

Editorial

Repetitions and dose in stroke rehabilitation

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This editorial introduces another of *Journal of Physiotherapy's* article collections.^{1–3} The studies in this article collection relate to stroke rehabilitation. Specifically, they are concerned with the dose-response relationship between practice and activity outcomes, and with strategies to increase the amount of practice undertaken by people with stroke.

Stroke is the second most common cause of death globally.⁴ Although stroke incidence has declined over time, the overall stroke burden (ie, absolute number of people affected or disabled by stroke) has increased globally.⁵ In the community as well as during inpatient rehabilitation, people with stroke typically achieve very low levels of any type of physical activity.

In an observational study by Alzahrani et al,⁶ people with stroke living in the community were monitored to establish the amount of free-living physical activity that they undertook during the day. Compared with age-matched healthy peers, people with stroke spent similar amounts of time in physical activity but achieved about half as many activity counts.

Kaur et al undertook an observational study of people in inpatient rehabilitation after stroke.⁷ Physiotherapists estimated the patients' total time in therapy and time spent in active practice during therapy. These times were also measured objectively from video recordings. Physiotherapists systematically overestimated both measures, which were very low: an average of 56 minutes total therapy time, of which only 31 minutes was active practice. These low amounts of time in practice are typical^{8–12} and persist even though there have been strong indications of a dose-response relationship between practice and outcomes for many years.^{13–18}

Since the late 1990s, many systematic reviews have examined the outcomes of increased dose of practice in stroke rehabilitation.^{14–16,18,19} The review by Schneider was the first to look at the dosage question without confounding by type of practice, because they included only studies in which the increased amount of therapy was of the same type of therapy.²⁰ This review confirmed that increasing the amount of therapy improves outcomes, but only when the dosage is increased by at least 240%. For example if the usual dose of practice is 30 minutes, this needs to increase to 100 minutes to reach the threshold amount.

The systematic review by de Sousa et al²¹ was designed to find out if repetitive practice that is known to improve activity outcomes also improves strength after stroke. Most people with stroke have an extensive loss of strength²² and in many people that loss of strength precludes the use of progressive resistance training as they do not have sufficient strength to move against gravity, let alone against resistance. However, they are generally able to do some form of repetitive practice of (modified) tasks. The pooled analysis in the review by de Sousa et al²¹ showed that repetitive practice substantially improves strength after stroke. The authors hypothesise that one of the

mechanisms for improved outcomes with repetitive practice is its ability to improve strength in addition to improvements in co-ordination of muscle activity.

The same group of investigators then examined the effect of two extra sessions of sit-to-stand training per day for people with stroke who were unable to stand up without assistance.²³ The extra sessions led to improved sit-to-stand ability and lower limb strength. This study and the systematic review by de Sousa et al²¹ support the concept that repetitive practice can increase strength as well as activity after stroke. This is important information because loss of strength is the main impairment contributing to activity limitations.^{24,25}

Providing extra therapy can also shorten the stay in hospital. In a meta-analysis of individual participant data from two clinical trials, English et al examined the difference in length of stay and outcomes between patients who did and did not receive weekend therapy.²⁶ Randomisation to the weekend therapy group reduced length of stay by 8 days (95% CI 2 to 13).

In the majority of trials above and other trials of increased practice in stroke rehabilitation,²⁷ extra therapy is delivered as one-to-one practice. Maintaining this would require additional staff, which may be unsustainable. The studies discussed below examine strategies to increase the amounts of time during which people with stroke have the opportunity to practise and strategies to increase the intensity of practice during their therapy time.

Providing therapy using groups or classes can increase opportunities to practise and is associated with improved activity outcomes.²⁸ An observational study by English et al²⁹ looked at both time in therapy and time in active practice when people with stroke were allocated to either circuit class therapy or one-to-one therapy in inpatient rehabilitation. There was no important difference in the proportion of each therapy session that was active practice. However the people in the circuit class were able to be in the gym area for much longer than the people in one-to-one therapy: an average of 73 minutes versus 47 minutes. Hence, overall the people in the circuit class spent longer doing active practice than the people in one-to-one therapy: an average of 35 minutes versus 23 minutes.

Increased time to practise in the gym area without direct therapist supervision can be achieved without compromising time spent in active practice or patient safety. The observational study by Dorsch et al³⁰ categorised the conditions of practice in an inpatient rehabilitation gym as: practice with a therapist, practice with a family member or practice with no direct supervision. Of the inpatients using the gym area at the time, 43% were people with stroke. Of the active practice taking place, 59% was being done with a therapist, 15% with a family member and 24% with no direct supervision. Evidently, semi-supervised practice (ie, practice that takes place in the gym area but without the direct supervision of a therapist) is a strategy that

could greatly increase the opportunities for practice in inpatient rehabilitation by allowing patients to be in the gym area for longer times. The inclusion of semi-supervised practice as a strategy did not have a deleterious effect on the time spent in active practice with 78% of the total observations being of active practice, compared with 67% of time observed in English et al²⁹ and 63% of time observed in Kaur et al.⁷ The inclusion of semi-supervised practice as a strategy did not have a deleterious effect on patient safety with no adverse incidents such as falls occurring during this time.

In addition to increasing opportunities for people with stroke to practise, there are strategies to increase the intensity of practice that is done during the available therapy time. The instructions a therapist uses can make an important difference to the intensity of practice that a person with stroke achieves. In a repeated-measures, experimental study by Hillig et al,³¹ three types of instructions were evaluated for their effect on intensity of practice. This was measured as the number of repetitions of an exercise completed in one minute. The most effective instruction ('do (exercise) 25 times, as fast as you can, aiming for a personal best') resulted in a rate of repetitions that was more than double that done with a non-goal-oriented instruction. The use of goal-oriented instructions is a simple, no-cost strategy that can be used to increase the intensity of practice in stroke rehabilitation.

Quantifying the dosage of practice as the number of exercise repetitions is a more accurate and valid method of quantifying the dose of practice than time in therapy or time in active practice. The earlier study by Kaur et al⁷ indicates that recording time in therapy is not an accurate measure of dosage of practice. As well as being an inaccurate measure, it does not appear to be a valid measure of practice. An observational study by Scrivener et al³² designed to assess the accuracy of patients' ability to count their repetitions of practice showed great variability in the amount of practice done. In this study, inpatients in a mixed rehabilitation unit completed somewhere between 4 and 369 repetitions in 30 minutes. With this variability in the rate of practice being done, recording the number of repetitions would be a more valid measure of dosage of practice than recording time practising or time in the gym. This study, in which 43% of the participants had stroke, showed that inpatients in rehabilitation can be accurate in counting repetitions of practice. Hence, there is a strong argument to use the counting of repetitions to quantify the amount of practice people have done.

If future research in this field used repetitions of practice to quantify dosage, we could generate more precise knowledge to share with people with stroke about the amounts of practice needed to achieve specific outcomes. An additional advantage of counting and

recording exercise repetitions is that numbers of repetitions can be used within instructions and goals, and baseline numbers of repetitions can be used in discussions about increasing amounts of practice. However, to date there does not appear to be research that has evaluated the effect of counting and recording repetitions of practice on amounts of practice over time. This research question could form part of future research into strategies with the potential to increase engagement in practice and motivation to practise. Such research would improve our ability to help people with stroke to achieve effective amounts of practice.

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