The effects of upper body exercise on the physical capacity of people with a spinal cord injury: a systematic review
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CRD summary
This review assessed the effects of upper body training on the physical capacity of people with paraplegia or tetraplegia. There is some methodologically weak evidence to support controlled upper body exercise as an intervention to improve physical capacity. Overall, the authors' conclusions follow from the evidence presented and the review is likely to be fairly reliable.

Authors' objectives
To assess the effects of upper body training on the physical capacity of people with paraplegia or tetraplegia.

Searching
PubMed, SPORTDiscus, CINAHL and the Cochrane Library were searched from 1970 to May 2006; the search terms were reported. Only English language papers were considered. The reference lists of included papers were screened for additional studies.

Study selection
Eligible populations for this review were required to comprise of no more than 25% with a further co-morbid impairment. Eligible interventions included a mode of training that focused on the upper extremities not including functional electrical stimulation. The included studies used arm crank exercise, wheelchair exercise, or a combination including circuit training or strength training. Eligible outcome measures were peak oxygen uptake (VO_{peak}) or peak power output (PO_{peak}) to reflect the primary outcome of physical capacity. The included studies reported one or both of these measures. Study design was not specified a priori and a mixture of randomised controlled trials (RCTs) and uncontrolled studies were included.

The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
Methodological quality was assessed using a modified 19-item published checklist (Van Tulder et al.). Two independent reviewers scored the studies and the mean score reported. Any disagreements were resolved by consensus. Studies with a score of more than 9 were considered to be of an acceptable quality; studies scoring less than 9 were considered to be of a low quality.

Data extraction
For each included study, data were extracted on the percentage change in VO_{peak} and/or PO_{peak}. The relative change in percentages were calculated, along with standard deviations (SDs), for each outcome.

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

Methods of synthesis
A narrative synthesis was carried out, rather than statistical pooling of the results, owing to the poor methodological quality (no control groups) and general heterogeneity between the studies. The results were grouped by outcome, and then subgrouped according to study quality where appropriate. The authors also assessed the impact of training by level of lesion.

Results of the review
Twenty-five studies (n=248) were included in this review: 4 RCTs, 2 controlled studies without randomisation and 19
uncontrolled before-and-after studies. The number of patients per study ranged from 1 to 20.

Overall, the methodological quality was judged to be acceptable in 14 studies (scoring better than 50% on the checklist) and low in 11 studies. The results were grouped according to study design, outcome measure and quality of the relevant trials, as shown below.

Two of the RCTs compared exercise versus no exercise and were described as being of low but acceptable quality, one looked at supine versus sitting training position and was of relatively high quality, and the fourth compared two intensities of training (quality not reported). Of the non-randomised studies, one compared two training intensities and the other assessed training versus no training.

VO\textsubscript{2peak} (21 studies): 18 out of 21 studies reported a significant improvement in VO\textsubscript{2peak} following training of some kind. Of these 21 studies, 13 were judged to be of acceptable quality and, overall, these showed a mean improvement of 17.6\% in VO\textsubscript{2peak} (SD=11.2).

PO\textsubscript{peak} (20 studies): 16 of the 20 studies reporting these data found a significant increase in PO\textsubscript{peak} following training and the remaining 4 studies found no increase. Twelve studies were of acceptable quality and, overall, reported a mean change of 26.1\% (SD=15.6).

VO\textsubscript{2peak} (paraplegia): 9 studies of acceptable quality (including 2 RCTs) assessed this outcome and found improvements of between 7\% and 30\%.

PO\textsubscript{peak} (paraplegia): 8 uncontrolled studies of acceptable quality assessed this outcome and found improvements of between 10\% and 30\%.

Four studies of acceptable quality reported results on VO\textsubscript{2peak} and PO\textsubscript{peak} for tetraplegic patients with mixed findings.

Type of training was considered in a further analysis, but was hindered by the lack of clear descriptions of the intervention used in the primary studies.

Authors' conclusions

There is some methodologically weak evidence to support controlled upper body exercise as an intervention to improve the physical capacity of spinal cord injury patients. Benefits appear to be accrued regardless of the level of lesion, and mixed programmes of exercise may be more effective than single activities.

CRD commentary

The review addressed a clear question and used appropriate inclusion criteria. The search was fairly thorough but might have missed relevant studies published in languages other than English, or unpublished research. Methodological quality was assessed in detail and taken into account within the synthesis of the results. A lack of reported details on the methods used to select studies and extract the data make it difficult to be sure that bias and error were suitably minimised at all stages. The narrative synthesis adequately summarised the primary data, grouping results appropriately and identifying better quality evidence. Overall, the authors' conclusions clearly follow from the evidence presented and the review is likely to be fairly reliable.

Implications of the review for practice and research

Practice: The authors stated that regular exercise seems beneficial for people with spinal cord injury, but no definite recommendations can be made as to the type, intensity, frequency or duration of exercise.

Research: The authors stated that further research on the effectiveness of exercise in people with spinal cord injury is urgently needed, particularly of a high methodological quality. RCTs are required, particularly in people with tetraplegia, and detailed reporting of future trials is essential. Additional research focusing on different training protocols and modes to identify the most effective interventions is recommended.

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