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Effect of physical exercise cessation on strength, functional, metabolic and structural outcomes in older adults: a protocol for systematic review and meta-analysis

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ABSTRACT

Introduction There is not a doubt that tailored exercise is an effective non-pharmacological approach for preventing, mitigating and even reversing ageing-related alterations. However, older adults are likely to experience prolonged periods of inactivity and training cessation periods as a consequence of falls or hospitalisation. Although recent evidence supports that exercise could have a protective effect and help in recovering, there is to date a lack of consensus about what kind of physical exercise prescription and training duration would produce better outcomes after training cessation periods. The current study will determine the effects that available exercise prescriptions produced in older adults in preserving physical conditioning following inactivity periods.

Methods and analysis A systematic search of the literature will be conducted in three databases, namely PubMed, Scopus and Web of Science, from inception to 1 February 2021. Only randomised controlled trials written in English or Spanish will be eligible. No year of publication restriction will be applied. Eligible studies will contain information on population (older adults over 60 years old), intervention (inactivity period, exercise programme their duration), comparator (treatment as usual or waiting list) and outcomes (strength, functional capacity, metabolic health and skeletal muscle structure). Two independent reviewers will (1) search, screen and select studies, (2) extract data about their main characteristics and (3) evaluate their methodological and reporting quality. When disagreements emerge, the reviewers will discuss to reach a consensus. We plan to conduct meta-analysis to quantitatively synthesise the effects under study.

Ethics and dissemination As systematic reviews use publicly available data, no formal ethical review and approval are needed. Findings will be published in a peer-reviewed journal(s) and presented at conferences.

PROSPERO registration number CRD42021235092.

Strengths and limitations of this study

- This study will be conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.
- We will include randomised controlled trials in which older adults received an exercise prescription of any kind (resistance training, endurance training, concurrent training, multicomponent training) before a training cessation period of any duration (days, weeks or months).
- To assess the effect of training cessation, standardised mean differences (Hedges' g) between the exercise and control groups will be calculated for each outcome and entered into random-effect meta-analysis.
- If applicable, subgroup analyses will be conducted to exclude differences related to age groups or frailty condition.
- The inclusion of heterogeneous samples and a large variety of exercise interventions may be a limitation.

INTRODUCTION

The population over the age of 60 is increasing day by day.[1] Ageing could be associated with a progressive health decline, but there is not a doubt that tailored exercise[2] is an effective non-pharmacological approach for preventing ageing-related syndromes (ie, frailty, sarcopenia and functional disability).[3 4] Regular physical activity produces cardiovascular, hormonal and skeletal muscle adaptations that counteract muscle atrophy and loss of bone density and contribute to increases in peak oxygen consumption and improvements of mitochondrial biogenesis.[5] Besides, short-term (1–4 weeks) benefits of exercise programmes have been recently reported in vulnerable populations such as institutionalised older adults.[6–9]

Different modalities of physical exercise programmes have been shown to produce diverse physical outcomes in older adults. Traditionally, resistance training (exercises against an external load to improve

strength) and endurance training (continuous aerobic/anaerobic exercise to improve cardiopulmonary fitness) have been prescribed separately for enhancing particular outcomes.[10–12] Advances in training methods lead to combined programmes such as concurrent training (combination of resistance and endurance training within the same session) or high-intensity intermittent training (repeated bouts of exercise at an intense effort interspersed by low-intensity exercise or periods of rest with varied recovery times), with promising results in health-related outcomes (eg, functionality, strength, body composition, resting heart rate and blood pressure) and greater adherence as a result of time saving.[13–16] Besides, supervised multicomponent programmes (combination of strength, balance, agility and cardiovascular exercises) has been suggested as the preferred strategy to mitigate ageing-related complications.[9 17–19] In addition to the particularities among training disciplines, new trends in sport sciences appeal to more individualised regimens with a variety of exercises, stimuli and intensities which are controlled by incorporating new technologies and monitoring tools.[20–25]

When people stop exercising regularly or there is an insufficient training stimulus, they may suffer a partial or complete loss of training-induced adaptations, namely the detraining effect.[26] While older adults commonly suffer from hospitalisation, illness or immobilisation that temporarily disrupt any physical activity,[27] prior studies have demonstrated that benefits of exercise may persist after short-term[28 29] and even long-term[30–32] exercise cessation in community-dwelling. However, other studies examining institutionalised older adults have reported inconclusive results on protective effect.[6 9 33] Thus, although supervised multicomponent exercise is considered one of the most effective treatments against ageing-related physical syndromes,[3 34] there is a lack of consensus on what kind of physical exercise prescription and training duration produce better protective effects after exercise cessation in both community-dwelling and institutionalised older adults.

Objective

This study aims to conduct a systematic review and meta-analysis to determine the effects of available exercise prescriptions in older adults in preserving physical conditioning after inactivity periods.

Review question

What kind of physical exercise prescription produces better residual/protective effects on strength, functional, metabolic and structural health in the short term and long term in older adults?

METHODS

Inclusion criteria

According to the PICOS approach, the inclusion criteria will be:

1. Participants: people aged 60 years and over who have completed a physical training programme followed by an exercise cessation phase.
2. Intervention: exercise training programmes (home based or supervised) of any type (resistance training, endurance training, concurrent training, multicomponent training) immediately followed by a training cessation period. Considering this review aims to identify what kind of physical exercise prescription produces better residual/protective effects, no duration restriction will be set for either the exercise or the cessation interventions to avoid potential bias. Training cessation phase will be considered as any follow-up measures with no active intervention (eg, forced exercise inactivity, hospitalisation, usual daily activity).
3. Comparator: a control group including participants who continued with their usual lifestyle and did not perform physical exercise.
4. Outcome measures: functional capacity measured by validated batteries (eg, Senior Fitness Test, Short Physical Performance Battery, Fullerton Fitness Test) or separate tests (eg, sit-to-stand, timed up and go, foot up and go, balance tests); maximal or submaximal, upper-limb or lower-limb strength measured by dynamic, isometric or isokinetic tests; maximal or submaximal, cardiovascular performance measured by validated aerobic tests with indirect calorimetry, lactate, of estimated equations methods; walking/gait speed; metabolic profile measured by tensiometer or/and blood analysis; body composition and skeletal muscle structure measured by bioimpedance, biopsy, MR or ultrasounds scan.
5. Studies: randomised controlled trials written in English or Spanish that should have at least (1) a control group (eg, treatment as usual or waiting list) and (2) an intervention group (exercise training interventions followed by a training cessation period). Studies with a control group and several intervention groups will also be considered.

No date restrictions will be applied.

Exclusion criteria

1. Studies without primary data (eg, reviews).
2. Works published in journals without peer-review.
3. Educational and behavioural interventions will be excluded.

Search strategy for identifying relevant studies

Two independent reviewers (ÁB-R and JC-I) will perform an electronic search in PubMed, MEDLINE and Web of Science Core Collection on 1 February 2021. The primary systematic literature search strategy will include the terms elder, elderly, older adults, detraining, training cessation, exercise interruption, deconditioning, retraining and physical restraint (online supplemental material 1).

Selection of studies for inclusion in the review

Metadata will be imported into the Mendeley Desktop, where duplicates will be automatically deleted. A data extraction sheet will be developed. Eligibility assessment will be performed by two reviewers independently (ÁB-R and JC-I). Relevant review articles will be screen for potential studies.[8 35 36] First, the studies will be screened by title and abstract. Second, the selected studies will be examined in full text to decide their definitive inclusion. When disagreements emerge between the two independent researchers, consensus will be obtained through discussion, or when required, the opinion of a third researcher (TV) will be considered.

Assessment of methodological quality and reporting of data

The Grading of Recommendations Assessment, Development and Evaluation framework will be used to assess the quality of the evidence across studies for each outcome separately. Risk of bias (RoB) 2 tool will be used to assess the RoB in randomised trials included in Cochrane Reviews. Studies with a score of at least five points will be considered as having high RoB. Two researchers will independently assess the RoB and the inconsistency, indirectness, imprecision and publication bias (ÁB-R and JC-I) of each eligible study. Disagreements on these assessments will be solved in a consensus meeting between the independent reviewers with another member of the team (TV).

Data extraction and management

Two independent reviewers (ÁB-R and JC-I) will extract the following data for each study: (1) characteristics of trial participants (total sample number, sex, age, weight, height, body composition); (2) details of the exercise intervention (volume, intensity, duration, exercises included, technological resources); (3) details of the training cessation period (type of inactivity, duration); (4) details of the control group (eg, education about nutrition or physical activity); (5) outcome measures (strength, functional, metabolic and structural variables); (6) methodological quality of individual studies, according to the Cochrane Handbook for Systematic Reviews and (7) funding sources. When discrepancies emerge in the coding between the two researchers' results, these will be discussed with a third reviewer (TV) to reach a consensus.

Data synthesis and analysis

To assess the effect of training cessation, standardised mean differences (Hedges' g) between the exercise and control groups will be calculated for each outcome and entered into random-effect meta-analysis. Effect sizes of 0.2, 0.4 and 0.8 will be considered as small, moderate and large, respectively. To check the robustness of the primary analysis, sensitivity analysis will be carried out by excluding studies with high RoB. Because hospitalisation usually resembles immobilisation, and therefore, the detraining effect will worsen much more than if there is a minimum stimulus such as exercise inactivity or daily activity, we will consider conducting subgroup analyses considering hospitalisation separately if possible. In addition, we will analyse different groups of older adults over 60 years with subgroups analyses considering: (1) different age groups (2) institutionalised or community-dwelling and (3) frailty level or fitness status if possible. Heterogeneity will be assessed using the I^2 statistic (the percentage of total variation attributed to between-study heterogeneity). Inconsistency across studies will be considered serious when heterogeneity will be high (I^2 ≥50%). In case of observing high heterogeneity (I^2 ≥50%) and a minimum number of 10 studies, potential effect moderators will be explored with meta-regression models using the *metafor* package in R. Indirectness will be considered serious when interventions include both exercise and additional components (ie, cointerventions). Imprecision will be considered serious when the 95% CI will be wide and will cross the line of no effect. Finally, the presence of publication bias and small study effects will be assessed using visual inspection of a funnel plot and random-effects version of Egger's regression test. All analyses will be performed using *metafor* package in R (The R Foundation for Statistical Computing, Vienna, Austria). Anticipated timeline for review: screening of search results by 5 November 2021, data analysis and write-up by 15 April 2022.

Presentation and reporting of results

The findings of the present systematic review and meta-analysis will be reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.[37] We will illustrate the process of study selection using a flow diagram. A table with the main characteristics of each study will also be provided.

Ethics and dissemination

As systematic reviews use publicly available data, no formal ethical review and approval are needed. Findings will be published in a peer-reviewed journal(s) and presented at conferences.

Patient and public involvement

An institutionalised older adult and a nursing home manager as research partners were actively involved in the design of the present systematic review and meta-analysis and will be involved in all the steps described in this protocol. Patients' associations and the general public will be reached through several approaches, including talks and discussions.

Limitations

The inclusion of heterogeneous samples and a large variety of exercise interventions may be a limitation. The conclusions from this review might have a limited generalisability to healthy adults who completing exercise on a regular basis. There is no guarantee the search was completely exhaustive despite the extensive search strategy.

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Contributors ÁB-R, TV, FE-L and JC-I designed the protocol. ÁB-R drafted the manuscript with the senior supervision by FE-L and JC-I. ÁB-R, TV, FE-L and JC-I revised and approved the final version of the manuscript. FE-L and JC-I will be the guarantors of the review.

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Supplementary Material 1. Search strategy

Pubmed
(("Elder"[All Fields] OR "Elderly"[All Fields] OR "older adults"[All Fields]) AND ("detrain"[All Fields] OR "detrained"[All Fields] OR "detraining"[All Fields] OR "Training cessation"[All Fields] OR "exercise interruption"[All Fields] OR "deconditioning"[All Fields] OR "retraining"[All Fields] OR "physical restraint"[All Fields])) Translations: Detraining: "detrain"[All Fields] OR "detrained"[All Fields] OR "detraining"[All Fields]
Web Of Science (Core Collection) and MEDLINE
TS=(("Elder" OR "Elderly" OR "older adults") AND ((Detraining OR "Training cessation" OR "exercise interruption" OR "deconditioning" OR "retraining" OR "physical restraint")))