SYSTEMATIC REVIEW

Post-stroke fatigue: a scoping review [version 1; peer review: awaiting peer review]

Ghazaleh Aali1,2, Avril Drummond3, Roshan das Nair1,2, Farhad Shokraneh1,2

1Division of Psychiatry and Applied Psychology, University of Nottingham, Nottingham, UK
2Institute of Mental Health, Nottinghamshire Healthcare NHS Foundation Trust, Nottingham, UK
3Faculty of Medicine and Health Sciences, School of Health Sciences, Queen's Medical Centre, University of Nottingham, Nottingham, UK

Abstract

Background: Post-stroke fatigue (PSF) is one of the most common and frustrating outcomes of stroke. It has a high prevalence and it can persist for many years after stroke. PSF itself contributes to a wider range of undesirable outcomes that affect all aspects of daily life. The aim of this review was to identify and summarise the most recent research on PSF, in order to update the evidence base.

Methods: We updated an existing review (Hinkle et al. 2017) systematically searching CINAHL, MEDLINE, PsycINFO, and PubMed to cover new research studies between 1st March 2016 and the search date (19th January 2020). We included interventional and observational research, and clinical practice guidelines that were not covered in the original review. After duplicate removal in EndNote, two reviewers screened the search results in Rayyan, and data from eligible full texts were extracted onto an Excel spreadsheet. Finally, we used RobotReviewer and a human reviewer to assess the risk of bias of randomised trials for this scoping review.

Results: We identified 45 records for 30 studies (14 observational, 10 interventional studies, and 6 guidelines). Apart from one, the interventional studies were single-centred, had high risk of bias and small sample size (median 50). They investigated exercise, pharmacotherapy, psychotherapy, education, and light therapy. Observational studies mainly reported the factors related to PSF including co-morbidities, depression and anxiety, quality of life, activities of daily living, stroke severity, medication use and polypharmacy, polymorphism, pain, apathy, limb heaviness, neuroticism, mobility, and thyroid-stimulating hormone. Guidelines either did not report on PSF or, when reported, their recommendations were supported by little or low level of evidence.

Conclusion: Although we identified a number of recent studies which have added to our current knowledge on PSF, none are robust enough to change current clinical practice.

Keywords
Post-Stroke Fatigue, Scoping Review
Corresponding author: Ghazaleh Aali (Ghazaleh.Aali@nottingham.ac.uk)

Author roles: Aali G: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Software, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; Drummond A: Conceptualization, Funding Acquisition, Supervision, Writing – Review & Editing; das Nair R: Conceptualization, Funding Acquisition, Supervision, Writing – Review & Editing; Shokraneh F: Conceptualization, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.


The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2020 Aali G et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Aali G, Drummond A, das Nair R and Shokraneh F. Post-stroke fatigue: a scoping review [version 1; peer review: awaiting peer review] F1000Research 2020, 9:242 (https://doi.org/10.12688/f1000research.22880.1)

Introduction
Post-stroke fatigue (PSF) has been defined as ‘overwhelming feeling of exhaustion or tiredness’, which is unrelated to exertion, and does not typically improve with rest. It is one of the most common outcomes of stroke and its prevalence varies between 25% and 85% However, it is generally accepted that it affects 50% of people after stroke. PSF is linked to undesirable stroke outcomes and affects patients’ participation in studies, adherence to medication, and effectiveness of rehabilitation. This has a negative impact on patients’ quality of life and daily life activities, and also contributes to the burden on family members and carers.

Although researchers have attempted to explain PSF mechanisms, its aetiology still remains unclear. This is partly because there are many contributing factors to PSF and each research team may focus only on some of the factors to find a route for preventing, treating or managing PSF. Any endeavour to find the most effective intervention in the research literature leads to a collection of heterogeneous interventions from physiotherapy and exercise to psychotherapy, pharmacotherapy, and recently laser therapy.

As a systematic effort to review these scattered interventions, a Cochrane review compared all the tested PSF treatments to a control group, to standard care, or to each other, through reviewing randomised controlled trials (RCTs). This review concluded that there was insufficient evidence of the efficacy of the tested interventions in trials, and more robust research with adequate sample sizes was required. Since then, more recent systematic reviews until 2019 have attempted to summarise the evidence of effectiveness of modafinil, mindfulness training, a traditional Chinese medicine, and smart technologies, but still came to a similar conclusion to that of the Cochrane review in 2015.

As a result of such uncertainty, current clinical practice guidelines rely on low levels of evidence, such as expert consensus, to make recommendations for PSF. However, the efforts to design and test treatments continue, which makes it necessary to keep up-to-date with new research and practice literature.

Objective
The objective of this review was to identify and summarise the most recent research literature related to PSF in order to update the evidence base. As there was an existing review covering the literature up until 2016, we only updated the literature not covered in this review.

Methods
Following methods from an existing review
In 2017, Hinkle et al. published a review covering emerging evidence relating to the management of PSF, up to and including February 2016. Because of the comprehensiveness of this review, we only searched for literature published after 1st March 2016. As the search methods of the Hinkle et al. review were not reproducible, and the search strategies and results were not available, we contacted the corresponding author and their librarian on 15th October 2019. Since we did not receive a reply, we designed the search methods for the reported databases in order to capture the majority of the literature included in Hinkle et al.’s review.

Following scoping review methods
We followed Arksey and O’Malley framework for conducting this scoping review. We also used Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Extension for Scoping Reviews (PRISMA-ScR) for reporting. The relevant PRISMA-ScR checklist is available as Extended data and the flow diagram is reported in the Results section (Figure 1).

Search methods
We ran a search to include literature between 1st March 2016 and 19th January 2020 (search date) in CINAHL via EBSCOhost, MEDLINE via Ovid SP, PubMed (excluding MEDLINE), and PsycINFO via Ovid. There were no limitations to language, document type (e.g., thesis), study completion status (e.g., ongoing), and publication status (e.g., unpublished) at the search stage. We report the search strategies for all databases in Extended data.

Selection of studies
We imported the search results into EndNote X6 and de-duplicated them based on title, and additionally double-checked the automatically identified duplicates manually. Two reviewers (GA and FS) screened the results independently against the eligibility criteria using Rayyan, which is a recommended screening system. Discrepancies were resolved through discussions or asking a third reviewer (AD).

Two reviewers (GA and FS) also investigated the full texts of relevant search results against the same criteria involving a third reviewer (AD) in case of disagreement. At full text screening stage, we also investigated the reference lists of the relevant studies to identify additional relevant studies. Since one study may have multiple reports or publications, we kept a record and cited all the reports of a single study to provide a better overview of the new research evidence.

Eligibility criteria
We included the following studies:

- Studies of adult humans with PSF – any definition of PSF – at any stage of the stroke care continuum;
- Any interventional (clinical trial) or observational (cohort, case-control, and cross-sectional) studies, and clinical practice guidelines;
- Studies reporting findings that had not been included in the previous review;
- Studies included in relevant systematic reviews.

We excluded the following studies:
- Studies with case reports, case series, and qualitative design;
Studies included in Hinkle et al. or results which repeated the summarised knowledge in that review;

- Studies of pre-clinical nature;
- Clinical studies where fatigue was reported only as a side effect of the treatment;
- Studies focusing on single muscle fatigue or muscle fatigue in general;
- Studies not focusing on fatigue and/or stroke or focusing on heat stroke, athletes’ fatigue or carers’ fatigue;
- Systematic or narrative or review papers;
- Ongoing studies or protocols with no results (listed and cited in this paper for further follow-up);
- Tool validation studies without reporting new findings on PSF.

Data extraction methods
One reviewer (GA) extracted and entered the data in Excel 2007 and the second reviewer (FS) checked the extracted and entered data against the full text and, if appropriate, corrected or amended the data.

For interventional studies, we extracted PICOS (participants, intervention, comparison, outcomes, and study design) and other data points:
- Study name and year;
- Clinical trial registration number (for further check on selective reporting bias);
We conducted this review to identify and summarise the most recent research studies on PSF since Hinkle et al.’s review (2017)80. We therefore documented the interventional and observational studies related to PSF, extracted relevant data, and assessed the quality of the evidence. We included 45 relevant records related to 24 studies and 6 guidelines (Figure 1).

The characteristics of included interventional studies have been charted in Table 1. The table shows eight RCTs some with multiple reports and one with a follow-up study89-97, one CCT94, and two single-arm trials75,76. All studies were based on single centre studies, except for West et al. (2019) which had two centres71. In studies that reported the intervention delivery details, the psychological interventions were delivered individually and face-to-face – rather than online – by psychologists. We also assessed the risk of bias for RCTs and reported the categories of risk in Table 2 with supporting statements in Extended data.

Most of the interventional studies have a medium to high risk of bias. Table 2 shows only two studies in green (indicating low risk of bias) but both have small sample size consisting of 34 (MIDAS study75-76) and 64 randomised patients88 respectively.

We identified 14 observational studies of which half had a prospective cohort design7-39 and the other half were cross-sectional surveys91-97. Three cross-sectional surveys were embedded within cohort studies91,94,97. Only one of the studies (NotFAST) had a follow-up report81-85. Details of all studies are reported in Table 3 as well as the Extended data.

Table 4 summarises the main finding of each interventional study all of which either have high risk of bias or small sample size. Such limitations make it hard to transfer the research findings to practice.

The majority of observational studies investigated factors related to PSF including co-morbidities, physical and mental outcomes, illness characteristics, characteristics of interventions, and biomarkers (Table 5).

We identified six recent guidelines from three English-speaking countries including the UK89 and two North American countries (one from Canada98 and four from the USA98-101). Among these, the Canadian guideline was the most recent and the only one with comprehensive recommendations on PSF. The UK guideline will be updated in 2021. Half of these guidelines, that is, all those from USA, have not provided specific recommendations on PSF, as reported in Table 6. In almost all the guidelines, the reliance on ‘experts’ consensus’ is apparent because of the limited evidence base for PSF (Table 6).
### Table 1. Characteristics of included interventional studies.

<table>
<thead>
<tr>
<th>Study name</th>
<th>Country</th>
<th>Design</th>
<th># participants</th>
<th>Stroke type</th>
<th>Time after stroke</th>
<th>Interventions</th>
<th>Duration of intervention</th>
<th>Delivered by</th>
<th>Delivery mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al. 2016</td>
<td>Taiwan</td>
<td>RCT</td>
<td>41</td>
<td>With CHF</td>
<td>64.95±53.07 D</td>
<td>Inspiratory Muscle Training + TAU v. TAU</td>
<td>10 W (5 D/W)</td>
<td>Respiratory Therapist</td>
<td>NR</td>
</tr>
<tr>
<td>Chen et al. 2019</td>
<td>Taiwan</td>
<td>RCT</td>
<td>72</td>
<td>Ischemic</td>
<td>NR</td>
<td>Mind-Body Exercise (Qigong) + TAU v. TAU</td>
<td>10 D</td>
<td>Researchers</td>
<td>Individual</td>
</tr>
<tr>
<td>Delva 2019</td>
<td>Ukraine</td>
<td>CCT</td>
<td>39</td>
<td>Ischemic/TIA</td>
<td>≥3 M</td>
<td>Acetylsalicylic Acid (Low Dose v. High Dose)</td>
<td>3 M</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Liu et al. 2016</td>
<td>Taiwan</td>
<td>RCT</td>
<td>64</td>
<td>Haemorrhagic/Infraction</td>
<td>≥3 M</td>
<td>Astragalus membranaceus v. Placebo</td>
<td>28 D</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Liu et al. 2018</td>
<td>China</td>
<td>RCT</td>
<td>140</td>
<td>NR</td>
<td>≥3 M</td>
<td>Vitamin C v. Wuling</td>
<td>12 W</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>MIDAS</td>
<td>Australia</td>
<td>RCT</td>
<td>36</td>
<td>NR</td>
<td>≥3 M</td>
<td>Modafinil v. Placebo</td>
<td>6 W</td>
<td>Patients</td>
<td>Individual</td>
</tr>
<tr>
<td>Nguyen et al. 2019</td>
<td>Australia</td>
<td>RCT</td>
<td>15</td>
<td>//</td>
<td>NR</td>
<td>CBT v. TAU</td>
<td>8 W</td>
<td>Psychologists*</td>
<td>Individual</td>
</tr>
<tr>
<td>Van Heest et al. 2017</td>
<td>USA</td>
<td>1-Arm CT</td>
<td>49</td>
<td>NR</td>
<td>NR</td>
<td>Fatigue Management Course</td>
<td>6 W</td>
<td>Clinical Psychologist</td>
<td>Individual</td>
</tr>
<tr>
<td>West et al. 2019</td>
<td>Denmark</td>
<td>RCT</td>
<td>90</td>
<td>NR</td>
<td>7.6±8.3 (Treatment), 6.0±4.4 (Control) D</td>
<td>Naturalistic Lighting (Artificial Sunlight Spectrum) v. Standard Indoor Lighting</td>
<td>45.3±22.1 (Treatment), 33.7±12.7 (Control) D</td>
<td>NA</td>
<td>Group</td>
</tr>
<tr>
<td>Wu et al. 2017</td>
<td>UK</td>
<td>1-Arm CT</td>
<td>12</td>
<td>First/Recurrent</td>
<td>3±24 M</td>
<td>Manuallyised Psychological Intervention</td>
<td>7 S</td>
<td>Clinical Psychologist</td>
<td>Individual</td>
</tr>
</tbody>
</table>

* Psychologists with doctoral qualifications in clinical neuropsychology

RCT: Randomised Controlled Trial; CCT: CONTROLLED CLINICAL TRIAL; CT: Clinical Trial; NR: Not Reported; NA: Not Applicable; CHF: Congestive Heart Failure; TIA: Transient Ischaemic Attack; D: Day; W: Week; M: Month; S: Session
Table 2. Risk of bias assessed by RobotReviewer and a human reviewer for randomised controlled trials.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Random sequence generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants and personnel</th>
<th>Blinding of outcome assessment</th>
<th>Selective reporting of outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al. 2016</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Chen et al. 2019</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Liu et al. 2016</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>MIDAS</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Nguyen et al. 2019</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>?</td>
</tr>
<tr>
<td>West et al. 2019</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>?</td>
<td>+</td>
</tr>
</tbody>
</table>

Question marks in red cells indicate unclear or high risk of bias and plus signs in green cells show low risk of bias.

Despite the high prevalence of PSF and its obvious effects on treatment adherence, in practice, only half of recent stroke guidelines have clinical recommendations on PSF. Of those that do, two guidelines provide only brief recommendations, and only one provides comprehensive recommendations, but these are based on low levels of evidence. The weak evidence base and the need to rely on expert consensus is likely to be the main reason that PSF is generally not covered in the guidelines.

While the observational studies reported the type of stroke, the interventional studies did not include this important data, which makes it difficult to summarise studies. Most of participants observed in this systematic review of observational studies and clinical practice guidelines since March 2016. However, there were some key contributors to the weak evidence base: (i) recording and reporting only some contributing factors to PSF in observational studies, (ii) the heterogeneity of designed interventions, (iii) high risk of bias, (iv) small sample size in interventional studies, and (v) variety of outcome measures in both observational and clinical studies. This, in turn, is reflected in the quality of the clinical recommendations for PSF.
Table 4. Descriptive summary of findings from included interventional studies.

<table>
<thead>
<tr>
<th>Study name</th>
<th>Country</th>
<th># of centres</th>
<th>Design</th>
<th># participants</th>
<th>Stroke type</th>
<th>Time after stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lau et al. 2017</td>
<td>Hong Kong</td>
<td>1</td>
<td>Cross-Sectional</td>
<td>191</td>
<td>Ischemic</td>
<td>3 M</td>
</tr>
<tr>
<td>MacIntosh et al. 2017</td>
<td>Canada</td>
<td>4</td>
<td>Cross-Sectional</td>
<td>335</td>
<td>Ischemic/Haemorrhagic</td>
<td>Within 6 M</td>
</tr>
<tr>
<td>NotFAST</td>
<td>UK</td>
<td>4</td>
<td>Cohort</td>
<td>268/371</td>
<td>First</td>
<td>4-6 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Follow-Up</td>
<td>263/371</td>
<td></td>
<td>6 M</td>
</tr>
<tr>
<td>STROKDEM</td>
<td>France</td>
<td>4</td>
<td>Cohort</td>
<td>153/179</td>
<td>Ischemic/Haemorrhagic</td>
<td>6 M</td>
</tr>
<tr>
<td>van Rijsbergen et al. 2019</td>
<td>Netherlands</td>
<td>1</td>
<td>Cross-Sectional (in Cohort)</td>
<td>208</td>
<td>First/Ischemic/Haemorrhagic/Recurrent</td>
<td>3.3±0.5 M</td>
</tr>
<tr>
<td>Wang et al. 2018</td>
<td>China</td>
<td>1</td>
<td>Cohort</td>
<td>634/703</td>
<td>Ischemic</td>
<td>Within 3 D</td>
</tr>
</tbody>
</table>

NR: Not Reported; Y: Year; M: Month; W: Week; D: Day

* For cohort studies, the left number shows the number of participants who finished follow-up, and the right number is the number of participants who started and took part in the study; for cross-sectional studies within cohort studies, the left number shows the number of participants in cross-sectional study and the right number is the number of participants in cohort study.

FAS: Fatigue Assessment Scale; VAS: Visual Analogue Scale; BFI: Brief Fatigue Index; MFI: Multidimensional Fatigue Inventory; FSS: Fatigue Severity Scale; FACIT: Functional Assessment of Chronic Illness Therapy; W: Weeks; D: Day; M: Month; S: Session; TAU: Treatment As Usual; CBT: Cognitive Behavioural Therapy.

* Grey cells contain findings from low risk studies; however they have small sample size.
White cells report findings from studies with high or unclear risk of bias.
<table>
<thead>
<tr>
<th>Study name</th>
<th>Fatigue measure</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCOS-IV</td>
<td>FSS</td>
<td>Having hypertension, diabetes mellitus, and arrhythmia at the time of stroke were associated with increased PSF.</td>
</tr>
<tr>
<td>Blomgren et al. 2019</td>
<td>FIS</td>
<td>Fatigue was independently explanatory of worse outcome on FAI summary score and domestic chores.</td>
</tr>
<tr>
<td>Chen et al. 2018</td>
<td>FACIT-Fatigue</td>
<td>Early PSF appears to be largely attributable to stroke severity, while chronic fatigue occurs in the setting of medical co-morbidities and medication use.</td>
</tr>
<tr>
<td>Choi-Kwon et al. 2017a</td>
<td>FSS</td>
<td>Of the 6 polymorphisms examined, only one marker, that is, low-activity Monoamine Oxidase A was associated with PSF in female patients.</td>
</tr>
<tr>
<td>Choi-Kwon et al. 2017b</td>
<td>FSS</td>
<td>Musculoskeletal pain and central post-stroke pain was related to fatigue.</td>
</tr>
<tr>
<td>Douven et al. 2017</td>
<td>FSS</td>
<td>No association between apathy and fatigue was found at baseline and no interaction with time was found. Change in fatigue from baseline to 12-month follow-up was associated with change in depression and with change in apathy. Bidirectional associations were found between PSF and PSD.</td>
</tr>
<tr>
<td>Kuppuswamy et al. 2016</td>
<td>FSS</td>
<td>Those with high perceived limb heaviness also reported significantly higher levels of fatigue than those with no perceived limb heaviness, but there was no difference in weakness between the 2 groups.</td>
</tr>
<tr>
<td>LAS-1</td>
<td>FSS</td>
<td>In almost all Stroke Impact Scale domains the odds for PSF were higher in persons with a higher perceived impact. Fatigue is still present in one-third of persons six years after stroke onset.</td>
</tr>
<tr>
<td>Lau et al. 2017</td>
<td>FAS</td>
<td>Fatigue severity positively correlated with NEO Five-Factor Inventory neuroticism scores.</td>
</tr>
<tr>
<td>MacIntosh et al. 2017</td>
<td>FAS</td>
<td>Fatigue and depressive symptoms are related distinctly to cognitive and mobility impairments post-stroke. Fatigue was associated with poorer lower limb motor function, and with cognition indirectly via depressive symptoms.</td>
</tr>
<tr>
<td>NotFAST</td>
<td>FSS of FAI</td>
<td>Pre-stroke fatigue, having a spouse/partner, lower Rivermead Mobility Index score, and higher scores on both the Brief Assessment Schedule Depression Cards and Beck Anxiety Index were independently associated with PSF. Of those reporting fatigue initially 69% continued to report fatigue in follow-up. New PSF cases were reported by 38%. Lower Nottingham Extended Activities of Daily Living scores and higher Beck Anxiety Index scores were independently associated with fatigue at six months.</td>
</tr>
<tr>
<td>STROKDEM</td>
<td>CFS</td>
<td>Medication use was not a PSF predictor; however, polypharmacy increased PSF severity.</td>
</tr>
<tr>
<td>van Rijssbergen et al. 2019</td>
<td>FAS</td>
<td>Fatigue was associated with CLCE scores, independent of demographic, cognitive performance and stroke-related covariates. After including personality traits and coping styles in the model, independent associations with CLCE scores were found for fatigue and neuroticism.</td>
</tr>
<tr>
<td>Wang et al. 2018</td>
<td>FSS</td>
<td>The serum levels of thyroid-stimulating hormone were inversely associated with the risk of PSF in both the acute phase and at follow-up. Thyroid function profiles may be predictor of PSF after acute ischemic stroke.</td>
</tr>
</tbody>
</table>

FSS: Fatigue Severity Scale; FIS: Fatigue Impact Scale; FACIT: Functional Assessment of Chronic Illness Therapy; FAS: Fatigue Assessment Scale; FAI: Fatigue Assessment Inventory; PSD: Post-Stroke Depression; CFS: Chalder Fatigue Scale; CLCE: Checklist for Cognitive and Emotional consequences following stroke.

entered the interventional studies three-months after stroke. This is likely to be due to a number of reasons; for example, fatigue is not recognised immediately after a stroke, some studies want to ensure that participants have a stable fatigue, and there is competition for recruitment in the early stages to more acute trials.

The variety of the interventions tested in studies and trials underlines the complexity of PSF and is an indication to researchers that probably the most effective interventions need to target multiple aspects of fatigue. While current reporting practice of interventions in RCTs included in our review is of concern (none followed TIDieR and two followed CONSORT), future studies should consider following reporting guidelines such as CONSORT and TIDieR for interventional studies, STROBE for observational studies, and RIGHT\textsuperscript{105}, AGREE\textsuperscript{106}, or CheckUP\textsuperscript{107} for clinical practice guidelines.

Among the observational studies, the populations-based study from the stroke register in New Zealand\textsuperscript{91} and Sweden\textsuperscript{77} provides valuable insights about the link between co-morbidities and increased PSF in long-term (4–7 years). This, and other
similar register-based studies, represent the added value of having high-quality data in health system databases for long-term observational and register-based studies\(^\text{108}\).

Psychologists delivered the psychotherapies in RCTs to individual patients and there was no intervention using online platforms as the media of delivery. This may be due to a number of reasons: it is usual to test the efficacy of an intervention face to face before moving to another medium; participants with stroke may have other problems which mean it is more difficult to deliver treatments online, e.g. communication issue and cognitive problems.

Fatigue Severity Scale (FSS) was the main outcome measure for PSF in observational studies, whereas Fatigue Assessment Scale (FAS) was used more frequently than other measures in interventional studies. The main reason that the FSS has been used is probably because it is now seen as a way to compare different studies: in simple terms, researchers use it because other researchers have used it. It is also relatively straightforward to complete.

Only one of observational studies and half of the interventional studies were registered in clinical trial registers, with the remaining unregistered trials potentially introducing bias in selective reporting of outcomes\(^\text{109,110}\). One of the interventional studies was registered retrospectively with potential for the same bias\(^\text{69,70}\).

### Limitations

It is possible that we overlooked studies which did not report PSF in the searchable part of the paper or if the report was not indexed in the searched databases. In such cases, we invite the audience of this review paper to contact us or comment on the paper online.

### Conclusion

The current trend of research on PSF shows the continued importance of this topic globally. Our review identified a weak evidence base that highlights the need for more research that could have the following characteristics: I) studies to design and test multi-component interventions for PSF; and II) Robust RCTs with adequate sample sizes to produce the evidence for recommendations in guidelines. From our current knowledge on PSF, none of the recent studies are robust enough to change current clinical practice.

### Data availability

**Underlying data**

Open Science Framework: Post-Stroke Fatigue: A Scoping Review, [https://doi.org/10.17605/OSF.IO/XJKCS\(^\text{111}\).]
Registration DOI: https://doi.org/10.17605/OSF.IO/XJKCS

This project contains the following underlying data:
- Extracted data from included studies

Extended data


This project contains the following extended data:
- Full search strategies
- Risk of bias assessment

Unedited draft of risk of bias reported by RobotReviewer: https://robotreviewer.vortex.systems/#report/gk5JV8oLUAd9hlmsx71G

Reporting guidelines


Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

References

15. Delva I: Factors associated with post-stroke fatigue dimensions over the second year after acute cerebrovascular events. Bulletin of Problems Biology and Medicine. 2018; 42(2 (147)): 139–42. Publisher Full Text


74. Delva II: Effectiveness of acetylsalicylic acid in correction of post-stroke fatigue during acute cerebrovascular events. Medical and Ecological Problems. 2019; 23(1–2): 8–12. Publisher Full Text


The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com