The use of aerobic exercise training in improving aerobic capacity in individuals with stroke: a meta-analysis

Pang M Y, Eng J J, Dawson A S, Gylfadottir S

CRD summary
This review, which evaluated the effect of aerobic exercise on aerobic capacity following stroke, concluded that there is good evidence that aerobic exercise is beneficial in those with mild and moderate stroke with a low risk of cardiac complications. Inadequate reporting of the review process weakens the robustness of the authors' conclusion, and there is a need to define the optimal protocol.

Authors' objectives
To determine whether aerobic exercise improves aerobic capacity in individuals recovering from a stroke.

Searching
MEDLINE (1966 to July 2005), CINAHL (1982 to July 2005), EMBASE (1980 to 2005), the Cochrane Database of Systematic Reviews (Issue 2, 2005) and PEDro were searched; the search terms were reported. The reference lists of included studies were also checked. Doctoral dissertations and reports in conference proceedings were excluded.

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

Specific interventions included in the review
Studies of aerobic exercise were eligible for inclusion. Aerobic exercise was defined as a structured exercise programme involving the use of large muscle groups for extended periods of time in activities that were rhythmic in nature. Most of the included studies used cycle ergometer; others used treadmill walking, a combination of stepping, brisk walk and repeated sit-to-stand, or water-based aerobic exercise. The control treatment varied and, where reported, included passive range of motion, usual therapy and a seated upper extremity exercise programme. All included studies used protocols similar to the American College of Sports Medicine: 20 to 40 minutes of continuous exercise with intensity varying from 50% to 80% of heart rate reserve, for 3 to 5 days per week for between 3 and 19 weeks.

Participants included in the review
Studies of participants who were recovering from a stroke were eligible for inclusion. The participants evaluated were in varying phases of stroke recovery: acute (defined as 0 to 1 month after the onset of stroke), sub-acute (defined as 1 to 6 months after onset) or chronic (defined as more than 6 months after onset). The mean age of the participants ranged from 43.2 to 70 years. All studies evaluated participants with mild to moderate stroke, and excluded those with a moderate to high risk of complications during exercise or that had unstable disease with activity restriction according to the American Heart Association Risk Stratification.

Outcomes assessed in the review
Studies that evaluated peak oxygen consumption (VO2) or peak workload as an indicator of aerobic capacity were eligible for inclusion. Walking velocity and adverse events were also assessed.

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
Each study was assigned a quality score to assess external and internal validity based on the 11-item PEDro scale. External validity was assigned as 'yes' or 'no' and internal validity was assigned a score out of 10: a score of 9 to 10 was considered 'excellent'; 6 to 8 was considered 'good'; 4 to 5 was considered 'fair'; and less than 4 was considered 'poor'.

Some of the studies appeared to have been located on the PEDro database, where studies have already been quality assessed by two independent individuals and any disagreements resolved by consensus, or discussion with a third person. It was unclear how many of the included studies were listed on this database, or how the assessment was performed on those studies not listed.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.

For each study, data were extracted on the mean change scores (post-intervention minus pre-intervention) in VO2 and peak workload and baseline standard deviations (SDs) and used to determine the standardised effect size (SES) with 95% confidence intervals (CIs). Baseline means and SDs were requested from the authors if not reported.

Methods of synthesis
How were the studies combined?
The studies were combined using either a fixed-effect meta-analysis (if studies were homogeneous) or random-effects meta-analysis (if studies were heterogeneous). A separate pooled SES with 95% CI was obtained for studies that reported aerobic capacity (peak VO2 and workload) and walking performance (walking velocity and endurance). The size of the pooled effect size was defined as small (0.2 to 0.5), medium (0.5 to 0.8) or large (greater than 0.8). Adjustments were made for studies with small sample sizes.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the Q statistic. Sensitivity analyses, which excluded those studies in which all patients did not have a diagnosis of stroke, were performed. Differences between the studies were discussed with respect to type of protocol used.

Results of the review
Seven RCTs (n=480) were included in the review.

In terms of methodological quality, 5 studies were considered to be 'good' and 2 studies were considered 'fair'.

Aerobic capacity.

Aerobic exercise was associated with a small, statistically significant increase in peak oxygen consumption (SES 0.42, 95% CI: 0.15, 0.69, P=0.001) and medium increase in peak workload (SES 0.5, 95% CI: 0.26, 0.73, P<0.001), compared with control, based on 5 RCTs. There was no evidence of statistical heterogeneity in either analysis. The sensitivity analysis, in which one study that included patients with a diagnosis other than stroke was removed, showed a greater effect size in favour of aerobic exercise.

Walking performance.

Aerobic exercise was associated with a small, statistically significant increase in walking velocity (SES 0.26, 95% CI: 0.05, 0.48, P=0.008; based on 5 RCTs) and walking endurance (SES 0.30, 95% CI: 0.06, 0.55, P=0.008; based on 4 RCTs). There was no evidence of statistical heterogeneity in either analysis. The sensitivity analysis, in which one study that included patients with a diagnosis other than stroke was removed, showed a greater effect size in favour of aerobic exercise.
Authors' conclusions
There was good evidence to suggest that aerobic exercise is beneficial in improving aerobic capacity in those recovering from mild to moderate stroke and who have a low risk of cardiac complications with exercise. It should be a component of stroke rehabilitation. Further research is needed to assess the effects on other patient populations.

CRD commentary
The review addressed a clear research question and the inclusion criteria appeared to be appropriate. Several relevant sources were used to identify relevant studies, although it was unclear whether any methods were used to minimise language bias. The methods used to select studies for inclusion and abstract the data were not reported, therefore the possibility of reviewer error and bias cannot be ruled out. A validity assessment was undertaken using methods to minimise error and bias, although this did not appear to have been performed by the reviewers.

Adequate details of each included study were presented, and methods were used to assess differences across the included studies. Although no evidence of statistical heterogeneity was found, it is clear that there were differences in protocols used across studies, and the control group in each study received some form of usual care, including some form of exercise. Furthermore, as the authors acknowledged, it was not possible to determine whether improvements were a result of a practice effect or a true improvement in aerobic capacity. Overall, the evidence presented appeared to support the authors' conclusions, but incomplete reporting of review methods means it is difficult to confirm the robustness of these conclusions. The authors' recommendation for further research, including studies in different patient populations, seems reasonable.

Implications of the review for practice and research
Practice: The authors stated that aerobic exercise should be an important component of stroke rehabilitation in those with mild to moderate stroke who have a low risk of cardiac complications with exercise.

Research: The authors stated that further research is needed. In particular, to determine the optimal protocol to train those with differing levels of physical impairment and cardiac risk; to determine the long-term effect of exercise; and to determine the relationship between improvement in aerobic capacity and daily function.

Funding
Heart and Stroke Foundation of New Brunswick, a grant-in-aid.

Bibliographic details

PubMedID
16541930

Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Aged; Exercise /physiology; Exercise Therapy /methods; Humans; Middle Aged; Oxygen Consumption; Physical Fitness /physiology; Randomized Controlled Trials as Topic; Stroke /physiopathology /rehabilitation; Walking /physiology

AccessionNumber
12006001262

Date bibliographic record published
Date abstract record published
28/02/2007

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.