

REVIEW ARTICLE (META-ANALYSIS)

# Physical Exercise Interventions for Improving Performance-Based Measures of Physical Function in Community-Dwelling, Frail Older Adults: A Systematic Review and Meta-Analysis



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## Abstract

**Objective:** To conduct a systematic review to determine the efficacy of exercise-based interventions on improving performance-based measures of physical function and markers of physical frailty in community-dwelling, frail older people.

**Data Sources:** Comprehensive bibliographic searches in MEDLINE, the Cochrane Library, PEDro, and CINAHL databases were conducted (April 2013).

**Study Selection:** Randomized controlled trials of community-dwelling older adults, defined as frail according to physical function and physical difficulties in activities of daily living (ADL). Included trials had to compare an exercise intervention with a control or another exercise intervention, and assess performance-based measures of physical function such as mobility and gait, or disability in ADL.

**Data Extraction:** Two review authors independently screened the search results and performed data extraction and risk of bias assessment. Nineteen trials were included, 12 of them comparing exercise with an inactive control. Most exercise programs were multicomponent.

**Data Synthesis:** Meta-analysis was performed for the comparison of exercise versus control with the inverse variance method under the random-effects models. When compared with control interventions, exercise was shown to improve normal gait speed (mean difference [MD] = .07m/s; 95% confidence interval [CI], .04–.09), fast gait speed (MD = .08m/s; 95% CI, .02–.14), and the Short Physical Performance Battery (MD = 2.18; 95% CI, 1.56–2.80). Results are inconclusive for endurance outcomes, and no consistent effect was observed on balance and the ADL functional mobility. The evidence comparing different modalities of exercise is scarce and heterogeneous.

**Conclusions:** Exercise has some benefits in frail older people, although uncertainty still exists with regard to which exercise characteristics (type, frequency, duration) are most effective.

Archives of Physical Medicine and Rehabilitation 2014;95:753-69

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As individuals get older, they may reach a stage of vulnerability called frailty that precedes and predisposes to disability and physical dependence. The terms *frail* and *frailty* are often used in the literature without clear definition or criteria,<sup>1</sup> and there is not yet a consensus on a standardized and valid method of clinically

screening for frailty.<sup>2,3</sup> Frailty is considered highly prevalent in old age and to confer a high risk for falls, worsening mobility, disability, hospitalization, and mortality.<sup>4</sup>

Two main definitions of frailty exist. The first one relates frailty to a physical phenotype consisting of solely physical components and has attracted the most attention of researchers.<sup>4</sup> The most well known of these is the frailty phenotype described by Fried et al,<sup>5</sup> which identifies someone as frail when 3 or more of the following criteria are present: unintentional weight loss,

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self-reported exhaustion, weakness, slow walking speed, and low levels of physical activity. The second definition has a broader scope and conceptualizes frailty as the result of multiple interacting factors such as having difficulties in activities of daily living (ADL), and social and psychological aspects.<sup>6</sup> This definition was operationalized into the Frailty Index,<sup>7</sup> built as a sum of deficits and able to capture gradations in health status ranging from mild to severe stages, and the risk of adverse outcomes.<sup>8</sup>

A review of the literature by Gobbens et al<sup>9</sup> showed that frailty affects multiple domains of functioning. These include gait and mobility, balance, muscle strength, motor processing, cognition, nutrition (often operationalized as nutritional status or weight change), endurance (including feelings of fatigue and exhaustion), and physical activity.

Frailty is common in older adults (>65y), but different operationalization of frailty status results in widely differing prevalences between studies. In a recent systematic review,<sup>10</sup> the weighted prevalence was 9.9% for physical frailty and 13.6% for the broad definition of frailty. The design of effective interventions to prevent or delay functional decline and disability in older persons is a public health priority. Most likely to benefit from such interventions are community-dwelling frail individuals, without disability or with only early disability, and who are at high risk of becoming functionally dependent.<sup>11</sup> Frail individuals who are institutionalized or hospitalized present a more deteriorated health status and functioning<sup>12</sup> and may need different types of interventions to prevent or minimize complications.

The benefits of exercise in delaying physical dependence in an elderly population have long been recognized,<sup>13,14</sup> and randomized controlled trials<sup>15,16</sup> have shown promising early results of physical exercise. Exercise seems to be beneficial in improving physical functions, such as sit-to-stand performance, balance, agility, and ambulation, in older adults.<sup>17-19</sup> Although there are 6 systematic reviews<sup>2,20-24</sup> exploring the benefits of exercise in frail older adults, a definite conclusion has not yet been reached. Four of the reviews<sup>20,22-24</sup> applied a very broad definition of frailty that included both nonfrail and prefrail participants. The other 2 reviews<sup>2,21</sup> applied consistent definitions of frailty but need to be updated with studies published recently in community-dwelling populations. The most recent reviews<sup>23,24</sup> did not identify some of the studies included in the present review, and both also included non-performance-based measures as main outcomes.

This systematic review aims to integrate the most current evidence on the effect of exercise interventions on improving performance-based measures of physical function and markers of physical frailty in community-dwelling older people defined as frail according to physical function and physical difficulties in ADL. Specifically, we aimed to (1) examine the effectiveness of exercise compared with control interventions; (2) determine which exercise modalities are most effective; and (3) determine whether there are adverse effects within the exercise interventions.

#### **List of abbreviations:**

<b>ADL</b>	<b>activities of daily living</b>
<b>BBS</b>	<b>Berg Balance Scale</b>
<b>CI</b>	<b>confidence interval</b>
<b>MD</b>	<b>mean difference</b>
<b>RCT</b>	<b>randomized controlled trial</b>
<b>SPPB</b>	<b>Short Physical Performance Battery</b>
<b>TUG</b>	<b>Timed Up and Go</b>

## **Methods**

We included randomized controlled trials (RCTs) evaluating the effect of physical exercise programs with or without other components on functional performance-based measures of physical function among community-dwelling, frail older adults. Inclusion criteria were as follows: participants should be (1) 65 years and older; (2) living in the community; and (3) defined as frail according to standardized criteria (eg, Fried's), or considered frail according to reduced physical function measured with physical performance scales (eg, Short Physical Performance Battery [SPPB]) or performance-based measures such as gait and mobility, muscle strength, nutritional intake, weight change, balance, endurance, fatigue, and physical activity. Participants either had to have limitations in 2 or more performance-based frailty measures or had to have clinically significant limitations in a single measure. Exclusion criteria were as follows: (1) inclusion of participants with disability (eg, advanced disability in performing ADL, dementia, or end-stage disease); (2) inclusion of prefrail participants (eg, those with nonsignificant impairment in frailty indicators); (3) inclusion of institutionalized participants; and (4) crossover design studies.

Primary outcomes were performance-based measures of physical function such as mobility, gait, muscular strength, balance, endurance, and disability in ADL. Secondary outcomes were number of falls; institutionalization; adverse effects of the exercise program such as falls, fractures, tendinitis, or muscular soreness; health-related quality of life; symptoms of depression; hospitalization; and death.

Searches were conducted in MEDLINE, The Cochrane Library, PEDro, and CINAHL databases (April 2013). All databases were searched using free text and descriptors. The search strategy was adapted for each database, including terms for frailty, older people, multiple expressions of exercise, and limiting for randomized controlled trial; the full search strategy is included in [supplemental appendix S1](#) (available online only at <http://www.archives-pmr.org/>). The search results were treated using bibliographic management software (Bibioscape 7.41<sup>a</sup>), allowing for duplicate consolidation and further refining of the article list. In addition, reference lists from previous systematic reviews<sup>19,21,22,25</sup> on exercise for the elderly were hand searched to identify trials on frail community-dwelling individuals. Two review authors (M.R., M.S., L.C., or M.G.) independently screened the search results and performed data extraction and risk of bias assessment. Any discrepancies were resolved by consensus or consulting with a third author.

We used the tool for assessing risk of bias proposed by the Cochrane Collaboration.<sup>26</sup> For each trial, we assessed the risk of bias of the following domains: random sequence generation, allocation concealment, blinding of assessments, incomplete outcome data, and selective outcome reporting. For each trial, an overall assessment of risk of bias was derived as low, high, or unclear based on the previous assessments. If any domain was at high risk of bias, the trial was considered to be at high risk of bias. Trials with 4 or 5 domains at low risk of bias were considered to be at low risk of bias. Otherwise, risk of bias of the trial was considered to be unclear.

We pooled data as presented in the original trials, either as intention to treat or not. Heterogeneity was assessed with the  $I^2$  statistic, considering values greater than 50% as a sign of relevant heterogeneity. The effect of treatment was estimated by mean

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