Resting heart rate changes after endurance training in older adults: a meta-analysis
Huang G, Shi X, Davis-Brezette J A, Osness W H

CRD summary
This review assessed the effects of endurance (aerobic) exercise training on resting heart rate in older adults. The authors concluded that the evidence supported the beneficial effects of training on heart rate. Limitations in the reporting of review methodology and the analysis suggest that this conclusion should be viewed with caution.

Authors' objectives
To assess the effects of controlled endurance exercise training on resting heart rate (HR) in sedentary older adults.

Searching
PubMed, SPORTDiscus, HealthSTAR, Current Contents (Chemical Medicine) and Dissertation Online were searched for journal articles published in English from 1980 to 2002. Books and journals specific to exercise and aging, and position statements of national and international organisations were handsearched. The bibliographies of identified articles and reviews were checked, and experts were contacted. Studies published as abstract, conference proceeding or dissertations were excluded.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) and non-randomised controlled studies were eligible for inclusion.

Specific interventions included in the review
Studies that assessed the effects of aerobic exercise and/or conditioning, compared with a non-intervention control, were eligible for inclusion. Training had to last for a minimum of 2 weeks and the frequency, duration and intensity of the training regimen had to be reported in quantifiable terms. Studies that also assessed the effects of diet or weight loss were excluded. The exercise programmes in the included studies consisted of one or more of the following: cycle or rowing ergometry, walking, jogging, treadmill or indoor or outdoor track running. Most of the included studies used walking as the primary training modality. Where stated, the control groups received no treatment or were added to a waiting list. The mean duration of the training sessions ranged from 20 to 51 minutes, mean frequency from 1.8 to 4 times per week and length from 8 to 45 weeks.

Participants included in the review
Studies on apparently sedentary older adults with a mean study population age of 60 years or older were eligible for inclusion. Men and women were included and the mean ages ranged from 62 to 82 years. Most studies described the participants as 'healthy'; others had hypertension. In some studies the participants were reported to be taking medication for the treatment of co-morbidities.

Outcomes assessed in the review
Studies that reported measures of change in resting HR were eligible for inclusion.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
Quality was assessed and scored using the Jadad scale, which considers the reporting and handling of randomisation, blinding and handling of withdrawals. The maximum score was 5. The authors also reported the drop-out rate and compliance of each study. The authors did not state how many reviewers performed the quality assessment.
Data extraction
A pre-designed data extraction form was used, and reliability checks were performed on randomly selected studies. Any discrepancies were resolved by reviewing, checking and discussion. Standardised effect sizes (SES) for each treatment group were calculated from reported means and standard deviations. Mean differences in HR between treatment and control group were calculated, along with 95% confidence intervals (CIs). If a study contained more than one treatment group, each group was included separately in the analysis.

Methods of synthesis
How were the studies combined?
Pooled SES with 95% CIs were calculated using fixed-effect and random-effects models. Publication bias was investigated using a funnel plot.

How were differences between studies investigated?
Heterogeneity was assessed using the Q statistic. Subgroup analyses were performed on the basis of study design, physical characteristics of the participants and exercise training characteristics.

Results of the review
Thirteen studies (651 participants) were included: 7 RCTs (285 participants) and 6 controlled studies (366 participants).

The quality scores ranged from 1 to 3 out of 5. Funnel plots showed no evidence of publication bias. The drop-out rate ranged from 0 to 23% in the intervention groups and from 0 to 30% in the control group. The authors stated that all studies appeared to analyse results on an 'analysis by protocol' basis. Where stated, compliance with the sessions ranged from 75 to 95%.

Endurance training was associated with a statistically significant moderate change in resting HR (SES -0.58, 95% CI: -0.74, -0.42, P=0.001) compared with control (based on fixed-effect model). This corresponded to an approximate 8.4% decrease in resting HR following aerobic endurance. There was no evidence of statistically significant heterogeneity (P=0.801).

The subgroup analysis showed that exercise programmes lasting more than 30 weeks had a greater benefit than those lasting less than 30 weeks (mean 8.37 versus 4.86 beats per minute; P=0.011). There were insufficient data to assess the effects of gender or ethnicity. No statistically significant differences were found in other subgroup analyses.

Authors’ conclusions
This review supports the beneficial effects of endurance exercise training in decreasing HR in older adults. A longer length of exercise training, probably of more than 30 weeks, may be more effective.

CRD commentary
The aims of this review were clearly stated and the inclusion criteria were defined. Several relevant sources were searched to identify studies, but only full journal articles published in English were included; thus it is possible studies were missed. Publication bias was investigated using funnel plots, although the results were not shown. The methods used to select studies for inclusion and assess quality were not clearly documented. Furthermore, it was unclear how many reviewers were involved in the data extraction. It is therefore not possible to ascertain whether attempts to minimise reviewer error and bias were taken. The studies were assessed for quality, but the results for the individual studies were not reported. This is of particular importance given the inclusion of both randomised and non-randomised studies.

Details of the demographics of participants evaluated in the included studies were limited, so it was difficult to assess whether it was appropriate to combine the studies. However, statistical heterogeneity was not found. The method used to deal with studies that had more than one treatment arm was unclear, thus it was not clear whether participants in the same control group were included in the analysis more than once. The decision to combine randomised and non-
randomised studies was not appropriate, and the authors did not report the pooled results separately. Overall, limitations in the reporting of review methodology and analysis mean that the authors’ conclusions should be viewed with some caution.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: More research is needed to confirm the effect of endurance training on resting HR in older adults, and to assess the effects of exercise components (e.g. intensity, duration, frequency).

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.