise interventions, with statistically significant effects favoring the intervention for the number of falls, the number of falls resulting in injury or medical care, and persons with one or more falls. For multifactorial interventions, only the number of falls was statistically significantly reduced for the intervention group when compared to the control group. The findings from the remaining interventions did not demonstrate a consistent relationship with falls, fall-related morbidity, or mortality—the small number of studies per intervention grouping often precluded any meta-analyses. Harms for all intervention types were scantily reported but generally mild in severity and associated with any exercise components of interventions.

Multifactorial Interventions

Summary of Results

We identified 28 trials (n=27,784) of multifactorial interventions to prevent falls in community-dwelling older adults (**Figure 5**). Each trial examined direct interventions and referrals customized to participants based on an initial risk assessment, although the specific assessment

and intervention components varied. Most of the trials recruited participants determined to be at high risk for falls; history of falls was the most common risk factor used for trial recruitment. Pooled results from 20 trials (n=22,115) demonstrated that multifactorial interventions were associated with a lower risk of falling at the longest followup (6–28 months) with substantial heterogeneity in the effect size (incidence rate ratio (IRR), 0.84 [95% CI, 0.74 to 0.95]; $I^2=85.0\%$). However, pooled results from 26 trials (n=23,626) demonstrated no association of multifactorial interventions with the risk of people experiencing a fall at the longest followup (6–28 months) (RR, 0.96 [95% CI, 0.91 to 1.02]; $I^2=48.2\%$). Multifactorial interventions were not associated with mortality at longest followup (6–42 months) in the multifactorial group compared to the control group (k=24; n=21,596; RR, 1.01 [95% CI, 0.88 to 1.17]; $I^2=0\%$). Qualitative analyses demonstrated multifactorial interventions were not associated with a change in hospitalization, institutionalization, IADLs, or QOL, but these outcomes are reported in just a small proportion of studies. There is sparse evidence on the harms of multifactorial interventions, and when reported, they were rare, minor, and associated with the exercise components of multifactorial interventions.

Characteristics of Included Studies

We included 28 trials (in 45 articles) of multifactorial assessments and interventions (n=27,784).^{22, 47-90} Of the 28 trials, 25 were included in the previous review^{53-59, 62, 63, 69-71, 73-75, 77, 78, 80, 82, 84-87, 89, 90} and three were newly identified.^{47, 49, 72} One trial⁹¹ from the previous review was excluded due to a high risk of bias for its falls ascertainment.

Study Characteristics

We identified nine good-quality^{47, 49, 56, 62, 74, 75, 84, 86, 89} and 19 fair-quality^{53-55, 57-59, 63, 69-73, 77, 78, 80, 82, 85} trials with a primary or secondary aim of examining the effectiveness of multifactorial interventions on falls and/or fall-related injuries (**Table 3; Appendix E Table 1**). Most of the trials were conducted outside of the United States, with only four taking place in the United States,^{47, 55, 86, 90} 18 in Europe,^{49, 54, 56-58, 63, 69, 71-74, 77, 78, 80, 84, 85, 87, 89} four in Australia or New Zealand,^{59, 62, 75, 82} and two in Canada.^{53, 70} The size of the trials (intervention plus control groups randomized for our analysis) ranged from 153⁷⁷ to 6,524⁴⁹ participants. One very large trial⁴⁹ was unusual in that the trial tested the effectiveness of screening and multifactorial assessment and intervention: all those in the intervention group received a screening assessment and only those assessed at intermediate or high risk for falls actually were assigned to receive the multifactorial assessment and interventions.

Population Characteristics

Most trials recruited participants age 65 years or older^{54, 57, 58, 69, 70, 72, 73, 77, 84, 85, 89, 90} or 70 years or older,^{47, 49, 56, 62, 78, 80, 86, 87} but two trials recruited participants from the oldest old age groups (≥ 80 ⁷¹ or ≥ 85 ⁶³ years) (**Table 3; Appendix E Tables 1 and 2**). Mean age ranged from 72 years⁵³ to 85 years.⁶³ The proportion of women in the trials ranged from 53 percent⁴⁹ to 94 percent.⁵³ Race and ethnicity were rarely reported (k=5). In three trials,^{47, 49, 90} 91 to 99 percent of participants were White. One trial⁴⁷ additionally reported that 5 percent of participants were Black and 8 percent were Hispanic/Latino. One trial⁵³ from Canada identified 6 percent of

participants as being from “Aboriginal origin” and a trial⁵⁹ from New Zealand reported 3 percent of participants classified themselves as “Maori or Pacific.” Measures of socioeconomic status, such as education or income level, varied widely. Nearly all trials solely recruited older adults living in the community. Fifteen trials recruited at least some proportion of participants from clinics,^{47, 49, 53, 56, 58, 59, 62, 63, 71, 72, 77, 78, 80, 84, 85, 87} and six trials exclusively recruited from the ED.^{54, 57, 69, 73, 82, 89} Three U.S. trials recruited patients from health maintenance organizations or health insurance databases.^{55, 86, 90} An additional trial recruited patients in Australia from health insurance member databases.⁷⁵

Sixteen trials excluded patients with cognitive impairment or dementia; many of these trials provided different Mini-Mental State Examination (MMSE) cutoff scores for inclusion.^{47, 54, 57-59, 62, 69, 71, 72, 75, 77, 82, 84-86, 89} An additional eight trials excluded those who could not understand instructions or provide their own informed consent.^{56, 58, 59, 71, 73, 74, 78, 80} None of the trials specifically recruited those with cognitive impairment, but one trial removed its initial exclusion of those with cognitive impairment in order to recruit enough generalizable participants,⁸² and one trial allowed participants with cognitive impairment with proxy consent.⁴⁷

Seven trials recruited patients unselected for their risk of falling (with the exception of their age).^{49, 55, 63, 71, 75, 80, 90} Among those unselected participants reporting percent at risk (k=5), 19 to 44 percent of those recruited were at increased risk for falls.^{49, 55, 63, 71, 75, 80, 90} Twenty-one trials^{47, 53, 54, 56-59, 62, 69, 70, 72-74, 77, 78, 82, 84-87, 89} solely recruited patients at increased risk for falls according to various definitions (**Figure 6; Appendix E Table 2**). Nearly half of the trials (13 of 28) defined high risk as having a history of falling as the sole risk criterion.^{55, 59, 70, 71, 80, 84, 85, 90} The remainder of the trials recruited participants who fulfilled one or more risk factor criteria from a list of possible risk factors. Of the trials using multiple risk factors to define fall risk, the most common risk factors included a hospitalization or ED visit,^{53, 54, 57, 58, 69, 73, 74, 77, 82, 89} physical function testing,^{49, 53, 56, 78, 86, 87} and a history of one or more falls.^{47, 49, 56, 78, 87} Three trials explicitly required participants to have the ability to walk independently without assistance from a device.^{56, 81, 82, 86} Overall, among the 26 trials reporting the proportion of those at risk, 65 percent of participants were at increased risk of falling.

Trials reporting some measure of ADL function generally reported fairly independent ADLs,^{55, 58, 63} although there were a few exceptions, such as the trial by Moller et al.,⁷⁷ which required participants to need assistance with at least two ADLs, and the trial by Russell et al.,⁸² in which a third of participants needed some assistance with ADLs. Sixteen trials reported a measure of medication use; mean number of medications ranged from 5.0 to 15.5 and the proportion of people taking more than four medications ranged from 41 to 65 percent. Seven trials^{47, 58, 59, 62, 69, 78, 82} reported mean number of medical comorbidities ranging from 1⁵⁸ to 7.⁶² One trial specifically recruited a high proportion of individuals with stroke (15%) and Parkinson’s disease (19%).⁷²

Intervention Details

The 28 multifactorial trial publications described a heterogeneous group of complex assessment and intervention components (**Figures 7–9; Appendix E Table 3**). All trials administered an initial assessment, which included several components such as medical history, medication review, clinical and laboratory tests, and patient questioning to assess and plan for fall risk

mitigation (**Figure 7**). Most trials (24 of 28) provided outside referrals (**Figure 8**) and administered some research team–delivered intervention components (**Figure 9**). The referrals and study-delivered treatment interventions were largely individualized and based on the risk factors identified in the initial assessment. They generally targeted multiple intervention components, such as exercise (unsupervised or supervised, group or individual), psychological (cognitive behavioral therapy), nutrition therapy, education (e.g., via DVDs, lectures, pamphlets), medication management, urinary incontinence management, environment (e.g., assistive technology or dwelling recommendations), and referral to physical or occupational therapy, social or community services, and specialists (e.g., ophthalmologist, neurologist, cardiologist). Nineteen trials included one or more home visits for the initial assessment, environment interventions, and/or physical therapy/exercises.^{53-55, 57, 59, 62, 69-74, 77, 78, 80, 82, 84, 86, 87} The vast majority of interventions in the trials, however, occurred in the outpatient setting. All interventions were in person, with some trials additionally including some telephone coaching.^{47, 55, 71, 77, 90}

Initial assessment. All 28 trials administered an initial assessment of modifiable fall risk factors in order to customize the intervention for each participant (**Figure 7; Appendix E Table 3**). This initial assessment could include a multidisciplinary comprehensive geriatric assessment or an assessment of falls risk factors with any number of the following assessment components: balance, gait, vision, cardiovascular health (e.g., postural blood pressure or pulse, carotid sinus stimulation), medication, environment/home hazard, cognition, and psychological health. The vast majority of the trials' initial assessments included an environmental assessment, functional assessment, medication review, and vision screening. The other assessment components varied. All trials assessed falls risk factors, most (k=24) including functional assessments(s) (i.e., TUG, Short Physical Performance Battery (SPPB)),^{47, 49, 53-59, 62, 63, 69-73, 75, 77, 78, 84-87, 89} an environmental assessment (k=24),^{47, 49, 53-59, 62, 63, 69, 70, 72-74, 77, 78, 80, 84-87, 90} or a medication review (k=22),^{47, 49, 53-58, 62, 63, 69, 72-74, 77, 78, 84-87, 89, 90} but only three trials^{72, 75, 82} administered a validated/formal falls risk assessment tool (Fall Risk for Older People in the Community [FROP-Com]). Of the 24 trials that provided an environmental assessment, 17 were conducted in participants' homes.^{53-55, 57, 59, 62, 69, 70, 72-74, 77, 78, 80, 84, 86, 87} Twenty trials assessed participants vision;^{47, 49, 54, 57-59, 63, 69-73, 75, 78, 82, 84-86, 89, 90} 11 trials assessed cognitive function;^{54, 59, 63, 69, 71-73, 78, 85, 87, 89} nine trials assessed medical diagnoses;^{56-59, 62, 69, 71, 86, 89} nine trials assessed mental health;^{54, 62, 69, 71, 78, 82, 84, 86, 89} nine trials assessed orthostatic blood pressure;^{47, 49, 53, 56-58, 70, 82, 85} eight trials assessed cardiovascular health;^{57, 59, 69, 72, 73, 78, 85, 89} six trials assessed hearing;^{63, 69, 71, 73, 86, 90} six trials assessed ADLs;^{53, 54, 63, 78, 86, 87} five trials assessed foot health;^{47, 49, 72, 73, 85} and three trials administered a physical examination.^{56, 58, 69} The initial assessment occurred in a clinical setting and/or the participant's home. The assessment was completed by nursing professionals (18 trials), physicians (12 trials), physical therapists (11 trials), and/or occupational therapists (6 trials).

Individualized services. Based on the results of the initial assessment, a variety of services or referrals for a service were described in the included trials (**Figure 8; Appendix E Table 3**). Eighteen trials referred some or all of the participants to an individual (such as one administered by a physical therapist) or group exercise intervention.^{47, 49, 53, 57-59, 62, 63, 70, 72, 75, 77, 78, 82, 85, 86, 89, 90} Fourteen trials performed or referred participants to a medication review.^{47, 49, 53, 54, 62, 72-74, 78, 84-86, 89, 90} Thirteen trials referred participants to vision and/or hearing specialists.^{47, 49, 57-59, 63, 70, 72, 73, 75, 85, 89, 90} Seven trials referred participants to occupational therapy.^{49, 53, 59, 62, 77, 82, 85} Nine trials referred participants back to their primary care provider with risk assessment information and

recommendations,^{47, 49, 55, 58, 59, 69, 72, 82, 90} and 11 trials communicated with primary care providers specifically regarding medication assessment results.^{47, 49, 53, 54, 62, 73, 74, 84-86, 90} Of the trials that provided an environmental assessment, 17 provided additional recommendations or referrals for modifications with or without modification implementation, if indicated by the initial assessment.^{47, 49, 54-59, 63, 69, 70, 72, 80, 85-87, 90}

Intervention components delivered to all participants in the intervention group. All trials delivered individualized falls prevention advice and recommendations based on the multifactorial risk assessment. Additionally, several trials provided intervention components to all participants regardless of the results of the risk assessment (**Figure 9; Appendix E Table 3**). Eleven trials provided environmental assessments, which were generally home visits with specific recommendations for modifications with or without modification implementation.^{54, 59, 63, 69, 72-74, 77, 78, 84, 87} Eight trials^{53, 55, 56, 59, 63, 72, 80, 84} provided educational materials related to falls prevention (e.g., printed materials) while five^{56, 72, 74, 80, 84} delivered falls-specific group education sessions. Nine of the trials^{55, 56, 59, 72, 74, 77, 78, 80, 84} delivered a physical activity intervention (exercise or physical therapy) to all participants and three trials^{47, 55, 71} delivered counseling/behavior modification coaching interventions focused on risk factor mitigation.

Intervention intensity and format. We could not quantify the intensity of the multifactorial interventions because total contact time was rarely reported, especially for the trials that included referrals to outside specialist care. In the studies that included an exercise intervention component, the frequency of exercise sessions was generally one to three times per week, while the duration of the exercise interventions ranged widely, from 6 weeks⁷⁴ to 12 months.^{59, 75, 77, 84, 87} Due to the nature of multifactorial interventions having potentially several types of referrals based on initial assessment risks, the total duration of the interventions beyond the initial assessment were rarely reported. When the intervention duration was reported, it reflected intervention components beyond the assessment and referral part of the intervention, such as periodic check-ins from a healthcare coordinator or continuing exercise and education classes. The vast majority of trials had interventions delivered individually. In a few cases, there was a group format for education or exercise sessions in addition to the individually directed intervention.^{72, 74, 80, 84, 90}

Intervention adherence. In general, most trials reported, in various degrees of detail, the percentage of participants who were referred to specialty services based on the initial falls risk assessment. Seventeen trials reported that 20 to 99 percent of participants attended the recommended referrals and/or implemented changes recommended by the referrals.^{49, 56, 59, 62, 63, 69, 70, 75, 77, 78, 80, 82, 84, 86, 87, 89, 90} Most commonly, the adherence in trials to recommendations was in the 60- to 70-percent range for any individual recommendation or referral. In one large multifactorial trial, however, adherence to some interventions, including medication review and environmental referrals, were generally low: 3.2 percent of those eligible for environmental assessment actually received a home safety assessment and 4.3 percent of those who qualified completed a visit with a pharmacist for medication review.^{47, 66} In the other large multifactorial trial, researchers found documented evidence of action for 36 percent of all treatments recommended in the multifactorial falls prevention intervention (e.g. referral to, or outcome of attendance at, other referrals).^{49, 51} In the multifactorial trials that included an exercise referral for

some or all participants, 23 to 74 percent attended some or all exercise classes or sessions.^{49, 59, 63, 80, 84}

Control groups. The majority (19 of 28) of trial control groups received no intervention or usual care.^{53, 54, 56-59, 62, 63, 69, 71-75, 77, 82, 85, 87, 89, 90} The remaining nine trials compared their intervention to a control group that received usual care plus minimal or attention control (pamphlet, social visit, brief fall-risk advice, letter).^{47, 49, 55, 70, 72, 78, 80, 84, 86}

Study Quality

Of the 28 trials, nine were rated good quality with low risk of bias in all domains (**Appendix A Figure 1**).^{47, 49, 56, 62, 74, 75, 84, 86, 89} Eighteen fair-quality trials^{53, 54, 57-59, 63, 69-73, 77, 78, 80, 82, 85, 87, 90} had moderate risk of bias in one or two domains and one trial⁵⁵ had moderate risk of bias in three domains. Five trials had moderate risk of bias for insufficient reporting of randomization or baseline confounding;^{55, 59, 73, 85, 90} five trials had moderate risk of bias for intervention deviations;^{55, 58, 59, 69, 82} and seven trials had moderate risk of bias for outcome measurement issues, typically recall of the falls outcome at longer than 1 month.^{53, 71, 73, 77, 78, 80, 90} Seven trials had high and/or differential attrition and missing data.^{54, 55, 63, 70, 72, 77, 87} The multifaceted and customized nature of these multifactorial interventions precluded analysis of intervention adherence rates. Nearly all trials used intention-to-treat analysis, where all randomized participants were included in the analysis regardless of their participation at the conclusion of the study. To ascertain falls, most trials (21 of 28 trials)^{47, 49, 53, 56-59, 62, 63, 69, 70, 72-75, 82, 84-87, 89} had the patient prospectively record falls on a calendar or in a diary, with or without additional confirmation (e.g., medical records or 3- to 6-month recall telephone calls). Six trials recorded falls by the patient's recall every 1 to 6 months,^{54, 55, 71, 77, 78, 80} and one study⁹⁰ recorded falls by the patient's recall at longer than 6 months and in hospital discharge summaries—however, we did not include the people with falls outcomes from this trial and only used their hospital documented fall-related injuries outcome.

Detailed Results

Falls

Meta-analysis of 20 multifactorial trials^{47, 49, 54-57, 59, 60, 63, 70, 72-74, 77, 78, 82, 84, 86, 89} (n=22,115) demonstrated a statistically significantly lower rate of falls in the multifactorial group versus the control group at the longest followup (6–28 months), although with substantial statistical heterogeneity (IRR, 0.84 [95% CI, 0.74 to 0.95]; $I^2=85.0\%$) (**Figure 10; Appendix E Table 4**). Absolute differences ranged from -6.77 falls per person-year (lower fall rate in the intervention group) to 1.31 falls per person-year (higher fall rate in the intervention group). In the control group, the rate of falls per person-year ranged from 0.38 to 7.68 events per person-year at the longest followup. Individual trials reported substantial variation in effect size, with wide confidence intervals and IRR point estimates, ranging from 0.39 (95% CI, 0.24 to 0.63)⁵⁴ to 1.13 (95% CI, 0.98 to 1.30).⁴⁹ Two trials particularly notable for much greater beneficial effect sizes were conducted by Close et al.⁵⁴ and Logan et al.,⁷⁴ with IRR point estimates of 0.39 and 0.45, respectively. These trials recruited participants from the ED⁵⁴ or an ambulance⁷⁴ following a fall; one had specific intervention protocols outlined in the publication,⁵⁴ and the other included

intensive interventions (six physical therapy sessions, 12 group sessions of supervised exercise or education on preventing falls, and up to 12 home sessions).⁷⁴

We explored heterogeneity by examining the number of falls by country, date of publication, recruitment setting, fall rate of the control group, recruitment inclusion criteria of unselected or increased risk of falls, mean age, followup period, and study quality (**Appendix E Table 5**). We were unable to explain the high heterogeneity by any single variable. Visual examination of the funnel plot for the 20 pooled trials (not included in this report) did not suggest a publication bias, and the Egger's test was not statistically significant ($p=0.17$).

People With a Fall and People With Recurrent Falls

Meta-analysis of the 26 multifactorial trials^{47, 49, 53-59, 62, 63, 69, 70, 72-75, 77, 78, 80, 82, 84-87, 89} ($n=23,626$) reporting the number of people with a fall demonstrated no statistically significant difference at the longest followup (6–28 months) in the multifactorial group compared to the control group (RR, 0.96 [95% CI, 0.91 to 1.02]; $I^2=48.2\%$) (**Figure 11; Appendix E Table 6**). Three trials^{54, 74, 78} reported a statistically significant modest reduction in people experiencing a fall (RR range, 0.62 to 0.84). The remaining 23 trials^{47, 49, 53, 55-59, 62, 63, 69, 70, 72, 73, 75, 77, 80, 82, 84-87, 89} showed no statistically significant difference in the number of people experiencing a fall, with one outlier study by Ciaschini et al.⁵³ reporting a nonsignificant increased risk of experiencing a fall among intervention participants versus the control (RR, 1.51 [95% CI, 0.88 to 2.60]). This trial enrolled the youngest population (mean age, 71.9 years), which was recruited from the ED after a fall. Approximately 40 percent of the trials (10 of 26) showed point estimates greater than 1.0, indicating that the control group had fewer people experiencing a fall, although none of the point estimates were statistically significant.^{53, 59, 62, 63, 75, 77, 82, 84, 87, 89} The percentage of people experiencing a fall in the control group ranged from 17.0 to 94.1 percent.

Similar to people with one or more falls, pooled analysis of people with two or more falls demonstrated no statistically significant difference between the multifactorial and control groups at 12 to 28 months (RR, 0.99 [95% CI, 0.94 to 1.04]; $I^2=0\%$; $k=11$; $n=14,471$) (**Figures 11 and 12; Appendix E Table 6**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

The association of multifactorial interventions with the risk of injurious falls and fall-related fractures was inconsistent among trials. Approximately 40 percent ($k=12$; $n=10,563$) of the 28 multifactorial trials reported falls resulting in injuries or resulting in medical care at 6 to 44 months (**Figure 13; Appendix E Table 7**).^{47, 59, 62, 72, 73, 75, 77, 84, 86, 89} The definition of “injuries” varied among trials, with some capturing only serious injuries (e.g., fractures, lacerations requiring sutures, head injuries requiring hospitalization) or injuries requiring medical care, and others including minor injuries as well (e.g., soft tissue bruises). Pooled results of these 12 trials showed no statistically significant association between multifactorial interventions and the number of injurious falls (IRR, 0.92 [95% CI, 0.84 to 1.01]; $I^2=21.8\%$). The IRRs in these 12 trials ranged from 0.51 (95% CI, 0.13 to 2.05) to 1.09 (95% CI, 0.87 to 1.35). Seven trials reported number of fall-related fractures ($n=15,211$), showing no statistically significant association between multifactorial interventions and fall-related fractures (IRR, 1.01 [95% CI, 0.81 to 1.26]; $I^2=34.0\%$). Individual IRRs ranged from 0.76 (95% CI, 0.35 to 1.64) to 1.50 (95%

CI, 0.80 to 2.82) (**Figure 14; Appendix E Table 8**). Three trials^{49, 62, 89} reported a nonsignificant increase in fracture risk in the intervention group.

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

Meta-analysis of 13 trials^{47, 54-56, 69, 71, 75, 77, 82, 86, 89, 90} (n=13,460) showed no difference in people with an injurious fall in the multifactorial group compared to the control group at the longest followup (9–28 months) (RR, 0.92 [95% CI, 0.83 to 1.02]; $I^2=47.3%$) (**Figure 15; Appendix E Table 9**). Seven trials^{47, 49, 53, 57, 80, 82, 85} (n=13,912) reported the number of people with a fall-related fracture or any fracture at 6 to 44 months of followup (control group prevalence range, 0.7% to 22%). Overall, there was no statistically significant difference between the multifactorial and control groups and people with a fracture (RR, 0.86 [95% CI, 0.60 to 1.24]; $I^2=49.0%$) (**Figure 16; Appendix E Table 10**). RR point estimates ranged from 0.52 to 1.27 in the seven trials with relatively few events, which made estimates unstable.^{47, 49, 53, 57, 80, 82, 85}

Mortality

Pooled analysis of 24 trials^{47, 49, 53, 54, 56, 57, 59, 63, 69-71, 73-75, 77, 78, 80, 82, 84-87, 89, 90} (n=21,596) showed no difference in all-cause mortality at 6 to 42 months in the multifactorial group compared to the control group (RR, 1.01 [95% CI, 0.88 to 1.17]; $I^2=0%$) (**Figure 17**). Individual study results varied widely, with RRs ranging from 0.6 to 8.3 and wide confidence intervals reflecting a relatively uncommon outcome with few events in most trials (**Appendix E Table 11**); not surprisingly, none of the relative comparisons were statistically significant as the trials were not intended nor powered to affect mortality outcomes.

Other Outcomes

Qualitative analysis demonstrates no effect on hospitalization, institutionalization, IADLs, or QOL, but these outcomes were reported in just a small proportion of multifactorial trials (**Appendix E Tables 12–14**).

Harms

In general, adverse events were sparsely reported. When reported, they were rare, minor, and associated with the exercise components of the multifactorial interventions. Five trials (n=4,199) reported harms associated with multifactorial interventions (**Appendix E Table 15**).^{49, 62, 69, 84, 86} One trial⁶⁹ reported no adverse events in the intervention or control groups. Four trials^{49, 62, 84, 86} reported adverse events in the intervention groups but did not provide data from the control group for comparison. One of these trials⁸⁴ reported three falls without injuries during the exercise sessions of the interventions, one reported back pain that either restricted ADLs for two or more days or resulted in medical attention in two intervention participants,⁶² one reported musculoskeletal complaints in 10 intervention participants,⁸⁶ and the other reported no adverse events in the intervention group.⁴⁹

Exercise Interventions

Summary of Results

We identified 37 trials (n=16,117) of exercise interventions to prevent falls in community-dwelling older adults (**Figure 5**). The trials generally included multiple exercise components, and the exercise interventions were primarily conducted in a supervised group setting. Fifty-eight percent of participants in these trials were determined to be at high risk for falls; fall history and hospital or ED admissions were the most common risk factor (alone or in combination) used for trial recruitment. Pooled analysis from 29 trials (n=14,475) demonstrated that exercise interventions were associated with a significant reduction in the rate of incident falls at the longest followup (6–24 months) (IRR, 0.85 [95% CI, 0.75 to 0.96]; $I^2=82.7\%$). Meta-analysis of 25 exercise RCTs (n=13,384) demonstrated that exercise is associated with a significantly reduced risk of people falling at the longest followup (6–24 months) (RR, 0.92 [95% CI, 0.87 to 0.98]; $I^2=24.3\%$). Exercise interventions were also associated with a reduction in the number of injurious falls, but people with an injurious fall and fall-related fractures did not show a statistically significant association. Pooled analysis of 15 RCTs (n=10,461) showed no significant association between exercise and all-cause mortality at longest followup (12–85 months) (RR, 0.87 [95% CI, 0.71 to 1.06]; $I^2=0.0\%$). Qualitative analysis demonstrates no effect on people with a hospitalization or ED visit (k=1), people institutionalized (k=3), IADLs (k=6), or QOL (k=13), but the outcomes are reported in a small proportion of the exercise trials. Conclusions about the harms of exercise interventions are limited by only half of the trials reporting harms (k=19; n=11,087), incomplete reporting of adverse events, and rare event rates. Seven trials reported no differences in serious harms. Harms, including musculoskeletal complaints associated with exercise, were generally minor.

Characteristics of Included Studies

We included 37 trials (in 70 articles) of exercise interventions (n=16,117).^{22, 49-51, 64, 92-156} One trial from the previous review was excluded because the control group was considered too intense¹⁵⁷ and two trials were excluded^{158, 159} because falls were not cumulatively measured (e.g., only from 12 to 24 months, rather than from baseline to 24 months).

Study Characteristics

We identified 32 fair-quality^{96, 98, 101-103, 107-109, 113, 115, 118-120, 122-129, 133, 134, 136-138, 140, 142, 146, 148, 149, 155} and five good-quality^{49, 106, 117, 151, 153} RCTs with a primary or secondary aim of examining the effectiveness of exercise on reducing falls and/or fall-related injuries at 6 to 85 months of followup (**Table 3; Appendix F Table 1**). Trials were primarily conducted outside of the United States, with only five trials taking place in the United States,^{98, 103, 120, 126, 146} 20 in Europe,^{49, 107, 109, 113, 115, 117-119, 122, 123, 125, 128, 133, 136, 138, 140, 142, 148, 149, 151} 11 in Australia or New Zealand,^{96, 101, 102, 106, 108, 124, 129, 134, 137, 153, 155} and one in Singapore.¹²⁷ Trial sizes varied widely, ranging from 35¹³⁶ to 6,502⁴⁹ (participants randomized to exercise and control arms for our analysis). One very large trial was unusual in that it tested screening and exercise intervention; of those randomized into the active exercise arm, only those who screened as intermediate or high risk for falls actually received the exercise intervention.⁴⁹

Population Characteristics

The most common target population ages for inclusion were 60 years or older^{101, 117, 118, 120, 126, 129, 137, 146, 153} or 65 years or older,^{96, 103, 109, 125, 127, 128, 136, 138, 140, 142, 148, 155} although two trials did recruit participants from the oldest old age groups (≥ 80 ¹⁰² or ≥ 85 ¹²³ years) (**Table 3; Appendix F Tables 1 and 2**). The mean age ranged from 68 years¹¹⁷ to 88 years.¹²³ Ten of the trials were conducted exclusively with women,^{102, 103, 107, 113, 115, 117, 118, 125, 133, 151} while in only three trials less than half of the participants were female.^{109, 119, 128} The majority of participants in the remaining trials were women.^{49, 96, 98, 101, 106, 108, 120, 122-124, 126, 127, 129, 134, 136-138, 140, 142, 146, 148, 149, 153, 155} Only seven trials reported race and ethnicity, and in all but one of these trials,¹²⁰ participants were almost exclusively White.^{49, 101, 109, 119, 140} Eighteen trials reported a measure of socioeconomic status—primarily education.^{49, 98, 101, 106, 107, 109, 119, 120, 122, 127, 128, 136, 140, 146, 148, 149, 153, 155} Trials reported socioeconomic status differently, making it difficult to summarize this measure, but most participants who reported socioeconomic status had achieved at least a high school or equivalent education. All trials recruited community-dwelling adults. Nineteen trials recruited from a community or population-based setting only (e.g., population-based registries),^{103, 106-108, 113, 115, 117, 120, 123, 127, 129, 133, 136, 142, 146, 148, 151, 153, 155} 13 trials recruited from a clinic setting (with or without additionally using community-based recruitment),^{49, 96, 101, 102, 109, 119, 122, 125, 126, 134, 138, 140, 149} two trials recruited from a hospital or ED only,^{118, 137} two trials recruited from insurance registries,^{98, 128} and one trial recruited from a retirement village.¹²⁴

Three trials recruited participants with mild to moderate cognitive impairment^{101, 109, 119} and one trial was limited to participants with established Alzheimer's disease.¹²⁸ Eighteen trials excluded participants with mild to severe cognitive impairment.^{101, 103, 106, 115, 120, 124, 127, 129, 133, 136, 137, 140, 142, 146, 149, 151, 153, 155} Nine trials excluded participants who were not ambulatory without the use of an assistive device.^{103, 106, 115, 118, 120, 125, 126, 142, 148, 153, 155}

Twenty trials required all participants to be at increased risk for falls.^{96, 103, 107, 115, 118, 122, 123, 125-128, 136-138, 140, 142, 146, 148, 149, 151} Fifteen trials^{49, 98, 101, 102, 106, 108, 117, 119, 120, 124, 129, 133, 134, 153, 155} included populations with 6 to 59 percent of participants at increased risk for falls. The definitions of increased risk for falls varied amongst the trials (**Figure 18; Appendix F Table 2**). Most of the trials (22 of 37 trials) included history of falls as either the sole criterion^{108, 119, 120, 124, 129, 134, 151, 153, 155} or one of several risk factors.^{49, 98, 101, 102, 106, 117, 122, 123, 125, 128, 136, 138, 148} Other common risk factors for falls included a hospital or ED visit,^{126, 137, 146} physical function testing thresholds,^{49, 96, 107, 122, 123, 128, 136, 138, 140, 148} osteopenia or osteoporosis,^{103, 115, 118, 125, 133} and frailty.^{127, 128, 142, 148} The baseline measures of health or functional status reported in the trials varied. The measures included living alone, experiencing a fall in the past year, physical function, ADL or IADL baseline score, QOL or self-reported health rating, number of medications, and other factors. Overall, at baseline, about 38 percent of participants in the included trials reported falling in the past year (k=12 reported people with one or more falls in the previous 12 months). Overall, among the 35 trials reporting the proportion of those at risk, 58 percent of participants were at increased risk of falling.

Intervention Details

The 37 exercise interventions varied along several dimensions: supervision, individual versus group exercise, duration, frequency, and exercise components (**Figures 19 and 20, Appendix F**

Table 3).

Supervision. Most of the intervention groups attended supervised group classes with an additional unsupervised individual component. Three trials,^{101, 106, 155} exceptionally, only utilized independent and unsupervised exercise sessions. Participants in the remaining 34 exercise trials were supervised during all or part of the intervention either in group classes,^{96, 98, 103, 107, 108, 113, 115, 117-120, 122-124, 126, 127, 136, 138, 140, 146, 148, 151, 153} individual sessions,^{49, 102, 109, 125, 134, 137, 142, 149} or both.^{128, 133} Supervision was conducted by a specialized exercise instructor,^{49, 96, 103, 107, 113, 119, 120, 122, 124, 133, 138, 140, 148, 153} physical or occupational therapist,^{49, 102, 108, 109, 115, 117-119, 123, 125, 126, 128, 129, 133, 136-138, 142, 149, 151} health professional,^{127, 134, 146} or unspecified supervisor.⁹⁸ Participants in the unsupervised trial were self-directed using a written program. One trial had entirely independently performed exercise programs with coaching via telephone followup.¹⁵⁵

Format. Twenty-four interventions included group exercise alone or in combination with home-based exercise.^{96, 98, 103, 107, 108, 113, 115, 117-120, 122-124, 126-128, 136, 138, 140, 146, 148, 151, 153} Seven interventions included only supervised individual-based exercise.^{49, 102, 109, 125, 134, 142, 149} One trial's exercise interventions (group and individual sessions) took place in a gym setting.¹³³

Duration. Exercise programs ranged from 2 months¹²⁶ to 30 months.¹¹⁵ The most common duration was 12 months in 15 trials.^{96, 102, 109, 113, 119, 120, 124, 125, 128, 134, 137, 140, 142, 149, 155}

Frequency. Supervised exercise sessions were typically scheduled once to three times per week. The most common frequency was twice per week^{117-120, 122, 124, 127, 128, 133, 140, 142, 151} or three times per week.^{98, 103, 113, 125, 126, 136, 146}

Exercise components. Most trials utilized multiple exercise components, including gait, balance, and functional training; strength and resistance; flexibility; tai chi/3-D training; general physical activity; and endurance (**Figure 20; Appendix F Table 3**). Nearly all exercise interventions included gait, balance, and functional training (30 of 37 trials). Two-thirds of the trials (25 of 37 trials)^{49, 96, 98, 101, 102, 108, 109, 113, 115, 117-119, 125-128, 133, 134, 137, 138, 140, 142, 146, 149, 151} additionally included a strength and resistance training component and approximately one-fifth (8 of 37 trials)^{102, 107, 108, 117, 123, 126, 136, 142} additionally included flexibility training. Thirteen trials^{49, 98, 102, 109, 119, 123, 125, 129, 134, 138, 142, 149, 155} included a general physical activity component. Six trials^{96, 98, 102, 119, 128, 142} included an endurance component. Six trials^{103, 120, 122, 124, 133, 153} included 3-D exercise like dance or tai chi. Thirteen^{49, 98, 102, 109, 119, 123, 125, 129, 134, 138, 142, 149, 155} of the trials employed general physical activity alone or in combination with another exercise component. Nine trials^{102, 109, 119, 129, 137, 138, 140, 149, 155} included lifestyle behavioral counseling including coaching and/or motivational interviewing.

Intervention adherence. In general, most of the participants were adherent to the exercise interventions. Thirty-five trials reported a measure of adherence or compliance with the exercise intervention, but the measures used to report adherence varied.^{49, 96, 98, 101-103, 106, 107, 109, 113, 115, 117-120, 122-129, 133, 134, 136-138, 140, 142, 146, 148, 149, 151, 153} Twelve trials reported 56 to 95 percent of sessions were attended. Three trials reported the mean number of sessions attended. The remaining 20 trials reported 42 to 94 percent were adherent based on varying definitions, such as the

proportion attending all sessions, the proportion attending at least 50 percent of sessions, or those still exercising at 12 months.

Control groups. Control groups in the trials were instructed to maintain usual activity levels and/or received usual care, no intervention, minimal written information, or other minimal education about health or preventing falls, or a social visit.

Study Quality

Of the 37 trials, five were rated good quality with low risk of bias in all domains (**Appendix A Figure 2**).^{49, 106, 117, 151, 153} Thirty-two fair-quality trials had moderate risk of bias in one or two domains and three trials^{102, 109, 123} had moderate risk of bias in three domains. Twenty-one trials^{96, 98, 102, 107-109, 113, 115, 118, 124-126, 128, 129, 133, 134, 136-138, 146, 149} had moderate risk of bias due to insufficient reporting of randomization procedures or baseline characteristics differences. Two trials^{102, 123} had moderate risk of bias for intervention deviations. Eight trials^{103, 109, 119, 123, 127, 136, 140, 142} had moderate risk of bias for outcome measurement issues, typically recall of the falls outcome at longer than 1 month. Eighteen trials^{96, 98, 101, 102, 107, 109, 115, 120, 122, 123, 126, 134, 138, 140, 146, 148, 149, 155} had high attrition, differential attrition, or missing data. To ascertain falls, most trials (24 of 36 trials)^{49, 98, 102, 106-109, 117, 122, 124-126, 128, 129, 133, 134, 137, 138, 146, 148, 149, 151, 153, 155} had the patient prospectively record falls on a calendar or in a diary or telephone text messaging, with or without additional confirmation (e.g., medical records or 3- to 6-month recall telephone calls). Twelve trials recorded falls by patient's recall every 1 to 6 months,^{96, 101, 103, 115, 118-120, 123, 127, 136, 140, 142} and two studies^{113, 133} recorded falls resulting in injuries or fractures from administrative or hospital discharge records.

Detailed Results

Falls

Meta-analysis of 29 exercise trials (n=14,475) reporting the outcome of falls demonstrated a significant reduction in the rate of incident falls at the longest followup (6–24 months) in the exercise group compared to the control group, with substantial statistical heterogeneity (IRR, 0.85 [95% CI, 0.75 to 0.96]; $I^2=82.7%$) (**Figure 21; Appendix F Table 4**).^{49, 96, 102, 103, 106-109, 115, 118-120, 122, 124, 125, 128, 129, 134, 136-138, 140, 142, 146, 149, 153, 155} The baseline fall rate of control groups varied widely, from 0.26 per person-year¹²⁰ to 5.0 per person-year.¹⁰³ Individual trials reported substantial variation in effect and effect size, with IRR point estimates ranging from 0.47 in favor of the intervention group¹⁰² to 1.83 in favor of the control group.¹⁴⁹

Two trials^{137, 149} were notable for the statistically significantly higher fall rate in the exercise group compared to the control group (IRR, 1.43 [95% CI, 1.06 to 1.92] and 1.83 [95% CI, 1.23 to 2.74]). The first study¹³⁷ recruited patients discharged from geriatric care, rehabilitation, and orthopedic wards at any of four public hospitals in Sydney, Australia. Participants had a mean age of 81 years, and the authors note that their recruited population was less healthy than those of other trials reporting a beneficial effect of exercise on falls. The intervention was an individually based program designed to improve balance; participants received instruction from a physical therapist and were asked to do the exercises at home six times a week. At 12 months, 57 percent

were participating in exercise sessions and 29 percent were no longer exercising. The second trial¹⁴⁹ was set in Sweden where recruitment required all participants to use walking aids and/or home help services; participants had a mean age of 83 years, and the control group falls rate was low relative to the other trials. The intervention was a 12-month independent home-based Otago Exercise Program with home visits and telephone support incorporating behavior change. The authors note that long winters could have affected the ability of older adults to take outdoor walks (only 52% of intervention participants were walking outdoors twice per week) and lessened the impact of the intervention. They also note their recruited population may have been more frail than other trials reporting a beneficial effect of the Otago Exercise Program on falls.

We explored heterogeneity by examining country where the trial took place, publication year, study quality, recruitment setting, selective recruitment for increased fall risk, control group event rate, mean age, duration of followup, specific exercise components (e.g., strength/resistance training), presence of a behavior change component as part of the intervention, presence of cognitive task exercises as part of the intervention, group versus individual exercise sessions, and intervention duration (**Appendix F Table 5**). However, we were unable to explain the high heterogeneity by any single variable after adjusting for multiple comparisons. Visual examination of the funnel plot for the 29 pooled trials (not included in this report) did not suggest a publication bias, and the Egger's test was not statistically significant ($p=0.68$).

People With a Fall and People With Recurrent Falls

Meta-analysis of 25 exercise trials ($n=13,384$) reporting the number of people with a fall demonstrated a reduced risk of falling at the longest followup (6–24 months) in the exercise group compared to the control group (RR, 0.92 [95% CI, 0.87 to 0.98]; $I^2=24.3\%$) (**Figure 22; Appendix F Table 6**).^{49, 96, 98, 101, 102, 106-108, 117, 119, 120, 122, 123, 125-127, 129, 137, 138, 148, 149, 153, 155}

Individual trials reported substantial variation in effect and effect size, with wide and overlapping confidence intervals and RR point estimates ranging from 0.40¹¹⁷ to 1.66.¹²⁰ The results from two trials were consistent with a statistically significant reduction in the number of people with a fall in the exercise group compared to the control group (14% to 60% reduced risk).^{107, 117} One trial¹³⁷ reported a statistically significant increase in the number of people with a fall in the exercise group compared to the control group (RR, 1.38 [95% CI, 1.11 to 1.72]) and two reported a nonstatistically significant association between exercise and people with a fall.^{101, 120} The remaining trials showed a nonsignificant benefit in terms of fewer people with a fall in the exercise group than in the control group.^{49, 96, 98, 102, 106, 108, 119, 122, 123, 125-127, 133, 138, 148, 149, 153, 155}

Nine trials ($n=8,502$) reporting people with recurrent falls (two or more falls) showed no statistically significant association between exercise interventions and the number of people experiencing recurrent falls (two or more falls) (RR, 0.77 [95% CI, 0.57 to 1.04]; $I^2=45.0\%$) (**Figure 23; Appendix F Table 6**).

We explored heterogeneity by examining the country where the trial took place, publication year, study quality, recruitment setting, selective recruitment for increased fall risk, proportion of control group with a fall, mean age, duration of followup, specific exercise components (e.g., strength/resistance training), presence of a behavior change component as part of the intervention, presence of cognitive task exercises as part of the intervention, group versus

unsupervised individual exercise sessions, and intervention duration (**Appendix F Table 7**). However, we were unable to explain the high heterogeneity by any single variable. Visual examination of the funnel plot for the 25 pooled trials (not included in this report) did not suggest a publication bias, and the Egger's test was not statistically significant ($p=0.12$).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

Meta-analysis of 12 exercise trials ($n=3,984$) reporting the outcome of injurious falls demonstrated a significant reduction in the rate of injurious falls at the longest followup (6 to 60 months) in the exercise group compared to the control group (IRR, 0.84 [95% CI, 0.74 to 0.95]; $I^2=14.6\%$) (**Figure 24; Appendix F Table 8**).^{96, 106-108, 113, 129, 134, 137, 138, 149} Specific definitions for fall-related injury outcomes were reported as falls resulting in injuries,^{96, 106, 108, 113, 129, 134, 151} fall-related injuries,^{133, 138, 149} falls resulting in serious injuries,¹⁰⁷ and falls resulting in medical care.¹³⁷ Four of the trials reported statistically significantly reduced rates of fall-related injuries,^{106, 113, 138} with significant effects ranging from 0.46¹⁵¹ to 0.80.¹¹³ Two trials^{137, 149} reported a nonstatistically significant increase in the rate of injuries among the intervention group compared to the control group (IRR, 1.14 [95% CI, 0.76 to 1.72] and 1.35 [95% CI, 0.76 to 2.42]).

Eight trials ($n=8,537$) reporting fall-related fractures show no statistically significant difference between the intervention and control groups (IRR, 0.81 [95% CI, 0.57 to 1.15]; $I^2=39.1\%$) (**Figure 25; Appendix F Table 9**).^{49, 113, 115, 118, 119, 128, 137}

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

Pooled results from nine trials ($n=3,924$) showed no statistically significant association between exercise interventions and a reduction in people experiencing an injurious fall at 6 to 60 months of followup (RR, 0.90 [95% CI, 0.79 to 1.02]; $I^2=26.7\%$) (**Figure 26; Appendix F Table 10**). Relative risks among the exercise group ranged from 0.61¹¹³ to 1.22.¹⁴⁹

Four trials ($n=7,994$) showed mixed results for people with fall-related fractures, with two trials reporting nonsignificant increased risk (RR, 1.13 [95% CI, 0.84 to 1.51] and 1.95 [95% CI, 0.22 to 17.28]),^{49, 119} one trial reporting a nonstatistically significant decreased risk (RR, 0.62 [95% CI, 0.38 to 1.01]),¹³³ and one trial reporting statistically significant decreased risk (RR, 0.36 [95% CI, 0.15 to 0.89])¹¹⁵ at 6 to 30 months of followup (**Appendix F Table 11**).

Mortality

Pooled analysis of 15 trials ($n=10,461$) showed no significant association with all-cause mortality at longest followup (12–85 months) in the exercise group compared to the control group (RR, 0.87 [95% CI, 0.71 to 1.06]; $I^2=0.0\%$) (**Figure 27; Appendix F Table 13**). Individual study results showed no statistically significant differences, and RRs varied widely (0.16^{96, 134} to 1.30¹¹⁹), with wide confidence intervals. The few deaths in most trials made estimates unstable.

Other Outcomes

Qualitative analysis demonstrates no effect on people with a hospitalization or ED visit (k=1), people institutionalized (k=3), IADLs (k=6), or QOL (k=13). Of the 13 trials reporting QOL,^{49, 103, 106, 109, 119, 120, 124, 129, 137, 140, 149, 151, 155} five measured QOL using the SF-12 or SF-36,^{49, 103, 120, 124, 137} six measured QOL using the EuroQol 5D visual analog scale (EQ-5D VAS) or EuroQol 5D 3-levels (EQ-5D-3L),^{106, 109, 119, 129, 140, 149} and two measured QOL using different scales (Liepad QOL¹⁵¹ and Australian QOL¹⁵⁵). These trials demonstrated no association between exercise interventions and mean differences in QOL. The remaining outcomes were reported in a small proportion of the exercise trials and results are shown in the appendix (**Appendix F Tables 14–16**).

Harms

Half of the trials reported harms (19 of 37), with generally minor musculoskeletal side effects being most common; serious side effects were generally very rare. Overall, the description of harms ascertainment was sparse; measurement varied from capturing spontaneous, self-reported comments to repeated questionnaires asking about harms. Nineteen trials (n=6,985)^{49, 101, 106, 107, 113, 119, 120, 124, 125, 127, 129, 133, 137, 138, 140, 142, 148, 149, 151} reported on harms in the intervention groups at 6 to 24 months (**Appendix F Table 17**). Five of these trials^{119, 120, 140, 148, 151} also reported harms in the control group for comparison.

Seventeen trials^{49, 101, 106, 107, 113, 119, 124, 125, 127, 129, 133, 137, 138, 142, 148, 149, 151} reported any adverse events occurring during the exercise intervention sessions, ranging from 0 percent^{49, 124, 125, 138, 148} to 58 percent.¹⁴² These adverse events directly related to the exercise intervention were largely musculoskeletal discomfort and pain symptoms, particularly in the trial reporting high rates of adverse events (one trial¹⁴² reporting 58% in the intervention group and no adverse event reporting in the control group). Zero percent¹⁴⁹ to 11 percent¹⁴² reported falls during the intervention exercise program. Serious adverse events related to the exercise intervention were measured in seven trials,^{49, 101, 107, 119, 133, 140, 151} with half of these trials^{49, 101, 133, 151} reporting zero serious adverse events related to the intervention and one trial¹¹⁹ reporting less than 1 percent serious adverse events related to the exercise (2/281). One trial¹⁰⁷ reported a fall-related wrist fracture (1/352). One trial reported angina pectoris-like chest pain (2/457) and pre-syncope symptoms (2/457) during the intervention.¹³³ Another trial¹⁴⁰ reported overall adverse events as 18 percent in the intervention group and 12 percent in the control group; however, only one adverse event (1/334), a hip fracture, was attributed to the exercise session.

Exercise + Education Interventions

Summary of Results

The evidence examining the effectiveness of exercise in combination with education interventions to prevent falls consists of four trials (n=1,047). In three of four trials, 100 percent of the participants were at increased risk for falling; in the fourth trial, 27 percent were at increased risk. Two trials recruited only participants with osteoporosis or osteopenia and the other two trials used fall¹⁶⁰ or fracture history to determine risk. Qualitative analysis showed

overall no effect on falls (IRR range, 0.61 [95% CI, 0.40 to 0.94] to 1.08 [95% CI, 0.70 to 1.67]), people with a fall (RR range, 0.87 [95% CI, 0.57 to 1.34] to 1.07 [95% CI, 0.57 to 2.00]), or falls resulting in injury or medical care (IRR range, 0.58 [95% CI, 0.33 to 1.01] to 1.02 [0.61 to 1.69]). The evidence on mortality was scant (RR, 0.67 [95% CI, 0.11 to 3.97] and 1.0 [95% CI, 0.06 to 15.72]). Conclusions about the harms of exercise plus education interventions are limited by the lack of control group comparison. While musculoskeletal pain was common, serious adverse events were very rare. Overall, the evidence is limited by few trials, imprecision demonstrated by wide confidence intervals, and largely insufficient evidence.

Characteristics of Included Studies

We included four trials (in four articles) of exercise plus education interventions (n=1,047).¹⁶⁰⁻¹⁶⁶ Of the four trials, one was included in the previous review¹⁶⁰ and three were newly identified.^{161, 162, 166}

Study Characteristics

We identified one fair-quality¹⁶⁶ and three good-quality¹⁶⁰⁻¹⁶² RCTs (n=1,047) examining the effectiveness of exercise plus educational interventions on reducing falls and/or fall-related injuries at 12 to 18 months of followup (**Table 3; Appendix G Table 1**). One trial was conducted in the United States,¹⁶⁰ two in Australia,^{161, 162} and one in the Netherlands.¹⁶⁶ Trial sizes ranged from 96¹⁶⁶ to 453¹⁶⁰ participants randomized to exercise plus education and control arms (for our analysis).

Population Characteristics

All trials recruited community-dwelling adults ages 60 to 65 years or older (**Table 3; Appendix G Tables 1 and 2**). The mean age ranged from 67 years¹⁶² to 78 years.¹⁶¹ The majority of the trials' participants were women, ranging from 73 percent¹⁶² to 94 percent.¹⁶⁶ Only one trial reported race and ethnicity and participants were almost exclusively White.¹⁶⁰ The trials did not report measures of socioeconomic status. One trial recruited participants from hospitals;¹⁶¹ two trials recruited from the community through advertisements;^{160, 162} and one trial had multiple strategies to identify those with osteoporosis/osteopenia through rheumatology departments, the Osteoporosis Patient Council, and local newspapers.¹⁶⁶

Three of the four trials solely recruited participants at increased risk for falls with the risk factors being history of fracture and/or osteopenia/osteoporosis (**Figure 28; Appendix G Table 2**).^{161, 162, 166} The fourth trial did not exclusively recruit based on fall risk; however, 27 percent of the participants in that trial reported experiencing a fall in the previous 3 months.¹⁶⁰ The baseline measures of health or functional status reported in the trials demonstrated a wide variation. For example, the number of medications and comorbidities varied widely; the number of mean medications varied from 2.5¹⁶⁶ to 6.5.¹⁶¹

Intervention Details

The four exercise plus education interventions varied along several dimensions: supervision, individual versus group exercise, duration, frequency, exercise components, and inclusion of

behavioral counseling (**Appendix G Table 3**). All included exercise plus education and two of these trials additionally included a behavioral counseling component with health coaching and/or motivational interviewing.^{161, 162} One trial also communicated results with the participants' primary care providers.¹⁶⁰

Education intervention. The educational components of these programs typically included multiple sessions focused on fall prevention with or without education about osteoporosis. The educational components varied in intensity and included: a one-hour education class each month for 12 months;¹⁶⁰ three educational seminars over 18 months;¹⁶² seven two-hour group education sessions over 12 months;¹⁶¹ and 11 sessions over 5.5 weeks.¹⁶⁶

Exercise supervision/individual versus group. Three of the trials^{160, 162, 166} had supervised group sessions, while one trial¹⁶¹ had supervised individual sessions plus self-directed prescribed exercise. Supervision was conducted by a specialized exercise instructor,^{160, 162} physical therapist,¹⁶¹ or occupational therapist.¹⁶⁶

Exercise frequency and duration. Supervised exercise sessions were scheduled two¹⁶⁶ to three^{160, 162} times per week,^{160, 162} with durations ranging from 1 month¹⁶⁶ to 18 months.¹⁶²

Exercise components. All trials included gait, balance, and functional training as well as strength/resistance training. Two of the trials additionally included flexibility^{160, 162} and two trials included general physical activity.^{160, 166}

Control Groups. Control groups received usual care^{161, 166} or a minimal intervention.^{160, 162}

Study Quality

Three exercise plus education trials were good quality, with low risk of bias in all domains (**Appendix A Figure 3**).¹⁶⁰⁻¹⁶² One trial had a low risk of bias in all domains except was rated to have a moderate risk of bias in the randomization/confounders domain based on scant baseline characteristics reporting.¹⁶⁶ All four trials used calendar diaries for falls ascertainment.

Detailed Results

Falls

Only one of the trials—a 1-month intervention in participants with osteopenia/osteoporosis—showed a statistically significant association between the intervention and reduction in the number of falls (IRR, 0.61 [95% CI, 0.40 to 0.94]) (**Figure 29; Appendix G Table 4**).¹⁶⁶ The remaining three trials reported nonsignificant results with wide confidence intervals and IRRs ranging from 0.75 (95% CI, 0.52 to 1.09)¹⁶⁰ to 1.08 (95% CI, 0.70 to 1.67).¹⁶²

People With a Fall and People With Recurrent Falls

None of the four trials reported a statistically significant association between the intervention and people with one or more falls. Confidence intervals were wide and point estimates for the RRs

ranged from 0.87 (95% CI, 0.57 to 1.34)¹⁶⁶ to 1.07 (95% CI, 0.57 to 2.00) (**Figure 30; Appendix G Table 5**).¹⁶²

Two trials reported people experiencing recurrent falls,^{161, 162} with no significant differences between the intervention and control groups (RR, 1.00 [95% CI, 0.65 to 1.53] and 1.59 [95% CI, 0.67 to 3.79]) (**Figure 31; Appendix G Table 5**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

Three trials reported falls resulting in injuries or medical care, showing no significant differences, with IRRs ranging from 0.58 (95% CI, 0.33 to 1.01) to 1.02 (95% CI, 0.61 to 1.69)^{160, 161, 166} (**Figure 32; Appendix G Table 5**). Two trials^{161, 166} reported fall-related fractures, also showing no significant differences between the intervention and control groups (IRR, 0.64 [95% CI, 0.30 to 1.35] and 0.32 [95% CI, 0.03 to 3.07]) (**Appendix G Table 6**).

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

No trials reported people with a fall resulting in injury, medical care, or fracture.

Mortality

Two of the trials^{160, 162} reported no statistically significant differences in mortality, with RRs of 0.67 (95% CI, 0.11 to 3.97) and 1.00 (95% CI, 0.06 to 15.72), with wide confidence intervals. The few deaths in most trials made estimates imprecise (**Figure 33; Appendix G Table 7**).

Other Outcomes

One trial (N=336) reported no statistically significant effect of the exercise plus education trials on falls requiring hospitalizations.¹⁶¹ IADLs, institutionalizations, and QOL were not reported in any of these trials (**Appendix G Table 8**).

Harms

All four trials (n=522 analyzed in the intervention group only) reported adverse events associated with the intervention but none reported adverse events in the control group for comparison^{160-162, 166} (**Appendix G Table 9**). Two trials reported no adverse events.^{160, 166} The most common complaints in the other two trials were musculoskeletal^{161, 162} (foot, knee, shoulder pain) and many were related to pre-existing injuries.¹⁶² A total of one compression fracture,¹⁶¹ one fracture complication,¹⁶¹ and one wrist fracture¹⁶² were the most serious, yet rare, events that occurred.

Exercise + Environment Interventions

Summary of Results

We identified three trials (n=935) examining the effectiveness of interventions combining exercise and an environment assessment with or without modifications (i.e., a single home visit to reduce home hazards) in older adults of varying risk. There is limited evidence based on the

three trials whether exercise plus environment interventions reduce falls and fallers, and meta-analysis was not possible. There appeared to be no statistically significant effect of the interventions on people with a fall (RR range, 0.81 [95% CI, 0.60 to 1.08] to 0.99 [95% CI, 0.82 to 1.19]). The evidence was inconclusive for the number of falls (IRR, 0.73 [95% CI, 0.60 to 0.90] and 0.78 [95% CI, 0.57 to 1.07]), injurious falls or falls resulting in medical care (IRR, 0.88 [95% CI, 0.67 to 1.15] and 1.18 [95% CI, 0.76 to 1.83]), people with an injurious fall (RR, 0.63 [95% CI, 0.40 to 0.98]), people with fall-related fracture (RR, 1.08 [95% CI, 0.45 to 2.59]), people hospitalized or who visited the hospital/ED (RR, 1.46 [95% CI, 0.81 to 2.64]), mortality (RR 0.34 [95% CI, 0.09 to 1.23]), QOL, and harms. No trials reported the number of fall-related fractures, people transitioning to institutional care, or IADLs.

Characteristics of Included Studies

We included three trials (in four articles) of interventions combining exercise and an environment assessment with or without modifications (i.e., a single home visit to reduce home hazards).^{105, 108, 167, 168} These interventions are hereafter described as exercise plus environment. Of the three included trials, one was included in the previous review¹⁰⁸ and two were newly identified.^{167, 168}

Study Characteristics

We identified one good-quality¹⁶⁷ and two fair-quality^{108, 168} RCTs (n=935) with a primary or secondary aim of examining the effectiveness of exercise plus environment assessment interventions on falls, fall-related injuries, or both (**Table 3; Appendix H Table 1**). Two trials were conducted in Australia^{108, 168} and one in Singapore.¹⁶⁷ Trials were small, with the number of randomly allocated participants to relevant groups ranging from 272¹⁶⁸ to 354.¹⁶⁷ Followup time ranged from 6 to 18 months.

Population Characteristics

Two trials recruited participants age 65 years or older;^{167, 168} one trial recruited participants age 70 years or older (**Table 3; Appendix G Tables 1 and 2**).¹⁰⁸ The mean age ranged from 76 years¹⁰⁸ to 82 years.¹⁶⁸ The proportion of women ranged from 49¹⁶⁸ to 77¹⁶⁷ percent. Only one study conducted in Singapore reported race and ethnicity; 83 percent of participants were of Chinese ethnicity.¹⁶⁷ Measures of socioeconomic status were reported in two trials.^{167, 168} One study¹⁶⁸ excluded patients with severe cognitive impairment.

All three trials recruited community-dwelling adults. Trials recruited participants from a population-based register,¹⁰⁸ the ED,¹⁶⁷ or health-related services, including elder care, memory and cognitive disorders clinics, and dementia-specific day centers.¹⁶⁸ All three trials recruited patients at increased risk for falls, defined as either a history of falls (in the previous month or 12 months)^{108, 168} or presentation to the ED for a fall or fall-related injury (**Figure 28; Appendix G Table 2**).¹⁶⁷ Measures of health or functional status at baseline in the trials varied and included comorbid conditions, number of medications, and cognitive impairment. Two trials reported mean number of medications as 3.4¹⁰⁸ and 5.6.¹⁶⁸ One trial¹⁶⁷ reported that nearly one-half (47%)

of participants had multiple comorbidities and another trial¹⁶⁸ reported that the mean number of comorbidities was 3.5.

Intervention Details

All trials included an intervention combining an environmental assessment with an exercise component—which was delivered in a group, individual, or a combination format (**Appendix H Table 3**). One trial included 15 weeks of group strength, balance, and flexibility classes supervised by a physiotherapist.¹⁰⁸ Classes were supplemented by daily home exercises and a home visit to modify hazards. Home hazard modifications were completed either by the participants or through a city program.¹⁰⁸ Another trial included 24 weeks of group strength and balance exercise classes twice per week for participants with adequate physical performance (i.e., SPPB score >6) and progressive home-based exercises (12 sessions three times per week for 3 months) led by a physical therapist for participants with lower physical performance (i.e., SPPB score >7).¹⁶⁷ Physical therapists also assessed the participants' homes for environmental hazards and provided brief advice and educational materials on falls prevention. The third trial included an individually tailored, home-based strength and balance exercise program as well as home safety visits to modify hazards.¹⁶⁸ Occupational therapists assessed participants' homes and provided home safety recommendations and modifications (90- to 120-minute sessions).¹⁶⁸

Intervention adherence. Adherence was variably reported among the three trials. Adherence to the exercise portion of the intervention ranged from 60 percent¹⁰⁸ (those attending at least half the sessions) to 98 percent¹⁶⁷ (participants completing the prescribed number of events). Adherence to the environment modifications was reported in two studies, with 55 percent fully completing home safety recommendations in one trial¹⁶⁸ and 76 percent receiving help to make modifications for home hazards in the second.¹⁰⁸

Control group. In all three trials, the control groups received usual care from their healthcare providers.^{108, 167, 168} In one trial,¹⁰⁸ the control group received a delayed intervention. In another trial, the control group received educational materials on falls prevention.¹⁶⁷

Study Quality

One of the three trials was rated good quality, with low risk of bias across all assessed domains (**Appendix A Figure 3**).¹⁰⁸ The remaining two trials were rated fair quality, with moderate risk in at least one of the assessed domains.^{167, 168} In one trial,¹⁶⁸ there was differential attrition between the intervention and control groups; this trial was rated to have moderate risk of bias due to missing data. The other fair-quality trial did not report baseline characteristics by study group and was rated moderate risk due to confounding.¹⁰⁸ In all three trials, participants used diaries or calendars to record the outcomes of falls prospectively. Two trials also used telephone calls to verify falls or followup with participants who failed to return their calendars.^{167, 168}

Detailed Results

Falls

Two exercise plus environment intervention trials (n=581)^{108, 168} showed inconclusive results in the reduction in number of falls at the longest followup (9–18 months) (**Figure 29; Appendix H Table 4**). One trial (n=272)¹⁰⁸ reported a statistically significant reduction in falls at the 18-month followup (IRR, 0.73 [95% CI, 0.60 to 0.90]). The other trial (n=309) also reported a reduction in the number of falls for the intervention compared to the control group at 12 months of followup, but the relative effect was not statistically significant (IRR, 0.78 [95% CI, 0.57 to 1.07]).¹⁶⁸

People With a Fall and People With Recurrent Falls

Three exercise plus environment trials (n=935)^{108, 167, 168} reported the number of people with one or more falls and showed no differences between the intervention groups and the control groups at the longest followup (9–18 months) (RR range, 0.81 [95% CI, 0.60 to 1.08] to 0.99 [95% CI, 0.82 to 1.19]) (**Figure 30; Appendix H Table 5**). Two trials (n=581)^{108, 168} reported people experiencing two or more falls, but only one showed a statistically significant reduction at 12 months (RR, 0.73 [95% CI, 0.54 to 0.99]) (**Figure 31; Appendix H Table 5**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

Two trials reported falls resulting in injuries or falls requiring medical attention at 12 and 18 months.^{108, 168} One trial (n=272)¹⁰⁸ reported a nonstatistically significant reduction in falls resulting in injuries (IRR, 0.88 [95% CI, 0.67 to 1.15]), while the other trial¹⁶⁸ reported a nonstatistically significant increase in falls resulting in medical attention (IRR, 1.18 [95% CI, 0.76 to 1.83]) (**Figure 32; Appendix H Table 6**). No exercise plus environment trials reported fractures.

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

One trial (n=354)¹⁶⁷ reported a statistically significant reduction in people experiencing an injurious fall at 9 months (RR, 0.63 [95% CI, 0.40 to 0.98]). One trial (n=309)¹⁶⁸ reported people with a fall-related fracture, but there was no difference between the intervention group and control groups at the 12-month followup (RR, 1.08 [95% CI, 0.45 to 2.59]) (**Appendix H Table 7**).

Mortality

One exercise plus environment trial (n=309)¹⁶⁸ reported mortality, but there was no difference between the intervention group and control group at the 12-month followup (RR, 0.34 [95% CI, 0.09 to 1.23]) (**Figure 33; Appendix H Table 8**).

Other Outcomes

One trial (n=309)¹⁶⁸ reported people with a fall-related presentation or hospitalization, but there was no difference between the intervention group and control group at 12 months (**Appendix H Table 7**). The same trial (n=309)¹⁶⁸ reported no difference in QOL at 12-month followup (**Appendix H Table 9**). No exercise plus environment trials reported on IADLs or people transitioning to institutional care.

Harms

One trial (IG n=153)¹⁶⁸ reported four falls attributed to the exercise plus environment intervention. One fall occurred while a participant was descending the stairs during an occupational therapy home assessment and three participants fell during an exercise session.¹⁶⁸ No significant injuries were associated with these falls.

Environment Assessment (With or Without Modifications) Interventions

Summary of Results

We identified six trials (n=4,162) that examined the effect of an environment assessment with or without modifications (i.e., a single home visit to reduce home hazards) on falls in older adults. All but one study was conducted outside of the United States. In pooled analysis, there was no statistically significant effect on falls (IRR, 0.83 [95% CI, 0.59 to 1.18]; $I^2=82.2\%$) or people with a fall (RR, 0.94 [95% CI, 0.83 to 1.07]; $I^2=20.3\%$). The results were inconclusive for the remaining outcomes, where only one or two trials reported the outcome: falls resulting in injury or medical care (IRR, 0.97 [95% CI, 0.75 to 1.26] and 1.06 [95% CI, 0.93 to 1.21]), mortality (RR, 1.87 [95% CI, 0.87 to 4.01]), falls resulting in hospitalization (IRR, 0.67 [95% CI, 0.38 to 1.21]), QOL, and IADLs. In the two trials reporting harms, there were no adverse events or serious adverse events.

Characteristics of Included Studies

We included six trials (in 10 articles) with a primary or secondary aim of examining the effectiveness of environment assessment with or without modification interventions on falls and/or fall-related injuries.^{105, 108, 169-176} Three were included in the previous review^{108, 173, 176} and three were newly identified.^{169, 170, 174}

Study Characteristics

We identified three good-quality RCTs^{170, 173, 174} and three fair-quality RCTs^{108, 169, 176} that examined the effect of environment interventions on falls (n=4,162) (**Table 3; Appendix I Table 1**). One trial was conducted in the United States,¹⁷⁴ while the remainder were conducted in Hong Kong (k=1),¹⁶⁹ Australia (k=2),^{108, 176} and Great Britain (k=2).^{170, 173} The size of the trials

ranged from 165¹⁷³ to 1,879¹⁷⁶ randomly assigned participants. Followup time ranged from 6 to 18 months.

Population Characteristics

All trials recruited community-dwelling older adults at least age 65 or 70 years (**Table 3; Appendix I Table 1**). The mean age ranged from 75¹⁷⁴ to 80¹⁷⁰ years. The majority of participants were women (ranging from 52%¹⁷⁶ to 78%¹⁷⁴). Only one study reported race and ethnicity at baseline,¹⁷⁴ noting that 56 percent of participants were Black. Two trials reported level of education; for one study,¹⁷⁴ the mean level of education was 13.7 years, while another study reported that 36 percent of participants had an education level of 6 years or less.¹⁶⁹ Baseline measures of health or functional status reported in the trials varied. The number of mean medications per day ranged from 3.4¹⁰⁸ to 7.5.¹⁷⁴ No trials reported frailty or comorbidities. Three trials required that all participants had fallen at least once in the past 12 months^{170, 173, 174} and one trial required presentation to an ED primarily due to a fall (**Figure 28; Appendix I Table 2**).

Intervention Details

A nurse,¹⁷⁶ home-maintenance staff member,¹⁰⁸ or physical or occupational therapist^{169, 170, 173, 174} conducted an assessment of the participant's home to identify environment hazards that could contribute to a fall and recommended modifications (**Appendix I Table 3**). When possible, modifications within the home were made during the assessment.^{170, 173, 176} In two trials, modifications were made through a city program (which paid up to \$100)¹⁰⁸ or a government-funded program for participants living in public housing.¹⁶⁹ In the latter trial, participants randomized to the intervention group and who resided in government-funded housing had their home modifications paid for; however, those residing in private housing were required to pay for the modifications themselves.¹⁶⁹ For hazards not modified during the assessor's visit or for participants living in private housing, the participant was responsible for making changes or hiring someone to complete the work.^{169, 173, 174}

Control groups. Participants in the control group in four trials were not given any intervention but could continue to receive usual care.^{170, 173, 174, 176} One trial offered a delayed intervention¹⁰⁸ and one trial received an attention control.¹⁶⁹

Intervention adherence. Participants' adherence to the intervention was variably reported. In one study, 76 percent received help to make the home modifications.¹⁰⁸ Approximately 50 percent¹⁷⁰ to 91 percent¹⁷⁴ of participants partially or fully adhered to the recommendations. One study reported that several hazards (e.g., unsafe steps, rugs, or mats; rooms with trailing cords; rooms with an unsafe favorite chair) were significantly reduced.¹⁷⁶

Study Quality

Three studies were rated as good quality, with low risk of bias for all assessed domains (**Appendix A Figure 3**).^{170, 173, 174} Three studies were rated as fair quality, with higher risk of bias in one or more domain.^{108, 169, 176} All three of these trials had moderate risk of bias due to randomization procedures.^{108, 169, 176} Five trials measured falls data by participants' diaries or

calendars,^{108, 170, 173, 174, 176} which were collected monthly. For one trial,¹⁶⁹ participants self-reported falls by telephone every 2 weeks. All trials reported adequate retention of participants during followup with minor differences between the intervention and control groups in attrition.

Detailed Results

Falls

Six environment trials (n=3,956) demonstrated no difference in the rate of falls in the environment group compared to the control group at the longest followup (12 to 18 months) (IRR, 0.83 [95% CI, 0.59 to 1.18]; $I^2=82.2\%$) (**Figure 29; Appendix I Table 4**).

People With a Fall and People With Recurrent Falls

Five trials (n=2,242)^{108, 169, 170, 173, 174} showed no statistically significant difference in people with a fall at 12 to 18 months (RR, 0.94 [95% CI, 0.83 to 1.07]; $I^2=20.3\%$) (**Figure 30; Appendix I Table 4**). Four trials (n=2,077)^{108, 169, 170, 174} reported people experiencing two or more falls and found similar nonstatistically significant results (RR range, 0.36 [95% CI, 0.07 to 1.75] to 1.04 [95% CI, 0.89 to 1.22]) (**Figure 31; Appendix I Table 5**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

Two trials captured falls resulting in injury or medical care (n=1,580).^{108, 170} There were no statistically significant differences in the environment group versus the control group at 12 to 18 months (IRR, 1.06 [95% CI, 0.93 to 1.21] and 0.97 [95% CI, 0.75 to 1.26]) (**Figure 32; Appendix I Table 6**). One trial additionally reported fractures,¹⁷⁰ but events were rare and there was no statistically significant difference at 12 months for hip fractures (IRR, 1.69 [95% CI, 0.45 to 6.30]) or fall-related fractures (IRR, 0.83 [95% CI, 0.46 to 1.47]) (**Appendix I Table 6**).

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

One trial (n=1,331)¹⁷⁰ reported people with a fall-related fracture. There was no significant difference between the intervention and control groups at the 12-month followup (RR, 0.88 [95% CI, 0.50 to 1.56]) (**Appendix I Table 7**).

Mortality

One trial (n=1,201)¹⁷⁰ reported mortality, but there was no significant difference between the environment group and control group at the 12-month followup (RR, 1.87 [95% CI, 0.87 to 4.01]) (**Figure 33; Appendix I Table 8**).

Other Outcomes

One environment trial (n=1,580) reported no statistically significant difference between the intervention group and the control group in fall-related overnight hospitalizations at 12 months (IRR, 0.67 [95% CI, 0.38 to 1.21]) (**Appendix I Table 6**).¹⁷⁰ One trial (n=198)¹⁶⁹ reported no statistically significant difference in people with a fall-related hospitalization (RR, 0.72 [95% CI,

0.21 to 2.48]) and people with a fall-related ED visit at 12 months (RR, 0.70 [95% CI, 0.37 to 1.34]) (**Appendix I Table 7**). Qualitative analysis showed no effect on QOL outcomes in three trials^{170, 173, 174} (using the EuroQol and SF-12) (**Appendix I Table 9**). One trial (n=198)¹⁶⁹ reported no significant difference from baseline to 12 months between the intervention and control groups in IADLs (**Appendix I Table 10**). No environment trials reported people transitioning to institutional care.

Harms

One trial¹⁷⁰ reported no serious adverse events were attributed to the intervention (n=430 in intervention group) and a second trial¹⁷⁴ noted that no adverse events were reported during the trial (n=275).

Medication Review/Modification Interventions

Summary of Results

Four RCTs were included (n=1,052) that examined the effectiveness of a medication review with or without modification in older adults, three of which were limited to older adults at increased risk of falls. Meta-analysis was not possible due to few trials. At 6- to 12-month followup, these trials reported no difference between the intervention and control groups in people with a fall (k=3; n=846; RR range, 1.02 [95% CI, 0.79 to 1.31] to 1.16 [95% CI, 0.55 to 2.41]). Evidence was limited for the remaining outcomes due to only one or two trials reporting each outcome: falls (IRR, 1.01 [95% CI, 0.81 to 1.26]), falls resulting in injury or medical care (IRR, 0.87 [95% CI, 0.62 to 1.24]), people with a fall resulting in injury or medical care (RR range, 0.67 [95% CI, 0.36 to 1.26] to 1.69 [95% CI, 1.00 to 2.85]), mortality (RR, 0.40 [95% CI, 0.10 to 1.55] and 1.50 [95% CI, 0.26 to 8.77]), and QOL. There were no trials that reported on harms of the intervention.

Characteristics of Included Studies

We included four trials (in eight articles) of medication review with or without modification interventions (n=1,052).¹⁷⁷⁻¹⁸⁴ Two trials were included in the previous review^{177, 181} and two were newly identified.^{178, 184}

Study Characteristics

We identified two fair-quality^{177, 181} and two good-quality^{178, 184} RCTs with a primary or secondary aim of examining the effectiveness of medication review interventions (n=1,052) (**Table 3; Appendix J Table 1**). Three were conducted in the United States^{177, 181, 184} and one in the Netherlands.¹⁷⁸ Trial sizes (participants randomized to medication review and control arms for our analysis) varied, ranging from 80¹⁸¹ to 612¹⁷⁸ participants.

Population Characteristics

Three RCTs recruited participants age 65 years or older,^{177, 178, 181} while one had a slightly older requirement of 70 years or older (**Table 3; Appendix J Tables 1 and 2**).¹⁸⁴ Mean age ranged from 75 to 83 years, and the majority of participants across trials were female (ranged from 62% to 79%). Race and ethnicity were only reported in two trials, where participants were predominantly White (ranging from 89% to 99%).^{177, 181} Measures of socioeconomic status were variably reported. Two trials excluded people with moderate or severe dementia.^{177, 184}

Recruitment setting varied across trials. From the U.S. trials, one trial recruited participants from a community pharmacy chain's central electronic database,¹⁷⁷ one trial recruited participants from a fall-prevention workshop,¹⁸¹ and one trial recruited from an ED.¹⁷⁸ All of these trials recruited people at high risk for falls based on fall history or combination of fall history and other criteria.^{177, 178, 181} The other study recruited from a family physician's office and had no fall-risk criteria for inclusion eligibility.¹⁸⁴

All participants were community-dwelling older adults, but two trials excluded participants with moderate/severe or significant dementia.^{177, 184} Baseline cognitive impairment was reported in two trials, both reporting no significant cognitive impairment (mean MMSE score, 27.0¹⁷⁸ and mean Clinical Dementia Rating [CDR] score, 2.4¹⁸⁴) among participants. Comorbidities were variably reported across the trials. One study reported the mean number of high-risk conditions as 1.62,¹⁷⁷ another reported the mean Charlson Comorbidity Index score as 1.9,¹⁷⁸ and one study reported the mean cumulative illness rating scale summary score as 16.7.¹⁸⁴ The remaining study reported that approximately 88 percent of participants self-reported their overall health to be "good, very good, or excellent."

Measures of baseline medication usage at recruitment were reported in all trials. The mean number of drugs currently taken ranged from 6.4¹⁷⁸ to 9.8.¹⁸⁴ In one trial, the proportion of participants taking at least one fall-risk-increasing drug (FRID) was 35 percent.¹⁸¹ Another trial reported the proportion of participants using three or more FRIDs as 71 percent.¹⁷⁸ One trial reported a mean of 14 high-risk medication prescriptions filled in the year prior to the study.¹⁷⁷

Three of the four trials recruited participants at increased risk for falling (**Figure 28; Appendix J Table 2**). Criteria for increased risk always included a fall history component. Additionally, one trial's criteria also recruited participants who had a fear of falling,¹⁸¹ another also required participants to present to the ED after a fall,¹⁷⁸ and the final also recruited participants who were taking four or more long-term prescription medications (of which one or more was a central nervous system medication [e.g., benzodiazepines, antidepressants, anticonvulsants, sedative-hypnotics, narcotic analgesics, antipsychotics, skeletal muscle relaxants]).¹⁷⁷

Intervention Details

All trials included a medication review or modification intervention that included an in-person assessment and consultation (**Appendix J Table 3**). Two of the trials were conducted in the pharmacy, with a face-to-face medication consultation.^{177, 181} The pharmacist either contacted the prescriber to approve the medication changes¹⁷⁷ or developed an action plan with prescriber communication only when deemed necessary.¹⁸¹ The other two trials were both conducted in a

clinical setting by a geriatrician. One trial's intervention consisted of a systematic fall-related medication assessment combined with drug modification or withdrawal if it could be done safely.¹⁷⁸ Another trial provided a comprehensive geriatric assessment and medication review, followed by the assessing geriatrician consulting the participants' primary provider briefly to summarize findings and, if needed, suggest changes to the drug regimen.¹⁸⁴

Intervention adherence. Three of the trials reported adherence to the intervention. One trial reported that of the 1,940 prescriptions for high-risk medications filled in the following year, 50 percent of these refills were filled by the patients in the intervention group.¹⁷⁷ Another trial reported that of the six medication-related problems identified, each resulted in recommendations.¹⁸¹ Of these, approximately 50 percent of the recommendations were communicated by the pharmacist to the patient in person, 31 percent were communicated by the patient to the prescribing physician, and 19 percent were faxed by the pharmacist directly to the prescribing physician.¹⁸¹ The third trial found that a medication change was deemed not possible or unnecessary for 40 percent of all FRIDs identified.¹⁷⁸ Additionally, in the same trial, 35 percent of all attempted FRID withdrawals were unsuccessful.¹⁷⁸

Control Group. The control group for all included trials received usual care.^{177, 178, 181, 184}

Study Quality

Of the four trials, two were rated good quality, with low risk of bias in all domains (**Appendix A Figure 3**).^{178, 184} The two remaining trials, which were previously included in the prior review, had moderate risk of bias in at least one domain, both with moderate risk due to missing data^{177, 181} and one with additional risk due to randomization procedures.¹⁷⁷ All trials recorded falls by using calendars that were turned in monthly and by participating in telephone interviews every 1 to 3 months.^{177, 178, 181, 184}

Detailed Results

Falls

One trial reported no difference in the rate of falls between the medication management group and the control group (IRR, 1.01 [95% CI, 0.81 to 1.26]) (**Figure 29; Appendix J Table 4**).¹⁷⁷

People With a Fall and People With Recurrent Falls

Four trials^{177, 178, 181, 184} reported the number of people with one or more falls at 6 to 12 months of followup. Results were inconclusive and none of the individual study comparisons were statistically significant. Individual RRs ranged from 1.02 (95% CI, 0.79 to 1.31) to 1.16 (95% CI, 0.55 to 2.41) in three trials and one trial reported an odds ratio of 0.75 (95% CI, 0.35 to 1.60) (**Figure 30; Appendix J Table 5**). Two trials^{178, 181} also reported no difference in the number of people who fell more than twice at 6 and 12 months (RR, 1.16 [95% CI, 0.79 to 1.71] and 2.10 [95% CI, 0.56 to 7.83]) (**Figure 31; Appendix J Table 5**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

One trial reported a nonstatistically significant reduction in injurious falls between the intervention and control groups at 12 months (IRR, 0.87 [95% CI, 0.62 to 1.24]) (**Figure 32; Appendix J Table 6**).¹⁷⁷ No trials reported fall-related fractures.

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

One trial reported no statistically significant difference in people with an injurious fall at 12 months (RR, 0.69 [95% CI, 0.46 to 1.04]) (**Appendix J Table 7**).¹⁷⁸

Mortality

Two trials^{177, 184} (n=344) reported no statistically significant difference in mortality between the intervention and control groups (RR, 0.40 [95% CI, 0.10 to 1.55] and 1.50 [95% CI, 0.26 to 8.77]) (**Figure 33; Appendix J Table 8**).

Other Outcomes

One trial reported people with a hospitalization (RR, 1.69 [95% CI, 1.00 to 2.85]) and one trial reported people with an ED visit (RR, 0.67 [95% CI, 0.36 to 1.26]) (**Appendix J Table 7**). Two trials^{178, 184} reported no statistically significant difference in QOL between the intervention and control groups at 6 to 12 months (**Appendix J Table 9**).

Harms

No study reported harms.

Psychological Interventions

Summary of Results

Three RCTs of cognitive behavioral interventions, which targeted community-dwelling older adults at high risk of falling, were included (n=979). Due to few trials, the evidence base is considered inconclusive for the effect of psychological interventions on falls and fall-related outcomes. Two trials showed nonstatistically significant reductions in falls at 12- and 14-month followup (IRR, 0.86 [95% CI, 0.65 to 1.13] and 0.86 [95% CI, 0.65 to 1.14]). Only one of the three trials showed a statistically significant reduction in people with a fall (RR, 0.72 [95% CI, 0.58 to 0.90]; RR, 0.96 [95% CI, 0.80 to 1.15]; odds ratio, 1.40 [95% CI, 0.45 to 4.37]). Only one trial reported a statistically significant reduction in people with two or more falls (RR, 0.59 [95% CI, 0.43 to 0.81] and 0.89 [95% CI, 0.67 to 1.19]). Trial results for falls resulting in injury were not statistically significant in either trial (RR, 0.78 [95% CI, 0.45 to 1.35] and 1.42 [95% CI, 0.96 to 2.10]). No study reported fall-related fractures or people with a fall resulting in injury. Trial results showed no difference in mortality between the intervention and control groups (RR, 0.98 [95% CI, 0.77 to 1.25] and 1.01 [95% CI, 0.36 to 2.81]). No differences were

found in IADL outcomes between the intervention and control groups. One study reported no adverse events.

Characteristics of Included Studies

We identified three RCTs (reported in six articles) that used cognitive behavioral interventions for reducing fear of falling (n=929).¹⁸⁵⁻¹⁹⁰ Two trials were included in the previous review^{186, 190} and one trial was newly identified.¹⁸⁹

Study Characteristics

The three fair-quality RCTs (n=979) aimed to reduce fear of falling and activity avoidance or to address concerns about falls in community-dwelling older adults (**Table 3; Appendix K Table 1**).^{186, 189, 190} Two trials were conducted in the Netherlands^{186, 190} and one was conducted in Australia.¹⁸⁹

Population Characteristics

All included trials targeted community-dwelling older adults with concerns or fear of falling, and two trials also recruited community-dwelling older adults who perceived their general health as fair or poor¹⁸⁶ or who had poor confidence in their balance¹⁸⁹ (**Table 3; Appendix K Tables 1 and 2**). Two trials recruited participants older than age 70 years,^{189, 190} while one trial recruited older adults older than age 65 years.¹⁸⁶ The mean age ranged from 74 to 78 years and the percent female ranged from 70 to 72 percent. In the previous 6 months prior to the trials starting, more than half of participants (61%) in one trial¹⁸⁶ and one-third of participants (35%) in another trial¹⁹⁰ had fallen at least once, and 44 percent of participants in the remaining trial had experienced at least one fall in the previous year¹⁸⁹ (**Figure 28; Appendix K Table 2**). Race and ethnicity were not reported for any of the included trials and measures of socioeconomic status were minimal.^{186, 190}

Intervention Details

The three included trials all used a cognitive behavioral intervention designed to reduce fear of falling. Two of the trials were delivered in person and facilitated by a nursing professional,^{186, 190} while the remaining trial was delivered virtually with self-directed online modules¹⁸⁹ (**Appendix K Table 3**). One trial delivered the intervention in group format and was comprised of eight weekly 2-hour sessions with the purpose of addressing misconceptions on fall risks, setting realistic goals for safe activity, reducing home hazards, and promoting physical exercise to increase strength and balance.¹⁹⁰ Six of the eight sessions included 15 minutes of low-intensity physical exercise.¹⁹⁰ The other in-person trial used an individual approach, with seven total sessions (three 60- to 75-minute home visits, four 35-minute telephone contacts) over 16 weeks, which aimed to address concerns about falls, thoughts about falling, physical exercise, asserting oneself, overcoming personal barriers, safe behavior, and managing concerns about falls.¹⁸⁶ The remaining trial delivered an intervention consisting of three modules from the myCompass program, which is a self-help online cognitive behavioral therapy program.¹⁸⁹ Participants were given access to three skill-building modules that were relevant to fear of falling (Managing Fear

and Anxiety, Taking Charge of Worry, and Solving Problems) for 6 weeks and were completed using a mobile device or a home computer.¹⁸⁹

Intervention adherence. All trials reported adherence to the psychological intervention. One trial reported 58 percent of participants attended five of the eight sessions.¹⁹⁰ In another trial, participant use of the action plans decreased towards the end of the trial, starting at 70 percent in initial sessions and dropping to 51 percent in the latter sessions.¹⁸⁶ In the online program intervention, the study reported that all intervention participants completed two out of the three required modules.¹⁸⁹

Control groups. The control group for the two trials delivering an in-person intervention received usual care.^{186, 190} The remaining trial delivered a minimal intervention to the control group, which consisted of all participants receiving two general health education booklets.¹⁸⁹

Study Quality

All trials were rated fair quality with moderate or high risk of bias in at least one domain (**Appendix A Figure 3**).^{186, 189, 190} Randomization was adequate, with no concerns that the groups differed at baseline. Data on falls were measured by participants' diaries, which were collected monthly^{186, 189} or every 3 months.¹⁹⁰ However, there was differential attrition between the intervention and control groups for all trials, which resulted in a higher risk of bias due to missing data.

Detailed Results

Falls

Both trials^{186, 190} reported the same nonstatistically significant lower rates of falls compared to the control group at 12 to 14 months of followup (IRR, 0.86 [95% CI, 0.65 to 1.13] and 0.86 [95% CI, 0.65 to 1.14]) (**Figure 29; Appendix K Table 4**).

People With a Fall and People With Recurrent Falls

Only one of the three trials found a statistically significant reduction in people with one or more falls (RR, 0.96 [95% CI, 0.80 to 1.15];¹⁸⁶ RR, 0.72 [95% CI, 0.58 to 0.90];¹⁹⁰ odds ratio, 1.40 [95% CI, 0.45 to 4.37]¹⁸⁹) (**Figure 30; Appendix K Table 5**). This same trial also reported a statistically significant reduction in people with two or more falls (RR, 0.59 [95% CI, 0.43 to 0.81]¹⁹⁰ and 0.89 [95% CI, 0.67 to 1.19]¹⁸⁶) (**Figure 31; Appendix K Table 5**).

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

The trial results for falls resulting in injury or medical care were mixed. At 12 to 14 months, one trial¹⁹⁰ showed a nonstatistically significant reduction in fall-related injuries resulting in medical care in the intervention group compared to the control group (IRR, 0.78 [95% CI, 0.45 to 1.35]), but the other trial¹⁸⁶ showed a nonsignificant increase in fall-related injuries (IRR, 1.42 [95% CI, 0.96 to 2.10]) (**Figure 32; Appendix K Table 6**). Neither trial reported fall-related fractures.

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fracture

Neither trial reported these outcomes.

Mortality

There was no difference in the number of participants who died between the intervention and control groups in either trial at longest followup (RR, 0.98 [95% CI, 0.77 to 1.25] at 7 years; RR, 1.01 [95% CI, 0.36 to 2.81] at 12 months) (**Figure 33; Appendix K Table 7**).

Other Outcomes

Both trials found no differences in IADLs between the intervention and control group over 12 to 14 months of followup (**Appendix K Table 8**).

Harms

One trial reported no adverse events or side effects in the trial,¹⁹⁰ while the other did not report these outcomes.¹⁸⁶

Education Interventions

Summary of Results

One trial that examined the effectiveness of a group education intervention in older adults at high risk of falls was included. This trial showed a statistically significant reduction in falls in the intervention group at 14 months (IRR, 0.68 [95% CI, 0.57 to 0.83]). No statistically significant difference was found between groups for people with a fall, people with recurrent falls, and QOL. No other relevant outcomes were reported.

Characteristics of Included Studies

We identified one trial (in one article) with a primary or secondary aim of examining the effectiveness of an educational intervention on falls or fall-related outcomes (n=310).¹⁹¹ This trial was previously included; no new trials were identified.

Study Characteristics

We identified one fair-quality RCT (n=310) conducted in Australia that examined the effectiveness of a group education intervention to prevent falls in adults age 70 years or older at increased risk for falling (**Table 3; Appendix L Table 1**).¹⁹¹

Population Characteristics

This trial recruited community-dwelling adults age 70 years or older (**Table 3; Appendix L Tables 1 and 2**).¹⁹¹ The mean age was 78, and approximately three-quarters of participants were

female (74%). All participants were at increased risk for falling, based on personal concerns related to falling or fall history. Those with cognitive impairment were excluded. Race and ethnicity and measures of socioeconomic status were not reported. Twenty percent of participants were currently using psychotropic drugs at the time of recruitment, and per inclusion criteria, all participants had a fall in the previous 12 months or reported concerns about falling (**Figure 28**).¹⁹¹

Intervention Details

The trial implemented the Stepping On program, which aimed to improve fall self-efficacy, encourage behavior change, and reduce falls (**Appendix L Table 3**).¹⁹¹ This program offered a combination of group classes in the community and a followup home visit. Facilitated by an occupational therapist, approximately 15.5 hours of education sessions were delivered. Content of the Stepping On program curriculum included covering such topics as balance and strength exercises, how to cope with vision loss, encouraging medication management, and recommendations for environmental and behavioral home safety, and community safety. Additionally, each session provided an opportunity for action planning and homework for the next week. The individual home visit aimed to support follow through of fall-prevention strategies and activities.¹⁹¹

Intervention adherence. At the end of the trial, 59 percent of intervention participants were still doing their exercise routinely, 72 percent of those who needed a vision assessment initiated one, and 70 percent of program participants adhered to at least half of the environment recommendations.

Control groups. This trial included an attention control for the comparison group.¹⁹¹ Participants randomized to the control group received up to two social visits from an occupational therapy student. Visits were conducted at the same time as the Stepping On intervention and students leading the social visits were instructed not to discuss falls or falls prevention with participants.¹⁹¹

Study Quality

The trial was rated fair quality, with low risk of bias in all but one domain (**Appendix A Figure 3**).¹⁹¹ The trial was found to have moderate risk of bias due to randomization procedures and confounding, as authors reported statistically significant baseline differences between the intervention and control groups. Despite being controlled for some of these differences in the analyses, this may overestimate any benefit from the intervention. Study participants used diaries to record falls prospectively.

Detailed Results

Falls

The included trial showed statistically significant reductions in falls in the intervention group compared to the control group (IRR, 0.68 [95% CI, 0.57 to 0.83]) (**Figure 29; Appendix L Table 4**).¹⁹¹

People With a Fall and People With Recurrent Falls

The trial showed no difference at 14 months of followup (RR, 0.90 [95% CI, 0.73 to 1.10]).¹⁹¹ Additionally, the trial reported a nonstatistically significant reduction in the number of people who had had two or more falls (RR, 0.74 [95% CI, 0.52 to 1.04]) (**Figures 30 and 31; Appendix L Table 5**).¹⁹¹

Falls Resulting in Injury or Medical Care and Fall-Related Fractures

The trial did not report these outcomes.

People With a Fall Resulting in Injury or Medical Care and Fall-Related Fractures

The trial did not report these outcomes.

Mortality

The trial did not report mortality.

Other Outcomes

The included trial (n=258) reported on QOL at 14 months using the SF-36 physical and mental health components.¹⁹¹ No statistically significant mean differences between the intervention and control group were found (**Appendix L Table 6**).¹⁹¹

Harms

The trial did not report harms.

Chapter 4. Discussion

Summary of Evidence

We conducted a systematic review to support the USPSTF in updating its recommendation on falls prevention in older community-dwelling adults. A summary of evidence for each intervention type appears in **Tables 4 and 5**. Of the 83 included trials, 32 were newly identified trials reporting falls, people with falls, or fall-related injuries in average- and increased-risk older adults: three new multifactorial, 19 new exercise, three new exercise plus education, two new exercise plus environmental, three new environmental, two new medication review, one new psychological, and no new education-only intervention trials. The largest bodies of literature evaluated within this review were multifactorial and exercise interventions, which included 28 trials (N=27,784) and 37 trials (N=16,117), respectively. Our findings suggest that there is a statistically significant reduction only in the number of falls with multifactorial interventions and a statistically significant reduction in multiple fall-related outcomes with exercise interventions. These overall conclusions are generally consistent with our previous review,³⁷ with the addition of newly published trials as well as trials solely recruiting specific populations with mild dementia, osteoporosis, osteoarthritis, and sarcopenia. In fact, there were few trials in these populations.^{101, 103, 109, 118, 119, 125, 128, 162} Of note, this update did not include vitamin D interventions, as another in-process review will address the effectiveness of vitamin D to prevent falls and fractures.³⁸ Our findings are likewise consistent with other reviews of exercise and multifactorial interventions in community-dwelling older adults.¹⁹²⁻²⁰⁰

For multifactorial interventions, similar to the previous review,³⁷ only the number of falls outcome was statistically significant in the pooled analysis. There were three new fair- or good-quality trials^{47, 49, 72} that were added to the evidence base for this update; however, these trials had null findings for their primary outcomes. One hypothesis for these results is that the contemporary standard of care may provide a level of risk modification in the control group (falls risk assessment, medication review, exercise referrals) that may diminish relative benefits seen in the intervention. Some of the trials included a universally recommended exercise component,^{55, 59, 78, 80, 84} while others provided exercise referrals only to some participants based on the initial risk assessment.^{47, 49, 53, 57-59, 62, 63, 70, 75, 77, 78, 82, 85, 86, 89, 90} Furthermore, the systematic multifactorial interventions in these trials were extensive in their assessment and referrals; there was adherence drop off at each step of the process, which may have diminished potential effectiveness. The effectiveness of such multistep interventions may require extensive monitoring and followup to ensure adherence.

Evidence is most consistent across multiple fall-related outcomes for the exercise trials. For exercise interventions, the included trials doubled in number compared to our previous review, and the conclusions are mostly similar.³⁷ There remains a statistically significant association with number of falls, people with a fall, and injurious falls. In contrast to the previous review, there is no longer a statistically significant association between exercise and people with an injurious fall. This change in conclusion for this one fall-related outcome and the discordance across fall-related outcomes cannot be readily explained as the clinical and statistical heterogeneity in this body of evidence are substantial. We explored heterogeneity by various study, population, and

intervention characteristics and found no patterns that suggested that any of these variables altered treatment effectiveness. Furthermore, two exercise trials reported within-study subgroup analyses for falls and/or fracture reporting no interaction by age, sex, history of falls, frailty, and/or cognitive impairment.^{49, 106} In terms of exercise harms, theoretically, increasing physical activity could lead to more frequent falls and injuries, but the trial literature is too limited to confirm this idea. Some of the exercise intervention trials and multifactorial interventions with exercise components have reported largely minor adverse effects associated with exercise, including muscle soreness; injurious falls occurring during exercise sessions were rare.^{49, 106, 120}

For all other interventions, conclusions were limited by few trials for each intervention type and the availability of new trials could alter effect direction and size considerably.

To determine the absolute benefit of multifactorial and exercise interventions, we estimated the number of falls and people with a fall that could be prevented based on the pooled relative effect sizes and confidence intervals from our review and both fall rates from the included trials and national falls data⁴ (**Figure 34**). These estimates should be interpreted with caution as they may suggest a false precision given the heterogeneity of intervention protocols and population characteristics for any given program and clinical population. In a hypothetical population of 1,000 older adults, based on national fall rates, multifactorial interventions would be expected to prevent between 36 and 186 falls. Exercise interventions would be expected to prevent 29 to 179 falls and 6 to 36 people from experiencing a fall, and 9 to 44 falls resulting in injury. These absolute benefits would be greater in populations at higher risk for falls. It is important to underscore that overall, the participants in the multifactorial and exercise trials were at higher risk for falls than the national average and absolute benefits will be greater in higher risk populations. Furthermore, the multifactorial trial populations were at even higher risk for falls compared to the exercise trial populations (falls: weighted mean, 1.46 falls per person-year versus 1.16 falls per person-year, respectively; weighted mean percent of people with one or more falls: 48.4% versus 41.4%, respectively).

Falls and Fall-Related Outcomes

Most trials were designed to be powered for falls. However, the authors often assumed a larger difference between the intervention and control groups than what we have found in our review. Both falls and people with a fall represent clinically meaningful outcomes. Since each fall could result in injury, an intervention that reduces the number of falls could provide an important public health benefit by reducing the number of injuries and thus overall morbidity. Likewise, reducing the number of people experiencing a fall may represent an important outcome to individuals seeking to prevent the first fall and subsequent injury, activity limitation, and functional decline.

For effective interventions, trials would ideally show that interventions lead to fewer falls, fewer people with a fall, and in turn, fewer fall-induced injuries. We attempted to increase our power to analyze the effect of interventions on injuries by creating a composite category of “falls resulting in injury or medical care” (defined as a trial-reported injurious fall, fall-induced injury, or fall with injury resulting in medical attention), although we recognized that the severity of injuries may vary widely even among falls that lead to visits to an ED. For exercise interventions, we

found a reduction in the number of injurious falls and people with injurious falls. The available evidence on injurious falls or people with injurious falls for the remaining intervention categories is either too limited or findings suggest no effect. However, concluding that interventions other than exercise have no effect on fall-related injuries would be premature given that so few of the trials were designed to have adequate power for preventing injury (or fracture). The uncertainty of the effect of all interventions except exercise on injuries remains.

Implementation Issues

There are some important implementation considerations in applying our findings to the U.S. healthcare system for the multifactorial and exercise interventions. First, identifying those at increased fall risk who would be candidates for interventions remains a challenge. Simplified self-administered questionnaires are ideal for efficiency, and while history of falls predicts future falls as well as primary care feasible questionnaires/functional tests, the use of falls history alone precludes prevention of the first fall.

While the majority of exercise trials consisted of group exercise programs (24 of 36 trials), one quarter (nine of 36 trials) involved individual programs similar to what is available in the United States in the form of physical therapy referral. Most exercise trials included an additional unsupervised physical activity component independent of the structured group or individual sessions. Most of the exercise trials included multiple exercise types, and the most common included gait/balance/function and strength/resistance training. Exploration of heterogeneity did not reveal any treatment modification based on exercise format or components, suggesting that primary care referrals for group community exercise programs, as well as traditional office-based physical therapy, are effective. The types of exercise programs provided varied across the interventions; however, the most commonly cited program was the Otago Exercise Program, which was delivered fully or partially by six studies.^{49, 59, 125, 142, 149, 168} The next most commonly cited exercise programs delivered were tai chi exercise programs (in four studies),^{103, 120, 122, 153} the Weight-bearing exercise for Better Balance program (delivered fully or in part in three studies),^{137, 161, 168} and the Standing Tall program (delivered in two trials).^{101, 106} In the multifactorial trials, the individual treatment intervention—including physician specialty referrals, physical therapy/exercise, and environment interventions—are largely reflective of what patients could receive piecemeal in primary care. However, given the time constraints in a busy primary care clinic, these referrals may or may not be delivered in such a comprehensive fashion in the current U.S. healthcare delivery system, despite the introduction of the Medicare Initial and Annual Preventive Visits.²⁰¹ Adherence with multiple referrals and recommendations provided in a single visit presents an implementation challenge and may require case management for follow through. The exercise/physical therapy interventions included in the multifactorial trials are similar to what patients receive in the U.S. clinical setting in their design (physical therapist designed and individually developed program based on functional assessment and diagnoses), delivery (physical therapist delivered most of the interventions—some individually and some group), and components (balance, gait, strength).

Ongoing Trials

There are several other ongoing research trials addressing the effectiveness of in-person and digital exercise programs, educational programs, home visitation programs, medication review interventions, and multicomponent interventions. These ongoing trials are listed in **Appendix M Table 1**. Four of these trials are based in the United States and the largest ongoing trial is the Electronic Strategies for Tailored Exercise to Prevent Falls (eSTEPS) study (jointly funded by Brigham and Women's Hospital and the National Institute on Aging of the National Institutes of Health).²⁰² This is a large-scale (n=8,353), pragmatic cluster RCT of a clinical decision support implemented tailored falls prevention exercise plan (eSTEPS) in community-dwelling older adults at risk for falls (based on the STEADI screening protocol). The trial will recruit participants from urban and rural primary care clinics in the United States, and report falls and fall-related injuries. The scheduled completion date is March 2025.²⁰²

Limitations of the Literature and Future Research Needs

Future research addressing multifactorial risk assessment interventions should include detailed protocol descriptions of such interventions, including the specific protocol for the risk assessment and referrals as well as the time and personnel required to administer the assessment. Such protocols should be tested in large pragmatic trials using streamlined protocols for multifactorial risk assessment and referrals that are feasible for use in primary care practices. Further, it would be helpful to have large trials of medication review in the clinical setting with seamless communications with primary care providers who can assess appropriateness of medication changes. Likewise, large trials providing environmental recommendations using checklists as well as capacity to implement modifications may provide an intervention that limits financial and logistical barriers to modification implementation. It remains uncertain whether psychological or educational interventions are effective for falls prevention, so trials of these interventions are needed. Finally, to provide adequate evidence on potential harms, all future research studies need to monitor adverse effects more consistently in both the control and intervention groups. There are several implementation issues, including equity issues surrounding best practices for implementing multifactorial and exercise interventions in historically marginalized and medically underserved communities and how to improve adherence in all populations in real-world settings. Future trials should recruit diverse participants representative of the U.S. population and report population characteristics. Additional trials are needed for multifactorial and exercise interventions in community-dwelling adults with mild cognitive impairment and mild dementia, osteoporosis, osteoarthritis, and sarcopenia. Any future research for multifactorial and exercise interventions in mixed-risk populations should report results stratified by risk category.

Limitations of Our Approach

There are several limitations to our review scope and approach that are important to note. We included trials only when the primary or secondary aim was to prevent falls among older adults and a falls outcome was reported, both to select interventions with biologic plausibility of

reducing falls and for pragmatic purposes. Further, our inclusion criteria generally represented community-dwelling older adults seen in primary care, and there are many subgroups of older adults to which these results may not apply. While we expanded our criteria to include trials recruiting older adults with mild cognitive impairment or mild dementia, osteoporosis, osteoarthritis, and sarcopenia, we still excluded trials that specifically recruited participants with major neurologic diagnoses (e.g., moderate to severe dementia, Parkinson’s disease, stroke) because those populations may require specialized approaches to preventing falls.

Our attempts to describe the recruitment setting may also have limitations. While we aimed to distinguish studies that recruited participants from primary care and the community as separate from those that identified participants through their use of the ED, mixed recruitment strategies at times meant we may have under or overestimated the applicability of the recruitment setting.

Further, we tried to consistently categorize and describe the interventions, but the intervention procedures were not always described in adequate detail. This likely resulted in imprecision and potentially some inaccuracies in our categorizations and descriptions of some of the included interventions. Similarly, we did not include comparative effectiveness trials and excluded any trial where the comparison group had an active control (e.g., stretching, walking). At times it was difficult to determine whether a comparator was too intense to be considered a minimal control. Our protocol prioritized health outcomes consistent with the USPSTF methodology—specifically falls, falls-related morbidity, and mortality—and did not include intermediate functional outcomes, such as changes in balance, endurance, or walking speed. It is possible that these interventions also have a beneficial impact on these intermediate functional outcomes, which may lead to a later decrease in falls. Additionally, while we recognize that falls efficacy scales and fear of falling are commonly reported in trials, we excluded these outcomes in favor of direct fall event outcomes. We also did not examine other non-fall-related health outcomes that may have a positive association with these interventions (e.g., the effect of exercise on cardiovascular or mental health outcomes).

Conclusion

The current evidence base demonstrates that exercise is associated with fewer falls, fewer people with a fall, and a reduced number of injurious falls in average- and increased-risk community-dwelling older adults. Multifactorial interventions appear to reduce falls but not people with a fall or injuries; trials are clinically and statistically heterogeneous. Other single falls prevention interventions, including environmental modification, medication management, education, and psychological interventions, as well as falls interventions with multiple components like exercise plus education and exercise plus environment have either few trials showing no statistically significant effect or a few trials reporting mixed results.

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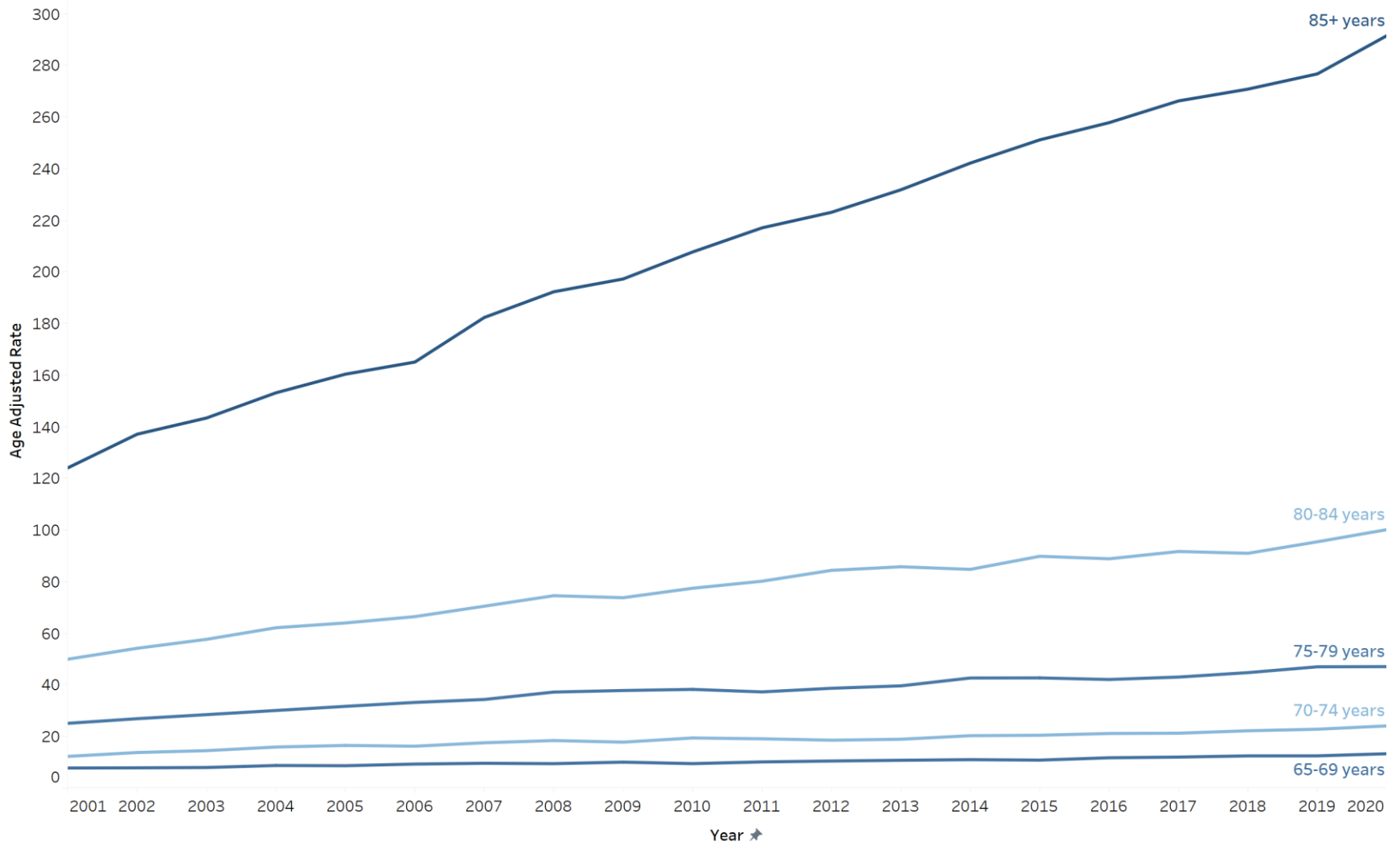
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Figure 1. Unintentional Fall Death Rate From 2001 to 2020, by Age Group



Note: Data on unintentional fall deaths from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System. <https://www.cdc.gov/injury/wisqars/index.html>. Accessed 10.23.2023.³

Figure 2. Analytic Framework

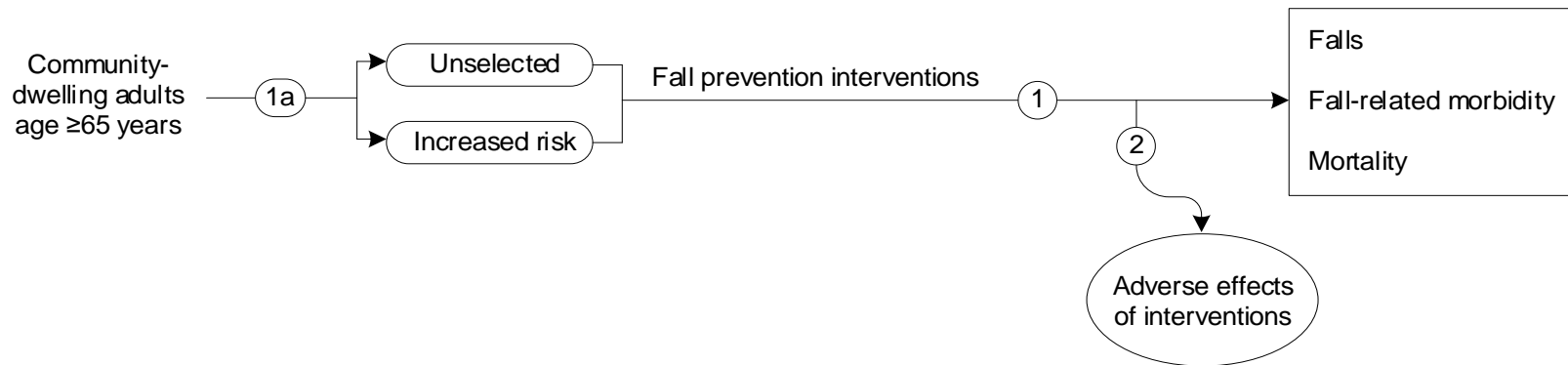
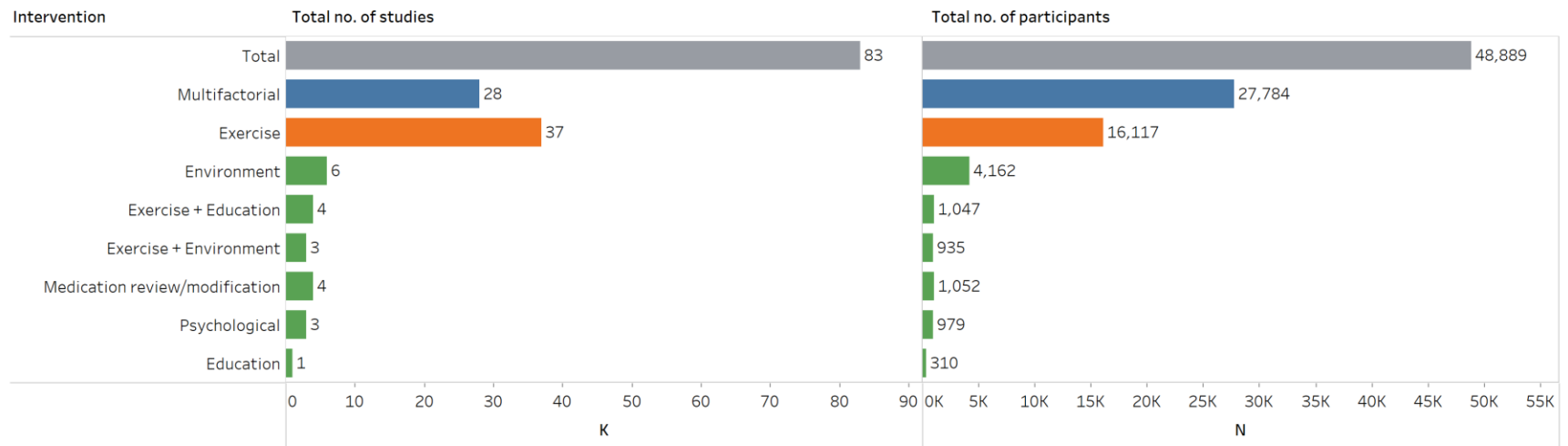


Figure 3. Total Number of Studies and Randomized Participants, by Intervention Group

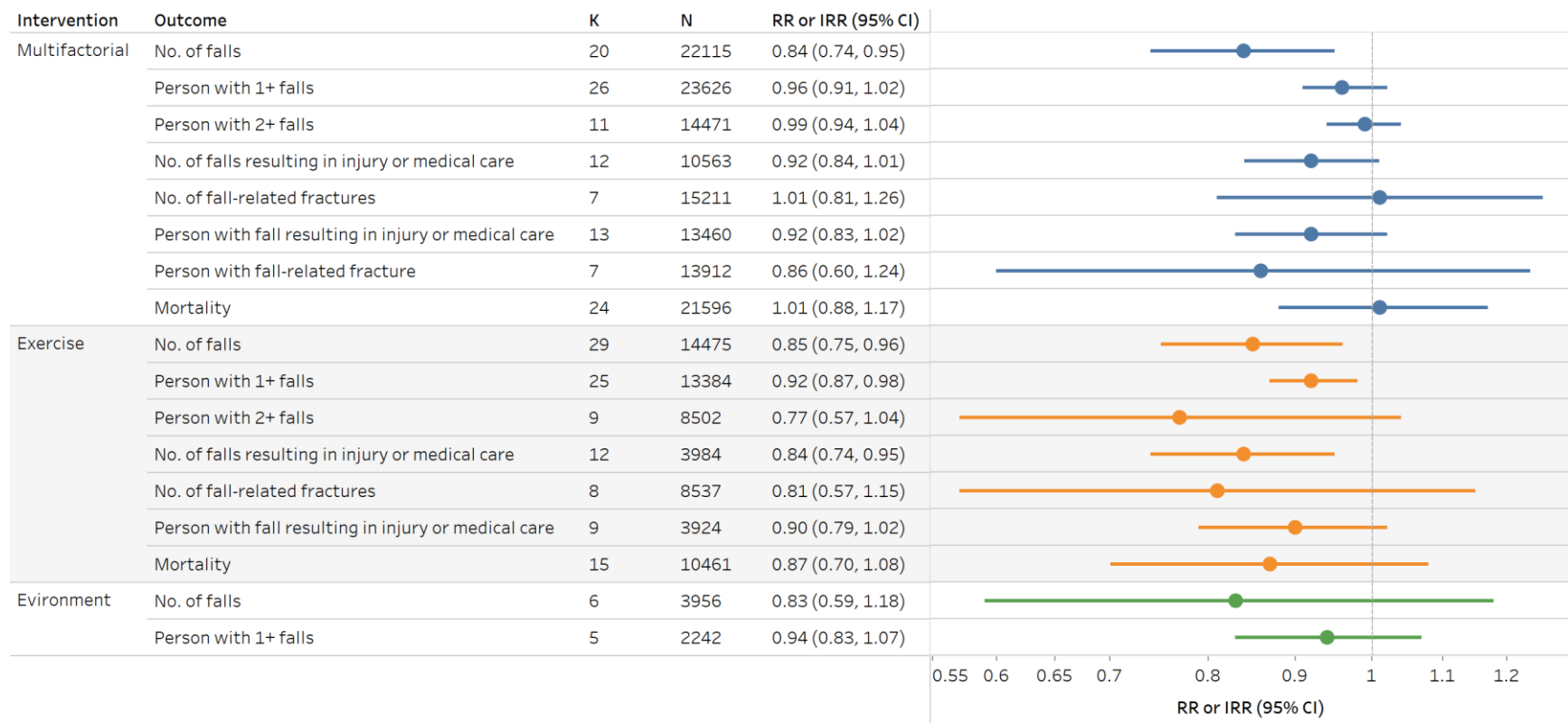


Abbreviations: k = number of studies, n = number of participants.

Figure 4. Evidence Map by Intervention Type: Outcomes and Number of People Analyzed



Figure 5. Pooled Analyses for Multifactorial, Exercise, and Environment Interventions



Abbreviations: CI = confidence interval; IRR = incidence rate ratio; k = number of studies; n = number of participants; RR = relative risk.

Figure 6. Baseline Fall Risk Ascertainment for Multifactorial Interventions

Author, year	% at increased risk	Fall history	Hospital/ED	Physical function	Osteoporosis/ osteopenia	Medications	Frailty	Fear of falling	Other	NR
Bhasin, 2020	100	×						×		
Ciaschini, 2009	100		×	×	×					
Close, 1999	100		×							
Conroy, 2010	100	×		×		×			×	
Davison, 2005	100		×							
de Vries, 2010	100		×							
Elley, 2008	100	×								
Fairhall, 2014	100						×			
Hendriks, 2008	100		×							
Hogan, 2001	100	×								
La Porta, 2022	100								×	
Lightbody, 2002	100		×							
Logan, 2010	100		×							
Moller, 2014	100		×						×	
Palvanen, 2014	100	×		×	×		×		×	
Russell, 2010	100		×							
Salminen, 2009	100	×								
Spice, 2009	100	×								
Tinetti, 1994	100			×		×			×	
van Haastregt, 2000	100	×		×						
Vind, 2009	100		×							
Cohen, 2015	19	×								
Perula, 2012	31	×								
Wagner, 1994	34	×								
Imhof, 2012	40	×								
Bruce, 2021	44	×		×						
Ferrer, 2014	NR									×
Lord, 2005	NR									×

Abbreviations: ED = emergency department; NR = not reported.

Figure 7. Baseline Assessment Components for Multifactorial Interventions

Author Year	Environ	Fxn	Meds	Vision	Diag	Physical exam	Geriatric assess	ADL	Assist device	Bone health	Cog Fxn	CVD	Exercise	Fall history	Fall risk	Foot health	Hearing	Mental health	Nutr	Ortho hypo	EtOH/ drugs	Urinary incont	
Bhasin, 2020	X	X	X	X						X						X				X			
Bruce, 2021	X	X	X	X										X		X					X		
Ciaschini, 2009	X	X	X					X													X		
Close, 1999	X	X	X	X			X	X			X							X					
Cohen, 2015	X	X	X											X									
Conroy, 2010	X	X	X		X	X															X		
Davison, 2005	X	X	X	X	X							X		X		X					X		
de Vries, 2010	X	X	X	X	X	X				X				X							X		
Elley, 2008	X	X		X	X					X	X	X		X									
Fairhall, 2014	X	X	X		X		X											X	X				X
Ferrer, 2014	X	X	X	X				X			X							X		X			
Hendriks, 2008	X	X	X	X	X	X					X	X		X			X	X					
Hogan, 2001	X	X		X																	X	X	
Imhof, 2012		X		X	X		X				X							X	X				X
La Porta, 2022	X	X	X	X			X		X	X	X	X			X					X			
Lightbody, 2002	X	X	X	X							X	X				X	X						
Logan, 2010	X		X																				
Lord, 2005		X		X											X								
Moller, 2014	X	X	X																				
Palvanen, 2014	X	X	X	X				X	X		X	X	X	X				X	X			X	
Perula, 2012	X														X								
Russell, 2010				X											X			X	X	X			
Salminen, 2009	X	X	X	X						X								X	X				
Spice, 2009	X	X	X	X						X	X	X		X		X					X	X	
Tinetti, 1994	X	X	X	X	X			X						X			X	X					
van Haastregt, 2000	X	X	X					X			X												
Vind, 2009		X	X	X	X	X					X	X		X				X					
Wagner, 1994	X		X	X									X				X					X	

Abbreviations: assist device = assistive devices; cog fxn = cognitive function; CVD = cardiovascular disease; EtOH/drugs = alcohol and drug use; Diag = diagnosis; Environ = environment; exam = examination; fxn = function; incont = incontinence; meds = medications; nutr = nutrition; ortho hypo = orthostatic hypotension.

Figure 8. Referrals/Recommendations as Indicated by the Assessment Results for Multifactorial Interventions

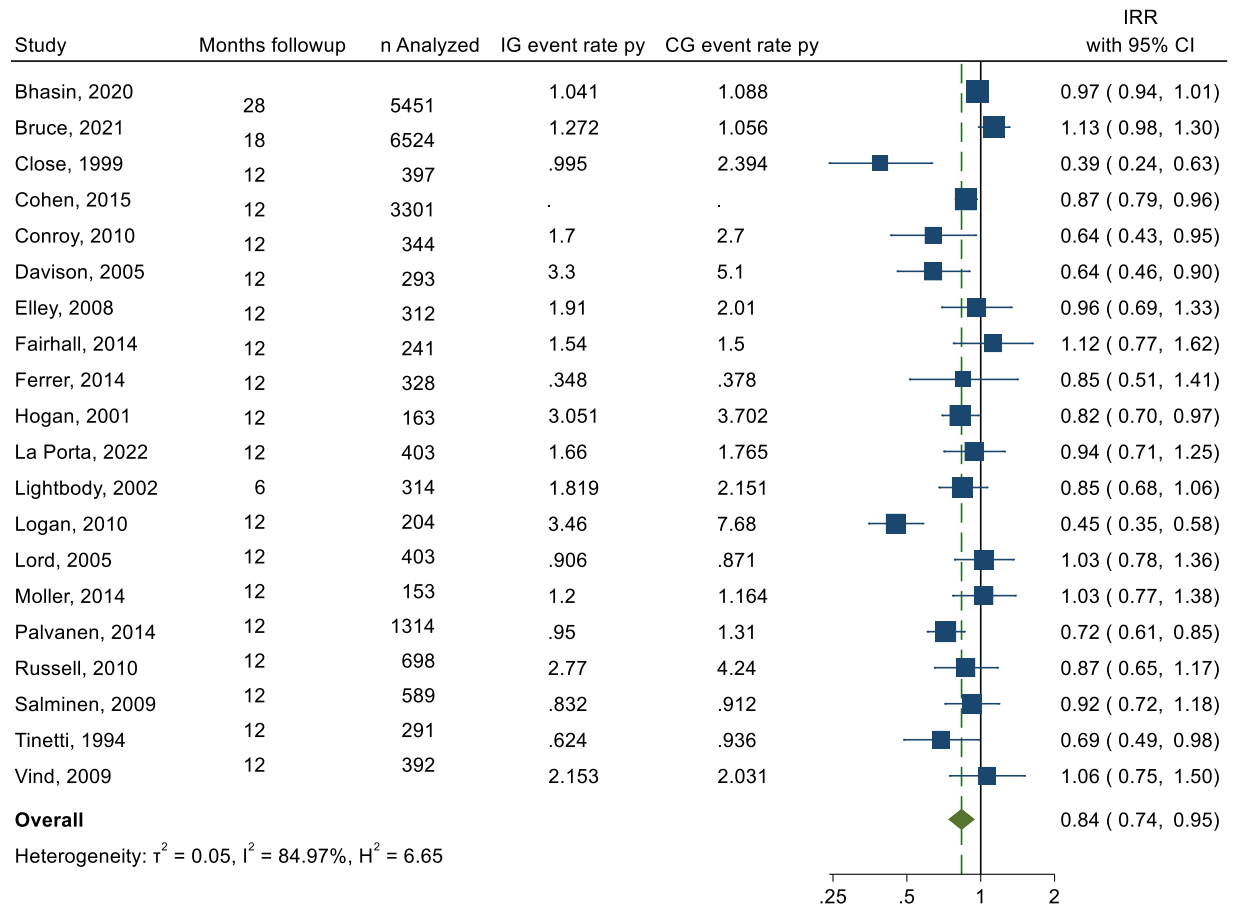
Author Year	Environ	Exer	Meds	Vision/Aud	PCP	OT	Assist devices	Pod	Nut	EtOH	CVD	Neuro	Osteo tx	Psych	Unspec
Bhasin, 2020	X	X	X	X	X			X					X		
Bruce, 2021	X	X	X	X	X	X		X							
Ciaschini, 2009		X	X			X									
Close, 1999	X		X												X
Cohen, 2015	X				X										
Conroy, 2010	X														X
Davison, 2005	X	X		X			X	X							
de Vries, 2010	X	X		X	X										X
Elley, 2008	X	X		X	X	X									X
Fairhall, 2014		X	X			X	X		X					X	X
Ferrer, 2014	X	X		X					X						X
Hendriks, 2008	X				X		X								
Hogan, 2001	X	X		X						X					X
Imhof, 2012															X
La Porta, 2022				X	X			X			X				X
Lightbody, 2002			X	X				X							X
Logan, 2010			X												
Lord, 2005		X		X											
Moller, 2014		X				X									X
Palvanen, 2014		X	X				X		X	X					X
Perula, 2012	X														
Russell, 2010		X			X	X	X	X	X						X
Salminen, 2009			X												
Spice, 2009	X	X	X	X		X									X
Tinetti, 1994	X	X	X												
van Haastregt, 2000	X														X
Vind, 2009		X	X	X							X	X			X
Wagner, 1994	X	X	X	X	X					X					

Abbreviations: environ = environment; exer = exercise; meds = medications; aud = auditory; PCP = primary care practitioner; OT = occupational therapist; assist devices = assistive devices; pod = podiatry; nut = nutrition; EtOH = alcohol; CVD = cardiovascular disease; neuro = neurology; psych = psychiatry; unspec = unspecified.

Figure 9. Components Delivered to All Intervention Participants for Multifactorial Interventions

Author Year	Advice	Environment	Educational materials	Exercise	Falls education	Counseling
Bhasin, 2020	X					X
Bruce, 2021	X					
Ciaschini, 2009	X		X			
Close, 1999	X	X				
Cohen, 2015	X		X	X		X
Conroy, 2010	X		X	X	X	
Davison, 2005	X					
de Vries, 2010	X					
Elley, 2008	X	X	X	X		
Fairhall, 2014	X					
Ferrer, 2014	X	X	X			
Hendriks, 2008	X	X				
Hogan, 2001	X					
Imhof, 2012	X					X
La Porta, 2022	X	X		X	X	
Lightbody, 2002	X	X				
Logan, 2010	X	X		X	X	
Lord, 2005	X					
Moller, 2014	X	X		X		
Palvanen, 2014	X	X		X		
Perula, 2012	X		X	X	X	
Russell, 2010	X					
Salminen, 2009	X	X	X	X	X	
Spice, 2009	X					
Tinetti, 1994	X					
van Haastregt, 2000	X	X				
Vind, 2009	X					
Wagner, 1994	X					

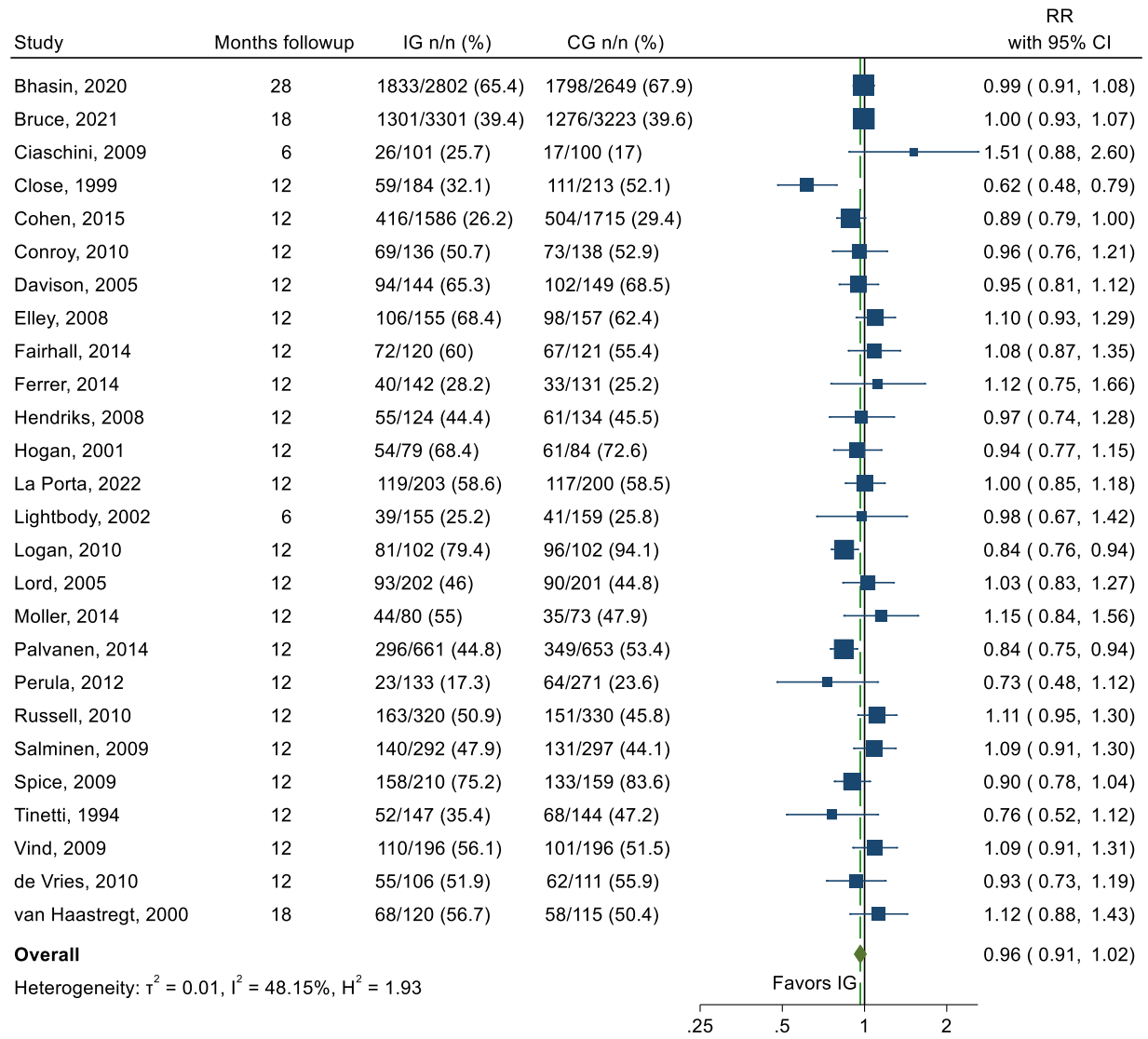
Figure 10. Key Question 1: Pooled Analysis of the Number of Falls at the Longest Followup for Multifactorial Interventions (k=20, n=22,115)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; p-y = person-year.

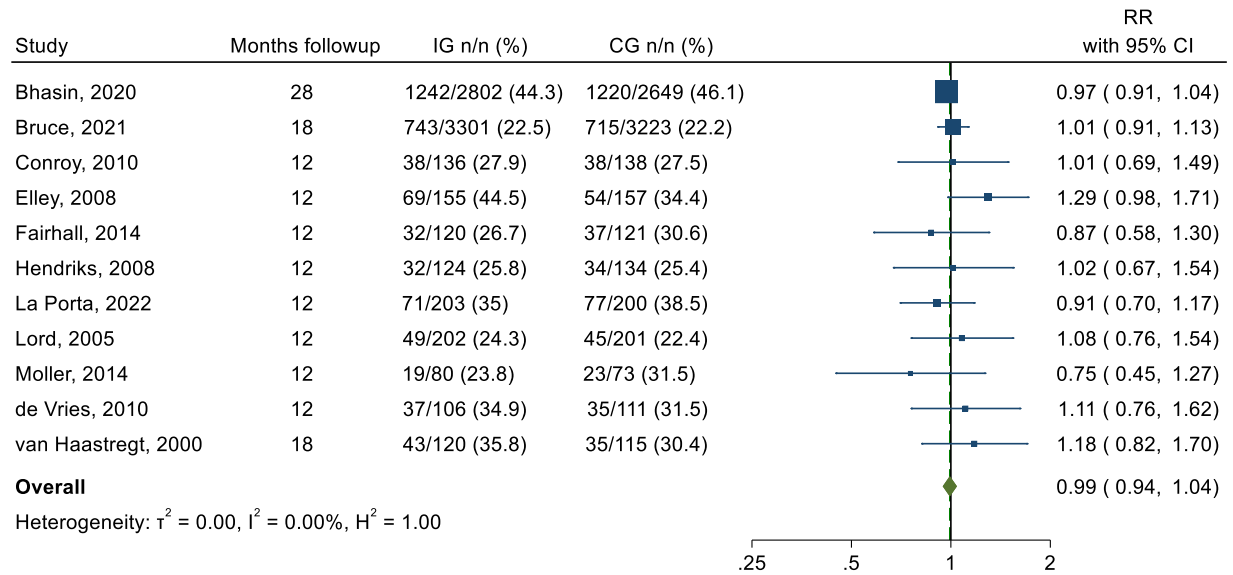
Figure 11. Key Question 1: Pooled Analysis of People With 1 or More Falls at the Longest Followup for Multifactorial Interventions (k=26, n=23,626)



Random-effects REML model
Knapp-Hartung standard errors

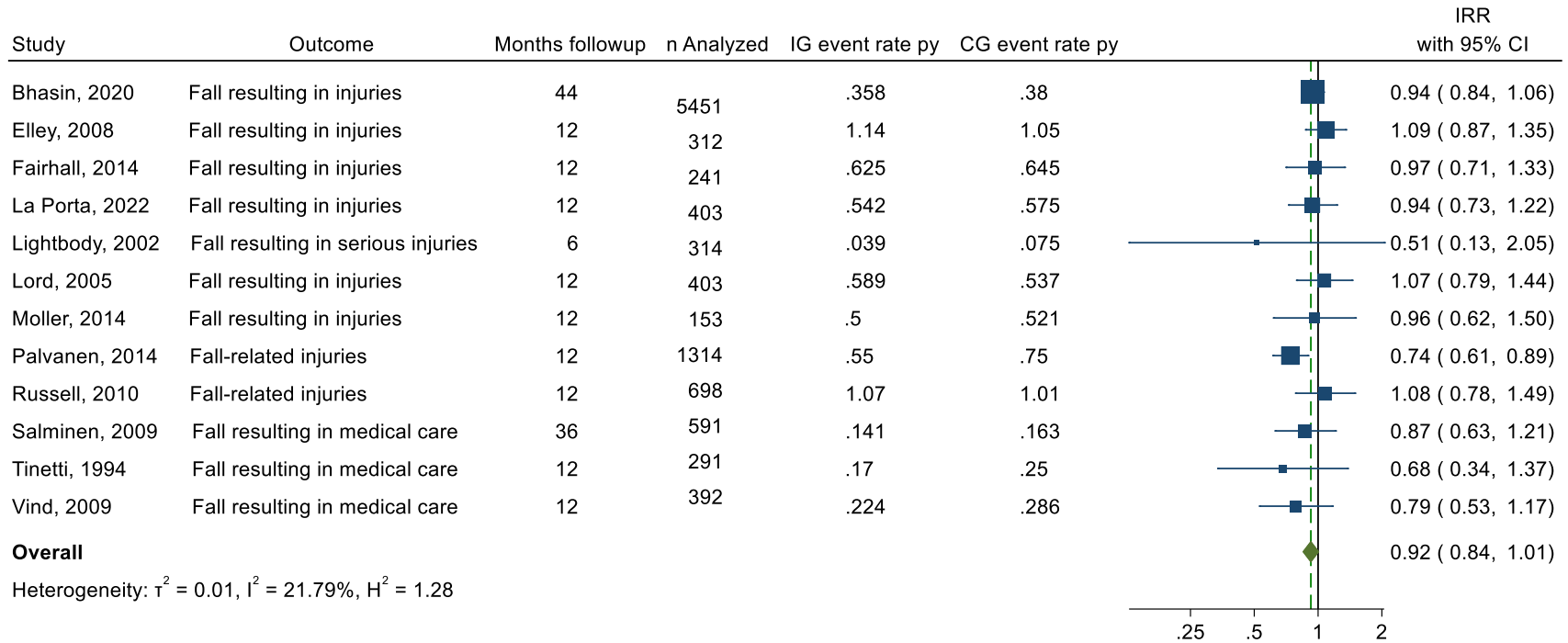
Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 12. Key Question 1: Pooled Analysis of People With 2 or More Falls at the Longest Followup for Multifactorial Interventions (k=11, n=14,471)



Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

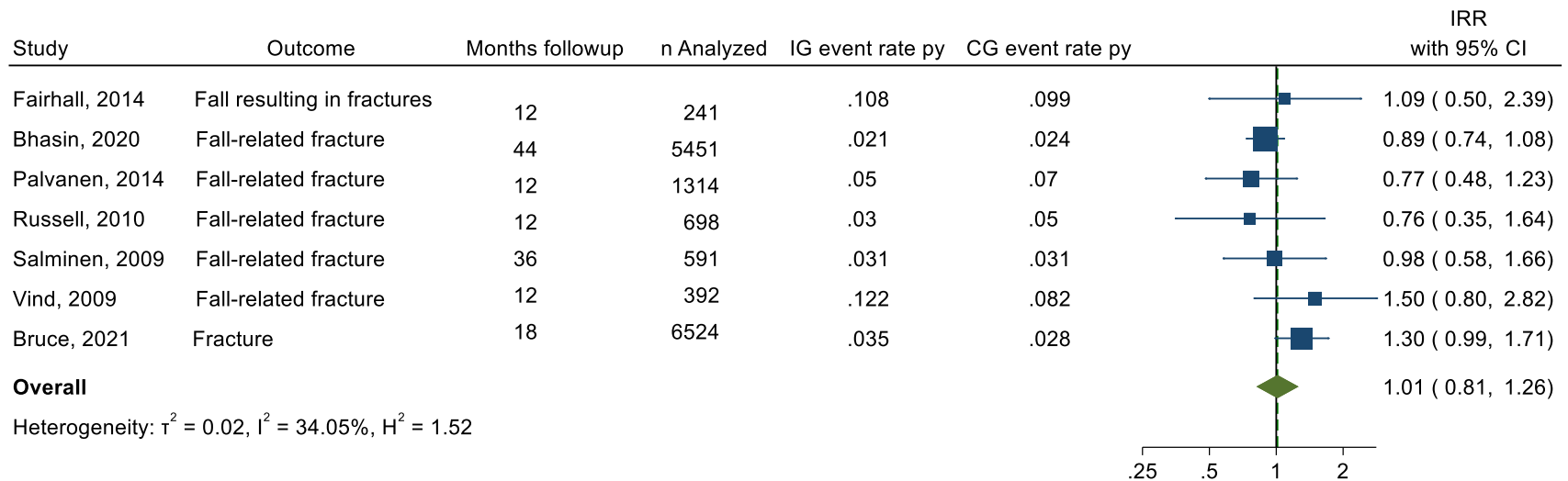
Figure 13. Key Question 1: Pooled Analysis of the Number of Falls Resulting in Injury or Medical Care at the Longest Followup for Multifactorial Interventions (k=12, n=10,563)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

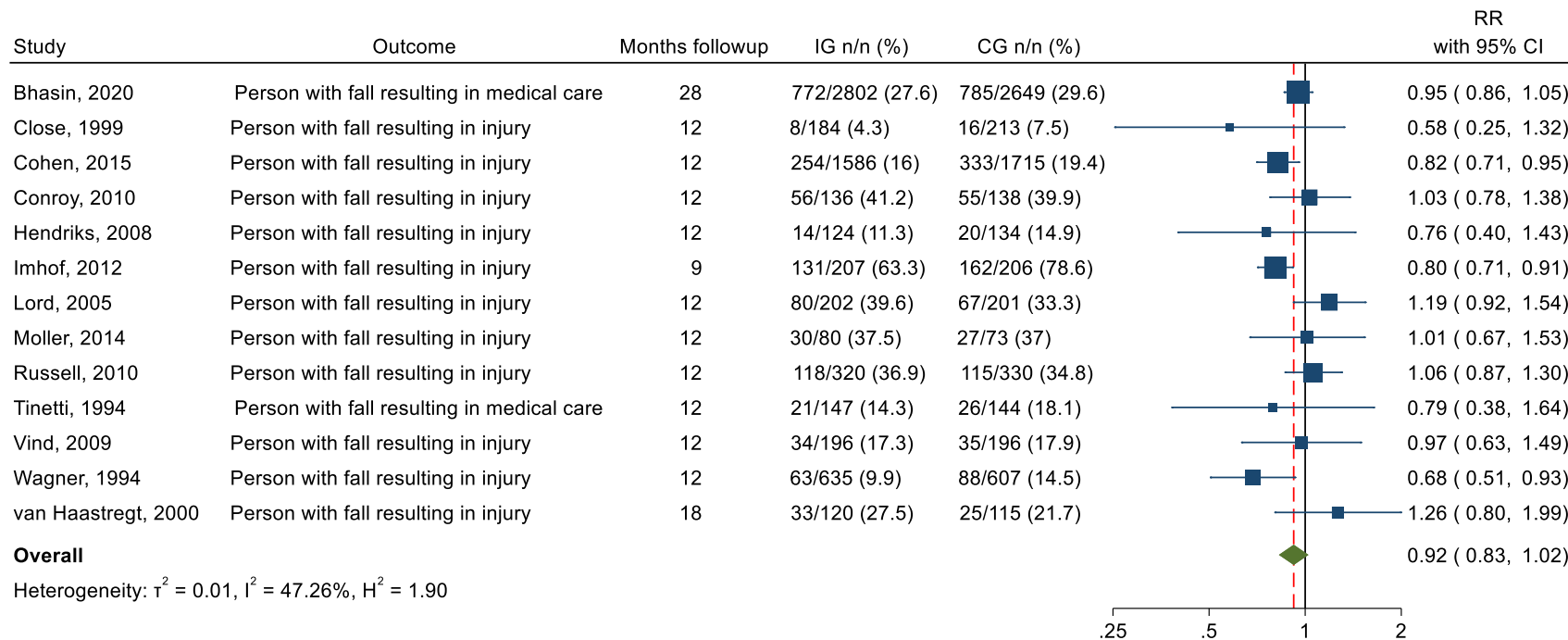
Figure 14. Key Question 1: Pooled Analysis of the Number of Fall-Related Fractures at the Longest Followup for Multifactorial Interventions (k=7, n=15,211)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

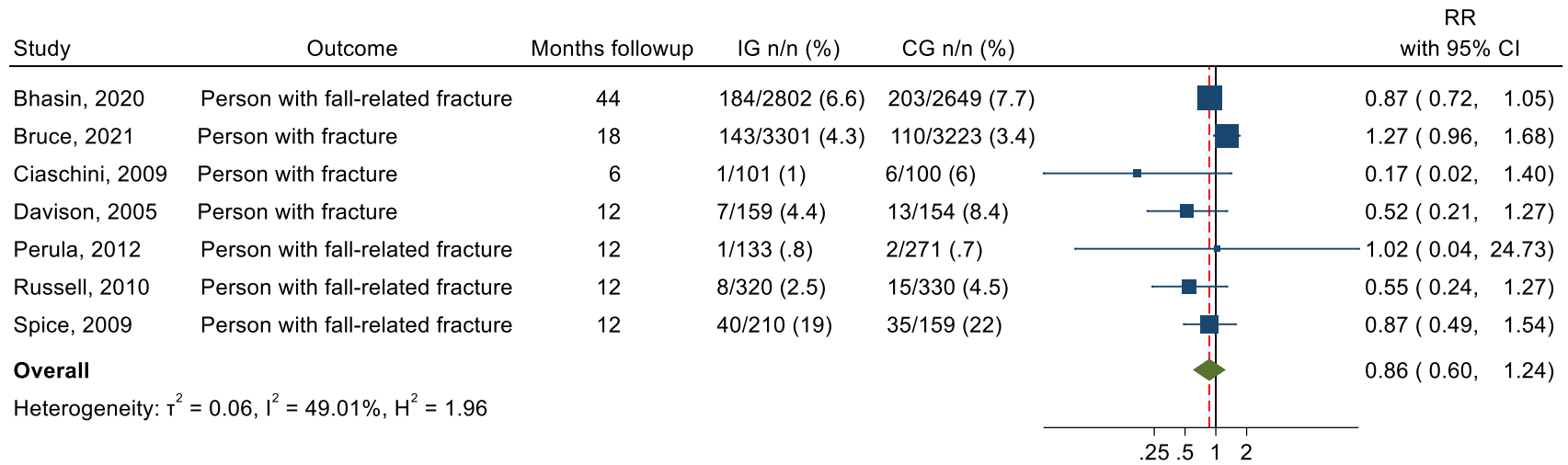
Figure 15. Key Question 1: Pooled Analysis of People With a Fall Resulting in Injury or Medical Care at the Longest Followup for Multifactorial Interventions (k=13, n=13,460)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

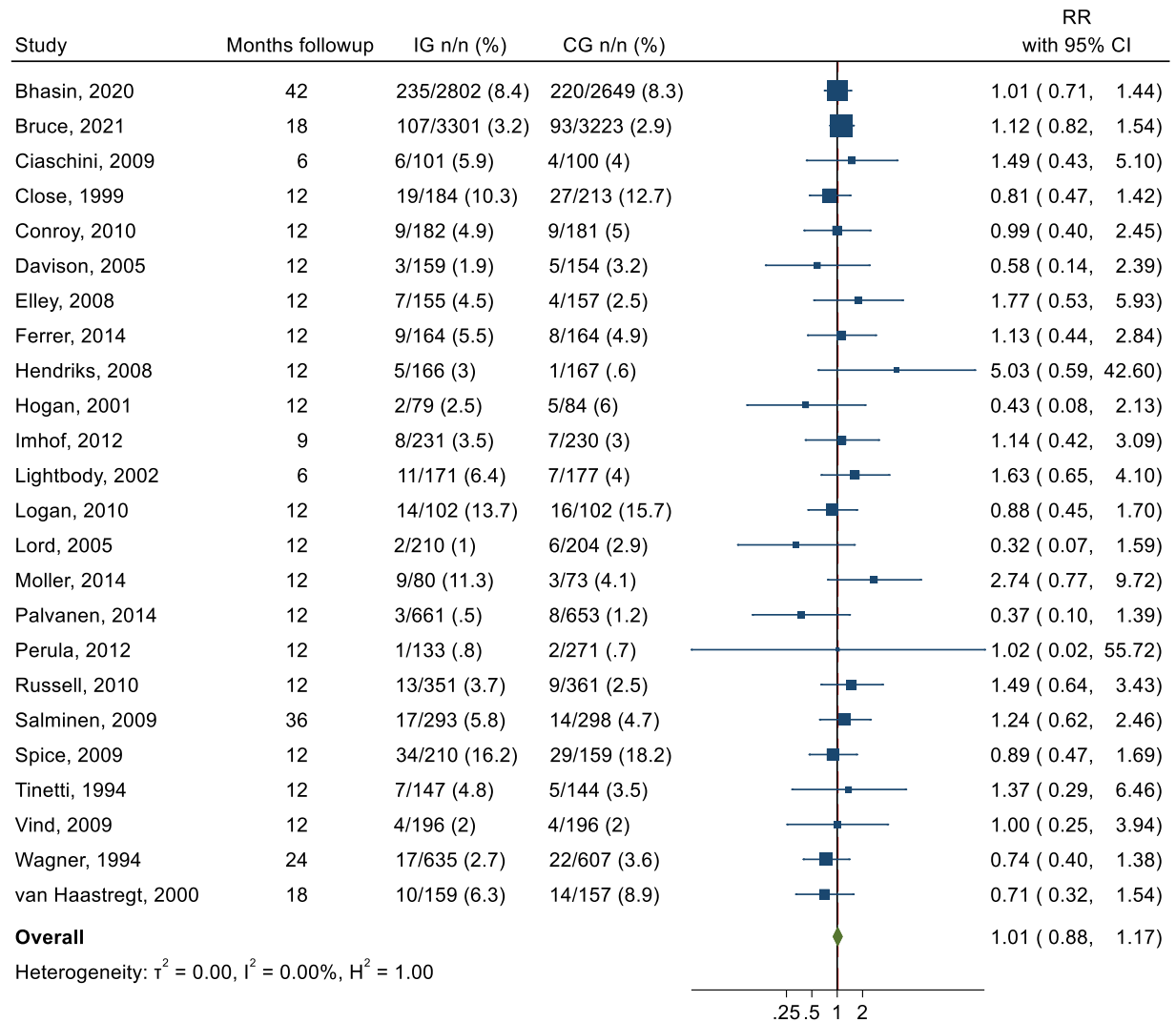
Figure 16. Key Question 1: Pooled Analysis of People With Fall-Related Fractures at the Longest Followup for Multifactorial Interventions (k=7, n=13,912)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 17. Key Question 1: Pooled Analysis of Mortality at the Longest Followup for Multifactorial Interventions (k=24, n=21,596)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 18. Baseline Fall Risk Ascertainment for Exercise Interventions

Author, year	% at increased risk	Fall history	Hospital/ED	Physical function	Osteoporosis/ osteopenia	Medications	Frailty	Fear of falling	Self-rated health	Other	NR
Uusi-Rasi, 2015	100	×									
Tuvelo Johnson, 2021	100									×	
Trombetti, 2011	100	×		×			×				
Tomita, 2016	100		×								
Suikkanen, 2021	100						×				
Stathi, 2022	100			×							
Siegrist, 2016	100	×		×				×			
Sherrington, 2014	100		×								
Rosado, 2021	100	×		×							
Ohman, 2016	100	×		×			×				
Ng, 2015	100						×				
Morgan, 2004	100		×							×	
Miko, 2018	100	×			×					×	
Luukinen, 2007	100	×		×					×	×	
Logghe, 2009	100	×		×		×				×	
Kronhed, 2009	100				×						
Korpelainen, 2006	100				×						
El-Khoury, 2015	100			×							
Chyu, 2010	100				×						
Barnett, 2003	100			×							
Rikkonen, 2023	59				×						
Campbell, 1997	51	×									
Lipsitz, 2019	48	×									
Bruce, 2021	43	×		×							
Kovacs, 2013	38	×									
Delbaere 2021	38	×									
Robertson, 2001	37	×									
Callisaya, 2021	35	×									
Voukelatos, 2007	33	×									
Lamb, 2018	30	×									
Oliveira, 2019	28	×									
Merom, 2016	28	×									
Buchner, 1997	25	×									
Voukelatos, 2015	22	×									
Fitzharris, 2010	6	×									
Karinkanta, 2015	NR										×
Goldberg 2019	NR										×

Abbreviations: ED = emergency department; NR = not reported.

Figure 19. Delivery Mode for Exercise Interventions

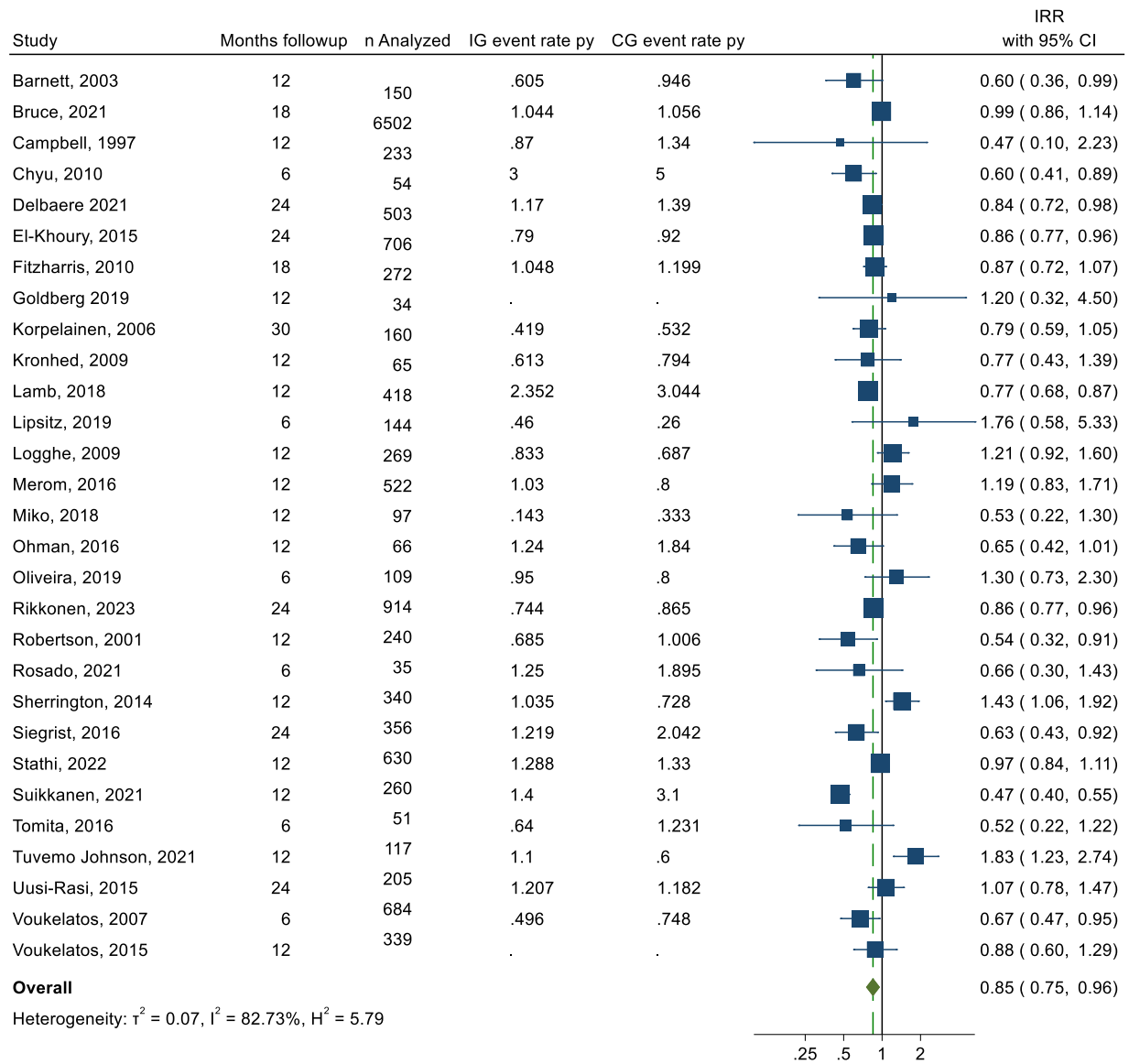
Author year	Supervised group classes	Supervised individual	Unsupervised individual
Barnett, 2003	X		X
Bruce, 2021		X	X
Buchner, 1997	X		X
Callisaya, 2021			X
Campbell, 1997		X	X
Chyu, 2010	X		
Delbaere 2021			X
El-Khoury, 2015	X		X
Fitzharris, 2010	X		X
Goldberg 2019		X	X
Karinkanta, 2015	X		
Korpelainen, 2006	X		X
Kovacs, 2013	X		
Kronhed, 2009	X		
Lamb, 2018	X		X
Lipsitz, 2019	X		X
Logghe, 2009	X		X
Luukinen, 2007	X		X
Merom, 2016	X		
Miko, 2018		X	X
Morgan, 2004	X		
Ng, 2015	X		X
Ohman, 2016	X	X	
Oliveira, 2019			X
Rikkonen, 2023	X	X	
Robertson, 2001		X	X
Rosado, 2021	X		
Sherrington, 2014		X	X
Siegrist, 2016	X		X
Stathi, 2022	X		
Suikkanen, 2021		X	X
Tomita, 2016	X		
Trombetti, 2011	X		
Tuvemo Johnson, 2021		X	X
Uusi-Rasi, 2015	X		X
Voukelatos, 2007	X		
Voukelatos, 2015			X

Figure 20. Components of Exercise Interventions

Author, year	Gait, balance, functional training	Strength/resistance	General PA	Flexibility	Endurance	3D	Behavioral counseling	Cognitive task exercises
Barnett, 2003	X	X			X			
Bruce, 2021	X	X	X					
Buchner, 1997	X	X	X		X			
Callisaya, 2021	X	X						X
Campbell, 1997	X	X	X	X	X		X	
Chyu, 2010						X		
Delbaere 2021	X							
El-Khoury, 2015	X			X				
Fitzharris, 2010	X			X				
Goldberg 2019	X	X	X				X	X
Karinkanta, 2015	X	X						
Korpelainen, 2006	X	X						
Kovacs, 2013	X	X		X				
Kronhed, 2009	X	X						
Lamb, 2018	X	X	X		X		X	
Lipsitz, 2019						X		
Logghe, 2009						X		
Luukinen, 2007	X		X	X				
Merom, 2016						X		
Miko, 2018	X	X	X					
Morgan, 2004	X	X		X				
Ng, 2015	X	X						
Ohman, 2016	X	X			X			
Oliveira, 2019			X				X	
Rikkonen, 2023	X	X				X		
Robertson, 2001	X	X	X					
Rosado, 2021	X			X				X
Sherrington, 2014	X	X					X	
Siegrist, 2016	X	X	X				X	
Stathi, 2022	X	X					X	
Suikkanen, 2021	X	X	X	X	X			
Tomita, 2016	X	X						
Trombetti, 2011	X							
Tuvemo Johnson, 2021	X	X	X				X	
Uusi-Rasi, 2015	X	X						
Voukelatos, 2007						X		
Voukelatos, 2015			X				X	

Abbreviations: 3D = tai chi; PA = physical activity.

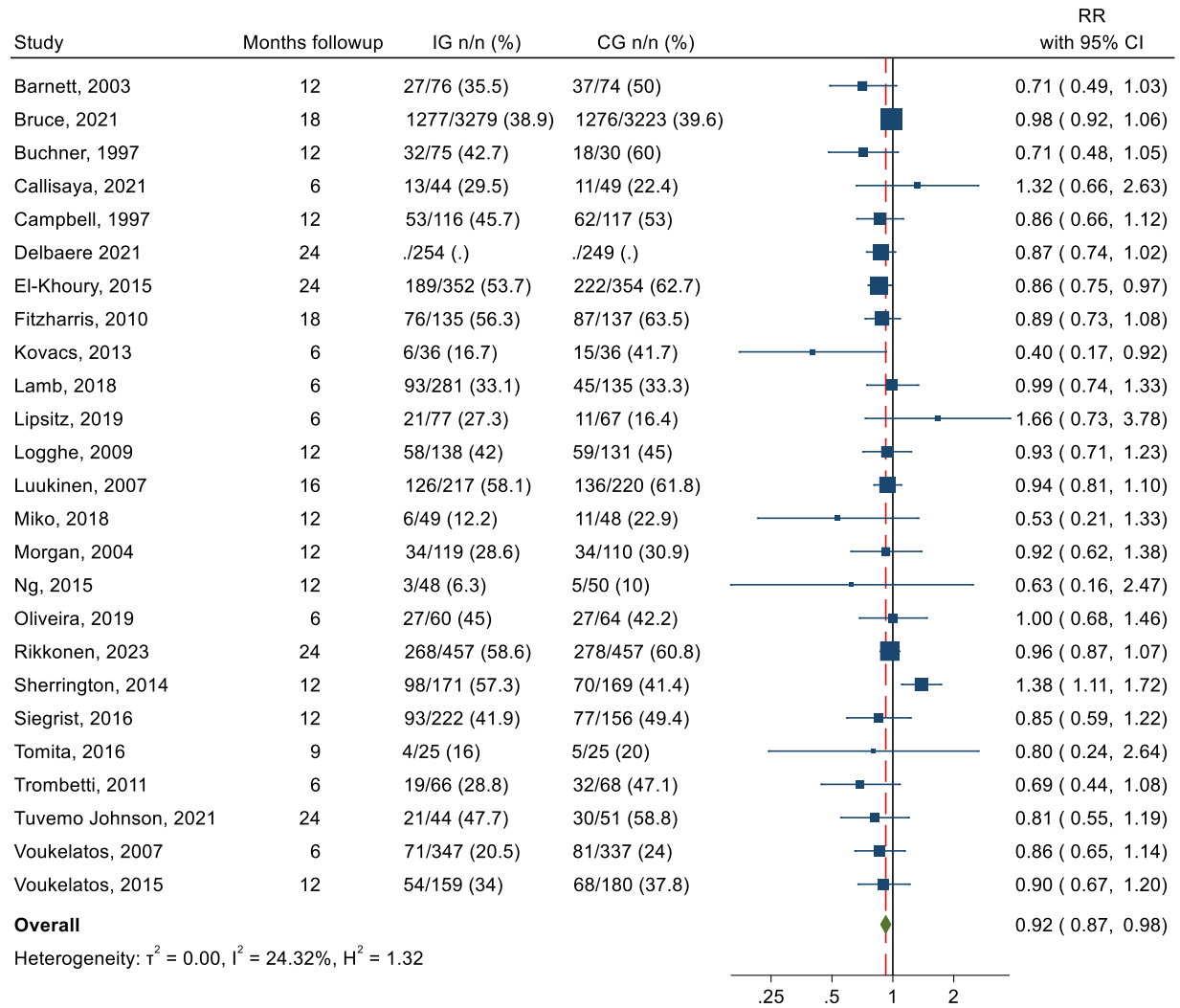
Figure 21. Key Question 1: Pooled Analysis of the Number of Falls at the Longest Followup for Exercise Interventions (k=29, n=14,475)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

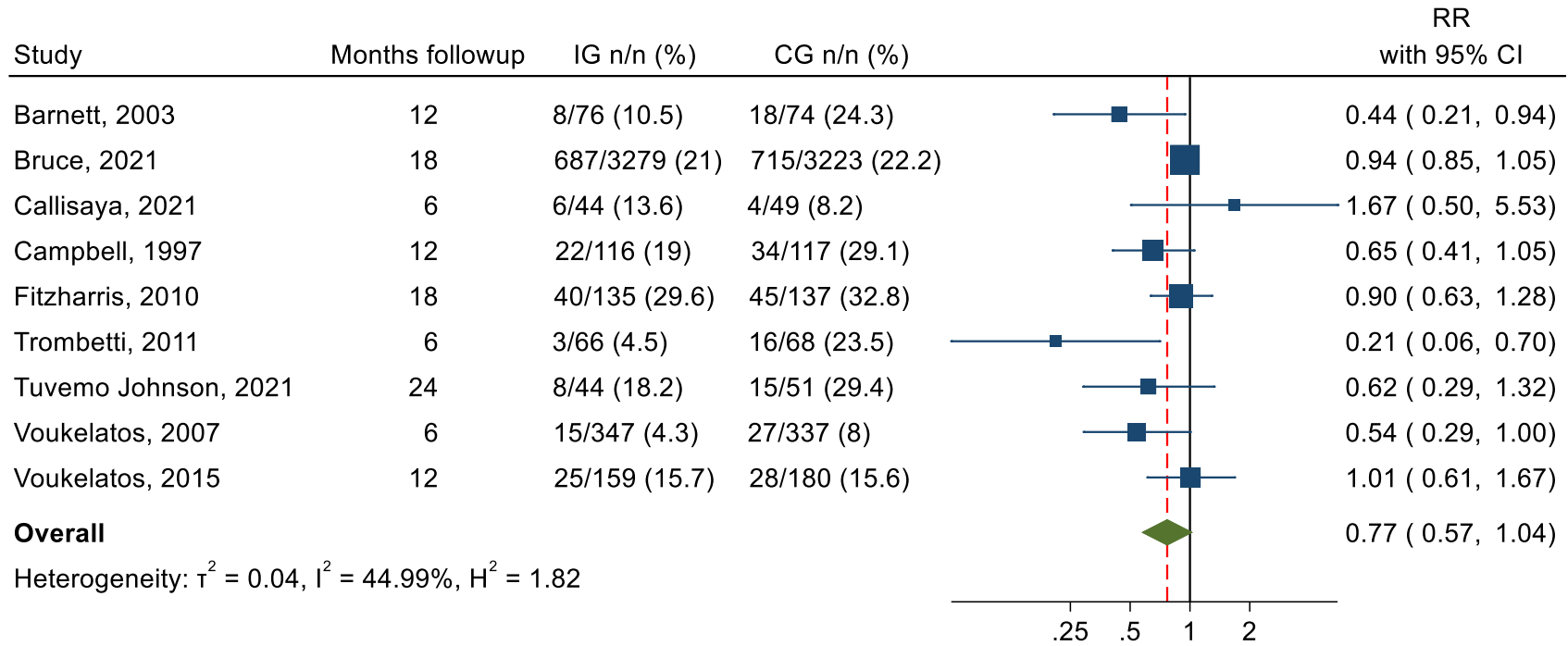
Figure 22. Key Question 1: Pooled Analysis of People With 1 or More Falls at the Longest Followup for Exercise Interventions (k=25, n=13,384)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

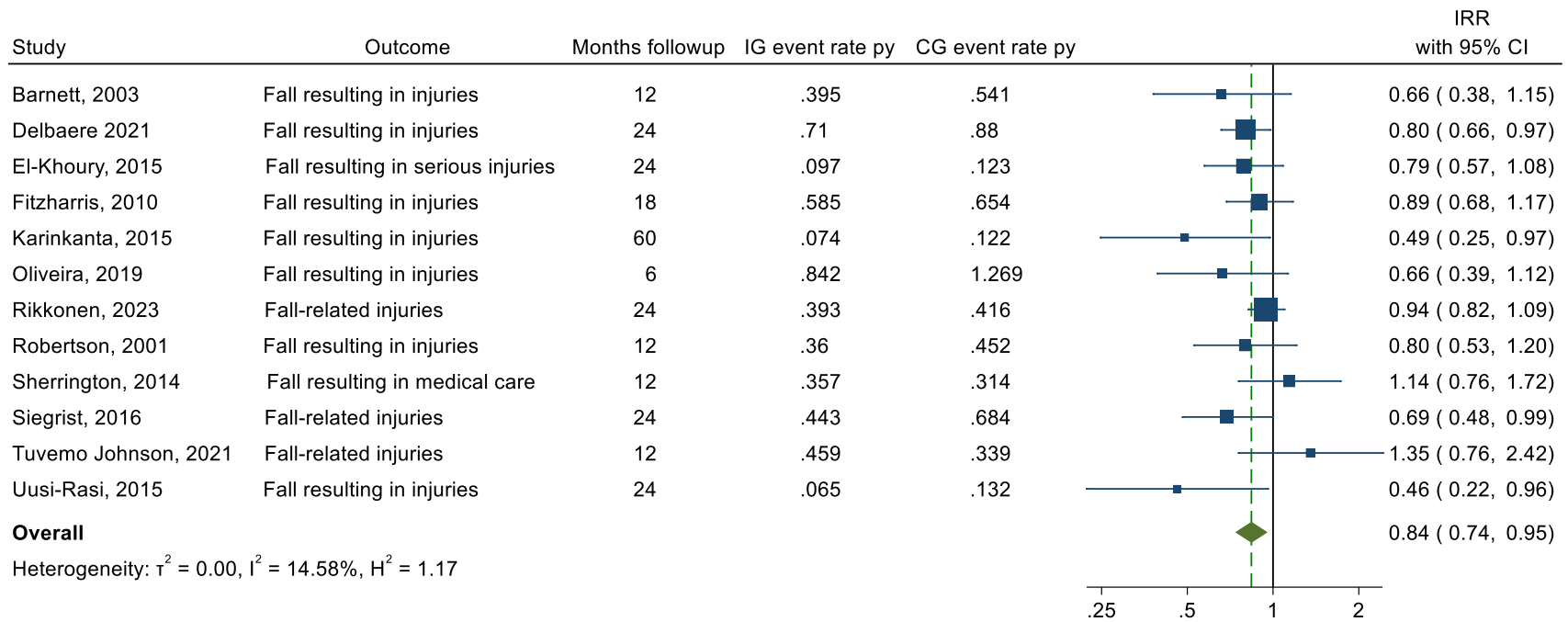
Figure 23. Key Question 1: Pooled Analysis of People With 2 or More Falls at the Longest Followup for Exercise Interventions (k=9, n=8,502)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

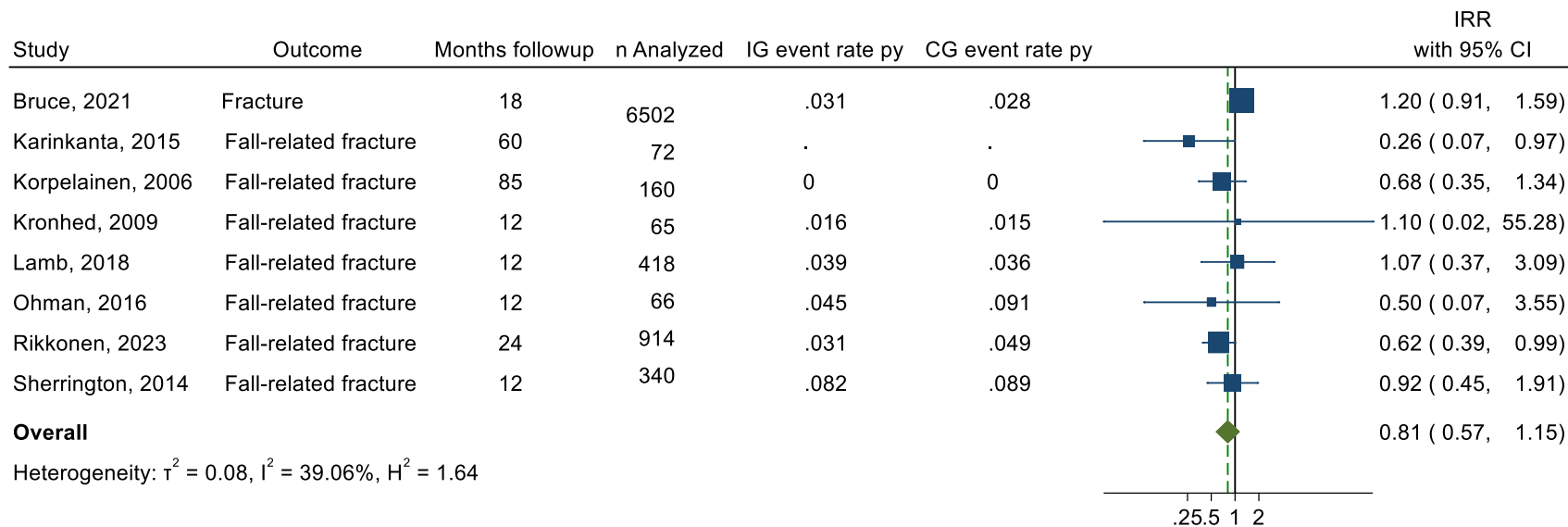
Figure 24. Key Question 1: Pooled Analysis of the Number of Falls Resulting in Injury or Medical Care at the Longest Followup for Exercise Interventions (k=12, n=3,984)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

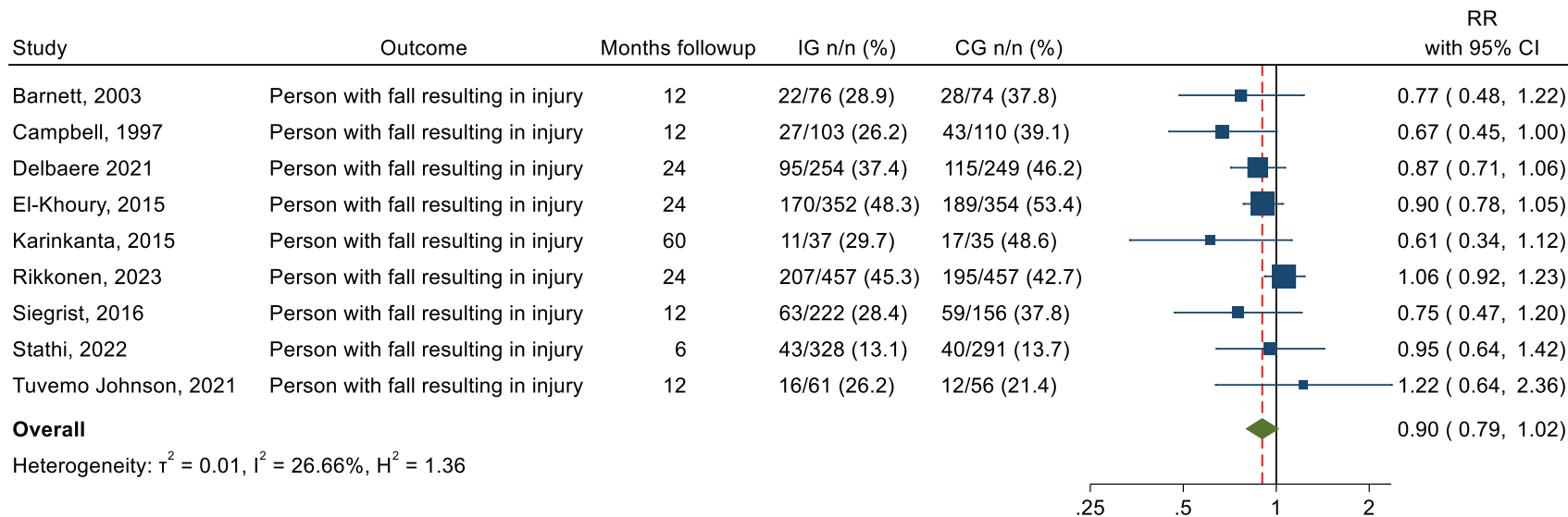
Figure 25. Key Question 1: Pooled Analysis of the Number of Fall-Related Fractures at the Longest Followup for Exercise Interventions (k=8, n=8,537)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

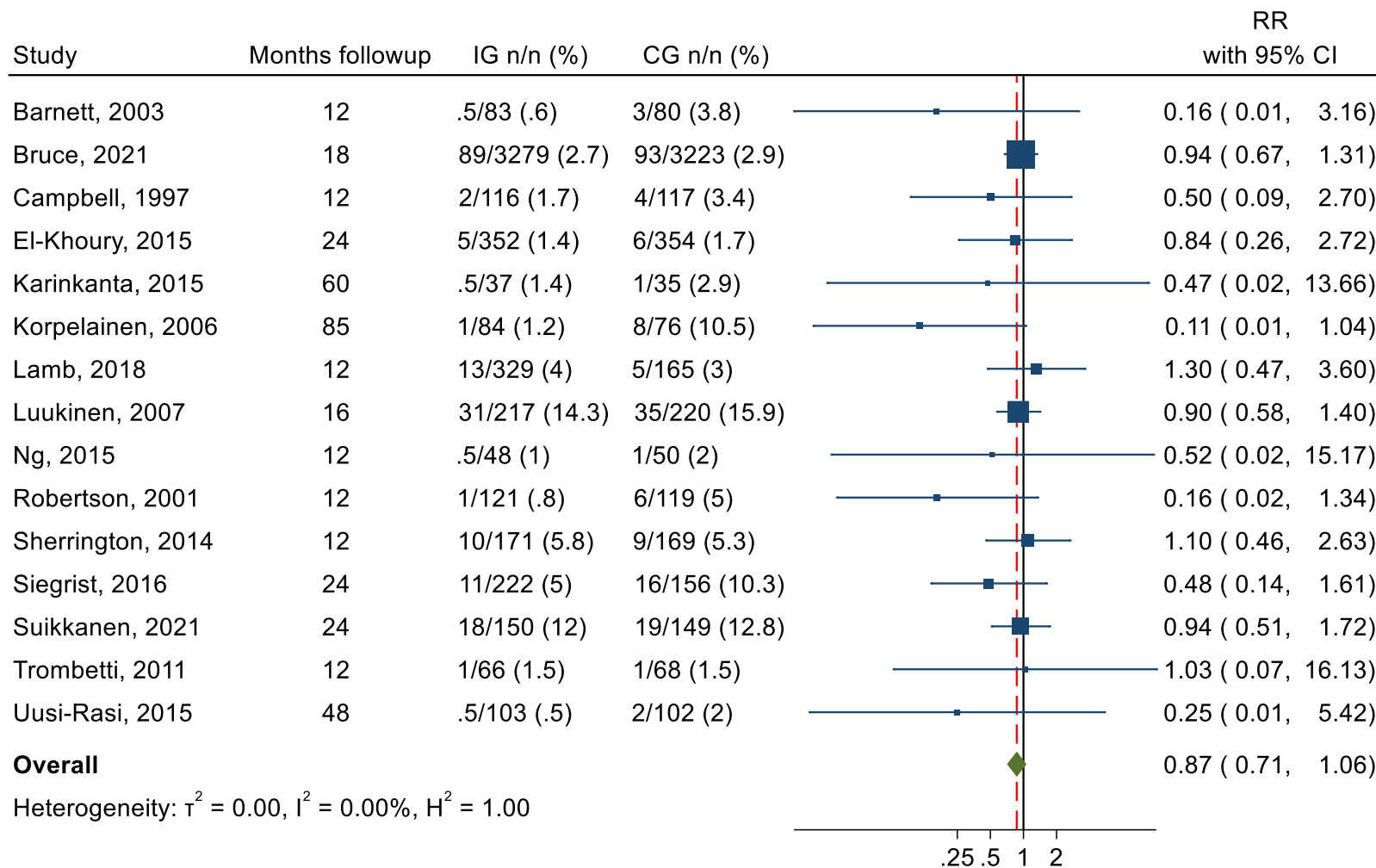
Figure 26. Key Question 1: Pooled Analysis of People With a Fall Resulting in Injury or Medical Care at the Longest Followup for Exercise Interventions (k=9, n=3,924)



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 27. Key Question 1: Pooled Analysis of Mortality at the Longest Followup for Exercise Interventions (k=15, n=10,461)



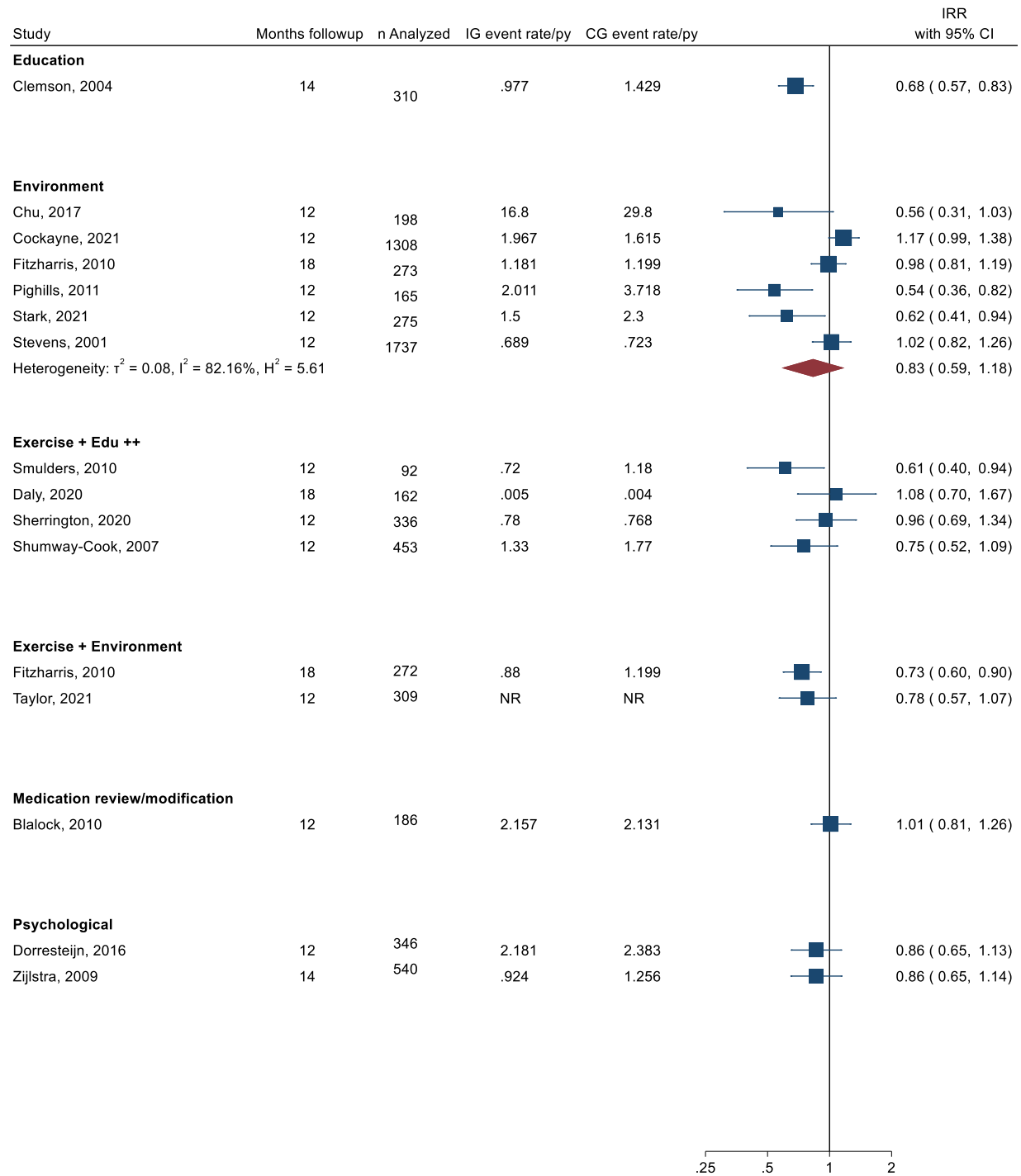
Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 28. Baseline Fall Risk Ascertainment for Other Intervention Groups

Intervention	Author, year	% at increased risk	Fall history	Hospital/ED	Physical function	Osteoporosis/ osteopenia	Medications	Fear of falling	Self-rated health	Other	NR
Exercise + Education + Other	Daly, 2020	100				X				X	
	Sherrington, 2020	100								X	
	Smulders, 2010	100	X			X					
	Shumway-Cook, 2007	27	X								
Exercise + Environment	Matchar, 2017	100		X							
	Taylor, 2021	52.8	X								
	Fitzharris, 2010	6	X								
Environment Assessment	Chu, 2017	100		X							
	Pighills, 2011	100	X								
	Stark, 2021	100	X					X			
	Stevens, 2001	27	X								
	Fitzharris, 2010	6	X								
	Cockayne, 2021	86	X			X					
Medication Review/Modification	Blalock, 2010	100	X				X				
	Boye, 2017	100		X							
	Mott, 2016	100	X								
	Romskaug, 2020	NR									X
Psychological	Dorresteijn, 2016	100						X	X		
	Lim, 2023	100			X			X			
	Zijlstra, 2009	100						X			
Education	Clemson, 2004	100	X								

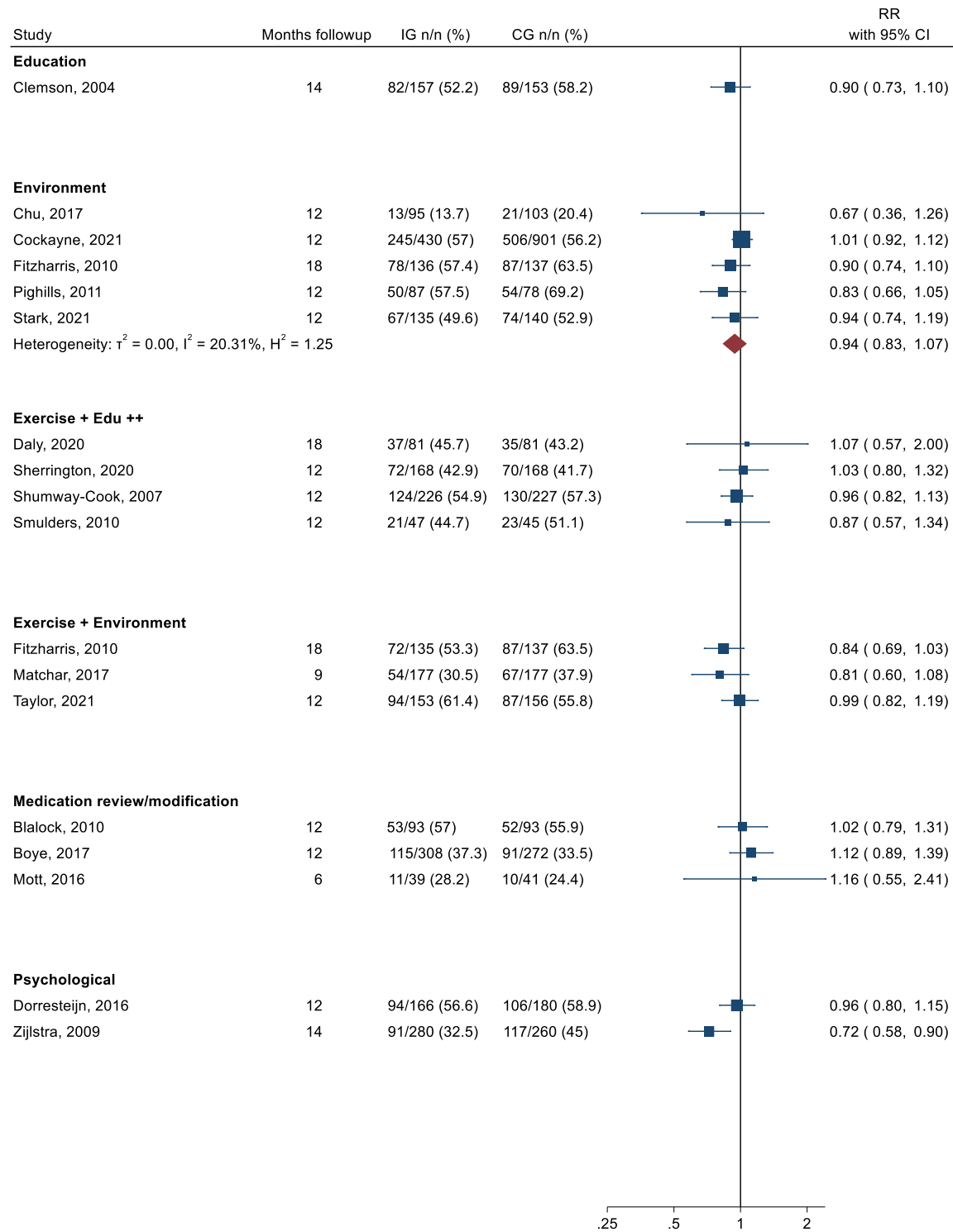
Figure 29. Key Question 1: Pooled Analysis of the Number of Falls at the Longest Followup for Other Interventions



Random-effects REML model
Knapp-Hartung standard errors

Abbreviations: CI = confidence interval; CG = control group; Edu = education; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

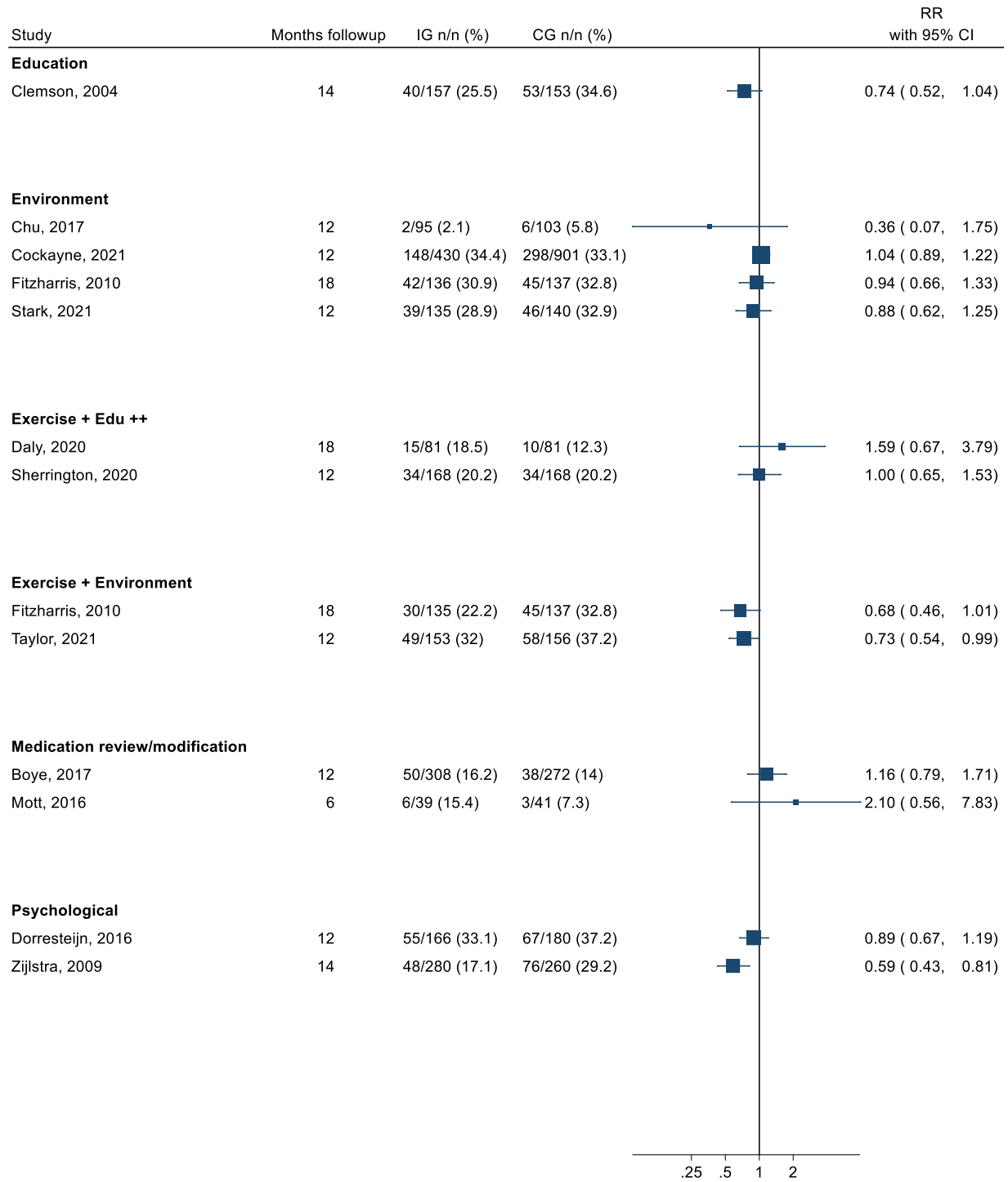
Figure 30. Key Question 1: Pooled Analysis of People With 1 or More Falls at the Longest Followup for Other Interventions



Random-effects REML model
Knapp-Hartung standard errors

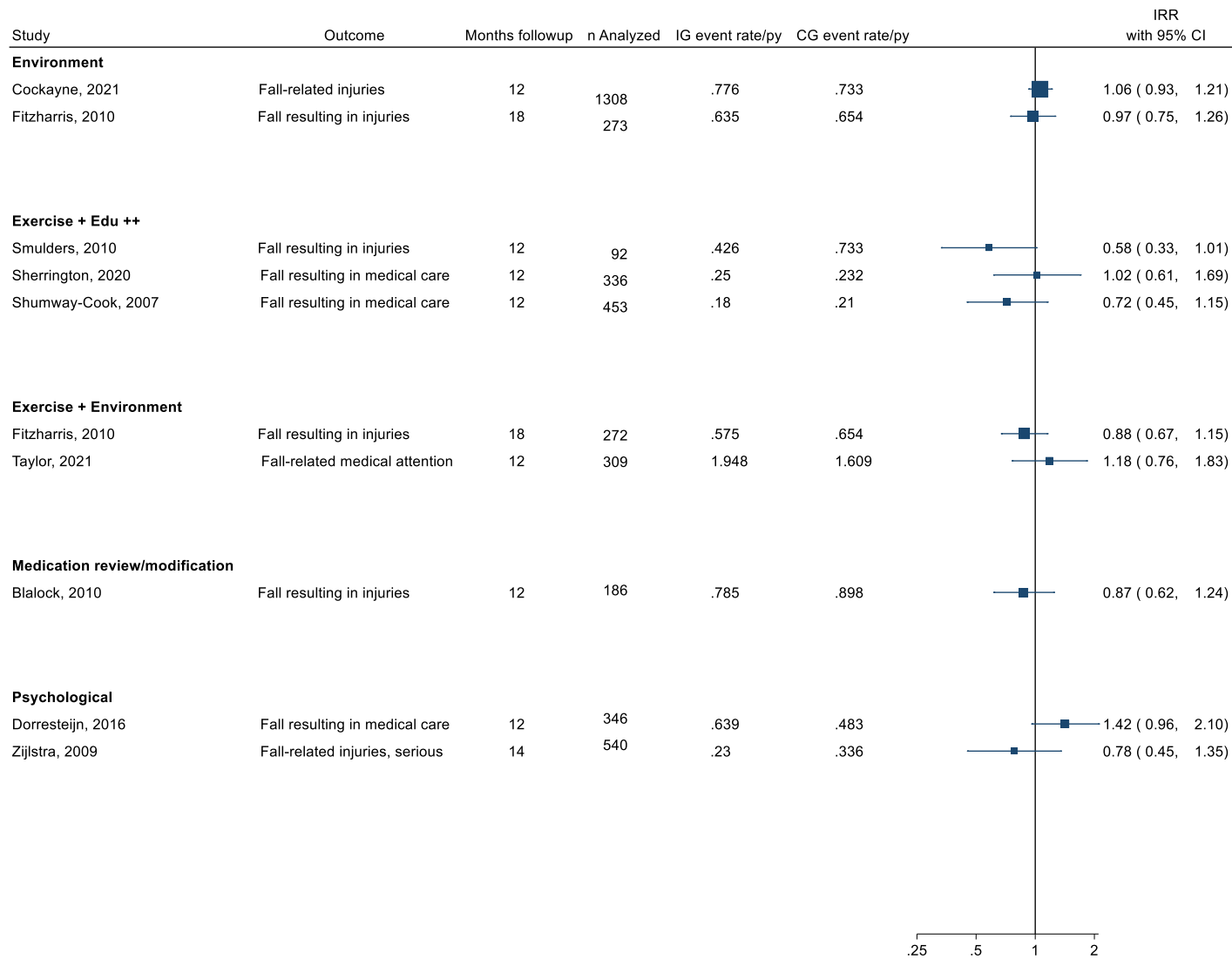
Abbreviations: CG = control group; CI = confidence interval; Edu = education; IG = intervention group; n = number; RR = relative risk.

Figure 31. Key Question 1: Forest Plot of People With 2 or More Falls at the Longest Followup for Other Interventions



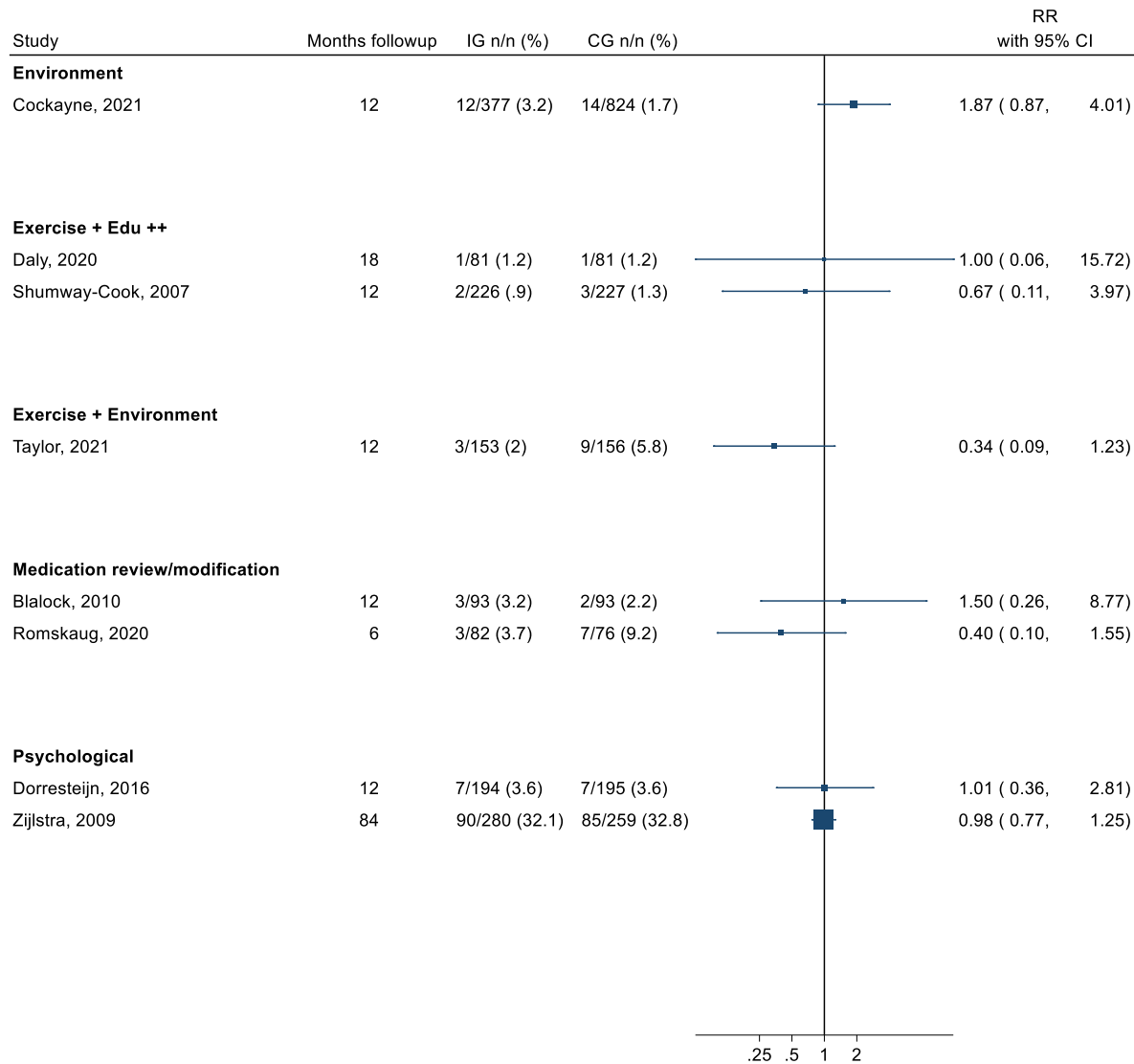
Abbreviations: CG = control group; CI = confidence interval; Edu = education; IG = intervention group; n = number; RR = relative risk.

Figure 32. Key Question 1: Forest Plot of the Number of Falls Resulting in Injury or Medical Care at the Longest Followup for Other Interventions



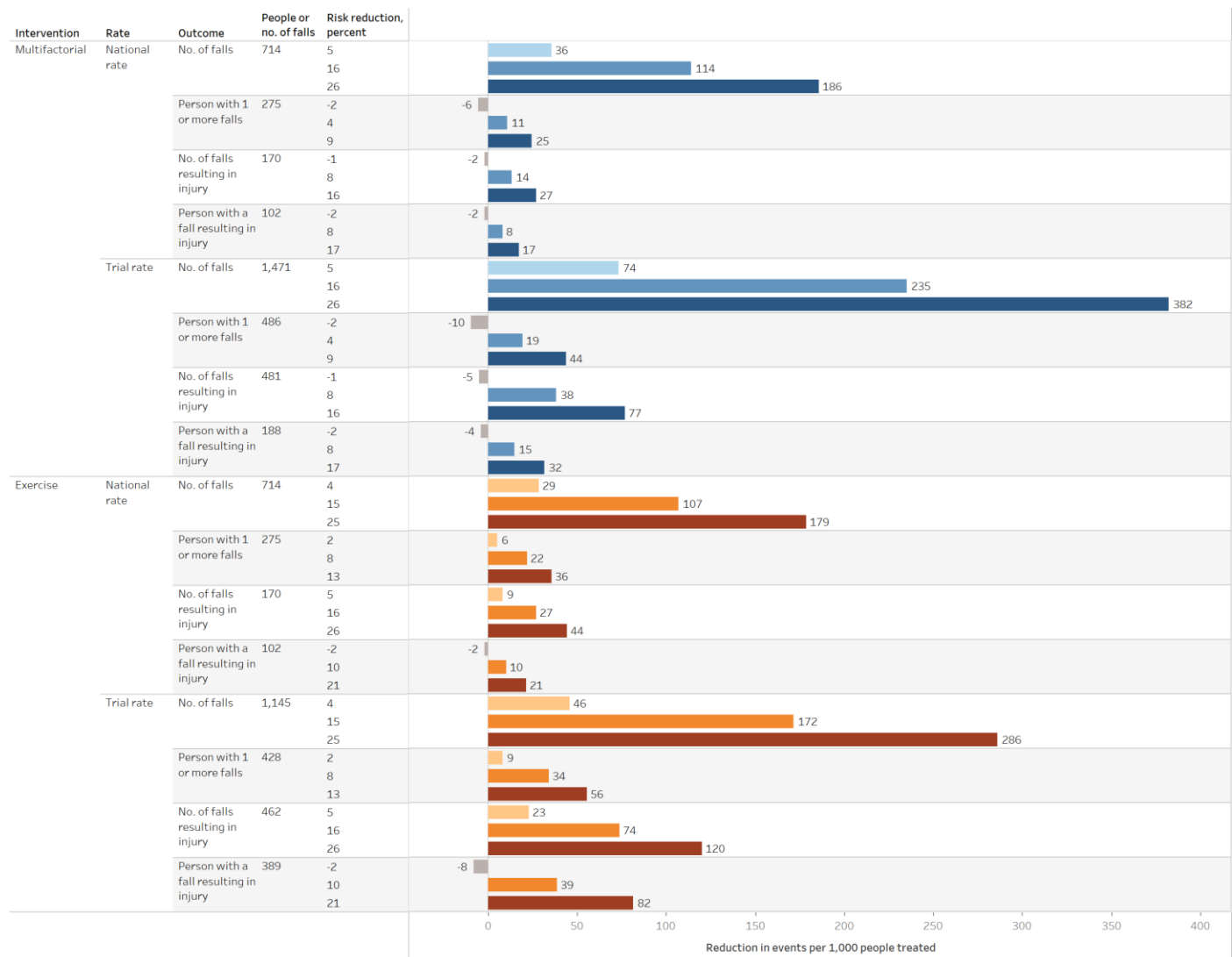
Abbreviations: CI = confidence interval; CG = control group; IG = intervention group; IRR = incidence rate ratio; n = number; p-y = person-year.

Figure 33. Key Question 1: Forest Plot of Mortality at the Longest Followup for Other Interventions



Abbreviations: CG = control group; CI = confidence interval; IG = intervention group; n = number; RR = relative risk.

Figure 34. Absolute Reduction in Falls and Falls Resulting in Injury*



* In a hypothetical population of 1,000 older adults with a fall rate of 714 falls/1,000 person-years, 27.5% older adults with a fall, fall injury rate of 170 fall injuries/1,000 person-years, and 10.2% older adults with a fall injury (based on 2018 BRFSS data,⁴) and using the lower confidence interval, point estimate, and upper confidence interval from our pooled results, this figure estimates the reductions in the fall-related events/people.

Table 1. Fall Risk Screening Tools Feasible for Primary Care*

Screening tool	Brief description of screening tool	K	N	Cutoff score	AUC, range†	Sensitivity, range	Specificity, range
Timed Up and Go test (TUG)	Participants are asked to stand up from a chair, walk 3 meters, turn, walk 3 meters back, and sit down again. The time taken to perform this task indicates high or low risk of falls.	12	5,240	Varied	0.46 to 0.89	0.10 to 0.83‡	0.28 to 0.97‡
Gait Speed test (4 m)	Participants are asked to walk 4 meters at their usual pace. The time taken to complete the task is recorded, and Gait Speed is calculated (m/s).	1	541	NR	0.54 to 0.68	NR	NR
		2	118	0.67 m/s to ≥18 s	NR	0.38 to 1.0	0.24 to 0.85
Berg Balance Scale (BBS)	Participants are asked to perform a variety of sitting, transferring, and standing positions.	1	187	≤52	0.47	NR	NR
		2	312	≤45 to ≤54	0.59 to 0.68	0.25 to 0.69	0.53 to 0.87
Performance Oriented Mobility Assessment – Balance (POMA-B)	Participants are asked to perform nine different movements to assess balance.	4	442	<8 to 10	NR	0.23 to 0.89	0.47 to 0.91
Performance Oriented Mobility Assessment - Gait (POMA-G)	Participants are asked to perform six different movements to assess gait. It is recommended to conduct this test in a corridor.	2	252	9	NR	0.21 to 0.64	0.62 to 0.95
Functional Reach test (FR)	Participants are asked to hold their arms in front of them at an angle of 90 degrees, stretch forward as far as possible and return to the starting position. The distance between the starting position and the stretched position is used as an indicator of the risk of falling.	2	1,544	NR	0.509 to 0.60	NR	NR
		1	50	8 in	NR	0.73	0.88
Falls History	Definition varies. Most commonly, participants are asked if they have had one or more falls in the previous year.	4	1,603	≥1 fall in the previous year	0.71§	0.39 to 0.69	0.63 to 0.82
		1	449	History of multiple falls	0.64	NR	NR
STEADI 12-question tool	12 questions addressing a variety of fall risk factors, including fall history, balance, worry about falling, leg strength, urinary urgency, foot numbness, medications, and symptoms of depression.	3	2,120	≥4	NR	0.53 to 0.78	0.61 to 0.88
STEADI 3-key question tool	Feeling unsteady, being worried about falling, and recent fall history.	3	2,120	Yes to any question	NR	0.69 to 0.94	0.35 to 0.75

* Adapted from Meeks, 2021¹⁷ and Lin, 2022.²⁴

† The reported area under the curve (AUC) for all tools included prospective falls ascertainment 6 months to 108 months after the tool’s administration.

‡ Reported in 8 studies.

§ Reported in 1 study.

Abbreviations: AUC = area under the curve; m = meter; NR = not reported; s = second.

Table 2. Society and Professional Organization Recommendations on Falls Prevention in Community-Dwelling Older Adults

Society or Professional Organization	Year	Age, years	Recommendation
World Falls Guideline ²⁰³	2022	NR	Recommends that all older adults should be advised on falls prevention and physical activity. Opportunistic case finding for falls risk is recommended for community-dwelling older adults. Those considered at high risk should be offered a comprehensive multifactorial falls risk assessment with a view to co-design and implement personalised multidomain interventions. Other recommendations cover details of assessment and intervention components and combinations, and recommendations for specific settings and populations.
Centers for Disease Control and Prevention ³²	2021	≥65	Recommends STEADI, a coordinated approach to implementing the AGS/BGS clinical practice guidelines for fall prevention that consists of three core elements: screen to identify fall risk, assess modifiable risk factors, and intervene using effective clinical and community strategies to reduce the identified risk. Clinical strategies include but are not limited to physical therapy and medication management. Community strategies include but are not limited to evidence-based exercise programs and home modification.
The Royal Australian College of General Practitioners ³³	2018	≥65	Recommend assessing risk of falls and if indicated by the screening questions, determine multifactorial fall risk and obtain relevant medical history, conduct a complete physical examination, and perform cognitive and functional assessments. Recommended interventions: exercise programs; medication review; vitamin D supplementation; podiatry intervention if indication; discuss dangers of bifocal and multifocal glasses when walking outdoors and recommend single lens glasses when outdoors; identify cataracts; and occupational therapy home assessment (if history of recent falls).
U.S. Department of Health and Human Services ³⁴	2021	NR	Recommends that older adults get at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week, as well as muscle-strengthening activities twice per week. Recommend balance training 3 or more days per week for older adults at risk of falls due to a recent fall or difficulty walking.
The National Institute of Aging ³⁵	2017	NR	Outlines several interventions for falls: exercise for strength and balance, monitoring for environmental hazards, regular medical care to ensure optimized hearing and vision, and medication management.
National Institute for Health and Care Excellence ²⁰⁴	2013	≥65	Older adults in contact with health professionals should be asked routinely whether they have fallen in the past year and asked about the frequency, context, and characteristics of the fall(s). Older people at risk of falling should be observed for balance and gait defects and considered for their ability to benefit from interventions to improve strength and balance. Older adults who present for medical attention because of a fall, or report recurrent falls in the past year, or demonstrate abnormalities of gait and/or balance should be offered a multifactorial falls risk assessment. Recommended interventions: Multifactorial interventions; strength and balance training; exercise in extended care settings; home hazard and safety intervention; psychotropic medication review; and cardiac pacing.

Table 2. Society and Professional Organization Recommendations on Falls Prevention in Community-Dwelling Older Adults

Society or Professional Organization	Year	Age, years	Recommendation
American Geriatrics Society/British Geriatrics Society* ²⁰⁵	2011	NR	<p>Recommend a multifactorial fall risk assessment for all older adults who present with a fall or who have gait and balance problems. Also recommend a multifactorial falls risk assessment for individuals who simply report difficulties with gait or balance. A falls risk assessment is not considered necessary for older persons reporting only a single fall without reported or demonstrated difficulty or unsteadiness.</p> <p>Recommend that assessments include examination of the feet and footwear, functional assessment (assessment of activity of daily living skills, including use of adaptive equipment and mobility aids, as appropriate); assessment of the individual's perceived functional ability and fear related to falling; and environmental assessment, including home safety.</p> <p>Recommended components of multifactorial interventions: exercise, specifically programs that include balance, gait, and strength training, such as tai chi or physical therapy, in group programs or as individual programs at home; environmental adaptation or modification; medication reduction or withdrawal; assessment and treatment of postural hypotension; cataract surgery on the first eye should be expedited in older persons in which the surgery is indicated; dual-chamber cardiac pacing when indicated; and vitamin D supplementation.</p>

*The AGS considers guidelines 5 years old and older to be no longer active. These inactive guidelines or recommendations have not been reviewed or updated by the AGS and the conclusions and recommendations in the guideline may not be current.

Abbreviations: AGS = American Geriatric Society; BGS = British Geriatrics Society; NR = not reported; STEADI = Stopping Elderly Accidents, Deaths, and Injuries.

Table 3. Summary of Study and Participant Characteristics, All Interventions

Characteristic	No. of studies* for each intervention type							
	MF	Exercise	Exercise + Edu + Other	Exercise + Environ	Environ	Med Review/ Mod	Psych	Edu
Total studies	28	37	4	3	6	4	3	1
Newly identified	3	19	3	2	3	2	1	0
Previously identified	25	18	1	1	3	2	2	1
Quality rating	-	-	-	-	-	-	-	-
Good	9	5	3	1	3	2	0	0
Fair	19	32	1	2	3	2	3	1
Country	-	-	-	-	-	-	-	-
US	4	5	1	0	1	3	0	0
Europe	18	20	1	0	3	1	2	0
Other	6	12	2	3	2	0	1	1
Recruitment setting	-	-	-	-	-	-	-	-
Clinic (with or without community-based)	16	13	1	1	2	1	0	0
Community- or population-based only	0	19	1	1	3	1	3	1
ED or hospital only	7	2	0	1	1	1	0	0
Other	5	3	2	0	0	1	0	0
Baseline risk of falling	-	-	-	-	-	-	-	-
At increased risk	21	20	3	1	3	3	3	1
Unselected for risk	7	17	1	2	3	1	0	0
Falls data collection	-	-	-	-	-	-	-	-
Diary/calendar (+/- recall, administrative records)	21	24	4	3	5	3	3	1
Recall and administrative records	1	1	0	0	0	0	0	0
Recall only (1 to 6 months)	6	11	0	0	1	1	0	0
Administrative records only	0	1	0	0	0	0	0	0
Race/ethnicity	-	-	-	-	-	-	-	-
Majority White	3	7	1	0	0	2	--	--
Race/ethnicity not reported	23	30	3	2	5	2	3	1
Randomized sample size, range	153-6,524	35-6,502	96-453	272-354	165-1,879	80-612	50-540	310
Age, weighted mean	79	77	75	79	77	77	78	78
Female, percent	62	68	78	63	60	66	71	74

* Value instead of number of studies when indicated.

Abbreviations: ED = emergency department; Edu = education interventions; Environ = environmental interventions; MF = multifactorial interventions; No. = number; Psych = psychological interventions; US = United States.

Table 4. Strength of Evidence: Multifactorial and Exercise Intervention Trials

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
Multifactorial	k=28 n random=27,784	<i>Falls:</i> IRR, 0.84 (95% CI, 0.74 to 0.95); $I^2=85.0\%$ k=20, n analyzed=22,115	Consistent, precise	Heterogenous assessment interventions and referrals. Heterogeneous populations as reflected in wide variation in baseline falls risk; heterogeneous interventions; trials typically powered for falls and not other outcomes.	Moderate for benefit	Populations studied older community-dwelling adults at both average and increased risk for falls. Most participants were at increased risk based on history of previous fall. Most studies took place outside the US but results are generalizable. Implementation of this multi-step, complex intervention would be challenging in any setting. Populations studied were largely those at increased risk of falls based on history of previous fall.
		<i>People with 1+ fall:</i> RR, 0.96 (95% CI, 0.91 to 1.02); $I^2=48.2\%$ k=26, n analyzed=23,626	Inconsistent, imprecise		Low for no benefit	
		<i>People with 2+ falls:</i> RR, 0.99 (95% CI, 0.94 to 1.04); $I^2=0.0\%$ k=11, n analyzed=14,471	Inconsistent, imprecise		Low for no benefit	
		<i>Falls resulting in injury or medical care:</i> IRR, 0.92 (95% CI, 0.84 to 1.01); $I^2=21.8\%$ k=12, n analyzed=10,563	Inconsistent, imprecise		Low for no benefit	
		<i>People with fall resulting in injury or medical care:</i> RR, 0.92 (95% CI, 0.83 to 1.02); $I^2=47.3\%$ k=13, n analyzed=13,460	Inconsistent, imprecise		Low for no benefit	
		<i>Fall-related fractures:</i> IRR, 1.01 (95% CI, 0.81 to 1.26); $I^2=34.0\%$ k=7, n analyzed=15,211	Inconsistent, imprecise		Low for no benefit	
		<i>People with fall-related fracture:</i> RR, 0.86 (95% CI, 0.60 to 1.24); $I^2=49.0\%$ k=7, n analyzed=13,912	Inconsistent, imprecise		Low for no benefit	
		<i>Mortality:</i> RR, 1.01 (95% CI, 0.88 to 1.17); $I^2=0\%$ k=24, n analyzed=21,596	Inconsistent, imprecise		Low for no benefit	
		<i>Harms:</i> Rare, minor, and associated with the exercise components k=5, n analyzed=4,199	Inconsistent, imprecise	Harms sparsely reported and often only reported in intervention arm.	Insufficient	

Table 4. Strength of Evidence: Multifactorial and Exercise Intervention Trials

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
Exercise	k=37 n random=16,117	<i>Falls:</i> IRR, 0.85 (95% CI, 0.75 to 0.96); $I^2=82.7\%$ k=29, n analyzed=14,475	Consistent, precise	Heterogeneous populations as reflected in wide variation in baseline falls risk; heterogeneous interventions; trials typically powered for falls and not other outcomes.	Moderate for benefit	Applicable to older community-dwelling populations at both average and increased risk for falls. Most participants in trials were at increased risk based on history of previous fall. Applicable to interventions (individual PT and exercise classes) that are typically available in the US. No single exercise/PT program protocol appears as a “best” model. Nearly all programs
		<i>People with 1+ fall:</i> RR, 0.92 (95% CI, 0.87 to 0.98); $I^2=24.3\%$ k=25, n analyzed=13,384	Consistent, precise		Moderate for benefit	
		<i>People with 2+ falls:</i> RR, 0.77 (95% CI, 0.57 to 1.04); $I^2=45.0\%$ k=9, n analyzed=8,502	Consistent, imprecise		Low for no benefit	
		<i>Falls resulting in injury or medical care:</i> IRR, 0.84 (95% CI, 0.74 to 0.95); $I^2=14.6\%$ k=12, n analyzed=3,984	Consistent, precise	Heterogeneous exercise interventions: individual vs. group; multiple different exercise components administered; different program frequencies and durations.	Low for benefit	
		<i>Fall-related fractures:</i> IRR, 0.81 (95% CI, 0.57 to 1.15); $I^2=39.1\%$ k=8, n analyzed=8,537	Inconsistent, imprecise		Low for no benefit	
		<i>People with fall resulting in injury or medical care:</i> RR, 0.90 (95% CI, 0.79 to 1.02); $I^2=26.7\%$ k=9, n analyzed=3,924	Consistent, imprecise		Low for no benefit	
		<i>People with fall-related fracture:</i> RR range, 0.36 (95% CI, 0.15 to 0.89) to 1.95 (95% CI, 0.22 to 17.3) k=4, n analyzed=7994	Inconsistent, imprecise		Insufficient	
		<i>Mortality:</i> RR, 0.87 (95% CI, 0.71 to 1.06); $I^2=0.0\%$ k=15, n analyzed=10,461	Consistent, imprecise		Low for no benefit	

Table 4. Strength of Evidence: Multifactorial and Exercise Intervention Trials

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
		<p><i>Harms</i> Generally minor musculoskeletal side effects; serious side effects were generally very rare (<1%). k=19, n analyzed=6,985</p>	Consistent, imprecise	Harms were sparsely reported and often only reported for the intervention arm.	Low for harm	<p>include gait/balance/functional training and strength/resistance.</p> <p>Adherence to exercise classes may be variable in real world settings.</p>

* For our review-of-reviews method, we adopted the strength of the overall body of evidence assigned within the primary systematic review. In most cases, these grades were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group definitions, which consider study limitations, consistency of effect, imprecision, indirectness, and publication bias. Where strength of evidence grades were not available, we adapted the EPC approach to assign an overall strength of evidence grade based on consensus discussions involving at least two reviewers.

Abbreviations: CI = confidence interval; IRR = incidence rate ratio; k = number of studies; n = number of participants; PT = physical therapy; RR = relative risk; US = United States.

Table 5. Strength of Evidence: Other Interventions

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability	
Exercise + Edu	k=4 n random=1,047	<i>Falls:</i> IRR range, 0.61 (95% CI, 0.40, 0.94) to 1.08 (95% CI, 0.70 to 1.67) k=4, n analyzed=1,043	Consistent Imprecise	Few heterogenous trials with mixed results	Low for no benefit	Intervention relevant to older community-dwelling populations at average and increased risk for falls; however, trials included only those at increased risk for falls. Exercise programs may be accessible in the US. Education programs variable.	
		<i>People with 1+ fall:</i> RR range, 0.87 (95% CI, 0.57 to 1.34) to 1.07 (95% CI, 0.57 to 2.00) k=4, n analyzed=1,043	Inconsistent Imprecise		Low for no benefit		
		<i>People with 2+ falls:</i> RR, 1.0 (95% CI, 0.65 to 1.53) and 1.59 (95% CI, 0.67 to 3.79) k=2, n analyzed=498	Inconsistent, imprecise		INSUFFICIENT		
		<i>Falls resulting in injury or medical care:</i> IRR range, 0.58 (95% CI, 0.33 to 1.01) to 1.02 (0.61 to 1.69) k=3, n analyzed=881	Consistent Imprecise		Low for no benefit		
		<i>Mortality:</i> RR, 0.67 (95% CI, 0.11 to 3.97) and 1.0 (95% CI, 0.06 to 15.72) k=2, n analyzed=615	Inconsistent Imprecise		INSUFFICIENT		
		<i>Harms</i> Two trials reported no AEs in IG, two trials reported mostly musculoskeletal side effects associated with exercise intervention in IG k=4, n analyzed=522	Consistent, imprecise		Few trials, no trials ascertained AEs in the CG. Ascertainment measurements unclear for harms.		Low for harm
		Exercise + Environment	k=3 n random=935		<i>Falls:</i> IRR, 0.73 (95% CI, 0.60 to 0.90) and 0.78 (95% CI, 0.57 to 1.07) k=2, n analyzed=581		Consistent Imprecise
<i>People with 1+ fall:</i> RR range, 0.81 (95% CI, 0.60 to 1.08) to 0.99 (95% CI, 0.82 to 1.19) k=3, n analyzed=935	Consistent, imprecise			Low for no benefit			
<i>People with 2+ falls:</i> RR, 0.68 (95% CI, 0.46 to 1.01) and 0.73 (95% CI, 0.54 to 0.99) k=2, n analyzed=581	Consistent, imprecise			INSUFFICIENT			
<i>Falls resulting in injury:</i> IRR, 0.88 (95% CI, 0.67 to 1.15) and 1.18 (95% CI, 0.76 to 1.83)	Inconsistent Imprecise			INSUFFICIENT			

Table 5. Strength of Evidence: Other Interventions

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
		k=2, n analyzed=581				
		<i>Mortality:</i> RR, 0.34 (95% CI, 0.09 to 1.23) k=1, n analyzed=309	Consistency NA, Imprecise		INSUFFICIENT	
		<i>Harms:</i> No trials reported on harms	NA	No trials	INSUFFICIENT	
Environment	k=6 n random=4,162	<i>Falls:</i> IRR, 0.83 (95% CI, 0.59 to 1.18); $I^2=82.2\%$ k=6, n analyzed=3,956	Inconsistent, Imprecise	Small number of trials. Some studies implemented modifications and others only made recommendations.	Low for no benefit	Intervention relevant to older community-dwelling populations at average and increased risk for falls.
		<i>People with 1+ fall:</i> RR, 0.94 (95% CI, 0.83 to 1.07); $I^2=20.3\%$ k=5, n analyzed=2,242	Consistent, imprecise		Low for no benefit	
		<i>People with 2+ falls:</i> RR range, 0.36 (95% CI, 0.07 to 1.75) to 1.04 (95% CI, 0.89 to 1.22) k=4, n analyzed=2,077	Consistent, imprecise		Low for no benefit	
		<i>Falls resulting in injury:</i> IRR, 0.97 (95% CI, 0.75 to 1.26) and 1.06 (95% CI, 0.93 to 1.21) k=2, n analyzed=1,604	Inconsistent Imprecise		INSUFFICIENT	
		<i>Mortality:</i> RR, 1.87 (95% CI, 0.87 to 4.01) k=1, n analyzed=1,201	Consistency NA, Imprecise		INSUFFICIENT	
		<i>Harms:</i> No serious AEs directly related to the IG (k=1, n=430) No AEs during the trial (k=1, n analyzed=175)	Consistent, imprecise		INSUFFICIENT	
Medication review/ modification	k=4 n random=1,052	<i>Falls:</i> IRR, 1.01 (95% CI, 0.81 to 1.26) k=1, n analyzed=186	Consistency NA, Imprecise	Small number of trials. Outcomes reported variably across trials. All study IGs included at least a one-time medication assessment but followup varied	INSUFFICIENT	Intervention relevant to populations at average and increased risk for falls. Three of four trials were conducted in the US.
		<i>People with 1+ fall:</i> RR range, 1.02 (95% CI, 0.79 to 1.31) to 1.16 (95% CI, 0.55 to 2.41) k=3, n analyzed=846 OR, 0.75 (95% CI, 0.35 to 1.60) k=1, n analyzed=158	Inconsistent, imprecise		Low for no benefit	

Table 5. Strength of Evidence: Other Interventions

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
		<i>People with 2+ falls:</i> RR, 1.16 (95% CI, 0.79 to 1.71) and 2.10 (95% CI, 0.56 to 7.83) k=2, n analyzed=660	Consistent, imprecise	and may have additionally included time to PCP contact or modification implementation. Adherence was generally <50%.	INSUFFICIENT	Only two trials were conducted in clinical setting by geriatrician; the other two were conducted in pharmacy by pharmacist.
		<i>Falls resulting in injury:</i> IRR, 0.87 (95% CI, 0.62 to 1.24) k=1, n analyzed=186	Consistency NA, Imprecise		INSUFFICIENT	
		<i>Mortality:</i> RR, 0.40 (95% CI, 0.10 to 1.55) and 1.50 (95% CI, 0.26 to 8.77) k=2, n analyzed=344	Inconsistent Imprecise		INSUFFICIENT	
		<i>Harms:</i> No trials reported on harms	NA		INSUFFICIENT	
Psychological	k=3 n random= 979	<i>Falls:</i> IRR, 95% CI, 0.65 to 1.13) and 0.86 (95% CI, 0.65 to 1.14) k=2, n analyzed=886	Consistent, imprecise	Small number of studies.	INSUFFICIENT	Intervention relevant to populations at average and increased risk for falls. Both non-US trials, with intervention facilitated by a nurse. Results applicable to US population.
		<i>People with 1+ fall:</i> RR, 0.72 (95% CI, 0.58 to 0.90) and 0.96 (95% CI, 0.80 to 1.15); OR, 1.40 (95% CI, 0.45 to 4.37) k=3, n analyzed=936	Inconsistent, imprecise		INSUFFICIENT	
		<i>People with 2+ falls:</i> RR, 0.59 (95% CI, 0.43 to 0.81) and 0.89 (95% CI, 0.67 to 1.19) k=2, n analyzed=886	Consistent, imprecise		INSUFFICIENT	
		<i>Falls resulting in injury:</i> IRR, 0.78 (95% CI, 0.45 to 1.35) and 1.42 (95% CI, 0.96 to 2.10) k=2, n analyzed=886	Inconsistent, Imprecise		INSUFFICIENT	
		<i>Mortality:</i> RR, 0.98 (95% CI, 0.77 to 1.25) and 1.01 (95% CI, 0.36 to 2.81) k=2, n analyzed=928	Consistent, Imprecise		INSUFFICIENT	
		<i>Harms:</i> No AEs or side effects reported k=1, n analyzed=540	NA		INSUFFICIENT	
					<i>No. of falls:</i> IRR, 0.68 (95% CI, 0.57 to 0.83) k=1, n analyzed=310	
Education	k=1 n random= 310	<i>People with 1+ fall:</i> RR, 0.90 (95% CI, 0.73 to 1.10) k=1, n analyzed=310	Consistency NA,	INSUFFICIENT		
					INSUFFICIENT	

Table 5. Strength of Evidence: Other Interventions

Intervention	Number of included studies	Summary of findings	Consistency and precision	Other limitations	Strength of evidence*	Applicability
			Imprecise			
		<i>People with 2+ falls:</i> RR, 0.74 (95% CI, 0.52 to 1.04) k=1, n analyzed=310	Consistency NA, Imprecise		INSUFFICIENT	
		<i>No. of falls resulting in injury:</i> k=0	NA		INSUFFICIENT	
		<i>Mortality:</i> k=0	NA		INSUFFICIENT	
		<i>Harms:</i> k=0	NA		INSUFFICIENT	

* For our review-of-reviews method, we adopted the strength of the overall body of evidence assigned within the primary systematic review. In most cases, these grades were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group definitions, which consider study limitations, consistency of effect, imprecision, indirectness, and publication bias. Where strength of evidence grades were not available, we adapted the EPC approach to assign an overall strength of evidence grade based on consensus discussions involving at least two reviewers.

Abbreviations: AE = adverse event; CI = confidence interval; Edu = education; IRR = incidence rate ratio; k = number of studies; n = number of participants; NA = not applicable; OR = odds ratio; RR = relative risk; US = United States.

Appendix A. Detailed Methods

Literature Search Strategies for Primary Literature

Bridge search – Date delivered 5/8/23

Original search – Date delivered 4/22/22

Sources Searched: database and platform 2016 to present
<i>MEDLINE via Ovid</i>
<i>CINAHL via EBSCO</i>
<i>Cochrane Central Register of Controlled Clinical Trials via Wiley</i>

Search filters used:

RCT filter:

- Chris Cooper, Jo Varley-Campbell and Patrice Carter, Established search filters may miss studies when identifying randomized controlled trials, *Journal of Clinical Epidemiology*, 2019-08-01, Volume 112, Pages 12-19
- Glanville JM, Lefebvre C, Miles JN, Camoso-Stefinovic J. How to identify randomized controlled trials in MEDLINE: ten years on. *Journal of the Medical Library Association* 2006; 94: 130-136. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1435857/>
- Box 3.d Cochrane Highly Sensitive Search Strategy for identifying randomized trials in MEDLINE: sensitivity- and precision-maximizing version (2008 revision); Ovid format from: Lefebvre C, Glanville J, Briscoe S, Littlewood A, Marshall C, Metzendorf M-I, Noel-Storr A, Rader T, Shokraneh F, Thomas J, Wieland LS. Chapter 4: Searching for and selecting studies. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). *Cochrane Handbook for Systematic Reviews of Interventions* version 6.2 (updated February 2021). Cochrane, 2021. Available from www.training.cochrane.org/handbook
- Glanville et al, 2019, Development of a Search Filter to Identify Reports of Controlled Clinical Trials Within CINAHL Plus

Justification for Limits (what studies/papers):

"This search strategy was adopted from/adapted from/.. the strategy used by SEARCH CREATOR/S (year). The following changes were made..."

Key:

/ = MeSH subject heading

\$ = truncation

ti = word in title

ab = word in abstract

pt = publication type

* = truncation

kw = keyword

kf = author attributed keyword

st = subset

MEDLINE

Database: Ovid MEDLINE(R) ALL <1946 to April 21, 2022>

Search Strategy:

Appendix A. Detailed Methods

-
- 1 Accidental Falls/ (27337)
 - 2 (falls or faller or fallers or fall injur\$.ti,ab,kf. (53652)
 - 3 (fall or falling).ti. (14131)
 - 4 1 or 2 or 3 (72260)
 - 5 aged/ or "aged, 80 and over"/ or frail elderly/ (3393862)
 - 6 Geriatric Assessment/ (31036)
 - 7 Geriatrics/ (31013)
 - 8 Health Services for the Aged/ (18137)
 - 9 geriatric\$.ti,ab,kf. (72187)
 - 10 older.ti,ab,kf. (503575)
 - 11 senior\$.ti,ab. (46894)
 - 12 elder\$.ti,ab,kf. (290222)
 - 13 aged.ti,ab,kf. (663188)
 - 14 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 (4137540)
 - 15 4 and 14 (32442)
 - 16 limit 15 to (english language and yr="2016 -Current") (12111)
 - 17 (randomized controlled trial or controlled clinical trial).pt. or clinical trials as topic.sh. or exp
Randomized Controlled Trials as Topic/ or (randomized or randomised or placebo or randomly or phase
iii or phase 3).ti,ab,kf. or trial.ti. (1570961)
 - 18 (RCT or sham or dummy or single blind\$ or double blind\$ or allocated or allocation or triple blind\$
or treble blind\$ or random\$.ti,ab,kf. not medline.st. (208715)
 - 19 17 or 18 (1648512)
 - 20 16 and 19 (1796)

CINAHL via EBSCO

S10 S8 AND S9 Limiters - Published Date: 20160101-; English Language

Expanders - Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 2,723

S9 (MH randomized controlled trials) or (MH double-blind studies) or (MH single-blind studies) or
(MH random assignment) or (MH pretest-posttest design) or (MH cluster sample) or (TI (randomised OR
randomized)) or (AB (random*)) or (TI (trial)) or (MH (sample size) AND AB (assigned OR allocated OR
control)) or (MH (placebos)) or (PT (randomized controlled trial)) or (AB (control W5 group)) or (MH
(crossover design) OR MH (comparative studies)) or (AB (cluster W3 RCT)) Expanders - Apply
equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 949,992

S8 (S4 AND S7) Expanders - Also search within the full text of the articles; Apply equivalent
subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 25,638

S7 S5 OR S6 Expanders - Also search within the full text of the articles; Apply equivalent
subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Appendix A. Detailed Methods

Search Screen - Advanced Search

Database - CINAHL with Full Text 1,173,921

S6 TI (geriatric* or older or senior* or elder* or aged) OR AB (geriatric* or older or senior* or elder* or aged) Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 503,910

S5 (MH "Frail Elderly") OR (MH "Aged") OR (MH "Aged, 80 and Over") Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 911,333

S4 S1 OR S2 OR S3 Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 57,328

S3 TI (fall or falling) Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 19,265

S2 TI ((falls or faller or fallers or fall injur*)) OR AB ((falls or faller or fallers or fall injur*)) Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 47,802

S1 mh "accidental falls" Expanders - Also search within the full text of the articles; Apply equivalent subjects

Search modes - Boolean/Phrase Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - CINAHL with Full Text 25,215

Cochrane Central Register of Controlled Clinical Trials (CENTRAL) via Wiley

Date Run: 22/04/2022 13:28:50

ID Search Hits

#1 "accidental falls":ti,ab,kw 1815

#2 (falls or faller or fallers or "fall injur*"):ti,ab,kw 8316

#3 (fall or falling):ti 1535

#4 ^{1-#3} 8954

#5 (geriatric* OR older OR senior* OR elder* OR aged):ti,ab,kw 594397

#6 #4 and #5 with Publication Year from 2016 to present, in Trials 2786

Appendix A Table 1. Inclusion and Exclusion Criteria

Category	Included	Excluded
Aim	Trials with the primary or secondary aim of reducing falls or falls-related injuries	Comparative effectiveness trials of fall interventions
Population	Community-dwelling, ambulatory adults age ≥65 years at unselected or increased risk for falls	Trials conducted exclusively in populations living in settings outside of the community (e.g., hospitals, nursing or care homes, rehabilitation centers, or other long-term care facilities) Trials conducted exclusively in special populations (e.g., adults with neurocognitive disorders such as moderate to severe dementia or Parkinson’s disease) where interventions may be considered disease management Trials conducted exclusively in a population with pre-existing social ties
Interventions	Interventions that are primary care feasible or referable Categories of included interventions: <ul style="list-style-type: none"> • Exercise (supervised or unsupervised, individual or group) • Multifactorial assessment and intervention • Medication modification/review • Psychological (individual or group) • Environmental assessment and modification • Knowledge/Education Interventions may be delivered alone or in combination	Categories of excluded interventions: <ul style="list-style-type: none"> • Social marketing • Policy • Surgery • Fluid or nutrition therapy • Management of urinary incontinence • Assistive technology • Vitamin D, supplements
Comparators	Placebo, minimal control (i.e., provision of education via written materials, video, lecture), usual care	Active comparators
Outcomes	KQ 1: <ul style="list-style-type: none"> • Falls • Mortality (all-cause and falls-related) • Fall-related morbidity, defined as: <ul style="list-style-type: none"> ○ Fall-related injuries and fractures ○ Disability (as measured by instrumental activities of daily life instruments) ○ Quality of life (validated instruments) ○ Hospitalizations for fall-related injuries ○ Emergency department visits for fall-related injuries ○ Institutionalizations (e.g., transition from community dwelling to nursing or care homes, or other long-term care facilities) KQ 2: Harms outcomes as reported in studies	KQ 1: <ul style="list-style-type: none"> • Basic activities of daily living • Falls Efficacy Scale • Function measures (e.g., Performance-Oriented Mobility Assessment, Timed Get Up & Go Test, 6-meter timed walk, Functional Reach Test, and Berg Balance Scale) KQ 2: Minor adverse events that are reported using nonvalidated, nongeneralizable measures
Followup	Minimum 6 months followup	
Study Designs	Randomized, controlled trials	Editorials, letters, systematic and nonsystematic reviews, opinions, non-randomized studies of interventions, convenience surveys, qualitative studies

Appendix A Table 1. Inclusion and Exclusion Criteria

Category	Included	Excluded
Setting	Interventions conducted in primary care, referable from primary care	
Country	Countries categorized as “Very High” on the 2019 Human Development Index*	Countries that are not categorized as “Very High”
Language	English only	Non-English language publications
Quality	Fair or good, according to design-specific criteria	Poor, according to design-specific criteria

* As defined by the United Nations Development Programme. Human Development Report 2020. <http://hdr.undp.org/sites/default/files/hdr2020.pdf>. Accessed 1/28/2022.

Abbreviation: KQ = key question.

Appendix A Table 2. Study-Design Quality Rating Criteria

Study Design	Adapted Quality Criteria
Randomized clinical trials*, adapted from U.S. Preventive Services Task Force Manual ²	<p>Bias arising in the randomization process or due to confounding</p> <ul style="list-style-type: none"> • Valid random assignment/random sequence generation method used • Allocation concealed • Balance in baseline characteristics <p>Bias due to departures from intended interventions</p> <ul style="list-style-type: none"> • Fidelity to the intervention protocol • Low risk of contamination between groups • Participants were analyzed as originally allocated <p>Bias from missing data</p> <ul style="list-style-type: none"> • No, or minimal, post-randomization exclusions • Outcome data are reasonably complete and comparable between groups • Reasons for missing data are similar across groups • Missing data are unlikely to bias results <p>Bias in measurement of outcomes</p> <ul style="list-style-type: none"> • Outcomes are measured using consistent and appropriate procedures and instruments across treatment groups • No evidence of biased use of inferential statistics <p>Bias in reporting results selectively</p> <p>No evidence that the measures, analyses, or subgroup analyses are selectively reported</p>

*Good quality studies generally meet all quality criteria. Fair quality studies do not meet all the criteria but do not have critical limitations that could invalidate study findings. Poor quality studies have a single fatal flaw or multiple important limitations that could invalidate study findings. Critical appraisal of studies using *a priori* quality criteria are conducted independently by at least two reviewers. Disagreements in final quality assessment are resolved by consensus, and, if needed, consultation with a third independent reviewer.

Abbreviations: KQ = key question; U.S. = United States.

Appendix A Figure 1. Risk of Bias in Multifactorial Intervention Trials, by Domain

Quality	Author	Domain				
		Randomization process/confounding	Intervention deviations	Outcome measurement	Missing data	Selective reporting
Good	Bhasin, 2020	✓	✓	✓	✓	✓
	Bruce, 2021	✓	✓	✓	✓	✓
	Conroy, 2010	✓	✓	✓	✓	✓
	Fairhall, 2014	✓	✓	✓	✓	✓
	Logan, 2010	✓	✓	✓	✓	✓
	Lord, 2005	✓	✓	✓	✓	✓
	Salminen, 2009	✓	✓	✓	✓	✓
	Tinetti, 1994	✓	✓	✓	✓	✓
	Vind, 2009	✓	✓	✓	✓	✓
Fair	Ciaschini, 2009	✓	✓	▲	✓	✓
	Close, 1999	✓	✓	✓	▲	✓
	Cohen, 2015	▲	▲	✓	▲	✓
	Davison, 2005	✓	✓	✓	✓	✓
	de Vries, 2010	✓	▲	✓	✓	✓
	Elley, 2008	▲	▲	✓	✓	✓
	Ferrer, 2014	✓	✓	✓	▲	✓
	Hendriks, 2008	✓	▲	✓	✓	✓
	Hogan, 2001	✓	✓	✓	▲	✓
	Imhof, 2012	✓	✓	▲	✓	✓
	La Porta, 2022	✓	✓	✓	▲	✓
	Lightbody, 2002	▲	✓	▲	✓	✓
	Moller, 2014	✓	✓	▲	▲	✓
	Palvanen, 2014	✓	✓	▲	✓	✓
	Perula, 2012	✓	✓	▲	✓	✓
	Russell, 2010	✓	▲	✓	✓	✓
	Spice, 2009	▲	✓	✓	✓	✓
	van Haastregt, 2000	✓	✓	✓	▲	✓
Wagner, 1994	▲	✓	▲	✓	✓	

Risk of bias
 ✓ Low
 ▲ Moderate

Appendix A Figure 2. Risk of Bias in Exercise Intervention Trials, by Domain

Quality	Author	Domain				
		Randomization process/confounding	Intervention deviations	Outcome measurement	Missing data	Selective reporting
Good	Bruce, 2021	✓	✓	✓	✓	✓
	Delbaere, 2021	✓	✓	✓	✓	✓
	Kovacs, 2013	✓	✓	✓	✓	✓
	Uusi-Rasi, 2015	✓	✓	✓	✓	✓
	Voukelatos, 2007	✓	✓	✓	✓	✓
Fair	Barnett, 2003	▲	✓	✓	▲	✓
	Buchner, 1997	▲	✓	✓	▲	✓
	Callisaya, 2021	✓	✓	✓	▲	✓
	Campbell, 1997	▲	▲	✓	▲	✓
	Chyu, 2010	✓	✓	▲	✓	✓
	El-Khoury, 2015	▲	✓	✓	▲	✓
	Fitzharris, 2010	▲	✓	✓	✓	✓
	Goldberg, 2019	▲	✓	▲	▲	✓
	Karinkanta, 2015	▲	✓	✓	✓	✓
	Korpelainen, 2006	▲	✓	✓	▲	✓
	Kronhed, 2009	▲	✓	✓	✓	✓
	Lamb, 2018	✓	✓	▲	✓	✓
	Lipsitz, 2019	✓	✓	✓	▲	✓
	Logghe, 2009	✓	✓	✓	▲	✓
	Luukinen, 2007	✓	▲	▲	▲	✓
	Merom, 2016	▲	✓	✓	✓	✓
	Miko, 2018	▲	✓	✓	✓	✓
	Morgan, 2004	▲	✓	✓	▲	✓
	Ng, 2015	✓	✓	▲	✓	✓
	Ohman, 2016	▲	✓	✓	✓	▲
	Oliveira, 2019	▲	✓	✓	✓	✓
	Rikkonen, 2023	▲	✓	✓	✓	✓
	Robertson, 2001	▲	✓	✓	▲	✓
	Rosado, 2021	▲	✓	▲	✓	✓
	Sherrington, 2014	▲	✓	✓	✓	✓
	Siegrist, 2016	▲	✓	✓	▲	✓
	Stathi, 2022	✓	✓	▲	▲	✓
	Suikkanen, 2021	✓	✓	▲	✓	✓
Tomita, 2016	▲	✓	✓	▲	✓	
Trombetti, 2011	✓	✓	✓	▲	✓	
Tuvemo Johnson, 2021	▲	✓	✓	▲	✓	
Voukelatos, 2015	✓	✓	✓	▲	✓	

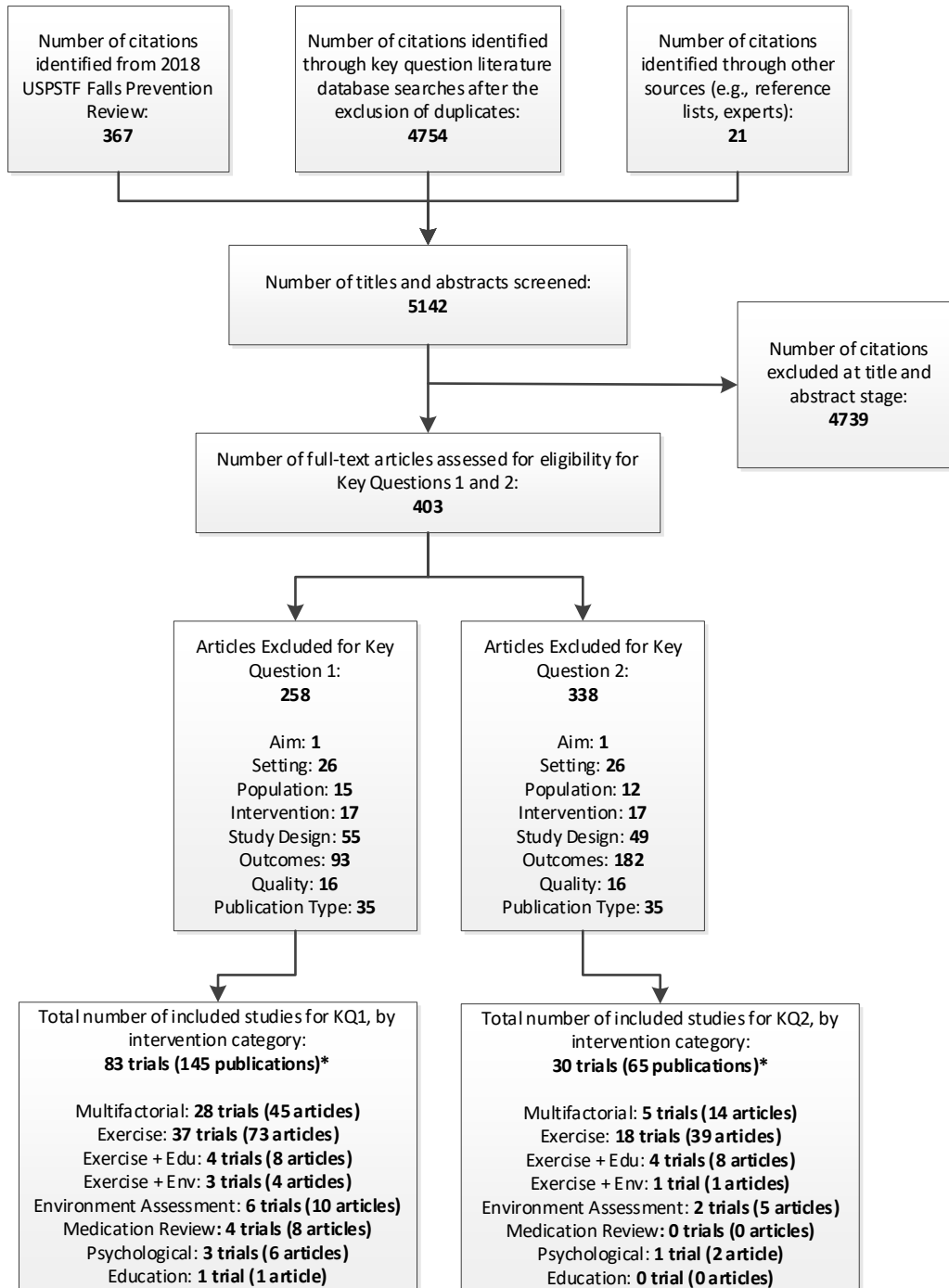
Risk of bias
 ✓ Low
 ▲ Moderate

Appendix A Figure 3. Risk of Bias in Other Intervention Trials, by Domain

Quality	Author	Domain				
		Randomization process/confounding	Intervention deviations	Outcome measurement	Missing data	Selective reporting
Good	Boye, 2017	✓	✓	✓	✓	✓
	Cockayne, 2021	✓	✓	✓	✓	✓
	Daly, 2020	✓	✓	✓	✓	✓
	Matchar, 2017	✓	✓	✓	✓	✓
	Pighills, 2011	✓	✓	✓	✓	✓
	Romskaug, 2020	✓	✓	✓	✓	✓
	Sherrington, 2020	✓	✓	✓	✓	✓
	Shumway-Cook, 2007	✓	✓	✓	✓	✓
	Stark, 2021	✓	✓	✓	✓	✓
Fair	Blalock, 2010	✓	✓	✓	▲	✓
	Chu, 2017	▲	✓	✓	✓	✓
	Clemson, 2004	▲	✓	✓	✓	✓
	Dorresteijn, 2016	✓	✓	✓	✗	✓
	Fitzharris, 2010	▲	✓	✓	✓	✓
	Lim, 2023	✓	✓	✓	▲	✓
	Mott, 2016	▲	✓	▲	▲	✓
	Smulders, 2010	▲	✓	✓	✓	✓
	Stevens, 2001	▲	✓	✓	✓	✓
	Taylor, 2021	✓	✓	✓	▲	✓
	Zijlstra, 2009	✓	✓	✓	▲	✓

Risk of bias
 ✗ High
 ✓ Low
 ▲ Moderate

Appendix B Figure 1. Literature Flow Diagram



*Study may appear in more than one intervention category.

Appendix C. Included Studies List

Included studies List, by Key Question (KQ) and Intervention Type
Ancillary publication(s) indented under primary article

KEY QUESTION 1

Multifactorial

1. Bhasin S, Gill TM, Reuben DB, et al. A Randomized Trial of a Multifactorial Strategy to Prevent Serious Fall Injuries. *N Engl J Med.* 2020;383(2):129-40. PMID: 32640131. <https://dx.doi.org/10.1056/NEJMoa2002183>
 - a. Bhasin S, Gill TM, Reuben DB, et al. Strategies to Reduce Injuries and Develop Confidence in Elders (STRIDE): A Cluster-Randomized Pragmatic Trial of a Multifactorial Fall Injury Prevention Strategy: Design and Methods. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences.* 2018;73(8):1053-61. PMID: 29045582. <https://dx.doi.org/10.1093/gerona/glx190>
 - b. Ganz DA, Siu AL, Magaziner J, et al. Protocol for serious fall injury adjudication in the Strategies to Reduce Injuries and Develop Confidence in Elders (STRIDE) study. *Injury Epidemiology.* 2019;6:14. PMID: 31245263. <https://dx.doi.org/10.1186/s40621-019-0190-2>
 - c. Ganz DA, Yuan AH, Greene EJ, et al. Effect of the STRIDE fall injury prevention intervention on falls, fall injuries, and health-related quality of life. *Journal of the American Geriatrics Society.* 2022;70(11):3221-9. PMID: 35932279. <https://dx.doi.org/10.1111/jgs.17964>
 - d. Gill TM, Bhasin S, Reuben DB, et al. Effect of a Multifactorial Fall Injury Prevention Intervention on Patient Well-Being: The STRIDE Study. *Journal of the American Geriatrics Society.* 2021;69(1):173-9. PMID: 33037632. <https://dx.doi.org/10.1111/jgs.16854>
 - e. Gill TM, McGloin JM, Latham NK, et al. Screening, Recruitment, and Baseline Characteristics for the Strategies to Reduce Injuries and Develop Confidence in Elders (STRIDE) Study. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences.* 2018;73(11):1495-501. PMID: 30020415. <https://dx.doi.org/10.1093/gerona/gly076>
 - f. McMahan S, Greene E, Latham N, et al. Engagement of older adults in STRIDE's multifactorial fall injury prevention intervention. *Journal of the American Geriatrics Society.* 2022;70(11):3116-26. PMID: 35924574. <https://doi.org/10.1111/jgs.17983>
 - g. Reuben DB, Gazarian P, Alexander N, et al. The Strategies to Reduce Injuries and Develop Confidence in Elders Intervention: Falls Risk Factor Assessment and Management, Patient Engagement, and Nurse Co-management. *Journal of the American Geriatrics Society.* 2017;65(12):2733-9. PMID: 29044479. <https://dx.doi.org/10.1111/jgs.15121>
2. Bruce J, Hossain A, Lall R, et al. Fall prevention interventions in primary care to reduce fractures and falls in people aged 70 years and over: the PreFIT three-arm cluster RCT. *Health Technol Assess.* 2021;25(34):1-114. PMID: 34075875. <https://dx.doi.org/10.3310/hta25340>

Appendix C. Included Studies List

- a. Bruce J, Lall R, Withers EJ, et al. A cluster randomised controlled trial of advice, exercise or multifactorial assessment to prevent falls and fractures in community-dwelling older adults: protocol for the prevention of falls injury trial (PreFIT). *BMJ Open*. 2016;6(1):e009362. PMID: 26781504. <https://dx.doi.org/10.1136/bmjopen-2015-009362>
- b. Bruce J, Ralhan S, Sheridan R, et al. The design and development of a complex multifactorial falls assessment intervention for falls prevention: The Prevention of Falls Injury Trial (PreFIT). *BMC Geriatrics*. 2017;17(1):116. PMID: 28571563. <https://dx.doi.org/10.1186/s12877-017-0492-6>
- c. Finnegan S, Bruce J, Skelton DA, et al. Development and delivery of an exercise programme for falls prevention: the Prevention of Falls Injury Trial (PreFIT). *Physiotherapy*. 2018;104(1):72-9. PMID: 28801033. <https://dx.doi.org/10.1016/j.physio.2017.06.004>
- d. Lamb SE, Bruce J, Hossain A, et al. Screening and Intervention to Prevent Falls and Fractures in Older People. *New England Journal of Medicine*. 2020;383(19):1848-59. PMID: 33211928. <https://dx.doi.org/10.1056/NEJMoa2001500>
3. Cameron ID, Fairhall N, Langron C, et al. A multifactorial interdisciplinary intervention reduces frailty in older people: randomized trial. *BMC medicine*. 2013;11:65. PMID: 23497404. <https://doi.org/10.1186/1741-7015-11-65>
4. Ciaschini PM, Straus SE, Dolovich LR, et al. Community-based intervention to optimise falls risk management: a randomised controlled trial. *Age Ageing*. 2009;38(6):724-30. PMID: 19767629. <https://doi.org/10.1093/ageing/afp176>
5. Close J, Ellis M, Hooper R, et al. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. *Lancet*. 1999;353(9147):93-7. PMID: 10023893. [https://doi.org/10.1016/S0140-6736\(98\)06119-4](https://doi.org/10.1016/S0140-6736(98)06119-4)
6. Cohen MA, Miller J, Xiaomei S, et al. Prevention Program Lowered The Risk Of Falls And Decreased Claims For Long-Term Services Among Elder Participants. *Health Affairs*. 2015;34(6):971-7. PMID: 26056202. <https://doi.org/10.1377/hlthaff.2014.1172>
7. Conroy S, Kendrick D, Harwood R, et al. A multicentre randomised controlled trial of day hospital-based falls prevention programme for a screened population of community-dwelling older people at high risk of falls. *Age Ageing*. 2010;39(6):704-10. PMID: 20823124. <http://dx.doi.org/10.1093/ageing/afq096>
8. Davison J, Bond J, Dawson P, et al. Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention--a randomised controlled trial. *Age Ageing*. 2005;34(2):162-8. PMID: 15716246. <https://doi.org/10.1093/ageing/afi053>
9. de Vries OJ, Peeters GM, Elders PJ, et al. Multifactorial intervention to reduce falls in older people at high risk of recurrent falls: a randomized controlled trial. *Arch Intern Med*. 2010;170(13):1110-7. PMID: 20625015. <http://dx.doi.org/10.1001/archinternmed.2010.169>
 - a. Peeters GM, de Vries OJ, Elders PJ, et al. Prevention of fall incidents in patients with a high risk of falling: design of a randomised controlled trial with an economic evaluation of the effect of multidisciplinary transmural care. *BMC Geriatr*. 2007;7:15. PMID: 17605771. <https://doi.org/10.1186/1471-2318-7-15>

Appendix C. Included Studies List

10. Elley CR, Robertson MC, Garrett S, et al. Effectiveness of a falls-and-fracture nurse coordinator to reduce falls: a randomized, controlled trial of at-risk older adults. *J Am Geriatr Soc.* 2008;56(8):1383-9. PMID: 18808597. <https://doi.org/10.1111/j.1532-5415.2008.01802.x>
11. Fairhall N, Sherrington C, Lord SR, et al. Effect of a multifactorial, interdisciplinary intervention on risk factors for falls and fall rate in frail older people: a randomised controlled trial. *Age Ageing.* 2014;43(5):616-22. PMID: 24381025. <http://dx.doi.org/10.1093/ageing/aft204>
 - a. Fairhall N, Aggar C, Kurrle SE, et al. Frailty Intervention Trial (FIT). *BMC Geriatr.* 2008;8:27. PMID: 18851754. <https://doi.org/10.1186/1471-2318-8-27>
 - b. Fairhall N, Sherrington C, Cameron ID, et al. A multifactorial intervention for frail older people is more than twice as effective among those who are compliant: complier average causal effect analysis of a randomised trial. *J Physiother.* 2017;63(1):40-4. PMID: 27993489. <https://dx.doi.org/10.1016/j.jphys.2016.11.007>
 - c. Ferrer A, Formiga F, Sanz H, et al. Multifactorial assessment and targeted intervention to reduce falls among the oldest-old: a randomized controlled trial. *Clin Interv Aging.* 2014;9:383-93. PMID: 24596458. <http://dx.doi.org/10.2147/CIA.S57580>
12. Hendriks MR, Bleijlevens MH, van Haastregt JC, et al. Lack of effectiveness of a multidisciplinary fall-prevention program in elderly people at risk: a randomized, controlled trial. *J Am Geriatr Soc.* 2008;56(8):1390-7. PMID: 18662214. <https://doi.org/10.1111/j.1532-5415.2008.01803.x>
13. Hogan DB, MacDonald FA, Betts J, et al. A randomized controlled trial of a community-based consultation service to prevent falls. *CMAJ.* 2001;165(5):537-43. PMID: 11563205.
14. Imhof L, Naef R, Wallhagen MI, et al. Effects of an advanced practice nurse in-home health consultation program for community-dwelling persons aged 80 and older. *J Am Geriatr Soc.* 2012;60(12):2223-31. PMID: 23194103. <http://dx.doi.org/10.1111/jgs.12026>
15. La Porta F, Lullini G, Caselli S, et al. Efficacy of a multiple-component and multifactorial personalized fall prevention program in a mixed population of community-dwelling older adults with stroke, Parkinson's Disease, or frailty compared to usual care: The PRE.C.I.S.A. randomized controlled trial. *Front Neurol.* 2022;13:943918. PMID: 36119666. <https://dx.doi.org/10.3389/fneur.2022.943918>
16. Lightbody E, Watkins C, Leathley M, et al. Evaluation of a nurse-led falls prevention programme versus usual care: a randomized controlled trial. *Age Ageing.* 2002;31(3):203-10. PMID: 12006310.
17. Logan PA, Coupland CA, Gladman JR, et al. Community falls prevention for people who call an emergency ambulance after a fall: randomised controlled trial. *BMJ.* 2010;340:c2102. PMID: 20460331. <http://dx.doi.org/10.1136/bmj.c2102>
18. Lord SR, Tiedemann A, Chapman K, et al. The effect of an individualized fall prevention program on fall risk and falls in older people: a randomized, controlled trial. *J Am Geriatr Soc.* 2005;53(8):1296-304. PMID: 16078954. <https://doi.org/10.1111/j.1532-5415.2005.53425.x>

Appendix C. Included Studies List

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Exercise

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 - b. Buchner DM, Hornbrook MC, Kutner NG, et al. Development of the common data base for the FICSIT trials. *J Am Geriatr Soc*. 1993;41(3):297-308. PMID: 8440854.
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 - b. Karinkanta S, Nupponen R, Heinonen A, et al. Effects of exercise on health-related quality of life and fear of falling in home-dwelling older women. *J Aging Phys Act*. 2012;20(2):198-214. PMID: 22472580.
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<https://doi.org/10.1016/j.amjmed.2015.06.017>
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 - a. Pitkala KH, Poysti MM, Laakkonen ML, et al. Effects of the Finnish Alzheimer disease exercise trial (FINALEX): a randomized controlled trial. *JAMA Intern Med*. 2013;173(10):894-901. PMID: 23589097.
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 - a. Blank WA, Freiberger E, Siegrist M, et al. An interdisciplinary intervention to prevent falls in community-dwelling elderly persons: protocol of a cluster-randomized trial [PreFalls]. *BMC Geriatr*. 2011;11:7. PMID: 21329525. <http://dx.doi.org/10.1186/1471-2318-11-7>
 - b. Hentschke C, Halle M, Geilhof B, et al. 24-Months Cluster-Randomized Intervention Trial of a Targeted Fall Prevention Program in a Primary Care Setting. *Journal of General Internal Medicine*. 2021;08:08. PMID: 34240282. <https://dx.doi.org/10.1007/s11606-021-06944-w>
30. Stathi A, Greaves CJ, Thompson JL, et al. Effect of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: the REACT (Retirement in Action) randomised controlled trial. *Lancet Public Health*. 2022;7(4):e316-e26. PMID: 35325627. [https://dx.doi.org/10.1016/S2468-2667\(22\)00004-4](https://dx.doi.org/10.1016/S2468-2667(22)00004-4)
 - a. Stathi A, Withall J, Greaves CJ, et al. A community-based physical activity intervention to prevent mobility-related disability for retired older people (REtirement in ACTion (REACT)): study protocol for a randomised controlled trial. *Trials*. 2018;19(1):228. PMID: 29665854. <https://10.1186/s13063-018-2603-x>
31. Suikkanen S, Soukkio P, Aartolahti E, et al. Effect of 12-Month Supervised, Home-Based Physical Exercise on Functioning Among Persons With Signs of Frailty: A Randomized Controlled Trial. *Archives of Physical Medicine & Rehabilitation*. 2021;102(12):2283-90. PMID: 34283997. <https://dx.doi.org/10.1016/j.apmr.2021.06.017>
 - a. Soukkio P, Suikkanen S, Kaaria S, et al. Effects of 12-month home-based physiotherapy on duration of living at home and functional capacity among older persons with signs of frailty or with a recent hip fracture - protocol of a randomized controlled trial (HIPFRA study). *BMC Geriatrics*. 2018;18(1):232. PMID: 30285645. <https://dx.doi.org/10.1186/s12877-018-0916-y>
 - b. Suikkanen SA, Soukkio PK, Aartolahti EM, et al. Effects of Home-Based Physical Exercise on Days at Home and Cost-Effectiveness in Pre-Frail and Frail Persons: Randomized Controlled Trial. *J Am Med Dir Assoc*. 2021;22(4):773-9. PMID: 32694001. [10.1016/j.jamda.2020.06.005](https://doi.org/10.1016/j.jamda.2020.06.005)
32. Tomita M, Fisher N, Ramsey D, et al. Effects of Virtual-Group Exercise at Home (V-GEAH) on Adherence and Fall Risks in Older Adults with a History of Falling. *Gerontology Geriatr Res*. 2016;2(3):1018.
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34. Tuvemo Johnson S, Anens E, Johansson AC, et al. The Otago Exercise Program With or Without Motivational Interviewing for Community-Dwelling Older Adults: A 12-Month Follow-Up of a Randomized, Controlled Trial. *J Appl Gerontol*. 2021;40(3):289-99. PMID: 32114877. <https://dx.doi.org/10.1177/0733464820902652>
 - a. Arkkukangas M, Johnson ST, Hellstrom K, et al. Fall Prevention Exercises With or Without Behavior Change Support for Community-Dwelling Older Adults: A Two-Year Follow-Up of a Randomized Controlled Trial. *J Aging Phys Act*. 2019/06/13 ed2019. p. 34-41. PMID: 31188707. <https://dx.doi.org/10.1123/japa.2019-0116>
 - b. Arkkukangas M, Soderlund A, Eriksson S, et al. One-Year Adherence to the Otago Exercise Program With or Without Motivational Interviewing in Community-Dwelling Older Adults. *J Aging Phys Activity*. 2018;26(3):390-5. PMID: 28952864. <https://dx.doi.org/10.1123/japa.2017-0009>
 - c. Arkkukangas M, Soderlund A, Eriksson S, et al. Fall Preventive Exercise With or Without Behavior Change Support for Community-Dwelling Older Adults: A Randomized Controlled Trial With Short-Term Follow-up. *Journal of Geriatric Physical Therapy*. 2019;42(1):9-17. PMID: 28244890. <https://dx.doi.org/10.1519/JPT.0000000000000129>
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 - a. Uusi-Rasi K, Kannus P, Karinkanta S, et al. Study protocol for prevention of falls: a randomized controlled trial of effects of vitamin D and exercise on falls prevention. *BMC Geriatr*. 2012;12:12. PMID: 22448872. <http://dx.doi.org/10.1186/1471-2318-12-12>
 - b. Uusi-Rasi K, Patil R, Karinkanta S, et al. A 2-Year Follow-Up After a 2-Year RCT with Vitamin D and Exercise: Effects on Falls, Injurious Falls and Physical Functioning Among Older Women. *J Gerontol A Biol Sci Med Sci*. 2017;72(9):1239-45. PMID: 28369286. <https://dx.doi.org/10.1093/gerona/glx044>
 - c. Patil R, Karinkanta S, Tokola K, et al. Effects of Vitamin D and Exercise on the Wellbeing of Older Community-Dwelling Women: A Randomized Controlled Trial. *Gerontology*. 2016;62(4):401-8. PMID: 26682749. <https://dx.doi.org/10.1159/000442441>
36. Voukelatos A, Cumming RG, Lord SR, et al. A randomized, controlled trial of tai chi for the prevention of falls: the Central Sydney tai chi trial. *J Am Geriatr Soc*. 2007;55(8):1185-91. PMID: 17661956. <https://doi.org/10.1111/j.1532-5415.2007.01244.x>
37. Voukelatos A, Merom D, Sherrington C, et al. The impact of a home-based walking programme on falls in older people: the Easy Steps randomised controlled trial. *Age Ageing*. 2015;44(3):377-83. PMID: 25572426. <http://dx.doi.org/10.1093/ageing/afu186>

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Exercise + Education +

1. Daly RM, Gianoudis J, Kersh ME, et al. Effects of a 12-Month Supervised, Community-Based, Multimodal Exercise Program Followed by a 6-Month Research-to-Practice Transition on Bone Mineral Density, Trabecular Microarchitecture, and Physical Function in Older Adults: A Randomized Controlled Trial. *Journal of Bone & Mineral Research*. 2020;35(3):419-29. PMID: 31498937. <https://dx.doi.org/10.1002/jbmr.3865>
 - a. Gianoudis J, Bailey CA, Ebeling PR, et al. Effects of a targeted multimodal exercise program incorporating high-speed power training on falls and fracture risk factors in older adults: a community-based randomized controlled trial. *J Bone Miner Res*. 2014;29(1):182-91. PMID: 23775701. <http://dx.doi.org/10.1002/jbmr.2014>
 - b. Gianoudis J, Bailey CA, Sanders KM, et al. Osteo-cise: strong bones for life: protocol for a community-based randomised controlled trial of a multi-modal exercise and osteoporosis education program for older adults at risk of falls and fractures. *BMC Musculoskelet Disord*. 2012;13:78. PMID: 22640372. <http://dx.doi.org/10.1186/1471-2474-13-78>
 - c. Talevski J, Gianoudis J, Bailey CA, et al. Effects of an 18-month community-based, multifaceted, exercise program on patient-reported outcomes in older adults at risk of fracture: secondary analysis of a randomised controlled trial. *Osteoporosis International*. 2023;34(5):891-900. PMID: 36862193. <https://dx.doi.org/10.1007/s00198-023-06693-y>
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Appendix C. Included Studies List

Exercise + Environment

1. Fitzharris MP, Day L, Lord SR, et al. The Whitehorse NoFalls trial: effects on fall rates and injurious fall rates. *Age Ageing*. 2010;39(6):728-33. PMID: 20817936. <http://dx.doi.org/10.1093/ageing/afq109>
 - a. Day L, Fildes B, Gordon I, et al. Randomised factorial trial of falls prevention among older people living in their own homes. *BMJ*. 2002;325(7356):128. PMID: 12130606.
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Environment

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 - a. Day L, Fildes B, Gordon I, et al. Randomised factorial trial of falls prevention among older people living in their own homes. *BMJ*. 2002;325(7356):128. PMID: 12130606.
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5. Stark S, Keglovits M, Somerville E, et al. Home Hazard Removal to Reduce Falls Among Community-Dwelling Older Adults: A Randomized Clinical Trial. *JAMA netw*. 2021;4(8):e2122044. PMID: 34463746.
<https://dx.doi.org/10.1001/jamanetworkopen.2021.22044>
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<http://dx.doi.org/10.1016/j.japh.2015.11.001>
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randomised controlled trial. *Trials* [Electronic Resource]. 2017;18(1):158. PMID: 28372591. <https://dx.doi.org/10.1186/s13063-017-1900-0>

Psychological

1. Dorresteijn TA, Zijlstra GA, Ambergen AW, et al. Effectiveness of a home-based cognitive behavioral program to manage concerns about falls in community-dwelling, frail older people: results of a randomized controlled trial.[Erratum appears in *BMC Geriatr.* 2016;16:108; PMID: 27220990]. *BMC Geriatr.* 2016;16:2. PMID: 26739339. <http://dx.doi.org/10.1186/s12877-015-0177-y>
 - a. Dorresteijn TA, Rixt Zijlstra GA, Van Haastregt JC, et al. Feasibility of a nurse-led in-home cognitive behavioral program to manage concerns about falls in frail older people: a process evaluation. *Res Nurs Health.* 2013;36(3):257-70. PMID: 23533013. <http://dx.doi.org/10.1002/nur.21534>
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KEY QUESTION 2

Multifactorial

1. Bruce J, Hossain A, Lall R, et al. Fall prevention interventions in primary care to reduce fractures and falls in people aged 70 years and over: the PreFIT three-arm cluster RCT. *Health Technol Assess.* 2021;25(34):1-114. PMID: 34075875. <https://dx.doi.org/10.3310/hta25340>

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- a. Bruce J, Lall R, Withers EJ, et al. A cluster randomised controlled trial of advice, exercise or multifactorial assessment to prevent falls and fractures in community-dwelling older adults: protocol for the prevention of falls injury trial (PreFIT). *BMJ Open*. 2016;6(1):e009362. PMID: 26781504. <https://dx.doi.org/10.1136/bmjopen-2015-009362>
 - b. Bruce J, Ralhan S, Sheridan R, et al. The design and development of a complex multifactorial falls assessment intervention for falls prevention: The Prevention of Falls Injury Trial (PreFIT). *BMC Geriatrics*. 2017;17(1):116. PMID: 28571563. <https://dx.doi.org/10.1186/s12877-017-0492-6>
 - c. Finnegan S, Bruce J, Skelton DA, et al. Development and delivery of an exercise programme for falls prevention: the Prevention of Falls Injury Trial (PreFIT). *Physiotherapy*. 2018;104(1):72-9. PMID: 28801033. <https://dx.doi.org/10.1016/j.physio.2017.06.004>
 - d. Lamb SE, Bruce J, Hossain A, et al. Screening and Intervention to Prevent Falls and Fractures in Older People. *New England Journal of Medicine*. 2020;383(19):1848-59. PMID: 33211928. <https://dx.doi.org/10.1056/NEJMoa2001500>
2. Fairhall N, Sherrington C, Lord SR, et al. Effect of a multifactorial, interdisciplinary intervention on risk factors for falls and fall rate in frail older people: a randomised controlled trial. *Age Ageing*. 2014;43(5):616-22. PMID: 24381025. <http://dx.doi.org/10.1093/ageing/aft204>
 - a. Fairhall N, Aggar C, Kurrle SE, et al. Frailty Intervention Trial (FIT). *BMC Geriatr*. 2008;8:27. PMID: 18851754. <https://doi.org/10.1186/1471-2318-8-27>
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 - a. Bruce J, Lall R, Withers EJ, et al. A cluster randomised controlled trial of advice, exercise or multifactorial assessment to prevent falls and fractures in community-dwelling older adults: protocol for the prevention of falls injury trial (PreFIT). *BMJ Open*. 2016;6(1):e009362. PMID: 26781504.
<https://dx.doi.org/10.1136/bmjopen-2015-009362>
 - b. Bruce J, Ralhan S, Sheridan R, et al. The design and development of a complex multifactorial falls assessment intervention for falls prevention: The Prevention of Falls Injury Trial (PreFIT). *BMC Geriatrics*. 2017;17(1):116. PMID: 28571563.
<https://dx.doi.org/10.1186/s12877-017-0492-6>
 - c. Finnegan S, Bruce J, Skelton DA, et al. Development and delivery of an exercise programme for falls prevention: the Prevention of Falls Injury Trial (PreFIT). *Physiotherapy*. 2018;104(1):72-9. PMID: 28801033.
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- a. Karinkanta S, Heinonen A, Sievanen H, et al. A multi-component exercise regimen to prevent functional decline and bone fragility in home-dwelling elderly women: randomized, controlled trial. *Osteoporos Int.* 2007;18(4):453-62. PMID: 17103296. [10.1007/s00198-006-0256-1](https://doi.org/10.1007/s00198-006-0256-1)
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6. Lamb SE, Mistry D, Alleyne S, et al. Aerobic and strength training exercise programme for cognitive impairment in people with mild to moderate dementia: the DAPA RCT. *Health Technology Assessment (Winchester, England).* 2018;22(28):1-202. PMID: 29848412. <https://dx.doi.org/10.3310/hta22280>
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12. Rikkinen T, Sund R, Koivumaa-Honkanen H, et al. Effectiveness of exercise on fall prevention in community-dwelling older adults: a 2-year randomized controlled study of 914 women. *Age & Ageing.* 2023;52(4):01. PMID: 37097767. <https://dx.doi.org/10.1093/ageing/afad059>

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 - b. Hentschke C, Halle M, Geilhof B, et al. 24-Months Cluster-Randomized Intervention Trial of a Targeted Fall Prevention Program in a Primary Care Setting. *Journal of General Internal Medicine*. 2021;08:08. PMID: 34240282.
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15. Stathi A, Greaves CJ, Thompson JL, et al. Effect of a physical activity and behaviour maintenance programme on functional mobility decline in older adults: the REACT (Retirement in Action) randomised controlled trial. *Lancet Public Health*. 2022;7(4):e316-e26. PMID: 35325627. [https://dx.doi.org/10.1016/S2468-2667\(22\)00004-4](https://dx.doi.org/10.1016/S2468-2667(22)00004-4)
 - a. Stathi A, Withall J, Greaves CJ, et al. A community-based physical activity intervention to prevent mobility-related disability for retired older people (REtirement in ACTion (REACT)): study protocol for a randomised controlled trial. *Trials*. 2018;19(1):228. PMID: 29665854. <https://10.1186/s13063-018-2603-x>
16. Suikkanen S, Soukkio P, Aartolahti E, et al. Effect of 12-Month Supervised, Home-Based Physical Exercise on Functioning Among Persons With Signs of Frailty: A Randomized Controlled Trial. *Archives of Physical Medicine & Rehabilitation*. 2021;102(12):2283-90. PMID: 34283997.
<https://dx.doi.org/10.1016/j.apmr.2021.06.017>
 - a. Soukkio P, Suikkanen S, Kaaria S, et al. Effects of 12-month home-based physiotherapy on duration of living at home and functional capacity among older persons with signs of frailty or with a recent hip fracture - protocol of a randomized controlled trial (HIPFRA study). *BMC Geriatrics*. 2018;18(1):232. PMID: 30285645. <https://dx.doi.org/10.1186/s12877-018-0916-y>
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- Month Follow-Up of a Randomized, Controlled Trial. *J Appl Gerontol*. 2021;40(3):289-99. PMID: 32114877. <https://dx.doi.org/10.1177/0733464820902652>
- a. Arkkukangas M, Johnson ST, Hellstrom K, et al. Fall Prevention Exercises With or Without Behavior Change Support for Community-Dwelling Older Adults: A Two-Year Follow-Up of a Randomized Controlled Trial. *J Aging Phys Act*. 2019/06/13 ed2019. p. 34-41. PMID: 31188707. <https://dx.doi.org/10.1123/japa.2019-0116>
 - b. Arkkukangas M, Soderlund A, Eriksson S, et al. One-Year Adherence to the Otago Exercise Program With or Without Motivational Interviewing in Community-Dwelling Older Adults. *J Aging Phys Activity*. 2018;26(3):390-5. PMID: 28952864. <https://dx.doi.org/10.1123/japa.2017-0009>
 - c. Arkkukangas M, Soderlund A, Eriksson S, et al. Fall Preventive Exercise With or Without Behavior Change Support for Community-Dwelling Older Adults: A Randomized Controlled Trial With Short-Term Follow-up. *Journal of Geriatric Physical Therapy*. 2019;42(1):9-17. PMID: 28244890. <https://dx.doi.org/10.1519/JPT.000000000000129>
19. Uusi-Rasi K, Patil R, Karinkanta S, et al. Exercise and vitamin D in fall prevention among older women: a randomized clinical trial. *JAMA Intern Med*. 2015;175(5):703-11. PMID: 25799402. <http://dx.doi.org/10.1001/jamainternmed.2015.0225>
- a. Uusi-Rasi K, Kannus P, Karinkanta S, et al. Study protocol for prevention of falls: a randomized controlled trial of effects of vitamin D and exercise on falls prevention. *BMC Geriatr*. 2012;12:12. PMID: 22448872. <http://dx.doi.org/10.1186/1471-2318-12-12>
 - b. Uusi-Rasi K, Patil R, Karinkanta S, et al. A 2-Year Follow-Up After a 2-Year RCT with Vitamin D and Exercise: Effects on Falls, Injurious Falls and Physical Functioning Among Older Women. *J Gerontol A Biol Sci Med Sci*. 2017;72(9):1239-45. PMID: 28369286. <https://dx.doi.org/10.1093/gerona/glx044>
 - c. Patil R, Karinkanta S, Tokola K, et al. Effects of Vitamin D and Exercise on the Wellbeing of Older Community-Dwelling Women: A Randomized Controlled Trial. *Gerontology*. 2016;62(4):401-8. PMID: 26682749. <https://dx.doi.org/10.1159/000442441>

Exercise + Education +

1. Daly RM, Gianoudis J, Kersh ME, et al. Effects of a 12-Month Supervised, Community-Based, Multimodal Exercise Program Followed by a 6-Month Research-to-Practice Transition on Bone Mineral Density, Trabecular Microarchitecture, and Physical Function in Older Adults: A Randomized Controlled Trial. *Journal of Bone & Mineral Research*. 2020;35(3):419-29. PMID: 31498937. <https://dx.doi.org/10.1002/jbmr.3865>
 - a. Gianoudis J, Bailey CA, Ebeling PR, et al. Effects of a targeted multimodal exercise program incorporating high-speed power training on falls and fracture risk factors in older adults: a community-based randomized controlled trial. *J Bone Miner Res*. 2014;29(1):182-91. PMID: 23775701. <http://dx.doi.org/10.1002/jbmr.2014>

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- b. Gianoudis J, Bailey CA, Sanders KM, et al. Osteo-cise: strong bones for life: protocol for a community-based randomised controlled trial of a multi-modal exercise and osteoporosis education program for older adults at risk of falls and fractures. *BMC Musculoskelet Disord*. 2012;13:78. PMID: 22640372. <http://dx.doi.org/10.1186/1471-2474-13-78>
2. Sherrington C, Fairhall N, Kirkham C, et al. Exercise to Reduce Mobility Disability and Prevent Falls After Fall-Related Leg or Pelvic Fracture: RESTORE Randomized Controlled Trial. *Journal of General Internal Medicine*. 2020;35(10):2907-16. PMID: 32016702. <https://dx.doi.org/10.1007/s11606-020-05666-9>
 - a. Sherrington C, Fairhall N, Kirkham C, et al. Exercise and fall prevention self-management to reduce mobility-related disability and falls after fall-related lower limb fracture in older people: protocol for the RESTORE (Recovery Exercises and STEpping On afterR fracturE) randomised controlled trial. *BMC Geriatrics*. 2016;16:34. PMID: 26838998. <https://dx.doi.org/10.1186/s12877-016-0206-5>
3. Shumway-Cook A, Silver I, Mary L, et al. Effectiveness of a community-based multifactorial intervention on falls and fall risk factors in community-living older adults: a randomized, controlled trial. *J Gerontol A Biol Sci Med Sci*. 2007;62(12):1420-7. PMID: 18166695.
4. Smulders E, Weerdesteyn V, Groen BE, et al. Efficacy of a short multidisciplinary falls prevention program for elderly persons with osteoporosis and a fall history: a randomized controlled trial. *Arch Phys Med Rehabil*. 2010;91(11):1705-11. PMID: 21044715. <http://dx.doi.org/10.1016/j.apmr.2010.08.004>

Exercise + Environment

1. Taylor ME, Wesson J, Sherrington C, et al. Tailored Exercise and Home Hazard Reduction Program for Fall Prevention in Older People With Cognitive Impairment: The i-FOCIS Randomized Controlled Trial. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences*. 2021;76(4):655-65. PMID: 32949456. <https://dx.doi.org/10.1093/gerona/glaa241>

Environment

1. Cockayne S, Pighills A, Adamson J, et al. Home environmental assessments and modification delivered by occupational therapists to reduce falls in people aged 65 years and over: the OTIS RCT. *Health Technol Assess*. 2021;25(46):1-118. PMID: 34254934. <https://dx.doi.org/10.3310/hta25460>
 - a. Cockayne S, Pighills A, Adamson J, et al. Can occupational therapist-led home environmental assessment prevent falls in older people? A modified cohort randomised controlled trial protocol. *BMJ Open*. 2018;8(9):e022488. PMID: 30206086. <https://dx.doi.org/10.1136/bmjopen-2018-022488>
 - b. Cockayne S, Pighills A, Fairhurst C, et al. Home hazard assessment and environmental modification to prevent falls in older people: the OTIS trial. *F1000Res*. 2021;25 June 2021:1-18. <https://doi.org/10.12688/f1000research.52313.1>
2. Stark S, Keglovits M, Somerville E, et al. Home Hazard Removal to Reduce Falls Among Community-Dwelling Older Adults: A Randomized Clinical Trial. *JAMA*

Appendix C. Included Studies List

netw. 2021;4(8):e2122044. PMID: 34463746.

<https://dx.doi.org/10.1001/jamanetworkopen.2021.22044>

- a. Stark S, Somerville E, Keglovits M, et al. Protocol for the home hazards removal program (HARP) study: a pragmatic, randomized clinical trial and implementation study. *BMC Geriatrics*. 2017;17(1):90. PMID: 28427336. <https://dx.doi.org/10.1186/s12877-017-0478-4>

Psychological

1. Zijlstra GA, van Haastregt JC, Ambergen T, et al. Effects of a multicomponent cognitive behavioral group intervention on fear of falling and activity avoidance in community-dwelling older adults: results of a randomized controlled trial. *J Am Geriatr Soc*. 2009;57(11):2020-8. PMID: 19793161. <https://doi.org/10.1111/j.1532-5415.2009.02489.x>
 - a. Kempen GI, Oude Wesselink SF, van Haastregt JC, et al. Long-term effect on mortality of a multicomponent cognitive behavioural group intervention to reduce fear of falling in older adults: a randomised controlled trial. *Age Ageing*. 2011;40(4):519-23. PMID: 21551460. <http://dx.doi.org/10.1093/ageing/afr041>

Appendix D. Excluded Studies List

Reason for Exclusion*
E1. Aim/relevant
E1a. Falls prevention not primary or secondary aim
E2. Study design
E3. Setting
E3a. Not a very high HDI country
E3b. Not primary care referable/feasible (e.g., intervention setting not accessible to general population, pre-existing social ties)
E4. Population
E4a. Adults <65 years
E4b. Adults not representative of general primary care population (e.g., Parkinson's, moderate to severe dementia, adults living in long-term care)
E5. No relevant outcomes
E5a. No additional relevant data (primary article included)
E5b. Only intermediate outcomes reported
E6. Intervention
E6a. <6 months followup
E6b. Comparative effectiveness trial
E6c. Not an included intervention type
E6d. Not minimal control group
E7. Publication
E7a. Publication type not included (correction, abstract)
E7b. Publication type not included (non-English)
E8. Full Text Unavailable
E9. Primary article excluded
E9a. Primary was poor quality
E10. Study quality

* Assigned at full-text phase

- Adnan, M, Anjum, H, et al. Effectiveness of Physical Activity in Geriatric Population to Decrease the Risk of Fall a Randomized Control Trial. Pakistan journal of medical and health sciences. 16(12): 589-591. 2022. PMID: NONE..
<https://dx.doi.org/10.53350/pjmhs20221612589>
KQ1E3a; KQ2E3a
- Agarwal, G, Angeles, R, et al. Evaluation of a community paramedicine health promotion and lifestyle risk assessment program for older adults who live in social housing: a cluster randomized trial. CMAJ Canadian Medical Association Journal. 190(21): E638-E647. 2018. PMID: 29807936.
<https://dx.doi.org/10.1503/cmaj.170740>
KQ1E5; KQ2E5
- Aibar-Almazan, A, Martinez-Amat, A, et al. Effects of Pilates on fall risk factors in community-dwelling elderly women: A randomized, controlled trial. European Journal of Sport Science EJSS : Official Journal of the European College of Sport Science. 19(10): 1386-1394. 2019. PMID: 30990762.
<https://dx.doi.org/10.1080/17461391.2019.1595739>
KQ1E5b; KQ2E5b
- Ailliaud, A, Moulis, É, et al. Assessment in the home of the elderly following a first fall with Samu intervention. Soins Gerontol. 27(153): 23-25. 2022. PMID: NONE.
10.1016/j.sger.2021.11.008 **KQ1E7b; KQ2E7b**
- Alakare, Janne, Kemp, Kirsi, et al. Systematic geriatric assessment for older patients with frailty in the emergency department: a randomised controlled trial. BMC Geriatr. 21(1): 1-11. 2021. PMID: NONE.
10.1186/s12877-021-02351-2 **KQ1E3; KQ2E3**

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6. Allison, SJ, Brooke-Wavell, K, et al. High and odd impact exercise training improved physical function and fall risk factors in community-dwelling older men. *Journal of Musculoskeletal Neuronal Interactions*. 18(1): 100-107. 2018. PMID: 29504585. **KQ1E2; KQ2E2**
7. Altamirano, Guerrero O, Balarezo, Garcia Mg, et al. Effectiveness of a preventive program for the reduction of falls in older adults. *NeuroQuantology*. 20(13): 287-292. 2022. <https://dx.doi.org/10.14704/NQ.2022.20.13.NQ88038> **KQ1E3a; KQ2E3a**
8. Althomali, MM, Vallis, LA, et al. Can older adults' balance and mobility improve with visual attention training?. *Eur J Appl Physiol*. 119(7): 1649-1661. 2019. PMID: 31055677. <https://dx.doi.org/10.1007/s00421-019-04153-2> **KQ1E5; KQ2E5**
9. Amaha, K, Arimoto, T. IFFAS-S13 03 Randomized control study of toe exercise for prevention from fall in elderly people. *Foot Ankle Surg*. 23(): 22-. 2017. PMID: NONE. 10.1016/j.fas.2017.07.1107 **KQ1E7a; KQ2E7a**
10. Anderson, ML, Allen, KD, et al. Fall Risk and Utilization of Balance Training for Adults With Symptomatic Knee Osteoarthritis: Secondary Analysis From a Randomized Clinical Trial. *Journal of Geriatric Physical Therapy*. 42(2): E39-E44. 2019. PMID: 30407270. <https://dx.doi.org/10.1519/JPT.0000000000000213> **KQ1E5b; KQ2E5b**
11. Anonymous, . E-health StandingTall balance exercise for fall prevention in older people: results of a two year randomised controlled trial. *BMJ*. 374(): n1908. 2021. PMID: 34404632. <https://dx.doi.org/10.1136/bmj.n1908> **KQ1E7a; KQ2E7a**
12. Ansai, JH, Aurichio, TR, et al. Effects of two physical exercise protocols on physical performance related to falls in the oldest old: A randomized controlled trial. *Geriatr Gerontol Int*. 16(4): 492-9. 2016. PMID: 25868484. <https://dx.doi.org/10.1111/ggi.12497> **KQ1E3a; KQ2E3a**
13. Apostolo, J, Dixe, MDA, et al. Effectiveness of a Combined Intervention on Psychological and Physical Capacities of Frail Older Adults: A Cluster Randomized Controlled Trial. *International Journal of Environmental Research & Public Health* [Electronic Resource]. 16(17): 28. 2019. PMID: 31466229. <https://dx.doi.org/10.3390/ijerph16173125> **KQ1E5; KQ2E5**
14. Aranda-Reneo, I, Albornos-Munoz, L, et al. Cost-Effectiveness of an Exercise Programme That Provided Group or Individual Training to Reduce the Fall Risk in Healthy Community-Dwelling People Aged 65-80: A Secondary Data Analysis. *Healthcare*. 9(6): 10. 2021. PMID: 34200873. <https://dx.doi.org/10.3390/healthcare9060714> **KQ1E6b; KQ2E6b**
15. Areedumwong, P, Salsalum, S, et al. Balance and functional fitness benefits of a Thai boxing dance program among community-dwelling older adults at risk of falling: A randomized controlled study. *Arch Gerontol Geriatr*. 83(): 231-238. 2019. PMID: 31102925. <https://dx.doi.org/10.1016/j.archger.2019.04.010> **KQ1E5; KQ2E5**
16. Arena, SK, Wilson, CM, et al. Impact of the HOP-UP-PT program on older adults at risk to fall: a randomized controlled trial. *BMC Geriatr*. 21(1): 520. 2021. PMID: 34598692. <https://dx.doi.org/10.1186/s12877-021-02450-0> **KQ1E10; KQ2E5**
17. Arghavani, H, Zolaktaf, V, et al. Comparing the effects of anticipatory postural adjustments focused training and balance training on postural preparation, balance confidence and quality of life in elderly with history of a fall. *Aging-Clinical & Experimental Research*. 32(9): 1757-1765. 2020. PMID: 31608424. <https://dx.doi.org/10.1007/s40520-019-01358-5> **KQ1E5; KQ2E5**
18. Arkkukangas, M, Stromqvist Baathe, K, et al. High Challenge Exercise and Learning Safe Landing Strategies among Community-Dwelling Older Adults: A Randomized Controlled Trial. *International Journal of Environmental Research & Public Health* [Electronic Resource]. 19(12): 16. 2022. PMID: 35742618. <https://dx.doi.org/10.3390/ijerph19127370> **KQ1E5b; KQ2E5b**

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19. Arnold, CM, Faulkner, RA. The effect of aquatic exercise and education on lowering fall risk in older adults with hip osteoarthritis [corrected] [published erratum appears in J AGING PHYS ACTIVITY 2010 Oct;18(4):477-479]. *J Aging Phys Act.* 18(3): 245-260. 2010. PMID: NONE. **KQ1E5; KQ2E5**
20. Barker, A, Cameron, P, et al. Evaluation of RESPOND, a patient-centred program to prevent falls in older people presenting to the emergency department with a fall: A randomised controlled trial. *PLoS Medicine / Public Library of Science.* 16(5): e1002807. 2019. PMID: 31125354. <https://dx.doi.org/10.1371/journal.pmed.1002807> **KQ1E6d; KQ2E6d**
21. Barker, AL, Cameron, PA, et al. RESPOND-- A patient-centred programme to prevent secondary falls in older people presenting to the emergency department with a fall: protocol for a multicentre randomised controlled trial. *Inj Prev.* 21(1): e1. 2015. PMID: 24958769. <http://dx.doi.org/10.1136/injuryprev-2014-041271> **KQ1E9; KQ2E9**
22. Barker, AL, Talevski, J, et al. Feasibility of Pilates exercise to decrease falls risk: a pilot randomized controlled trial in community-dwelling older people. *Clin Rehabil.* 30(10): 984-996. 2016. PMID: 26385357. **KQ1E6d; KQ2E6d**
23. Bayliss, EA, Shetterly, SM, et al. The OPTIMIZE patient- and family-centered, primary care-based deprescribing intervention for older adults with dementia or mild cognitive impairment and multiple chronic conditions: study protocol for a pragmatic cluster randomized controlled trial. *Trials [Electronic Resource].* 21(1): 542. 2020. PMID: 32552857. <https://dx.doi.org/10.1186/s13063-020-04482-0> **KQ1E5; KQ2E5**
24. Belleville, S, Cuesta, M, et al. Rationale and protocol of the StayFitLonger study: a multicentre trial to measure efficacy and adherence of a home-based computerised multidomain intervention in healthy older adults. *BMC Geriatr.* 20(1): 315. 2020. PMID: 32859156. <https://dx.doi.org/10.1186/s12877-020-01709-2> **KQ1E5; KQ2E5**
25. Bellumori, Maria, Uygur, Mehmet, et al. High-Speed Cycling Intervention Improves Rate-Dependent Mobility in Older Adults. *Med Sci Sports Exerc.* 49(1): 106-114. 2017. PMID: NONE. 10.1249/MSS.0000000000001069 **KQ1E5b; KQ2E5b**
26. Benavent-Caballer, V, Rosado-Calatayud, P, et al. The effectiveness of a video-supported group-based Otago exercise programme on physical performance in community-dwelling older adults: a preliminary study. *Physiotherapy.* 102(3): 280-6. 2016. PMID: 26395209. <https://dx.doi.org/10.1016/j.physio.2015.08.002> **KQ1E5; KQ2E5**
27. Bernabei, R, Landi, F, et al. Multicomponent intervention to prevent mobility disability in frail older adults: randomised controlled trial (SPRINTT project). *BMJ.* 377(): e068788. 2022. PMID: 35545258. 10.1136/bmj-2021-068788 **KQ1E6c; KQ2E6c**
28. Bernardelli, G, Roncaglione, C, et al. Adapted physical activity to promote active and healthy ageing: the PoliFIT pilot randomized waiting list-controlled trial. *Aging-Clinical & Experimental Research.* 31(4): 511-518. 2019. PMID: 30019265. <https://dx.doi.org/10.1007/s40520-018-1002-1> **KQ1E6a; KQ2E6a**
29. Birimoglu, Okuyan C, Bilgili, N. Effect of tai chi chuan on fear of falling, balance and physical self-perception in elderly: a randomised controlled trial. *Turk geriatri dergisi.* 20(3): 232-241. 2017. PMID: NONE. **KQ1E4b; KQ2E4b**
30. Bischoff-Ferrari, HA, de Godoi Rezende Costa Molino, C, et al. DO-HEALTH: Vitamin D3 - Omega-3 - Home exercise - Healthy aging and longevity trial - Design of a multinational clinical trial on healthy aging among European seniors. *Contemp Clin Trials.* 100(): 106124. 2021. PMID: 32858228. <https://dx.doi.org/10.1016/j.cct.2020.106124> **KQ1E9; KQ2E9**

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31. Bischoff-Ferrari, HA, Freystatter, G, et al. Effects of vitamin D, omega-3 fatty acids and a simple home strength exercise program on fall prevention: the DO-HEALTH randomized clinical trial. *Am J Clin Nutr.* 07(): 07. 2022. PMID: 35136915. <https://dx.doi.org/10.1093/ajcn/nqac022>
KQ1E6d; KQ2E6d
32. Bischoff-Ferrari, HA, Orav, EJ, et al. Effect of cholecalciferol plus calcium on falling in ambulatory older men and women: a 3-year randomized controlled trial. *Arch Intern Med.* 166(4): 424-430. 2006. PMID: 16505262. <https://doi.org/10.1001/archinte.166.4.424>
KQ1E6c; KQ2E6c
33. Bjerk, M, Brovold, T, et al. A falls prevention programme to improve quality of life, physical function and falls efficacy in older people receiving home help services: study protocol for a randomised controlled trial. *BMC Health Serv Res.* 17(1): 559. 2017. PMID: 28806904. <https://dx.doi.org/10.1186/s12913-017-2516-5>
KQ1E6a; KQ2E5
34. Bjerk, M, Brovold, T, et al. Effects of a falls prevention exercise programme on health-related quality of life in older home care recipients: a randomised controlled trial. *Age Ageing.* 48(2): 213-219. 2019. PMID: 30615055. <https://dx.doi.org/10.1093/ageing/afy192>
KQ1E6a; KQ2E6a
35. Bjerk, M, Brovold, T, et al. Effects of a falls prevention programme on health-related quality of life in older home care recipients: a randomised controlled trial. *Eur Geriatr Med.* 9(): S169-. 2018. PMID: NONE. [10.1007/s41999-018-0097-4](https://doi.org/10.1007/s41999-018-0097-4) **KQ1E7a; KQ2E7a**
36. Bjerk, M, Brovold, T, et al. Evaluating a falls prevention intervention in older home care recipients: a comparison of SF-6D and EQ-5D. *Qual Life Res.* 28(12): 3187-3195. 2019. PMID: 31364036. <https://dx.doi.org/10.1007/s11136-019-02258-x> **KQ1E2; KQ2E2**
37. Bjerk, M, Brovold, T, et al. Health-related quality of life in home care recipients after a falls prevention intervention: a 6-month follow-up. *Eur J Public Health.* 30(1): 64-69. 2020. PMID: 31169888. <https://dx.doi.org/10.1093/eurpub/ckz106>
KQ1E6a; KQ2E5
38. Blancafort Alias, S, Cuevas-Lara, C, et al. A Multi-Domain Group-Based Intervention to Promote Physical Activity, Healthy Nutrition, and Psychological Wellbeing in Older People with Losses in Intrinsic Capacity: AMICOPE Development Study. *International Journal of Environmental Research & Public Health* [Electronic Resource]. 18(11): 02. 2021. PMID: 34199566. <https://dx.doi.org/10.3390/ijerph18115979>
KQ1E5; KQ2E5
39. Blalock, SJ, Ferreri, SP, et al. Impact of STEADI-Rx: A Community Pharmacy-Based Fall Prevention Intervention. *J Am Geriatr Soc.* 68(8): 1778-1786. 2020. PMID: 32315461. <https://dx.doi.org/10.1111/jgs.16459> **KQ1E10; KQ2E5**
40. Bohm, S, Mandla-Liebsch, M, et al. Exercise of Dynamic Stability in the Presence of Perturbations Elicit Fast Improvements of Simulated Fall Recovery and Strength in Older Adults: A Randomized Controlled Trial. *Frontiers in Sports & Active Living.* 2(): 52. 2020. PMID: 33345043. <https://dx.doi.org/10.3389/fspor.2020.00052>
KQ1E5; KQ2E5
41. Bolton, KL, Egerton, T, et al. Effects of exercise on bone density and falls risk factors in post-menopausal women with osteopenia: a randomised controlled trial. *Journal of Science & Medicine in Sport.* 15(2): 102-9. 2012. PMID: NONE. <http://dx.doi.org/10.1016/j.jsams.2011.08.007>
KQ1E4a; KQ2E4a
42. Boongird, C, Keesukphan, P, et al. Effects of a simple home-based exercise program on fall prevention in older adults: A 12-month primary care setting, randomized controlled trial. *Geriatr Gerontol Int.* 17(11): 2157-2163. 2017. PMID: 28436154. <https://dx.doi.org/10.1111/ggi.13052>
KQ1E3a; KQ2E3a
43. Bouzid, W, Tavassoli, N, et al. Impact of a personalised care plan for the elderly calling emergency medical services after a fall at home: The RISING-DOM multi-centre randomised controlled trial protocol. *BMC Geriatr.* 22(1): 182. 2022. PMID: 35246053. <https://dx.doi.org/10.1186/s12877-022-02850-w>
KQ1E6a; KQ2E6a

Appendix D. Excluded Studies List

44. Braghin, RMB, Libardi, EC, et al. Exercise on balance and function for knee osteoarthritis: A randomized controlled trial. *J Bodyw Mov Ther*. 22(1): 76-82. 2018. PMID: 29332761. <https://dx.doi.org/10.1016/j.jbmt.2017.04.006> **KQ1E3a; KQ2E3a**
45. Breyse, Jill, Dixon, Sherry, et al. Aging Gracefully in Place: An Evaluation of the Capability of the CAPABLE © Approach. *J Appl Gerontol*. 41(3): 718-728. 2022. PMID: None. 10.1177/07334648211042606 **KQ1E10; KQ2E5**
46. Brown, JD, Smith, SM, et al. Comparative Effects of Angiotensin-Converting Enzyme Inhibitors and Angiotensin Receptor Blockers on Response to a Physical Activity Intervention in Older Adults: Results From the Lifestyle Interventions and Independence for Elders Study. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences*. 75(5): 1010-1016. 2020. PMID: 31070702. <https://dx.doi.org/10.1093/gerona/glz120> **KQ1E4b; KQ2E4b**
47. Burke, Thomaz Nogueira, França, Fábio Jorge Renovato, et al. Postural control in elderly women with osteoporosis: comparison of balance, strengthening and stretching exercises. A randomized controlled trial. *Clin Rehabil*. 26(11): 1021-1031. 2012. PMID: None. 10.1177/0269215512442204 **KQ1E3a; KQ2E3a**
48. Burton, E, Hill, K, et al. Balance on the Brain: a randomised controlled trial evaluating the effect of a multimodal exercise programme on physical performance, falls, quality of life and cognition for people with mild cognitive impairment-study protocol. *BMJ Open*. 12(4): e054725. 2022. PMID: 35437246. <https://dx.doi.org/10.1136/bmjopen-2021-054725> **KQ1E5; KQ2E5**
49. Bustamante-Troncoso, C, Herrera-López, Lm, et al. Effect of a multidimensional intervention for prevention of falls in the elderly. *Aten Primaria*. 52(10): 722-730. 2020. PMID: None. 10.1016/j.aprim.2019.07.018 **KQ1E7b; KQ2E7b**
50. Carta, MG, Cossu, G, et al. Active elderly and health-can moderate exercise improve health and wellbeing in older adults? Protocol for a randomized controlled trial. *Trials [Electronic Resource]*. 22(1): 331. 2021. PMID: 33962664. <https://dx.doi.org/10.1186/s13063-021-05278-6> **KQ1E5; KQ2E5**
51. Casas-Herrero, A, Anton-Rodrigo, I, et al. Effect of a multicomponent exercise programme (VIVIFRAIL) on functional capacity in frail community elders with cognitive decline: study protocol for a randomized multicentre control trial. *Trials [Electronic Resource]*. 20(1): 362. 2019. PMID: 31208471. <https://dx.doi.org/10.1186/s13063-019-3426-0> **KQ1E9; KQ2E9**
52. Casas-Herrero, A, Saez de Asteasu, ML, et al. Effects of Vivifrail multicomponent intervention on functional capacity: a multicentre, randomized controlled trial. *J Cachexia Sarcopenia Muscle*. 13(2): 884-893. 2022. PMID: 35150086. <https://dx.doi.org/10.1002/jcsm.12925> **KQ1E6a; KQ2E6a**
53. Cezar, NOC, Ansai, JH, et al. Feasibility of improving strength and functioning and decreasing the risk of falls in older adults with Alzheimer's dementia: a randomized controlled home-based exercise trial. *Arch Gerontol Geriatr*. 96(): 104476. 2021. PMID: 34260986. <https://dx.doi.org/10.1016/j.archger.2021.104476> **KQ1E3a; KQ2E3a**
54. Chittrakul, J, Siviroj, P, et al. Multi-System Physical Exercise Intervention for Fall Prevention and Quality of Life in Pre-Frail Older Adults: A Randomized Controlled Trial. *Int J Environ Res Public Health*. 17(9): . 2020. PMID: 32365613. <https://dx.doi.org/10.3390/ijerph17093102> **KQ1E3a; KQ2E3a**
55. Clemson, L, Mackenzie, L, et al. Integrated solutions for sustainable fall prevention in primary care, the iSOLVE project: a type 2 hybrid effectiveness-implementation design. *Implementation Science*. 12(1): 12. 2017. PMID: 28173827. <https://dx.doi.org/10.1186/s13012-016-0529-9> **KQ1E5; KQ2E5**

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56. Conneely, M, Leahy, A, et al. A physiotherapy-led transition to home intervention for older adults following emergency department discharge: protocol for a pilot feasibility randomised controlled trial. *Pilot & Feasibility Studies*. 8(1): 3. 2022. PMID: 34980285. <https://dx.doi.org/10.1186/s40814-021-00954-5> **KQ1E6a; KQ2E6a**
57. Conradsson, D, Halvarsson, A. The effects of dual-task balance training on gait in older women with osteoporosis: A randomized controlled trial. *Gait Posture*. 68(): 562-568. 2019. PMID: 30640156. <https://dx.doi.org/10.1016/j.gaitpost.2019.01.005> **KQ1E5b; KQ2E5b**
58. Costa, JNA, Ribeiro, ALA, et al. Balance Exercise Circuit for fall prevention in older adults: a randomized controlled crossover trial. *Journal of Frailty Sarcopenia & Falls*. 7(2): 60-71. 2022. PMID: 35775091. <https://dx.doi.org/10.22540/JFSF-07-060> **KQ1E3a; KQ2E3a**
59. Davis, JC, Hsu, CL, et al. Baseline health-related quality of life predicts falls: a secondary analysis of a randomized controlled trial. *Qual Life Res*. 31(11): 3211-3220. 2022. PMID: 35798988. <https://dx.doi.org/10.1007/s11136-022-03175-2> **KQ1E9; KQ2E9**
60. Davis, JC, Hsu, CL, et al. Comparing the cost-effectiveness of the Otago Exercise Programme among older women and men: A secondary analysis of a randomized controlled trial. *PLoS ONE [Electronic Resource]*. 17(4): e0267247. 2022. PMID: 35442974. <https://dx.doi.org/10.1371/journal.pone.0267247> **KQ1E9; KQ2E9**
61. Davis, JC, Khan, KM, et al. Action Seniors! Cost-Effectiveness Analysis of a Secondary Falls Prevention Strategy Among Community-Dwelling Older Fallers. *J Am Geriatr Soc*. 68(9): 1988-1997. 2020. PMID: 32472567. <https://dx.doi.org/10.1111/jgs.16476> **KQ1E9; KQ2E9**
62. Dawson-Hughes, B, Harris, SS, et al. Effect of calcium and vitamin D supplementation on bone density in men and women 65 years of age or older. *N Engl J Med*. 337(10): 670-676. 1997. PMID: 9278463. <https://doi.org/10.1056/NEJM199709043371003> **KQ1E6c; KQ2E6c**
63. Dedeayne, L, Dupont, J, et al. The exercise and nutrition for healthy ageing (ENHANCE) project: protocol of a triple blinded, randomized controlled trial. *Osteoporos Int*. 30(Suppl 2): S538-. 2019. PMID: NONE. 10.1007/s00198-019-04993-w **KQ1E9; KQ2E9**
64. Deepeshwar, S, Tanwar, M, et al. Effect of Yoga Based Lifestyle Intervention on Patients With Knee Osteoarthritis: A Randomized Controlled Trial. *Frontiers in psychiatry* Frontiers Research Foundation. 9(): 180. 2018. PMID: 29867604. <https://dx.doi.org/10.3389/fpsy.2018.00180> **KQ1E4a; KQ2E4a**
65. Desborough, JA, Clark, A, et al. Clinical and cost effectiveness of a multi-professional medication reviews in care homes (CAREMED). *International Journal of Pharmacy Practice*. 28(6): 626-634. 2020. PMID: 32666576. <https://dx.doi.org/10.1111/ijpp.12656> **KQ1E4b; KQ2E5**
66. DeWalt, NC, Stahorsky, KA, et al. Simulation Versus Written Fall Prevention Education in Older Hospitalized Adults: A Randomized Controlled Study. *Clin Nurs Res*. (): 10547738221082192. 2022. PMID: 35291853. <https://dx.doi.org/10.1177/10547738221082192> **KQ1E3; KQ2E3**
67. Dispennette, AK, Schafer, MA, et al. Effects of a Game-Centered Health Promotion Program on Fall Risk, Health Knowledge, and Quality of Life in Community-Dwelling Older Adults. *Int J Exerc Sci*. 12(4): 1149-1160. 2019. PMID: 31839849. **KQ1E5b; KQ2E5b**
68. Dizdar, M, Irdesel, JF, et al. Effects of Balance-Coordination, Strengthening, and Aerobic Exercises to Prevent Falls in Postmenopausal Patients With Osteoporosis: A 6-Month Randomized Parallel Prospective Study. *J Aging Phys Act*. 26(1): 41-51. 2018. PMID: 28422544. <https://dx.doi.org/10.1123/japa.2016-0284> **KQ1E6b; KQ2E6b**

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69. Dohrn, IM, Hagstromer, M, et al. Short- and Long-Term Effects of Balance Training on Physical Activity in Older Adults With Osteoporosis: A Randomized Controlled Trial. *Journal of Geriatric Physical Therapy*. 40(2): 102-111. 2017. PMID: 26859463. <https://dx.doi.org/10.1519/JPT.000000000000077> **KQ1E5b; KQ2E5b**
70. Donatoni, da Silva L, Shiel, A, et al. Effects of Pilates on the risk of falls, gait, balance and functional mobility in healthy older adults: a randomised controlled trial. *J Bodyw Mov Ther*. 30(): 30-41. 2022. PMID: NONE. [10.1016/j.jbmt.2022.02.020](https://doi.org/10.1016/j.jbmt.2022.02.020) **KQ1E5b; KQ2E5b**
71. Duckham, RL, Masud, T, et al. Randomised controlled trial of the effectiveness of community group and home-based falls prevention exercise programmes on bone health in older people: the ProAct \geq 65 bone study. *Age Ageing*. 44(4): 573-9. 2015. PMID: 25906791. <http://dx.doi.org/10.1093/ageing/afv055> **KQ1E5; KQ2E5**
72. Dukas, L, Bischoff, HA, et al. Alfacalcidol reduces the number of fallers in a community-dwelling elderly population with a minimum calcium intake of more than 500 mg daily. *J Am Geriatr Soc*. 52(2): 230-236. 2004. PMID: 14728632. **KQ1E6c; KQ2E6c**
73. Evers, Smaa, Dorresteijn, TAC, et al. Economic evaluation of a home-based programme to reduce concerns about falls in frail, independently-living older people. *Expert Rev Pharmacoecon Outcomes Res*. 20(6): 641-651. 2020. PMID: 31502897. <https://dx.doi.org/10.1080/14737167.2019.1666714> **KQ1E5a; KQ2E5a**
74. Fahlstrom, G, Kamwendo, K, et al. Fall prevention by nursing assistants among community-living elderly people. A randomised controlled trial. *Scand J Caring Sci*. 32(2): 575-585. 2018. PMID: 28851132. <https://dx.doi.org/10.1111/scs.12481> **KQ1E10; KQ2E5**
75. Ferreira, A, Chaves, P, et al. The effect of a fall prevention exercise programme on fear of falling in the elderly. *Eur Geriatr Med*. 7(): S189-. 2016. PMID: NONE. **KQ1E7a; KQ2E7a**
76. Fielding, RA, Rejeski, WJ, et al. The Lifestyle Interventions and Independence for Elders Study: design and methods. *J Gerontol A Biol Sci Med Sci*. 66(11): 1226-37. 2011. PMID: 21825283. <https://doi.org/10.1093/gerona/glr123> **KQ1E9; KQ2E9**
77. Finnegan, S, Bruce, J, et al. Life after falls prevention exercise - experiences of older people taking part in a clinical trial: a phenomenological study. *BMC Geriatr*. 21(1): 91. 2021. PMID: 33517904. <https://dx.doi.org/10.1186/s12877-021-02037-9> **KQ1E2; KQ2E2**
78. Fischbacher, M, Chocano-Bedoya, PO, et al. Safety and feasibility of a Dalcroze eurhythmics and a simple home exercise program among older adults with mild cognitive impairment (MCI) or mild dementia: the MOVE for your MIND pilot trial. *Pilot & Feasibility Studies*. 6(): 101. 2020. PMID: 32695433. <https://dx.doi.org/10.1186/s40814-020-00645-7> **KQ1E10; KQ2E10**
79. Franco-Garcia, JM, Carlos-Vivas, J, et al. Effects of 6-Month Square Stepping Exercise Intervention on Physical and Cognitive Competence, Regucalcin, and Body Composition in Older People: Study Protocol for a Randomised Control Trial. *International Journal of Environmental Research & Public Health* [Electronic Resource]. 19(5): 06. 2022. PMID: 35270778. <https://dx.doi.org/10.3390/ijerph19053086> **KQ1E6a; KQ2E6a**
80. Freiburger, E, Haberle, L, et al. Long-term effects of three multicomponent exercise interventions on physical performance and fall-related psychological outcomes in community-dwelling older adults: a randomized controlled trial. *J Am Geriatr Soc*. 60(3): 437-46. 2012. PMID: 22324753. <http://dx.doi.org/10.1111/j.1532-5415.2011.03859.x> **KQ1E2; KQ2E5**
81. Fujita, K, Umegaki, H, et al. Short- and long-term effects of different exercise programs on the gait performance of older adults with subjective cognitive decline: A randomized controlled trial. *Exp Gerontol*. 156(): 111590. 2021. PMID: 34648847. <https://dx.doi.org/10.1016/j.exger.2021.111590> **KQ1E5; KQ2E5**

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82. Gallagher, JC, Fowler, SE, et al. Combination treatment with estrogen and calcitriol in the prevention of age-related bone loss. *J Clin Endocrinol Metab.* 86(8): 3618-3628. 2001. PMID: 11502787. <https://doi.org/10.1210/jcem.86.8.7703> **KQ1E6c; KQ2E6c**
83. Gallagher, JC, Rapuri, PB, et al. An age-related decrease in creatinine clearance is associated with an increase in number of falls in untreated women but not in women receiving calcitriol treatment. *J Clin Endocrinol Metab.* 92(1): 51-8. 2007. PMID: 17032712. <https://dx.doi.org/10.1210/jc.2006-1153> **KQ1E6c; KQ2E6c**
84. Gawler, S, Skelton, DA, et al. Reducing falls among older people in general practice: The ProAct \geq 65 exercise intervention trial. *Arch Gerontol Geriatr.* 67(): 46-54. 2016. PMID: 27420150. <https://doi.org/10.1016/j.archger.2016.06.019> **KQ1E10; KQ2E5**
85. Gill, TM, McGloin, JM, et al. Optimizing Retention in a Pragmatic Trial of Community-Living Older Persons: The STRIDE Study. *J Am Geriatr Soc.* 68(6): 1242-1249. 2020. PMID: 32212395. <https://dx.doi.org/10.1111/jgs.16356> **KQ1E5; KQ2E5**
86. Gill, TM, Pahor, M, et al. Effect of structured physical activity on prevention of serious fall injuries in adults aged 70-89: randomized clinical trial (LIFE Study). *BMJ.* 352(): i245. 2016. PMID: 26842425. <http://dx.doi.org/10.1136/bmj.i245> **KQ1E6d; KQ2E6d**
87. Glendenning, P, Zhu, K, et al. Effects of three-monthly oral 150,000 IU cholecalciferol supplementation on falls, mobility, and muscle strength in older postmenopausal women: a randomized controlled trial. *J Bone Miner Res.* 27(1): 170-6. 2012. PMID: 21956713. <http://dx.doi.org/10.1002/jbmr.524> **KQ1E6c; KQ2E6c**
88. Glickman-Simon, R. Home-based Tai Chi Chuan May Reduce Fall Rate Compared to Lower Extremity Exercise Training in Older Adults with History of Falls. *Explore: the journal of science and healing.* 13(1): 79-80. 2017. PMID: NONE. 10.1016/j.explore.2016.10.015 **KQ1E7a; KQ2E7a**
89. Goldberg, Em, Marks, Sj, et al. 4EMF A Pilot Randomized Controlled Trial of GAPcare: the Geriatric Acute and Postacute Fall Prevention Intervention: feasibility and Acceptability. *Ann Emerg Med.* 74(4): S152-. 2019. PMID: NONE. 10.1016/j.annemergmed.2019.08.350 **KQ1E7a; KQ2E7a**
90. Goldberg, EM, Marks, SJ, et al. GAPcare: The Geriatric Acute and Post-Acute Fall Prevention Intervention in the Emergency Department: Preliminary Data. *J Am Geriatr Soc.* 68(1): 198-206. 2020. PMID: 31621901. <https://dx.doi.org/10.1111/jgs.16210> **KQ1E3; KQ2E3**
91. Goldberg, Em, Resnik, L, et al. Feasibility and initial efficacy of gapcare: the geriatric acute and post-acute care coordination fall prevention program. *Acad Emerg Med.* 26(): S125-. 2019. PMID: NONE. 10.1111/acem.13756 **KQ1E7a; KQ2E7a**
92. Goldberg, EM, Resnik, L, et al. GAPcare: the Geriatric Acute and Post-acute Fall Prevention Intervention-a pilot investigation of an emergency department-based fall prevention program for community-dwelling older adults. *Pilot & Feasibility Studies.* 5(): 106. 2019. PMID: 31463079. <https://dx.doi.org/10.1186/s40814-019-0491-9> **KQ1E9; KQ2E9**
93. Gomes, GCV, Simoes, MDS, et al. Feasibility, safety, acceptability, and functional outcomes of playing Nintendo Wii Fit PlusTM for frail older adults: A randomized feasibility clinical trial. *Maturitas.* 118(): 20-28. 2018. PMID: 30415751. <https://dx.doi.org/10.1016/j.maturitas.2018.10.02> **KQ1E3a; KQ2E3a**

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94. Gouveia, BR, Goncalves Jardim, H, et al. An evaluation of a nurse-led rehabilitation programme (the ProBalance Programme) to improve balance and reduce fall risk of community-dwelling older people: A randomised controlled trial. *Int J Nurs Stud.* 56(): 1-8. 2016. PMID: 26742607. <https://dx.doi.org/10.1016/j.ijnurstu.2015.12.004> **KQ1E5b; KQ2E5b**
95. Granacher, U, Muehlbauer, T, et al. The performance of balance exercises during daily tooth brushing is not sufficient to improve balance and muscle strength in healthy older adults. *BMC Geriatr.* 21(1): 257. 2021. PMID: 33865308. <https://dx.doi.org/10.1186/s12877-021-02206-w> **KQ1E5; KQ2E5**
96. Granbom, M, Clemson, L, et al. Preventing falls among older fallers: study protocol for a two-phase pilot study of the multicomponent LIVE LiFE program. *Trials [Electronic Resource].* 20(1): 2. 2019. PMID: 30606239. <https://dx.doi.org/10.1186/s13063-018-3114-5> **KQ1E9; KQ2E9**
97. Greenberg, MR, Goodheart, V, et al. Emergency Department Stopping Elderly Accidents, Deaths and Injuries (ED STEADI) Program. *J Emerg Med.* 59(1): 1-11. 2020. PMID: 32389434. <https://dx.doi.org/10.1016/j.jemermed.2020.04.019> **KQ1E3; KQ2E3**
98. Griffin, J, Withers, Ej, et al. Comparison and impact of prospective and retrospective falls data completion methods in the prefit trial: results of a randomised methodology study within a trial (SWAT). *Trials.* 18(): . 2017. PMID: NONE. <https://dx.doi.org/10.1186/s13063-017-1902-y> **KQ1E7a; KQ2E7a**
99. Gustafson, DH, Sr, Kornfield, et al. Effect of an eHealth intervention on older adults' quality of life and health-related outcomes: a randomized clinical trial. *J Gen Intern Med.* 37(3): 521-530. 2022. PMID: 34100234. <https://dx.doi.org/10.1007/s11606-021-06888-1> **KQ1E5; KQ2E5**
100. Haas, M. Economic analysis of tai chi AS a means of preventing falls and related injuries among older adults. *CHERE working paper 2006/4.* Centre for Health Economics Research and Evaluation. Faculty of Business, University of Technology, Sydney. https://www.uts.edu.au/sites/default/files/wp2006_3.pdf. (). 2019. PMID: NONE. **KQ1E6a; KQ2E6a**
101. Hagoyska, M, Olekszyova, Z. Impact of the combination of cognitive and balance training on gait, fear and risk of falling and quality of life in seniors with mild cognitive impairment. *Geriatr Gerontol Int.* 16(9): 1043-50. 2016. PMID: 26338465. <https://dx.doi.org/10.1111/ggi.12593> **KQ1E6c; KQ2E6c**
102. Halvarsson, A, Oddsson, L, et al. Long-term effects of a progressive and specific balance-training programme with multi-task exercises for older adults with osteoporosis: a randomized controlled study. *Clin Rehabil.* 30(11): 1049-1059. 2016. PMID: 26396164. <https://dx.doi.org/10.1177/0269215515605553> **KQ1E10; KQ2E5**
103. Hamrick, I, Mross, P, et al. Yoga's effect on falls in rural, older adults. *Complement Ther Med.* 35(): 57-63. 2017. PMID: 29154068. <https://dx.doi.org/10.1016/j.ctim.2017.09.007> **KQ1E6d; KQ2E6d**
104. Harper, KJ, Barton, AD, et al. Controlled clinical trial exploring the impact of a brief intervention for prevention of falls in an emergency department. *Emergency Medicine Australasia.* 29(5): 524-530. 2017. PMID: 28544279. <https://dx.doi.org/10.1111/1742-6723.12804> **KQ1E3; KQ2E3**
105. Harper, Kristie J, Barton, Annette D, et al. Risk assessment and the impact of point of contact intervention following emergency department presentation with a fall. *Phys Occup Ther Geriatr.* 35(3-4): 182-194. 2017. PMID: None. <https://doi.org/10.1080/02703181.2017.1300620> **KQ1E6a; KQ2E5**

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106. Harris, T, Limb, ES, et al. Effect of pedometer-based walking interventions on long-term health outcomes: Prospective 4-year follow-up of two randomised controlled trials using routine primary care data. *PLoS Medicine / Public Library of Science*. 16(6): e1002836. 2019. PMID: 31237875.
<https://dx.doi.org/10.1371/journal.pmed.1002836> **KQ1E1a; KQ2E1a**
107. Hawley-Hague, H, Tacconi, C, et al. Using smartphone TechnoLOGy to support an EffectiVe Home ExeRcise intervention to prevent falls amongst community dwelling older adults The TOGETHER feasibility RCT. *Gerontology*. 05(): 05. 2022. PMID: 36470216.
<https://dx.doi.org/10.1159/000528471> **KQ1E6d; KQ2E6d**
108. Haynes, A, Naylor, LH, et al. Land-walking vs. water-walking interventions in older adults: Effects on aerobic fitness. *Journal of Sport & Health Science*. 9(3): 274-282. 2020. PMID: 32444152.
<https://dx.doi.org/10.1016/j.jshs.2019.11.005> **KQ1E4a; KQ2E4a**
109. Hill, K, Barker, A, et al. Responding to the first fall to prevent the second: successful RCT in reducing falls using a person centred approach for older fallers presenting to emergency departments. *Age Ageing*. 48(2): iv18-. 2019. PMID: NONE.
10.1093/ageing/afz164.106 **KQ1E7a; KQ2E7a**
110. Hinrichs, T, Bucker, B, et al. Home-Based Exercise Supported by General Practitioner Practices: Ineffective in a Sample of Chronically Ill, Mobility-Limited Older Adults (the HOMEfit Randomized Controlled Trial). *J Am Geriatr Soc*. 64(11): 2270-2279. 2016. PMID: 27676362.
<https://dx.doi.org/10.1111/jgs.14392> **KQ1E5; KQ2E5**
111. Hofgaard, J, Ermidis, G, et al. Effects of a 6-Week Faroese Chain Dance Programme on Postural Balance, Physical Function, and Health Profile in Elderly Subjects: A Pilot Study. *Biomed Res Int*. 2019(): 5392970. 2019. PMID: 31392213.
<https://dx.doi.org/10.1155/2019/5392970> **KQ1E5; KQ2E5**
112. Hong, J, Kong, HJ, et al. Web-Based Telepresence Exercise Program for Community-Dwelling Elderly Women With a High Risk of Falling: Randomized Controlled Trial. *JMIR MHealth and UHealth*. 6(5): e132. 2018. PMID: 29807877.
<https://dx.doi.org/10.2196/mhealth.9563> **KQ1E5b; KQ2E5b**
113. Hosseini, L, Kargozar, E, et al. Tai Chi Chuan can improve balance and reduce fear of falling in community dwelling older adults: a randomized control trial. *Journal of Exercise Rehabilitation*. 14(6): 1024-1031. 2018. PMID: 30656165.
<https://dx.doi.org/10.12965/jer.1836488.244> **KQ1E3a; KQ2E3a**
114. Huang, N, Li, W, et al. Effects of a Modified Tai Chi Program on Older People with Mild Dementia: A Randomized Controlled Trial. *J Alzheimers Dis*. 72(3): 947-956. 2019. PMID: 31743998. 10.3233/JAD-190487 **KQ1E3a; KQ2E3a**
115. Hung, WilliamW. Fall Injury Among Community-Dwelling Older Adults: Effect of a Multifactorial Intervention and a Home Hazard Removal Program. *Journal of Clinical Outcomes Management*. 29(3): 102-105. 2022. PMID: . <https://doi.org/10.12788/jcom.0096> **KQ1E2; KQ2E2**
116. Iliffe, S, Kendrick, D, et al. Multicentre cluster randomised trial comparing a community group exercise programme and home-based exercise with usual care for people aged 65 years and over in primary care. *Health Technol Assess*. 18(49): vii-xxvii, 1-105. 2014. PMID: 25098959.
<http://dx.doi.org/10.3310/hta18490> **KQ1E9a; KQ2E9a**
117. Iliffe, S, Kendrick, D, et al. Multi-centre cluster randomised trial comparing a community group exercise programme with home based exercise with usual care for people aged 65 and over in primary care: protocol of the ProAct ≥65 trial. *Trials*. 11(): 6. 2010. PMID: 20082696.
<http://dx.doi.org/10.1186/1745-6215-11-6> **KQ1E9a; KQ2E9a**

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118. Jagdhane, S, Kanekar, N, et al. The Effect of a Four-Week Balance Training Program on Anticipatory Postural Adjustments in Older Adults: A Pilot Feasibility Study. *Curr Aging Sci.* 9(4): 295-300. 2016. PMID: 27071477. **KQ1E7b; KQ2E7b**
119. Jansen, CP, Nerz, C, et al. Lifestyle-integrated functional exercise to prevent falls and promote physical activity: Results from the LiFE-is-LiFE randomized non-inferiority trial. *International Journal of Behavioral Nutrition & Physical Activity.* 18(1): 115. 2021. PMID: 34479573. <https://dx.doi.org/10.1186/s12966-021-01190-z> **KQ1E6b; KQ2E6b**
120. Johansson, Erika, Jonsson, Hans, et al. The efficacy of a multifactorial falls-prevention programme, implemented in primary health care. *British journal of occupational therapy.* 81(8): 474-481. 2018. PMID: None. <https://doi.org/10.1177/0308022618756303> **KQ1E10; KQ2E5**
121. Johnson, Shanthi, McLeod, Bill, et al. Impact of a home-based nutrition and exercise intervention in improving functional capacity associated with falls among rural seniors in Canada. *Quality in Ageing & Older Adults.* 19(4): 261-272. 2018. PMID: NONE. 10.1108/QAOA-11-2017-0044 **KQ1E5b; KQ2E5b**
122. Jun, Dai, Saleheen, Sibgat, et al. Video-based fall prevention education for cognitively impaired inpatients: a pilot study. *Asian Journal of Gerontology & Geriatrics.* 17(1): 11-16. 2022. <https://doi.org/10.12809/ajgg-2021-490-0a> **KQ1E4b; KQ2E4b**
123. Kamide, N, Shiba, Y, et al. Effects on balance, falls, and bone mineral density of a home-based exercise program without home visits in community-dwelling elderly women: a randomized controlled trial. *J Physiol Anthropol.* 28(3): 115-22. 2009. PMID: 19483372. **KQ1E2; KQ2E5**
124. Karinkanta, S, Heinonen, A, et al. Maintenance of exercise-induced benefits in physical functioning and bone among elderly women. *Osteoporos Int.* 20(4): 665-74. 2009. PMID: 18696173. 10.1007/s00198-008-0703-2 **KQ1E5a; KQ2E5a**
125. Kazar-Toth, K, Karoczi, Ck, et al. HPR efficacy of different types of exercise programs in osteoporosis with high risk of falls. *Ann Rheum Dis.* 76(): 1482-. 2017. PMID: NONE. 10.1136/annrheumdis-2017-eular.3783 **KQ1E7a; KQ2E7a**
126. Keall, MD, Pierse, N, et al. Cost-benefit analysis of fall injuries prevented by a programme of home modifications: a cluster randomised controlled trial. *Injury Prevention.* 23(1): 22-26. 2017. PMID: 27312961. <https://dx.doi.org/10.1136/injuryprev-2015-041947> **KQ1E5; KQ2E5**
127. Keall, MD, Pierse, N, et al. Home modifications to reduce injuries from falls in the home injury prevention intervention (HIPI) study: a cluster-randomised controlled trial. *Lancet.* 385(9964): 231-8. 2015. PMID: 25255696. [http://dx.doi.org/10.1016/S0140-6736\(14\)61006-0](http://dx.doi.org/10.1016/S0140-6736(14)61006-0) **KQ1E4a; KQ2E5**
128. Keall, MD, Tupara, H, et al. Home modifications to prevent home fall injuries in houses with Maori occupants (MHIPI): a randomised controlled trial. *The lancet. Public Health.* 6(9): e631-e640. 2021. PMID: 34371005. [https://dx.doi.org/10.1016/S2468-2667\(21\)00135-3](https://dx.doi.org/10.1016/S2468-2667(21)00135-3) **KQ1E4a; KQ2E5**
129. Kemmler, W, Stengel S V, Mayer, et al. [Effect of whole body vibration on the neuromuscular performance of females 65 years and older. One-year results of the controlled randomized ELVIS study]. *Z Gerontol Geriatr.* 43(2): 125-32. 2010. PMID: NONE. 10.1007/s00391-009-0074-0 **KQ1E7b; KQ2E7b**

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130. Kienle, GS, Werthmann, PG, et al. A multi-centre, parallel-group, randomised controlled trial to assess the efficacy and safety of eurythmy therapy and tai chi in comparison with standard care in chronically ill elderly patients with increased risk of falling (ENTAiER): a trial protocol. *BMC Geriatr*. 20(1): 108. 2020. PMID: 32183768. <https://dx.doi.org/10.1186/s12877-020-1503-6> **KQ1E6a; KQ2E6a**
131. Konnopka, C, Buchele, G, et al. Health-Economic Evaluation of the German Osteoporotic Fracture Prevention Program in Rural Areas (OFRA): Mobility and Falls Prevention Classes, Examination of Bone Health, and Consultation on Safety in the Living Environment. *J Gen Intern Med*. 38(3): 641-647. 2023. PMID: 35879537. <https://dx.doi.org/10.1007/s11606-022-07691-2> **KQ1E6c; KQ2E6c**
132. Kornholt, J, Feizi, ST, et al. Effects of a comprehensive medication review intervention on health-related quality of life and other clinical outcomes in geriatric outpatients with polypharmacy: A pragmatic randomized clinical trial. *Br J Clin Pharmacol*. 20(): 20. 2022. PMID: 35184324. <https://dx.doi.org/10.1111/bcp.15287> **KQ1E10; KQ2E5**
133. Korpelainen, R, Keinanen-Kiukaanniemi, S, et al. Effect of exercise on extraskeletal risk factors for hip fractures in elderly women with low BMD: a population-based randomized controlled trial. *J Bone Miner Res*. 21(5): 772-9. 2006. PMID: 16734393. 10.1359/jbmr.060116 **KQ1E5a; KQ2E5a**
134. Kulkarni, S, Nagarkar, A. Effect of a video-assisted fall prevention program on fall incidence in community-dwelling older adults during COVID. *Geriatr Nurs (Minneapolis)*. 50(): 31-37. 2023. PMID: 36640516. <https://dx.doi.org/10.1016/j.gerinurse.2022.12.022> **KQ1E3a; KQ2E3a**
135. Kumar, R. Pedal exerciser for Improving muscle strength in the elderly- a randomised cluster controlled feasibility study. *Physiotherapy (United Kingdom)*. 107(): e123-. 2020. PMID: NONE. 10.1016/j.physio.2020.03.177 **KQ1E7a; KQ2E7a**
136. Landi, F, Cesari, M, et al. The "Sarcopenia and Physical fRailty IN older people: multi-component Treatment strategies" (SPRINTT) randomized controlled trial: design and methods. *Aging-Clinical & Experimental Research*. 29(1): 89-100. 2017. PMID: 28144914. <https://dx.doi.org/10.1007/s40520-016-0715-2> **KQ1E9; KQ2E9**
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138. Law, H, Bte, Ismail N, et al. Targeting falls through frailty intervention by a combined nutritional intervention and physical exercise programme in community-dwelling older fallers: a pilot randomized clinical trial. *J Am Geriatr Soc*. 66(): S128-. 2018. PMID: NONE. 10.1111/jgs.15376 **KQ1E7a; KQ2E7a**
139. Levinger, P, Dunn, J, et al. High-speed resistance training and balance training for people with knee osteoarthritis to reduce falls risk: study protocol for a pilot randomized controlled trial. *Trials [Electronic Resource]*. 18(1): 384. 2017. PMID: 28821271. <https://dx.doi.org/10.1186/s13063-017-2129-7> **KQ1E5; KQ2E5**
140. Li, Chi Yu. Efficacy of Low-Magnitude High-Frequency Vibration on Preventing Fall and Muscle Loss in Community Elderly. . Ph.D.(): 200 p. 2014. PMID: None. **KQ1E7a; KQ2E7a**
141. Li, CY, Leung, KS, et al. Low-magnitude, high-frequency vibration treatment reduced fall incidences and fracture risks in community elderly: A prospective cluster-randomized controlled trial and 1 year follow-up. *Osteoporos Int*. 24(): S529. 2013. PMID: None. 10.1007/s00198-013-2538-8 **KQ1E7a; KQ2E7a**
142. Li, F, Harmer, P, et al. Cost-Effectiveness of a Therapeutic Tai Ji Quan Fall Prevention Intervention for Older Adults at High Risk of Falling. *Journals of gerontology. Series A, Biological sciences and medical sciences*. 74(9): 1504-1510. 2019. PMID: NONE. 10.1093/gerona/glz008 **KQ1E6d; KQ2E6d**

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143. Li, F, Harmer, P, et al. Dual-Task Walking Capacity Mediates Tai Ji Quan Impact on Physical and Cognitive Function. *Med Sci Sports Exerc.* 51(11): 2318-2324. 2019. PMID: 31169795. <https://dx.doi.org/10.1249/MSS.00000000000002051> **KQ1E6d; KQ2E6d**
144. Li, F, Harmer, P, et al. Effectiveness of Tai Ji Quan vs Multimodal and Stretching Exercise Interventions for Reducing Injurious Falls in Older Adults at High Risk of Falling: Follow-up Analysis of a Randomized Clinical Trial. *JAMA Network Open.* 2(2): e188280. 2019. PMID: 30768195. <https://dx.doi.org/10.1001/jamanetworkopen.2018.8280> **KQ1E6d; KQ2E6d**
145. Li, F, Harmer, P, et al. Implementing an Online Virtual Falls Prevention Intervention During a Public Health Pandemic for Older Adults with Mild Cognitive Impairment: A Feasibility Trial. *Clin Interv Aging.* 16(): 973-983. 2021. PMID: 34079243. <https://dx.doi.org/10.2147/CIA.S306431> **KQ1E6b; KQ2E6b**
146. Liew, LK, Tan, MP, et al. The Modified Otago Exercises Prevent Grip Strength Deterioration Among Older Fallers in the Malaysian Falls Assessment and Intervention Trial (MyFAIT). *Journal of Geriatric Physical Therapy.* 42(3): 123-129. 2019. PMID: 29381526. <https://dx.doi.org/10.1519/JPT.0000000000000155> **KQ1E5; KQ2E5**
147. Lindgren, Charlotte, Ståhle, Agneta, et al. Long-term effects of self-reported physical function and disability after participation in an individually adjusted and specific progressive balance training programme for older adults with fear of falling and tendency to fall. *European Journal of Physiotherapy.* 20(3): 152-158. 2018. PMID: NONE. 10.1080/21679169.2018.1429491 **KQ1E5b; KQ2E5b**
148. Liu, M, Xue, QL, et al. Disability Prevention Program Improves Life-Space and Falls Efficacy: A Randomized Controlled Trial. *J Am Geriatr Soc.* 69(1): 85-90. 2021. PMID: 32951215. <https://dx.doi.org/10.1111/jgs.16808> **KQ1E5; KQ2E5**
149. Liu-Ambrose, T, Davis, J, et al. Action seniors! Promoting executive functions with exercise to prevent falls in at-risk older adults. *Alzheimer's & dementia.* 14(7): P989-. 2018. PMID: NONE. 10.1016/j.jalz.2018.06.1339 **KQ1E7a; KQ2E7a**
150. Liu-Ambrose, T, Davis, JC, et al. Effect of a Home-Based Exercise Program on Subsequent Falls Among Community-Dwelling High-Risk Older Adults After a Fall: A Randomized Clinical Trial. *JAMA.* 321(21): 2092-2100. 2019. PMID: 31162569. <https://dx.doi.org/10.1001/jama.2019.5795> **KQ1E6d; KQ2E6d**
151. Liu-Ambrose, T, Davis, JC, et al. Exercise, Processing Speed, and Subsequent Falls: A Secondary Analysis of a 12-Month Randomized Controlled Trial. *J Gerontol A Biol Sci Med Sci.* 76(4): 675-682. 2021. PMID: 33225343. <https://dx.doi.org/10.1093/gerona/glaa239> **KQ1E6d; KQ2E6d**
152. Lo, B. A multidisciplinary ED-based fall prevention intervention reduced subsequent ED visits in older adults. *Ann Intern Med.* 174(2): JC19. 2021. PMID: 33524284. <https://dx.doi.org/10.7326/ACPJ202102160-019> **KQ1E7a; KQ2E7a**
153. Lytras, D, Sykaras, E, et al. Effects of a modified Otago exercise program delivered through outpatient physical therapy to community-dwelling older adult fallers in Greece during the COVID-19 pandemic: a controlled, randomized, multicenter trial. *Eur Geriatr Med.* 13(4): 893-906. 2022. PMID: 35606677. <https://dx.doi.org/10.1007/s41999-022-00656-y> **KQ1E6d; KQ2E6d**
154. Lyu, J, Li, W, et al. Efficacy of practising Tai Chi for older people with mild dementia: protocol for a randomised controlled study. *BMJ Open.* 8(5): e019940. 2018. PMID: 29764877. <https://dx.doi.org/10.1136/bmjopen-2017-019940> **KQ1E3a; KQ2E3a**
155. Madureira, MM, Bonfa, E, et al. A 12-month randomized controlled trial of balance training in elderly women with osteoporosis: improvement of quality of life. *Maturitas.* 66(2): 206-11. 2010. PMID: NONE. <http://dx.doi.org/10.1016/j.maturitas.2010.03.009> **KQ1E3a; KQ2E3a**

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156. Madureira, MM. Efetividade de um programa de treino de equilíbrio no estado funcional e na frequência de quedas em mulheres idosas com osteoporose: estudo randomizado e controlado/ Effectiveness of a balance training program on functional status and falling frequency in elderly women with osteoporosis: a randomized controlled study. . (). . 2010. PMID: NONE. **KQ1E3a; KQ2E3a**
157. Mahlknecht, A, Wiedermann, CJ, et al. Expert-based medication reviews to reduce polypharmacy in older patients in primary care: a northern-Italian cluster-randomised controlled trial. *BMC Geriatr.* 21(1): 659. 2021. PMID: 34814835. <https://dx.doi.org/10.1186/s12877-021-02612-0> **KQ1E10; KQ2E5**
158. Mangin, D, Lamarche, L, et al. Team approach to polypharmacy evaluation and reduction: study protocol for a randomized controlled trial. *Trials [Electronic Resource].* 22(1): 746. 2021. PMID: 34702336. <https://dx.doi.org/10.1186/s13063-021-05685-9> **KQ1E5; KQ2E5**
159. Mat, S, Ng, CT, et al. Effect of Modified Otago Exercises on Postural Balance, Fear of Falling, and Fall Risk in Older Fallers With Knee Osteoarthritis and Impaired Gait and Balance: A Secondary Analysis. *Pm & R.* 10(3): 254-262. 2018. PMID: 28827207. <https://dx.doi.org/10.1016/j.pmrj.2017.08.405> **KQ1E9; KQ2E9**
160. Mat, S, Ng, Ct, et al. Effect of the Otago exercises on postural balance and fear of falling among older fallers with knee osteoarthritis. *Osteoarthritis and cartilage.* 24(): S66-. 2016. PMID: NONE. **KQ1E7a; KQ2E7a**
161. Matchar, DB, Eom, K, et al. A Cost-Effectiveness Analysis of a Randomized Control Trial of a Tailored, Multifactorial Program to Prevent Falls Among the Community-Dwelling Elderly. *Arch Phys Med Rehabil.* 100(1): 1-8. 2019. PMID: 30165053. <https://dx.doi.org/10.1016/j.apmr.2018.07.434> **KQ1E5a; KQ2E5a**
162. McGinnis, Gj, Yu, B, et al. E4 cancer survivors show better fall and functional status outcomes after receiving exercise interventions than non-E4 cancer survivors. *International journal of radiation oncology biology physics.* 99(2): E541-. 2017. PMID: NONE. 10.1016/j.ijrobp.2017.06.1900 **KQ1E7a; KQ2E7a**
163. McMahan, SK, Wyman, JF, et al. Combining Motivational and Physical Intervention Components to Promote Fall-Reducing Physical Activity Among Community-Dwelling Older Adults: A Feasibility Study. *American Journal of Health Promotion.* 30(8): 638-644. 2016. PMID: 26389979. **KQ1E5; KQ2E5**
164. Merchant, RA, Chan, YH, et al. Possible Sarcopenia and Impact of Dual-Task Exercise on Gait Speed, Handgrip Strength, Falls, and Perceived Health. *Frontiers in Medicine.* 8(): 660463. 2021. PMID: 33937294. <https://dx.doi.org/10.3389/fmed.2021.660463> **KQ1E5; KQ2E5**
165. Meziere, A, Oubaya, N, et al. Exercise Interventions With Trained Home Helpers for Preventing Loss of Autonomy and Falls in Community-Dwelling Older Adults Receiving Home Health Physical Therapy T4H: A Randomized Controlled Pilot Study. *Journal of Geriatric Physical Therapy.* 44(3): E138-E149. 2021. PMID: 33534333. <https://dx.doi.org/10.1519/JPT.000000000000287> **KQ1E6a; KQ2E6a**
166. Mikolaizak, AS, Lord, SR, et al. A multidisciplinary intervention to prevent subsequent falls and health service use following fall-related paramedic care: a randomised controlled trial. *Age Ageing.* 46(2): 200-207. 2017. PMID: 28399219. <https://dx.doi.org/10.1093/ageing/afw190> **KQ1E6d; KQ2E6d**
167. Mikolaizak, AS, Lord, SR, et al. Adherence to a multifactorial fall prevention program following paramedic care: Predictors and impact on falls and health service use. Results from an RCT a priori subgroup analysis. *Australas J Ageing.* 37(1): 54-61. 2018. PMID: 29139599. <https://dx.doi.org/10.1111/ajag.12465> **KQ1E9; KQ2E9**

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168. Mikolaizak, AS, Simpson, PM, et al. Intervention to prevent further falls in older people who call an ambulance as a result of a fall: a protocol for the iPREFER randomised controlled trial. *BMC Health Serv Res.* 13(): 360. 2013. PMID: 24070456. 10.1186/1472-6963-13-360 **KQ1E9; KQ2E9**
169. Montero-Alia, P, Miralles-Bassedá, R, et al. Controlled trial of balance training using a video game console in community-dwelling older adults. *Age Ageing.* 48(4): 506-512. 2019. PMID: 31081504. <https://dx.doi.org/10.1093/ageing/afz047> **KQ1E10; KQ2E10**
170. Montero-Alia, P, Munoz-Ortiz, L, et al. Study protocol of a randomized clinical trial evaluating the effectiveness of a primary care intervention using the Nintendo TM Wii console to improve balance and decrease falls in the elderly. *BMC Geriatr.* 16(): 8. 2016. PMID: 26796956. <https://dx.doi.org/10.1186/s12877-015-0178-x> **KQ1E9a; KQ2E9a**
171. Mortsiefer, A, Wilm, S, et al. Family conferences and shared prioritisation to improve patient safety in the frail elderly (COFRAIL): study protocol of a cluster randomised intervention trial in primary care. *Trials [Electronic Resource].* 21(1): 285. 2020. PMID: 32197631. <https://dx.doi.org/10.1186/s13063-020-4182-x> **KQ1E6a; KQ2E6a**
172. Muller, C, Lautenschlager, S, et al. A feasibility study of a home-based lifestyle-integrated physical exercise training and home modification for community-living older people (Part 2): the FIT-at-Home fall prevention program. *Disabil Rehabil.* 43(10): 1380-1390. 2021. PMID: 31868030. <https://doi.org/10.1080/09638288.2019.1700564> **KQ1E2; KQ2E2**
173. Muller, C, Lautenschlager, S, et al. Development of a lifestyle-integrated physical exercise training and home modification intervention for older people living in a community with a risk of falling (Part 1): the FIT-at-Home fall prevention program. *Disabil Rehabil.* 43(10): 1367-1379. 2021. PMID: 31760814. <https://doi.org/10.1080/09638288.2019.1661530> **KQ1E9; KQ2E9**
174. Narita, M, Islam, Mm, et al. Effects of Customized Balance Exercises on Older Women Whose Balance Ability Has Deteriorated With Age. *J Women Aging.* 27(3): 237-250. 2015. PMID: . <https://dx.doi.org/10.1080/08952841.2014.933633> **KQ1E6a; KQ2E5**
175. Naseri, C, McPhail, Sm, et al. Evaluation of Tailored Falls Education on Older Adults' Behavior Following Hospitalization. *J Am Geriatr Soc.* 67(11): 2274-2281. 2019. PMID: NONE. 10.1111/jgs.16053 **KQ1E4b; KQ2E4b**
176. Newbury, JW, Marley, JE, et al. A randomised controlled trial of the outcome of health assessment of people aged 75 years and over. *Med J Aust.* 175(2): 104-107. 2001. PMID: 11556409. **KQ1E10; KQ2E5**
177. Niznik, J, Ferreri, SP, et al. A deprescribing medication program to evaluate falls in older adults: methods for a randomized pragmatic clinical trial. *Trials [Electronic Resource].* 23(1): 256. 2022. PMID: 35379307. <https://dx.doi.org/10.1186/s13063-022-06164-5> **KQ1E5; KQ2E5**
178. Noopud, P, Suputtitada, A, et al. Effects of Thai traditional dance on balance performance in daily life among older women. *Aging-Clinical & Experimental Research.* 31(7): 961-967. 2019. PMID: 30298380. <https://dx.doi.org/10.1007/s40520-018-1040-8> **KQ1E5; KQ2E5**
179. Nyman, SR, Hayward, C, et al. A randomised controlled trial comparing the effectiveness of tai chi alongside usual care with usual care alone on the postural balance of community-dwelling people with dementia: protocol for the TACIT trial (TAi Chi for people with demenTia). *BMC Geriatr.* 18(1): 263. 2018. PMID: 30390620. <https://dx.doi.org/10.1186/s12877-018-0935-8> **KQ1E9; KQ2E9**
180. Nyman, SR, Ingram, W, et al. Randomised Controlled Trial Of The Effect Of Tai Chi On Postural Balance Of People With Dementia. *Clin Interv Aging.* 14(): 2017-2029. 2019. PMID: 31819385. <https://dx.doi.org/10.2147/CIA.S228931> **KQ1E4b; KQ2E4b**

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181. Oliveira, JS, Sherrington, C, et al. Statistical analysis plan for the coaching for healthy AGEing trial - a cluster-randomised controlled trial to enhance physical activity and prevent falls in community-dwelling older people. *Braz J Phys Ther.* 25(6): 908-914. 2021. PMID: 34802917. <https://dx.doi.org/10.1016/j.bjpt.2021.10.003> **KQ1E5; KQ2E5**
182. Olsen, CF, Bergland, A. The effect of exercise and education on fear of falling in elderly women with osteoporosis and a history of vertebral fracture: results of a randomized controlled trial. *Osteoporos Int.* 25(8): 2017-25. 2014. PMID: . <http://dx.doi.org/10.1007/s00198-014-2724-3> **KQ1E10; KQ2E10**
183. Pahor, M, Guralnik, JM, et al. Impact and Lessons From the Lifestyle Interventions and Independence for Elders (LIFE) Clinical Trials of Physical Activity to Prevent Mobility Disability. *J Am Geriatr Soc.* 68(4): 872-881. 2020. PMID: 32105353. <https://dx.doi.org/10.1111/jgs.16365> **KQ1E5; KQ2E5**
184. Parry, SW, Bamford, C, et al. Cognitive-behavioural therapy-based intervention to reduce fear of falling in older people: therapy development and randomised controlled trial - the Strategies for Increasing Independence, Confidence and Energy (STRIDE) study. *Health Technol Assess.* 20(56): 1-206. 2016. PMID: 27480813. <https://dx.doi.org/10.3310/hta20560> **KQ1E6d; KQ2E6d**
185. Patil, R, Kolu, P, et al. Cost-effectiveness of vitamin D supplementation and exercise in preventing injurious falls among older home-dwelling women: findings from an RCT. *Osteoporos Int.* 27(1): 193-201. 2015. PMID: 26205890. <https://doi.org/10.1007/s00198-015-3240-9> **KQ1E5a; KQ2E5a**
186. Patru, S, Marcu, Ir, et al. Effects of tai chi exercise on muscle strength and balance in postmenopausal women with osteopaenia. *Osteoporos Int.* 28(): S301-. 2017. PMID: NONE. [10.1007/s00198-017-3950-2](https://doi.org/10.1007/s00198-017-3950-2) **KQ1E7a; KQ2E7a**
187. Pazit, L, Jeremy, D, et al. Safety and feasibility of high speed resistance training with and without balance exercises for knee osteoarthritis: A pilot randomised controlled trial. *Physical Therapy in Sport.* 34(): 154-163. 2018. PMID: 30317013. <https://dx.doi.org/10.1016/j.ptsp.2018.10.001> **KQ1E5; KQ2E5**
188. Pekkarinen, T, Loyttyniemi, E, et al. Hip fracture prevention with a multifactorial educational program in elderly community-dwelling Finnish women. *Osteoporos Int.* 24(12): 2983-92. 2013. PMID: 23652464. <http://dx.doi.org/10.1007/s00198-013-2381-y> **KQ1E3; KQ2E3**
189. Perttila, NM, Ohman, H, et al. Effect of Exercise on Drug-Related Falls Among Persons with Alzheimer's Disease: A Secondary Analysis of the FINALEX Study. *Drugs Aging.* 35(11): 1017-1023. 2018. PMID: 30315403. <https://dx.doi.org/10.1007/s40266-018-0594-7> **KQ1E4b; KQ2E4b**
190. Pettersson, B, Lundin-Olsson, L, et al. Effectiveness of a self-managed digital exercise programme to prevent falls in older community-dwelling adults: study protocol for the Safe Step randomised controlled trial. *BMJ Open.* 10(5): e036194. 2020. PMID: 32423936. <https://dx.doi.org/10.1136/bmjopen-2019-036194> **KQ1E6a; KQ2E6a**
191. Phirom, K, Kamnardsiri, T, et al. Beneficial Effects of Interactive Physical-Cognitive Game-Based Training on Fall Risk and Cognitive Performance of Older Adults. *International Journal of Environmental Research & Public Health [Electronic Resource].* 17(17): 21. 2020. PMID: 32825555. <https://dx.doi.org/10.3390/ijerph17176079> **KQ1E5; KQ2E5**
192. Porthouse, J, Cockayne, S, et al. Randomised controlled trial of calcium and supplementation with cholecalciferol (vitamin D3) for prevention of fractures in primary care. *BMJ.* 330(7498): 1003. 2005. PMID: 15860827. <https://doi.org/10.1136/bmj.330.7498.1003> **KQ1E6c; KQ2E6c**

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193. Posch, M, Schranz, A, et al. Effectiveness of a Mini-Trampoline Training Program on Balance and Functional Mobility, Gait Performance, Strength, Fear of Falling and Bone Mineral Density in Older Women with Osteopenia. *Clin Interv Aging*. 14(): 2281-2293. 2019. PMID: 31908438. <https://dx.doi.org/10.2147/CIA.S230008> **KQ1E5; KQ2E5**
194. Purkart, B, Bertonecelj, B, et al. Improving Postural Stability in Active Older Adults: Argentine Tango Dance as an Alternative Fall-prevention Strategy. *Altern Ther Health Med*. 24(): 24. 2022. PMID: 35325871. **KQ1E6a; KQ2E6a**
195. Quintela Cardoso do Carmo, Paulo Jorge, Carvalho, Joana, et al. IMBALANCE AND FALL-RISK IMPROVEMENTS IN THE ELDERLY: EFFECTS OF COMBINED STRENGTH AND AEROBIC TRAINING. *Journal of Hearing Science*. 10(): 41-47. 2020. PMID: NONE. 10.17430/JHS.2020.10.1.5 **KQ1E5; KQ2E5**
196. Raichlen, DA, Bharadwaj, PK, et al. Effects of simultaneous cognitive and aerobic exercise training on dual-task walking performance in healthy older adults: results from a pilot randomized controlled trial. *BMC Geriatr*. 20(1): 83. 2020. PMID: 32122325. <https://dx.doi.org/10.1186/s12877-020-1484-5> **KQ1E5; KQ2E5**
197. Ramon-Espinoza, F, Anton-Rodrigo, I, et al. Effect of a multicomponent exercise programme (VIVIFRAIL) on cognitive function in Frail Community Elders with Cognitive Decline: study Protocol for a Randomized Multicentre Control Trial. *Eur Geriatr Med*. 11(Suppl 1): S116-. 2020. PMID: NONE. 10.1007/s41999-020-00428-6 **KQ1E7a; KQ2E7a**
198. Rapp, K, Kampe, K, et al. The osteoporotic fracture prevention program in rural areas (OFRA): a protocol for a cluster-randomized health care fund driven intervention in a routine health care setting. *BMC Musculoskelet Disord*. 17(1): 458. 2016. PMID: 27821102. **KQ1E6c; KQ2E6c**
199. Rapp, K, Lamb, SE, et al. Effect of an osteoporotic fracture prevention program on fracture incidence in routine care: a cluster-randomized trial. *BMC Med*. 20(1): 49. 2022. PMID: 35114993. <https://dx.doi.org/10.1186/s12916-021-02226-8> **KQ1E6c; KQ2E6c**
200. Renehan, E, Meyer, C, et al. Posthospital Falls Prevention Intervention: A Mixed-Methods Study. *J Aging Phys Act*. 27(2): 155-165. 2019. PMID: 29989468. <https://dx.doi.org/10.1123/japa.2017-0406> **KQ1E10; KQ2E5**
201. Rodrigues, Elisângela Valevein, Gallo, Luiza Herminia, et al. Effects of Dance Exergaming on Depressive Symptoms, Fear of Falling, and Musculoskeletal Function in Fallers and Nonfallers Community-Dwelling Older Women. *Rejuvenation Res*. 21(6): 518-526. 2018. PMID: NONE. 10.1089/rej.2017.2041 **KQ1E3a; KQ2E3a**
202. Rodrigues, IB, Wang, E, et al. The MoveStrong program for promoting balance and functional strength training and adequate protein intake in pre-frail older adults: A pilot randomized controlled trial. *PLoS ONE [Electronic Resource]*. 16(9): e0257742. 2021. PMID: 34559837. <https://dx.doi.org/10.1371/journal.pone.0257742> **KQ1E5; KQ2E5**
203. Rogers, MW, Creath, RA, et al. Comparison of Lateral Perturbation-Induced Step Training and Hip Muscle Strengthening Exercise on Balance and Falls in Community-Dwelling Older Adults: A Blinded Randomized Controlled Trial. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences*. 76(9): e194-e202. 2021. PMID: 33491052. <https://dx.doi.org/10.1093/gerona/glab017> **KQ1E10; KQ1E10**
204. Roller, M, Kachingwe, A, et al. Pilates Reformer exercises for fall risk reduction in older adults: A randomized controlled trial. *J Bodyw Mov Ther*. 22(4): 983-998. 2018. PMID: 30368346. <https://dx.doi.org/10.1016/j.jbmt.2017.09.004> **KQ1E5; KQ2E5**

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KQ1E5b; KQ2E5b
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KQ1E6a; KQ2E6a
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KQ1E6c; KQ2E6c
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KQ1E2; KQ2E2
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KQ1E5; KQ2E5
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KQ1E6a; KQ2E6a
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KQ1E5; KQ2E5
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KQ1E5a; KQ2E5a
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KQ1E5; KQ2E5
228. Tan, PJ, Khoo, EM, et al. An individually-tailored multifactorial intervention program for older fallers in a middle-income developing country: Malaysian Falls Assessment and Intervention Trial (MyFAIT). *BMC Geriatr.* 14(): 78. 2014. PMID: 24951180. 10.1186/1471-2318-14-78 **KQ1E9; KQ2E9**

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244. Vogel, O, Niederer, D, et al. Multimodal Exercise Effects in Older Adults Depend on Sleep, Movement Biography, and Habitual Physical Activity: A Randomized Controlled Trial. *Front Aging Neurosci*. 13(): 722799. 2021. PMID: 34744686. <https://dx.doi.org/10.3389/fnagi.2021.722799> **KQ1E5b; KQ2E5b**
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254. Yang, F, Su, X, et al. Vibration training reducing falls in community-living older adults: a pilot randomized controlled trial. *Aging-Clinical & Experimental Research*. 35(4): 803-814. 2023. PMID: 36781617. <https://dx.doi.org/10.1007/s40520-023-02362-6> **KQ1E6; KQ2E6**
255. Yingyongyudha, A, Ramrong, T, et al. Effect of dual task training regarding to postural stability in the healthy elderly. *Age Ageing*. 48(2): iv9-. 2019. PMID: NONE. 10.1093/ageing/afz164.32 **KQ1E7a; KQ2E7a**
256. Zhao, Y, Chung, PK, et al. Effectiveness of a balance-focused exercise program for enhancing functional fitness of older adults at risk of falling: A randomised controlled trial. *Geriatr Nurs (Minneap)*. 38(6): 491-497. 2017. PMID: 28359614. <https://dx.doi.org/10.1016/j.gerinurse.2017.02.011> **KQ1E5; KQ2E5**
257. Zhao, Y, Chung, PK, et al. Effectiveness of a Community-Based Exercise Program on Balance Performance and Fear of Falling in Older Nonfallers at Risk for Falling: A Randomized, Controlled Study. *J Aging Phys Act*. 24(4): 516-524. 2016. PMID: 26796916. **KQ1E6d; KQ2E6d**
258. Zieschang, T, Schwenk, M, et al. Falls and Physical Activity in Persons With Mild to Moderate Dementia Participating in an Intensive Motor Training: Randomized Controlled Trial. *Alzheimer Dis Assoc Disord*. 31(4): 307-314. 2017. PMID: 28628488. <https://dx.doi.org/10.1097/WAD.0000000000000201> **KQ1E6d; KQ2E6d**

Appendix E Table 1. Multifactorial Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting(s)	N rand	Mean age (range)	Female, %	Race/ethnicity, %
Bruce, 2021 ³ Prevention of Fall Injury Trial (PreFIT)	Good	GBR	Community-dwelling older people age ≥70 years	PC/GP	9803	78 (≥70)	53	White: 99
Bhasin, 2020 ⁴ Strategies to Reduce Injuries and Develop Confidence in Elders (STRIDE)	Good	US	Community-dwelling older adults, age ≥70 years, at increased risk for fall injuries	PC/GP	5451	80 (≥70)	62	White: 91 Black: 5 Hispanic/Latino: 8 Other: 3.5
Ciaschini, 2009 ⁵	Fair	CAN	Community-dwelling persons age ≥55 years identified to be at a risk for fall-related fractures	Clinical, NOS or varied; ED; Hospital; Other	201	72 (≥55)	94	Aboriginal origin: 6
Close, 1999 ⁶ Prevention of falls in the elderly trial (PROFET)	Fair	GBR	Age ≥65 years, living in the community, and presenting to an Accident & ED with a fall	ED	397	78 (≥65)	68	NR
Cohen, 2015 ⁷ Living Independently and Falls-free Together (LIFT) Wellness Program	Fair	US	Community-dwelling older adults age ≥75 years	Insurance	5310	81 (≥75)	58	NR
Conroy, 2010 ⁸	Good	GBR	Older people age ≥70 years	PC/GP	364	79 (≥70)	60	NR
Davison, 2005 ⁹	Fair	GBR	Cognitively intact men and women age ≥65 years presenting to Accident & ED with a fall or fall-related injury	ED	313	77 (≥65)	72	NR
de Vries, 2010 ¹⁰	Fair	NLD	Persons age ≥65 years who consulted the ED or their family physician after a fall	ED; PC/GP	217	80 (≥65)	70	NR

Appendix E Table 1. Multifactorial Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting(s)	N rand	Mean age (range)	Female, %	Race/ethnicity, %
Elley, 2008 ¹¹	Fair	NZL	Community-living people age ≥75 years who had fallen in the previous year	PC/GP	312	81 (≥75)	69	Maori or Pacific people (age range 61–75): 3
Fairhall, 2014 ¹² The Frailty Intervention Trial	Good	AUS	Community-dwelling adults age ≥70 years without severe cognitive impairment who met the Cardiovascular Health Study frailty definition	Clinical, NOS or varied	241	83 (≥70)	68	NR
Ferrer, 2014 ¹³	Fair	ESP	Community-dwelling adults born in 1924	Clinical, NOS or varied; PC/GP	328	85 (85)	62	NR
Hendriks, 2008 ¹⁴	Fair	NLD	Community-dwelling people age ≥65 years who were seen in an ED after a fall	ED	333	74 (≥65)	69	NR
Hogan, 2001 ¹⁵	Fair	CAN	Community-dwelling persons age ≥65 years who had fallen within the previous 3 months	NR	163	77.6 (≥65)	72	NR
Imhof, 2012 ¹⁶	Fair	CHE	Community-dwelling adults age ≥80 years	Community-based; Hospital; PC/GP; Other	461	85 (≥80)	72.7	NR
La Porta, 2022 ¹⁷	Fair	ITA	Community-dwelling older adults at moderate to high risk of falling	Hospital	403	76 (≥65)	66	NR
Lightbody, 2002 ¹⁸	Fair	GBR	Patients age ≥65 attending the Accident & ED with a primary diagnosis of a fall	ED	348	75 (≥65)	74	NR

Appendix E Table 1. Multifactorial Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting(s)	N rand	Mean age (range)	Female, %	Race/ethnicity, %
Logan, 2010 ¹⁹	Good	GBR	Adults age ≥60 years living at home or in residential care who had fallen and called an emergency ambulance but were not taken to the hospital	Other	204	82 (≥60)	64.7	NR
Lord, 2005 ²⁰	Good	AUS	Community-dwelling adults age ≥75 years	Insurance	414	80 (≥75)	68	NR
Moller, 2014 ²¹	Fair	SWE	Persons age ≥65 years living in the study municipality	PC/GP; Other	153	82 (≥65)	67	NR
Palvanen, 2014 ²² Chaos Clinic Falls Prevention Programme	Fair	FIN	Home-dwelling people age ≥70 years	Clinical, NOS or varied; Other	1314	78 (≥70)	86	NR
Perula, 2012 ²³	Fair	ESP	Community-dwelling adults age ≥70 years	PC/GP	404	76 (≥70)	53	NR
Russell, 2010 ²⁴	Fair	AUS	Community-dwelling adults age ≥60 years, presenting to an ED after a fall and discharged directly home	ED	712	75 (≥60)	70	NR
Salminen, 2009 ²⁵	Good	FIN	Community-dwelling adults age 65 years or older who had fallen at least once during the previous 12 months	Clinical, NOS or varied; Community-based; Hospital; PC/GP; Other	591	73 (≥65)	84	NR

Appendix E Table 1. Multifactorial Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting(s)	N rand	Mean age (range)	Female, %	Race/ethnicity, %
Spice, 2009 ²⁶ Winchester falls project	Fair	GBR	Community-dwelling adults age 65 years or older who had two or more falls in the previous year and did not present to an ED with the index fall	PC/GP	375	82 (≥65)	73	NR
Tinetti, 1994 ²⁷	Good	US	Community-dwelling adults age ≥70 years	Insurance	301	78 (≥70)	69	NR
van Haastregt, 2000 ²⁸	Fair	NLD	Community-dwelling adults age ≥70 years with moderate impairments in mobility or a history of recent falls	PC/GP	316	77 (≥70)	66	NR
Vind, 2009 ²⁹	Good	DNK	Older adults who had visited the ED or had been hospitalized due to a fall	ED; Hospital	392	74 (≥65)	74	NR
Wagner, 1994 ³⁰	Fair	US	Ambulatory older adults age ≥65 years	Insurance	1242	73 (≥65)	60	NR

Abbreviations: AUS = Australia; CAN = Canada; CHE = Switzerland; DNK = Denmark; ED = Emergency department; ESP = Spain; FIN = Finland; GBR = Great Britain; N = Number of participants; NLD = Netherlands; NOS = Not otherwise specified; NR = Not reported; NZL = New Zealand; PC/GP = Primary care/General practitioner; QR = Quality rating; Rand = Randomized; SWE = Sweden; US = United States.

Appendix E Table 2. Multifactorial Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Bruce, 2021 ³ Prevention of Fall Injury Trial (PreFIT)	43.8	Fall in the previous 12 mo and current balance problems whilst walking, dressing, toileting, or taking a bath.	Met Strawbridge Frailty Index, %: 21	≥3 coexisting conditions, %: 19	NR	Possible cognitive impairment (as indicated by CDT), %: 9
Bhasin, 2020 ⁴ Strategies to Reduce Injuries and Develop Confidence in Elders (STRIDE)	100	≥2 falls or had a fall-related injury in the previous 12 mo; or afraid of falling because of problems with balance or walking.	NR	Mean # of chronic coexisting conditions: 2.1	NR	Clinically significant cognitive impairment, %: 3
Ciaschini, 2009 ⁵	100	Presented to ED due to a fall and TUG of more than 14 s; or referred because at high risk of fracture and TUG of more than 14 s; or attended hospital fracture clinic for a non-pathological fracture of the vertebrae, hip, or wrist; or had a BMD in the previous 12 mo with a t-score of ≤-2.0.	NR	NR	Taking ≥4 meds, %: 56.2	NR
Close, 1999 ⁶ Prevention of falls in the elderly trial (PROFET)	100	Presented to ED due to a fall.	NR	NR	NR	NR

Appendix E Table 2. Multifactorial Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Cohen, 2015 ⁷ Living Independently and Falls-free Together (LIFT) Wellness Program	19	1+ fall in the previous 6 mo.	NR	NR	NR	NR
Conroy, 2010 ⁸	100	A previous fall or ≥2 of the following falls risk factors: ≥1 falls in the previous 12 mo, taking >4 prescribed medications, previous stroke, Parkinson’s disease, inability to stand from a chair without using arms to push up, symptoms of dizziness on standing, use of a mobility aid, and being housebound.	NR	NR	Taking >4 meds, %: 53	NR
Davison, 2005 ⁹	100	Presented to A&E with a fall or fall-related injury.	NR	NR	NR	Median MMSE score: 28
de Vries, 2010 ¹⁰	100	Consulted the ED or family physician after a fall.	NR	Median # of chronic diseases: 1	Mean # of meds: 5.8	Median MMSE score: 28
Elley, 2008 ¹¹	100	Fall or trip in the previous 12 mo.	NR	Mean # of medical conditions: 7.0	Mean # of meds: 5.5 Psychotropic meds, %: 29 Bone-sparing meds*, %: 28	NR
Fairhall, 2014 ¹² The Frailty Intervention Trial	100	Met specified cut-offs for ≥3 of the CHS frailty criteria: slow gait, weak grip, exhaustion, low energy expenditure, and weight loss.	≥3 CHS frailty criteria, %: 100 <3 frailty criteria present, %: 65 <4 frailty criteria present, %: 26 <5 frailty criteria present, %: 9	Medical conditions (0–26)†: 7.4	Mean # of meds: 6.9 Psychotropic, %: 17 Benzodiazepine, %: 7	Mean MMSE score: 26.3

Appendix E Table 2. Multifactorial Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Ferrer, 2014 ¹³	NR	NA	NR	Charlson Comorbidity Index (0–37), median: 1	Median # of drugs: 6	Median MEC score [‡] : 28.5 Dementia, %: 9
Hendriks, 2008 ¹⁴	100	Presented to ED due to a fall.	NR	Mean # of illnesses: 3	NR	NR
Hogan, 2001 ¹⁵	100	Fall within the previous 3 mo without resulting in a lower-extremity fracture.	NR	NR	NR	Mean MMSE score: 27.7
Imhof, 2012 ¹⁶	40	Falls within last 12 mo.	NR	NR	NR	NR
La Porta, 2022 ¹⁷	100	Moderate-to-high fall risk associated with age and/or neurological conditions (i.e., Parkinson’s disease and stroke)	NR	Parkinsons, %: 19 Stroke, %: 15	NR	NR
Lightbody, 2002 ¹⁸	100	Presenting to A&E due to a fall.	NR	NR	Taking ≥3 meds, %: 48.8 On target meds, %: 71.5	NR
Logan, 2010 ¹⁹	100	Fallen and contacted an ambulance service through the emergency telephone system but had not been taken to a hospital.	NR	NR	Taking ≥4 drugs, %: 56.8	NR
Lord, 2005 ²⁰	NR	NA	NR	NR	Taking ≥4 meds, %: 50.5 Musculoskeletal, %: 25.8 CV, %: 72.4 Psychoactive, %: 14.5	NR
Moller, 2014 ²¹	100	Help needed with ≥2 activities of daily living, admitted to hospital ≥2 times, or have had ≥4 outpatient contacts during the previous 12 mo.	NR	Median # of health complaints: 11	NR	NR

Appendix E Table 2. Multifactorial Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Palvanen, 2014 ²² Chaos Clinic Falls Prevention Programme	100	At least one of the following: problems in mobility and everyday function, ≥3 falls during the previous 12 mo, a previous fracture after the age of 50, an osteoporotic fracture (hip fracture) in a close relative (mother or father), osteoporosis (diagnosed or a strong clinical suspicion such as thoracic kyphosis), low body weight (BMI <19), and sickness or illness essentially increasing the risk for osteoporosis, falls, and fractures.	NR	Mean # of medical conditions: 4.7	Mean # of meds: 5.6	Mean MMSE score: 27.3
Perula, 2012 ²³	31	Fall in the previous 12 mo.	NR	Comorbidity, %: 61.8	Mean # of prescribed meds: 15.5 People who take drugs associated w/fall risks, %: 60.9	NR
Russell, 2010 ²⁴	100	Presented to ED after a fall and was discharged directly home.	NR	Mean # of medical conditions: 2.8	Mean # of meds: 5.0	Abbreviated Mental Test Score <7 (cognitively impaired), %: 4.2
Salminen, 2009 ²⁵	100	1+ fall in the previous 12 mo.	NR		≥4 prescribed meds, %: 49.7	Median MMSE score: 72.75
Spice, 2009 ²⁶ Winchester falls project	100	≥2 falls in the previous 12 mo.	NR	NR	Mean # of drugs: 5 Taking ≥4 drugs: 65%	Mean AMT: 9

Appendix E Table 2. Multifactorial Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Tinetti, 1994 ²⁷	100	At least one of the following risk factors for falling: postural hypotension; use of sedatives; use of ≥4 prescription medications; and impairment in arm or leg strength or range of motion, balance, ability to move safely from bed to chair or to the bathtub or toilet (transfer skills), or gait (from inclusion)	NR	1 chronic condition, %: 19.2 ≥2 chronic conditions, %: 73.1	Use of ≥4 prescription meds, %: 41 Use of benzodiazepine or other sedative-hypnotic agents, %: 19	MMSE score of 25+, %: 83.7
van Haastregt, 2000 ²⁸	100	≥2 falls in the previous 6 mo or have scored three or more on the mobility control scale of the short version of the sickness impact profile.	NR	NR	NR	Mean mental health [‡] ; 22
Vind, 2009 ²⁹	100	Presented to ED or had been hospitalized due to a fall.	NR	≥3 comorbidities, %: 39	Takes daily prescription drugs, %: 85	NR
Wagner, 1994 ³⁰	34	Fall in previous 12 mo.	NR	NR	NR	NR

* Includes bisphosphonate, vitamin D supplement, calcium supplement, and multivitamin.

† Self-reported, doctor diagnosed medical conditions.

‡ Spanish version of the MMSE (cognitive impairment, 24/35).

§ RAND-36, 5 to 30 (favorable).

Abbreviations:

A&E = Accident and Emergency; AMT = Abbreviated Mental Test; BMD = Bone mineral density; BMI = Body Mass Index; CDT = Clostridioides difficile infection; CHS = Cardiovascular Health Study; Cog = Cognitive; CV = Cardiovascular; ED = Emergency department; MEC = Medical eligibility criteria; Meds = Medications; MMSE = Mini-Mental State Examination; Mo = Months; NA = Not applicable; NR = Not reported; S = seconds; TUG = Timed Up and Go Test.

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
Bruce, 2021 ³	Multifactorial falls prevention assessment followed by recommendations or further onward referral to another service, when indicated.	Hospital; GP/PC office	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1 hr assessment
Bhasin, 2020 ⁴	Standardized assessment, followed by recommendations for management of risk factors with motivational interviewing, development of individualized care plan, implementation of care plan including referrals as needed, and followup care.	NR	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	NA
Ciaschini, 2009 ⁵	Multifaceted intervention providing pt-specific evidence-based recommendations targeted to reduce falls risk based on assessment of falls risk, functional status, and home environment.	Home	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1x assessment
Close, 1999 ⁶	Assessment of patient and home, modification of fall risk factors, if possible, advice/education provided, referrals if needed.	Hospital; Home	Two 1x assessments; duration of tx varied based on recommendations/referral(s)	NA	1x medical assessment, 1x home visit
Cohen, 2015 ⁷	Assessment of patient and home followed by customized recommendations, fall prevention and wellness toolkit, education, and coaching with regard to tailored action plan.	Home	1x home assessment, 1 FU phone call (duration NR), printed newsletter 1–2 yrs, Exercise recommendations given (duration NR)	NA	1x home assessment & 1 FU phone call
Conroy, 2010 ⁸	Day hospital-delivered multifactorial falls prevention program, consisting of a medical review, home hazards	Hospital	1x assessment, program duration NR	NR	NR, assumed varied by tx recommendations

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
	assessment, and strength and balance training.				
Davison, 2005 ⁹	Hospital-based medical assessment, and home-based physiotherapy and occupational therapy assessment followed by individualized intervention(s) for fall risk factors as indicated.	Hospital; Home	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1x assessment
de Vries, 2010 ¹⁰	Multifactorial fall-risk assessment followed by referrals as needed. Discussion of referrals to medical specialists, medication changes, and followup with PCP.	Geriatric clinic	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1x assessment + referrals
Elley, 2008 ¹¹	Home visit by nurse to conduct a standardized health assessment and an evidence-based algorithm to assess risk of falls and refer participants as appropriate to an optometrist, podiatrist, physical therapist, or occupational therapist and to receive a home-based exercise program to address identified risks.	Home	1x assessment, duration of exercise component 12 mo	5 sessions over 12 mo (length of sessions NR)	1x assessment plus 5 exercise home visits from PT for 1 year (during home visits at Weeks 1, 2, 4, and 8 and after 6 mo); assume independent exercises encouraged but duration or frequency NR.
Fairhall, 2014 ¹²	Multifactorial, interdisciplinary intervention tailored to each participant based on baseline CHS frailty criteria and issues identified during comprehensive geriatric evaluation. Intervention could include case mgmt, exercise, nutritional, and psychological mgmt.	In home	1x assessment; duration of tx varied based on recommendations/referral(s) (up to 12 mo)	NA	PT: median of eight sessions. The median number of face-to-face sessions with a physiotherapist was 10 (range 0–24)

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
Ferrer, 2014 ¹³	Multifactorial falls-risk assessment followed by a tailored treatment plan devised based on existing medical care and service networks in the community.	Clinic, NOS	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1x assessment, FU tx varied
Hendriks, 2008 ¹⁴	Multifactorial intervention that included a detailed medical and occupational-therapy assessment to assess and address potential risk factors for new falls, followed by recommendations and referrals if indicated.	Hospital; In home	Two 1x assessments; duration of tx varied based on recommendations/referral(s)	NA	2, 1x assessments + recommendations
Hogan, 2001 ¹⁵	Multifactorial, in-home assessment, followed by recommendations, referrals, and a tailored care plan.	Home	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	1 home assessment (Initial visit took 1–2 hrs), subjects participated on average 3x in the exercise class (those that were referred, n=NR)
Imhof, 2012 ¹⁶	A 9-month in-home health consultation program (HCP) delivered by an advanced practice nurse. The HCP included a standardized comprehensive geriatric assessment, followed by 4 in-home, tailored consultations and followup telephone calls.	Home	9	NA	4 home visits (mean length 46 ±6 minutes) after 4, 12, 24, and 36 weeks, and three telephone calls (mean length 17 ±4 minutes) after 8, 18, and 30 weeks. Total intervention time per participant averaged 4 hrs.
La Porta, 2022 ¹⁷	Multiple component intervention that included (1) group exercise classes, (2) group educational sessions on fall risk factors, (3) environment/home risk assessment and personalized recommendations, (4) personalized home exercise program, and (5) multifactorial assessment and referrals	Class outside of home; Home, supervised	2.5 months	60-min group session 1x/wk for 11 wks;	Group exercise: one weekly six-person group session of 60 minutes for 11 weeks; Personalized, independent home exercise program (in addition to group exercise): 2x/wk for 30 min plus 30-min walk 2x/wk on rest days from other exercises.

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
	based on individual fall-risk profile				
Lightbody, 2002 ¹⁸	In-home assessment of risk factors for falls by a nurse after discharge from ED, followed by recommendations and referrals as indicated.	Home	1x assessment; duration of tx varied based on recommendations/ referral(s)	NA	1x assessment
Logan, 2010 ¹⁹	Individualized multifactorial intervention program that included medication review, in-home home hazard assessment and modification, individual training in strength and balance, and group community classes on falls prevention.	Home; Community	1x assessment, home exercise and group session up to 6 wks	Up to 6 sessions but varied based on pt needs or interest (length and duration NR)	<p>1x assessment plus (1) home training in strength and balance for at least six sessions led by the physiotherapist, and (2) rolling program of 12 group sessions on fall prevention, twice weekly over 6 weeks, in local community centers. Participants received as many sessions in their own homes as deemed clinically necessary and attended as many group sessions in the rolling program as they wished, up to a maximum of 12.</p> <p>The mean number of home or group sessions was 9.9 (SD, 8.8), and the median duration of contact time for face-to-face therapy was 490 minutes (interquartile range, 250–1257 minutes). Seventy-three participants received seven or more therapy sessions. Participants received a median of eight muscle strengthening sessions (interquartile range, 6–12 sessions), 7.5 balance training (interquartile range, 2–12) sessions, and 13.5 sessions on functional activities and reduction</p>

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
Lord, 2005 ²⁰	Individualized falls prevention program comprising an assessment, and if indicated, falls prevention counseling, or referrals for an exercise program or to an eye care specialist.	Clinic, NOS	1x assessment; duration of tx varied based on recommendations/ referral(s) (up to 12 mo if referred to exercise)	NR	of hazards (interquartile range, 6–18 sessions). 1x assessment. If referred to exercise classes—these were conducted twice weekly over a 12-month period. The average number of exercise classes offered to the 153 subjects in the EIG was 78 (range, 67–90).
Moller, 2014 ²¹	Home-based care management intervention that included home visits delivering falls prevention education, a tailored, independent exercise program, brief home hazard assessment, and if indicated, referrals to PT or OT.	Home	12	NA	Intended: The case manager (CM) performed at least one home visit per month during 12 mo. Because of the variability in the participant’s functional ability, the intensity, frequency, and duration of the individual exercise programs varied. Efforts were made to continuously, (i.e., at least once a month) support and motivate the participants to be physically active and to evaluate and modify the home exercise program if needed. Delivered: The case manager or PT performed at least one home visit per month during 12 mo. During the 12-month intervention the PTs performed visits (mean = 10.4) and telephone calls (mean = 0.8), and the nurses performed an average of 11.1 home visits and 1.9 telephone calls for those completing the intervention.

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
Palvanen, 2014 ²²	A multifactorial, individualized falls prevention program that included medical review and referrals, medication review, home hazard assessment and modification, and recommendations for strength and balance training if indicated.	Clinic, NOS; Home	Three 1x assessments; duration of tx varied based on recommendations/referral(s)	NA	Multiple assessments (total ~3 hr): 1-hr structured home visit; 1-hr PT assessment at clinic, 1-hr assessment w/nurse in clinic. Exercise referrals: intensity NR, but assume for 12 mo
Perula, 2012 ²³	Multifactorial intervention consisting of individual advice, group physical exercise program, group health education, and a home visit for environmental home hazard risk assessment and intervention.	Class outside of home; Home	Three 1x assessments, duration of all given IGs NR (supervised exercise component 3 wks)	Five 90-minute sessions over 3 weeks of treatment	Five 90-min exercise sessions over 3 weeks plus recommended walking at least 30 min a day and doing the exercises for 30 min at least 4 d/wk. Two home visits on home hazard assessment
Russell, 2010 ²⁴	Targeted referrals to existing community services and health promotion recommendations, based on the falls risk factors found in a baseline assessment.	Home	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	Assessment and referrals.
Salminen, 2009 ²⁵	Geriatric assessment, counseling and guidance in fall prevention, home hazards assessment, group physical exercise, home exercise, group falls prevention lectures in groups, and psychosocial groups.	Class outside of home; In home	12	Group exercise 45–50 minutes sessions every second week for 1 yr	One 45-minute assessment, 1 home hazard assessment, group exercise 45–50 minutes sessions every second week for 1 yr; psychosocial groups 1x/mo for 12 mo, falls prevention lecture 1x/mo for 12 mo
Spice, 2009 ²⁶	Intervention assessments were standardised; further management of each participant was then individualised, with no specific protocol.	Clinic, NOS	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	The mean duration of the secondary care intervention was 121 min for assessment by doctor, nurse, physiotherapist, and occupational therapist.

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Author, year	Brief intervention description	Setting	Intervention duration	Frequency of supervised IG	Intensity
Tinetti, 1994 ²⁷	Patients were assessed by a nurse and physical therapist during an in-home visit. Medication review, environmental changes, and physical therapy were provided as appropriate.	In home	2x assessment; duration of exercise component (if indicated) could be up to 3 mo	NA	1 medical assessment, 1 PT assessment, followed by PT exercises if indicated: 2x/day for 15–20 min, IG phase lasted ~3 mo.
van Haastregt, 2000 ²⁸	Five home visits by a community nurse over a period of 1 year. Visits consisted of screening for medical, environmental, and behavioral factors causing falls and impairments in mobility, followed by specific advice, referrals, and other actions aimed at dealing with the observed hazards.	In home	5 home visits over 12 mo	NA	5 home visits over 12 mo, on average the home visits lasted 51 minutes.
Vind, 2009 ²⁹	A team assessed patients over two visits to the clinic through a physical examination and questionnaires to tailor followup such as medical management, CVD management, and physical therapy with referrals to outside providers as appropriate for conditions such as neurological conditions, CVD specialists, and vision correction.	Clinic, NOS	Three 1x assessments, duration of tx varied based on recommendations/referral(s) (IG lasted a median of 13 wks)	NA	1-hr physician assessment; 1.5-hr nurse assessment, 1.5-hr PT assessment. Intervention lasted for a median of 13 weeks (IQR, 9–17). Each participant in the intervention group visited the outpatient clinic a median of 6 times (IQR, 4–9) and had 2 (IQR, 2–3) visits to the doctor, 1 (IQR, 1–1) to the nurse, 3 (IQR, 2–4) to the physiotherapist, and 1 (IQR, 1–3) for supplementing examinations.
Wagner, 1994 ³⁰	Participants had an assessment visit with questionnaires and clinical assessment to develop a tailored intervention plan to address risk factors.	Geriatric clinic	1x assessment; duration of tx varied based on recommendations/referral(s)	NA	One 60- to 90-min assessment

Appendix E Table 3. Multifactorial Interventions: Intervention Components

Abbreviations: Apr = April; CG = Control group; Descr = Description; CHS = Cardiovascular Health Study; CVD = Cardiovascular disease; ED = Emergency department; EIG = Exercise intervention group; Freq= Frequency; FU = Followup; GP/PC = General practitioner/Primary care provider; Hr = Hour; IG = intervention group; IQR = Interquartile range; Mgmt. = Management; Min = Minutes; Mo = Months; NA = Not applicable; NR = Not reported; NOS = Not otherwise specified; OEP = Otago Exercise Program; OT = Occupational therapy; PCP = Primary care provider; PT = physical therapy; SD = Standard deviation; Sep = September; Tx = Treatment; Wk = Week; X = Times; Yrs = Years.

Appendix E Table 4. Multifactorial Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Bruce, 2021 ³	18	4842 (1.27)	4309 (1.06)	1.13 (0.98, 1.30)
Close, 1999 ⁶	12	183 (0.99)	510 (2.39)	0.39 (0.23, 0.60)
Cohen, 2015 ⁷	6	NR	NR	0.79 (0.69, 0.91)
	9	NR	NR	0.80 (0.71, 0.89)
	12	NR	NR	0.87 (0.79, 0.96)
Conroy, 2010 ⁸	12	260 (1.7)	417 (2.7)	0.64 (0.43, 0.95)
Davison, 2005 ⁹	12	435 (3.3)	1251 (5.1)	0.64 (0.46, 0.90)
Elley, 2008 ¹¹	12	285 (1.91)	299 (2.01)	0.96 (0.70, 1.34)
Fairhall, 2014 ¹²	12	183 (1.54)	178 (1.5)	1.12 (0.78, 1.63)
Ferrer, 2014 ¹³	12	57 (0.35)	62 (0.38)	0.85 (0.51, 1.40)
Hogan, 2001 ¹⁵	12	241 (3.05)	311 (3.7)	0.82 (0.70, 0.97)
La Porta, 2022 ¹⁷	12	337 (1.66)	353 (1.765)	0.94 (0.71, 1.25)
Lightbody, 2002 ¹⁸	6	141 (1.82)	171 (2.15)	0.85 (0.68, 1.06)
Logan, 2010 ¹⁹	12	NR (3.46)	NR (7.68)	0.45 (0.35, 0.58)
Lord, 2005 ²⁰	12	183 (0.91)	175 (0.87)	1.03 (0.78, 1.35)
Moller, 2014 ²¹	12	96 (1.2)	85 (1.16)	1.03 (0.77, 1.38)
Palvanen, 2014 ²²	12	608 (0.95)	825 (1.31)	0.72 (0.61, 0.86)
Russell, 2010 ²⁴	12	908 (2.77)	1449 (4.24)	0.87 (0.65, 1.17)
Salminen, 2009 ²⁵	12	243 (0.83)	271 (0.91)	0.92 (0.72, 1.19)
Tinetti, 1994 ²⁷	12	94 (0.62)	164 (0.94)	0.69 (0.52, 0.90)
Vind, 2009 ²⁹	12	422 (2.15)	398 (2.03)	1.06 (0.75, 1.51)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix E Table 5. Multifactorial Interventions: Falls, Exploring Heterogeneity

Characteristic/ Component	Groups	k	IRR (95% CI)	Test of group differences, p
ED/hospital recruitment	ED/hospital	7	0.71 (0.50, 1.00)	0.10
	Other	13	0.90 (0.82, 1.00)	
Fall risk	Selected for fall risk	17	0.82 (0.71, 0.95)	0.34
	Unselected for fall risk	3	0.89 (0.75, 1.04)	
Quality	Good	9	0.86 (0.68, 1.10)	0.69
	Fair	11	0.82 (0.73, 0.93)	
Conducted in the US	US	3	0.90 (0.65, 1.23)	0.40
	Non-US	17	0.82 (0.71, 0.96)	

Note: Also visually inspected plots sorted by publication year, mean age, followup, and CG event rate.

Abbreviations: CI = Confidence interval; ED = Emergency department; IRR = Incidence rate ratio; k = Number of studies.

Appendix E Table 6. Multifactorial Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bruce, 2021 ³	Fallers (1 plus falls)	18	1301/3301 (39.4)	1276/3223 (39.6)	1.00 (0.93, 1.07)
	Fallers (2 plus falls)	18	743/3301 (22.5)	715/3223 (22.2)	1.01 (0.91, 1.13)
Ciaschini, 2009 ⁵	Fallers (1 plus falls)	6	26/101 (25.7)	17/100 (17)	1.51 (0.88, 2.61)
Close, 1999 ⁶	Fallers (3 plus falls)	12	21/184 (11.4)	55/213 (25.8)	0.44 (0.28, 0.70)
	Fallers (1 plus falls)	12	59/184 (32.1)	111/213 (52.1)	0.62 (0.48, 0.79)
Cohen, 2015 ⁷	Fallers (1 plus falls)	6	229/1661 (13.8)	305/1815 (16.8)	0.82 (0.70, 0.96)
	Fallers (1 plus falls)	9	312/1615 (19.3)	434/1756 (24.7)	0.78 (0.68, 0.89)
	Fallers (1 plus falls)	12	416/1586 (26.2)	504/1715 (29.4)	0.89 (0.79, 1.00)
Conroy, 2010 ⁸	Fallers (1 plus falls)	12	69/136 (50.7)	73/138 (52.9)	0.96 (0.76, 1.21)
	Fallers (2 plus falls)	12	38/136 (27.9)	38/138 (27.5)	1.01 (0.69, 1.49)
Davison, 2005 ⁹	Fallers (1 plus falls)	12	94/144 (65.3)	102/149 (68.5)	0.95 (0.81, 1.12)
de Vries, 2010 ¹⁰	Fallers (1 plus falls)	12	55/106 (51.9)	62/111 (55.9)	0.93 (0.73, 1.19)
	Fallers (2 plus falls)	12	37/106 (34.9)	35/111 (31.5)	1.11 (0.76, 1.62)
Elley, 2008 ¹¹	Fallers (1 plus falls)	12	106/155 (68.4)	98/157 (62.4)	1.10 (0.93, 1.29)
	Fallers (2 plus falls)	12	69/155 (44.5)	54/157 (34.4)	1.29 (0.98, 1.71)
Fairhall, 2014 ¹²	Fallers (1 plus falls)	12	72/120 (60)	67/121 (55.4)	1.08 (0.87, 1.35)
	Fallers (2 plus falls)	12	32/120 (26.7)	37/121 (30.6)	0.87 (0.58, 1.30)
Ferrer, 2014 ¹³	Fallers (1 plus falls)	12	40/142 (28.2)	33/131 (25.2)	1.12 (0.75, 1.66)
Hendriks, 2008 ¹⁴	Fallers (1 plus falls)	12	55/124 (44.4)	61/134 (45.5)	0.97 (0.74, 1.28)
	Fallers (2 plus falls)	12	32/124 (25.8)	34/134 (25.4)	1.02 (0.67, 1.54)
Hogan, 2001 ¹⁵	Fallers (1 plus falls)	12	54/79 (68.4)	61/84 (72.6)	0.94 (0.77, 1.15)
	Fallers (3 plus falls)	12	26/79 (32.9)	35/84 (41.7)	0.79 (0.53, 1.18)
La Porta, 2022 ¹⁷	Fallers (1 plus falls)	12	119/203 (58.6)	117/200 (58.5)	1.00 (0.85, 1.18)
	Fallers (2 plus falls)	12	71/203 (35)	77/200 (38.5)	0.91 (0.70, 1.17)
Lightbody, 2002 ¹⁸	Fallers (1 plus falls)	6	39/155 (25.2)	41/159 (25.8)	0.98 (0.67, 1.42)
Logan, 2010 ¹⁹	Fallers (1 plus falls)	12	81/102 (79.4)	96/102 (94.1)	0.84 (0.76, 0.94)
Lord, 2005 ²⁰	Fallers (1 plus falls)	12	93/202 (46)	90/201 (44.8)	1.03 (0.83, 1.27)
	Fallers (2 plus falls)	12	49/202 (24.3)	45/201 (22.4)	1.08 (0.76, 1.54)
Moller, 2014 ²¹	Fallers (1 plus falls)	12	44/80 (55)	35/73 (47.9)	1.15 (0.84, 1.56)

Appendix E Table 6. Multifactorial Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
	Fallers (2 plus falls)	12	19/80 (23.8)	23/73 (31.5)	0.75 (0.45, 1.27)
	Fallers (3 plus falls)	12	13/80 (16.3)	11/73 (15.1)	1.08 (0.52, 2.25)
Palvanen, 2014 ²²	Fallers (1 plus falls)	12	296/661 (44.8)	349/653 (53.4)	0.84 (0.75, 0.94)
Perula, 2012 ²³	Fallers (1 plus falls)	6	10/133 (7.5)	31/271 (11.4)	0.66 (0.33, 1.30)
		12	23/133 (17.3)	64/271 (23.6)	0.73 (0.48, 1.12)
Russell, 2010 ²⁴	Fallers (1 plus falls)	12	163/320 (50.9)	151/330 (45.8)	1.11 (0.95, 1.31)
Salminen, 2009 ²⁵	Fallers (1 plus falls)	12	140/292 (47.9)	131/297 (44.1)	1.09 (0.91, 1.30)
Spice, 2009 ²⁶	Fallers (1 plus falls)	12	158/210 (75.2)	133/159 (83.6)	0.90 (0.78, 1.04)
Tinetti, 1994 ²⁷	Fallers (1 plus falls)	12	52/147 (35.4)	68/144 (47.2)	0.76 (0.58, 0.98)
van Haastregt, 2000 ²⁸	Fallers (1 plus falls)	12	63/129 (48.8)	53/123 (43.1)	1.13 (0.87, 1.48)
		18	68/120 (56.7)	58/115 (50.4)	1.12 (0.88, 1.43)
	Fallers (2 plus falls)	12	34/129 (26.4)	29/123 (23.6)	1.12 (0.73, 1.72)
		18	43/120 (35.8)	35/115 (30.4)	1.18 (0.82, 1.70)
Vind, 2009 ²⁹	Fallers (1 plus falls)	12	110/196 (56.1)	101/196 (51.5)	1.09 (0.91, 1.31)
	Fallers (3 plus falls)	12	43/196 (21.9)	44/196 (22.4)	0.98 (0.67, 1.42)
Wagner, 1994 ³⁰	Fallers (1 plus falls)	12	175/635 (27.6)	223/607 (36.7)	0.75 (0.64, 0.88)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix E Table 7. Multifactorial Interventions: Injurious Falls

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Bhasin, 2020 ⁴	Fall resulting in injuries	44	2268 (0.36)	2298 (0.38)	0.94 (0.84, 1.06)
	Fall resulting in serious injuries	44	330 (0.05)	336 (0.06)	0.93 (0.68, 1.26)
Elley, 2008 ¹¹	Fall resulting in injuries	12	170 (1.14)	156 (1.05)	1.09 (0.87, 1.35)
	Fall resulting in moderate injuries	12	156 (1.05)	149 (1)	1.05 (0.84, 1.31)
	Fall resulting in serious injuries	12	14 (0.09)	7 (0.05)	1.80 (0.73, 4.46)
Fairhall, 2014 ¹²	Fall resulting in injuries	12	75 (0.63)	78 (0.64)	0.97 (0.71, 1.33)
La Porta, 2022 ¹⁷	Falls resulting in injuries	12	110 (0.542)	115 (0.575)	0.94 (0.73, 1.22)
	Falls resulting in moderate injuries	12	90 (NR)	91 (NR)	NR (NR)
	Falls resulting in serious injuries	12	20 (NR)	24 (NR)	NR (NR)
Lightbody, 2002 ¹⁸	Fall resulting in serious injuries	6	3 (0.04)	6 (0.08)	0.51 (0.13, 2.05)
Lord, 2005 ²⁰	Fall resulting in injuries	12	119 (0.59)	108 (0.54)	1.07 (0.79, 1.44)
Moller, 2014 ²¹	Fall resulting in injuries	12	40 (0.5)	38 (0.52)	0.96 (0.62, 1.50)
	Fall resulting in medical care	12	19 (0.24)	15 (0.21)	1.16 (0.59, 2.27)
Palvanen, 2014 ²²	Fall-related injuries	12	351 (0.55)	468 (0.75)	0.74 (0.61, 0.89)
Russell, 2010 ²⁴	Fall-related injuries	12	352 (1.07)	344 (1.01)	1.08 (0.78, 1.48)
	Fall-related serious injuries	12	30 (0.09)	26 (0.08)	1.31 (0.77, 2.23)
Salminen, 2009 ²⁵	Fall resulting in medical care	12	48 (0.16)	48 (0.16)	1.04 (0.64, 1.69)
		24	80 (0.14)	98 (0.16)	0.83 (0.62, 1.12)
		36	124 (0.14)	146 (0.16)	0.87 (0.63, 1.21)
	Fall resulting in serious injuries	12	14 (0.05)	10 (0.03)	1.42 (0.63, 3.21)
		24	26 (0.04)	26 (0.04)	1.02 (0.59, 1.75)
		36	39 (0.04)	37 (0.04)	1.07 (0.68, 1.68)
Tinetti, 1994 ²⁷	Fall resulting in medical care	12	25 (0.17)	36 (0.25)	0.68 (0.34, 1.37)
	Fall resulting in serious injuries	12	13 (0.09)	18 (0.13)	0.71 (0.26, 1.89)
Vind, 2009 ²⁹	Fall resulting in medical care	12	44 (0.22)	56 (0.29)	0.79 (0.53, 1.17)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix E Table 8. Multifactorial Interventions: Fractures

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Bhasin, 2020 ⁴	Fall-related fracture	44	211 (0.02)	230 (0.02)	0.87 (0.59, 1.27)
	Hip fracture	44	40 (0)	43 (0)	0.88 (0.37, 2.10)
Bruce, 2021 ³	Fracture	18	173 (0.04)	133 (0.03)	1.30 (0.99, 1.71)
	Hip fracture	18	28 (0.01)	33 (0.01)	0.83 (0.46, 1.49)
Fairhall, 2014 ¹²	Fall resulting in fractures	12	13 (0.11)	12 (0.1)	1.09 (0.50, 2.39)
Palvanen, 2014 ²²	Fall-related fracture	12	33 (0.05)	42 (0.07)	0.77 (0.48, 1.23)
Russell, 2010 ²⁴	Fall-related fracture	12	11 (0.03)	17 (0.05)	0.76 (0.35, 1.63)
Salminen, 2009 ²⁵	Fall-related fracture	12	11 (0.04)	8 (0.03)	1.40 (0.56, 3.48)
		24	16 (0.03)	19 (0.03)	0.86 (0.44, 1.67)
		36	27 (0.03)	28 (0.03)	0.98 (0.58, 1.66)
	Fall-related hip fracture	12	1 (0)	1 (0)	1.02 (0.06, 16.26)
		24	2 (0)	2 (0)	1.02 (0.14, 7.22)
		36	4 (0)	4 (0)	1.02 (0.25, 4.07)
Vind, 2009 ²⁹	Fall-related fracture	12	24 (0.12)	16 (0.08)	1.50 (0.80, 2.82)
	Hip fracture	12	6 (0.03)	11 (0.06)	0.55 (0.20, 1.47)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix E Table 9. Multifactorial Interventions: People With a Fall Resulting in Injuries or Medical Care

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bhasin, 2020 ⁴	Serious injurious faller	44	291/2802 (10.4)	301/2649 (11.4)	0.91 (0.67, 1.24)
Close, 1999 ⁶	Injurious fallers	12	8/184 (4.3)	16/213 (7.5)	0.58 (0.25, 1.32)
Cohen, 2015 ⁷	Injurious fallers	6	136/1661 (8.2)	189/1815 (10.4)	0.79 (0.64, 0.98)
		9	186/1615 (11.5)	276/1756 (15.7)	0.73 (0.62, 0.87)
		12	254/1586 (16)	333/1715 (19.4)	0.82 (0.71, 0.96)
Conroy, 2010 ⁸	Injurious fallers	12	56/136 (41.2)	55/138 (39.9)	1.03 (0.78, 1.38)
Hendriks, 2008 ¹⁴	Injurious fallers	12	14/124 (11.3)	20/134 (14.9)	0.76 (0.40, 1.43)
Imhof, 2012	Injurious fallers	9	131/207 (63.3)	162/206 (78.6)	0.80 (0.71, 0.91)
Lord, 2005 ²⁰	Injurious fallers	12	80/202 (39.6)	67/201 (33.3)	1.19 (0.92, 1.54)
Moller, 2014 ²¹	Injurious fallers	12	30/80 (37.5)	27/73 (37)	1.01 (0.67, 1.53)
	Person with fall resulting in medical care	12	15/80 (18.8)	9/73 (12.3)	1.52 (0.71, 3.26)
Russell, 2010 ²⁴	Injurious fallers	12	118/320 (36.9)	115/330 (34.8)	1.06 (0.86, 1.29)
	Serious injurious faller	12	23/320 (7.2)	23/330 (7)	1.03 (0.59, 1.80)
Tinetti, 1994 ²⁷	Person with fall resulting in medical care	12	21/147 (14.3)	26/144 (18.1)	0.79 (0.38, 1.64)
	Serious injurious faller	12	12/147 (8.2)	14/144 (9.7)	0.84 (0.30, 2.32)
van Haastregt, 2000 ²⁸	Injurious fallers	12	26/129 (20.2)	21/123 (17.1)	1.18 (0.70, 1.98)
		18	33/120 (27.5)	25/115 (21.7)	1.26 (0.80, 1.99)
	Person with fall resulting in medical care	12	15/129 (11.6)	11/123 (8.9)	1.30 (0.62, 2.72)
		18	21/120 (17.5)	14/115 (12.2)	1.44 (0.77, 2.69)
Vind, 2009 ²⁹	Injurious fallers	12	34/196 (17.3)	35/196 (17.9)	0.97 (0.63, 1.49)
Wagner, 1994 ³⁰	Injurious fallers	12	63/635 (9.9)	88/607 (14.5)	0.68 (0.51, 0.93)
	Person with fall resulting in medical care	12	42/635 (6.6)	57/607 (9.4)	0.70 (0.48, 1.03)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix E Table 10. Multifactorial Interventions: People With a Fall-Related Fracture

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bhasin, 2020 ⁴	Person with fall-related fracture	44	184/2802 (6.6)	203/2649 (7.7)	0.86 (0.58, 1.26)
	Person with hip fracture	44	38/2802 (1.4)	42/2649 (1.6)	0.86 (0.35, 2.07)
Bruce, 2021 ³	Person with fracture	18	143/3301 (4.3)	110/3223 (3.4)	1.27 (0.96, 1.68)
Ciaschini, 2009 ⁵	Person with fracture	6	1/101 (1)	6/100 (6)	0.17 (0.02, 1.35)
Davison, 2005 ⁹	Person with fracture	12	7/159 (4.4)	13/154 (8.4)	0.52 (0.21, 1.27)
	Person with hip fracture	12	1/159 (0.6)	2/154 (1.3)	0.48 (0.04, 5.29)
Perula, 2012 ²³	Person with fall-related fracture	12	1/133 (0.8)	2/271 (0.7)	1.02 (0.02, 11.17)
Russell, 2010 ²⁴	Person with fall-related fracture	12	8/320 (2.5)	15/330 (4.5)	0.55 (0.24, 1.28)
Spice, 2009 ²⁶	Person with fall-related fracture	12	40/210 (19)	35/159 (22)	0.87 (0.49, 1.54)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix E Table 11. Multifactorial Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bruce, 2021 ³	18	107/3301 (3.2)	93/3223 (2.9)	1.12 (0.82, 1.54)
Bhasin, 2020 ⁴	42	235/2802 (8.4)	220/2649 (8.3)	1.01 (0.71, 1.44)
Ciaschini, 2009 ⁵	6	6/101 (5.9)	4/100 (4)	1.49 (0.43, 5.10)
Close, 1999 ⁶	12	19/184 (10.3)	27/213 (12.7)	0.81 (0.47, 1.42)
Conroy, 2010 ⁸	12	9/182 (4.9)	9/181 (5)	0.99 (0.40, 2.45)
Davison, 2005 ⁹	12	3/159 (1.9)	5/154 (3.2)	0.58 (0.14, 2.39)
Elley, 2008 ¹¹	12	7/155 (4.5)	4/157 (2.5)	1.77 (0.53, 5.93)
Ferrer, 2014 ¹³	12	9/164 (5.5)	8/164 (4.9)	1.13 (0.44, 2.84)
Hendriks, 2008 ¹⁴	12	5/166 (3)	1/167 (0.6)	5.03 (0.59, 42.60)
Hogan, 2001 ¹⁵	12	2/79 (2.5)	5/84 (6)	0.43 (0.08, 2.13)
Imhof, 2012	9	8/231 (3.5)	7/230 (3)	1.14 (0.42, 3.09)
Lightbody, 2002 ¹⁸	6	11/171 (6.4)	7/177 (4)	1.63 (0.65, 4.10)
Logan, 2010 ¹⁹	12	14/102 (13.7)	16/102 (15.7)	0.88 (0.45, 1.70)
Lord, 2005 ²⁰	6	1/210 (0.5)	3/204 (1.5)	0.32 (0.03, 3.09)
	12	2/210 (1)	6/204 (2.9)	0.32 (0.07, 1.59)
Moller, 2014 ²¹	6	6/80 (7.5)	1/73 (1.4)	5.47 (0.68, 44.40)
	12	9/80 (11.3)	3/73 (4.1)	2.74 (0.77, 9.72)
Palvanen, 2014 ²²	12	3/661 (0.5)	8/653 (1.2)	0.37 (0.10, 1.39)
Perula, 2012 ²³	12	1/133 (0.8)	2/271 (0.7)	1.02 (0.02, 55.72)
Russell, 2010 ²⁴	12	13/351 (3.7)	9/361 (2.5)	1.49 (0.64, 3.43)
Salminen, 2009 ²⁵	12	6/293 (2)	4/298 (1.3)	1.53 (0.43, 5.35)
	24	9/293 (3.1)	10/298 (3.4)	0.92 (0.38, 2.22)
	36	17/293 (5.8)	14/298 (4.7)	1.24 (0.62, 2.46)
Spice, 2009 ²⁶	12	34/210 (16.2)	29/159 (18.2)	0.89 (0.47, 1.69)
Tinetti, 1994 ²⁷	12	7/147 (4.8)	5/144 (3.5)	1.37 (0.29, 6.46)
van Haastregt, 2000 ²⁸	18	10/159 (6.3)	14/157 (8.9)	0.71 (0.32, 1.54)
Vind, 2009 ²⁹	12	4/196 (2)	4/196 (2)	1.00 (0.25, 3.94)
Wagner, 1994 ³⁰	24	17/635 (2.7)	22/607 (3.6)	0.74 (0.40, 1.38)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix E Table 12. Multifactorial Interventions: People With a Fall Resulting in Hospitalization or ED Visit

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bhasin, 2020 ⁴	Person with hospitalization	44	1139/2802 (40.6)	1108/2649 (41.8)	0.97 (0.85, 1.10)
Ciaschini, 2009 ⁵	Person with hospitalization/ED visit	6	2/101 (2)	3/100 (3)	0.66 (0.11, 3.87)
Close, 1999 ⁶	Person with hospitalization	12	NR/184 (NR)	NR/213 (NR)	OR 0.61 (0.35, 1.05)
Davison, 2005 ⁹	Person with fall-related ED visit	12	25/159 (15.7)	27/154 (17.5)	0.90 (0.55, 1.47)
	Person with fall-related hospitalization	12	14/159 (8.8)	17/154 (11)	0.80 (0.41, 1.56)
Hogan, 2001 ¹⁵	Person with ED visit	12	9/79 (11.4)	8/84 (9.5)	1.20 (0.49, 2.95)
	Person with fall-related hospitalization	12	5/79 (6.3)	6/84 (7.1)	0.89 (0.28, 2.79)
Logan, 2010 ¹⁹	Person with fracture-related hospitalization	12	3/102 (2.9)	6/102 (5.9)	0.50 (0.13, 1.95)
	Person with hospitalization	12	53/102 (52)	54/102 (52.9)	0.98 (0.76, 1.27)
Spice, 2009 ²⁶	Person with fall-related hospitalization	12	39/210 (18.6)	27/159 (17)	1.09 (0.58, 2.07)
Wagner, 1994 ³⁰	Person with hospitalization	12	3/635 (0.5)	5/607 (0.8)	0.57 (0.14, 2.39)

Abbreviations: CG = Control group; CI = Confidence interval; ED = Emergency department; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix E Table 13. Multifactorial Interventions: IADLs

Author, year	Outcome (Instrument)	Timepoint, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)
Bhasin, 2020 ^{4*}	IADL, physical function (Late-Life Function)	0	380	358	60.2 (0.46)	58.9 (0.47)	--	--
		12	313	284	59.8 (0.54)	58.9 (0.57)	--	--
		24	290	257	59.1 (0.61)	58.0 (0.53)	--	--
	IADL, disability (Late-Life Disability)	0	380	358	57.3 (0.53)	56.2 (0.51)	--	--
		12	313	283	56.4 (0.64)	55.8 (0.66)	--	--
		24	290	256	56.7 (0.76)	55.8 (0.63)	--	--
de Vries, 2010 ¹⁰	IADL (Lawton and Brody)	12	106	111	--	--	-0.15 (1.73)	0.01 (1.61)
Elley, 2008 ¹¹	ADL/IADL (Nottingham Extended Activities of Daily Living)	0	135	145	Median: 19.0 (IQR 18.0, 21.0)	Median 19.0 (IQR 16.0, 20.0)	--	--
		12	135	145	Median: 18.0 (IQR 17.0, 20.0)	Median 19.0 (IQR 17.0, 20.0)	--	--
Hendriks, 2008 ¹⁴	IADL (Frenchay Activities Index)	0	166	167	23.3 (8.7)	23.7 (8.6)	--	--
		12	124	134	25.6 (8.0)	24.5 (9.1)	--	--
Logan, 2010 ¹⁹	ADL/IADL (Nottingham Extended Activities of Daily Living)	0	102	102	Median: 6.0 (IQR 3.0, 9.0)	Median 8.5 (IQR 4, 12)	--	--
		12	102	102	Median: 8.0 (IQR 4.0, 13.0)	Median 6.0 (IQR 1.0, 10.0)	--	--
Moller, 2014 ²¹	ADL/IADL (Sonn and Asberg)	0	80	73	Median: 2.0 (IQR 1.0, 3.0)	Median 2.0 (IQR 1.0, 3.0)	--	--
		12	80	73	Median: 2.0 (IQR 1.0, 3.35)	Median 2.0 (IQR 1.0, 3.5)	--	--
Vind, 2009 ²⁹	IADL (Frenchay Activities Index)	0	196	196	29.5 (6.7)	28.5 (8.2)	--	--
		6	196	196	29.4 (6.9)	28.2 (7.9)	--	--
		12	196	196	30.1 (6.9)	29.4 (7.3)	--	--

* Random subgroup of adults age 75 years or older.

Abbreviations: ADL = Activities of daily living; BL = Baseline; CG = Control group; IADL = Instrumental activities of daily living; IG = Intervention group; IQR = Interquartile range; Mo = Months; N = Number of participants; SD = Standard deviation.

Appendix E Table 14. Multifactorial Interventions: Quality of Life

Author, year	Instrument	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Bhasin, 2020 ⁴	QOL-EQ-5D-VAS	0	2771	2627	78.9 (16.3)	78.8 (16.2)	NA	NA	NA
		12	2360	2247	77.0 (17.3)	76.6 (17.0)	NR	NR	NR
		24	2234	2122	77.3 (17.3)	76.7 (16.9)	NR	NR	NR
Bruce, 2021 ³	SF-12 Physical Component	0	3301	3223	50.0 (10.5)	50.3 (10.2)	NA	NA	NA
		18	2216	2234	49.8 (10.3)	49.9 (10.0)	NR	NR	0.08 (-0.32, 0.47) p=0.70
	SF-12 Mental Component	0	3301	3223	50.1 (9.3)	50.2 (9.3)	NA	NA	NA
		18	2216	2234	49.9 (9.5)	50.0 (9.0)	NR	NR	-0.19 (-0.62, 0.25) p=0.40
de Vries, 2010 ¹⁰	EQ-5D	12	106	111	NR	NR	0.01 (0.16)	0.07 (0.16)	NR
	SF-12 Mental Component	12	106	111	NR	NR	-0.31 (-1.43)	-1.43 (10.23)	NR
	SF-12 Physical Component	12	106	111	NR	NR	2.60 (8.6)	1.86 (10.23)	NR
Elley, 2008 ¹¹	SF-36 Mental Component	0	135	145	Median 57.5 (IQR 50.1, 61.8)	Median 58.7 (IQR 53.1, 62.5)	NA	NA	NA
		12	135	145	Median 56.7 (IQR 48.8, 61.3)	Median 57.7 (IQR 49.4, 61.9)	NR	NR	NR
	SF-36 Physical Component	0	135	145	Median 35.4 (IQR, 29.4, 43.8)	Median 36.5 (IQR 29.7, 43.9)	NA	NA	NA
		12	135	145	Median 39.4 (IQR, 29.9, 46.0)	Median 37.2 (IQR 29.0, 45.4)	NR	NR	NR
Fairhall, 2014 ¹²	EQ-5D VAS	0	120	121	58.2 (15.8)	57.9 (18.4)	NA	NA	NA
		12	107	108	57.5 (20.8)	57.7 (19.7)	NR	NR	NR
Vind, 2009 ²⁹	SF-36 Physical Component	0	196	196	61.4 (27)	62.4 (27)	NA	NA	NA
		6	196	196	69.1 (24)	66.6 (28)	NR	NR	NR
		12	196	196	67.9 (25)	65.2 (27)	NR	NR	NR
	SF-36 Mental Component	0	196	196	77.4 (19)	76.1 (23)	NA	NA	NA
		6	196	196	80.6 (18)	79.4 (21)	NR	NR	NR
		12	196	196	81.5 (18)	78.1 (23)	NR	NR	NR

Abbreviations: ADL = Activities of daily living; BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D = EuroQol instrument; IADL = Instrumental activities of daily living; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; SF = Short Form Survey; Time = Timepoint; VAS = Visual analogue scale.

Appendix E Table 15. Multifactorial Interventions: Harms

Author, year	Outcome	FU, mo	IG n/n	CG n/n
Bruce, 2021 ³	Serious AE directly related to the intervention	18	0/3301	NR
	AE	18	0/3301	NR
Fairhall, 2014 ¹²	Back pain	12	2/3279*	NR
Hendriks, 2008 ¹⁴	AE	12	0/166	0/166
Salminen, 2009 ²⁵	Fall during intervention	12	3/292	NR
Tinetti, 1994 ²⁷	AEs during intervention - musculoskeletal complaints	12	10/153	NR

*Events, not people.

Abbreviations: AE = Adverse event; CG = Control group; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported.

Appendix F Table 1. Exercise Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Intervention component(s)	Target population	Recruitment setting	N rand	Age, mean (range)	Female, %	Race/ethnicity, %
Barnett, 2003 ³¹	Fair	AUS	Exercise	Older adults age ≥65 years at risk of falling.	Clinical, NOS or varied; Hospital	163	75 (≥65)	67	NR
Bruce, 2021 ³ Prevention of Fall Injury Trial (PreFIT)	Good	GBR	Exercise	Older adults age ≥70 years.	PC/GP	9803	78 (≥70)	53	White: 99 Other: 1
Buchner, 1997 ³² Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT)	Fair	US	Exercise	Older adults ages 68–85 years with at least mild deficits in strength and balance.	Insurance	55	75 (68–85)	51	White: 93
Callisaya, 2021 ³³ StandingTall	Fair	AUS	Exercise	Older adults age ≥60 years with subjective and/or objective cognitive impairment.	Community-based; Hospital; PC/GP	93	72.8 (≥60)	58	White: 97
Campbell, 1997 ³⁴	Fair	NZL	Exercise + Behavior change support	Women age ≥80 years.	Clinical, NOS or varied	233	84 (80+)	100	NR
Chyu, 2010 ³⁵	Fair	US	Exercise	Postmenopausal women age ≥65 with osteopenia.	Community-based	61	72 (≥65)	100	NR
Delbaere 2021 ³⁶	Good	AUS	Exercise	Older adults age ≥70 years.	Community-based	503	77 (≥70)	67	NR
El-Khoury, 2015 ³⁷ Ossebo Intervention	Fair	FRA	Exercise	Women ages 75–85 years with diminished balance and gait capacities.	Population-based register	706	78 (75–85)	100	NR
Fitzharris, 2010 ³⁸ Whitehorse NoFalls trial	Fair	AUS	Exercise	Older adults age ≥70 years.	Population-based register	543	76.1 (≥70)	60	NR
Goldberg 2019 ³⁹ Promoting activity, Independence and stability in early	Fair	GBR	Exercise + Behavior change support	Older adults age ≥65 years with mild dementia or mild cognitive impairment.	Clinical, NOS or varied	41	76 (≥65 [65–91])	46	White: 98

Appendix F Table 1. Exercise Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Intervention component(s)	Target population	Recruitment setting	N rand	Age, mean (range)	Female, %	Race/ethnicity, %
dementia (PrAISED trial)									
Karinkanta, 2015 ⁴⁰ The KAAMU Study	Fair	FIN	Exercise	Women age ≥70 years.	Population-based register	75	73 (70–79)	100	NR
Korpelainen, 2006 ⁴¹	Fair	FIN	Exercise	Older women with low BMD.	Population-based register	160	73 (70–73)	100	NR
Kovacs, 2013 ⁴²	Good	Hungary	Exercise	Women age ≥60 years.	Community-based	72	68 (≥60)	100	NR
Kronhed, 2009 ⁴³	Fair	SWE	Exercise	Women ages 60–81 years with osteoporosis.	Hospital	73	71 (60–81)	100	NR
Lamb, 2018 ⁴⁴ Dementia and Physical Activity trial (DAPA)	Fair	GBR	Exercise + Behavior change support	Adults age ≥18 years with mild to moderate dementia.	Clinical, NOS or varied; Population-based register; Other	494	77 (≥18)	39	White: 97 Other: 3
Lipsitz, 2019 ⁴⁵ Mind Body-Wellness in Supportive Housing (Mi-WISH)	Fair	US	Exercise	Older adults age ≥60 years and living in low-income housing.	Community-based	180	75 (≥60)	67	White: 62 Black: 32 Asian: 2 Hispanic/Latino: 4 Other: 3
Logghe, 2009 ⁴⁶	Fair	NLD	Exercise	Older adults age ≥70 years with a high risk of falling.	Clinical, NOS or varied	269	77 (69–93)	71	NR
Luukinen, 2007 ⁴⁷	Fair	FIN	Exercise	Older adults age ≥85 years.	Population-based register	437	88 (≥85)	79	NR
Merom, 2016 ⁴⁸	Fair	AUS	Exercise	Resident of participating retirement villages.	Retirement villages	530	NR (NR)	85	NR
Miko, 2018 ⁴⁹	Fair	Hungary	Exercise	Women age ≥65 years with osteoporosis and at least one previous fracture.	Clinical, NOS or varied	100	69 (≥65)	100	NR
Morgan, 2004 ⁵⁰	Fair	US	Exercise	Older adults age ≥60 years with either a hospital admission lasting 2 days or longer or had been on	Clinical, NOS or varied	219	81 (≥60)	71	NR

Appendix F Table 1. Exercise Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Intervention component(s)	Target population	Recruitment setting	N rand	Age, mean (range)	Female, %	Race/ethnicity, %
				bed rest for 2 days or more within the past month.					
Ng, 2015 ⁵¹	Fair	Singapore	Exercise	Frail and prefrail older adults age ≥65 years.	Community-based	98	70 (≥65)	56	NR
Ohman, 2016 ⁵² Effects of the Finnish Alzheimer Disease Exercise Trial (FINALEX)	Fair	FIN	Exercise	Older adults age ≥65 with Alzheimer's disease.	Insurance	69	77 (≥65)	32	NR
Oliveira, 2019 ⁵³	Fair	AUS	Exercise + Behavior change support	Older adults age ≥60 years.	Community-based	131	72 (≥60)	71	NR
Rikkonen, 2023 ⁵⁴	Fair	FIN	Exercise	Home-dwelling older women.	Population-based register	914	76 (71–85)	100	NR
Robertson, 2001 ⁵⁵	Fair	NZL	Exercise	Older adults age ≥75 years.	Clinical, NOS or varied	240	81 (75–95)	68	NR
Rosado, 2021 ⁵⁶	Fair	PRT	Exercise	Older adults age ≥65 years.	Community-based	35	75.6 (≥65)	82	NR
Sherrington, 2014 ⁵⁷	Fair	AUS	Exercise + Behavior change support	Older adults age ≥60 years and had been admitted to and subsequently discharged from a hospital.	Hospital	340	81 (≥60)	74	NR
Siegrist, 2016 ⁵⁸ PreFalls	Fair	DEU	Exercise + Behavior change support	Older adults at high risk of falls.	PC/GP	378	78 (≥65)	75	NR
Stathi, 2022 ⁵⁹ Retirement in Action (REACT)	Fair	GBR	Exercise + Behavior change support	Older adults age ≥65 years at increased risk of mobility limitations.	Community-based; PC/GP; Other	777	78 (≥65)	66	White: 95 Black: 2 Asian: 1 African or Caribbean: 2.5 Other/mixed: 1

Appendix F Table 1. Exercise Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Intervention component(s)	Target population	Recruitment setting	N rand	Age, mean (range)	Female, %	Race/ethnicity, %
Suikkanen, 2021 ⁶⁰	Fair	FIN	Exercise	Older adults age ≥65 years with signs of frailty.	Community-based	300	82 (≥65)	75	NR
Tomita, 2016 ⁶¹ Virtual-Group Exercise at Home (V-GEAH)	Fair	US	Exercise	Older adults ages 60–90 years and had a fall within the past 12 mo.	Community-based	56	73 (60–90)	88	NR
Trombetti, 2011 ⁶²	Fair	CHE	Exercise	Older adults age ≥65 years at increased risk of falling.	Community-based	134	76 (≥65)	96	NR
Tuvemo Johnson, 2021 ⁶³	Fair	SWE	Exercise	Older adults age ≥75 years who needed walking aids and/or home help service.	Clinical, NOS or varied; Social service	175	83 (≥75)	70	NR
Uusi-Rasi, 2015 ⁶⁴	Good	FIN	Exercise	Women ages 70–80 years old.	Population-based register	205	74 (70–80)	100	NR
Voukelatos, 2007 ⁶⁵	Good	AUS	Exercise	Relatively healthy older adults age ≥60 years.	Community-based	702	69 (60–96)	84	NR
Voukelatos, 2015 ⁶⁶ Easy Steps	Fair	AUS	Exercise + Behavior change support	Inactive, older adults age ≥65 years.	Community-based	386	73 (65–90)	74	NR

Abbreviations: AUS = Australia; BMD = Bone mineral density; CAN = Canada; CHE = Switzerland; DEU = Germany; DNK = Denmark; FIN = Finland; FRA = France; GBR = Great Britain; mo = months; N = Number of participants; NLD = Netherlands; NOS = Not otherwise specified; NR = Not reported; NZL = New Zealand; PC/GP = Primary care/General practitioner; PRT = Portugal; QR = Quality rating; Rand = Randomized; SWE = Sweden; US = United States.

Appendix F Table 2. Exercise Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Barnett, 2003 ³¹	100	One or more physical performance impairments that have been found to be important risk factors for falls that could be addressed by exercise participation: lower limb weakness, poor balance, and slow reaction time.	NR	NR	Taking ≥4 meds: 48.5%	NR
Bruce, 2021 ³ Prevention of Fall Injury Trial (PreFIT)	43.8	Fall in the previous 12 mo and current balance problems whilst walking, dressing, toileting, or taking a bath.	Met Strawbridge Frailty Index, %: 21	≥3 coexisting conditions, %: 19	NR	Possible cognitive impairment (as indicated by CDT), %: 9
Buchner, 1997 ³² Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT)	25	Fall in the previous 12 mo.	NR	NR	NR	NR
Callisaya, 2021 ³³ StandingTall	35.5	Fall in the previous 12 mo.	NR	NR	NR	MoCA <24 (MCI or more), %: 15.1
Campbell, 1997 ³⁴	51.0	Fall in the previous 12 mo.	NR	NR	Mean # of meds: 3.2	NR
Chyu, 2010 ³⁵	100	Diagnosis of osteopenia, defined as bone mineral density T-score at the spine and/or hip between 1 and 2.5 standard deviation (SD) below the young normal sex-matched bone mineral density of the reference database.	NR	NR	NR	NR
Delbaere 2021 ³⁶	38	Fall in the previous 12 mo.	NR	Median # of medical conditions: 0	Median # of prescription drugs: 3	Median MoCA score: 27
El-Khoury, 2015 ³⁷ Ossebo Intervention	100	Diminished balance or gait capacities.	NR	NR	NR	NR

Appendix F Table 2. Exercise Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Fitzharris, 2010 ³⁸ Whitehorse NoFalls trial	6	Fall in the previous 1 mo.	NR	NR	Mean # of meds: 3.4	NR
Goldberg 2019 ³⁹ Promoting activity, Independence and stability in early dementia (PrAISED trial)	NR	NA	NR	NR	NR	Mean MMSE score: 25.4 Dementia, %: 92
Karinkanta, 2015 ⁴⁰ The KAAMU Study	NR	NA	NR	NR	NR	NR
Korpelainen, 2006 ⁴¹	100	Diagnosed osteopenia.	NR	NR	NR	NR
Kovacs, 2013 ⁴²	38	Fall in the previous 12 mo.	NR	NR	Medication >4, %: 21	NR
Kronhed, 2009 ⁴³	100	Established osteoporosis.	NR	NR	NR	NR
Lamb, 2018 ⁴⁴ Dementia and Physical Activity trial (DAPA)	30	Fall in the previous 6 mo.	NR	NR	Mean # of meds: 5.6 (By dementia meds available)	Per inclusion criteria, 100% have probable dementia according to the DSM-IV criteria or have probable MMD (a score of >10 on the sMMSE). The overall mean imputed ADAS-Cog score was 21.5 (SD, 9.0) out of a possible score of 70, for which a higher score indicates greater cognitive impairment.
Lipsitz, 2019 ⁴⁵ Mind Body-Wellness in Supportive Housing (Mi-WISH)	48	Fall in the previous 12 mo.	NR	Mean # of health problems: 5.1	NR	Mean MMSE score: 25.7

Appendix F Table 2. Exercise Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Logghe, 2009 ⁴⁶	100	Fall in the previous 12 mo or ≥ 2 of the following fall risk factors: disturbed balance, mobility problems, dizziness, and the use of benzodiazepines or diuretics.	NR	NR	Medication use, %: 98.5	NR
Luukinen, 2007 ⁴⁷	100	>2 falls in the previous 12 mo; frequent feelings of loneliness; poor self-rated health; poor visual acuity; poor hearing; depression; poor cognition; impaired balance; impaired chair rise; or slow walking speed.	NR	NR	Mean # of used meds: 6	Mean MMSE score (30–0): 23.5
Merom, 2016 ⁴⁸	28	≥ 1 fall in the previous 12 mo.	NR	≥ 2 chronic conditions, %: 71	Taking ≥ 5 meds, %: 40 Taking psychoactive meds, %: 5	MMSE score 28–30, %: 70 MMSE score <27, %: 30
Miko, 2018 ⁴⁹	100	Established postmenopausal osteoporosis based on WHO criteria (T-score below -2.5 SD in lumbar spine, femur neck, or total femur region); and at least one osteoporotic fracture in their personal medical history	NR	NR	NR	NR
Morgan, 2004 ⁵⁰	100	Hospital admission lasting ≥ 2 days or had been on bed rest ≥ 2 days in the past 1 month.	NR	NR	Mean # of meds: 4	NR
Ng, 2015 ⁵¹	100	Prefrail and frail older adults.	Mean frailty score (range 0–5): 2.2 Prefrail, %: 60.4 Frail, %: 39.6*	≥ 5 medical comorbidities, %: 10.4	NR	Mean MMSE score: 29.1
Ohman, 2016 ⁵² Effects of the Finnish Alzheimer Disease Exercise Trial (FINALEX)	100	≥ 1 fall in the previous 12 mo, reduced walking speed, or unintentional weight loss.	Per inclusion criteria, 100% considered frail†	Charlson comorbidity index: 2.7	Mean # of meds: 6.4	Per inclusion criteria, 100% had established diagnosis of AD‡, mean MMSE score: 22.8

Appendix F Table 2. Exercise Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Oliveira, 2019 ⁵³	28	Fall in the previous 12 mo.	NR	Mean # of comorbidities: 2.6	Mean # of meds: 2.2	NR
Rikkonen, 2023 ⁵⁴	NR	NA	NR	Osteopenia: 51.6% Osteoporosis: 7.6%	NR	NR
Robertson, 2001 ⁵⁵	37	Fall in previous 12 mo.	NR	NR	Mean # of prescribed drugs: 3 Taking psychotropic drugs, %: 19	NR
Rosado, 2021 ⁵⁶	100	≥1 fall in the previous 6 mo or at high risk of falling ^s	NR	NR	NR	Mean MMSE score: 28.1
Sherrington, 2014 ⁵⁷	100	Recent discharge from hospital.	NR	NR	Mean # of meds: 7.5 Psychotropic medication, %: 14 Benzodiazepine medication, %: 15	Mean MMSE score: 28
Siegrist, 2016 ⁵⁸ PreFalls	100	≥1 fall in the previous 12 mo, low physical function ^{ll}	NR	NR	Taking ≥4 meds, %: 62.8	NR
Stathi, 2022 ⁵⁹ Retirement in Action (REACT)	100	At increased risk of mobility limitation.	NR	1 chronic illness, %: 23.5 ≥2 chronic illnesses, %: 43.3	NR	Mean MOCA score: 24.37
Suikkanen, 2021 ⁶⁰	100	Score of ≥1 point on the FRAIL questionnaire and fulfilled ≥1 phenotype criterion of frailty: criteria used were weight loss ≥5% during the previous 12 mo, physical activity <30 min/wk, a feeling of “not getting going” or “everything is an effort” for most or all of the time, handgrip strength under cutoff values based on BMI, sex, and walking speed <0.46 m/s (walking length either 4 or 2.44 m).	Met 1–2 frailty criteria, %: 61 Met ≥3 frailty criteria, %: 39	NR	Mean # of regular meds: 6.8	Mean MMSE score: 24.4

Appendix F Table 2. Exercise Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Tomita, 2016 ⁶¹ Virtual-Group Exercise at Home (V-GEAH)	100	Presentation to ED or visit to PCP due to a fall in home environment or a workplace within the previous 12 mo.	NR	Mean # of illnesses: 3.5	Mean # of meds: 3.7 Mean # of meds that may cause drowsiness: 1.1	NR
Trombetti, 2011 ⁶²	100	At least one of the following: ≥1 falls after the age of 65 years; balance impairment as assessed by a simplified Tinetti test with a score higher than 2 of 7; and 1 or 2 criteria of physical frailty [¶]	Only frailty components reported [#]	Charlson comorbidity index, mean score: 1	Mean # of meds: 3.5 Current use of psychotropic medication, %: 23	MMSE, mean: 26 MMSE, score <24, %: 3
Tuvemo Johnson, 2021 ⁶³	100	Needed walking aids and/or home help service.	NR	NR	NR**	Mean MMSE score: 28
Uusi-Rasi, 2015 ⁶⁴	100	≥1 fall in the previous 12 mo.	NR	NR	Mean # of meds: 2.3	Mean MMSE score: 28.2
Voukelatos, 2007 ⁶⁵	33	≥1 fall in the previous 12 mo.	NR	NR	NR	NR
Voukelatos, 2015 ⁶⁶ Easy Steps	22	Fall in the previous 12 mo.	NR	NR	NR	NR

* Prefrail and frail older adults were identified based on 5 CHS criteria defining physical frailty: unintentional weight loss, slowness, weakness, exhaustion, and low activity, which were scored 1 if present and 0 if absent. The total summed scores ranging from 0 to 5 were used to classify a participant as robust (score=0), prefrail (score=1 to 2), or frail (score= 3 to 5).

[†] ≥1 fall in the previous 12 mo, reduced walking speed, or unintentional weight loss.

[‡] Diagnosed with AD by a geriatrician or a neurologist based on the NINCDS-ADRDA Alzheimer's criteria.

[§] A score of ≤25 points on the Fullerton Advanced Balance Scale.

^{||} TUG or Chair-Stand-Test >10 seconds or subjective or objective balance deficits or fear of falling.

[¶] Unintentional weight loss, exhaustion, low physical activity level, slow walking speed, grip strength.

[#] Unintentional weight loss, exhaustion, low PA level, slow walking speed, grip strength.

** By medication available: Hypnotics, %: 32.9; Tranquilizer, %: 7.5.

Abbreviations: AD = Alzheimer's Disease; ADAS = Alzheimer's Disease Assessment Scale; BMD = Bone mineral density; BMI = Body Mass Index; CDT = Clostridioides difficile infection; CHS = Cardiovascular Health Study; Cog = Cognitive; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, fourth edition; ED = Emergency department; FRAIL = Fatigue, Resistance, Ambulation, Illnesses, and Loss of Weight; MCI = Mild cognitive impairment; m = Meters; Meds = Medications; MMD = MMSE = Mini-Mental State Examination; Mo = Months; MoCA = Montreal Cognitive Assessment; NA = Not applicable; NINCDS-ADRDA = National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association; NR = Not reported; PCP = Primary care physician; S = seconds; SD = Standard deviation; TUG = Timed Up and Go Test; WHO = World Health Organization.

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Barnett, 2003 ³¹	IG1	Group exercises to improve balance, coordination, and muscle strength plus independent exercise instruction.	Individual; Group	Class outside of home; Home	Exercise Instructor	37 wkly, 1-hr group exercise sessions were provided. Participants were also provided with a home exercise program with a diary to record sessions.	Thirty-seven 1-hr group classes every wk in 4 sessions over 12 mo (37 classes total)	Minimal intervention
Bruce, 2021 ³	IG1	Prescribed, home exercise program (based on OEP) plus recreational walking	Individual	Home	Exercise Instructor; Occupational therapist; Physical therapist	Recommended six contacts over 6 mo: three face-to-face appointments and three telephone contacts.	3 face-to-face visits, 3 telephone contacts over 6 mo	Minimal intervention
Buchner, 1997 ³²	IG1	Exercise consisted of endurance training and/or strength training in supervised classes followed by self-supervised exercise for 24 to 26 wks.	Individual; Group	Class outside of home; Home	NR	The walking plan advice was to walk at the usual pace for up to 30 mins at least twice per wk. Outdoor walking was recommended if the physiotherapist felt that it was safe for participants. Walks could be broken up into shorter sessions (e.g., three 10-min daily walks) and recommendations were given about how to incorporate walking into daily activities.	1-hr group class 3x/wk over 6 mo	Usual care
Callisaya, 2021 ³³	IG1	Tablet-delivered, cognitive-motor program focused on mobility.	Individual	Home	Physiotherapist; Self-directed (manual or instructions given)	3 x 1-hr sessions per wk (180 min); 78 total sessions. At discharge from supervised exercise all subjects agreed to try to continue exercising.	NA, primarily self-directed	Minimal intervention
Campbell, 1997 ³⁴	IG1	Individually tailored home exercise program with regular phone calls to maintain motivation.	Individual	Home	Physical therapist	2 hr of balance exercises per wk (from 40 min in wks 1 and 2, to 120 min from wk 9 onwards. Participants could choose the time they wished to exercise (e.g., 10, 15, 20, 25, or 30 min) to reach the wkly time goal.	Four 1-hr PT visits	Attention control

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Chyu, 2010 ³⁵	IG1	Supervised, group tai chi classes.	Group	Class outside of home	Exercise Instructor	3 x 30-min sessions per wk; 156 total sessions (78 hrs). Encouraged to walk outside the home at least three times a wk.	Three 60-min group class/wk for 24 wks	No intervention
Delbaere 2021 ³⁶	IG1	Tailored, tablet-delivered balance exercises	Individual	Home	Self-directed (manual or instructions given)	Three 60-min instructed tai chi group sessions each wk for 24 wks (72 hrs total)	NA	Attention control
Ei-Khoury, 2015 ³⁷	IG1	Supervised group sessions of progressive balance training offered in community-based premises for 2 years, supplemented by individually prescribed home exercises.	Individual; Group	Class outside of home; Home	Exercise Instructor	2 hrs of exercise per wk for 24 mo.	1-hr group class/wk for 2 yrs	Usual care
Fitzharris, 2010 ³⁸	IG1	Group exercise classes supplemented by independent home exercises.	Individual; Group	Class outside of home; Home	Physical therapist	1-hr group session per wk; total of 96 sessions; also expected to perform exercises at home at least once a wk.	1-hr group exercise class/wk for 15 wks	Usual care
Goldberg 2019 ³⁹	IG1	High intensity, supervised tailored exercise program with behavior change support.	Individual	Home	Occupational therapist; Physical therapist; Rehabilitation support workers	1 hr/wk for 15 wks	Aim of 3 hr/wk for 12 mo (50 home visits offered over 12 mo)	Minimal intervention
Karinkanta, 2015 ⁴⁰	IG1	Combination training program consisting of resistance and balance-jumping training in alternating wks	Group	Class outside of home	Exercise Instructor	High intensity with 50 individual sessions offered over 12 mo. In the high intensity supervision group, participants completed a mean of 71 min (SD, 56; range, 11 to 246 min) per wk of physical activity.	Three 45-min group sessions per wk for 12 mo	Usual care
Korpelainen, 2006 ⁴¹	IG1	Supervised, group exercise program in addition to an	Individual; Group	Class outside of home; Home	Physical therapist	3 x 45-min sessions per wk (135 min); 156 total sessions (117 hrs).	One 1-hr group class/wk for 6 mo	Usual care

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
		independent home exercise program.						
Kovacs, 2013 ⁴²	IG1	Adapted Physical Activity program with structured group exercises and physical games.	Group	Class outside of home	Physical therapist	The mean duration of moderate non-intervention physical activity (4.5) during the intervention was 7 (SD, 4) hr/wk in the IG and CG groups.	Two 1-hr group sessions/wk for 25 wks	Usual care
Kronhed, 2009 ⁴³	IG1	Supervised, group strength-training program.	Group	Class outside of home	Physical therapist	Over 30 mo: Sep-Mar (6 mo): 1-hr group exercise classes 1x/wk; Apr-Sep (6 mo): 20-min daily home exercises.	Two 1-hr group sessions/wk for 4 mo	Usual care
Lamb, 2018 ⁴⁴	IG1	12-mo exercise intervention (4 mo supervised group exercise, followed by 8 mo unsupervised exercise program) combined with behavior change support.	Individual; Group	Class outside of home; Home	Exercise Instructor; Physical therapist	2 x 1-hr sessions per wk (120 min/wk); total of 50 sessions (50 hrs).	1-hr group exercise 2x/wk for 4 mo	Usual care
Lipsitz, 2019 ⁴⁵	IG1	Group tai chi class supplemented with independent, home exercises.	Individual; Group	Class outside of home; Home	Exercise Instructor; Self-directed (manual or instructions given)	Total number of 30 1-hr group exercise training sessions, delivered twice-wkly for 4 mo; participants encouraged to continue the training exercise program on their own at senior gyms after the supervised group exercise training period.	Two group classes (length NR)/wk for up to 52 wks	Attention control
Logghe, 2009 ⁴⁶	IG1	Tai chi Chuan training in group class, supplemented by independent practice at home.	Individual; Group	Class outside of home; Home	Exercise Instructor	Twice-wkly exercise sessions of approximately 1 hr duration for 4 mo. After the 4 mo of exercise classes, all of the 150 mins of activity per wk at moderate intensity was carried out unsupervised for another 8 mo.	1-hr group sessions 2x/wk for 26 wks	Usual care

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Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Luukinen, 2007 ⁴⁷	IG1	Prescribed exercise intervention that could consist of home exercise, walking exercise, group exercise, and/or self-care exercises.	Individual; Group	Class outside of home; Home	Occupational therapist; Physical therapist	Average # of sessions attended was 21.	Varied based on ability and recommendations.	Usual care
Merom, 2016 ⁴⁸	IG1	Community group dance classes.	Group	Class outside of home	Exercise Instructor	2/wk supervised group classes (length of class NR) plus 3/wk 20-min independent exercise sessions encouraged.	1-hr group class 2x/wk (total of 80 hr) over 12 mo	No intervention
Miko, 2018 ⁴⁹	IG1	Supervised balance-training program, supplemented with independent, at-home exercise and walking program based on elements of the Otago exercise program.	Individual	Home; Outpatient	Physiotherapist	1-hr sessions 2x/wk (120 total min per wk); 26 sessions total	Three 30-min sessions/wk for 12 mo	No intervention
Morgan, 2004 ⁵⁰	IG1	Group exercise sessions focusing on gait, balance, and flexibility utilizing physical therapy exercises.	Group	Class outside of home	Physical therapist	Variable, not clearly described.	Three 45-min group sessions/wk for 8 wks	Usual care
Ng, 2015 ⁵¹	IG1	Tailored physical exercise program that included supervised group classes, followed by independent, home-based exercises.	Individual; Group	Class outside of home; Home	Other modern health professionals	Dance classes were offered for 1 hr, twice a wk, for a total of 80 hr over 12 mo (allowing for short breaks).	Two 90-min group classes/wk for 6 wks	Usual care
Ohman, 2016 ⁵²	IG1	Based on participant ability, assigned to either (1) supervised, home-based exercise program, or (2) supervised, group-based exercise class outside the home.	Individual; Group	Class outside of home; Home	Physical therapist	Planned: 30 min/session *3 sessions/wk*52 wks + 25–35 min walks at home (days/wks NR)	Varied based on ability but could be (1) Two 1-hr PT home visit/wk for 12 mo or (2) two 1-hr group classes/wk for 12 mo	Usual care

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Oliveira, 2019 ⁵³	IG1	Health coaching for mobility-related goals.	Individual	Home	Physical therapist	3 sessions per wk, 45 min, 8 wks	NA	Usual care
Robertson, 2001 ⁵⁵	IG1	Prescribed at-home exercise and walking program; included 5 home visits by instructor.	Individual	Home	Nurse	Two 90-min sessions per wk (180 min per wk); 48 total sessions (72 hrs), followed by 12 wks of home-based exercises (duration or freq NR)	Five home visits over 1 yr (length of visit NR)	Usual care
Rosado, 2021 ⁵⁶	IG1	Supervised, group multimodal exercise program combining physical with cognitive training.	Group	Class outside of home	Physical therapist	1 hr, twice per wk, for 1 year (individual at home or group classes based on ability). The mean active exercise time per person was approximately 1 hr/d because of breaks and waiting times.	Three 74-min group sessions/wk for 24 wks	No intervention
Sherrington, 2014 ⁵⁷	IG1	At-home exercise program with behavioral change support; 10 home visits from PT.	Individual	Home	Physical therapist	2 hr home visit + telephone coaching every 2 wks for 6 mo	Up to 10 home visits over 12 mo	Minimal intervention
Siegrist, 2016 ⁵⁸	IG1	Group exercise sessions and prescribed home-exercise program addressing strength, balance, and gait plus cognitive behavioral program to reduce fear of falling by increasing self-efficacy.	Individual; Group	Class outside of home; Home	Exercise Instructor Physical therapist	Recommended three 30-min strength sessions and 2 walking sessions per wk.	One 1-hr group session per wk	Usual care
Stathi, 2022 ⁵⁹	IG1	Community-based exercise program combined with a behavioral maintenance program.	Group	Class outside of home	Exercise Instructor	24 wks, 75 min/session; 3x/wk on alternate days	1-hr group classes 2x/wk for 12 wks, then 1x/wk for an additional 40 wks (64 group sessions in total over 12 mo)	Minimal intervention

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Suikkanen, 2021 ⁶⁰	IG1	Supervised, multicomponent home physical exercise program based on the OEP.	Individual	Home	Physical therapist	20–30 min of at-home exercise sessions for 6 days per wk. Up to 10 home visits from PT over a year.	Two 1-hr PT sessions/wk for 12 mo	Usual care
Tomita, 2016 ⁶¹	IG1	Supervised, virtual-group, home exercise program.	Group	Home	Other modern health professionals	One 60-min supervised exercise session (group) per wk over 16 wks, plus a cognitive behavioral program intensity NR. After 4 wks the patients were asked to add an unsupervised session per wk (12 sessions in all) according to a booklet with written information and images on how to perform the exercise at home, as well as safety issues.	3 virtual group sessions/wk for 24 wks	Minimal intervention
Trombetti, 2011 ⁶²	IG1	Group dance and music class sessions aiming to improve gait, balance, and function.	Group	Class outside of home	Exercise Instructor	1-hr exercise sessions were delivered twice a wk for 12 wks, reduced to once a wk for a further 40 wks (64 sessions in total over 12 mo)	One 60-min group class 1/wk for 6 mo	Usual care
Tuvemo Johnson, 2021 ⁶³	IG1	Independent, home-based Otago Exercise Programme; home visits and telephone support incorporating behavior change support.	Individual	Home	Physical therapist	Two 1-hr PT-delivered exercise sessions each wk for 1 year; encouraged participant to be physically active outside the supervised exercise sessions	Six 1-hr PT home visits over 12 mo (length NR)	No intervention
	IG2	Independent, home-based Otago Exercise Program; home visits and telephone support.	Individual	Home	Physical therapist	Planned: 72 sessions (25 to 40 min per session, 3 sessions per wk for 24 wks). At the end of the intervention, the last 34-min exercise instruction on YouTube was provided to the treatment group and they were encouraged to continue the exercise.	Six 1-hr PT home visits over 12 mo (length NR)	No intervention

Appendix F Table 3. Exercise Interventions: Intervention Components

Author, year	Arm	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Uusi-Rasi, 2015 ⁶⁴	IG1	Exercise program consisting of group and individual sessions over 24 mo with placebo.	Individual; Group	Class outside of home; Home	Physical therapist	60-min session once per wk for 6 mo	Group class 2x/wk for 12 mo, then 1x/wk for an additional 12 mo	Usual care
Voukelatos, 2007 ⁶⁵	IG1	Community-based, group tai chi classes.	Group	Class outside of home	Exercise Instructor	Each home exercise session was estimated to take 30 min and to be performed at a rate of 3 times per wk. 6 home visits, 3 telephone calls from PT. Walks were endorsed on days when no exercise was performed for a minimum of 3 times per wk.	One 60-min group class/wk for 16 wks.	Usual care
Voukelatos, 2015 ⁶⁶	IG1	Self-managed, at-home walking program with telephone coaching at 3 timepoints.	Individual	Home	Self-directed (manual or instructions given); Unclear	Each home exercise session was estimated to take 30 min and to be performed at a rate of 3 times per wk. 6 home visits, 3 telephone calls from PT. Walks were endorsed on days when no exercise was performed for a minimum of 3 times per wk.	NA, self-directed	Attention control

Abbreviations: Apr = April; CG = Control group; Descr = Description; Freq= Frequency; Hr = Hour; IG = Intervention group; min = minutes; mo = Months; NA = Not applicable; NR = Not reported; OEP = Otago Exercise Program; PT = Physical therapy; SD = Standard deviation; Sep = September; wk = Week; X = Times; yrs = Years.

Appendix F Table 4. Exercise Interventions: Falls

Author, year	FU, mo	IG n	CG n	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Barnett, 2003 ³¹	12	76	74	NR (0.61)	NR (0.95)	0.60 (0.36, 0.99)
Bruce, 2021 ³	18	3279	3223	4277 (1.04)	4309 (1.06)	0.99 (0.86, 1.14)
Campbell, 1997 ³⁴	12	116	117	88 (0.87)	152 (1.34)	0.47 (0.04, 0.90)
Chyu, 2010 ³⁵	6	26	28	39 (3)	70 (5)	0.60 (0.41, 0.89)
Delbaere 2021 ³⁶	12	254	249	NR (0.61)	NR (0.75)	0.82 (0.66, 1.02)
	24	254	249	NR (1.17)	NR (1.39)	0.84 (0.72, 0.98)
El-Khoury, 2015 ³⁷	24	352	354	533 (0.79)	640 (0.92)	0.86 (0.77, 0.96)
Fitzharris, 2010 ³⁸	18	135	137	181 (1.05)	211 (1.2)	0.87 (0.72, 1.07)
Goldberg 2019 ³⁹	12	18	16	NR	NR	1.20 (0.32, 4.50)
Korpelainen, 2006 ⁴¹	30	84	76	88 (0.42)	101 (0.53)	0.79 (0.59, 1.05)
Kronhed, 2009 ⁴³	12	31	34	19 (0.61)	27 (0.79)	0.77 (0.43, 1.39)
Lamb, 2018 ⁴⁴	6	281	137	335 (2.38)	180 (2.63)	1.20 (0.81, 1.74)
	12	281	137	661 (2.35)	417 (3.04)	0.77 (0.68, 0.87)
Lipsitz, 2019 ⁴⁵	6	77	67	26 (0.46)	16 (0.26)	1.76 (0.58, 5.31)
Logghe, 2009 ⁴⁶	12	138	131	115 (0.83)	90 (0.69)	1.21 (0.92, 1.60)
Luukinen, 2007 ⁴⁷	16	217	220	NR (1.15)	NR (1.23)	0.93 (NR)
Merom, 2016 ⁴⁸	12	275	247	257 (1.03)	187 (0.8)	1.19 (0.83, 1.71)
Miko, 2018 ⁴⁹	12	49	48	7 (0.14)	16 (0.33)	0.53 (0.22, 1.30)
Ohman, 2016 ⁵²	12	44	22	NR (1.24)	NR (1.84)	0.65 (0.42, 1.01)
Oliveira, 2019 ⁵³	6	57	52	57 (0.95)	52 (0.8)	1.30 (0.70, 2.20)
Rikkonen, 2023 ⁵⁴	24	457	457	641 (0.744)	739 (0.865)	0.86 (0.77, 0.96)
Robertson, 2001 ⁵⁵	12	121	119	80 (0.69)	109 (1.01)	0.54 (0.32, 0.90)
Rosado, 2021 ⁵⁶	6	16	19	10 (1.25)	18 (1.89)	0.66 (0.30, 1.43)
Sherrington, 2014 ⁵⁷	12	171	169	177 (1.04)	123 (0.73)	1.43 (1.07, 1.93)
Siegrist, 2016 ⁵⁸	12	222	156	291 (1.3)	367 (2.4)	0.68 (0.42, 1.22)
	24	212	144	517 (1.22)	588 (2.04)	0.63 (0.44, 0.94)
Stathi, 2022 ⁵⁹	6	335	295	194 (1.16)	180 (1.22)	0.95 (0.77, 1.16)
	12	330	300	425 (1.29)	399 (1.33)	0.97 (0.84, 1.11)
Suikkanen, 2021 ⁶⁰	12	133	127	NR (1.4)	NR (3.1)	0.47 (0.40, 0.55)

Appendix F Table 4. Exercise Interventions: Falls

Author, year	FU, mo	IG n	CG n	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Tomita, 2016 ⁶¹	6	25	26	8 (0.64)	16 (1.23)	0.52 (0.22, 1.22)
Tuvemo Johnson, 2021 ⁶³	12	58	56	79 (1.4)	36 (0.6)	2.33 (1.57, 3.46)
		61	56	70 (1.1)	36 (0.6)	1.83 (1.23, 2.74)
Uusi-Rasi, 2015 ⁶⁴	24	103	102	NR (1.21)	NR (1.18)	1.07 (0.77, 1.45)
	48	86	89	NR (1.02)	NR (1.11)	0.93 (NR)
Voukelatos, 2007 ⁶⁵	6	347	337	86 (0.5)	126 (0.75)	0.67 (0.47, 0.94)
Voukelatos, 2015 ⁶⁶	12	159	180	NR	NR	0.88 (0.60, 1.29)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix F Table 5. Exercise Interventions: Falls, Exploring Heterogeneity

Characteristic/ Component	Groups	k	IRR (95% CI)	Test of group differences, p
Group versus individual	Any group (+/- any individual)	18	0.84 (0.76, 0.94)	0.95
	Any supervised individual (+/- unsupervised individual)	8	0.86 (0.54, 1.36)	
	Unsupervised individual only	3	0.87 (0.64, 1.18)	
General PA	General PA	11	0.81 (0.60, 1.09)	0.54
	No general PA	18	0.88 (0.78, 1.00)	
Endurance	Endurance	5	0.61 (0.46, 0.81)	0.01*
	No endurance	24	0.91 (0.81, 1.03)	
Flexibility	Flexibility	5	0.69 (0.47, 1.01)	0.15
	No flexibility	24	0.89 (0.78, 1.02)	
Gait	Gait	22	0.82 (0.71, 0.95)	0.32
	No gait	7	0.95 (0.69, 1.31)	
Strength	Strength	19	0.82 (0.69, 0.97)	0.42
	No strength	10	0.90 (0.74, 1.09)	
3D	3D	6	0.91 (0.64, 1.29)	0.56
	No 3D	23	0.83 (0.72, 0.96)	
Cognitive task exercises	Cognitive task exercises	2	0.77 (0.03, 21.10)	0.77
	No cognitive tasks	27	0.85 (0.75, 0.97)	
Behavior change component	Behavior change	8	0.93 (0.72, 1.20)	0.35
	No behavior change	21	0.82 (0.70, 0.96)	
ED/hospital recruitment	ED/hospital	2	1.11 (0.02, 52.5)	0.35
	Other	27	0.83 (0.73, 0.94)	
Fall risk	Selected for fall risk	17	0.83 (0.69, 1.01)	0.97
	Unselected for fall risk	12	0.84 (0.77, 0.91)	
Quality	Good	4	0.90 (0.68, 1.18)	0.53
	Fair	25	0.84 (0.72, 0.97)	
Conducted in the US	US	3	0.69 (0.20, 2.39)	0.37
	Non-US	26	0.86 (0.76, 0.98)	

* Not statistically significant after adjusted for multiple comparisons.

Note: Also visually inspected plots sorted by intervention duration, publication year, mean age, followup, and control group fall event rate.

Abbreviations: 3D = Three dimensional; CI = Confidence interval; ED = Emergency department; IRR = Incidence rate ratio; K = Number of studies; PA = Physical activity; US = United States.

Appendix F Table 6. Exercise Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Barnett, 2003 ³¹	Person with 1+ falls	12	27/76 (35.5)	37/74 (50)	0.71 (0.49, 1.04)
	Person with 2+ falls	12	8/76 (10.5)	18/74 (24.3)	0.44 (0.21, 0.96)
Bruce, 2021 ³	Person with 1+ falls	18	1277/3279 (38.9)	1276/3223 (39.6)	0.98 (0.92, 1.06)
	Person with 2+ falls	18	687/3279 (21)	715/3223 (22.2)	0.94 (0.85, 1.05)
Buchner, 1997 ³²	Person with 1+ falls	12	32/75 (42.7)	18/30 (60)	0.71 (0.48, 1.05)
Callisaya, 2021 ³³	Person with 1+ falls	6	13/44 (29.5)	11/49 (22.4)	1.32 (0.66, 2.63)
	Person with 2+ falls	6	6/44 (13.6)	4/49 (8.2)	1.67 (0.50, 5.53)
Campbell, 1997 ³⁴	Person with 1+ falls	12	53/116 (45.7)	62/117 (53)	0.86 (0.66, 1.12)
	Person with 2+ falls	12	22/116 (19)	34/117 (29.1)	0.65 (0.41, 1.05)
Delbaere 2021 ³⁶	Person with 1+ falls	12	88/254 (34.6)	100/249 (40.2)	0.90 (0.72, 1.12)
	Person with 1+ falls	24	NR/254 (NR)	NR/249 (NR)	0.87 (0.74, 1.02)
El-Khoury, 2015 ³⁷	Person with 1+ falls	24	189/352 (53.7)	222/354 (62.7)	0.86 (0.75, 0.97)
Fitzharris, 2010 ³⁸	Person with 1+ falls	18	76/135 (56.3)	87/137 (63.5)	0.89 (0.73, 1.08)
	Person with 2+ falls	18	40/135 (29.6)	45/137 (32.8)	0.90 (0.63, 1.28)
	Person with 3+ falls	18	30/135 (22.2)	25/137 (18.2)	1.22 (0.76, 1.96)
Kovacs, 2013 ⁴²	Person with 1+ falls	6	6/36 (16.7)	15/36 (41.7)	0.40 (0.17, 0.92)
Lamb, 2018 ⁴⁴	Person with 1+ falls	6	93/281 (33.1)	45/135 (33.3)	0.99 (0.74, 1.33)
Lipsitz, 2019 ⁴⁵	Person with 1+ falls	6	21/77 (27.3)	11/67 (16.4)	1.66 (0.73, 3.78)
Logghe, 2009 ⁴⁶	Person with 1+ falls	12	58/138 (42)	59/131 (45)	0.93 (0.71, 1.23)
Luukinen, 2007 ⁴⁷	Person with 1+ falls	16	126/217 (58.1)	136/220 (61.8)	0.94 (0.81, 1.10)
	Person with 3+ falls	16	38/217 (17.5)	43/220 (19.5)	0.90 (0.60, 1.33)
Miko, 2018 ⁴⁹	Person with 1+ falls	12	6/49 (12.2)	11/48 (22.9)	0.53 (0.21, 1.33)
Morgan, 2004 ⁵⁰	Person with 1+ falls	12	34/119 (28.6)	34/110 (30.9)	0.92 (0.62, 1.38)
Ng, 2015 ⁵¹	Person with 1+ falls	6	3/48 (6.3)	5/50 (10)	0.63 (0.16, 2.47)
	Person with 1+ falls	12	3/48 (6.3)	5/50 (10)	0.63 (0.16, 2.47)
Oliveira, 2019 ⁵³	Person with 1+ falls	6	27/60 (45)	27/64 (42.2)	1.00 (0.70, 1.50)
Rikkonen, 2023 ⁵⁴	Person with 1+ falls	24	268/457 (58.6)	278/457 (60.8)	0.96 (0.87, 1.07)
Sherrington, 2014 ⁵⁷	Person with 1+ falls	12	98/171 (57.3)	70/169 (41.4)	1.38 (1.11, 1.73)
Siegrist, 2016 ⁵⁸	Person with 1+ falls	12	93/222 (41.9)	77/156 (49.4)	0.85 (0.59, 1.22)
Tomita, 2016 ⁶¹	Person with 1+ falls	9	4/25 (21)	5/25 (27)	0.80 (0.24, 2.64)
Trombetti, 2011 ⁶²	Person with 1+ falls	6	19/66 (28.8)	32/68 (47.1)	0.69 (0.44, 1.07)

Appendix F Table 6. Exercise Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
	Person with 2+ falls	6	3/66 (4.5)	16/68 (23.5)	0.21 (0.06, 0.67)
Tuvemo Johnson, 2021 ⁶³	Person with 1+ falls	12 (IG1)	33/58 (56.9)	19/56 (33.9)	1.68 (1.09, 2.57)
		12 (IG2)	22/61 (36.1)	19/56 (33.9)	1.06 (0.65, 1.74)
		24 (IG1)	24/47 (51.1)	30/51 (58.8)	0.87 (0.60, 1.25)
		24 (IG2)	21/44 (47.7)	30/51 (58.8)	0.81 (0.55, 1.19)
	Person with 2+ falls	12 (IG1)	14/58 (24.1)	10/56 (17.9)	1.35 (0.66, 2.79)
		12 (IG2)	10/60 (16.7)	10/56 (17.9)	0.93 (0.42, 2.07)
		24 (IG1)	13/47 (27.7)	15/51 (29.4)	0.94 (0.50, 1.76)
		24 (IG2)	8/44 (18.2)	15/51 (29.4)	0.62 (0.29, 1.32)
Uusi-Rasi, 2015 ⁶⁴	Person with 1+ falls	24	NR/103 (NR)	NR/102 (NR)	HR 0.93 (0.66, 1.31)
		48	NR/86 (NR)	NR/89 (NR)	HR 1.01 (0.74, 1.39)
	Person with 2+ falls	24	NR/103 (NR)	NR/102 (NR)	HR 1.14 (0.76, 1.71)
Voukelatos, 2007 ⁶⁵	Person with 1+ falls	6	71/347 (20.5)	81/337 (24)	0.86 (0.65, 1.14)
	Person with 2+ falls	6	15/347 (4.3)	27/337 (8)	0.54 (0.28, 0.96)
Voukelatos, 2015 ⁶⁶	Person with 1+ falls	12	54/159 (34)	68/180 (37.8)	0.90 (0.67, 1.20)
	Person with 2+ falls	12	25/159 (15.7)	28/180 (15.6)	1.01 (0.61, 1.67)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; HR = Hazard ratio; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; RR = Relative risk.

Appendix F Table 7. Exercise Interventions: People With a Fall, Exploring Heterogeneity

Characteristic/ Component	Groups	k	RR (95% CI)	Test of group differences, p
Group versus individual	Any group (+/- any individual)	16	0.90 (0.85, 0.96)	0.80
	Any supervised individual (+/- unsupervised individual)	5	0.97 (0.70, 1.36)	
	Unsupervised individual only	4	0.90 (0.77, 1.05)	
General PA	General PA	10	0.95 (0.89, 1.01)	0.60
	No general PA	15	0.92 (0.81, 1.03)	
Endurance	Endurance	4	0.84 (0.66, 1.08)	0.23
	No endurance	21	0.93 (0.87, 1.00)	
Flexibility	Flexibility	6	0.88 (0.80, 0.97)	0.30
	No flexibility	19	0.94 (0.86, 1.02)	
Gait	Gait	20	0.91 (0.85, 0.99)	0.84
	No gait	5	0.93 (0.79, 1.09)	
Strength	Strength	16	0.92 (0.82, 1.03)	0.55
	No strength	9	0.89 (0.83, 0.95)	
3D	3D	4	0.96 (0.84, 1.09)	0.42
	No 3D	21	0.91 (0.84, 0.98)	
Cognitive task exercises	Cognitive task exercises	1	1.32 (0.66, 2.63)	0.31
	No cognitive tasks	24	0.92 (0.86, 0.98)	
Behavior change component	Behavior change	6	1.00 (0.81, 1.23)	0.31
	No behavior change	19	0.91 (0.86, 0.96)	
ED/hospital recruitment	ED/hospital	1	1.38 (1.11, 1.72)	0.00
	Other	24	0.91 (0.87, 0.96)	
Fall risk	Selected for fall risk	13	0.92 (0.82, 1.03)	1.00
	Unselected for fall risk	12	0.92 (0.85, 0.99)	
Quality	Good	4	0.92 (0.72, 1.16)	0.92
	Fair	21	0.92 (0.85, 1.00)	
Conducted in the US	US	4	0.88 (0.55, 1.41)	0.73
	Non-US	21	0.93 (0.87, 0.99)	

Abbreviations: 3D = Three dimensional; CI = Confidence interval; ED = Emergency department; RR = Relative risk; K = Number of studies; PA = Physical activity; US = United States.

Appendix F Table 8. Exercise Interventions: Injurious Falls

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Barnett, 2003 ³¹	Fall resulting in injuries	12	NR (0.4)	NR (0.54)	0.66 (0.38, 1.15)
Delbaere 2021 ³⁶	Fall resulting in injuries	24	NR (0.71)	NR (0.88)	0.80 (0.66, 0.98)
El-Khoury, 2015 ³⁷	Fall resulting in injuries	24	NR (0.45)	NR (0.56)	0.80 (NR)
	Fall resulting in serious injuries	24	68 (0.1)	87 (0.12)	0.79 (0.57, 1.08)
Fitzharris, 2010 ³⁸	Fall resulting in injuries	18	101 (0.58)	115 (0.65)	0.89 (0.68, 1.17)
	Fall resulting in medical care	18	16 (0.09)	18 (0.1)	0.91 (0.46, 1.79)
Karinkanta, 2015 ⁴⁰	Fall resulting in injuries	60	14 (0.07)	22 (0.12)	0.49 (0.25, 0.98)
Luukinen, 2007 ⁴⁷	Fall-related injuries, serious	16	NR (0.18)	NR (0.19)	0.95 (NR)
Oliveira, 2019 ⁵³	Fall resulting in injuries	6	24 (0.84)	33 (1.27)	0.66 (0.39, 1.12)
	Fall resulting in medical care	6	5 (0.18)	7 (0.27)	0.65 (0.21, 2.05)
Rikkonen, 2023 ⁵⁴	Fall-related injuries	24	359 (0.393)	380 (0.416)	0.94 (0.182, 1.09)
	Fall-related injuries, moderate	24	335 (NR)	343 (NR)	0.59 (0.36, 0.99)
	Fall-related injuries, serious	24	24 (NR)	37 (NR)	NR (NR)
	Fall-related medical attention	24	78 (NR)	93 (NR)	0.83 (0.61, 1.12)
Robertson, 2001 ⁵⁵	Fall resulting in injuries	12	42 (0.36)	49 (0.45)	0.80 (0.53, 1.20)
	Fall resulting in medical care	12	18 (0.15)	26 (0.22)	0.68 (0.37, 1.24)
	Fall resulting in serious injuries	12	2 (0.02)	9 (0.08)	0.22 (0.05, 1.01)
Sherrington, 2014 ⁵⁷	Fall resulting in medical care	12	61 (0.36)	53 (0.31)	1.14 (0.76, 1.73)
Siegrist, 2016 ⁵⁸	Fall-related injuries	12	NR (NR)	NR (NR)	0.79 (0.49, 1.33)
		24	188 (0.44)	197 (0.68)	0.69 (0.47, 0.97)
Tuvemo Johnson, 2021 ⁶³	Fall-related injuries	12 (IG1)	36 (0.62)	19 (0.34)	1.83 (1.05, 3.19)
		12 (IG2)	28 (0.46)	19 (0.34)	1.35 (0.76, 2.42)
	Fall-related injuries, minor	12 (IG1)	33 (0.57)	16 (0.29)	1.99 (1.10, 3.62)
		12 (IG2)	27 (0.44)	16 (0.29)	1.55 (0.83, 2.88)
	Fall-related injuries, serious	12 (IG1)	3 (0.05)	3 (0.05)	0.97 (0.19, 4.78)
		12 (IG2)	1 (0.02)	3 (0.05)	0.31 (0.03, 2.94)
Uusi-Rasi, 2015 ⁶⁴	Fall resulting in injuries	24	NR (0.06)	NR (0.13)	0.46 (0.22, 0.95)
		48	NR (0.09)	NR (0.19)	0.46 (NR)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix F Table 9. Exercise Interventions: Fractures

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Bruce, 2021 ³	Fracture	18	152 (0.03)	133 (0.03)	1.20 (0.91, 1.59)
	Hip fracture	18	26 (0.01)	33 (0.01)	0.77 (0.43, 1.41)
Karinkanta, 2015 ⁴⁰	Fall-related fracture	60	NR	NR	0.26 (0.07, 0.97)
Korpelainen, 2006 ⁴¹	Fall-related fracture	30	6 (0.03)	16 (0.08)	0.34 (0.13, 0.87)
		85	17 (0)	23 (0)	0.68 (0.34, 1.32)
	Fall-related hip fracture	85	0.5 (0)	5 (0.01)	0.09 (0.00, 1.66)
Kronhed, 2009 ⁴³	Fall-related fracture	12	0.5 (0.02)	0.5 (0.01)	1.10 (0.02, 55.28)
Lamb, 2018 ⁴⁴	Fall-related fracture	6	4 (0.03)	1 (0.01)	1.95 (0.22, 17.45)
		12	11 (0.04)	5 (0.04)	1.07 (0.37, 3.09)
Ohman, 2016 ⁵²	Fall-related fracture	12	2 (0.05)	2 (0.09)	0.50 (0.07, 3.55)
	Hip fracture	12	0.5 (0.01)	1 (0.05)	0.25 (0.01, 7.45)
Rikkonen, 2023 ⁵⁴	Fall-related fracture	24	28 (0.031)	45 (0.049)	0.62 (0.39, 0.99)
	Fall-related hip fracture	24	5 (NR)	6 (NR)	NR
Sherrington, 2014 ⁵⁷	Fall-related fracture	12	14 (0.08)	15 (0.09)	0.92 (0.45, 1.91)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix F Table 10. Exercise Interventions: People With a Fall Resulting in Injuries or Medical Care

Author, year	Outcomes	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Barnett, 2003 ³¹	Injurious fallers	12	22/76 (28.9)	28/74 (37.8)	0.77 (0.48, 1.21)
Campbell, 1997 ³⁴	Injurious fallers	12	27/103 (26.2)	43/110 (39.1)	0.67 (0.45, 1.00)
Delbaere 2021 ³⁶	Injurious fallers	24	95/254 (37.4)	115/249 (46.2)	0.87 (0.71, 1.06)
El-Khoury, 2015 ³⁷	Injurious fallers	24	170/352 (48.3)	189/354 (53.4)	0.90 (0.78, 1.05)
Karinkanta, 2015 ⁴⁰	Injurious fallers	60	11/37 (29.7)	17/35 (48.6)	0.61 (0.34, 1.12)
Rikkonen, 2023 ⁵⁴	Injurious fallers	24	207/457 (45.3)	195/457 (42.7)	1.06 (0.92, 1.23)
Siegrist, 2016 ⁵⁸	Injurious fallers	12	63/222 (28.4)	59/156 (37.8)	0.75 (0.47, 1.20)
Stathi, 2022 ⁵⁹	Injurious fallers	6	43/328 (13.1)	40/291 (13.7)	0.95 (0.64, 1.42)
Tuvemo Johnson, 2021 ⁶³	Injurious fallers	12 (IG1)	25/58 (43.1)	12/56 (21.4)	2.01 (1.12, 3.60)
		12 (IG2)	16/61 (26.2)	12/56 (21.4)	1.22 (0.64, 2.36)
Uusi-Rasi, 2015 ⁶⁴	Injurious fallers	24	NR/103 (NR)	NR/102 (NR)	HR 0.47 (0.23, 0.99)
		48	NR/86 (NR)	NR/89 (NR)	HR 0.46 (0.28, 0.76)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; RR = Relative risk.

Appendix F Table 11. Exercise Interventions: People With a Fall-Related Fracture

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Bruce, 2021 ³	Person with fracture	18	126/3279 (3.8)	110/3223 (3.4)	1.13 (0.84, 1.51)
Korpelainen, 2006 ⁴¹	Person with fall-related fracture	30	6/84 (7.1)	15/76 (19.7)	0.36 (0.15, 0.89)
Lamb, 2018 ⁴⁴	Person with fall-related fracture	6	4/281 (1.4)	1/137 (0.7)	1.95 (0.22, 17.28)
Rikkonen, 2023 ⁵⁴	Person with fall-related fracture	24	24/457 (5.2)	39/457 (8.5)	NR (NR)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; RR = Relative risk.

Appendix F Table 12. Exercise Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Barnett, 2003 ³¹	12	0.5/83 (0.6)	3/80 (3.8)	0.16 (0.01, 3.16)
Bruce, 2021 ³	18	89/3279 (2.7)	93/3223 (2.9)	0.94 (0.67, 1.31)
Campbell, 1997 ³⁴	12	2/116 (1.7)	4/117 (3.4)	0.50 (0.09, 2.70)
El-Khoury, 2015 ³⁷	12	2/352 (0.6)	3/354 (.8)	0.67 (0.11, 3.99)
	24	5/352 (1.4)	6/354 (1.7)	0.84 (0.26, 2.72)
Karinkanta, 2015 ⁴⁰	60	0.5/37 (1.4)	1/35 (2.9)	0.47 (0.02, 13.66)
Korpelainen, 2006 ⁴¹	85	1/84 (1.2)	8/76 (10.5)	0.11 (0.01, 0.85)
Lamb, 2018 ⁴⁴	12	13/329 (4)	5/165 (3)	1.30 (0.47, 3.60)
Luukinen, 2007 ⁴⁷	16	31/217 (14.3)	35/220 (15.9)	0.90 (0.58, 1.40)
Ng, 2015 ⁵¹	12	0.5/48 (1)	1/50 (2)	0.52 (0.02, 15.17)
Robertson, 2001 ⁵⁵	12	1/121 (0.8)	6/119 (5)	0.16 (0.02, 1.34)
Sherrington, 2014 ⁵⁷	12	10/171 (5.8)	9/169 (5.3)	1.10 (0.46, 2.63)
Siegrist, 2016 ⁵⁸	12	8/222 (3.6)	10/156 (6.4)	0.56 (0.13, 2.46)
	24	11/222 (5)	16/156 (10.3)	0.48 (0.14, 1.61)
Suikkanen, 2021 ⁶⁰	12	5/150 (3.3)	10/149 (6.7)	0.50 (0.17, 1.42)
	24	18/150 (12)	19/149 (12.8)	0.94 (0.51, 1.72)
Trombetti, 2011 ⁶²	12	1/66 (1.5)	1/68 (1.5)	1.03 (0.07, 16.13)
Uusi-Rasi, 2015 ⁶⁴	24	0.5/103 (0.5)	2/102 (2)	0.25 (0.01, 5.42)
	48	0.5/103 (0.5)	2/102 (2)	0.25 (0.01, 5.42)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix F Table 13. Exercise Interventions: People With a Fall Resulting in Hospitalization/ED Visit or People With Institutionalization

Outcome	Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
People with a fall resulting in hospitalization or ED visit	Ng, 2015 ⁵¹	6	1/48 (2.1)	2/50 (4)	0.52 (0.05, 5.56)
		12	3/48 (6.3)	2/50 (4)	1.56 (0.27, 8.95)
People with institutionalization	Kovacs, 2013 ⁴²	6	0/36 (0)	1/36 (2.8)	0.50 (0.02, 14.44)
	Suikkanen, 2021 ⁶⁰	24	11/150 (7.3)	13/149 (8.7)	0.84 (0.39, 1.82)
	Trombetti, 2011 ⁶²	12	0/66 (0)	1/68 (1.5)	0.52 (0.02, 15.10)

Abbreviations: CG = Control group; CI = Confidence interval; ED =Emergency department; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix F Table 14. Exercise Interventions: IADLs

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Buchner, 1997 ³²	IADL (modified Lawton and Brody)	0	24	29	4.6 (1.0)	4.6 (0.7)	NA	NA	NA
		6	24	29	NR	NR	0.1 (0.4)	0.2 (0.7)	NR
		9	22	NR	NR	NR	-0.1 (0.4)	NR	NR
Goldberg, 2019 ³⁹	IADL (Nottingham Extended Activities of Daily Living)	0	17	10	16 (5)	16 (4)	NA	NA	NA
		12	17	10	15 (5)	15 (6)	NR	NR	NR
Delbaere 2021 ³⁶	IADL (WHO-DAS)	0	254	249	Median 4.1 (IQR 0, 9.3)	Median 6.3 (IQR 0, 12.5)	NA	NA	NA
		12	254	249	Median 6.3 (IQR 0, 13.4)	Median 8.8 (IQR, 1.45 to 16.2)	NR	NR	-0.2 (-2.7, 2.3)
		24	254	249	Median 7.7 (IQR 0.4, 15)	Median 6.3 (IQR 0, 16.5)	NR	NR	0.2 (-2.0, 2.5)
Suikkanen, 2021 ⁶⁰	IADL (Lawton and Brody)	0	150	149	23 (5)	23 (6)	NA	NA	NA
		12	NR	NR	NR	NR	-1.4 (95% CI, -1.9, -0.9)	-2.1 (95% CI, -2.6, -1.6)	NR

Abbreviations: BL = Baseline; CG = Control group; IADL = Instrumental activities of daily living; IG = Intervention group; IQR = Interquartile range; Mo = Months; N = Number of participants; NA = Not applicable; NR = Not reported; SD = Standard deviation; Time = Timepoint; WHO-DAS = World Health Organization - Disability Assessment Schedule.

Appendix F Table 15. Exercise Interventions: Quality of Life

Author, year	Instrument	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Bruce, 2021 ³	SF-12 Mental	0	3279	3223	50.3 (8.9)	50.2 (9.3)	NA	NA	NA
		18	2214	2234	50.3 (9.1)	50.0 (9.0)	NR	NR	0.02 (-0.41, 0.45)
	SF-12 Physical	0	3279	3223	50.5 (10.3)	50.3 (10.2)	NA	NA	NA
		18	2214	2234	50.4 (10.0)	49.9 (10.0)	NR	NR	0.24 (-0.15, 0.64)
Chyu, 2010 ³⁵	SF-36 Mental Component	0	30	31	51.82 (11.2)	55.01 (8.30)	NA	NA	NA
		6	26	28	55.03 (8.76)	55.30 (6.07)	NR	NR	NR
	SF-36 Physical Component	0	30	31	43.29 (9.02)	44.60 (10.06)	NA	NA	NA
		6	26	28	47.09 (7.07)	45.17 (9.39)	NR	NR	NR
Delbaere 2021 ³⁶	EQ-5D VAS	0	254	249	Median 90 (IQR 82.5, 97.5)	Median 85 (IQR 77.5, 92.5)	NA	NA	NA
		12	254	249	Median 89 (IQR 83.5, 94.5)	Median 83 (73.5, 92.5)	NR	NR	0 (-4, 4)
		24	254	249	Median 88 (IQR 81, 95)	Median 80 (70, 90)	NR	NR	1 (-4, 6)
Goldberg 2019 ³⁹	EQ-5D-3L	0	16	13	0.8 (0.2)	0.8 (0.2)	NA	NA	NA
		12	16	13	0.8 (0.2)	0.7 (0.2)	NR	NR	NR
Lamb, 2018 ⁴⁴	EQ-5D-3L	0	278	137	0.84 (0.19)	0.86 (0.16)	NA	NA	NA
		6	292	139	0.80 (0.21)	0.83 (0.21)	NR	NR	NR
		12	261	131	0.81 (0.22)	0.82 (0.25)	NR	NR	NR
	QoL-AD	0	278	137	39.1 (5.4)	39.4 (5.0)	NA	NA	NA
		6	263	124	38.9 (6.1)	39.0 (5.9)	NR	NR	NR
		12	237	119	38.4 (5.8)	39.1 (5.7)	NR	NR	NR
Lipsitz, 2019 ⁴⁵	SF-12 Mental	0	93	87	51.8 (9.8)	52.3 (10.0)	NA	NA	NA
		6	93	87	NR	NR	-1.81 (SE 1.16)	-0.71 (SE 1.19)	-1.104 (-4.41, 2.21)
	SF-12 Physical	0	93	87	40.6 (10.7)	40.8 (10.9)	NA	NA	NA
		6	93	87	NR	NR	0.22 (SE 0.99)	-0.64 (SE 1.04)	0.854 (-2.00, 3.71)
Merom, 2016 ⁴⁸	SF-12 Mental	0	275	247	52.1 (8.4)	51.9 (7.6)	NA	NA	NA

Appendix F Table 15. Exercise Interventions: Quality of Life

Author, year	Instrument	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
	SF-12 Physical	12	275	247	49.4 (10.8)	50.3 (9.5)	NR	NR	-0.9 (-2.9, 2.0)
		0	275	247	43.0 (8.8)	44.3 (8.7)	NA	NA	NA
		12	275	247	39.8 (10.9)	40.8 (10.8)	NR	NR	0.0 (1.8, 1.9)
Oliveira, 2019 ⁵³	EQ-5D-3L	0	64	67	0.8 (0.2)	0.8 (0.1)	NA	NA	NA
		6	54	55	0.8 (0.1)	0.8 (0.1)	NR	NR	0.02 (-0.01, 0.05)
		12	46	52	0.8 (0.1)	0.8 (0.1)	NR	NR	-0.01 (-0.04, 0.02)
Sherrington, 2014 ⁵⁷	SF-12 Mental	0	171	169	54.71 (6.49)	54.70 (6.79)	NA	NA	NA
		12	157	155	55.87 (5.02)	55.19 (7.09)	NR	NR	NR
	SF-12 Physical	0	171	69	37.44 (8.90)	38.17 (8.36)	NR	NR	NR
		12	157	155	40.37 (8.29)	39.27 (9.26)	NR	NR	NR
Stathi, 2022 ⁵⁹	EuroQol EQ-5D	0	357	352	0.69 (0.16)	0.68 (0.17)	NA	NA	NA
		6	346	299	0.68 (0.15)	0.70 (0.15)	NR	NR	NR
		12	337	293	0.69 (0.14)	0.70 (0.14)	NR	NR	NR
		24	330	302	0.69 (0.16)	0.67 (0.16)	NR	NR	NR
	SF-36 Mental Component	0	353	392	54.55 (8.33)	53.77 (8.66)	NA	NA	NA
		6	342	293	54.41 (6.88)	54.19 (7.46)	NR	NR	NR
		12	334	293	53.95 (7.81)	54.52 (7.52)	NR	NR	NR
		24	306	295	54.33 (9.18)	54.73 (7.64)	NR	NR	NR
	SF-36 Physical Component	0	353	392	29.7 (10.96)	30.01 (10.61)	NA	NA	NA
		6	342	293	32.75 (8.42)	30.64 (8.68)	NR	NR	NR
		12	334	293	32.25 (8.23)	29.66 (8.53)	NR	NR	NR
		24	306	295	30.84 (10.04)	29.38 (9.39)	NR	NR	NR
Tuvemo Johnson, 2021 ⁶³	EuroQol EQ-5D	0 (IG1)	42	44	0.70 (0.20)	0.69 (0.21)	NA	NA	NA
		0 (IG2)	38	44	0.74 (0.09)	0.69 (0.21)	NA	NA	NA
		24 (IG1)	42	44	0.70 (0.22)	0.66 (0.21)	0.00	0.03	NR
		24 (IG2)	38	44	0.70 (0.21)	0.66 (0.21)	0.03	0.03	NR
	EQ-5D VAS	0 (IG1)	42	44	66 (16)	62 (15)	NA	NA	NA
		0 (IG2)	38	44	65 (14)	62 (15)	NA	NA	NA

Appendix F Table 15. Exercise Interventions: Quality of Life

Author, year	Instrument	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
		24 (IG1)	42	44	65 (15)	58 (19)	0.69	3.75	NR
		24 (IG2)	38	44	64 (20)	58 (19)	0.79	3.75	NR
Uusi-Rasi, 2015 ⁶⁴	Leipad QOL	0	103	102	15.8 (7.7)	14.9 (7.02)	NA	NA	NA
		12	91	95		()	% change -0.2 (95% CI -10.4, 11.3)	% change -1.8 (95% CI -12.1, 9.7)	NR
		24	91	95		()	% change 2.4 (95% CI -8.6, 14.6)	% change -0.9 (95% CI -11.7, 11.2)	NR
Voukelatos, 2015 ⁶⁶	Australian QoL	0	191	194	0.81 (95% CI, 0.79, 0.83)	0.81 (95% CI 0.79, 0.83)	NA	NA	NA
		6	144	169	0.84 (95% CI 0.82, 0.86)	0.83 (95% CI 0.81, 0.85)	NR	NR	NR

Abbreviations: AD = Alzheimer’s Disease; ADL = Activities of daily living; BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D/3L = EuroQol instrument 5 Dimensions/3 Level Version; IADL = Instrumental activities of daily living; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; SE = Standard error; SF = Short Form Survey; Time = Timepoint; VAS = Visual analogue scale.

Appendix F Table 16. Exercise Interventions: Harms

Author, year	Outcome	FU, mo	IG n/n	CG n/n
Bruce, 2021 ³	AE	18	1/3279	NR
	Serious AE directly related to the intervention	18	0/3279	NR
Callisaya, 2021 ³³	AEs during intervention	6	7*/44	NR
	Fall during intervention	6	1*/44	NR
	Serious AE directly related to the intervention	6	0/44	NR
Delbaere 2021 ³⁶	Fall during intervention	24	5/254	NR
El-Khoury, 2015 ³⁷	AE	24	7*/352	NR
	AEs during intervention	24	4*/352	NR
	Fracture during intervention	24	1/352	NR
Karinkanta, 2015 ⁴⁰	Fall during intervention	12	2/37	NR
Lamb, 2018 ⁴⁴	AE	12	31/281	0/137
	AEs during intervention	12	15/281	NR
	SAE	12	4/281	0/137
Lipsitz, 2019 ⁴⁵	AE	6	32/77	11/67
	Arthralgia	6	5/77	0/67
	Musculoskeletal discomfort	6	18/77	1/67
	Nervous system disorders	6	6/77	0/67
	Other musculoskeletal and connective tissue disorders	6	29/77	4/67
Merom, 2016 ⁴⁸	AEs during intervention	12	0/275	NR
Miko, 2018 ⁴⁹	AEs during intervention	12	0/49	NR
Ng, 2015 ⁵¹	AEs during intervention - musculoskeletal complaints	6	2/48	NR
Oliveira, 2019 ⁵³	AEs during intervention	6	5/60	NR
Rikkonen, 2023 ⁵⁴	SAE	24	0/457	0/457
	AEs during intervention - increased joint pain	24	14/457	NR
	AEs during intervention - pre-syncope symptoms	24	2/457	NR

Appendix F Table 16. Exercise Interventions: Harms

Author, year	Outcome	FU, mo	IG n/n	CG n/n
	AEs during the intervention - angina pectoris-like chest pain	24	2/457	NR
Sherrington, 2014 ⁵⁷	AEs during intervention	12	12/171	NR
Siegrist, 2016 ⁵⁸	AEs during intervention	12	0/222	NR
Stathi, 2022 ⁵⁹	SAE	24	59/334	34/294
	Serious AE directly related to the intervention	24	1/334	NR
Suikkanen, 2021 ⁶⁰	AEs during intervention - musculoskeletal complaints	12	87/150	NR
	Fall during intervention	12	17*/150	NR
	Injurious fall during intervention	12	1/150	NR
Trombetti, 2011 ⁶²	AE	12	0/66	0/68
	AEs during intervention	12	0/66	NR
Tuvemo Johnson, 2021 ⁶³	Fall during intervention	12 (IG1)	1/58	NR
	Fall during intervention	12 (IG2)	0/61	NR
Uusi-Rasi, 2015 ⁶⁴	AEs during intervention	24	3/103	NR
	Back pain	24	4/103	NR
	Fall during intervention	24	2/103	NR
	Musculoskeletal discomfort	24	22/103	1/102
	Serious AE directly related to the intervention	24	0/103	NR

* Events, not people.

Abbreviations: AE = Adverse event; CG = Control group; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; SAE = Serious adverse event.

Appendix G Table 1. Exercise + Education Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Intervention component(s)	Target population	Recruitment setting	N rand	Age, mean (range)	Female, %	Race/ethnicity, %
Daly, 2020 ⁶⁷ Strong Bones for Life study (Osteo-cise)	Good	AUS	Exercise + Edu + Behavior change support	Older adults age ≥60 years with osteopenia or at increased falls risk.	Clinical, NOS or varied; Community-based; Other	162	67 (≥60)	73	NR
Sherrington, 2020 ⁶⁸ Recovery Exercises and STepping On after R fracturE (RESTORE)	Good	AUS	Exercise + Edu + Behavior change support	Older adults age ≥60 years with fall-related lower limb or pelvic fracture in the previous 2 years.	Community-based; ED; Hospital	336	78 (59-99)	76	NR
Shumway-Cook, 2007 ⁶⁹	Good	US	Exercise + Edu + PC communication	Older adults age ≥65 years.	Community-based	453	76 (≥65)	77	White: 95
Smulders, 2010 ⁷⁰	Fair	NLD	Exercise + Edu	Older adults age ≥65 years with osteoporosis and a fall history.	Community-based; Hospital; Other	96	71 (≥65)	94	NR

Abbreviations: AUS = Australia; Edu = Education; ED = Emergency department; N = Number of participants; NLD = Netherlands; NOS = Not otherwise specified; NR = Not reported; PC = Primary care; QR = Quality rating; Rand = Randomized; US = United States.

Appendix G Table 2. Exercise + Education Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Daly, 2020 ⁶⁷ Strong Bones for Life study (Osteo-cise)	100	Diagnosis of osteopenia (T-score between -1.0 and -2.5 SD) at the total hip, femoral neck, or lumbar spine or have a total risk score of ≥ 3 points on a short falls and fracture risk questionnaire.	NR	NR	NR	NR
Sherrington, 2020 ⁶⁸ Recovery Exercises and STEpping On afterR fracturE (RESTORE)	100	Fall-related lower limb or pelvic fracture in the 24 mo before recruitment.	NR	Mean # of comorbidities: 8	Mean # of meds: 6.5	Mean cognition score, SPMSW: 0.45
Shumway-Cook, 2007 ⁶⁹	27	Fall in the previous 3 mo.	NR	≥ 2 chronic conditions, %: 86.5	Taking ≥ 4 meds, %: 63	Mental health examination, no errors, %: 60.5
Smulders, 2010 ⁷⁰	100	Osteoporosis and ≥ 1 fall in the previous 12 mo.	NR	Mean # of comorbid conditions: 1.2	Mean # of meds used: 2.5	NR

Abbreviations: Cog = Cognitive; Meds = medications; Mo = Months; NR = Not reported; SD = Standard deviation; SPMSW = Short Portable Mental Status Questionnaire.

Appendix G Table 3. Exercise + Education Interventions: Intervention Components

Author, year	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Daly, 2020 ⁶⁷	Exercise program with behavioral change and education components	Group	Class outside of home	Exercise Instructor	Group exercise program 3x/wk for 18 mo plus behavioral modification support/strategies and social support; 3 educational seminars	60-min group classes 3 days/wk for 18 mo	Minimal intervention
Sherrington, 2020 ⁶⁸	Self-managed, home exercise program with behavior change support plus fall prevention education based on the Stepping On program.	Individual; Group	Class outside of home; Home	Physical therapist	Participants could receive up to 10 visits with the prescribing PT in the 12-mo study period, to prescribe and modify a home exercise program. Participants were asked to undertake a 20- to 30-min program of lower limb balance and strengthening exercises at least three times per wk at home for 12 mo. Participants randomized to the intervention group received an average of 8.4 (SD, 2.9; median, 10; range, 0 to 13) home visits and 4.3 (SD, 1.9; median, 5; range, 0 to 10) telephone calls from the study physiotherapists.	Home visits up to 10x over 12 mo (duration NR)	Usual care
Shumway-Cook, 2007 ⁶⁹	Multifaceted intervention including exercise, education, and sending results of comprehensive falls risk assessment to PCP.	Group	Class outside of home	Exercise Instructor; Nurse	Three 1-hr exercise classes per wk; one 1-hr education class per month	1-hr group exercise classes 3x/wk for up to 12 mo	Minimal intervention
Smulders, 2010 ⁷⁰	Multicomponent exercise intervention, including education and fall techniques	Group	Hospital	Occupational therapist; Physical therapist	11 sessions during 5.5 wks	11 group sessions over 5.5 wks	Usual care

Abbreviations: CG = Control group; Descr = Description; Freq= Frequency; Hr = Hour; IG = Intervention group; Min = Minutes; Mo = Months; NA = Not applicable; NR = Not reported; PCP = Primary care physician; PT = Physical therapy; SD = Standard deviation; Wk = Week; X = Times; Yrs = Years.

Appendix G Table 4. Exercise + Education Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Daly, 2020 ⁶⁷	12	46 (0.57)	34 (0.42)	1.22 (0.72, 2.04)
	18	59 (0.00)	53 (0.00)	1.08 (0.70, 1.67)
Sherrington, 2020 ⁶⁸	12	131 (0.78)	129 (0.77)	0.96 (0.69, 1.34)
Shumway-Cook, 2007 ⁶⁹	12	297 (1.33)	398 (1.77)	0.75 (0.52, 1.09)
Smulders, 2010 ⁷⁰	12	34 (0.72)	52 (1.18)	0.61 (0.40, 0.94)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix G Table 5. Exercise + Education Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Daly, 2020 ⁶⁷	Fallers (1 plus falls)	12	29/81 (35.8)	25/81 (30.9)	1.15 (0.66, 1.99)
		18	37/81 (45.7)	35/81 (43.2)	1.07 (0.57, 2.00)
	Fallers (2 plus falls)	12	13/81 (16)	6/81 (7.4)	1.99 (0.74, 5.36)
		18	15/81 (18.5)	10/81 (12.3)	1.59 (0.67, 3.81)
Sherrington, 2020 ⁷¹	Fallers (1 plus falls)	12	72/168 (42.9)	70/168 (41.7)	1.03 (0.80, 1.32)
	Fallers (2 plus falls)	12	34/168 (20.2)	34/168 (20.2)	1.00 (0.65, 1.53)
	Fallers (3 plus falls)	12	12/168 (7.1)	14/168 (8.3)	0.86 (0.41, 1.80)
Shumway-Cook, 2007 ⁶⁹	Fallers (1 plus falls)	12	124/226 (54.9)	130/227 (57.3)	0.96 (0.82, 1.13)
Smulders, 2010 ⁷⁰	Fallers (1 plus falls)	12	21/47 (44.7)	23/45 (51.1)	0.87 (0.57, 1.34)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix G Table 6. Exercise + Education Interventions: Injurious Falls (Including Fracture) and Fall-Related Hospitalization

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Sherrington, 2020 ⁶⁸	Fall resulting in fractures	12	12 (0.07)	18 (0.11)	0.64 (0.30, 1.35)
	Fall resulting in hospital admission	12	16 (0.10)	18 (0.11)	0.85 (0.43, 1.68)
	Fall resulting in medical care	12	42 (0.25)	39 (0.23)	1.02 (0.61, 1.68)
Shumway-Cook, 2007 ⁶⁹	Fall resulting in medical care	12	NR (0.18)	NR (0.21)	0.72 (0.45, 1.15)
Smulders, 2010 ⁷⁰	Fall resulting in minor injuries	12	19 (0.40)	28 (0.62)	0.65 (0.36, 1.16)
	Fall resulting in serious injuries	12	1 (0.02)	5 (0.11)	0.19 (0.02, 1.64)
	Fall-related fracture	12	1 (0.02)	3 (0.07)	0.32 (0.03, 3.07)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix G Table 7. Exercise + Education Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Daly, 2020 ⁶⁷	12	1/81 (1.2)	1/81 (1.2)	1.00 (0.06, 15.72)
	18	1/81 (1.2)	1/81 (1.2)	1.00 (0.06, 15.72)
Shumway-Cook, 2007 ⁶⁹	12	2/226 (0.9)	3/227 (1.3)	0.67 (0.11, 3.97)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix G Table 8. Exercise + Education Interventions: Quality of Life

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Daly, 2020 ⁶⁷	QOL-EQ-5D-VAS	0	74	69	80.70 (12.83)	83.06 (13.27)	NA	NA	NA
		6	74	69	NR	NR	1.08 (95% CI: -2.26, 4.42)	0.15 (95% CI: -2.55, 2.86)	0.93 (-3.33, 5.19)
		12	74	69	NR	NR	1.43 (95% CI: -1.16, 4.02)	-0.73 (95% CI: -3.86, 2.40)	2.16 (-1.85, 6.17)
		18	74	69	NR	NR	1.68 (95% CI: -1.69, 5.04)	-1.42 (95% CI: -4.06, 1.22)	3.10 (-1.19, 7.38)
Smulders, 2010 ⁷⁰	QOL-QUALEFFO-41	0	46	37	25.2 (10.0)	28.7 (10.9)	NA	NA	NA
		12	46	37	26.2 (10.6)	27.3 (11.0)	NR	NR	NR

Abbreviations: BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D = EuroQol instrument; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; Time = Timepoint; VAS = Visual analogue scale.

Appendix G Table 9. Exercise + Education Interventions: Harms

Author, year	Outcome	FU, mo	IG n/n	CG n/n
Daly, 2020 ⁶⁷	AEs during intervention - musculoskeletal complaints requiring treatment	12	27/81*	NR
		18	32/81*	
	AEs during intervention - musculoskeletal complaints	12	34/81	
			40/81*	
		18	41/81	
			47/81*	
	Withdrew due to AEs	12	6/81	
Fracture during intervention	12	1/81		
Sherrington, 2020 ⁶⁸	AEs during intervention	12	6/168	NR
Shumway-Cook, 2007 ⁶⁹	AEs during intervention	12	0/226	0/227
Smulders, 2010 ⁷⁰	AEs during intervention	12	0/47	NR

* Events, not people.

Abbreviations: AE = Adverse event; CG = Control group; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported.

Appendix H Table 1. Exercise + Environment Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target pop	Recruitment setting	N rand	Female, %	Age, mean (range)	Race/ ethnicity, %
Fitzharris, 2010 ³⁸ Whitehorse NoFalls trial	Fair	AUS	Older adults age ≥70 years.	Population-based register	543	60	76.1 (≥70)	NR
Matchar, 2017 ⁷² Steps to Avoid Falls in the Elderly (SAFE)	Good	Singapore	Older adults age ≥65 years at higher risk of falling.	ED	354	77	78 (65–99)	Chinese: 83% Non-Chinese: 17%
Taylor, 2021 ⁷³ Intervention for Falls in Older Cognitively Impaired Subjects (i-FOCIS)	Fair	AUS	Older adults age ≥65 years with cognitive impairment	Assisted living/day care; Clinical, NOS or varied	309	49	82.3 (≥65)	NR

Abbreviations: AUS = Australia; ED = Emergency department; N = Number of participants; NOS = Not otherwise specified; NR = Not reported; Pop = Population; QR = Quality rating; Rand = Randomized.

Appendix H Table 2. Exercise + Environment Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Fitzharris, 2010 ³⁸ Whitehorse NoFalls trial	6	Fall in previous 1 month.	NR	NR	Mean # of meds: 3.4	NR
Matchar, 2017 ⁷² Steps to Avoid Falls in the Elderly (SAFE)	100	Presentation to ED for a fall or fall-related injury.	NR	Multiple comorbidities, %: 47*	Polypharmacy, %: 55	Mean MoCA score: 18.6
Taylor, 2021 ⁷³ Intervention for Falls in Older Cognitively Impaired Subjects (i-FOCIS)	52.8	Fall in previous 12 mo.	NR	Mean # of comorbidities: 3.5	Mean # of meds: 5.6	Mean MoCA score: 25.4 Mean m-Ace score: 14.4 Mean ACE-III score: 63 [†]

* NOTE: Two or more of emphysema, cardiac failure, circulation problem, stroke, Parkinson's disease, cancer, and MoCA score <26.

† NOTE: Higher scores indicate better performance for ACE-III (/100), m-ACE (/30).

Abbreviations: ACE-III = Addenbrooke's cognitive examination III; Cog = Cognitive; ED = Emergency department; m-ACE = Mini-Addenbrooke's Cognitive Examination; Meds = Medications; Mo = Months; MoCA = Montreal Cognitive Assessment; NR = Not reported.

Appendix H Table 3. Exercise + Environment Interventions: Intervention Components

Author, year	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	Freq of supervised IG	CG descr
Fitzharris, 2010 ³⁸	Group exercise classes supplemented by independent home exercises, plus removal or modification of home hazard(s) identified in risk factor assessment.	Individual; Group	Class outside of home; Home	City staff; Physical therapist	Exercise: 1 hr per wk for 15 wks Environment: 1 time	1-hr group exercise class/wk for 15 wks	Usual care
Matchar, 2017 ⁷²	Group or individual exercise program, determined by SPPB score plus home environment assessment and recommendations.	Individual; Group	Class outside of home; Home	Physical therapist	Home exercise 12 sessions 3x per wk for 3 mo transitioning to group sessions. Group sessions 2x per wk for 3 mo*	Varied based on BL assessment. Could be 2x/wk for 3 mo (group, supervised) or 3x/wk (individual, unsupervised)	Usual care
Taylor, 2021 ⁷³	Exercise and home hazard reduction program designed and delivered based on participants' functional cognition.	Individual	Home	Occupational therapist; Physiotherapist	Planned: The intervention visit schedule comprised 11 visits† and up to 10 support telephone calls during the 12-mo study period. OT (home hazard): 90- to 120-min sessions Physiotherapy (exercise): 40–60 min	NR‡	Usual care

* Individual and group offered simultaneously, participants could not participate in both at the same time.

† A variable combination of physiotherapy and occupational therapy based on identified need.

‡ Varied based on needs, up to 10 home visits but not specified if this was physical therapy.

Abbreviations: BL = Baseline; CG = Control group; Descr = Description; Freq= Frequency; Hr = Hour; IG = Intervention group; Min = Minutes; Mo = Months; NR = Not reported; OT = Occupational therapy; SPPB = Short Physical Performance Battery; Wk = Week; X = Times; Yrs = Years.

Appendix H Table 4. Exercise + Environment Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Fitzharris, 2010 ³⁸	18	153 (0.88)	211 (1.20)	0.73 (0.60, 0.90)
Taylor, 2021 ⁷³	12	NR	NR	0.78 (0.57, 1.07)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix H Table 5. Exercise + Environment Interventions: People With a Fall

Author, year	Outcomes	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Fitzharris, 2010 ³⁸	Fallers (1 plus falls)	18	72/135 (53.3)	87/137 (63.5)	0.84 (0.69, 1.03)
	Fallers (2 plus falls)	18	30/135 (22.2)	45/137 (32.8)	0.68 (0.46, 1.01)
	Fallers (3 plus falls)	18	14/135 (10.4)	25/137 (18.2)	0.57 (0.31, 1.05)
Matchar, 2017 ⁷²	Fallers (1 plus falls)	9	54/177 (30.5)	67/177 (37.9)	0.81 (0.60, 1.08)
Taylor, 2021 ⁷³	Fallers (1 plus falls)	12	94/153 (61.4)	87/156 (55.8)	0.99 (0.82, 1.19)
	Fallers (2 plus falls)	12	49/153 (32)	58/156 (37.2)	0.73 (0.54, 0.99)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix H Table 6. Exercise + Environment Interventions: Injurious Falls (Including Fracture) and Fall-Related Hospitalization

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Fitzharris, 2010 ³⁸	Fall resulting in injuries	18	100 (0.57)	115 (0.65)	0.88 (0.67, 1.15)
	Fall resulting in medical care	18	14 (0.08)	18 (0.10)	0.79 (0.39, 1.60)
Taylor, 2021 ⁷³	Fall-related hospitalization/ED visit	12	67 (0.44)	47 (0.30)	1.39 (0.90, 2.14)
	Fall-related medical attention	12	298 (1.95)	251 (1.61)	1.18 (0.76, 1.82)

Abbreviations: CG = Control group; CI = Confidence interval; ED = Emergency department; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix H Table 7. Exercise + Environment Interventions: People With a Fall Resulting in Injuries or Hospitalization

Author, year	Outcomes	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Matchar, 2017 ⁷²	Injurious fallers	9	25/177 (14.1)	40/177 (22.6)	0.63 (0.40, 0.98)
Taylor, 2021 ⁷³	Person with fall-related fracture	12	10/153 (6.5)	9/156 (5.8)	1.08 (0.45, 2.58)
	Person with fall-related hospitalization	12	24/153 (15.7)	16/156 (10.3)	1.46 (0.81, 2.64)

Abbreviations: CG = Control group; CI = Confidence interval; ED = Emergency department; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix H Table 8. Exercise + Environment Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Taylor, 2021 ⁷³	6	1/153 (0.7)	2/156 (1.3)	0.51 (0.05, 5.56)
	12	3/153 (2)	9/156 (5.8)	0.34 (0.09, 1.23)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix H Table 9. Exercise + Environment Interventions: Quality of Life

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Taylor, 2021 ⁷³	QOL-EuroQol EQ-5D	0	153	156	0.78 (95% CI, 0.75, 0.81)	0.79 (95% CI, 0.76, 0.82)	NA	NA	NA
		6	153	156	0.83 (95% CI, 0.80, 0.86)	0.80 (95% CI, 0.77, 0.83)	NR	NR	0.03 (-0.01, 0.08)
		12	153	156	0.78 (95% CI, 0.82, 0.77)	0.77 (95% CI, 0.73, 0.81)	NR	NR	-0.04 (-0.04, 0.07)

Abbreviations: BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D = EuroQol instrument; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; Time = Timepoint.

Appendix I Table 1. Environmental Interventions: Study and Population Characteristics

Author, year	QR	Country	Target population	Recruitment setting	N rand	Female, %	Age, mean (range)	Race/Ethnicity, %
Chu, 2017 ⁷⁴	Fair	HKG	Individuals age ≥65 years who had fallen	ED	204	71	78 (≥65)	NR
Cockayne, 2021 ⁷⁵ Occupational Therapist Intervention Study (OTIS)	Good	GBR	Community-dwelling people age ≥65 years who are at risk of falling	Community-based	1331	66	80 (65–99)	NR
Fitzharris, 2010 ³⁸ Whitehorse NoFalls	Fair	AUS	Older adults age ≥70 years	Population-based register	1090	60	76.1 (≥70)	NR
Pighills, 2011 ⁷⁶	Good	GBR	Community-dwelling adults age ≥70 years with a history of falls in the previous year	Community-based; PC/GP	238	69	79 (≥70)	NR
Stark, 2021 ⁷⁷ Home Hazard Removal Program (HARP)	Good	US	Community-dwelling older adults at risk for falling who received services from an Area Agency on Aging	Community-based	310	78	75 (≥65)	Black: 55.6
Stevens, 2001 ⁷⁸	Fair	AUS	People age ≥70 years living independently	Population-based register	1879	52	76 (≥70)	NR

Abbreviations: AUS = Australia; ED = Emergency department; GP = General practitioner; HKG = Hong Kong; N = Number of participants; NR = Not reported; PC = Primary care; QR = Quality rating; Rand = Randomized; US = United States.

Appendix I Table 2. Environmental Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Chu, 2017 ⁷⁴	100	Presentation to ED primarily because of a fall.	NR	NR	Taking ≥4 meds, %: 33	Mean MMSE score: 20.0
Cockayne, 2021 ⁷⁵ Occupational Therapist Intervention Study (OTIS)	86	Fall in the previous 12 mo or balance problems while walking or dressing, or at least moderate problems doing usual activities	NR	NR	Taking >4 meds prescribed by doctor, %: 50	NR
Fitzharris, 2010 ³⁸ Whitehorse NoFalls	6	Fall in the previous 1 mo	NR	NR	Mean # of meds: 3.4	NR
Pighills, 2011 ⁷⁶	100	Fall in the previous 12 mo	NR	NR	Mean # of daily meds: 5	NR
Stark, 2021 ⁷⁷ Home Hazard Removal Program (HARP)	100	≥1 fall in the previous 12 mo or worried about falling	NR	NR	Mean # of meds: 7.5	Mean cognitive dysfunction score, Short Blessed Test of memory and concentration*, score: 2.9
Stevens, 2001 ⁷⁸	27	Fall in the previous 12 mo	NR	NR	NR	NR

* Score of ≥10 = cog impairment.

Abbreviations: Cog = Cognitive; ED = Emergency department; Meds = Medications; MMSE = Mini-Mental State Examination Mo = Months; NR = Not reported.

Appendix I Table 3. Environmental Interventions: Intervention Components

Author, year	Brief IG descr	Format	Setting(s)	Provider(s)	Intensity	CG descr
Chu, 2017 ⁷⁴	Occupational therapy home visit program for reducing subsequent falls in older community-dwelling adults	Individual	In-home, supervised	Occupational therapist	1 home visit lasting 1.5 hrs + followup telephone call 2 mo after home visit	Attention control
Cockayne, 2021 ⁷⁵	One-time home environmental assessment and modification offered.	Individual	In-home, supervised	Occupational therapist	1x assessment (Home hazard assessments average 1.5 hrs to deliver) (ranging from 25 min to 3 hrs).	Usual care
Fitzharris, 2010 ³⁸	Removal or modification of home hazard(s) identified in risk factor assessment.	Individual	Home	City staff	1 time assessment	Usual care
Pighills, 2011 ⁷⁶	Occupational therapist led environmental assessment	Individual	In-home, supervised	Occupational therapist	Initial assessment of 1.5–2 hrs and 2 followup telephone calls.	Usual care
Stark, 2021 ⁷⁷	Brief program focused on removing home hazards and teaching self-management strategies to prevent falls	Individual	Home	Occupational therapist	Planned: 3 sessions (totaling 170 mins over 3.9 wks) + booster at 6 mo	Usual care
Stevens, 2001 ⁷⁸	Home hazard assessment from a trained research nurse, installation of free safety devices, and recommendations for strategies to remove or modify home hazards.	Individual	In-home, supervised	Nurse	Single visit	Usual care

Abbreviations: CG = Control group; Descr = Description; Hr = Hour; IG = Intervention group; Min = Minutes; Mo = Months; Wk = Week; X = Times.

Appendix I Table 4. Environmental Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Chu, 2017 ⁷⁴	6	3 (7.60)	12 (23.40)	0.32 (0.09, 1.15)
	12	16 (16.80)	30 (29.80)	0.56 (0.31, 1.03)
Cockayne, 2021 ⁷⁵	12	826 (1.97)	1434 (1.61)	1.17 (0.99, 1.38)
Fitzharris, 2010 ³⁸	18	212 (1.18)	211 (1.20)	0.98 (0.81, 1.19)
Pighills, 2011 ⁷⁶	12	175 (2.01)	290 (3.72)	0.54 (0.36, 0.83)
Stark, 2021 ⁷⁷	12	201 (1.50)	316 (2.30)	0.62 (0.41, 0.95)
Stevens, 2001 ⁷⁸	12	NR (0.69)	NR (0.72)	1.02 (0.83, 1.27)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; NR = Not reported; P-y = Person-year.

Appendix I Table 5. Environmental Interventions: People With a Fall

Author, year	Outcomes	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Chu, 2017 ⁷⁴	Fallers (1 plus falls)	6	3/95 (3.2)	12/103 (11.7)	0.27 (0.08, 0.93)
		12	13/95 (13.7)	21/103 (20.4)	0.67 (0.36, 1.26)
	Fallers (2 plus falls)	6	0/95 (0)	2/103 (1.9)	0.27 (0.01, 5.94)
		12	2/95 (2.1)	6/103 (5.8)	0.36 (0.07, 1.75)
Cockayne, 2021 ⁷⁵	Fallers (1 plus falls)	12	245/430 (57)	506/901 (56.2)	1.01 (0.92, 1.12)
	Fallers (2 plus falls)	12	148/430 (34.4)	298/901 (33.1)	1.04 (0.89, 1.22)
Fitzharris, 2010 ³⁸	Fallers (1 plus falls)	18	78/136 (57.4)	87/137 (63.5)	0.90 (0.74, 1.10)
	Fallers (2 plus falls)	18	42/136 (30.9)	45/137 (32.8)	0.94 (0.66, 1.33)
Pighills, 2011 ⁷⁶	Fallers (1 plus falls)	12	50/87 (57.5)	54/78 (69.2)	0.83 (0.66, 1.05)
Stark, 2021 ⁷⁷	Fallers (1 plus falls)	12	67/135 (49.6)	74/140 (52.9)	0.94 (0.74, 1.18)
	Fallers (2 plus falls)	12	39/135 (28.9)	46/140 (32.9)	0.88 (0.62, 1.25)
	Fallers (3 plus falls)	12	22/135 (16.3)	27/140 (19.3)	0.85 (0.51, 1.41)
Stevens, 2001 ⁷⁸	Fallers (1 plus falls)	12	NR/570 (NR)	NR/1167 (NR)	0.93 (0.75, 1.15)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix I Table 6. Environmental Interventions: Injurious Falls (Including Fracture) and Fall-Related Hospitalization

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Fitzharris, 2010 ³⁸	Fall resulting in injuries	18	114 (0.63)	115 (0.65)	0.97 (0.75, 1.26)
	Fall resulting in medical care	18	27 (0.15)	18 (0.10)	1.47 (0.81, 2.67)
Cockayne, 2021 ⁷⁵	Fall-related fracture	12	16 (0.04)	41 (0.05)	0.83 (0.46, 1.47)
	Fall-related injuries	12	326 (0.78)	651 (0.73)	1.06 (0.93, 1.21)
	Fall-related injuries, minor	12	287 (0.68)	582 (0.66)	1.04 (0.91, 1.20)
	Fall-related overnight hospitalization	12	15 (0.04)	47 (0.05)	0.67 (0.38, 1.21)
	Hip fracture	12	4 (0.01)	5 (0.01)	1.69 (0.45, 6.30)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix I Table 7. Environmental Interventions: People With a Fall Resulting in Injuries or Hospitalization

Author, year	Outcomes	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Chu, 2017 ⁷⁴	Person with ED visit	6	3/95 (3.2)	8/103 (7.8)	0.41 (0.11, 1.49)
		12	13/95 (13.7)	20/103 (19.4)	0.70 (0.37, 1.34)
	Person with hospitalization	12	4/95 (4.2)	6/103 (5.8)	0.72 (0.21, 2.48)
Cockayne, 2021 ⁷⁵	Person with fall-related fracture	12	16/430 (3.7)	38/901 (4.2)	0.88 (0.50, 1.56)

Abbreviations: CG = Control group; CI = Confidence interval; ED = Emergency department; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix I Table 8. Environmental Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Cockayne, 2021 ⁷⁵	8	5/394 (1.3)	6/840 (0.7)	1.78 (0.55, 5.79)
	12	12/377 (3.2)	14/824 (1.7)	1.87 (0.87, 4.01)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix I Table 9. Environmental Interventions: Quality of Life

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Cockayne, 2021 ⁷⁵	QOL-EQ-5D-5L VAS	0	398	840	73.3 (17.3)	73.7 (17.1)	NA	NA	NA
		8	386	823	71.9 (18.2)	72.3 (17.8)	NR	NR	NR
		12	371	815	71.5 (18.4)	72.1 (18.4)			
Pighills, 2011 ⁷⁶	QOL-EuroQol EQ-5D	0	87	78	0.60 (0.30)	0.60 (0.30)	NA	NA	NA
		12	87	78	0.58 (95% CI 0.55, 0.62)	0.56 (95% CI 0.53, 0.60)	NR	NR	NR
	QOL-SF-12 Mental	0	87	78	49 (11)	47 (11.11)	NA	NA	NA
		12	87	78	50 (95% CI 48, 51)	49 (95% CI 48, 50)	NR	NR	NR
	QOL-SF-12 Physical	0	87	78	33 (14)	33 (12.12)	NA	NA	NA
		12	87	78	35 (95% CI 34, 37)	34 (95% CI 32, 36)	NR	NR	NR
Stark, 2021 ⁷⁷	QOL-SF-36	0	135	140	41.81 (10.98)	44.44 (10.38)	NA	NA	NA
		12	135	140	42.26 (11.01)	43.74 (11.10)	NR	NR	NR

Abbreviations: BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D = EuroQol instrument; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; SF = Short Form Survey; Time = Timepoint; VAS = Visual analogue scale.

Appendix I Table 10. Environmental Interventions: IADLs

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)
Chu, 2017 ⁷⁴	IADL-Frenchay Activities Index	0	95	103	19.4 (7.3)	19.4 (7.4)	NA	NA
		8	95	103	19.0 (8.1)	19.5 (8.2)	NR	NR
		12	95	103	19.0 (8.1)	19.5 (7.8)		

Abbreviations: BL = Baseline; CG = Control group; IADL = Instrumental activities of daily living; IG = Intervention group; Mo = Months; N = Number of participants; NA = Not applicable; NR = Not reported; SD = Standard deviation; Time = Timepoint.

Appendix J Table 1. Medication Review/Modification Interventions: Study & Participant Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting	N rand	Female, %	Age, mean (range)	Race/ethnicity, %
Blalock, 2010 ⁷⁹	Fair	US	Individuals at high risk for falling, specifically those ≥65 years of age	Other	186	71	75 (≥65)	White: 89 Other: 11
Boye, 2017 ⁸⁰ Improving Medication Prescribing to reduce Risk Of FALLs (IMPROVeFALL)	Good	NLD	Community-dwelling older adults who visited the ED due to a fall	ED	612	62	76 (≥65)	NR
Mott, 2016 ⁸¹	Fair	US	Older adults who completed a fall prevention workshop.	Community-based	80	79	76 (≥65)	White: 99 Hispanic: 1
Romskaug, 2020 ⁸² The COOP Study	Good	US	Home-dwelling patients 70 years or older using at least 7 medications regularly.	PC/GP	174	68	83 (≥70)	NR

Abbreviations: ED = Emergency department; N = Number of participants; NOS = Not otherwise specified; ; NLD = Netherlands; NR = Not reported; PC/GP = Primary care/General practitioner; QR = Quality rating; Rand = Randomized; US = United States.

Appendix J Table 2. Medication Review/Modification Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Blalock, 2010 ⁷⁹	100	≥1 fall in previous 12 mo (not attributable to syncope) and taking ≥4 different chronic prescription medications, ≥1 of which was a CNS-active medication.	NR	Mean # of high-risk conditions: 1.62*	# of prescriptions for high-risk medication filled during previous year: 14.2	NR
Boye, 2017 ⁸⁰ Improving Medication Prescribing to reduce Risk Of FALLs (IMPROveFALL)	100	Presentation to ED due to a fall incident.	NR	Charlson comorbidity index: 1.9	Mean # of drugs: 6.4 Participants using ≥3 FRIDs, %: 71	Mean MMSE score: 27.0
Mott, 2016 ⁸¹	100	Fall in the previous 12 mo or have a fear of falling.	NR	NR	Using ≥1 FRID at time of intervention, %: 35	NR
Romskaug, 2020 ⁸² The COOP Study	NR	NA	NR	Mean cumulative illness rating scale summary score: 16.7	Mean # regularly used drugs: 9.8	Mean CDR score: 2.4

* NOTE: conditions included in the count were dizziness, DM, urinary incontinence, arthritis, PD, history of stroke.

Abbreviations: CDR = Clinical dementia rating scale; CNS = Central nervous system; Cog = Cognitive; DM = Diabetes mellitus; ED = Emergency department; FRID = Fall risk increasing drugs; MMSE = Mini-Mental State Examination; Mo = Months; NR = Not reported; PD = Parkinson's disease.

Appendix J Table 3. Medication Review/Modification Interventions: Intervention Components

Author, year	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	CG descr
Blalock, 2010 ⁷⁹	An in-person medication review by a pharmacy resident to identify medications that increase the risk of falling. If participant was interested in making a change in medication regimen, the provider was contacted to approve the change.	Individual	Pharmacy	Pharmacy resident	One 45-min medication assessment	Usual care
Boye, 2017 ⁸⁰	A systematic fall-related medication assessment combined with drug withdrawal or modification, if safely possible.	Individual	In home	Geriatrician; research nurse	1x assessment & med review, wkly counseling offered by telephone calls over a period of 1 mo	Usual care
Mott, 2016 ⁸¹	An in-person medication review by a pharmacist to develop an action plan to modify falls risk-increasing medication use.	Individual	Pharmacy	Pharmacist	One 60-min review, 1 followup telephone call at 3 mo by the pharmacist	Usual care
Romskaug, 2020 ⁸²	Clinical geriatric assessments and collaborative medication reviews by geriatrician and family physician, including meeting between the geriatrician and family physician and clinical followup	Individual	Clinic	Geriatrician	1-hr consultation between geriatrician + 15-min discussion between geriatrician & FP + FU with FP (NOS)	Usual care

Abbreviations: CG = Control group; Descr = Description; FP = Family physician; FU = Followup; Hr = Hour; IG = Intervention group; Min = Minutes; Mo = Months; NOS = Not otherwise specified; Wk = Week; X = Times.

Appendix J Table 4. Medication Review/Modification Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Blalock, 2010 ⁷⁹	12	151 (2.11)	171 (2.13)	1.01 (0.81, 1.26)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix J Table 5. Medication Review/Modification Interventions: People With a Fall

Author, year	Outcome	FU	IG n/n (%)	CG n/n (%)	RR (95% CI)
Blalock, 2010 ⁷⁹	Fallers (1 plus falls)	12	53/93 (57)	52/93 (55.9)	1.02 (0.79, 1.31)
Boye, 2017 ⁸⁰	Fallers (1 plus falls)	12	115/308 (37.3)	91/272 (33.5)	1.12 (0.89, 1.39)
	Fallers (2 plus falls)	12	50/308 (16.2)	38/272 (14)	1.16 (0.79, 1.71)
Mott, 2016 ⁸¹	Fallers (1 plus falls)	6	11/39 (28.2)	10/41 (24.4)	1.16 (0.55, 2.41)
	Fallers (2 plus falls)	6	6/39 (15.4)	3/41 (7.3)	2.10 (0.56, 7.83)
	Fallers (3 plus falls)	6	2/39 (5.1)	2/41 (4.9)	1.05 (0.16, 7.10)
Romskaug, 2020 ⁸²	Fallers (1 plus falls)	6	NR/82 (NR)	NR/76 (NR)	OR: 0.75 (0.35, 1.60)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; RR = Relative risk.

Appendix J Table 6. Medication Review/Modification Interventions: Injurious Falls

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Blalock, 2010 ⁷⁹	Fall resulting in injuries	12	55 (0.75)	72 (0.90)	0.87 (0.62, 1.24)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix J Table 7. Medication Review/Modification Interventions: People With a Fall Resulting in Medical Care, Hospitalization, or ED Visit

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Boye, 2017 ⁸⁰	Person with fall resulting in medical care	12	36/308 (11.7)	46/272 (16.9)	0.69 (0.46, 1.04)
	Person with fall-related ED visit	12	16/308 (5.2)	21/272 (7.7)	0.67 (0.36, 1.26)
Romskaug, 2020 ⁸²	Person with hospitalization	6	31/82 (37.8)	17/76 (22.4)	1.69 (1.00, 2.85)

Abbreviations: CG = Control group; CI = Confidence interval; ED = Emergency department; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix J Table 8. Medication Review/Modification Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Blalock, 2010 ⁷⁹	12	3/93 (3.2)	2/93 (2.2)	1.50 (0.26, 8.77)
Romskaug, 2020 ⁸²	6	3/82 (3.7)	7/76 (9.2)	0.40 (0.10, 1.55)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix J Table 9. Medication Review/Modification Interventions: Quality of Life

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean diff in change from BL (95% CI)
Boye, 2017 ⁸⁰	QOL-SF-12 Physical	0	283	258	45.6 (9.5)	46.2 (9.9)	NA	NA	NA
		12	283	258	43.0 (10.7)	42.2 (11.6)	-2.6 (8.5)	-3.9 (8.5)	NSD
	QOL-SF-12 Mental	0	283	258	53.3 (9.5)	53.2 (9.0)	NA	NA	NA
		12	283	258	52.5 (9.0)	52.5 (9.2)	-0.8 (9.7)	-0.7 (9.7)	NSD
Romskaug, 2020 ⁸²	QOL-15D	0	87	87	0.708 (0.121)	0.714 (0.113)	NA	NA	NA
		6	82	76	0.675 (0.186)	0.620 (0.216)	NR	NR	0.052 (-0.002, 0.105)* p=NSD

* After adjustment for the Clinical Dementia Rating Scale Sum of Boxes score, the between-group difference was 0.064 (95% CI, 0.011–0.116; P=0.02). Analyzed by linear mixed model, the between-group difference was 0.061 (95% CI, 0.004–0.118; P=0.04).

Abbreviations: BL = Baseline; CG = Control group; CI = Confidence interval; EQ-5D = EuroQol instrument; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; NSD = Non-significant difference; QoL = Quality of life; SD = Standard deviation; SF = Short Form Survey; Time = Timepoint; VAS = Visual analogue scale.

Appendix K Table 1. Psychological Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting	N rand	Female, %	Age, mean (range)	Race/ ethnicity, %
Dorresteijn, 2016 ⁸³	Fair	NLD	Frail community-dwelling older adults age ≥70 years with some concerns about falls and related activity avoidance	Population-based register	389	70	78 (≥70)	NR
Lim, 2022 ⁸⁴	Fair	AUS	Community-dwelling older adults with fear of falling	Community-based	50	70	74 (66 to 91)	NR
Zijlstra, 2009 ⁸⁵	Fair	NLD	Adults age ≥70 who reported fear of falling and fear- induced activity avoidance	Population-based register	540	72	78 (≥70)	NR

Abbreviations: N = Number of participants; AUS = Australia; NLD = Netherlands; NR = Not reported; QR = Quality rating; Rand = Randomized.

Appendix K Table 2. Psychological Interventions: Fall Risk and Comorbidities

Author, year	Risk for falls %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Dorresteijn, 2016 ⁸³	100	Reported at least some concerns about falls; reported at least some associated avoidance of activity; perceived their general health as fair or poor.	NR	NR	NR	NR
Lim, 2022 ⁸⁴	44	1+ fall in previous 12 mo (56% self-reported moderate to high risk of falling).	NR	Charlson comorbidity index: 3.16	Medication, mean: 2.3	Executive Function - Trails B-A score: 51.8 (Major cognitive impairment excluded per inclusion criteria)
Zijlstra, 2009 ⁸⁵	100	Some fear of falling and at least some activity avoidance due to fear of falling.	NR	NR	NR	NR

Abbreviations: Cog = Cognitive; NR = Not reported.

Appendix K Table 3. Psychological Interventions: Intervention Components

Author, year Study name	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	CG descr
Dorresteijn, 2016 ⁸³	Home-based, cognitive behavioral program consisting of 7 sessions including three home visits and four telephone contacts aimed to instill adaptive and realistic views of fall risks and to increase activity and safe behavior.	Individual	Class outside the home	Nurse	Three home visits of 60–75 min and four telephone calls of 35 min over a 4-mo period	Usual care
Lim, 2022 ⁸⁴	Three modules from an online CBT program (myCompass).	Individual	In home	Self-directed	6-wk access to online modules	Minimal intervention
Zijlstra, 2009 ⁸⁵	8 wkly, 2-hr multicomponent cognitive behavioral group sessions addressing fear of falling, safely increasing activity, home environment changes, and exercise.	Group	Class outside the home	Nurse	2-hr sessions once per wk	Usual care

Abbreviations: CBT = cognitive behavioral therapy; CG = Control group; Descr = Description; Hr = Hour; IG = Intervention group; Min = Minutes; Mo = Months; Wk = Week.

Appendix K Table 4. Psychological Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Dorresteijn, 2016 ⁸³	12	362 (2.13)	429 (2.38)	0.86 (0.65, 1.13)
Zijlstra, 2009 ⁸⁵	14	302 (0.93)	381 (1.26)	0.86 (0.65, 1.14)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix K Table 5. Psychological Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Dorresteijn, 2016 ⁸³	Fallers (1 plus falls)	12	94/166 (56.6)	106/180 (58.9)	0.96 (0.80, 1.15)
	Fallers (2 plus falls)	12	55/166 (33.1)	67/180 (37.2)	0.89 (0.67, 1.19)
Lim, 2022 ⁸⁴	Fallers (1 plus falls)	12	NR/25 (NR)	NR/25 (NR)	OR: 1.40 (0.45, 4.37)
Zijlstra, 2009 ⁸⁵	Fallers (1 plus falls)	8	80/280 (28.6)	95/260 (36.5)	0.78 (0.61, 1.00)
		14	91/280 (32.5)	117/260 (45)	0.72 (0.58, 0.90)
	Fallers (2 plus falls)	8	35/280 (12.5)	53/260 (20.4)	0.61 (0.41, 0.91)
		14	48/280 (17.1)	76/260 (29.2)	0.59 (0.43, 0.81)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; NR = Not reported; RR = Relative risk.

Appendix K Table 6. Psychological Interventions: Injurious Falls

Author, year	Outcome	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Dorresteijn, 2016 ⁸³	Fall resulting in medical care	12	106 (0.61)	87 (0.48)	1.42 (0.96, 2.10)
Zijlstra, 2009 ⁸⁵	Fall-related injuries, serious	14	75 (0.27)	102 (0.34)	0.78 (0.45, 1.35)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix K Table 7. Psychological Interventions: Mortality

Author, year	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Dorresteijn, 2016 ⁸³	12	7/194 (3.6)	7/195 (3.6)	1.01 (0.36, 2.81)
Zijlstra, 2009 ⁸⁵	14	6/280 (2.1)	6/260 (2.3)	0.93 (0.30, 2.84)
	84	90/280 (32.1)	85/259 (32.8)	0.98 (0.77, 1.25)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix K Table 8. Psychological Interventions: IADLs

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean diff in change from BL (95% CI)
Dorresteijn, 2016 ⁸³	IADL-Groningen Activity Restriction Scale	0	141	171	15.64 (5.1)	15.03 (4.9)	NA	NA	NA
		12	141	171	14.82 (5.0)	15.35 (5.1)	NR	NR	-1.01 (-∞, -0.41)
Zijlstra, 2009 ⁸⁵	IADL-Frenchay Activities Index	0	280	260	39.5 (7.2)	38.2 (7.2)	NA	NA	NA
		8	280	260	40.3 (6.9)	38.0 (7.4)	NR	NR	0.94 (0.13, 1.74) p=0.02
		14	280	260	39.6 (7.4)	37.7 (7.6)	NR	NR	0.54 (-0.35, 1.42)

Abbreviations: BL = Baseline; CG = Control group; IADL = Instrumental activities of daily living; IG = Intervention group; Mo = Months; N = Number of participants; NA = Not applicable; NR = Not reported; SD = Standard deviation; Time = Timepoint.

Appendix L Table 1. Education Interventions: Study and Population Characteristics

Author, year Study name	QR	Country	Target population	Recruitment setting	N rand	Female, %	Age, mean (range)	Race/ethnicity, %
Clemson, 2004 ⁸⁶ Stepping On	Fair	AUS	Community residents age ≥70 years who had a fall in the previous 12 mo or were concerned about falling.	Community-based	310	74	78 (≥70)	NR

Abbreviations: AUS = Australia; Mo = Months; N = Number of participants; NR = Not reported; QR = Quality rating; Rand = Randomized.

Appendix L Table 2. Education Interventions: Fall Risk and Comorbidities

Author, year Study name	Risk for falls, %	Fall risk criteria	Frailty	Comorbidities	Medications	Cog impairment
Clemson, 2004 ⁸⁶ Stepping On	100	Fall in the previous 12 mo or concerned about falling.	NR	NR	Use of psychotropic drugs, %: 20	NR

Abbreviations: Cog = Cognitive; Mo = Months; NR = Not reported.

Appendix L Table 3. Education Interventions: Intervention Components

Author, year	Brief IG descr	Format	Setting(s)	Provider(s)	IG intensity	CG descr
Clemson, 2004 ⁸⁶	Participants attended group sessions of the Stepping On program to improve fall self-efficacy, encourage behavioral change, and reduce falls. Program focuses on balance and strength, vision screening, medication management, home safety, and community safety.	Group	Class outside of home; In-home	Occupational Therapist	Seven 2-hr group sessions, plus 1 home visit*	Attention control

* There was a total of 15.5 hrs of intervention constituting the seven 2-hr program sessions (including one community mobility session) and the individual home visit. A booster session conducted 3 mo after session seven, lasting 1.5 hrs, occurred at the program venue.

Abbreviations: CG = Control group; Descr = Description; Hr = Hour; IG = Intervention group; Mo = Month.

Appendix L Table 3. Education Interventions: Falls

Author, year	FU, mo	IG events (event rate p-y)	CG events (event rate p-y)	IRR (95% CI)
Clemson, 2004 ⁸⁶	14	179 (0.91)	255 (1.43)	0.68 (0.57, 0.83)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; IRR = Incidence rate ratio; Mo = Months; P-y = Person-year.

Appendix L Table 3. Education Interventions: People With a Fall

Author, year	Outcome	FU, mo	IG n/n (%)	CG n/n (%)	RR (95% CI)
Clemson, 2004 ⁸⁶	Fallers (1 plus falls)	14	82/157 (52.2)	89/153 (58.2)	0.90 (0.73, 1.10)
	Fallers (2 plus falls)	14	40/157 (25.5)	53/153 (34.6)	0.74 (0.52, 1.04)

Abbreviations: CG = Control group; CI = Confidence interval; FU = Followup; IG = Intervention group; Mo = Months; n/n = Number of people with event/number of participants; RR = Relative risk.

Appendix L Table 4. Education Interventions: Quality of Life

Author, year	Outcome (Instrument)	Time, mo	IG n	CG n	IG Mean (SD)	CG Mean (SD)	IG Mean change from BL (SD)	CG Mean change from BL (SD)	Mean difference in change (95% CI)
Clemson, 2004 ⁸⁶	QOL-SF-36 Mental Component	0	157	153	53.21 (11.08)	54.29 (10.26)	NA	NA	NA
		14	133	125	NR	NR	0.01 (9.65)	-0.52 (10.00)	0.53 (-2.95, 1.88)
	QOL-SF-36 Physical Component	0	157	153	38.37 (10.84)	38.79 (10.74)	NA	NA	NA
		14	133	125	NR	NR	-0.02 (8.34)	0.68 (9.04)	0.70 (-2.94, 1.88)

Abbreviations: BL = Baseline; CG = Control group; CI = Confidence interval; IG = Intervention group; Mo = Months; n = Number of participants; NA = Not applicable; NR = Not reported; QoL = Quality of life; SD = Standard deviation; SF = Short Form Survey; Time = Timepoint.

Appendix M Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	N	Aim	Relevant Outcome(s)	Status 2023
NCT 04993781	Electronic Strategies for Tailored Exercise to Prevent Falls (eSTEPS)	US	8353	Test the efficacy of a tailored fall prevention exercise (eSTEPS) intervention on falls and injurious falls in patients over age 65 at high risk for falls.	Falls; injurious falls	Recruiting Estimated completion date: December 2025
NCT 05807724	Geriatric Emergency Department (ED) Fall Injury Prevention Project	US	1600	Assess whether certain ED patients at high risk of recurrent falls and injuries related to falls will benefit from the recommendations of the Centers for Disease Control and Prevention's Stopping Elderly Accidents, Deaths and Injuries (STEADI) program.	Recurrent fall requiring ED revisit; injurious falls; fall-related mortality	Recruiting Estimated completion date: September 2024
NCT 05691166	Reducing Falls with Progressive Resistance Training (ReFit) for the Oldest Old Adults With Sarcopenia. A 12-month Randomized Controlled Trial	US	240	Investigate the effects of 12 mo of high-intensity progressive resistance training compared with a control group on fall-rate in older adults with sarcopenia.	Falls	Recruiting Estimated completion date: December 2025
NCT 05016141	Health in Motion- A Pragmatic Clinical Trial-Home	US	120	Evaluate the use of a digital solution that translates evidence-based fall prevention programs (such as Otago Exercise Program and Matter of Balance) to a digital solution (Health in Motion Fall Prevention Platform), as an alternative to home-based fall prevention programs that is affordable, scales to the millions of older adults across the country at risk for falls, and is sustainable for the older adult's life.	Falls	Active Estimated completion date: July 2023
NCT 03963570	The Effectiveness of a Self-managed Digital Exercise Program to	SWE	1628	Evaluate the effectiveness of a digital self-management exercise program in preventing falls in community-dwelling older people.	Falls	Completed, no results posted

Appendix M Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	N	Aim	Relevant Outcome(s)	Status 2023
	Prevent Falls in Older Community-dwelling People (SafeStepRCT)					Estimated completion date: May 2022
NCT 05694494	Training- and Cost-effectiveness of an Internet-based Lifestyle-integrated Functional Exercise Program (iLiFE)	HK	322	Compare the effectiveness of an internet-based LiFE program in reducing subsequent falls and promoting exercise adherence in community-dwelling older adults.	Falls	Enrolling by invitation Estimated completion date: November 2024
NCT 05406323	The Effect of a Web-Based Fall Prevention Program on Fall, Fall Risk and Fall Fear Among Elderly	TR	72	Assess the effect of Web-Based Fall Prevention Program on falling, fall risk, and fear of fall.	Falls	Not yet recruiting Estimated completion date: July 2023
NCT 04787432	Salutogenic Frailty Prevention Program for Women Aged 55 Years and Over (SAFRAPP)	TR	84	Examine the effectiveness of Salutogenic Model-Based Frailty Prevention Program (SAFRAPP) for pre-frail women.	Falls	Unknown Estimated Study Completion Date: January 2022
NCT 05615077	Effectiveness of Comprehensive Intervention for the Prevention of Fall in Older Adults; a Randomized Controlled Trial	KOR	484	Demonstrate the effect of combined exercise-education intervention in old adults with fall risk. This study will be conducted with prospectively randomized controlled trial comparing outcome of combined exercise-education intervention with conventional medical care.	Falls, injurious falls	Recruiting Estimated completion date: May 2026
NCT 05192408	Multi-component Intervention for Reducing Fear of Falling in Community-dwelling Older Adults	SGP	420	Compare the effectiveness of a multi-component intervention comprising exercise recommendations, cognitive behavioral therapy components, and motivational interviewing-based telephone review against usual care for reducing fear of falling and falls in community-dwelling older adults.	Falls	Recruiting Estimated completion date: May 2023

Appendix M Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	N	Aim	Relevant Outcome(s)	Status 2023
NCT 04801316	Steady Feet	SGP	290	Evaluate the effects of a strength and balance intervention (Steady Feet) among older adults age 60 years or older who are at high risk of falls.	Injurious falls	Recruiting Estimated completion date: December 2022
DRKS 00016609	A multi-centre, parallel-group, randomized controlled trial to assess the efficacy and safety of eurythmy therapy and tai chi in comparison with standard care in chronically ill elderly patients with increased risk of falling (ENTAiER)	DEU	550	Determine whether eurythmy therapy and tai chi can reduce the risk of falling (i.e., experiencing at least one fall), which usually marks the beginning of dependency and the decline of mobility.	Falls	NR Registered: July 2019
NCT 04911179	Combined Exercise and Cognitive Stimulation for Falls Prevention	ESP	310	Investigate the effect of the combined intervention (exercise and cognitive intervention) in frail older participants living in the community and at risk of falling.	Falls; fall-related hospitalizations; fall-related fractures; fall-related death	Recruiting Estimated completion date: April 2024
NCT 05449470	Falls Prevention Improvement Through Developing a Computerized Clinical Support System: Effectiveness of Individualized Medication Withdrawal	NLD	800	Assess whether of the use of a clinical decision support system and a patient portal for communicating medication-related fall risk to fall clinic patients may improve joint medication management between patients and physicians and reduce the incidence of injurious falls.	Falls; injurious falls	Recruiting Estimated completion date: June 2024
NCT 04717258	Safe and Well Visits by the Fire and Rescue Service to Prevent Falls and Improve Quality of Life in Older People (FIREFLI)	UK	1156	Assess whether Safe and Well Visits delivered by the Fire and Rescue Service will lead to a reduction in the number of falls and an improvement in health-related quality of life in older people.	Falls; injurious falls; people experiencing a fall	Recruiting Estimated completion date: September 2024

Appendix M Table 1. Ongoing Studies

Trial Identifier	Study Name	Country	N	Aim	Relevant Outcome(s)	Status 2023
NCT04313062	Older People Self-Caring Through a Comprehensive Model Based on House Calls and Oriented Towards Falling Prevention (PM ACTIVAS)	CHL	220	Design, implement, and evaluate a comprehensive model based on house calls and oriented towards falling prevention (PM ACTIVAS' model), with the hypothesis that people who received the educational intervention following the PM ACTIVAS' model will: fall less frequently, improve their management on falls risk factors present at home, and have a higher falls risk perception than the control group.	Falls	Completed, no results posted Estimated completion date: April 2022
NCT 05533333	Self-administered Dual-task Training for Reducing Falls Among the Older Adults	HK	190	Evaluate the effectiveness and cost-effectiveness of self-administered dual-task training for preventing falls among older adults.	Falls	Recruiting Estimated completion date: December 2024

Abbreviations: AUS = Australia; CHL = Chile; ESP = Spain; DEU = Germany; HK = Hong Kong; KOR = South Korea; NLD = Netherlands; NR = Not reported; SGP = Singapore; SWE = Sweden; TR = Turkey; US = United States.

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