Aerobic exercise and resting blood pressure in older adults: a meta-analytic review of randomized controlled trials
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Authors' objectives
To assess the effect of aerobic exercise on the resting systolic and diastolic blood-pressure (SBP and DBP, respectively) in older adults.

Searching
MEDLINE, Current Contents and SPORTDiscus were searched for studies published in the English language between January 1996 and January 1998. In addition, extensive cross-referencing of original review articles was performed. An expert on exercise and BP also reviewed the authors' reference list for thoroughness. The specific search terms were not provided.

Study selection
Study designs of evaluations included in the review
The included studies were randomised controlled trials (RCTs).

Specific interventions included in the review
The intervention was 16 to 24 weeks of walking, jogging, aerobic dance or cycling, performed 3 to 6 times per week, or no exercise. The inclusion criteria for this study specified aerobic activity as the only exercise intervention and a non-exercise control group. The authors reported that all seven of the included studies appeared to adhere to the American College of Sports Medicine guidelines for the development and maintenance of cardiorespiratory fitness (see Other Publications of Related Interest no.1).

Participants included in the review
The participants had to be adults aged 50 years or over. The participants actually included were aged 50 to 87 years and were primarily white and Japanese. The exercise and control groups were similar in terms of their age, height and weight, body mass index, body and maximum oxygen consumption. Some participants were taking antihypertensive medication both before and during the study. The participants were a mixture of smokers and non-smokers.

Outcomes assessed in the review
The primary outcomes were the initial and final resting SBP, and the initial and final resting DBP. The secondary outcomes were weight, body mass index, percentage body fat, maximum oxygen consumption and resting heart rate.

How were decisions on the relevance of primary studies made?
Two authors independently retrieved the studies for inclusion.

Assessment of study quality
Study quality was assessed using the 3-item questionnaire of Jadad et al. (see Other Publications of Related Interest no.2), which was designed to assess randomisation, blinding, withdrawals and/or drop-outs. The minimum and maximum possible scores were 0 and 5, respectively, where a higher score was indicative of higher quality. The authors do not state how the papers were assessed for quality, or how many of the reviewers performed the quality assessment.

Data extraction
Two authors independently extracted the data. The authors then met and reviewed each coded item. Any discrepancies were resolved by consensus. Coding sheets for 246 items were developed and utilised in this investigation. In addition, code books, which described how to code each variable on the coding sheet, were developed and utilised. The major
categories of variables coded included the following: study design characteristics, physical characteristics of the participants, training programme characteristics, BP assessment characteristics, and primary and secondary outcomes. The study authors were contacted for missing data.

Methods of synthesis
How were the studies combined?
The data from the studies were combined using a meta-analysis with 95% confidence intervals (CIs). A random-effects model was used for all analyses (see Other Publications of Related Interest no.3). Publication bias was examined using Kendall's tau rank statistic (see Other Publications of Related Interest no.4).

How were differences between studies investigated?
Heterogeneity of net changes in resting SBP and DBP were examined using the Q statistic (see Other Publications of Related Interest no.4. Subgroup analyses were also performed. Subgroup analyses for categorical variables were conducted using analysis of variance-like procedures for meta-analyses. These were country of study (USA versus other), gender, medications that could affect resting BP, smoking, and high-to-normal versus normal SBP and/or DBP. Regression analyses were used to examine which continuous variables, if any, were predictors of changes of SBP, e.g. initial BP, age, height, weight, percentage body fat, maximum oxygen consumption, resting heart rate and training programme.

Results of the review
Nine studies met the inclusion criteria. Data could not be obtained from 2 studies, therefore data from the remaining 7 RCTs were included. The number of participants in the 7 RCTs was unclear.

Across all studies, small but statistically-significant decreases were found for resting SBP, but not DBP, in those participants who received exercise training compared to the control groups. The changes in resting BP were equivalent to an approximately 2% reduction in resting SBP and a 1% reduction in resting DBP. The mean reduction was 2 plus or minus 3 mmHg (95% CI: -4, -1) for SBP, and 1 plus or minus 2 mmHg (95% CI: -2, 0) for DBP.

No publication bias was observed for changes in either the resting SBP (P=0.09) or DBP (P=0.09).

Regression analysis.
A simple regression analysis showed a statistically-significant association between changes in the resting SBP and initial resting SBP (R=0.73, standard error of the estimate = 0.57, p=0.003). No other statistically-significant associations were found for changes in resting SBP on selected variables such as body weight, body mass index and percentage body fat. The SBP and DBP data from the individual studies were presented.

Authors’ conclusions
This study supported the efficacy of aerobic exercise for reducing resting SBP in older adults. However, final conclusions regarding the effectiveness of aerobic exercise for reducing the resting SBP and DBP in older adults cannot be drawn until further studies addressing this issue are conducted.

CRD commentary
The review question is important. The inclusion criteria were clearly stated but did not mention co-morbidity. All the studies included fitted these criteria. The duration of the exercise intervention was not included and this may be important. No specific search terms were given and no attempt was made to look for unpublished studies. In addition, the papers were limited to English language publications, so some published in non-English languages may have been omitted. Finally, the sources searched were limited and this may have led to the omission of studies.

The authors used a scoring system to assess the quality of the studies, but did not say how they implemented it. Details of the primary data extraction were well presented. However, the number of participants included in the studies was not consistent throughout the paper. The authors discussed the loss to follow-up, which is important in studies of lifestyle...
interventions and 'intent to treat analysis' and 'analysis by protocol'. All of the included studies used 'analysis by protocol'.

The authors' conclusions are consistent with the results. The intensity and duration of the interventions were not considered in the data analysis. Nearly all the participants were American or Japanese, thus the results may not be generalisable.

**Implications of the review for practice and research**

Practice: The authors did not state any implications for practice.

Research: The authors state that further studies, which address the effectiveness of aerobic exercise for reducing resting BP in older adults, are required.

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