Quality Indicators for Falls and Mobility Problems in Vulnerable Elders

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Falls and mobility problems are common and serious problems facing older adults. Accidents are the fifth leading cause of death in older adults, with falls accounting for two-thirds of these accidental deaths.[1] About one-third of those aged 65 and older living in the community fall at least once a year. This increases to one in two for those aged 80 and older.[2,3] Although most falls result in no serious injury, in any given year, approximately 5% of these older fallers experience a fracture or require hospitalization.[1] The related problems of mobility disorders are also prevalent in older adults. Detectable gait abnormalities affect 20% to 40% of individuals aged 65 and older and 40% to 50% of those aged 85 and older.[4,5]

Falls are generally the result of multiple, diverse, and interacting etiologies. Several cohort studies have identified gait and balance disorders, functional impairment, visual deficits, cognitive impairment, and use of psychotropic medications as the most important risk factors for falling.[6–9] Several studies have shown that the risk of falling increases dramatically as the number of risk factors increases. Three separate studies have reported that 65% to 100% of elderly individuals with three or more risk factors fell in a 12-month observation period, compared with 8% to 12% of persons with no risk factors.[1,10–12]

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However, the quality of falls care in vulnerable older adults remains suboptimal. One study found that only 34% of recommended care for falls and mobility disorders was completed.[13]

Numerous clinical approaches have been advocated for ameliorating the complex and serious problems of falls and mobility problems in older persons. The following indicators have been updated from those developed in Assessing Care of Vulnerable Elders (ACOVE)-1[14] and reviewed by an expert panel to reflect the current literature in this area. Recent data on vitamin D supplementation[15–23] and footwear[24–28] were reviewed but did not pass the expert panel process. Figure 1 conceptualizes an approach to the detection, evaluation, and intervention options for falls and mobility disorders.

METHODS

A total of 182 articles were considered in this review: 16 identified using a Web search, 108 through reference mining, and 58 through the ACOVE-3 literature searches.

RESULTS

Of the 15 potential quality indicators (QIs), the expert panel process judged 12 to be valid (see the QIs on pages S464–S487 of this supplement). Three indicators were rejected. The literature summaries that support each of the indicators judged to be valid in the expert panel process are described.

Detection of Falls

1. ALL vulnerable elders (VEs) should have documentation that they have been asked annually about the occurrence of recent falls, **BECAUSE** falls are common, often preventable, frequently unreported, and often cause injury and unnecessary restriction of activity, which results in a reduction in overall health and quality of life. Additionally, a recent history of falls is a potent predictor of future falls.

Supporting Evidence

No controlled trials or observational studies that directly demonstrated benefit of inquiring about the occurrence of recent falls were found, although a convincing chain of

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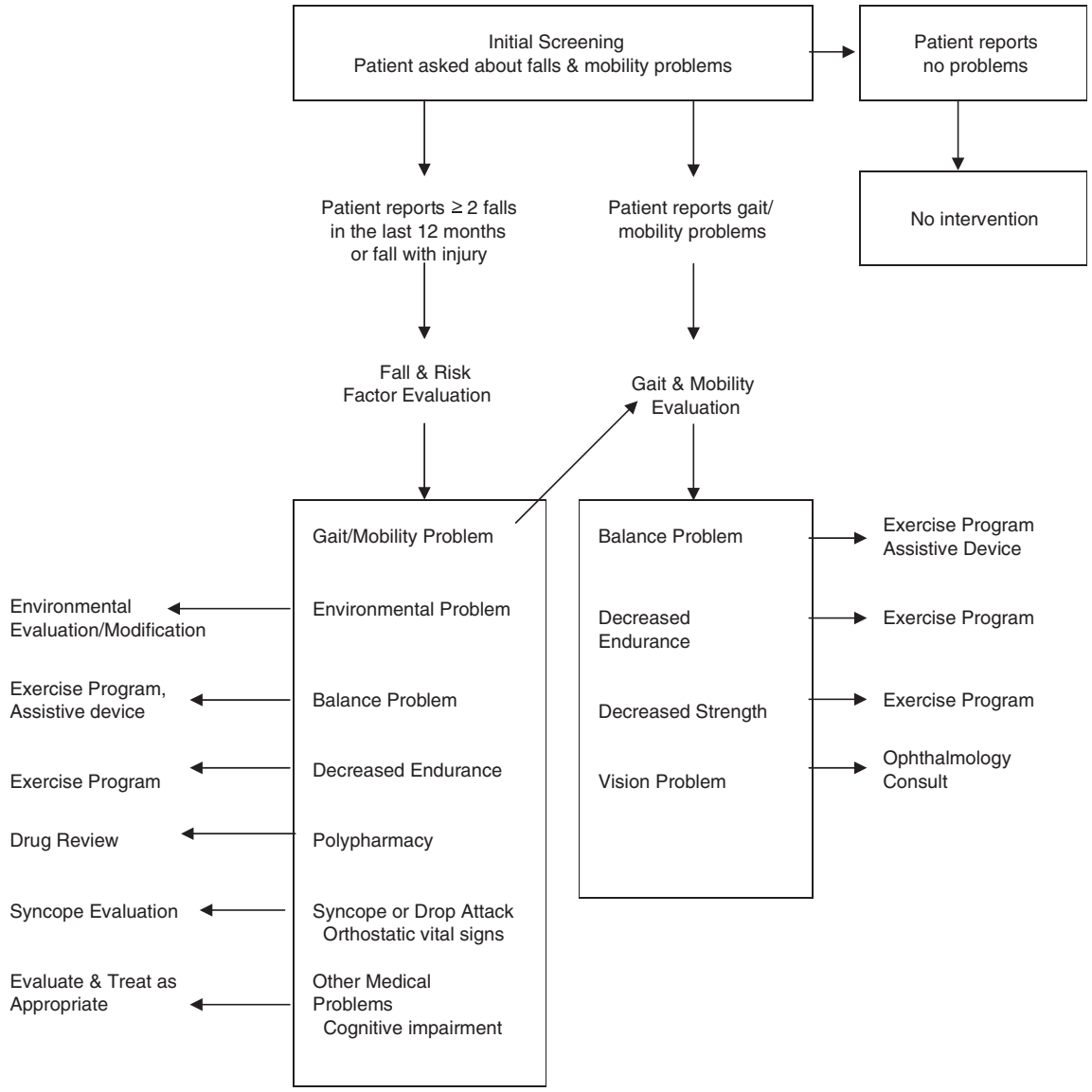

Figure 1. Falls and mobility problems: detection, evaluation, and intervention. (Adapted from[14].)

indirect evidence to support this practice was found: falls are frequently undetected, people who fall are at increased risk of recurrent falls, and falls are potentially preventable. Detecting falls is likely to prompt assessment and management of fall risk factors and reduce the likelihood of future falls.

A number of studies indicate that many problems (including falls) in the elderly population go undetected.[29–31] Falls are serious events that can, in addition to causing injury, be strong indicators of accelerating frailty and the presence of underlying risk factors that can be treated.[1,10] Moreover, patients and providers alike often ignore falls if no injury has occurred, thus missing important opportunities for potentially lifesaving evaluation and treatment. A cornerstone of most fall-prevention programs is identifying risk factors, one of the strongest of which is previous falling. Inquiring regularly about recent falls can help to detect this risk factor and lead to appropriate evaluations and interventions. A systematic review and meta-analysis of randomized, controlled trials (RCTs) of interventions to prevent falls has shown that multifactorial falls-risk assessment and management programs are effective in reducing the risk and rate of falling.[32]

Multifactorial Falls-Risk Assessment

A recent meta-analysis demonstrated the benefit of a multifactorial approach to assessing and intervening on falls. In this meta-analysis, the pooled adjusted risk ratio for a first fall in subjects enrolled in multifactorial programs relative to controls was 0.82 (95% confidence interval (CI) = 0.72–0.94); the pooled adjusted incidence rate ratio for any fall was 0.63 (95% CI = 0.49–0.83). The result was 11.8 fewer falls per 100 person-months in intervention than in control groups.[32] Several components were common to the multifactorial interventions studied and are reflected in the ACOVE-3 QIs for evaluating falls: medication review, assessment of basic and instrumental activities of daily living, orthostatic blood pressure measurement, vision assessment, gait and balance evaluation, cognitive evaluation, and assess-

ment and modification of environmental hazards. Below, additional evidence relevant to each individual indicator that is part of the multifactorial falls risk assessment is detailed.

Basic Fall History (Including Medication Review and Functional Status)

2. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of a basic fall history (circumstances, medications, chronic conditions, mobility, alcohol intake) within 3 months of the report (or within 4 weeks of the report if the most recent fall occurred in the previous 4 weeks), **BECAUSE** a basic fall history provides the necessary information to implement an individualized multifactorial falls-risk intervention strategy.

Supporting Evidence

Of the 13 studies included in the meta-analysis of multifactorial falls interventions that showed a reduction in the fall rate, 11[33–43] performed a medication review, and seven[38–44] gathered information on basic or instrumental activities of daily living.

Three additional RCTs of multifactorial interventions to decrease the risk of falls (not included in the meta-analysis) performed a medication review as part of their evaluation;[25,26,45]although crude fall outcomes were favorable to the intervention group in all cases, statistically significant results were infrequent among the various fall outcomes examined (number of fallers,[25,26,45] number of falls,[25,26,45] and mean time to first fall[45]).

One clinical practice guideline recommends a multifactorial fall-risk reduction program for individuals at greater risk of falling, without specifying what data should be gathered for the fall history.[46] Another recommends prioritization of multifactorial interventions but does not make recommendations regarding fall history.[47] A third guideline recommends a fall evaluation for individuals who require medical attention because of a fall, report recurrent falls in the previous year, or demonstrate abnormalities of gait or balance.[48] Included in this fall evaluation are an assessment of fall circumstances, medications, acute or chronic medical problems, and mobility levels. A fourth guideline recommends multifactorial risk assessment for the same categories of patients, noting that multifactorial risk assessment may include identification of fall history, assessment of functional ability, and medication review.[49]

Alcohol consumption was found to be a significant and relevant risk factor for injurious falls in a cohort study.[50] Alcohol use has also been found to be a risk factor for older adults presenting to the emergency department with a fall,[51–53] particularly in those younger than 70,[51] although there was no association between alcohol consumption and all falls in another study.[9]

Orthostatic Vital Signs

3. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of orthostatic vital signs (blood pressure and pulse) within 3 months of the report (or within 4 weeks of the report if the most recent fall occurred in the previous 4 weeks), **BECAUSE** detection and treatment of orthostatic hypotension decreases the risk of future falls as part of a multifactorial intervention.

Supporting Evidence

Of the 13 studies included in a meta-analysis of multifactorial falls interventions that showed a reduction in the fall rate, seven[33,34,37,40–43] assessed orthostatic blood pressure.

An additional three RCTs of multifactorial interventions to decrease the risk of falls (not included in the meta-analysis) assessed orthostatic vital signs[25,26,45] as part of their evaluation; although crude fall outcomes were favorable to the intervention group in all cases, statistically significant results were infrequent among the various fall outcomes examined.

Several large cohort studies in community-dwelling adults[6–9] have gathered information on orthostatic hypotension and the risk of falls. In two studies,[6,8] there was no association at the bivariate level between orthostatic hypotension and falls; in the other two studies,[7,9] there was an association at the bivariate level but not at the multivariate level.

One clinical practice guideline recommends prioritization of multifactorial interventions, including correction of postural hypotension.[47] Another guideline recommends assessment of postural pulse and blood pressure as part of a fall evaluation for individuals who require medical attention because of a fall, report recurrent falls in the previous year, or demonstrate abnormalities of gait or balance.[48] A third guideline recommends multifactorial risk assessment for the same categories of patients, noting that multifactorial risk assessment may include cardiovascular examination but without mentioning orthostatic hypotension specifically.[49]

Visual Acuity Testing

4. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of receipt of an eye examination in the previous year or evidence of visual acuity testing within 3 months of the report, **BECAUSE** detection and treatment of some forms of visual impairment reduces the risk of falls.

Supporting Evidence

Of the 13 studies included in the meta-analysis of multifactorial falls interventions that showed a reduction in the fall rate, eight included some assessment of visual acuity. The type of assessment and what was done with the information varied from study to study. In the meta-analysis, it was not possible to discern which components of the multifactorial assessment were responsible for the reduction in the risk of falling.

An additional three RCTs of multifactorial interventions to decrease the risk of falls (not included in the meta-analysis) assessed vision[25,26,45] as part of their evaluation; although crude fall outcomes were favorable to the intervention group in all cases, statistically significant results were infrequent among the various fall outcomes examined.

One RCT[54] specifically assessed the effect of expedited versus routine surgery for cataracts in women aged 70 and older on the risk of falls. The median time from randomization to surgery was 27 days for the expedited surgery group (range 71–212 days) and 337 days for the routine

surgery group (range 133–485 days). Over 1 year of follow-up, 49% of patients in the expedited surgery group fell at least once, compared with 45% of control patients. Over the same period, 18% of the expedited group fell at least twice, compared with 25% of control patients (hazard ratio = 0.60, 95% CI = 0.36–0.98, $P = .04$). The rate of falling was 1.00 per 1,000 patient-days in the expedited group and 1.52 per 1,000 patient-days in the control group (rate ratio = 0.66, 95% CI = 0.45–0.96). Measures of visual function improved in the expedited group and declined in the control group.

One cohort study demonstrated a greater risk of falls, in multivariate analysis, in individuals who lost visual acuity.[55] Of four cohort studies assessing multiple risk factors for falls,[6–9] visual acuity was a risk factor for falls in multivariate analysis in one.[6]

One clinical practice guideline recommends vision assessment as part of a fall evaluation for individuals who require medical attention because of a fall, report recurrent falls in the previous year, or demonstrate abnormalities of gait or balance.[48] Another guideline recommends multifactorial risk assessment for the same categories of patients, noting that multifactorial risk assessment may include assessment of visual impairment.[49]

Gait and Balance Evaluation for Falls and Mobility Disorders

5. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of a basic gait, balance, and strength evaluation within 3 months of the report (or within 4 weeks of the report if the most recent fall occurred in the previous 4 weeks);
6. IF a VE has new or worsening difficulty with ambulation, balance, or mobility, **THEN** there should be documentation of a basic gait, balance, and strength evaluation within 3 months of the report;

BECAUSE detection and treatment of gait and balance disorders reduces the risk of future falls as part of a multifactorial intervention.

Supporting Evidence

Of the 13 studies included in the meta-analysis of multifactorial falls interventions that showed a reduction in the fall rate, six[37,39–43] performed an assessment of balance and gait.

An additional three RCTs of multifactorial interventions to decrease the risk of falls (not included in the meta-analysis) assessed gait or balance[25,26,45] as part of their evaluation; although crude fall outcomes were favorable to the intervention group in all cases, statistically significant results were infrequent among the various fall outcomes examined.

Of four cohort studies that assessed multiple risk factors for falls,[7,8,9] abnormalities of gait or balance were significant predictors of falls in multivariate analysis in three.[6]

One clinical practice guideline recommends prioritization of multifactorial interventions, including interventions to improve balance, transfers, and gait.[47] Another guideline recommends assessment of gait and balance as part of a fall evaluation for individuals who require medical attention because of a fall, report recurrent falls in the previous year, or demonstrate abnormalities of gait or balance.[48] A third guideline recommends multifactorial risk assessment for the same categories of patients, noting that multifactorial risk assessment may include assessment of gait, balance and mobility, and muscle weakness.[49]

Cognitive Assessment

7. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of an assessment of cognitive status in the previous 6 months or within 3 months of the report (or within 4 weeks of the report if the most recent fall occurred in the previous 4 weeks), **BECAUSE** detection and management of cognitive impairment reduces the risk of falls as part of a multifactorial intervention.

Supporting Evidence

Of the 13 studies included in the meta-analysis of multifactorial falls risk assessment that showed a reduction in the fall rate, six[38–43] included some form of cognitive evaluation, of which four[39–42] specifically mention using the Mini-Mental State Examination.

In one additional RCT of multifactorial falls risk assessment not included in the meta-analysis,[25] assessment of cognition had no statistically significant effect on falls, although there were fewer falls and fallers in the intervention group.

Of four cohort studies assessing multiple risk factors for falls,[6–9] one[9] found cognitive impairment to be a risk factor in multivariate analysis, and another found cognitive impairment to be a risk factor for falls when only clinical predictors (as opposed to clinical and functional predictors together) were considered.[7]

One clinical practice guideline recommends assessment of mental status as part of a fall evaluation for individuals who require medical attention because of a fall, report recurrent falls in the previous year, or demonstrate abnormalities of gait or balance.[48] Another guideline recommends multifactorial risk assessment for the same categories of patients, noting that multifactorial risk assessment may include assessment of cognitive impairment.[49]

Home Hazard Assessment and Modification

8. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year, **THEN** there should be documentation of an assessment and modification of home hazards recommended in the previous year or within 3 months of the report, **BECAUSE** environmental factors can contribute to risk of falls and mobility problems, and an assessment and modification of home hazards may decrease this risk.

Supporting Evidence

The review identified a number of controlled trials supporting the concept of environmental evaluation for frail elderly persons, particularly for those who are fall-prone or who have difficulty with ambulation. In an RCT of more than 3,000 persons, the intervention group that received an in-home safety–mobility assessment experienced significantly fewer falls (odds ratio of falling was reduced from 1.0 to 0.85, or about 15%).[56] A second study of environmental assessment and modification using an occupational

therapist found significant reductions in the 12-month risk of falling (relative risk (RR) of at least one fall during follow-up 0.64, 95% CI = 0.50–0.83) in older adults with greater risk for falling.[57–60] A recent randomized trial comparing a home safety program and a home exercise program in older adults with severe visual impairment showed significantly fewer falls in the group randomized to the home safety program (incidence rate ratio = 0.59, 95% CI = 0.42–0.83) but not in the home exercise group.[61] A recent meta-analysis[32] found that the relative effectiveness of environmental modification programs trended toward falls risk and falls rate reduction but did not reach statistical significance based on the six studies included.[57,58,60,62–64] Finally, a systematic review combining three trials found that professionally prescribed home hazard assessment and modification in older adults with a history of falling reduced the risk of falling (RR = 0.66, 95% CI = 0.54–0.81).[65]

Benzodiazepine Discontinuation

9. IF a VE reports a history of two or more falls (or one fall with injury) in the previous year and is taking a benzodiazepine, **THEN** there should be documentation of a discussion of related risks and assistance offered to reduce or discontinue benzodiazepine use, **BECAUSE** benzodiazepine use increases the risk of future falls.

Supporting Evidence

One RCT[66] specifically addressed the withdrawal of psychotropic medications in 93 ambulatory individuals aged 65 and older who were taking a benzodiazepine, any other hypnotic, or any antidepressant or major tranquilizer. Subjects were randomized to medication withdrawal plus exercise, medication withdrawal only, exercise only, or no intervention. Over 44 weeks, medication withdrawal groups had a lower rate of falls (0.52 vs 1.16 falls per person-year, difference = 0.64, 95% CI = 0.07–1.35), although this was not statistically significant. After adjusting for a history of falls in the previous year and the total number of medications taken, the relative hazard for falls in the medication withdrawal group was 0.34 (95% CI = 0.16–0.74). Controlling for benzodiazepine use and antidepressant use did not change the magnitude or statistical significance of the above result. One month after study completion, 47% (8/17) of participants from the medication withdrawal group restarted taking psychotropic medication.

A meta-analysis of observational studies[67] demonstrated a pooled odds ratio for the association between benzodiazepines and falls of 1.40 (95% CI = 1.11–1.76) in cohort studies, 2.57 (95% CI = 1.46–4.51) in case-control studies, and 1.34 (95% CI = 0.95–1.88) in cross-sectional studies.

One clinical practice guideline recommends medication review,[48] with particular attention to review of and potential modification of psychotropic medications. Another guideline[49] states that older individuals taking psychotropic medications should have them reviewed, and discontinued if appropriate, to reduce fall risk. A third guideline[47] recommends "rationalisation of drugs if possible."

Assistive Device

10. IF a VE demonstrates poor balance or proprioception or excessive postural sway and does not have an assistive device, **THEN** an evaluation or prescription for an assistive device should be offered within 3 months, **BECAUSE** impaired balance or proprioception or excessive postural sway can contribute to instability, and appropriate treatment will reduce the likelihood of falls and their complications.

11. IF a VE reports a history of two or more falls (or 1 fall with injury) in the previous year and has an assistive device, **THEN** there should be documentation of an assistive device review in the previous 6 months or within 3 months of the report (or within 4 weeks of the report if the most recent fall occurred in the previous 4 weeks), **BECAUSE** a poorly fitted assistive device or one used inappropriately along with impaired balance or proprioception or excessive postural sway can contribute to instability, and the appropriate use of an assistive device will reduce the likelihood of falls and their complications.

Supporting Evidence

A number of studies suggest that assistive devices can increase an older adult's confidence, reduce fear of falling, and improve independence,[68–70] although the relationship between assistive devices and the risk of falls is not clear. Some studies suggest that the use of the devices may increase the risk of falling,[71,72] whereas others suggest that assistive device use is a marker for falls risk.[73]

Exercise Programs

12. IF a VE is found to have a problem with gait, balance, strength, or endurance, **THEN** there should be documentation of a structured or supervised exercise program offered in the previous 6 months or within 3 months of the report, **BECAUSE** these problems can contribute to falls and mobility dysfunction, and exercise intervention can improve or ameliorate them and reduce the likelihood of falls and their complications.

Supporting Evidence

There is ample evidence of a significant association between muscle strength and functional gait parameters in various populations, including elderly people.[74–78] Three of six RCTs evaluating the effects of exercise on gait parameters in elderly people specifically examined the effects of strength training on gait parameters in the elderly. Two studies[79,80] found that, after strength training, elderly adults (aged $\geq$60) did not improve gait velocity or other objective measures of ambulation. In contrast, another study found that greater lower extremity strength was related to better gait speed.[81] A separate study demonstrated that lower extremity muscle strength was related to ability to rise from a chair.[82] Two RCTs evaluated the effects of a walking and endurance program on gait characteristics in elderly adults (average age 70).[83,84] These studies reported significant increases of 5% to 15% in ambulatory function after 8- to 12-week interventions.

Three studies specifically examined balance training. The findings of the two randomized trials demonstrated improvements of 20% to 50% in various force-plate balance parameters in older adults (aged $\geq$65).[85,86] An addi-

tional study reported a 32% improvement in balance parameters (postural-sway velocities) in young adults participating in tai chi, but there was no comparison group.[87] A randomized trial of a tai chi group exercise intervention also found a significant reduction in the risk of falls (OR = 0.51, 95% CI = 0.36–0.73).[88] A more recent study by the same group found a nonsignificant trend for a reduction in falls (RR = 0.75, 95% CI = 0.52–1.08).[89]

Four studies specifically examined the effects of aerobic and endurance exercise on improvements in balance. One found an inverse relationship between aerobic and anaerobic capacities and balance indicators; greater aerobic capacity was associated with less postural sway in subjects aged 50 to 55.[90] Three RCTs evaluated the effects of aerobic activity on balance in elderly persons (aged ≥70) and found that subjects in the conditioning groups demonstrated an improvement in balance of approximately 20%.[91]

One RCT specifically examined the effect of strengthening exercises on balance parameters, but found no effect.[80]

Eight RCTs in adults aged 65 and older evaluated balance outcomes of multidimensional exercise programs. Five of these studies demonstrated an average improvement in balance parameters of approximately 20%.[37,77,92–94] One study found an inconsistent exercise effect on balance measures,[95] and one found no improvement.[96]

Apart from the influence of exercise on measures of balance, several studies have reported fall reductions after exercise programs. A preplanned meta-analysis of the seven Frailty and Injuries: Cooperative Studies on Intervention Techniques (FICSIT) trials reported that treatments including exercise resulted in significant reduction in the risk of a fall or increased time to a fall (incidence ratio = 0.90, 95% CI = 0.81–0.99).[97]

Two RCTs reported that general, home-based exercises (strengthening, balance, and gait) reduced falls 9% and 35% in an elderly population (aged ≥70).[98,99] By contrast, two other RCTs did not show a significant reduction in falls agter a multidimensional exercise program.[77]

Recent systematic analyses suggest that exercise interventions are effective at reducing the risk of falling (RR = 0.86, 95% CI = 0.75–0.99).[32,33,58,63,100–103] Another systematic review found that individualized strength and balance retraining by a trained health professional reduced the risk of falls 20% (RR = 0.80, 95% CI = 0.66–0.98).[99]

These studies support the use of exercise to improve measures of balance and reduce the incidence of falls. It would appear that the use of a multidimensional exercise program that incorporates balance training and strengthening should improve postural stability and reduce the risk of falling in elderly people.

DISCUSSION

There are many risk factors for falls in older adults, especially in the high-risk population of VEs. Many approaches to treatment exist and are effective but only if the underlying risks are recognized using a comprehensive approach. These 12 updated QIs were judged sufficiently valid for use as measures for the quality of fall and mobility disorder detection and management in community-dwelling VEs. These indicators can potentially serve as a basis by which different providers, medical groups, and health plans can measure and compare the quality of falls care and measure changes in the quality of care delivered over time. Future improvements in the quality of falls care should help lead to measurable changes in falls outcomes: fewer falls and preservation of function and independence.

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