Maturitas 116 (2018) 24–35

Contents lists available at ScienceDirect

Maturitas

journal homepage: www.elsevier.com/locate/maturitas

Effect of exercise alone or combined with dietary supplements on anthropometric and physical performance measures in community-dwelling elderly people with sarcopenic obesity: A meta-analysis of randomized controlled trials

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ARTICLE INFO

Keywords:
Elderly
Dietary supplement
Exercise
Meta-analysis
Obesity
Physical performance
Sarcopenia
Sarcopenic obesity

ABSTRACT

Objective: To evaluate the effect of exercise (EXE) alone or exercise combined with dietary supplements (EXE-SUPPL) on body composition and physical performance in subjects 60 years and older with sarcopenic obesity.
Methods: A systematic review was carried out of studies identified through five search engines up to April 15, 2018. We searched for randomized controlled trials (RCTs) evaluating EXE or EXE-SUPPL in elderly individuals with sarcopenic obesity for at least six weeks. Primary outcomes were percentage of body fat mass, appendicular skeletal muscle mass, and hand grip strength. Random effects meta-analyses with the inverse variance method were used to evaluate the effects of interventions on outcomes. Effects were expressed as mean differences (MD) and their 95% confidence intervals (CI). Risk of bias was assessed with the Cochrane tool.
Results: Nine papers reporting seven RCTs (with a total of 558 participants) were included in the review. EXE alone and EXE-SUPPL increased grip strength (MD 1.30 kg; 95% CI 0.58–2.01), gait speed (MD 0.05 m/s; 95% CI 0.03–0.07) and appendicular skeletal muscle mass (MD 0.40 kg; 95% CI 0.18–0.63). EXE alone and EXE-SUPPL reduced waist circumference (MD −1,40 cm; 95% CI −1.99 to −0.81), total fat mass (MD −1,77 kg; 95% CI −2.49 to −1.04), and trunk fat mass (MD −0.82 kg; 95% CI −1.22 to −0.42).
Conclusion: EXE alone and EXE-SUPPL improved muscle-related outcomes and reduced fat-related outcomes in subjects with sarcopenic obesity. There is a need for better-designed RCTs with systematic assessment of both different exercise regimes and dietary supplements in sarcopenic obese subjects.

1. Introduction

Aging is associated with changes in body composition, insulin resistance, excessive weight, dynapenia, sarcopenia, and frailty [1–3]. Age-related abdominal fat mass accumulation and muscle weakness are major medical concerns due to negative influence on health outcomes such as cardiometabolic factors, disability and mortality risk [4–7]. At the same time, muscle disuse is a major cause of loss of muscle mass and strength [1]. Regarding the diagnostic criteria of sarcopenia, several working groups have proposed the presence of decreased skeletal muscle mass, either alone or with low muscle strength and/or diminished physical performance [8,9]. Due to the inverse relationship between fat accumulation and muscle atrophy, the term sarcopenic obesity has been coined. This condition is highly prevalent among subjects older than 60 years [10,11].

Appendicular skeletal muscle mass and total body fat predict physical limitations, type 2 diabetes, cardiovascular risks and mortality [12]. Insulin resistance plays a major role in adipose accumulation, muscle fiber atrophy and mitochondrial dysfunction [2,10,13]. Obesity-related lipotoxicity, elevated oxidative stress and release of pro-inflammatory cytokines may also contribute to the pathological status [14].

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https://doi.org/10.1016/j.maturitas.2018.07.007
Received 18 June 2018; Received in revised form 11 July 2018; Accepted 18 July 2018
0378-5122/

Physical activity and programmed exercise may partly neutralize insulin resistance and associated metabolic changes in midlife and older subjects [14–16]. Muscle disability may be reduced by programmed physical exercise and supplementary nutrition such as whey protein, amino acids (arginine, glutamine, leucine or its active metabolite beta-hydroxy-beta-methylbutyrate), cholecalciferol or catechin, may improve muscle function [11,17,18]. Different exercise and nutrition programs had been recommended to overcome sarcopenic obesity-related risks. However, there are contradictory results about their effectiveness to reduce skeletal and metabolic complications [11,19].

The objective of our study was to systematically review randomized controlled trials (RCTs) and meta-analyze effects of exercise alone or exercise plus dietary supplements on body composition and muscle function in elderly individuals with sarcopenic obesity.

2. Methods

The systematic review was undertaken following the principles of the PRISMA guidelines [20].

2.1. Systematic search strategy

A systematic literature search was conducted on CINAHL, Cochrane Plus, PubMed, SCOPUS, Web of Science databases through April 15, 2018, and limited to English language (FHC, AMA). We searched for free terms “sarcopenic obesity” OR “sarcobesity” OR “sarcopenic obese” OR “obese sarcopenia” OR the Medical Subject Heading (MeSH) terms “sarcopenia” AND “obesity” combined with “exercise” (MeSH) OR "training” OR “physical”. The PubMed search strategy is available in the Appendix A. An iterative process was used to ensure all relevant articles were obtained. A further manual search of bibliographic references was carried out in selected studies and in existing reviews to identify potential studies not captured by the electronic database searches.

2.2. Inclusion and exclusion criteria

RCTs that investigated the effects of any exercise modalities alone or combined with dietary supplements, for at least 6 weeks, on body composition, muscle strength and physical performance in healthy community-dwelling men and/or women aged 60 years and older with sarcopenic obesity as defined by the authors. Sarcopenia criteria should include at least the presence of low skeletal muscle mass assessed by either appendicular fat free mass, total or appendicular skeletal muscle mass, relatives to height squared, weight or body mass index (BMI). Obesity was assessed by either BMI, percentage of body fat or visceral fat area. Individuals did not have severe disease (cancer, heart diseases, cognitive limitations, or caring for other persons) and had independent life. Also, body composition was assessed with bioelectrical impedance analysis (BIA) or dual-energy X-ray (DEXA), and control groups were defined as subjects who did not participate in programmed physical exercises and did not receive dietary supplements. Sarcopenic obesity was defined as the coexistence of both sarcopenia and obesity, as defined in the included RCTs (Table 1).

Studies were excluded due to the following reasons: (i) non-RCTs; (ii) lack of programmed physical exercises for at least 6 weeks; (iii) lack of body composition assessment with a validated instrument; and (iv) lack of a control group.

2.3. Pre-specified outcomes

Primary outcomes of this study: BMI (kg/m^2) validity to assess obesity status in older adults, especially in women, has been questioned [21], and thus percentage of body fat was analyzed as a primary outcome for obesity. Regarding the three sarcopenia diagnostic criteria [8] were also considered as primary outcomes (i) appendicular skeletal muscle mass (kg) assessed by summing the muscle mass of the four limbs; (ii) grip strength (kg) assessed by a hand dynamometer; and (iii) gait speed (m/s). These three primary outcomes representing muscle mass, muscle strength and physical performance, respectively.

Secondary outcomes included (i) weight (total body weight, kg), BMI (kg/m^2), waist circumference (cm); (ii) body composition endpoints as measured by standard BIA or DEXA: total body fat (kg), trunk fat mass (kg), visceral fat mass, total skeletal muscle mass (kg), skeletal muscle mass index, and other anthropometric endpoints as reported by the authors (Table 1).

2.4. Study selection and data extraction

Two authors (FHC, AMA) independently selected abstracts. Full-text articles that matched the eligibility criteria were screened to ensure they met the inclusion criteria (FRPL, DCD). Any disagreements between the reviewers were resolved by discussion until consensus was reached. Extracted data included (FHC, JBN): authors, year of publication, country, studied population (number, age, sex and group distribution), sarcopenic obesity screening (assessment techniques and criteria), obesity- and sarcopenia-related parameters (muscle mass and strength, physical performance) and other outcomes, description of the intervention procedures (type of exercises and/or nutritional supplements), measured time points, and dropouts reported in each study. Sarcopenic obesity participants were diagnosed according to the authors (Table 1).

2.5. Risk of bias assessment

The risk of bias among the included studies was assessed by two independent reviewers (FHC, FRPL) using the Cochrane risk of bias tool [22]. Disagreements were resolved by consulting a third reviewer (AVH) to reach a consensus. Categories included in the methodological assessment were 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), and other biases due to problems not covered elsewhere in the table. Each item was classified as low-risk, unclear-risk (specific details or description were not reported) or high-risk (not fulfilling the criteria). A study with at least one high risk item of randomization or blinding was judged as having high risk of bias.

2.6. Data synthesis and statistical analyses

Analyses were stratified by the type of intervention (EXE vs control, and EXE + dietary supplement (SUPPL) vs control). Mean differences (MDs) and standardized MDs (SMDs) and 95% confidence intervals (95% CIs) between intervention and control groups at follow up were calculated per RCT after adjusting for baseline values of outcomes. Individual MDs and SMDs were pooled using meta-analyses of random effects models and inverse variance method. SMDs were used when the units of continuous outcomes were not the same across studies. The magnitude of SMDs was considered “small” (0.20), “moderate” (0.50) or “large” (0.80) [23].

We evaluated statistical heterogeneity using the Cochrane chi square (X^2), the I^2 statistic, and the between-study variance using the tau-square (tau^2) with the DerSimonian and Laird estimator [24]. I^2 values of 0–30%, 30%–60%, and > 60% represented a low, moderate or high level of heterogeneity, respectively. A p-value < 0.1 for the chi-square defined the presence of heterogeneity; and a $tau^2 > 1$ defined the presence of substantial statistical heterogeneity [25,26]. Small study effects were evaluated with the funnel plot and Egger’s tests [27].

Depending on availability of data, subgroup analyses were planned according to the duration of intervention. We used the Review Manager software (RevMan 5.3; Cochrane Collaboration, Oxford, UK) [28] and the Comprehensive Meta-analysis (Version 2; Biostat, Englewood, NJ) [29] for statistical analyses.