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## Original Study

## Interventions for Treating Sarcopenia: A Systematic Review and Meta-Analysis of Randomized Controlled Studies



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## A B S T R A C T

**Keywords:**  
Sarcopenia  
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**Background:** Much interest has been focused on interventions for treating sarcopenia; however, the effects have gained little evidence.

**Objective:** To analyze the effectiveness of exercise, nutritional, drug, and combinational interventions for treating sarcopenia in older people.

**Method:** We systematically searched MEDLINE via PubMed, the Cochrane Library of Cochrane Reviews and Cochrane Central Register of Controlled Trials, and Ichushi-Web for randomized controlled trials (RCTs) from January 2000 to December 2016. We have assessed the type of intervention, the cohort used, the way sarcopenia was diagnosed, the outcomes, and the quality of evidence. We meta-analyzed the outcomes with the net difference between-group treatment from baseline to the end of the study.

**Results:** We screened a total of 2668 records and included seven RCTs that investigated the effects of exercise (4 RCTs), nutrition (5 RCTs), drug (1 RCT), and combination (4 RCTs) on muscle mass, strength, and function in older people with sarcopenia. Very low to low-quality evidence suggests that (1) exercise interventions may play a role in improving muscle mass, muscle strength, and walking speed in 3 months of intervention; (2) nutritional interventions may be effective in improving muscle strength in 3 months of intervention; (3) as drug intervention, selective androgen receptor modulator had no clear effect on muscle mass, strength, and physical function; and (4) a combined intervention of exercise and nutrition may have positive effects in improving the walking speed in 3 months of intervention.

**Conclusion:** Our systematic review and meta-analysis showed some positive effects of exercise and nutritional interventions for treating sarcopenia in older people, although the quality of the evidence was low. Future high-quality RCTs should be implemented to strengthen the results.

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Sarcopenia—the age-related loss of skeletal muscle mass, strength, and function<sup>1,2</sup>—is a common clinical problem in older people and often leads to severe adverse outcomes. The growing interest of sarcopenia has highlighted the need to understand more about its management. The preservation or improvement of physical function and independent living are vital in frail older adults,<sup>3</sup> and sarcopenia is a major contributor to physical frailty.<sup>4</sup> Several definitions of sarcopenia have been globally proposed thus far,<sup>5–12</sup> although no consensus has been reached. Moreover, sarcopenia is now recognized as an independent condition by an ICD-10-CM code.<sup>13</sup>

Although the awareness of the clinical importance of sarcopenia has increased, the implementation of therapeutic interventions for sarcopenia remains challenging. Exercise and nutrition have been found to be effective for treating different conditions in various populations of adults and older people; however, the evidence of the effects of such treatment is scarce.<sup>5,14</sup> In the present study, we aimed to assess the effectiveness of exercise, nutritional, drug, and their combinational interventions for treating sarcopenia in older people, particularly reported in randomized controlled trials (RCTs).

## Materials and Methods

We performed this systematic review in accordance with the PRISMA guidelines.<sup>15</sup> The protocol of this systematic review is registered at PROSPERO, as CRD42017054215.

### Review Questions

(1) Does exercise intervention improve the muscle mass, strength, and physical function of older people with sarcopenia? (2) Does nutritional intervention improve the muscle mass, strength, and physical function of older people with sarcopenia? (3) Does drug intervention improve the muscle mass, strength, and physical function of older people with sarcopenia? and (4) Does a combined intervention improve the muscle mass, strength, and physical function of older people with sarcopenia?

### Search Strategy

A systematic search was conducted on the MEDLINE via PubMed, Cochrane Library of Cochrane Reviews (CDSR) and Cochrane Central Register of Controlled Trials (CENTRAL), and Ichushi-Web (Igaku Chuo Zasshi; Japan Medical Abstracts Society)<sup>16</sup> databases to identify suitable articles from January 2000 to December 2016 (see [Supplementary Material](#) for details on the search strategies). Moreover, a manual search of the reference lists of relevant reviews and articles included in the systematic review was performed. We did not apply any language restrictions.

### Types of Study to Be Included

We included RCTs to assess the effects of different treatments, including nutritional, exercise, and drug treatments, and their combination, in the treatment of sarcopenia. We also included trials that could not be analyzed on an intention-to-treat basis, and those that lacked blinding or placebo treatment use.

### Types of Participants: Inclusion and Exclusion Criteria

We included all studies with older individuals diagnosed with sarcopenia. The studies included in this review provided the definition of sarcopenia based on the assessment of muscle mass, with or without muscle strength or physical performance. We expected that the participants would be diagnosed based on the definitions of the European Working Group on Sarcopenia in Older People (EWGSOP),<sup>2</sup> the Asian Working Group for Sarcopenia (AWGS),<sup>12</sup> or others.

We excluded the cases with the following conditions: not elderly, or those with decreased functional status due to other specific health conditions, such as cancer, diabetes, AIDS, chronic heart failure, chronic obstructive pulmonary disease, kidney failure, liver cirrhosis, rheumatoid arthritis, anorexia, recent surgery or transplant, or severe neurologic or cognitive disorders.

### Types of Interventions

All types of exercise, nutritional, and drug interventions for the treatment of sarcopenia were included for assessment and were compared.

### Types of Outcomes

The primary outcome was muscle mass (eg, appendicular skeletal muscle, skeletal muscle mass index, and lean body mass). The secondary outcomes included muscle strength (eg, handgrip strength, knee extension strength) and physical function (eg, walking speed).

### Data Extraction

The full texts were read if the study was found to be eligible by at least 1 reviewer, and at least 2 reviewers (each from Y.Y., H.W., or M.Y.) then evaluated the eligibility of the retrieved full-text studies. Consensus on inclusion was reached via discussion among the reviewers. The excluded studies and the reasons for exclusion are listed. Any disagreements were resolved via a discussion. The following data were extracted from the included studies: (1) author,

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Kim 2012	+	+	-	+	+	?	?
Kim 2013	+	+	-	+	+	?	?
Kim 2016	+	?	-	-	+	?	?
Maltais 2016	+	?	-	-	+	?	?
Papanicolaou, 2013	?	?	+	?	?	?	?
Wei 2016	+	?	?	?	?	?	+
Zdzieblik 2015	+	?	-	-	+	?	?

**Fig. 1.** Risk of bias summary of interventions: review authors' judgments about each risk of bias item for each included study.

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