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Research

# Increasing the amount of usual rehabilitation improves activity after stroke: a systematic review

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KEY WORDS

Stroke
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Occupational therapy
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ABSTRACT

**Questions:** In people receiving rehabilitation aimed at reducing activity limitations of the lower and/or upper limb after stroke, does adding extra rehabilitation (of the same content as the usual rehabilitation) improve activity? What is the amount of extra rehabilitation that needs to be provided to achieve a beneficial effect? **Design:** Systematic review with meta-analysis of randomised trials. **Participants:** Adults aged 18 years or older that had a diagnosis of stroke. **Intervention:** Extra rehabilitation with the same content as usual rehabilitation aimed at reducing activity limitations of the lower and/or upper limb. **Outcome measures:** Activity measured as lower or upper limb ability. **Results:** A total of 14 studies, comprising 15 comparisons, met the inclusion criteria. Pooling data from all the included studies showed that extra rehabilitation improved activity immediately after the intervention period (SMD = 0.39, 95% CI 0.07 to 0.71, $I^2$ = 66%). When only studies with a large increase in rehabilitation (> 100%) were included, the effect was greater (SMD 0.59, 95% CI 0.23 to 0.94, $I^2$ = 44%). There was a trend towards a positive relationship ($r$ = 0.53, $p$ = 0.09) between extra rehabilitation and improved activity. The turning point on the ROC curve of false versus true benefit (AUC = 0.88, $p$ = 0.04) indicated that at least an extra 240% of rehabilitation was needed for significant likelihood that extra rehabilitation would improve activity. **Conclusion:** Increasing the amount of usual rehabilitation aimed at reducing activity limitations improves activity in people after stroke. The amount of extra rehabilitation that needs to be provided to achieve a beneficial effect is large. **Trial registration:** PROSPERO CRD42012003221. **[Schneider EJ, Lannin NA, Ada L, Schmidt J (2016) Increasing the amount of usual rehabilitation improves activity after stroke: a systematic review. *Journal of Physiotherapy* XX: XX–XX]**



## Introduction

Stroke is the leading cause of disability worldwide.[1] Difficulty walking and using the arm to complete self-care tasks are the most common activity limitations reported by stroke survivors.[2,3] Practice is essential for motor learning and needs to be structured to offer a progressive challenge to reduce activity limitations.[4–7] Consequently, clinical practice guidelines for stroke rehabilitation worldwide recommend that programs deliver a large amount of practice in order to maximise outcome after stroke.[8–10]

Several systematic reviews have explored the effect of the amount of practice on outcome after stroke.[5–7,11–14] Three systematic reviews with meta-analyses have specifically investigated the effect of extra practice on motor outcomes after stroke. Kwakkel et al[11] found that extra rehabilitation improved activities of daily living (SMD 0.13, 95% CI 0.03 to 0.23, 24 randomised trials). Verbeek et al[6] found that extra lower limb rehabilitation within 6 months of stroke improved walking ability (SMD 0.32, 95% CI 0.11 to 0.52, 11 randomised trials) and walking speed (SMD 0.22, 95% CI 0.01 to 0.43, eight randomised trials). Most recently, Lohse et al[5] found that extra rehabilitation improved outcome (SMD 0.35, 95% CI 0.26 to 0.45, 34 randomised trials). Furthermore, previous reviews have suggested that there is a dose-response relationship, where the greater the extra rehabilitation, the greater the benefit,[5–7,11,12,14] regardless of time after stroke.[5]

Importantly, however, these previous systematic reviews included trials that did not investigate different doses of the same content of rehabilitation. For example, some of the included trials compared the effect of rehabilitation with no rehabilitation. Other included trials provided extra rehabilitation that was of different content to the usual rehabilitation, thereby confounding the analysis of amount of rehabilitation with type of rehabilitation. Cooke et al[12] recognised these limitations and examined seven trials where the extra rehabilitation was delivered on top of usual rehabilitation and was of the same content. A meta-analysis of the seven studies was not performed, but the effect sizes of several trials with the same outcomes suggested that there was some evidence supporting the hypothesis that extra rehabilitation on top of usual rehabilitation improves outcomes after stroke.[12]

Rehabilitation is resource intensive, both on the part of the patient and the healthcare system. It is therefore important to

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determine the effect of increasing the amount of usual rehabilitation after stroke, and to ensure that this estimate is not confounded by the effect of extra rehabilitation of different content. Therefore, the aim of this review was to examine the effect of extra rehabilitation of the same content on top of usual rehabilitation.

Therefore, the research questions for this systematic review were:

1. In people receiving rehabilitation aimed at reducing activity limitations of the lower and/or upper limb after stroke, does adding extra rehabilitation (of the same content as the usual rehabilitation) improve activity?
2. What is the amount of extra rehabilitation that needs to be provided to achieve a beneficial effect?

**Box 1.** Inclusion criteria.

Design
- Randomised or quasi-randomised trial

Participants
- Adults (≥ 18 years old)
- Diagnosis of stroke (≥ 80% participants with stroke, others being stroke-like)

Intervention
- Extra rehabilitation (of the same content as usual rehabilitation) aimed at reducing activity limitations (of lower and/or upper limb)

Outcome measures
- Measures of activity

Comparisons
- Extra rehabilitation on top of usual rehabilitation versus usual rehabilitation

## Method

### *Identification and selection of studies*

A systematic review of randomised or quasi-randomised trials was undertaken so that guidelines could be based on the highest level of evidence. Searches were conducted of Medline, EMBASE, CINAHL, and the Cochrane Register of Controlled Trials (CENTRAL) databases, from the earliest date available until October 2015, for relevant articles available in English. Search terms included words related to *stroke*, *physical therapy*, *occupational therapy*, *rehabilitation* and *intensity* (such as dose, frequency, quantity, duration and amount) (see Appendix 1 on the eAddenda for full search strategy). Titles and abstracts were displayed and screened by one reviewer to identify potentially relevant studies. Full paper copies of potentially relevant papers were retrieved. Reference lists of articles included in this review and of similar systematic reviews were screened to determine any additional studies meeting the inclusion criteria. The methods of retrieved papers were reviewed independently by two reviewers (ES and JS) using predetermined criteria (Box 1). An independent reviewer (NL or LA) adjudicated any disagreements.

### *Assessment of characteristics of studies*

*Quality*

The quality of the included studies was assessed by extracting PEDro scores from the Physiotherapy Evidence Database (www.pedro.org.au). The PEDro scale generates a score out of 10 depending on whether the quality of each study meets each item of the tool.[15] Where a study was not included on the database, two review authors independently scored the study (ES and JS), and a third review author resolved any disagreements (NL).

*Participants*

Studies were included if ≥ 80% participants were adults with stroke (with the remainder being stroke-like conditions such as cerebral aneurysm). Characteristics of participants, such as age, gender, time since stroke and type of rehabilitation service, were examined to assess the similarity of the studies.

*Intervention*

Studies were included if they examined the effect of an increased dose of rehabilitation. That is, the experimental group received extra rehabilitation (of the same content as usual rehabilitation) on top of usual rehabilitation aimed at improving lower limb activity or upper limb activity or both. The control group received usual rehabilitation alone. The dose of usual rehabilitation was calculated as the amount of time dedicated to rehabilitation of the activity included in the extra rehabilitation. For example, if the experimental group received 30 minutes of extra upper limb rehabilitation, and the control group received 60 minutes of rehabilitation consisting of 30 minutes upper limb and 30 minutes lower limb, the comparison of the same content would be 30 minutes extra upper limb rehabilitation plus 30 minutes usual upper limb rehabilitation (60 minutes) versus 30 minutes usual upper limb rehabilitation.

*Outcome measures*

Measures involving direct observation of upper or lower limb activity were used, regardless of whether they produced continuous data (eg, Box and Block Test, 10-m Walk Test) or ordinal data (eg, Action Research Arm Test, Functional Ambulation Category).

### *Data analysis*

Information about the method (ie, design, participants, intervention, measures) and results (ie, number of participants and mean (SD) of outcomes) were extracted by one reviewer and crosschecked by another reviewer. Data were converted, where necessary, using methods recommended by the *Cochrane Handbook of Systematic Reviews*.[16] Authors were contacted where information was unavailable.

Post-intervention scores were used to obtain the pooled estimate of the effect of extra rehabilitation using RevMan 5.1 software.[17] Since different outcome measures were used, the effect size was reported as Cohen's standardised mean difference (SMD) with a 95% CI. A random-effects model was used and in the case of significant heterogeneity ($I^2 > 50\%$), a sensitivity analysis was carried out to confirm the source of heterogeneity. Sub-group analyses according to the time after stroke (acute versus chronic) and body part (upper versus lower limb) were planned *a priori* where there were a sufficient number of comparable studies. The relationship between percentage of extra rehabilitation provided and the effect size was calculated using Pearson correlation coefficient. The amount of extra rehabilitation needed to provide a beneficial effect was determined from a receiver-operator characteristic (ROC) curve.

## Results

### *Flow of studies through the review*

The electronic search strategy identified 5141 studies, of which 284 were duplicates. After screening titles, abstracts and reference lists, 89 potentially relevant papers were retrieved. Among these, 74 papers failed to meet the inclusion criteria (see Appendix 2 on the eAddenda for a summary of excluded papers), and therefore 15 papers reporting 14 studies were included in the review (Figure 1).

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