The impact of increased duration of exercise therapy on functional recovery following stroke: what is the evidence?

Galvin R, Murphy B, Casack T, Stokes E

CRD summary
This review concluded that increased duration of exercise therapy improved activities of daily living and had a positive effect on lower extremity impairment and walking speed compared with standard exercise therapy in patients with stroke. Only the former conclusion relating to activities of daily living is an accurate and reliable reflection of the results of the review.

Authors' objectives
To examine the effect of increased duration of exercise therapy compared to routine formal exercise on functional recovery after stroke.

Searching
Searches of AMED, CINAHL, Science Direct, the Cochrane Library, DARE, MEDLINE, Physiotherapy Evidence Database (PEDro), and EMBASE were conducted. Search terms, but no date years, were provided. Reference lists of retrieved papers were also screened for further references. Only English language studies were included.

Study selection
Randomised controlled trials (RCTs) of increased duration of exercise therapy compared to a routine exercise intervention in patients presenting with stroke, as defined by the World Health Organisation, were included. Exercise therapy was defined as occupational or physical therapy but did not include physical education and training. Trials considering the use of specific interventions, such as constraint-induced movement therapy or the use of special equipment, were excluded. Studies were excluded if no exercise intervention was delivered to the control group. No formal inclusion criteria relating to what constituted ‘routine’ or ‘increased duration’ was used. Outcomes relating to impairment of structures, limitations of Activities of Daily Living, and quality of life were included.

Additional exercise therapy time actually prescribed to experimental groups varied according to type of exercise therapy: arm exercise therapy ranged from 24 to 60 minutes; lower extremity exercise therapy ranged from 30 to 120 minutes; general exercise therapy ranged from 10 to 75 minutes; and community-based exercise therapy ranged from 67 to 450 minutes. Interventions were delivered mainly in the immediate days following stroke, although some studies were conducted weeks or months following stroke. The duration of exercise programmes ranged from one week to 20 weeks, with those delivering arm exercise therapy generally being of the shortest duration (four to six weeks).

The search results were assessed for study retrieval by one reviewer. Two reviewers independently ranked retrieved studies as relevant, irrelevant, or unsure. Any disagreements were resolved through discussion.

Assessment of study quality
Trials were quality assessed against the criteria laid out in the Cochrane Handbook for Systematic Reviews of Interventions (selection bias, performance bias, attrition bias, and detection bias). The overall quality of trials as documented by the PEDro database was also given as a score out of 10. No indication of the criteria or individual scoring used to make up the overall score was provided. Trials with PEDro quality scores of less than 5 were excluded.

Quality assessment was performed independently by two reviewers; disagreements were resolved through discussion.

Data extraction
For each outcome measure scores (mean and standard deviation) were recorded at baseline, first assessment post intervention, and again at six months. Median values were used if the mean scores were not available. Standard deviations, interquartile ranges, or overall ranges were recorded when available (in that preferred order). Multiples of
0.75 times the interquartile range or 0.25 times the range were used as proxies for the standard deviation values. Authors were contacted for clarification or to provide missing data if necessary.

The authors did not state how many reviewers performed the data extraction.

**Methods of synthesis**

Studies were combined using the meta-analytic method of Cooper and Hedges, using both fixed-effect and random-effects models. Standardised mean differences were estimated and pooled to estimate standard effect sizes (SEs), weighted by sample size. Cohen's classification of effect sizes was used to judge results: effect sizes below 0.2 were classified as small, from 0.2 to 0.5 as medium, and above 0.5 as large.

A statistical test for heterogeneity was not reported, but if significant between-study variation was present a random-effects model was used. Studies were summarised in terms of study characteristics (i.e. type of exercise therapy), but results were presented according to outcome reported: upper extremity outcome measures, lower extremity outcomes and activities of daily living.

**Results of the review**

20 RCTs (n=1,906 participants) were included. PEDro quality scores ranged from 5 to 8 points; risk of bias was judged high for 13 trials, and low for the remaining seven trials.

**Arm exercise therapy:** No significant effects from additional arm exercise therapy were identified post-treatment for trials using the Action Research Arm Test (five RCTs; n=669 participants); the Motricity Index (two RCTs; n=193 participants); or the Fugl-Meyer (two RCTs; n=126 participants). No effect at six months was identified for the Action Research Arm Test studies.

**Lower extremity exercise therapy:** Additional lower extremity exercise therapy also had no statistically significant post-treatment effects for studies reporting walking speed (five RCTs; n=296 participants) or for those reporting the lower extremity section of the Fugl-Meyer-UL (two RCTs; n=183 participants). Results for walking speed at six months post intervention showed some trend towards statistical significance (SES 0.24, 95%CI -0.02 to 0.51).

**Additional exercise therapy:** Small improvements in activities of daily living were reported for additional exercise therapy groups (type of therapy not reported) for trials reporting results using the Barthel Index (10 RCTs; n=1,349 participants) for post-treatment (SES 0.13, 95% CI 0.01 to 0.25) and at six months (SES 0.15, 95% CI 0.05 to 0.26). Trials reporting results using the Nottingham Extended Activities of Daily Living Index (four RCTs, n=613 participants) found no significant benefit at six months.

**Authors’ conclusions**

The authors concluded that increased duration of exercise therapy, when compared to standard exercise regimes, improved functional outcome, as measured by the Barthel Index, in patients with stroke both post-treatment and at six months follow-up. They also indicated that their findings supported a positive effect on lower extremity impairment and walking speed.

**CRD commentary**

This review had a clear aim and inclusion criteria and adequate details of studies included were provided. The literature search covered several databases but no attempt was made to uncover unpublished or non-English language studies, leaving the review open to possible publication and language bias. Only one reviewer assessed the references for retrieval, but full papers were screened by two reviewers, limiting possible reviewer bias. Quality assessment was performed independently by two reviewers, but it was not clear whether data extraction was performed in the same way. A relatively thorough quality assessment appeared to have been performed, although details of the process and criteria used to assess studies for the PEDro database would have added to this. The choice of statistical synthesis and method used was appropriate. Only results for trials reporting the same outcome measure were pooled, but given that results using different scales were converted to standardised mean differences, results could have been pooled across
scales giving the analyses greater power, although this might have been at the expense of meaningful results if the scales were not assessing sufficiently similar outcomes. No details of the heterogeneity assessment were provided and no graphical presentation of trial results was given to allow the reader to assess the similarity of included trials. This was a reasonable well-conducted review and the authors' conclusions with respect to functional outcome are an accurate and reliable reflection of the results of the review, although the authors did not indicate that the actual observed effect was small in magnitude. The conclusions relating to lower extremity impairment and walking speed are not based on the results of the review and cannot be regarded as reliable.

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

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

**Research:** The authors stated that further research work is required to establish what particular type of patient gains optimum benefit from additional exercise therapy post-stroke, and on the number of minutes of additional exercise therapy that is needed to demonstrate a significant effect. Research should focus on novel ways of delivering increased exercise, perhaps in the form of family-mediated exercise therapy, in addition to methods to motivate ongoing participation in these programs.

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