Intensity of Task-Specific Training for Functional Ability Post-stroke: Protocol for a Systematic Review

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Protocol

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Abstract

Background This study aimed to describe and present detailed protocol of a systematic review aimed at determining available research evidence regarding the intensity, and frequency of task-specific training (TST) that can best result in improved motor function and mobility outcomes in both upper and lower extremities in acute, sub-acute and chronic stroke survivors. Methods Literature search strategies were developed using Medical Subject Headings (MeSH) terms and text key words related to stroke rehabilitation and the use of TST to search for relevant randomized controlled trials (RCTs). The Cochrane Central Register of Controlled Trials, MEDLINE (PubMed search engine), Excerpta Medica dataBASE (EMBASE), Physiotherapy Evidence Database (PEDro), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Google Scholar were searched for eligible articles published from inception to date. Two reviewers independently screened the titles, selected appropriate abstract/studies and extracted relevant data as yielded by the search based on the study inclusion criteria. Assessment of the study risk of bias and quality of included studies were appraised using the Cochrane's tool for assessing risk of bias or other appropriate tools. Discussion This paper presented the description of the systematic review methods, and it is expected to guide researchers in conducting systematic review in similar fields of research. Sources of literature search terms and reviewers have been determined. Systematic review registration The study protocol has been registered with PROSPERO (130991)

Background

This review will explore the various intensities for task-specific training (TST) administered in stroke rehabilitation and identify the dose that best promotes functional ability in both the upper and lower extremities with minimal adverse effect. For the purpose of this review, intensity for TST is considered to include:

1. The number of repetitions per treatment session;
2. The number of treatment sessions provided per day; an
3. The number of days per week on which treatment was provided.

It is possible that different intensities of TST provided during stroke rehabilitation may have different effects on functional outcomes. For example, a high intensity of TST may promote better outcome, but it may also be associated with discomfort to the patient, while administering a low intensity may not be adequate to impact on outcome, even though it may not produce any adverse effect. Also, the number of repetitions of TST required to achieve the desired goal in the upper extremity, may differ from that required in the lower extremity.

Description of the Condition

Stroke is a major cause of long-term neurological disability in adults.[1] The majority of people who suffer a stroke present with motor function and mobility limitations, with consequent reduction in their physical

activity and community participation levels. Although, the prevalence rates of impairment and disability vary according to individuals, in the acute stage of stroke, about half of all stroke survivors present with severe functional problems.[2] In cases accompanied by paralysis, complete motor recovery occurs in less than 15 percent of the patients, both for the upper and lower extremities.[3] Approximately 65 percent of survivors cannot integrate the affected hand into their usual activities six months following stroke.[3] In the lower extremities, about 35 percent of stroke survivors with initial paralysis of the leg do not regain useful function, and 20 to 25 percent of all survivors are unable to walk without full physical assistance.[4]

These consequences of stroke have long-standing effects and may require extensive duration management to address the resultant limitations. As the population of stroke survivors increases and the number of survivors with disability and prolonged care needs rises, the need for rehabilitation care will intensify.[5]

Description of the Intervention

A host of contemporary motor learning approaches have been developed and are being practiced by therapists managing individuals affected by neurological disorders such as stroke to address their rehabilitation needs and promote functional recovery.

The practice of TST is one of the contemporary approaches to stroke rehabilitation. The term TST evolved from the movement science and motor skills learning literature,[6] and can be defined as a training or therapy in which the patient *'practices context-specific motor tasks and receives some form of feedback*.'[7] Other terms used to describe these elements include 'repetitive functional task practice', 'repetitive task practice',[8] 'task-related training'[9] and 'task-orientated therapy'.[10]

The use of TST in stroke rehabilitation has been well documented and its effectiveness has been substantiated by a plethora of empirical studies.[11,12] In rehabilitation, TST lays emphasis on enhancement of functional tasks performance through goal-oriented practice and repetition. The focus is on training in functional tasks rather than addressing impairment, just as is done with muscle strengthening.[13]

How the Intervention might work

Task-specific training is fundamentally based on the concept that repeated practice results in learning a specific task.[10] There is increasing evidence of neural plastic changes associated with repeated training,[14] and several aspects of rehabilitation entail repetition of movement. Repeated motor practice has been demonstrated to decrease muscle weakness and spasticity,[15,16] and to form the physiological foundation of motor learning.[17] Repeated practice of challenging movement tasks results in larger brain representations of the practiced movement.[18,19]

Why it is important to do this review

Task-specific training has the potential to be a resource-efficient element of stroke rehabilitation, including self-rehabilitation in the home environment or delivery during a circuit class therapy. Presently, TST is increasingly being used in rehabilitation programmes and packages developed for self-rehabilitation among community-dwelling stroke survivors.[20,21,22] Additionally, repetition of movement is the basic mechanism of action associated with the mechanical or robotic devices being developed [23,24] to assist and increase motor activity.[11]

Most of the evidence-based recommended dosages for physical therapy during stroke rehabilitation[25,26,27] are based on duration of active practice rather than number of repetitions in a treatment session. The Canadian Best Practice guidelines for rehabilitation for example, recommends that patients should receive a minimum of three hours of task-specific therapy, five days per week.[26] However, Lee et al. stated that adhering to the repeated practices for a long duration of time often poses challenges to both stroke survivors and healthcare providers.[28] Similarly, it is possible that within three hours one can do few repetitions of TST with long breaks in between and therefore, end up doing an inadequate number of repetitions than the number that may be required to attain the desired goal. On the other hand, it is possible within an hour to perform a large amount of TST that would have undesired adverse effects such as fatigue and pain, which may subsequently, affect recovery. Additionally, the number of repetitions in a session of TST, and the frequency of sessions per week that would promote motor learning in the upper extremity might differ from that of the lower extremity. Therefore, in administering TST during stroke rehabilitation, and particularly, for self-rehabilitation, the number of repetitions of TST per treatment session may arguably be more meaningful as well as more useful than the number of hours covered while practicing.

The effectiveness of number of repetitions of TST in a training session for stroke rehabilitation has been investigated in the literature; however, the studies were not unanimous on the number of repetitions of TST per session required to produce the desired rehabilitation outcome for each of the extremities (i.e. upper and lower extremities). Different studies have used varied numbers of repetitions per treatment session, [29,30,31,32] however, the number of repetitions needed for optimal human learning without adverse effect is still contentious.

Lang et al. observed that in the delivery of TST during stroke rehabilitation in seven inpatient and outpatient sites around the US and Canada, the average number of repetitions of upper extremity TST per treatment session was 32 (95% CI = 20–44) while for the lower extremity it was 37 (95% CI = 296–418).[19] In another study, Birkenmeier et al. successfully delivered an average of 322 repetitions per TST session.[32] These and other findings [29,30,31] led to the argument current doses of task-specific practice during rehabilitation are not sufficient to drive the neural reorganization needed to promote optimal function post-stroke.[19] Birkenmeier et al. also pointed out that the current dose of TST administered during stroke rehabilitation is, in terms of amount, lower than what is currently administered in animal models of stroke and in human motor-learning studies.[32]

The present review is designed to conduct a systematic literature search to identify available research evidence regarding the intensity (number of repetitions per treatment session) of TST for the improvement of motor function and mobility outcomes in both the upper and lower extremities.

Objectives

1. To determine the most effective and adequate intensity of TST in stroke rehabilitation that can produce greater improvement in:

    a. Upper extremity mobility;
    b. Hand dexterity;
    c. Coordination in the upper extremity;
    d. Lower extremity mobility;
    e. Balance.

2. To determine the most effective and adequate intensity of TST in stroke rehabilitation that has the best effect on:

    a. Activities of daily living (ADL) function;
    b. Quality of life (QoL)/health status measures;
    c. Adverse outcomes.

3. To determine the effect of TST on acute, sub-acute and chronic stroke.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P) guidelines[33] and check list (see Additional file 1) were followed in writing this protocol. Also PRISMA guidelines informed the conduct and reporting of the systematic review. Furthermore, in order to promote and maintain transparency, minimize the risk of bias and avoid unnecessary review duplication,[34] this systematic review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO).

Study selection criteria

Studies will be selected according to the criteria outlined below:

Study design

a. Randomized control trials which examined the effectiveness of TST for improving functional ability post-stroke in comparison to a control;

b. Randomized control trials which examined the effect of different dosages (intensity and/or frequency) of TST for improving functional ability post-stroke;
c. Studies Published from inception of the database to date;
d. Cross-sectional studies, case series, and case reports will be excluded.

Participants

a. Studies examining general adult humans (presumably 18 years and older);
b. Trials on stroke as defined by the World Health Organization (WHO) as "a syndrome of rapidly developing symptoms and signs of focal, and at times global, loss of cerebral function lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin"[35]
c. Trials involving either acute, sub-acute or chronic stroke patients or all in a single study.

Interventions

a. Trials in which at least an arm of the trial included an intervention in which an active motor sequence was done repetitively within a training session, and where the training was aimed at achieving a clear functional goal.
b. Trials which involve multiple movements with functional measurement of outcome.
c. Trials in which the time duration or number of repetitions per session of training and the number of sessions administered can be identified.
d. Trials that clearly used motor relearning as a whole therapy approach and the amount of task-specific training received can be identified.
e. Trials in which TST is combined with another intervention and the influence of the TST cannot be isolated will be excluded

Timing

For all decision-making endpoint outcomes, studies should have a follow-up time of at least six months.

Setting

There will be no restrictions by type of setting.

Language

No language restriction will be imposed on the search, although only studies in languages other than English that can be translated adequately into English language using Google translate or iTranslate Translator will be included, due to resource limits.

Outcome measures

The review will consider studies which included either one or more of the following outcome measures:

Primary outcomes

a. Upper extremity function

    i. Arm function measures;
    ii. Hand function measures;
    iii. Sitting balance/reach measures.

b. Lower extremity function/balance

    i. Lower extremity function/mobility measures such as:

        - Walking distance;
        - Walking speed;
        - Functional ambulation.

    ii. Standing balance/reach measures

c. Global motor function measures

Secondary outcomes

i. ADL function measures;
ii. Measures of task performance or impairment;
iii. Measures of quality of life, health status, user satisfaction;
iv. Any adverse effect(s) such as pain, fall, injury, fatigue, etc.

Search Methods for Identification of Studies

Information sources

The following electronic databases will be searched for eligible articles published from inception to date;

- Cochrane Central Register of Controlled Trials;
- MEDLINE (PubMed search engine);
- Excerpta Medica dataBASE (EMBASE);
- Physiotherapy Evidence Database (PEDro);
- The Cumulative Index to Nursing and Allied Health Literature (CINAHL);
- Google Scholar.

To ensure literature saturation, reference lists of included studies or relevant reviews identified will be scanned for possible eligible articles.

Search strategy

AHRQ's Effective Health Care Program[36] guidance was used in developing the search strategy.

First, we searched the MeSH browser to identify relevant MeSH terms, key words, and index terms relevant to stroke rehabilitation and TST.

Second, an extensive search of the databases will be conducted using the following identified search terms: Stroke, Cerebrovascular Accident, Cerebrovascular Apoplexy, Cerebrovascular Stroke, CVA, Cerebral Stroke, Stroke Rehabilitation, Task-specific training, Task-oriented training, and Repetitive task training, including the use of Boolean operations, truncation and wild cards, to identify potentially relevant studies for inclusion. Guidance was sought from a University Health Sciences librarian experienced in systematic review, to arrive at the search strategies relevant to each database to be used. -

Lastly, the reference lists of the retrieved articles, the International Clinical Trials Registry Platform Search Portal, ClinicalTrials.gov, and PROSPERO will also be searched. The information flow diagram for the review is shown in fig. 1.

Data Collection and Analysis

Selection of studies

Two reviewers will independently screen the titles and abstracts yielded by the search against the inclusion criteria. It will be ensured that the full reports for all titles that appear to meet the inclusion criteria or where there is any uncertainty are obtained. Reviewers will then screen the full text reports together and decide whether they meet the inclusion criteria. Additional information will be sought from study authors where necessary and if possible to resolve questions about eligibility. Disagreements will be resolved through discussion. Records regarding the reasons for excluding trials will be made available. None of the reviewers will be blinded to the titles of the journals or to the included study authors or their institutions.

Data Extraction and Management

The results of the literature search will be uploaded to an online internet-based software programme (Covidence) that can facilitate collaboration among the during the study selection process. The screening questions will be developed based on the inclusion and exclusion criteria. Citation abstracts and full text articles with screening questions will be uploaded to the software.

Two reviewers will extract data independently and in duplicate from each eligible study using a detailed instruction manual provided by the internet-based software that will be used; this is to inform specific

tailoring of an online data abstraction. Data to be abstracted include: participants' characteristics (personal and clinical); methodology (including trial design, trial size, duration of follow-up); intervention details; the type of control used; dosage, frequency and duration of treatment; any reported adverse effects and all reported patient-important outcomes that are relevant to the review questions.

Assessment of risk of bias in included studies

Two independent review authors will assess the quality of included studies using Cochrane's tool for assessing risk of bias.[37] Any disagreements will be resolved by the two reviewer's meeting for discussion or by involving a third review author. The following domains will be considered in assessing the risk of bias.

- Sequence generation
- Allocation concealment
- Blinding of participants, personnel and outcome
- Incomplete outcome data
- Selective outcome reporting
- Other sources of bias

Other possible sources of bias that would be assessed include baseline inequality between groups, non-comparable co-interventions between intervention and control groups. Risk of bias for each domain will be graded as described by Higgins et al. as high, low or unclear and justification will be given for each of the grading in the 'Risk of bias' tables.[37]

The risk of bias will be summarized for each individual study and across studies using a 'risk of bias' summary and a 'risk of bias' graph respectively. The grading for risk of bias of blinding of outcome assessment will depend on the potential influence that lack of blinding may have. A high risk will be assigned if the outcome assessor is reported not blinded and the review authors judge that the outcome measure could be influenced by the assessor. If the review authors judge that the outcome measure could not be influenced by the assessor, a low risk of bias will be assigned, irrespective of whether the outcome assessor was blinded or not.

Data Synthesis

If all necessary data can be obtained from the included studies, a test of heterogeneity will be conducted using the I-squared (I^2) statistic. If I^2 is less than or equal to 50%, meta-analysis will be conducted, if I^2 is greater than 50%, a systematic narrative synthesis will be conducted, with information presented in the text and tables to summarize and explain the characteristics and findings of the included studies. The narrative synthesis will explore the relationship and findings both within and between the included studies regarding the effectiveness of the various intensities of TST in improving functional mobility, as well as any adverse effect(s) reported in the management of stroke survivors.

Discussion

The aim of this systematic review will be to determine the adequate dose (frequency and intensity) of TST for both upper and lower extremities that can promote optimal motor learning among stroke survivors and possible adverse effects of the doses. Also this review would investigate the time of the day when a TST is administered, and determine its effect on outcomes.

The review results may impact on practice, policy and research. Researchers, healthcare providers, and managers could use the findings to improve the delivery of TST as an intervention option for stroke survivors in many ways. First, healthcare providers could use the result as a guide for prescribing TST as a home programme for stroke survivors. Second, the result of the review could help researchers in developing and implementing a self-rehabilitation model of TST for community-dwelling stroke survivors, and third, the result could guide managers and developers of mechanical or robotic devices aimed at assisting and/or increasing motor activity following stroke.

Abbreviations

TST – Task-Specific Training

ADL- Activities of Daily Living

QoL- Quality of Life

PRISMA-P- Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols

PRISMA- Preferred Reporting Items for Systematic Reviews and Meta-analysis

PROSPERO- Prospective Register of Systematic Reviews

WHO- World Health Organization

MeSH- Medical Subject Headings

AHRQ- Agency for Healthcare Research and Quality

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

IUL and RI conceived the idea of the review. RI wrote the initial draft of the manuscript. IUL and CJ reviewed the initial manuscript, and developed a suitable search strategy. All authors read and approved the final manuscript.

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Figures

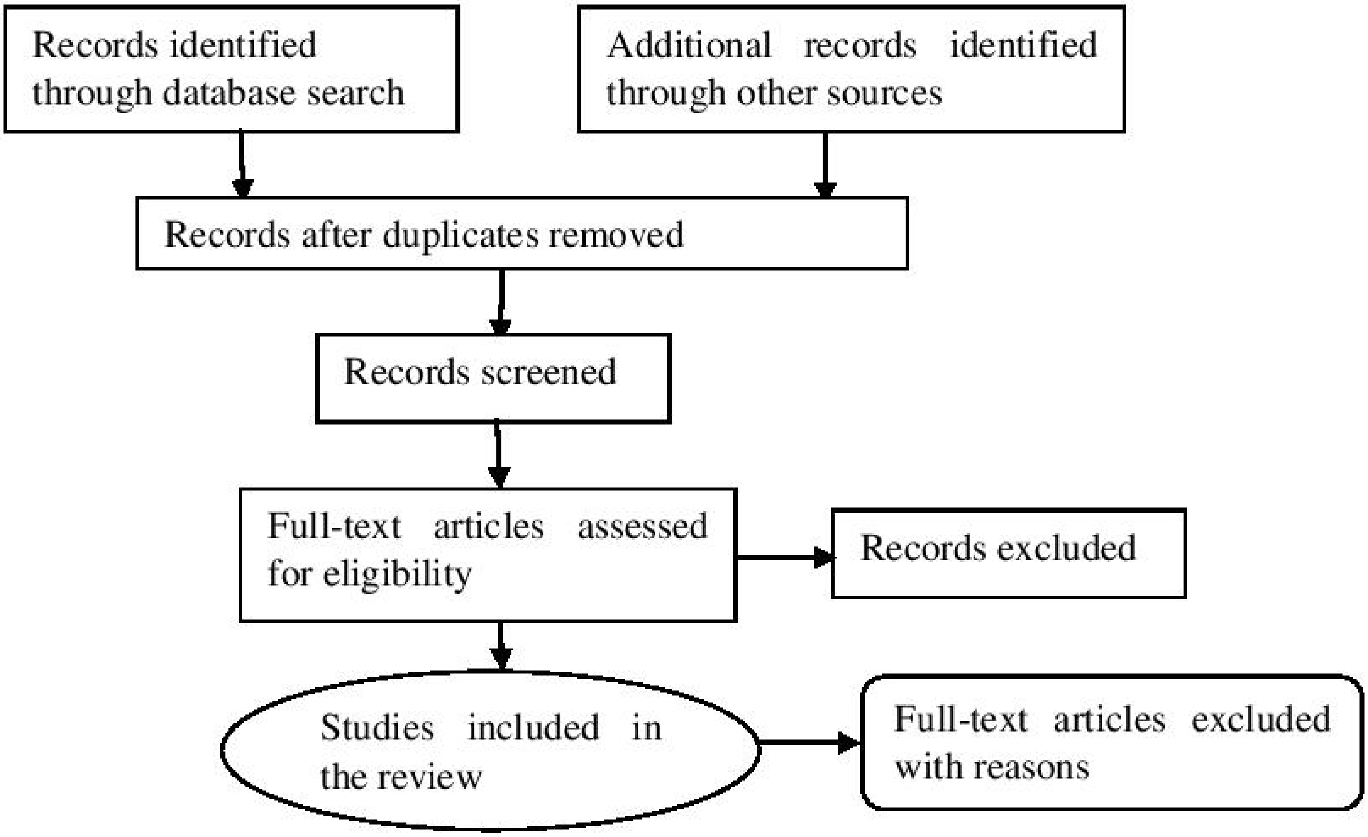

Figure 1

Review Information Flow Diagram

Supplementary Files

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- PRISMAPchecklist1.doc